TEXAS BOARD OF WATER ENGINEERS
C. S. Clark, Chairman
John W. Pritchett, Member
E. V. Spence, Member

# GEOLOGY AND GROUND WATER RESOURCES OF COMAL COUNTY, TEXAS

PREPARED IN COOPERATION WITH THE UNITED STATES
DEPARTMENT OF THE INTERIOR, GEOLOGICAL SURVEY

FEBRUARY 1947

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# GEOLOGY AND GROUND-WATER RESOURCES OF COMAL COUNTY, TEXAS

By William O. George

With a section on the chemical character of water
By Warren W. Hastings
and
A section on surface-water runoff
By Seth D. Breeding

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# GEOLOGY AND GROUND-WATER RESOURCES OF COMAL COUNTY, TEXAS

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## INTRODUCTION

Purpose and scope.- The investigation in Comal County was made possible through cooperation between the Texas State Board of Water Engineers and the U. S. Geological Survey, and is a part of a State-wide program of study of the underground-water resources of Texas. In general the purposes of these investigations are to obtain facts regarding the thickness, depth beneath the land surface, and areal extent of the water-bearing formations; to compute the capacity of the formations to absorb, transmit, and discharge water; and to determine the chemical character of the ground water. In Comal County the principal purpose of this investigation was to determine the source of the water that issues from Comal Springs which have the largest average flow of any known springs in the southwestern part of the United States. The investigation was started in 1941 by Robert R, Bennett of the Geological Survey, and was taken over by the writer in September 1943 when Mr. Bennett was transferred to another State. The study was interrupted repeatedly by work relating to defense and war projects, and was not completed until 1946.

The investigation is a part of the study of the discharge, recharge, and movement of ground water along the entire Balcones fault zone, particularly in the Edwards limestone. This fault zone which passes through Comal County is about 250 miles long. The ground-water reservoirs in the Edwards Plateau yield an average of about 400 million gallons of water a day to large springs along the Balcones fault zone at Austin, San Marcos, New Braunfels, San Antonio, and Uvalde.

The investigation was made under the administrative direction of O. E. Meinzer, geologist in charge of the Division of Ground Water of the U. S. Geological Survey. Mr. Meinzer retired on December 1, 1946, and was succeeded by A. N. Sayre. The field work was done and the report was prepared under the direct supervision of Walter N. White, district engineer in charge of ground-water investigations in Texas.

Location.- Comal County is in south-central Texas. The county contains about 559 square miles and its greatest length is about 39 miles, measured east and west, and greatest width about 30 miles, measured north and south. The intersection of latitude 29° 50' north and longitude 98° 15' east falls in the central portion of the county. According to the U. S. Census Bureau the population of Comal County was 12,321 in 1940.

Transportation facilities include several paved Federal and State Highways and an extensive network of farm-to-market roads, many of which are paved. The Missouri Pacific and the Missouri, Kansas, and Texas railway systems serve New Braunfels and other smaller stations in the county.

History of settlement.- New Braunfels, the county seat and only large town in the county, had a population of 6,979 in 1940. The settlement was founded by German immigrants in 1845, and the majority of the inhabitants of the county are descendants of these founders. The leader of the group was Carl, Prince of Solms-Braunfels, a cousin of Queen Victoria 1/. In 1842 he and 20 others founded the Society for the Protection of German Immigrants in Texas. A document bearing the following inscription was placed in the "Sophienburg", a fortress built at New Braunfels for the protection of the immigrants.

> "In the year of our Lord, One Thousand Eight Hundred and Forty-two, an association of Princes, Counts and Gentlemen, was formed in Germany, who mindful of the increasing excess of population and the poverty growing therefrom, particularly among the lower classes of people, made it their object to redress this evil by regulating the already considerable immigration".

The first settlers landed at Galveston in 1844 and more arrived at Indian Point in Lavaca Bay on March 1, 1845. On Good Friday, March 21, the immigrants crossed the Guadalupe and established camp on Comal Creek and from there the town was laid out to which was given the name, "New Braunfels" 2/. The camp was probably near Comal Springs which was then known as "Las Fontanas".

Agriculture and industrial development.- Agriculture in the more rugged upland areas northwest of the Balcones escarpment is limited to the raising of cattle, sheep, and goats, except along stream terraces where supplementary feed and grain crops can be raised. The upland area is well known for the abundance of "white tail" deer which attract many hunters during the deer season, thus adding materially to the income of the ranchers.

The relatively level country southeast of the escarpment is used mostly for farming; cotton, corn, oats, maize, and wheat being the principal crops. No large fields in the county are irrigated.

The early settlers of New Braunfels made use of the water power afforded by Comal Springs and the Guadalupe River to operate mills of various kinds. At present, the city of San Antonio has a power plant a few hundred feet below the springs, which has a capacity of 60,000 kilowatts. This plant is operated by water power supplemented by steam-driven turbines using natural gas as fuel. Flour, feed, cotton textiles, gauze, childrens' garments, mattresses, cedar oil, dairy products, lime, road-building material, rock, wool, leather goods, furniture, and hosiery are manufactured at New Braunfels. A farmers cooperative association has been established for handling and marketing farm and ranch products.

Landa Park, maintained by the city at Comal Springs, is noted for its recreational facilities, including a large swimming pool supplied by the cool water of the springs, lakes for boating, and a golf course. The park attracts a large number of summer vacationists and tourists.

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1/ Solms-Braunfels, Carl, Prince of, Texas 1844-45, p. 103 (Translation) Anson Jones Press, Houston, Texas, 1936.

2/ For more details of organization and settlement see Biesele, B. F., The history of German settlements in Texas, Press of Von Boeckman-Jones Co., Austin, Texas, 1930.

Methods of investigation.- In mapping the geology of Comal County, use was made of the U. S. Geological Survey geologic map of Texas. Detailed geologic information was sketched on topographic sheets and mosaics of aerial photographs on the scale of 2 inches to the mile. The following topographic sheets were used: The Bracken, Boerne, New Braunfels, Leon Springs, and Hunter quadrangles, prepared by the Corps of Engineers of the U. S. Army; and the Smithson Valley quadrangle, east half of the New Braunfels quadrangle, and southwest quarter of the Hunter quadrangle, prepared by the Topographic Branch of the U. S. Geological Survey.

In connection with the investigation, current-meter measurements, commonly called "seepage measurements", were made at intervals along the Guadalupe River and Cibolo Creek in stretches where these streams cross the outcrops of the water-bearing formations, in order to determine losses by seepage and gains from ground-water inflow in each of these sections. Three permanent gaging stations were recently established on Cibolo Creek. Discharge measurements at these stations and at other gaging stations in the county are discussed by Seth Breeding in a later section of this report (pp. 61 to 74).

Records of about 365 wells and springs, most of which were obtained by Michal 3/ in 1936-37 or by the writer in 1945-46, are tabulated in the table of well records on pages 75 to 110. These records give information as to the depths and diameters of the wells, the depths to the water level, the geologic formations from which the water is obtained, the use that is made of the water, and other data. Samples of water were obtained from most of the wells and springs for complete or partial analyses. The results of the analyses are shown in the table on pages 129 to 142.

Previous investigations.- Records of a few of the wells in the western part of the county, including the altitude of the water levels, were obtained by Livingston 4/ in 1934 as a part of the study of the water resources of the Edwards limestone in the vicinity of San Antonio.

A number of wells have been selected as observation wells, and periodic measurements have been made of the depth to water in these wells. The results of these measurements have been published in a series of water supply papers of the U. S. Geological Survey entitled, "Water levels and artesian pressures in the United States". The water-level measurements have been assembled and are tabulated on pages 115 to 128 of this report.

Acknowledgments.- In the compilation of this report, the notes and geologic maps made by Bennett, which covered about half of the county, have been used freely. Although all parts of the county were visited by the writer, only minor changes were made in Bennett's tentative delineation of geologic features. A small area in the vicinity of Bracken was mapped by A. N. Sayre 5/ in connection with a ground-water investigation of the San Antonio area. These data were also used in a similar manner. Complete cooperation of the Surface Water Division of the U. S. Geological Survey resulted in prompt response to specific requests for stream measurements.

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3/ Michal, Emil J., Records of wells and springs in Comal County; Texas State Board of Water Engineers, 1937. Works Projects Administration Ground-Water Survey Project 2084.

4/ Livingston, Penn, Sayre, A. N., and White, W. N., Water resources of the Edwards limestone in the San Antonio area, Texas: U. S. Geol. Survey Water-Supply Paper 773-B, pp. 58-113, 1936.

5/ Livingston, Penn, Sayre, A. N., and White, W. N., op. cit.

The writer thanks the farmers and ranchers in the county for their cordial cooperation in supplying information about their wells and permitting access to their properties. Well logs furnished by water-well drillers, particularly E. B. Kutscher of San Marcos and J. R. "Bob" Johnson of San Antonio, have been helpful in the interpretation of the geology of the area. The assistance of Walter N. White, district engineer in charge of ground-water work in Texas, in the planning of field work and the preparation of this report is gratefully acknowledged.

## CLIMATE

The highest and lowest temperatures recorded by the U. S. Weather Bureau at New Braunfels over a period of 60 years were 107° F. and 2° F., respectively. The mean monthly temperatures are given in the following table:

| Month | Mean temperature (degrees Fahrenheit) | Month | Mean temperature (degrees Fahrenheit) |
|---|---|---|---|
| Jan. | 53.4 | July | 85.0 |
| Feb. | 57.0 | Aug. | 85.6 |
| Mar. | 68.7 | Sept. | 81.2 |
| Apr. | 68.4 | Oct. | 69.1 |
| May | 76.4 | Nov. | 65.4 |
| June | 84.0 | Dec. | 52.8 |

The following table gives the dates of the last killing frost in spring and the earliest killing frost in autumn at New Braunfels for a period of 16 years. On the basis of these figures the average length of the growing season was 265 days.

The altitude at New Braunfels is about 640 feet, which is considerably lower than the average altitude of the "hill country" of the Edwards Plateau comprising the greater part of the county. For this reason, the average length of the growing season in the county as a whole may be somewhat shorter than the average at New Braunfels.

Frost data for New Braunfels for the years 1930-45, inclusive.
(From publications of U. S. Weather Bureau)

| Year | Date of last killing frost in spring | Date of first killing frost in autumn |
|---|---|---|
| 1930 | Jan. 31+ | Nov. 25 |
| 1931 | Mar. 9 | Dec. 4 |
| 1932 | Mar. 14 | Nov. 12 |
| 1933 | Feb. 21+ | Dec. 12+ |
| 1934 | Jan. 9 | Dec. 1 |
| 1935 | Feb. 28 | Dec. 26 |
| 1936 | Feb. 18 | Nov. 4 |
| 1937 | Feb. 3(?) | Nov. 20 |
| 1938 | Feb. 1 | Nov. 8 |
| 1939 | Feb. 26 | Dec. 27 |
| 1940 | Apr. 13 | Nov. 13 |
| 1941 | Feb. 28 | Dec. 7+ |
| 1942 | Mar. 3 | Nov. 12 |
| 1943 | Mar. 3 | Nov. 30+ |
| 1944 | Mar. 30 | Nov. 27 |
| 1945 | Feb. 23 | Nov. 22 |

+ No killing frost reported; date of earliest or latest freezing temperatures given.

The average annual precipitation at New Braunfels during a period of 57 years was 31.0 inches. The records show a wide variation from year to year; the lowest precipitation of record was 13.29 inches in 1917 and the highest was 60.21 inches in 1919. During the 57 years of record, periods in which there was no rainfall during the month have been observed 16 times. April, May and June have had some rainfall during each of the 57 years.

The following table gives the monthly precipitation for New Braunfels with the average rainfall for each month of the period of record.

Monthly precipitation, in inches, at New Braunfels, Comal County, Texas, (1889-1945)
(Compiled by A. C. Cook, engineer, State Board of Water Engineers from U. S. Weather Bureau reports.)

| Year | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1889 | 6.00 | 3.73 | 4.00 | 1.93 | 0.71 | 7.42 | 2.60 | 6.00 | 7.96 | 0.90 | 4.73 | T | 45.98 |
| 1890 | .70 | 2.40 | 1.01 | 8.41 | 3.82 | 4.38 | .84 | 1.58 | 6.47 | 2.58 | .63 | 1.24 | 34.06 |
| 1891 | 6.33 | .49 | .32 | 6.35 | 2.11 | 2.55 | 3.19 | 1.72 | 2.58 | 1.14 | .81 | 7.22 | 34.83 |
| 1892 | 2.03 | .54 | 1.08 | 1.03 | 3.86 | 1.76 | 2.41 | 4.92 | 1.29 | 2.68 | 1.48 | 4.98 | 28.06 |
| 1893 | .11 | .69 | 2.27 | 3.28 | 2.87 | .55 | .39 | 1.27 | .07 | 0 | 3.35 | .58 | 15.43 |
| 1894 | .93 | .58 | 1.14 | 3.07 | 3.59 | 3.45 | 1.03 | 8.12 | .81 | 1.91 | 0 | 0 | 24.63 |
| 1895 | 1.38 | 2.75 | 2.38 | .32 | 7.51 | 9.39 | T. | 1.93 | .60 | 1.17 | 4.15 | 1.03 | 32.61 |
| 1896 | 3.01 | 2.27 | .33 | 3.34 | .64 | .12 | 1.10 | T | 4.59 | 6.19 | 0 | 1.90 | 23.49 |
| 1897 | 1.56 | .14 | 2.43 | 3.10 | 1.75 | 2.93 | 1.19 | 1.91 | 1.24 | 1.72 | .32 | 1.84 | 20.13 |
| 1898 | .90 | 1.16 | 1.31 | 2.40 | 4.60 | 7.60 | 3.02 | 3.18 | 1.83 | .29 | 1.24 | 1.53 | 29.06 |
| 1899 | .31 | .46 | 0 | 2.20 | 2.35 | 5.21 | 5.94 | 0. | 1.17 | 2.43 | 2.89 | 4.29 | 27.25 |
| 1900 | 4.00 | .74 | 4.45 | 11.80 | 3.75 | T. | 3.58 | 2.73 | 4.55 | 3.78 | 1.48 | 1.22 | 42.08 |
| 1901 | .57 | .69 | 1.40 | 1.30 | 5.25 | 1.99 | 3.16 | .86 | 2.72 | .02 | .47 | .81 | 19.24 |
| 1902 | 1.08 | .66 | .63 | 2.40 | 3.35 | .22 | 7.89 | 0 | 7.31 | 2.04 | 4.60 | 2.31 | 32.49 |
| 1903 | 2.73 | 9.87 | 1.38 | 1.82 | 1.89 | 5.63 | 6.15 | 3.19 | .55 | 2.20 | 0 | 1.82 | 37.23 |
| 1904 | .24 | .71 | .43 | 2.99 | 7.06 | 2.42 | 2.13 | 1.35 | 5.76 | 2.84 | .73 | 1.27 | 27.93 |
| 1905 | 1.77 | 2.33 | 4.44 | 7.66 | 2.31 | 4.39 | 1.81 | .26 | 1.11 | 2.57 | 3.94 | 2.39 | 34.98 |
| 1906 | .39 | 1.31 | 1.70 | 2.84 | .61 | 1.84 | 3.25 | 3.66 | 1.45 | 1.30 | 1.81 | 3.60 | 23.76 |
| 1907 | .24 | .25 | 2.24 | 2.11 | - | - | - | - | - | 6.24 | 9.28 | - | 20.37 |
| 1908 | .91 | 3.19 | 1.88 | 3.52 | 3.90 | .21 | .43 | 3.08 | 3.78 | 3.04 | 1.58 | 3.98 | 29.50 |
| 1909 | 0 | .47 | .51 | 1.31 | 2.36 | 1.12 | 3.77 | 1.27 | .19 | 4.57 | 2.48 | 1.61 | 19.66 |
| 1910 | .27 | 1.03 | .19 | 3.70 | 2.71 | .39 | .80 | .18 | 1.40 | 2.52 | .45 | 2.36 | 16.00 |
| 1911 | .04 | 2.34 | 5.50 | 4.64 | 2.17 | .29 | .79 | 1.18 | 1.00 | 3.17 | 1.65 | 2.79 | 25.56 |
| 1912 | .46 | 5.38 | 2.76 | 1.51 | 2.21 | 2.54 | .77 | T | 1.34 | 2.51 | 3.07 | 3.35 | 25.90 |
| 1913 | 1.05 | 2.36 | 1.48 | .95 | 3.11 | 5.64 | 1.40 | 2.25 | 4.66 | 12.78 | 6.60 | 8.12 | 50.40 |
| 1914 | .19 | 1.85 | 2.37 | 5.41 | 4.79 | 1.41 | .62 | 7.35 | 1.66 | 5.51 | 4.09 | 2.46 | 37.71 |
| 1915 | 1.23 | 1.98 | 1.62 | 9.75 | 2.78 | .18 | .94 | 3.23 | 2.66 | .49 | .63 | 2.47 | 27.96 |
| 1916 | 2.67 | 0 | 0 | 3.11 | 4.99 | .71 | 3.77 | 3.12 | 1.41 | 2.54 | 1.93 | .33 | 24.58 |
| 1917 | 1.23 | 1.29 | .24 | .64 | 4.51 | .11 | 3.31 | T | 1.39 | .57 | 0 | 0 | 13.29 |
| 1918 | .87 | 1.04 | 1.19 | 2.36 | 3.72 | 1.39 | .20 | .54 | 1.79 | 4.55 | 3.42 | 4.79 | 25.86 |
| 1919 | 4.81 | 1.94 | 1.47 | 4.02 | 5.88 | 6.72 | 6.97 | 3.82 | 5.54 | 16.44 | 1.18 | 1.42 | 60.21 |
| 1920 | 3.64 | .42 | .84 | 1.00 | 3.98 | 3.12 | .14 | 6.98 | .88 | 2.02 | 2.68 | .18 | 25.88 |
| 1921 | 3.11 | .67 | 5.70 | 5.60 | 1.68 | 5.04 | .23 | .90 | 10.07 | .98 | .38 | 1.16 | 35.52 |
| 1922 | 1.36 | 1.72 | 5.08 | 6.81 | 4.02 | 3.32 | .58 | .53 | 1.33 | 4.59 | 1.31 | .20 | 30.85 |
| 1923 | 1.16 | 4.44 | 2.48 | 3.77 | 3.32 | 2.25 | 2.15 | 1.58 | 3.77 | 5.57 | 3.06 | 5.98 | 39.49 |
| 1924 | 1.57 | 3.32 | 1.98 | 4.08 | 5.77 | 2.36 | T | .15 | 2.30 | .61 | .05 | 2.39 | 24.58 |
| 1925 | .20 | .14 | 0 | .33 | 1.94 | 3.13 | .30 | 2.94 | 4.28 | 3.70 | 2.09 | 1.11 | 20.16 |
| 1926 | 4.37 | .12 | 6.55 | 9.64 | 3.97 | 1.41 | .90 | .42 | 1.61 | 2.29 | 2.00 | 2.98 | 36.26 |
| 1927 | 1.29 | 1.64 | 3.73 | 1.37 | 1.71 | 4.78 | 1.20 | 0 | 1.18 | 3.87 | 0 | 2.17 | 22.94 |
| 1928 | .81 | 5.13 | 1.18 | 1.58 | 3.13 | 8.36 | 2.44 | .84 | 4.71 | 1.58 | 3.03 | 3.28 | 36.07 |
| 1929 | 2.47 | .35 | 4.69 | 2.59 | 11.39 | 2.02 | 5.37 | .64 | 1.85 | 3.69 | 3.35 | 1.74 | 40.15 |
| 1930 | 1.58 | 2.09 | 2.11 | 1.64 | 3.01 | 7.21 | .30 | 0 | 1.57 | 5.24 | 2.28 | 1.68 | 28.71 |
| 1931 | 5.79 | 4.10 | 5.34 | 1.66 | .93 | 2.41 | 4.34 | 1.77 | .08 | .35 | .86 | 3.95 | 31.58 |
| 1932 | 4.66 | 2.92 | 1.61 | 2.76 | 1.92 | 1.61 | 2.50 | 4.90 | 5.19 | .28 | .75 | 2.05 | 31.15 |
| 1933 | 1.48 | 2.15 | 1.37 | 2.36 | 4.98 | 1.29 | 5.69 | 1.38 | 1.80 | 2.53 | .83 | .89 | 26.75 |
| 1934 | 7.98 | 1.94 | 3.02 | 1.85 | .92 | .29 | 3.02 | .58 | 2.49 | .18 | 2.55 | 5.98 | 30.80 |
| 1935 | .71 | 2.84 | 1.87 | 2.44 | 11.81 | 4.21 | 3.10 | .18 | 9.88 | .93 | .31 | 3.39 | 41.67 |
| 1936 | .80 | .63 | 1.64 | 2.51 | 5.47 | 3.60 | 1.29 | 3.28 | 4.53 | 2.55 | 2.67 | 1.44 | 30.41 |
| 1937 | 1.33 | .15 | 4.07 | .85 | 4.43 | 5.41 | .53 | .54 | .51 | 3.30 | 1.90 | 6.17 | 29.19 |
| 1938 | 4.12 | 1.61 | 2.39 | 8.81 | 5.20 | .75 | 2.22 | .29 | .65 | .20 | .97 | 1.11 | 28.32 |
| 1939 | 1.35 | .81 | .95 | .98 | 2.15 | .90 | 1.93 | 1.07 | .67 | .50 | 1.32 | .72 | 13.35 |
| 1940 | .90 | 2.95 | 1.57 | 3.62 | 3.45 | 9.89 | 1.04 | 1.00 | 1.43 | 3.74 | 4.50 | 4.02 | 38.11 |
| 1941 | 2.04 | 3.17 | 3.65 | 8.07 | 6.28 | 6.69 | 1.60 | .49 | 3.70 | 4.51 | 1.28 | 1.51 | 42.99 |
| 1942 | .46 | 2.92 | .67 | 3.63 | 2.87 | 2.21 | 10.44 | 3.61 | 6.49 | 7.15 | 1.06 | .57 | 42.08 |
| 1943 | 1.44 | .22 | 1.17 | .58 | 3.30 | 3.32 | 4.73 | 0 | 9.50 | 1.25 | 2.46 | 1.96 | 29.93 |
| 1944 | 6.24 | 3.22 | 4.03 | 1.58 | 8.93 | 1.68 | .22 | 3.94 | 1.34 | .46 | 6.48 | 5.02 | 43.14 |
| 1945 | 3.71 | 5.33 | 6.27 | 2.41 | .89 | 3.29 | 2.41 | 1.41 | 2.11 | 8.45 | 1.44 | 1.66 | 39.38 |
| Average | 1.98 | 1.92 | 2.21 | 3.36 | 3.72 | 3.09 | 2.36 | 1.93 | 2.91 | 3.00 | 2.08 | 2.44 | 31.00 |

The following table gives the record of precipitation at Fischer's Store, near the north end of the county, for a period of 55 years. The annual average is about the same as the average at New Braunfels, but the monthly and yearly totals at the two stations differ materially:

Monthly precipitation, in inches, at Fischer's Store, Comal County, Texas, 1890-1945 (Compiled by A. C. Cook, engineer, State Board of Water Engineers, from U. S. Weather Bureau reports).

| Year | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1890 | 1.70 | 1.55 | .20 | 4.95 | 4.32 | 3.91 | 0 | 1.77 | 7.00 | 1.26 | 1.56 | .81 | 29.03 |
| 1891 | 5.50 | .76 | .76 | 4.40 | 2.60 | 1.71 | .80 | 1.65 | 4.30 | .01 | 1.75 | 8.40 | 32.64 |
| 1892 | 2.00 | .16 | .65 | .25 | 3.90 | 1.60 | 1.70 | 5.46 | .28 | 2.05 | 1.16 | 5.05 | 24.26 |
| 1893 | 0 | .10 | 2.40 | .75 | 2.40 | 1.55 | .25 | .05 | .01 | 0 | 4.85 | 1.25 | 13.61 |
| 1894 | 1.25 | .50 | .40 | 4.55 | 3.20 | 1.30 | .45 | 7.35 | 1.00 | 1.75 | 0 | .25 | 22.00 |
| 1895 | 1.25 | 2.45 | 1.35 | 1.25 | 5.20 | 4.90 | 0 | 1.25 | 2.65 | 1.76 | 3.30 | .60 | 25.96 |
| 1896 | 4.50 | 3.60 | 1.10 | 4.85 | 0 | 1.00 | 4.20 | 0 | 12.25 | 4.80 | .15 | 2.10 | 38.55 |
| 1897 | 1.90 | 0 | 3.20 | 2.65 | .85 | 2.10 | .50 | 3.10 | .85 | 2.00 | 0 | 1.10 | 18.25 |
| 1898 | .75 | .75 | 1.25 | 1.90 | 1.50 | 5.75 | 3.35 | 1.50 | .50 | .15 | .75 | .25 | 18.40 |
| 1899 | 0 | 0 | 0 | 1.90 | 2.15 | 6.45 | 3.20 | 0 | .50 | 4.48 | 1.50 | 4.00 | 24.18 |
| 1900 | 4.50 | 0 | 2.40 | 9.35 | 5.18 | 0 | 5.35 | 4.15 | 2.25 | 1.55 | .50 | .75 | 35.98 |
| 1901 | 0 | 0 | .85 | .50 | 4.52 | .75 | 2.25 | 1.00 | 3.50 | 0 | .50 | 0 | 13.87 |
| 1902 | .75 | .75 | 1.85 | 2.25 | 4.63 | 1.15 | 6.00 | 0 | 3.95 | 2.00 | 5.05 | 3.50 | 31.88 |
| 1903 | 2.00 | 7.25 | 1.00 | 2.10 | .50 | 4.00 | 7.00 | 2.65 | .25 | 3.75 | 0 | 2.00 | 32.50 |
| 1904 | 0 | - | .75 | 4.13 | 6.80 | 4.65 | 2.75 | 3.50 | 3.50 | 2.50 | .25 | .75 | 29.58 |
| 1905 | 1.75 | 1.75 | 3.25 | 6.75 | 2.00 | 2.40 | 2.50 | 1.25 | 2.75 | 2.50 | 2.50 | 1.00 | 30.40 |
| 1906 | 0 | 1.00 | .50 | 1.50 | 1.10 | 1.50 | 4.38 | .75 | 3.50 | 0 | 1.00 | 3.50 | 18.73 |
| 1907 | .20 | .25 | 1.00 | 2.53 | 7.25 | 1.25 | 1.00 | 0 | 1.50 | 5.50 | 5.25 | 0 | 25.73 |
| 1908 | 1.50 | 1.50 | 1.38 | .50 | 5.00 | .25 | 0 | 4.65 | .50 | 1.50 | .75 | 1.50 | 19.03 |
| 1909 | 0 | 0 | .50 | 1.55 | 5.65 | .89 | 4.25 | .75 | 1.25 | 2.50 | 3.85 | 1.50 | 22.60 |
| 1910 | 0 | .50 | .56 | 4.00 | 4.75 | 1.50 | 1.50 | .87 | .90 | 2.88 | 1.25 | 3.33 | 22.04 |
| 1911 | 0 | 1.75 | 2.40 | 6.75 | 3.00 | 0 | .50 | .25 | .65 | 1.27 | 2.75 | 2.00 | 21.32 |
| 1912 | 0 | 3.00 | 1.65 | 3.00 | .95 | 3.75 | .35 | 1.00 | .25 | 3.75 | 2.25 | 1.50 | 21.45 |
| 1913 | .75 | 1.25 | 1.20 | .75 | 2.75 | 5.25 | 0 | 3.35 | 11.25 | 11.75 | 0 | 8.40 | 46.70 |
| 1914 | 0 | .75 | 5.65 | 5.94 | 6.75 | .75 | 0 | 16.85 | 1.00 | 2.75 | 2.40 | 2.00 | 44.84 |
| 1915 | 1.25 | 2.00 | 1.25 | 10.75 | 1.40 | .30 | 2.63 | 3.00 | 2.25 | 0 | .75 | 3.00 | 28.58 |
| 1916 | 3.90 | 0 | 4.15 | 1.15 | 7.35 | .50 | 7.00 | 3.25 | 2.00 | 1.70 | 2.25 | .25 | 33.50 |
| 1917 | .50 | .87 | 0 | 1.15 | 5.98 | 0 | 1.00 | .75 | .50 | .25 | 1.25 | 0 | 12.25 |
| 1918 | .60 | 2.00 | 1.10 | 6.73 | 1.75 | 1.15 | 1.25 | 3.30 | .90 | 2.75 | 3.25 | 6.00 | 30.78 |
| 1919 | 3.55 | 2.75 | 1.95 | 2.00 | 4.03 | 5.50 | 10.00 | 5.00 | 7.40 | 8.50 | .25 | .75 | 51.68 |
| 1920 | 4.25 | .35 | 1.22 | 0 | 7.25 | 2.55 | .25 | 4.85 | 1.13 | 2.25 | 2.75 | 0 | 26.85 |
| 1921 | 1.65 | 1.00 | 3.50 | 4.60 | 1.75 | 5.60 | 1.25 | 0 | 12.00 | .75 | .75 | 0 | 32.85 |
| 1922 | 1.50 | 1.05 | 2.80 | 6.60 | 3.25 | 3.10 | .25 | 3.15 | 2.00 | 2.50 | 1.40 | 0 | 27.60 |
| 1923 | 0 | 5.25 | 2.85 | 3.75 | 1.85 | 1.75 | 1.35 | 1.20 | 7.30 | 3.90 | 3.60 | 4.55 | 37.35 |
| 1924 | 1.38 | 3.30 | 2.65 | 3.20 | 6.20 | 1.75 | 1.34 | .15 | 3.50 | 0 | 0 | 1.35 | 24.82 |
| 1925 | .60 | 0 | 0 | 2.27 | 1.35 | .67 | 2.37 | 3.14 | 1.76 | 7.73 | 2.65 | 1.00 | 23.54 |
| 1926 | 4.02 | 0 | 4.52 | 6.90 | 4.55 | 3.05 | 6.95 | .90 | .90 | 3.19 | 2.35 | 3.36 | 40.69 |
| 1927 | 1.28 | 3.02 | 2.45 | 2.36 | 1.40 | 5.15 | 2.06 | .40 | .70 | 8.15 | 0 | 2.95 | 29.92 |
| 1928 | .53 | 3.57 | 1.38 | 1.75 | 5.15 | 3.28 | 3.19 | .28 | 3.80 | .80 | 2.85 | 2.25 | 28.83 |
| 1929 | 2.87 | 0 | 3.00 | 4.70 | 15.15 | 1.40 | 5.70 | 0 | 1.00 | 1.53 | 3.85 | 1.40 | 40.60 |
| 1930 | .95 | 1.15 | 1.77 | 1.60 | 8.90 | 2.00 | 1.05 | .32 | 2.27 | 6.71 | 2.05 | 2.03 | 30.80 |
| 1931 | 4.35 | 4.53 | 3.20 | 5.50 | .90 | 3.27 | 4.25 | 1.35 | 0 | .75 | 1.00 | 3.47 | 32.57 |
| 1932 | 5.21 | 2.12 | 2.47 | 1.00 | 1.52 | .90 | 1.90 | 6.20 | 3.35 | .15 | .78 | 1.98 | 27.58 |
| 1933 | 3.50 | 2.03 | .60 | 1.38 | 2.70 | 1.70 | 4.20 | 5.05 | 1.97 | 1.97 | .60 | 1.20 | 26.90 |
| 1934 | 6.77 | 2.13 | 2.90 | 4.70 | 1.10 | .20 | 2.65 | .45 | .70 | 0 | 3.45 | 3.57 | 28.62 |
| 1935 | 1.51 | 3.68 | .50 | .50 | 11.43 | 7.48 | 3.80 | 1.28 | 5.84 | 2.75 | .20 | 3.10 | 42.07 |
| 1936 | .43 | .85 | 1.18 | 2.25 | 8.03 | 5.85 | 3.83 | 1.95 | 6.65 | 2.60 | 1.95 | 2.29 | 37.86 |
| 1937 | 3.00 | 0 | 2.87 | .85 | 3.44 | 1.91 | 1.63 | 1.22 | .51 | 5.41 | 1.55 | 6.55 | 28.94 |
| 1938 | 3.80 | 1.43 | 1.35 | 5.21 | 3.05 | 2.33 | 2.20 | .43 | .70 | .41 | .52 | 1.70 | 23.13 |
| 1939 | 10.08 | 1.23 | .41 | 2.98 | 1.84 | .83 | 4.89 | 2.64 | .32 | 1.10 | 1.82 | 1.39 | 29.53 |
| 1940 | 3.95 | 3.65 | 1.51 | 2.50 | 1.08 | 2.82 | 4.00 | 3.12 | 1.40 | 3.30 | 4.20 | 5.75 | 37.28 |
| 1941 | 2.20 | 2.47 | 4.23 | 5.71 | 3.73 | 8.75 | 0 | 0 | 2.18 | 4.98 | .60 | 1.17 | 36.02 |
| 1942 | 0 | 1.50 | .96 | 4.64 | 2.38 | 2.20 | 3.14 | 4.62 | 6.40 | 3.48 | 1.23 | .60 | 31.15 |
| 1943 | .69 | .18 | 2.55 | 1.60 | 5.39 | 1.78 | 3.15 | 1.00 | 2.68 | .45 | 1.05 | 2.31 | 22.83 |
| 1944 | 5.67 | 3.45 | 3.17 | 1.15 | 6.50 | 1.84 | .38 | 4.02 | 2.88 | 1.35 | 5.59 | 5.55 | 41.55 |
| 1945 | 3.33 | 4.22 | 4.55 | 1.38 | 0.73 | 3.68 | 4.10 | 2.60 | 3.41 | 3.40 | 0.80 | 3.10 | 29.28 |
| Av. | 2.03 | 1.60 | 1.84 | 3.21 | 3.89 | 2.53 | 2.57 | 2.30 | 2.76 | 2.59 | 1.76 | 2.29 | 29.37 |

The following table gives the monthly precipitation at Boerne, in Kendall County

Monthly precipitation, in inches, at Boerne, Kendall County, Texas, 1892-1945 (Compiled by A.C.Cook, engineer, State Board of Water Engineers, from U.S. Weather Bureau reports).

| Year | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1892 | 2.03 | 0.54 | 1.08 | 1.03 | 3.86 | 2.13 | 0.43 | 4.44 | 0.17 | 4.23 | 2.16 | 4.86 | 26.96 |
| 1893 | .21 | .98 | 2.10 | 1.89 | 2.79 | 1.34 | .91 | 1.05 | .23 | .60 | 3.84 | 1.02 | 16.96 |
| 1894 | 1.68 | 1.16 | 1.10 | 7.78 | 6.05 | 2.17 | .13 | 6.87 | 1.97 | 2.72 | .07 | .23 | 31.93 |
| 1895 | 1.48 | 4.02 | 2.09 | .51 | 6.30 | 4.76 | .16 | 1.22 | 4.30 | 1.55 | 4.75 | .81 | 31.95 |
| 1896 | 4.41 | 2.82 | .83 | 2.95 | .98 | .37 | 6.71 | .62 | 5.59 | 4.86 | .31 | 2.41 | 32.86 |
| 1897 | 1.56 | .10 | 4.06 | 3.26 | 1.45 | 2.15 | 1.82 | 4.03 | 3.29 | 2.33 | .12 | 2.29 | 26.46 |
| 1898 | 1.25 | 1.24 | 1.92 | 3.88 | 2.71 | 6.71 | 1.66 | 1.70 | 2.10 | 3.32 | 2.16 | 2.77 | 31.42 |
| 1899 | .42 | .45 | .03 | 1.77 | 3.10 | 4.96 | 3.29 | .39 | 2.97 | 8.96 | 2.59 | 4.91 | 33.84 |
| 1900 | 5.31 | .25 | 3.36 | 12.36 | 7.71 | 1.08 | 8.40 | 2.46 | 1.99 | 4.62 | 1.35 | 1.30 | 50.19 |
| 1901 | .47 | 1.08 | 1.20 | 1.15 | 3.74 | 1.86 | 6.04 | 1.18 | 3.06 | .74 | .75 | .33 | 21.60 |
| 1902 | .97 | 1.02 | 1.97 | 2.32 | 5.94 | .39 | 2.77 | .06 | 2.84 | 2.78 | 9.00 | 3.65 | 33.71 |
| 1903 | 3.35 | 8.70 | 2.21 | 2.03 | 2.05 | 6.15 | 9.50 | .58 | 1.62 | 1.59 | T | .75 | 38.53 |
| 1904 | .12 | 1.33 | .88 | 4.26 | 8.28 | 1.84 | 1.99 | 4.16 | 8.83 | 2.50 | .55 | 1.67 | 36.41 |
| 1905 | 1.00 | 1.50 | 3.30 | 9.30 | .17 | 4.10 | 1.30 | 1.60 | 3.80 | 2.10 | 4.50 | 1.80 | 34.47 |
| 1906 | .40 | .90 | .45 | 2.40 | 1.20 | 1.05 | 7.00 | 1.95 | 5.60 | 1.00 | 1.20 | 3.00 | 26.15 |
| 1907 | .20 | 1.00 | 1.40 | 2.40 | 7.75 | .20 | 1.50 | .60 | 1.70 | 7.95 | 10.40 | 1.50 | 36.60 |
| 1908 | .40 | 2.10 | 2.00 | 2.40 | 7.60 | .00 | 5.50 | 5.90 | 1.00 | .45 | 2.35 | .83 | 30.53 |
| 1909 | .00 | .30 | 1.57 | 2.10 | 3.89 | 1.05 | 6.90 | .88 | 1.94 | 1.42 | 2.95 | 2.76 | 25.76 |
| 1910 | .05 | .68 | 3.70 | 3.38 | 1.91 | .61 | .84 | T | 1.43 | 3.11 | 1.34 | 4.41 | 21.46 |
| 1911 | .58 | 2.17 | 5.45 | 4.72 | 1.36 | .13 | 1.70 | 1.05 | .40 | 1.97 | 2.95 | 2.95 | 25.43 |
| 1912 | .34 | 3.55 | 3.53 | 2.73 | 1.15 | 3.41 | .92 | .86 | 1.73 | 3.47 | 3.84 | 2.18 | 27.71 |
| 1913 | 1.21 | 1.80 | .90 | 1.94 | 3.85 | 6.05 | .33 | .53 | 5.64 | 16.37 | 8.03 | 5.82 | 52.47 |
| 1914 | .05 | 1.73 | 1.32 | 6.57 | 15.65 | .50 | .84 | 10.00 | 1.56 | 2.52 | 3.80 | 2.24 | 46.78 |
| 1915 | 1.68 | 2.90 | 1.69 | 9.94 | 1.30 | .16 | 1.61 | 5.20 | 5.34 | 1.18 | .67 | 2.04 | 33.71 |
| 1916 | 4.35 | .04 | .23 | 6.76 | 7.54 | .54 | 3.62 | 2.63 | 5.44 | 4.39 | .87 | .25 | 36.66 |
| 1917 | 1.05 | 1.30 | .28 | 1.14 | 6.85 | 3.65 | .58 | .13 | 3.05 | .95 | .79 | .05 | 19.82 |
| 1918 | .28 | 1.65 | .93 | 3.72 | 1.28 | 2.56 | .12 | 1.27 | 4.01 | 3.47 | 4.72 | 6.57 | 30.58 |
| 1919 | 4.14 | 2.85 | 1.73 | 3.84 | 4.16 | 5.74 | 6.27 | 7.06 | 13.90 | 10.49 | 1.08 | 1.21 | 62.47 |
| 1920 | 2.72 | .74 | .94 | 1.31 | 2.44 | 3.89 | 1.53 | 2.99 | 2.63 | 3.54 | 5.04 | .22 | 27.99 |
| 1921 | 2.16 | .87 | 3.35 | 4.81 | 2.35 | 3.87 | 1.02 | .90 | 9.69 | 1.02 | 1.39 | 1.38 | 32.81 |
| 1922 | 1.42 | 1.54 | 3.18 | 7.59 | 3.22 | 3.15 | .28 | .41 | 1.66 | 2.24 | 1.41 | .13 | 26.23 |
| 1923 | .56 | 5.35 | 3.28 | 4.89 | 1.61 | 1.48 | 3.23 | 1.92 | 9.97 | 7.18 | 4.02 | 4.74 | 48.23 |
| 1924 | 1.64 | 3.61 | 2.91 | 3.86 | 9.82 | 4.10 | .00 | .10 | 4.06 | .79 | .24 | 1.66 | 32.79 |
| 1925 | .42 | .12 | T | 1.51 | 2.35 | 1.02 | .59 | 2.10 | 3.17 | 6.00 | 2.66 | 1.07 | 21.01 |
| 1926 | 2.85 | .11 | 6.04 | 8.11 | 4.17 | 2.96 | 2.85 | .89 | .27 | 4.13 | 3.10 | 3.08 | 38.56 |
| 1927 | 1.54 | 4.60 | 2.72 | 3.48 | 2.72 | 5.58 | 3.17 | .15 | .86 | 1.75 | .10 | 3.23 | 29.90 |
| 1928 | .64 | 3.90 | .68 | 1.70 | 1.01 | 2.64 | 4.07 | 1.64 | 5.73 | 1.07 | 2.06 | 2.61 | 27.75 |
| 1929 | 1.58 | .62 | 1.34 | 2.42 | 8.04 | 1.28 | 6.83 | .64 | 2.02 | 2.86 | 3.17 | 3.26 | 34.06 |
| 1930 | 1.54 | 1.22 | 2.51 | 1.95 | 5.20 | 4.27 | 1.22 | .94 | 2.01 | 9.85 | 2.34 | 1.40 | 34.45 |
| 1931 | 6.44 | 5.53 | 2.69 | 7.09 | 1.62 | 1.79 | 3.81 | 1.60 | .17 | - | - | 3.78 | 34.52 |
| 1932 | 4.38 | 3.84 | 3.14 | 3.01 | 1.94 | 1.22 | 5.62 | 4.49 | 5.19 | .00 | .47 | 3.35 | 36.65 |
| 1933 | 4.13 | 2.51 | .85 | 1.32 | 3.75 | 1.20 | 2.37 | .83 | 2.52 | .13 | .48 | .49 | 20.58 |
| 1934 | 6.01 | 2.33 | 2.54 | 2.73 | 1.74 | .55 | 5.17 | .38 | .91 | .14 | .99 | 3.29 | 26.78 |
| 1935 | .42 | 3.02 | .77 | 2.45 | 12.59 | 8.59 | 6.80 | .57 | 10.40 | 2.14 | 1.35 | 3.81 | 52.93 |
| 1936 | .70 | .65 | 1.74 | .97 | 11.17 | 9.27 | 2.80 | 2.44 | 11.43 | 2.97 | 1.77 | 1.68 | 47.59 |
| 1937 | 1.98 | .15 | 2.92 | 1.60 | 5.94 | 5.50 | 3.24 | 1.49 | .10 | 2.89 | 1.54 | 5.46 | 32.81 |
| 1938 | 4.06 | 1.61 | 2.07 | 4.52 | 2.59 | 1.33 | 1.84 | .22 | 3.97 | .16 | .48 | 1.29 | 24.14 |
| 1939 | 3.54 | .86 | .65 | 1.46 | 2.58 | .58 | 6.55 | 3.05 | .48 | 3.16 | 2.33 | .96 | 26.20 |
| 1940 | .68 | 3.69 | 1.59 | 2.24 | 3.45 | 3.90 | .79 | 1.19 | 1.17 | 4.71 | 3.67 | 5.21 | 32.29 |
| 1941 | 1.81 | 5.88 | 4.71 | 5.76 | 4.51 | 3.03 | 1.61 | .55 | 5.00 | 7.02 | .85 | .87 | 41.60 |
| 1942 | .41 | 1.17 | .66 | 3.53 | 3.79 | 1.27 | 2.62 | 3.91 | 4.78 | 5.65 | 1.58 | 1.75 | 31.12 |
| 1943 | .86 | .07 | 1.71 | 1.27 | 4.26 | 3.57 | 5.16 | .05 | 4.76 | .39 | 1.59 | 2.64 | 26.33 |
| 1944 | 3.67 | 3.75 | 3.70 | 1.08 | 8.56 | 1.88 | .87 | 7.56 | 2.25 | 1.37 | 3.91 | 4.38 | 42.98 |
| 1945 | 3.55 | 2.94 | 1.98 | 1.10 | 1.00 | 2.65 | 4.22 | 2.85 | 5.01 | 3.94 | 1.30 | 2.96 | 33.50 |
| Av. | 1.83 | 2.02 | 2.04 | 3.52 | 4.32 | 2.71 | 2.98 | 2.08 | 3.62 | 3.33 | 2.36 | 2.39 | 33.20 |

The following is a record of monthly precipitation at Bulverde, in the western part part of Comal County in the drainage area of Cibolo Creek from 1940 to 1945.

Monthly precipitation, in inches, at Bulverde, Comal County, Texas 1940-45

| Year | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1940 | - | 1.14* | 0.79 | 2.84 | 3.69 | 4.47 | 1.91 | 1.50 | 1.48 | 2.88 | 4.94 | 5.81 | 31.45* |
| 1941 | 1.18 | 4.31 | 3.85 | 6.00 | 3.00 | 5.48 | 2.02 | 0.54 | 3.52 | 7.05 | .48 | 1.54 | 38.97 |
| 1942 | .12 | 2.76 | .20 | 3.97 | 2.40 | 2.17 | 4.86 | 3.15 | 7.17 | 8.15 | 1.32 | .72 | 36.99 |
| 1943 | .55 | .15 | 1.53 | 1.78 | 3.62 | 2.17 | 7.45 | .12 | 7.57 | 1.42 | 1.98 | 2.78 | 31.12 |
| 1944 | 3.91 | 3.81 | 4.42 | 4.83 | 5.87 | 2.53 | .75 | 4.89 | 2.33 | 1.13 | 5.80 | 5.61 | 45.88 |
| 1945 | 3.21 | 4.08 | 5.19 | 1.45 | .78 | 3.00 | 1.14 | .35 | 2.92 | 4.43 | .78 | 2.06 | 29.39 |

* Station established February 15, 1940

The following 7-year record was obtained by Alvin W. Glass by means of a standard gage. The station is north of the Guadalupe River, a mile south of Spring Branch post office.

Monthly and annual precipitation, in inches, at Alvin W. Glass farm, Comal County, Tex. (One mile south Spring Branch Post Office. Unofficial record) 1939-1945

| Year | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1939 | 4.16 | 1.04 | 0.63 | 1.60 | 2.51 | .85 | 4.12 | 2.03 | 0.50 | 0.61 | 2.00 | 1.07 | 21.12 |
| 1940 | .74 | 2.88 | 1.36 | 2.10 | 1.24 | 4.07 | 2.48 | 1.51 | 1.36 | 3.01 | 3.95 | 6.54 | 31.23 |
| 1941 | 2.00 | 2.63 | 4.86 | 5.59 | 3.25 | 2.91 | 1.45 | 0 | 1.37 | 7.95 | .64 | 1.23 | 33.88 |
| 1942 | 0 | 1.52 | 0 | 3.90 | 2.66 | .75 | 2.70 | 4.83 | 9.19 | 6.02 | 2.01 | 2.08 | 35.66 |
| 1943 | .65 | 0 | 2.32 | 1.58 | 4.96 | 1.62 | 4.97 | 2.46 | 4.43 | .28 | 1.03 | 1.99 | 26.29 |
| 1944 | 5.14 | 3.25 | 3.35 | .69 | 9.27 | 2.55 | 0 | 4.61 | .79 | 1.07 | 4.41 | 1.91 | 37.04 |
| 1945 | 2.79 | 5.16 | 4.88 | .61 | .45 | 1.36 | .90 | .79 | 3.68 | 5.52 | .99 | 2.32 | 29.52 |

## TOPOGRAPHY

General features.- Comal County falls within two physiographic provinces, the Edwards Plateau northwest of the Balcones escarpment and the Coastal Plain southeast of the escarpment.

The Edwards limestone, which is named for the Edwards Plateau, together with remnants of formations of the Washita group covers most of the surface of the vast area northwest of the Balcones escarpment. Locally the Plateau is dissected so that the Edwards limestone has been removed and only small remnants cap the hills.

On the Edwards Plateau, in the central part of the county, much of the area is rough or rolling and is referred to locally as the "mountains" or "hill country". In certain stretches along the Guadalupe River and Cibolo Creek, canyons have been developed. The canyon along the Guadalupe River a few miles northwest of New Braunfels has almost vertical walls and is well known for its scenic beauty. In places the uplands are pitted with sinkholes.

The highest point in the county, with an altitude of 1,527 feet, is at the summ summit of Devil's Hill, 7 miles west of Smithson Valley; the lowest point, with an altitude of about 600 feet, is in the channel of the Guadalupe River where it enters Guadalupe County. The total relief in the county, therefore, is more than 900 feet.

In the western part of the county, beds of massive limestone alternating with softer clays and shales result in steplike terraces which circle the steep slopes like contours. In this area there are sharp divides, in contrast to the fairly wide and comparatively flat mesas of the Edwards Plateau.

Drainage.- Most of Comal County drains directly into the Guadalupe River. The northernmost part of the county is drained by the Little Blanco River and the southwestern part by Cibolo Creek and Comal Creek. These streams have wide meanders, characteristic of old streams, and have apparently held their general courses through the events of recent geologic history. There is much evidence, however, of comparatively recent rejuvenation. The streams are actively degrading their channels within their meander belts. The channels are barren of sediments except for large boulders. Rapids are found where major faults cross the streams (plate 1), indicating comparatively recent movement along the fault planes.

A. Guadalupe River at Hueco Springs fault.

B. Guadalupe River at Comal Springs fault about 3 miles northeast of New Braunfels. Rapids mark fault which brings Edwards limestone in contact with Taylor marl.

## GEOLOGY

### Introduction

Sedimentary rocks may be seen at the surface in all parts of Comal County, but only small outcrops of igneous rocks have been found. Basalt porphyry intrudes the Glen Rose limestone near the Kendall County line. No igneous rock has been reported in the log of any well in the county. Metamorphic rock in the form of schist is reported in the log of the oil test (well 395, see drillers' log) on the Erhard Heidrick ranch 6½ miles west of New Braunfels.

The sedimentary rocks are composed of layers of limestone, shale, clay, sandstone, and sand, which for convenience of study and reference have been grouped by geologists into formations and larger units, usually named for the areas in which they were first observed and described. The limestones, sandstones, and sands contain the underground-water reservoirs in Comal County. Openings 6/ in these rocks such as cavities in limestone caused by solution or fracturing, or spaces between grains of sand, permit the movement of water from the surface downward to the ground-water reservoirs and also laterally within the reservoirs. Clays and shales generally transmit little or no water and are regarded as barriers which retard or prevent the movement of water.

The occurrence of ground water is closely related to the geologic history of Comal County. Gradual elevation or subsidence of the land relative to the level of the sea is clearly shown by the upward succession of strata, marked by the fossil remains of animals contained in them. Breaks in the continuity of sediments that were deposited in the sea are indicated by the absence of strata that are known to occur elsewhere in Texas. This means that Comal County was above the level of the sea while other parts of Texas were still below sea level. In such areas sediments were still being deposited to form strata not found in Comal County. These breaks in sedimentation are called disconformities and are mentioned later in the descriptions of the formations.

More abrupt movements within the earth underlying Comal County have resulted in the dislocation of the rock, so that in some places formations that were deposited early in the geologic history are now found to be in contact with and at the same level as formations that were deposited much later and normally belong at much higher levels. The planes of contact between these formations are called faults and can be traced at the surface in linear patterns. The major faults are shown on the geologic map, plate 5. Deformation along fault lines has caused some strata to dip or to be inclined from their original nearly horizontal position. The deformations of strata resulting from earth movements is discussed later under the heading of structural geology.

Except for a few isolated alluvial deposits of Pleistocene age the water-bearing rocks in Comal County are of Cretaceous age. The following table shows the thicknesses of the various geologic formations and gives brief descriptions of the character of the formations, their water-bearing properties, and the characteristic appearance of the land where the formations are at the surface.

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6/ For a complete classification and discussion of openings in rocks see Meinzer, O. E., The occurrence of ground water in the United States: U. S. Geol. Survey Water-Supply Paper 489, pp. 109-148, 1923.

# GEOLOGIC FORMATIONS IN COMAL COUNTY, TEXAS

| System | Series and group | | Formation | Thickness (feet) | Character of rocks | Characteristic appearance of land surface | Water supply |
|---|---|---|---|---|---|---|---|
| Quaternary | Recent | | Alluvium | 0 - 15± | Sand, silt, clay, and gravel. | Lowest stream terraces. | No dependable reservoirs. |
| Quaternary | Pleistocene | | Leona formation | 0 - 50± | Sand, silt, and gravel. | Wide flat terraces in stream valleys 30 to 75 feet above beds of streams. Good farm land. | Furnishes good water to many wells in Guadalupe River Valley southeast of New Braunfels, and to a few wells in parts of Cibolo Creek Valley. |
| Tertiary (?) | Pliocene (?) | | Uvalde gravel | 0 - 15± | Coarse flinty gravel. | Caps hills and divides. | No wells are known to draw water from this formation. |
| Cretaceous | Upper Cretaceous | | Taylor marl and Anacacho limestone, undifferentiated | 300± | Calcareous clay and chalky marl. | Rounded hills with clayey soils. | Yields highly mineralized water to a few shallow wells. |
| | | | Austin chalk | 150± | White to buff chalk and limestone | Low rounded hills and "black land" soils. | Wells usually have small yield. |
| | | | Eagle Ford shale | 15 - 20± | Yellow clay and sandy clay. Brown arenaceous flagstones. Lignite common in wells. | Slight terraces where flagstones are present. | No wells known to obtain water from this formation in Comal County. |
| | Lower Cretaceous | Washita group | Buda limestone | 2 - 70± | Splintery massive limestone. Yellow to buff. Often speckled with darker spots. | Forms low ridges. Generally broken fragments or boulders. | Generally not water-bearing. |
| | | | Grayson (Del Rio) shale | 20- 60± | Greenish-yellow clay. Some hard calcareous beds. "Ram's horn" (*Exogyra arietina*) fossils abundant. | Usually partially covered by boulders from overlying Buda limestone. Cultivated in places. | Yields no water to wells in Comal County. |

GEOLOGIC FORMATIONS IN COMAL COUNTY, TEXAS -- CONTINUED

| System | Series and group | | Formation | Thickness (feet) | Character of rocks | Characteristic appearance of land surface | Water supply |
|---|---|---|---|---|---|---|---|
| Creta-ceous | Lower Creta-ceous | Fred-er-icks-burg group | Georgetown limestone | 5 - 30 | Hard massive lime-stone. Thin marl beds in some places. | Rocky slopes. Arable fields where marl beds are present. | Generally yields little or no water. |
| | | | Edwards limestone | 350 -500± | Hard white limestone with flint nodules. Honeycombed and cavernous. Some chalky beds. | Deep canyons along streams. Upland surface undulating and pitted with sinkholes | Yields more water than any other formation in Comal County. |
| | | | Comanche Peak limestone | 20 - 55 | Hard limestone, similar to Edwards limestone. Contains no flint. | Forms part of canyon along streams. | Not distinguished from Edwards lime-stone in wells. |
| | | | Walnut clay | 1 - 15 | Fossiliferous marl and limestone | Arable land in valleys. Used for road surfacing. | Small yield to few farm wells. |
| | | Trini-ty group | Glen Rose limestone: upper member; lower member | 650-1150± | Alternating beds of hard limestone and dark blue marl. Thick massive lime-stone beds at base. | Step terraces and rugged topography. Sinkholes and honeycombed rock where lower part of formation is exposed. | Yield usually small. Supplies large number of ranch wells. |
| | | | Travis Peak formation (Pearsall formation in wells) | 100± 300± | Fine sand, marl, and limestone. | Middle Cow Creek limestone member forms canyons. Underlying Sycamore sand member not exposed. | Few good springs in limestone. No large yield from wells. |
| | | | Hosston formation | ? | Dark and red shales and sand-stone. | Not exposed in Comal County. | Probably not water-bearing. |
| Pre-Creta-ceous rocks | ? | | ? | ? | Schist. | do. | do. |

## Rock formations and their water-bearing properties

### Pre-Cretaceous rocks

No rocks older than those of Cretaceous age crop out in Comal County and it is believed that no wells in Comal County yield water from such formations.

After the long and complex history of the Paleozoic era, as shown by the rocks which crop out in Llano County and adjacent counties, the sea retreated from central Texas and a large part of Texas became a mountainous land and remained above sea level during the Triassic and Jurassic periods which followed. It is believed that Paleozoic rocks underlie Comal County at considerable depth but Triassic and Jurassic formations are probably absent. The schist reported in the driller's log of well 388 is probably Paleozoic in age. Sellards 7/ and Udden have identified Paleozoic schists in two deep wells in the Leon Springs area, a few miles south of the western part of Comal County, and at other places along the Balcones fault zone 8/, indicating a large subsurface area of these schists.

### Cretaceous system
### Lower Cretaceous series
### Pre-Comanche rocks

As yet not enough deep wells have been drilled to clarify the geologic history of the early Cretaceous formations in Comal County. From 15 to 20 miles north of the north tip of Comal County, in Blanco County along the Pedernales River, the Travis Peak formation 9/ lies directly upon Paleozoic rocks ranging in age from Ordovician to Carboniferous. The Travis Peak formation 10/ has long been regarded as the oldest Cretaceous strata in central Texas.

However, Ralph W. Imlay 11/ of the Geologic Branch of the U. S. Geological Survey, in cooperation with a number of other geologists associated with the oil industry has recently presented evidence to indicate that the older basinward strata of Cretaceous age extending from Arkansas to Mexico should be classified as the Hosston, Sligo, and Pearsall formations in ascending order; the Pearsall being the subsurface equivalent of the Travis Peak formation. The Hosston and Sligo have not been positively identified in Comal County wells. There is a possibility, however, that the 177 feet of "red beds" and blue lime shown from 1,518 feet to 1,795 feet in the driller's log of well 388 may belong to the Hosston formation.

No potable water has been reported from pre-Trinity rocks in Comal County.

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7/ Sellards, E. H., Geology and mineral resources of Bexar County: Univ. Texas Bull. 1932 pp. 19-21, 1920.

8/ Sellards, E. H., Rocks underlying Cretaceous in Balcones fault zone of Central Texas: Am. Assoc. Petroleum Geologist Bull., vol. XV, pp. 819-827, 1931.

9/ Cuyler, Robert H., Travis Peak formation of Central Texas; Am. Assoc. Petroleum Geologists Bull., vol. 23, pp. 625-642, 1939.

10/ Hill, Robert T., Geography and geology of the Black and Grand Prairies, Texas: U. S. Geol. Survey, 21st Ann. Report, p. 140, 1901.

11/ Imlay, Ralph W., Subsurface Lower Cretaceous formations of South Texas: Am. Assoc. Petroleum Geologists Bull., vol. 29, pp. 1416-1469, 1945.

## Comanche series

### Trinity group

#### Travis Peak (Pearsall) formation

The Travis Peak formation was divided by Hill 12/ into three members, which in ascending order are: the Sycamore sand member, the Cow Creek (limestone) member, and the Hensell sand member. These members were described from outcrops near the Travis Peak post office in the northern part of Travis County, Texas.

Rocks that are believed to be the equivalents of the Cow Creek limestone and Hensell sand members of the Travis Peak are exposed near the Guadalupe River in the northwestern part of Comal County. These are the oldest rocks that are exposed in the county. They were observed by Cuyler 13/, who pointed out that these two members are uniform in thickness as compared with Hill's Sycamore sand member. The Sycamore contains materials characteristic of the first deposits of a transgressing sea and differs in thickness according to the topography of the land surface on which it was deposited.

In the outcrop areas of the Sycamore sand member in north-central Texas the sands are coarse and some parts of the member are conglomeratic, and east of the outcrop area this member is an important source of ground water for municipalities and industries. The Sycamore does not crop out in Comal County and it is doubtful that such sands are present beneath the surface. A number of wells in the Guadalupe River valley in the vicinity of Spring Branch (wells 106, 107, 108, 110, and others) are deep enough to have encountered these sands if they were present but no such sands have been reported. No well logs for these wells are available, however, and no tests have been made to determine the probable maximum yield.

The Cow Creek limestone member consists of massive gray-white fossiliferous limestone and has a total thickness of about 75 feet. The limestone is honeycombed in some places along the outcrop but little is known regarding the permeability of the Cow Creek where it is deeply buried and protected from surface weathering. In well 120, on the south bank of the Guadalupe River near Highway 281, however, honeycombed rock which yields an ample supply of water for domestic and stock use was encountered at a depth of 330-380 feet. It is believed that the honeycombed rock is a part of the Cow Creek member.

Rebecca Creek Spring (74), 9 miles northwest of Hancock, which at times flows as much as 2,000 gallons a minute, issues from the lower part of the Cow Creek.

The Hensell sand member is composed of buff-colored argillaceous and calcareous fine-grained sand containing siliceous and calcareous geodes locally known as "Katzenkopfe" (cat heads). There are also sandy limestone beds containing glauconite which adds a greenish tint to the buff color. Within the limited area of exposure in Comal County the contact between the Glen Rose and the Travis Peak formations appears to be conformable and is shown on plate 5. It is arbitrarily placed at the top of the greenish-colored galuconitic limestone of the Travis Peak that is in contrast with the overlying gray-white honeycombed rudistid Glen Rose limestone. The following section was observed 2.3 miles northeast of the Spring Branch post office, above U. S. Geological Survey bench mark R 26 Texas, 1924; altitude 1,036 feet.

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12/ Hill, Robert T., op. cit. pp. 141-144.
13/ Cuyler, Robert H., op. cit.

| | Thickness (feet) | Altitude top of bed (feet) |
|---|---|---|
| Glen Rose limestone: | | |
| Limestone, massive, honeycombed, gray-white; contains rudistids | 3 | 1059 |
| Travis Peak formation - Hensell sand member: | | |
| Limestone, greenish buff, sandy, nodular, with honeycomb texture; glauconite abundant | 22 | 1086 |
| Sandstone, fine-grained, greenish buff, calcareous; contains white hard siliceous geodes ranging in diameter from 1 to 8 inches, locally known as "Katzenkopfe" (cat heads) | 6 | 1064 |
| Sandstone, yellow to buff, calcareous, containing large fossil oysters near top. The fossils (Exogyra) have concentric surface markings of secondary siliceous material (beekite) | 11 | 1058 |
| Sandstone, fine-grained, buff, argillaceous; contains "cat heads". Stratified, some poorly preserved fossils | 1½ | 1047 |
| Limestone, hard, buff; contains large fossil oysters also covered with beekite like those above | 2 | 1045½ |
| Covered | 7½ | 1043½ |
| Fault | | 1036 |
| Glen Rose limestone | | 1036 |
| Bench mark | | 1036 |

The rocks of the Hensell member, buff-colored where weathered, are probably blue where protected from weathering. In wells the member is known as "the blue rock". The member generally yields sufficient water for domestic and stock use, but, because of its relative low permeability, large yields probably cannot be developed from wells obtaining water from this source.

Evidence of the lack of permeability in the Hensell sand member is shown by the fact that at least two fairly large springs (80, 104) issue near the contact between the Glen Rose limestone and the underlying Hensell sand member of the Travis Peak formation. The water accumulates in sinkholes and in the honeycombed rudistid limestone of the basal Glen Rose limestone, which covers a fairly large area in the western part of Comal County and the adjacent part of Kendall County. It flows underground on top of the Hensell sand to points where the streams have cut through the contact whence it issues as springs.

Glen Rose limestone

The Glen Rose limestone is exposed at the surface in the northwestern part of the county in an area equal to about one-half of the area of the county. The thickness of the formation ranges from about 650 feet in the northern part of Comal County to about 1,200 (?) feet in the southern part of the county, where the formation has been penetrated by oil tests. Where thick sections are exposed at the surface the Glen Rose is easily recognized at a distance because of the characteristic terraces or "stair-step" topography due to the alteration of limestone and more easily eroded marl beds.

For convenience of reference, the Glen Rose limestone is arbitrarily divided into two parts and is referred to in this report as the upper and lower members of the Glen Rose limestone. The division is made at a well-known fossil bed called the Salenia texana zone which occurs somewhat below the middle of the formation. This fossil bed (see section on p. 21 ) has been studied in detail and has been traced in an area covering several counties in central Texas by Professor F. L. Whitney and associates of the University of Texas. It is an excellent marker because it is easily recognized and several of the fossils in the bed arenot found elsewhere in the Glen Rose.

The locations of the outcrops of the Salenia texana zone coincide with the contact between the upper and lower members of the Glen Rose limestone as shown on plate 5. The following species were collected from the Salenia texana zone at a location 2.9 miles south of the Guadalupe River on Highway 281, and have been identified by the members of the U. S. Geological Survey who are listed below the table.

1. Orbitolina texana (Roemer)
2. Salenia texana Credner
3. Tetragramma
4. Hemiaster comanchei Clark
5. Enallaster texanus (Roemer)
6. Prohinnites? sp.
7. Leda?
8. Panope cf P. henselli (Hill)
9. Homomya jurafacies Cragin
10. Arctica medialis (Conrad)
11. Arctica roemeri (Cragin)
12. Cucullaea cf C.terminalis Conrad
13. Cucullaea sp.
14. Volsella sp.
15. Protocardia? sp.
16. Neithea occidentalis (Conrad)
17. Pteria sp.
18. Trigonia crenulata Roemer (not Lamarck)
19. Apporrhais? sp.
20. Nerinea sp.
21. Nerinea n. sp.
22. Lunatia? praegrandis Roemer
23. Tylostoma sp.
24. Porocystis globularis (Giebel)

The echinoids listed above were identified by C. Wythe Cooke; the Orbitolina by Lloyd Henbest; all others by R. W. Imlay.

Glen Rose limestone, lower member.- Although alternating limestones and marls are characteristic of the whole formation, the lower Glen Rose contains thicker and more massive limestone beds and is more fossiliferous than the upper Glen Rose. With the exception of a few small areas, the lower Glen Rose is exposed in Comal County only in the area west of the Tom Creek fault. (See geologic map, pl. 5) The basal limestones in this area are composed almost entirely of poorly preserved fossils and have a total thickness of about 100 feet. In the outcrop area the rock is honeycombed and sinkholes are common; in the northwestern part of the county and the adjacent part of Kendall County these limestones yield a considerable volume of water to springs. Spring Branch Spring, Honey Creek Spring, and Crane's Mill Spring (see nos. 104, 80, and 35, respectively, on geologic map, and in table of well records), and other smaller springs issue from these basal limestones. At Spring Branch Spring, however, the water issues at the contact between the basal limestone and the underlying Travis Peak formation. Above the spring massive fossiliferous limestone forms a cliff about 25 feet in height. Here the fossils have been partly dissolved from the matrix, leaving a honeycomb mass of moulds of rudistids, gastropods, and mollusks. Moulds of the genius Trigonia are especially abundant. It is believed that the springs are fed through solutional channels developed along fractures connecting sinkholes. In the areas where these limestones are deeply buried beneath younger rocks, no large yields are reported from wells that penetrate them, and the solutional channels are probably limited to the outcrop area.

In the extreme western and southwestern parts of the county, particularly in the valley of Cibolo Creek, the lower Glen Rose is cavernous (see pl. 2), and a great deal of surface water enters these rocks. (p.45 ), which does not return to the surface as springs in the outcrop area of the Glen Rose limestone. Just south of the creek, in Bexar County, and in the Leon Springs military reservation, honeycombed limestone was reported by a well driller at a depth of 199 feet. North of Cibolo Creek in Kendall County, in the same general area, a cave which caused the drill to drop a foot was found at a depth of 269 feet. At this depth the water rose 60 or 70 feet in the drill hole.

A. Cavern in flood plain of Cibolo Creek on O. Weidner Ranch, half a mile east of Highway 281.

B. Cavern in Glen Rose limestone near Cibolo Creek. Rompel Ranch, 4 1/2 miles east of Highway 281.

Between the basal limestone and the Salenia texana zone, the alternating beds of limestone and marl are characterized by casts of large gastropods and mollusks. Fossils with original shell material are seldom found. The casts of the large mollusks are known locally as "ox hearts". This part of the section yields very little water to wells. About 80 feet below the Salenia texana zone is a bed containing the large species of foraminifera Orbitolina whitneyi Carsey, believed by some palentologists to be the same species as O. texana (Roemer). In some places this fossil occurs in such numbers as to form a "sand" which yields small amounts of water. Oolitic sands in the lower Glen Rose yield as much as 100 gallons a minute to wells in the vicinity of Wimberly in Hays County, but no such horizon has been found in Comal County.

The Salenia texana zone is associated with some fine-grained sandy beds both above and below and is the source of water in some wells and springs. Seep springs occur in nearly all the valleys where this zone is exposed at the surface, although most of them disappear after long dry seasons. In the western part of the county, however, rocks in this zone are more permeable and the yield to wells is somewhat greater. On the Hohman ranch, a spring (176) yields about 50 gallons a minute during wet seasons and some water is always available in any season.

Glen Rose limestone, upper member.- No unconformity was observed between the upper and lower members of the Glen Rose limestone. Outcrops of the upper Glen Rose appear in valleys in the central part of the county, cover most of the north-central part of the county, and are found at relatively high altitudes in the extreme northern part of the county. The upper limestone is comparatively barren of fossils. Orbitolina texana occurs irregularly at five or six horizons and a few other beds are fossiliferous, but in the upper part of the section no fossils are found. Ripple marks, cross-bedding, and other manifestations of shallow-water deposition are common. Water is found in small quantities in fine-grained sandy marl and sandy limestone and in beds of fine-grained loose sand from 1 to 2 feet thick. The maximum yield for most water wells in the upper Glen Rose is probably less than 3 gallons a minute.

The following section includes parts of both the upper and lower members of the Glen Rose.

Section measured from foot of windmill near ránch house at Byler ranch northward to U. S. Geological Survey bench marl on flat-topped hill. (U. S. Geological Survey bench mark 12-T; altitude 1,450 feet±.)

| Glen Rose limestone, upper member | Feet |
|---|---|
| Limestone, massive, gray, honeycombed | 3 |
| Marl, blue-gray | 2 |
| Limestone, massive, honeycombed, forms prominent terrace | 8 |
| Limestone, chalky | 6 |
| Covered; soil moist from seepage | 13 |
| Limestone, hard, gray-brown, brittle, roughly stratified; forms terrace | 3 |
| Limestone, soft, yellow to gray, nodular, a few fossil casts in lower part | 24 |
| Marl, blue, weathers buff; fossils rare | 12 |
| Limestone, hard, buff | 2 |
| Limestone, earthy, honeycombed, grading upward into marl ... containing an abundance of casts of large and small mollusks | 16 |
| Limestone, cross-bedded, sandy; forms terrace | 2 |
| Marl | 5 |
| Limestone, hard, brittle; forms terrace | 1 |
| Marl | 5 |

| Glen Rose limestone, upper member -- Continued | Feet |
|---|---|
| Limestone, hard, brittle; forms terrace | 1 |
| Limestone, irregularly bedded, honeycombed | 4 |
| Limestone, earthy, in 6-inch beds | 2 |
| Marl, blue; weathers buff | 4 |
| Limestone, hard, 2-inch to 4-inch flags | 2 |
| Marl, platy | 5 |
| Limestone, gray-brown, crystalline, composed of fossil fragments | ½ |
| Marl, platy | 5 |
| Limestone, gray-brown, crystalline, fossil fragments | ½ |
| Marl | 5 |
| Limestone, light gray, 2-inch flagstones | 2 |
| Marl | 5½ |
| Limestone, gray, 2-inch flagstones | 1 |
| Marl, platy | 11 |
| Limestone, blocky with rectangular fracture, some thin flagstones | 2 |
| Marl, with thin beds of limestone | 18 |
| Limestone with an abundance of small fossils (*Leda? sp.*) that look like wheat seeds. Usually forms prominent terrace | ½ |
| Limestone, fossiliferous, honeycombed | 2 |
| **Glen Rose limestone, lower member** | |
| Marl, fossiliferous, fine sandy, containing *Salenia texana* Credner, *Hemiaster sp.*, *Porocystis sp.*, *Nerinea sp.*, *Orbitolina texana* Roemer, and casts of large mollusks. Source of seep springs in valleys | 5 |
| Limestone, irregularly bedded, with an abundance of poorly preserved fossils | 2 |
| Marl, fine sandy, source of seep springs in valleys | 5 |
| Limestone, poorly stratified, porous; nodular structure | 3 |
| Marl | 13 |
| Limestone, massive, sandy | 1 |
| Marl | 6½ |
| Limestone, hard, buff; forms terrace | ½ |
| Marl | 5 |
| Alternating marl and limestone with casts of large mollusks | 11 |
| Limestone, hard, flaggy | 2½ |
| Marl | 3 |
| Limestone, hard, buff; porcelaneous texture; forms terrace | 2 |
| Marl with casts of large mollusks ("ox hearts") | 10 |
| Limestone, hard, porous, fossiliferous, massive, containing *Orbitolina whitneyi* Carsey | 2½ |
| Marl, fine sandy, buff and blue; contains abundance of *Orbitolina texana* | 9 |
| Covered. Broad grassy valley | 27 |

Foot of windmill.

## Fredericksburg group

The Fredericksburg group includes the Walnut clay, the Comanche Peak limestone, and the Edwards limestone. The three formations are shown as a single unit on the geologic map. The Kiamichi formation, the uppermost member of the group, is absent in Comal County.

Adkins 14/ has offered the following opinion regarding the classification of the formations in the Fredericksburg group.

> "Although in this discussion the Fredericksburg is divided into the usual conventional formations, it is the writer's opinion that all formations in this group should be suppressed and only the facies used. However, a decision on this procedure can be reached only after the zonation is better known and the meaning of the term 'formation' better clarified".

Hydrologically, in Comal County, the Comanche Peak and Edwards limestones may be regarded as a single unit.

## Walnut clay

The Walnut clay, the lowest formation of the group, lies conformably on the Glen Rose limestone and marks the change from the alternating marl and limestone of the Glen Rose to the thick, massive beds of the Comanche Peak limestone and the Edwards limestone.

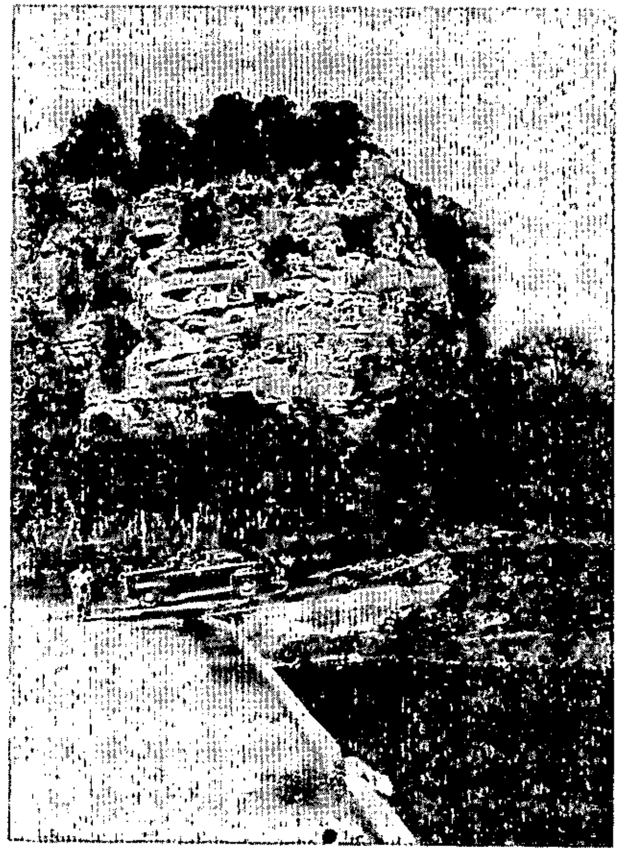
The typical Walnut clay of central Texas includes a buff-colored sandy clay or marl containing a comparatively large fauna characterized by an abundance of *Exogyra texana* Roemer. In Comal County such beds occur only in the northeastern part of the county near the Hays County line. Westward the formation becomes thinner and less fossiliferous. In most places in Comal County it is represented by a bed of sandy marl from 3 to 5 feet in thickness, which contains small white nodules of calcareous material and a few scattered speciments of *Exogyra texana*. In some places the formation is only a few inches thick and fragments of *E. texana* can be found only by diligent searching. The presence of *E. texana* in the marly beds of the overlying Comanche Peak limestone makes the exact position of the Walnut clay uncertain, particularly in faulted areas. The Walnut clay may yield small amounts of water to some wells in Comal County where the marl is sandy, but such occurrences are probably rare.

## Comanche Peak limestone

The Comanche Peak limestone appears to lie conformably upon the Walnut clay. The range in thickness in Comal County is from 20 to 55 feet but the thickness in most places is about 40 feet. It is composed chiefly of hard gray-white massive limestone, but in some places beds of marl containing *Exogyra texana* occur in the lower part of the formation. The similarity of these beds to the Walnut clay makes it difficult to define the lower limits of the Comanche Peak limestone. Along the Guadalupe River upstream from Hueco Springs, (pl. 3), the basal Comanche Peak is composed of massive, honeycombed caprinid limestone. The most distinguishing characteristic of the formation in Comal County is the presence of secondary crystalline calcite in the form of nodules and veins. Honeycomb structure is usually associated with biostroms containing caprinid and other fossils. Well drillers do not distinguish the Comanche Peak from the Edwards.

14/ Sellards, E. H., Adkins, W. S., and Plummer, F. B., The geology of Texas: Univ. Texas Bull. 3232, p. 323, 1932.

A. Rudistid limestone in Comanche Peak limestone in Guadalupe River canyon.



B. Edwards and Comanche Peak limestones in Guadalupe River canyon just above Hueco Springs. Lower part of cliff is Comanche Peak limestone.

## Edwards limestone

The Edwards limestone lies conformably upon the Comanche Peak limestone. The thickness of the Edwards in Comal County has not been accurately determined but it probably ranges from 350 to 500 feet. The outcrop area is mostly in the southeastern part of the county. The areal distribution is discussed in more detail and in relation to faults under the heading of structural geology (pp. 29 to 33). The Edwards is composed almost entirely of hard, massive limestones that are extensively honeycombed. The most distinguishing characteristic of the formation is the occurrence of flint nodules ranging in size from small pebbles to irregularly lenticular-shaped masses as much as a foot in diameter. Flint is not found in any other Cretaceous strata in Comal County. The flint is not uniformly distributed in the Edwards but occurs at a number of horizons. No flint is found at the base of the formation.

Shale or clay lenses up to 40 feet thick (see log of well 266) occur irregularly in the Edwards but are extensive enough to retard the downward movement of water in some areas, so that the water table is temporarily perched in these areas. Well 258, dug to a depth of 90 feet in the Edwards limestone on the R. J. Haug ranch, 5 miles west of New Braunfels, overflows during wet seasons, whereas water levels in deeper drilled wells in the same area and at approximately the same altitude are from 300 feet to 400 feet below the land surface. Well 258 is not in use, probably because of failure in dry seasons. The Servtex Company reports a bed of clay 10 feet thick at the bottom of their quarry in the Edwards limestone, about 9 miles southwest of New Braunfels. Some of the clay beds reported by drillers may be old caves that have been filled with mud.

In contrast to the brittle crystalline material of most of the Edwards limestone, a white chalky limestone 15 to 20 feet thick, very similar in appearance to the Austin chalk, occurs in the upper part of the Edwards. Samples from an outcrop 6 miles northeast of New Braunfels were examined under the microscope by Frank E. Lozo, Jr., 15/. They contained an abundance of ostracods and reef-forming organisms but very few foraminifera. Chara seeds were also reported.

The most complete section of the Edwards limestone compiled during the Comal County investigation is given in the field description of a core test drilled by the Corps of Engineers, U. S. Army, 5 miles north of New Braunfels. (Pl.5 and well 401 in table of drillers' logs). No clay or shale beds are reported in this section. Most of the limestones are porous and many cavities from 1 to 3 feet in depth were found.

The land surface in the outcrop area of the Edwards limestone is characterized by gentle slopes pitted by sinkholes that range in size from small openings to depressions 15 to 20 acres in extent. In the vicinity of the main streams the slopes are precipitous. The Edwards, together with the Comanche Peak limestone, forms the walls of the Guadalupe River canyons above Hueco Springs.

## Washita group

The Washita group in Comal County includes the Georgetown limestone and the Grayson (Del Rio) shale of lower Cretaceous age and the Buda limestone of upper Cretaceous age.

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15/ Personal communication.

Georgetown limestone

Present outcrops of Georgetown limestone occur only in a belt from 3 to 6 miles wide lying between the Comal Springs fault and the Bat Cave fault where the formation is exposed in an irregular pattern.

After the Edwards limestone was deposited, a part of the surface of the Edwards was elevated above the level of the sea and was subjected to erosion. During this period some of the upper part of the Edwards was removed and a part of it became honeycombed and probably cavernous as a result of solution by fresh water. When the Edwards was submerged again, the encroaching Georgetown sea first filled the valleys in the partially dissected surface of the Edwards and later covered all of the present outcrop area of the Edwards limestone in Comal County. At present all of the Georgetown limestone south of the escarpment is covered by younger formations. The extent of the disconformity between the Georgetown and the Edwards has not been fully determined, but it is generally recognized that on the broad uplift known as the San Marcos arch (see p. 32 ) the equivalents of the Kiamichi of the Fredericksburg group and the Duck Creek, Fort Worth, Denton, Waco, and Pawpaw formations of the Washita group are either absent or are represented by comparatively thin beds. The formations mentioned above are described by Adkins 16/ together with provisional zonation of the fossils found in them.

The importance of the disconformity in relation to ground water lies in the probability that the high permeability of the upper part of the Edwards, now buried beneath succeeding formations in the area south and southeast of the Balcones escarpment, may have been caused by solution during the interval indicated by the disconformity. Some drillers, particularly in the San Antonio area, are careful to cement casing in the Georgetown limestone before drilling into the Edwards. Experience in that area has shown that, if the well is drilled into the Edwards before attempting to cement the casing, it is sometimes necessary to mix rags, cotton hulls, etc., with the mud to shut off the water long enough to allow the cement to set. As a result of this procedure a considerable part of the potential yield of the well may be permanently lost.

In the report on the San Antonio area by Livingston, Sayre, and White 17/ , a line of demarcation is shown between water of good quality and water of poor quality which is believed to be the gulfward limit of free circulation of ground water in the Edwards limestone.

Solution cavities at unconformable contacts and their relationship to the circulation of ground water in limestones have been recognized by Piper 18/ in Tennessee and by Nye 19/ in New Mexico.

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16/ Adkins, W. S., The geology of Texas, Vol. 1, Stratigraphy: Texas Univ. Bull. 3232, pp. 359-386, 1932.

17/ Livingston, Penn, Sayre, A. N., and White, W. N., Water resources of the Edwards limestone in the San Antonio area, Texas: U. S. Geol Survey Water-Supply Paper 773, pl. 5 and p. 104, 1936.

18/ Piper, Arthur M., Ground water in north-central Tennessee: U. S. Geol. Survey Water-Supply Paper 640, p. 74, 1932.

19/ Fiedler, Albert G., and Nye, Spencer S., Geology and ground-water resources of the Roswell artesian basin, New Mexico: U. S. Geol. Survey Water-Supply Paper 639, p. 88, 1933.

The thickness of the Georgetown limestone in the outcrop area in Comal County seldom exceeds 15 feet, but in wells the thickness reported by drillers is from 40 to 50 feet. This is measured as the thickness between the last clay bed in the Grayson (Del Rio) shale and the appearance of water, presumably in the top of the Edwards limestone. The Georgetown appears to be conformable with the Grayson (Del Rio) shale above it. In many places there is an abundance of well-preserved brachiopods of the species Kingena wacoensis (Roemer) in the thin marly beds at the top of the formation. These beds are about 2 feet thick and grade downward into massive limestones that weather to a buff color. In some places the limestone has a brittle procelaneous texture similar to some beds in the Buda limestone. In the lower beds the fossil oyster of the genus Alectryonia, an oyster recognized by the zigzag pattern on the margin of the shell, is fairly abundant. In many places however, it is difficult to distinguish the Georgetown from the Edwards.

The Georgetown limestone is not water-bearing in Comal County. It serves as one of the upper confining beds in the artesian area of the Edwards limestone.

### Grayson (Del Rio) shale

Like the Georgetown limestone, the outcrops of the Grayson shale are confined to the belt between the Comal Springs fault and the Bat Cave fault, in many places occurring in isolated patches in depressions in the Edwards limestone. The Grayson appears to lie conformably on the Georgetown limestone.

In the outcrop area the thickness of the Grayson shale ranges from a knife edge to about 30 feet; in wells it is usually reported as 40 feet thick.

In Comal County the Grayson is predominantly a marl. It weathers to a buff color at the surface but drill cuttings are usually blue. Geologists and drillers alike look for the characteristic fossil Exogyra arietina (Roemer), an oyster having a shell shaped like a ram's horn. This fossil is particularly abundant in the lower part of the formation and in some parts of the formation are cemented together to form beds of limestone 12 to 18 inches thick. The Grayson is probably the most impermeable formation in Comal County and many surface reservoirs or "tanks" for stock use are constructed in the outcrop area of this formation.

## Upper Cretaceous series

## Comanche series (Continued)

### Washita group (Continued)

### Buda limestone

The Buda limestone is believed to lie conformably upon the Grayson shale but there are few good exposures of the contact between the two formations. The thickness of exposed sections lying north and northwest of the Comal Springs fault does not exceed 30 feet. In wells south and southeast of the Comal Springs fault, (see logs of wells 392 and 395) thicknesses of 42 feet and 70 feet have been reported. In many places in the outcrop area low brushy or wooded ridges are covered by boulders of Buda limestone which extend out on to the slopes of the underlying Grayson. The Grayson becomes more or less plastic when wet and small landslides cause the overlying beds of the Buda to give way and to break up into boulders.

The greater part of the Buda as observed in Comal County is hard and brittle and has a porcelaneous texture. Its color is gray, yellow, and red and in most places it is speckled with small spots of darker-colored rock reported to be oxidized glauconite. Some of the outcrops of the Buda are honeycombed but the formation is not known to yield water to wells in Comal County.

## Gulf series

The Gulf series is represented in Comal County in ascending order by the Eagle Ford shale, the Austin chalk, and the Taylor marl and its probable age equivalent, the Anacacho limestone.

### Eagle Ford shale

The Eagle Ford shale, lowest formation of the Gulf series, lies unconformably on the Buda limestone of the Comanche series. It is found at the surface only between the Comal Springs fault and the Bat Cave fault.

According to Stephenson 20/, "The Upper Cretaceous or Gulf series of Texas is separated from the Comanche series below by an unconformity which certainly represents a considerable interval of geologic time".

In Comal County there appears to be no discordance in dip between the Eagle Ford and the Buda but in some places the Buda is very thin. West of the road between Highway 46 and the Hueco Springs road the Eagle Ford appears to rest directly upon the Grayson, but the Buda may be obscured by land slides in the Grayson and by complex faulting.

In most places in Comal County the Eagle Ford shale is about 30 feet thick and is composed of sandy yellow clay. The black clay or lignitic facies is not conspicuous at the surface but is nearly always reported in well logs. Good exposures of the Eagle Ford are found along the old Austin Post Road east of New Braunfels, near the Hays County line.

The Eagle Ford is not a water-bearing formation in Comal County.

### Austin chalk

In Comal County the Austin chalk lies unconformably on the Eagle Ford shale. This wide-spread unconformity has been described by Stephenson.

According to drillers' logs, the Austin chalk is 135 to 150 feet thick in the area south of the Comal Springs fault. In the outcrop area between the Comal Springs fault and the Bat Cave fault only thin remnants are found. Here it is a nearly white chalky and fossiliferous limestone and its characteristic appearance is fairly uniform from top to bottom. Remnants of the formation crop out north of the Comal Springs fault in the vicinity of Bracken, along Highway 36, 6 miles northwest of New Braunfels, and also east of New Braunfels. South of the fault the Austin is exposed in the beds of Cibolo Creek and the Guadalupe River.

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20/ Stephenson, Lloyd W., Unconformities in the Upper Cretaceous series of Texas: Am. Assoc. Petroleum Geologists Bull., vol. 13, pp. 1323-1334, 1929.

21/ Stephenson, Lloyd W., op. cit., p. 1328.

The formation is not generally prolific as an aquifer. Eight wells recorded in Comal County are known to draw water from the Austin chalk. One of these (well 346) at Hunter, flows a small stream during wet seasons. Some of these wells yield water with a hydrogen sulfide odor. In most of the area where the Austin chalk has been uncovered, surface and ground water have begun to dissolved the rock. Fairly large solution cavities were observed along Cibolo Creek, just above the bridge on U. S. Highway 81.

## Anacacho limestone and Taylor marl

According to Stephenson 22/ the Anacacho limestone and the Taylor marl are of the same age, and the limestone facies of the Anacacho west of San Antonio merges with the marl of the Taylor in Comal County. Typical exposures of Taylor marl are found in the eastern part of the county. In the western part of the county the Anacacho limestone also contains marly beds but limestone beds are absent. Only small nodules of lime remain.

Stephenson 23/ also states that both formations lie unconformably upon the Austin chalk and describes two sections that were observed at the contact.

According to the drillers' logs of wells 395 and 419 the Taylor and Anacacho, considered as a unit, has a thickness of about 300 feet. Neither the Taylor nor the Anacacho is found in any part of the area north and northwest of the Comal Springs fault. Southwest of New Braunfels, below the escarpment, a few wells are believed to draw water from the base of the Taylor and Anacacho, where from 0.5 to 2 feet of sandy lime or gravel has been reported. This sand or gravel may be fed through the cavernous limestone in the upper part of the Austin chalk. The spring (no. 348) on the Altgelt farm 2¼ miles southwest of New Braunfels may be from this source.

## Tertiary (?) system

## Pliocene (?) series

### Uvalde gravel

The Uvalde gravel occurs only in small remnants on hilltops. They are effective in retarding erosion in the same manner that ballast protects a railroad track. Because of the small size and thickness of the outcrops and the topographic position which permits the water to seep out rapidly, no water is obtained from wells in the Uvalde gravel.

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22/ Stephenson, L. W., Stratigraphic relations of the Austin, Taylor, and equivalent formations in Texas: U. S. Geol. Survey Prof. Paper 186, pp. 113-146, 1937.

23/ Stephenson, L. W., op. cit., p. 136.

## Quaternary system

### Pleistocene series

#### Leona formation

The Leona formation is composed of limestone gravels, sand, and clay arranged in terraces by the present streams in their valleys. The terraces overlie all formations crossed by the streams and the formation ranges in thickness from a knife edge to a maximum of 65 feet (see driller's log of well 420). The formation is found mainly in the valleys of the Guadalupe River and Cibolo Creek. In the valleys above the escarpment formed by Comal Springs fault, the Leona fills old abandoned meander channels and is rarely used as s source of water, probably because of leakage into underlying rocks and drainage into the streams. However, one dug well 50 feet deep (well 246), 13½ miles southwest of New Braunfels and in the valley of the Cibolo, has served more than 50 years without failure.

Below the escarpment and between the Guadalupe River and Alligator Creek, the Leona formation overlies the relatively impervious Taylor marl and provides a dependable ground-water supply for a considerable number of families. Failures in this area are unknown, however, attempts to pump large volumes of water for irrigation have been reported. The log of well 420, 3 miles northeast of New Braunfels, indicates the kind of material encountered in the Leona. Depth-to-water measurements indicate that normally not more than 10 feet of this material is saturated with water. Because of this fact, attempts at irrigation on a large scale would probably be unsuccessful.

## Structural geology

### Faults

Major faults.- In Comal County the development of ground-water reservoirs, particularly reservoirs in the Edwards, Comanche Peak, and Glen Rose limestones, and the position of the main channels of movement of ground water are closely related to a system of faults in the Balcones fault zone. This zone is 20 miles wide in places and extends from near Waco southwest through Comal, Bexar, and Medina Counties into Uvalde County. The faults are roughly parallel, and in Comal County the zone includes seven major faults that trend in directions ranging from S. 45° W. to S. 60° W. In the following paragraphs the major faults are discussed in the order of their occurrence from southeast to northwest. (See geologic map and cross-section.)

The most conspicuous fault in the zone forms the escarpment separating the Coastal Plain from the Edwards Plateau, and is here designated the Comal Springs fault. The fault enters the eastern part of the county near Hunter, passes through Landa Park at New Braunfels, and continues westward through Bracken near the southwestern extremity of the county. Comal Springs issues from fissures al along this fault. At some places along the fault the Taylor marl is brought in contact with the Edwards limestone, indicating the possibility of a stratigraphic displacement of 400 to 600 feet. North of this fault, water in the Edwards limestone occurs under water-table (unconfined) conditions and is of good chemical quality. South of the fault the Edwards is buried to a depth of several hundred feet; the water in it is under artesian pressure and is highly mineralized.

The second major fault, called the Hueco Springs fault in this report, enters the eastern boundary of the county about a mile north of the Comal Springs fault, crosses the Guadalupe River at Hueco Springs, about 2½ miles north of Comal Springs, and continues westward across the westward boundary of the county about 4 miles north of Bracken. Structural relations along this fault are complex. Where the fault crosses Highway 46, between wells 227 and 390, the rocks at the contact are crushed into a fault breccia and secondary calcareous material fills the spaces between the boulders. From this point to the river the rocks dip northeastward toward the river at the rate of about 200 feet to the mile. On the east side of the river, opposite Hueco Springs, the fault has brought rocks of the Georgetown limestone, containing an abundance of specimens of the fossil Kingena wacoensis, in contact with beds containing Exogyra texana, probably of Walnut age. It is difficult, however, to determine the amount of displacement along the fault because of the thinning of the displaced formations and the unconformities between them. (See p. 25 ). Moreover, there is possibility that a part of the apparent displacement is due to the collapse of roofs of former caverns in the Edwards limestone. (See pp. 25 to 33). In most of the area between the Comal Springs fault and the Hueco Springs fault, the Edwards limestone crops out, and an adequate supply of good water for farm and ranch use may be obtained from wells.

The third fault, called Bat Cave fault, enters the eastern boundary of the county about 2 miles north of the Comal Springs fault, crosses the Guadalupe River about 2 miles north of Hueco Springs, and crosses the western boundary of the county 5½ miles northwest of Bracken in the vicinity of Bat Cave. East of the Guadalupe River this fault forms the south side of a downfaulted block or graben in which a narrow wedge of younger rocks appears between outcrops of Edwards limestone. Actually the graben may be a slump or valley sink produced by the collapse of a former cavern in the Edwards limestone, which lowered the younger rocks below the level of the Edwards limestone, thus protecting the fallen block from erosion. In the western part of the county where the faulting has brought the upper member of the Glen Rose limestone in contact with the Edwards limestone, the displacement is estimated to be about 300 feet. A hole drilled to a depth of 500 feet on the Dietz Ranch about 300 feet northwest of well 386 is believed to have passed through the fault plane. Normally plenty of water is available in the Edwards at this locality, but this well failed to encounter any water. The dry hole may be due to the presence of relatively impervious pulverized rock which was ground between the two walls of the fault in the process of movement. Another possible explanation is that the underground channels at this point have been filled with mud carried in by infiltrating surface waters. The Edwards limestone is exposed at the surface over most of the area between the Hueco Springs and Bat Cave faults and together with the underlying Comanche Peak limestone is thick enough to transmit large volumes of water. Farm and ranch wells in the area obtain adequate supplies from the limestones.

The fourth or Bear Creek fault crosses the Guadalupe River about a mile southwest of Sattler. From that point it can be traced more or less continuously southwestward to Bear Creek and thence to Cibolo Creek at the west boundary of the county, where it was observed about 6 miles south of Smithson's Valley. The fault has less displacement than the three already mentioned. Between the Bat Cave and Bear Creek faults, the thickness of the Edwards limestone has been considerably reduced by erosion; and in the deeper valleys, the streams have cut through both the Edwards and Comanche Peak limestones into the upper part of the upper Glen Rose. The Glen Rose limestone within this block is believed to dip southeastward and generally is at a higher level than the water level in the Edwards and Comanche Peak limestones southeast of the Bat Cave fault. Thus the ground water in the Edwards limestone between the Bat Cave and Bear Creek faults tends to drain toward the block southeast of the Bat Cave fault. This is indicated by the failure of some wells such as wells 162 and 429, to obtain an adequate supply of water for ranch use from the Edwards and Comanche Peak limestones.

The fifth major fault or Hidden Valley fault crosses the Guadalupe River near the lower end of Hidden Valley and thence continues southwestward across the county to a point on Cibolo Creek about 5 miles east of Bulverde. The average displacement of the strata along this fault is estimated to be about 200 feet. Between the Bear Creek and Hidden Valley faults, the Edwards limestone is still thinner and the areas of upper member of the Glen Rose limestone exposed at the surface are still larger than they are between the Bat Cave and Bear Creek faults. It is believed that most wells in this area must penetrate strata below the Edwards and Comanche Peak limestones to obtain sufficient water for ranch use.

The trace of the sixth major fault or Tom Creek fault passes about half a mile south of Hancock, in the eastern part of the county, and thence crosses the county in a fairly straight line which passes about a quarter of a mile south of Smithson's Valley post office. Tom Creek follows the trace of the fault for about 5 miles between Hancock and Smithson's Valley. In the area between the Hidden Valley and Tom Creek faults, the upper Glen Rose limestone covers most of the surface, and the Edwards and Comanche Peak limestones are found only as caps on the higher hills. Along the river, small areas of lower Glen Rose limestone are exposed. In this area only small yields are reported from the upper and lower members of the Glen Rose limestone, but satisfactory yields have been obtained from deep wells (as in well 92) in the Pearsall formation.

The seventh fault, called the Spring Branch fault, in this paper, is really twin faults that are probably contemporaneous and are closely related to each other. The trace of the first one was observed about a mile north of Fischer's Store, and from this point it extends southwestward to the Guadalupe River. The second part of the fault is about $1\frac{1}{4}$ miles north of the first and extends in the same general direction about $2\frac{1}{2}$ miles each way from Spring Branch post office. The maximum displacement along these faults is probably in the magnitude of 300 feet. In most of the area between the Tom Creek and Spring Branch faults the lower member of the Glen Rose limestone is exposed over the greater part of the area, the upper member occupying only the areas of higher altitude. The Spring Branch faults mark the southeastern limit of the outcrop of the Travis Peak formation in Comal County. North of the Travis Peak area the lower member of the Glen Rose occupies the valleys and the upper member the more elevated areas. Water for domestic and ranch use is obtained from wells and springs in the lower member of the Glen Rose limestone and in the Pearsall formation.

Minor faults and folds.- There are many minor faults parallel to the trend of the major faults, some of which have not been positively identified because of the lack of horizon markers in the area in which they occur. Other small faults diverge from the major faults, notably east and northeast of New Braunfels and in the vicinity of Bracken and Selma. Near Bracken there is evidence of folding and faulting in a direction more or less transverse to the trend of the major faults. These structural features appear to have had some effect upon the direction of the movement of water in that area. (See p. 55).

Cause of faulting.- Individual faults in the Balcones fault zone seem to be definitely related to each other in origin because of the roughly parallel pattern. Most of them are normal faults with downthrow to the southeast, and they are generally regarded as having been caused by the gradual sinking of the Coastal Plain with reference to the Llano uplift. Stephenson 24/ has pointed out, [illegible]

24/ Stephenson, L. W., Structural features of the Atlantic and Gulf Coastal Plain, Geol. Soc. America, Bull. Vol. 39, p. 899, 1928.

however, that uplift may have occurred as well as sinking. Foley 25/produced a group of faults similar to the Balcones faults in laboratory materials by applying tensional forces.

Age of faulting.- The age of the faulting along the Balcones fault zone has not been accurately determined, but it is believed that faulting may have occurred from early Cretaceous to Recent geologic time. Sayre 26/ states that in Medina County the faults are believed to be late Pliocene or early Pleistocene, though possibly early Pliocene or Miocene in age. Bryan 27/ has presented evidence to show that there have been three movements along the Balcones fault zone at Waco, Texas, the first during early Cretaceous, the second during Georgetown, and the third during very Recent time.

The Comal Springs fault extends the length of the county, through New Braunfels, causing a bold escarpment with an extremely youthful appearance. The escarpment seems to have been only slightly eroded as though it might have been formed very recently. This appearance may be deceptive, however, as much of the Edwards limestone has been removed internally by solution of infiltrating waters instead of by external erosion. None of the other faults in Comal County retains this youthful appearance because the escarpments have been removed by erosion. However, as previously stated, rapids are found in the Guadalupe River at nearly every place that a fault crosses the river. (See pl. 1).

## Other structural features

San Marcos arch.- One of the older structural features of the area is the broad San Marcos arch, which was pointed out by Stephenson 28/ in 1928 and was later named by Adkins 29/. The axis of this arch extends southeastward from the Llano uplift through San Marcos in Hays County and thence follows the cource of the San Marcos River toward Gonzales in Gonzales County. In Comal County the results of this uplift are seen in the thinning or absence of sediments that normally occur between the Edwards limestone and the Taylor marl. Topographic expression of the arch is lacking or is obscured by the more abrupt movements of the Balcones fault zone.

In addition to the deformation related to faults of the Balcones fault zone, a large number of small faults and steep dips are definitely related to sinks and probably bear no relation to deep-seated crustal movements.

Regional dips.- The regional dip of the Cretaceous rocks on the Edwards Plateau is generally accepted to be about 15 feet to the mile in a southeasterly direction. In the Coastal Plain the dip steepens considerably, particularly at depths where the seaward thickening of the younger formations has taken place.

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25/ Foley, Lyndon L., Mechanics of Balcones and Mexia faulting: Am. Assoc. Petroleum Geologists Bull., vol. 10, pp. 1261-1269, 1926.

26/ Sayre, Albert Nelson, Geology and ground-water resources of Uvalde and Medina Counties, Texas: U. S. Geol. Survey Water-Supply Paper 678, p. 29, 1936.

27/ Bryan, Frank, Recent movement along the fault of the Balcones system, McLennan County, Texas: Am. Assoc. Petroleum Geologists Bull., vol. 17, pp. 439-442, 1933. See also vol. 20, p. 1357, 1936.

28/ Stephenson, L. W., Structural features of the Atlantic and Gulf Coastal Plain: Geol. Soc. America Bull., vol. 39, pp. 887-889, 1928.

29/ Adkins, W. S., Geology of Texas, Vol. 1, Stratigraphy: Texas Univ. Bull. 3232, p. 266, 1932.

In Comal County, however, as a result of crustal deformation, there are many departures from the regional dip. In the vicinity of faults, the dips are likely to be abnormally steep. Stephenson 30/ observed a perceptible northwest dip in the Austin chalk and Taylor marl on the Guadalupe River about 2 miles south of the Comal Springs fault.

In addition to these local irregularities, in the eastern part of the county there is a rather general steepening of the dip of the rocks eastward. For example, the top of the Glen Rose limestone crops out in the small valleys on the east side of the Guadalupe River at an altitude of about 900 feet. In a number of wells east of these valleys, the Edwards limestone is found in wells at considerable depth. In well 422 a limestone reported as Edwards limestone (but probably Comanche Peak) was found at a depth of 482 feet or at an altitude of 374 feet. This indicates an eastward dip of at least 526 feet in about 5 miles or more than 100 feet to the mile.

Sinkholes.- The solution of limestone by ground water may result in the development of large caverns. If such a cavern becomes so large that the roof is not able to support its own weight, the roof will collapse, leaving a large hole or pit in the surface of the ground. These holes may be more or less round or elongated or irregular in shape, depending on the shape of the cavern. Large sinkholes with vertical walls were not found in Comal County. A very few, ranging from 5 to 15 acres in area, are circular and have gently sloping sides, suggesting that collapse kept pace with undermining. After heavy rains they are likely to hold water for several weeks. Smaller and less conspicuous sinkholes are more numerous and do not hold water.

Many of the sinkholes in the Edwards limestone in Comal County are filled with Georgetown limestone and Grayson shale. In some places, the Georgetown is completely covered by the Grayson so that only the Grayson appears to be in contact with the Edwards. Because of the lack of observable bedding planes, the dip of the Grayson shale in the sinks could not be determined. The Georgetown limestone generally dips steeply toward the center of the sink. The Edwards limestone on the perimeter of the sink may also dip toward the sink or may be faulted. These fault lines are usually curvilinear and often transverse to the trend of major faults. On the basis of these observations it is assumed that some of the caverns collapsed after the Georgetown was deposited.

Apparently such sinks or slumps are not unusual in Texas. Dumble 31/ observed deep ravines in the Edwards limestone filled with Eagle Ford shale in areas west of the Pecos River, which he ascribed to disconformity. Adkins 32/ believes that these valleys were caused by underground solution and subsequent slumping.

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30/ Stephenson, L. W., Stratigraphic relations of the Austin, Taylor, and equivalent formations in Texas, U. S. Geol. Survey Prof. Paper 186-g, p. 136.

31/ Dumble, E. T., The geology of east Texas: Univ. of Texas Bull. 1869, pp. 19-20, 1918.

32/ Adkins, W. S., The geology of Texas: Univ. of Texas Bull. 3232, pp. 361 and 401, 1932.

## OCCURRENCE OF GROUND WATER, WITH SPECIAL REFERENCE TO DISCHARGE AND SOURCE OF COMAL SPRINGS

### Introduction

The occurrence of ground water in all classes of rocks and the conditions that control the movement of water from areas of intake toward areas of discharge have been described by Meinzer 33/ and Wenzel 34/. The section that follows is limited to a brief discussion of some of the conditions in Comal County. The springs and most of the wells in the county are supplied with water from ground-water reservoirs in limestone, of which the reservoir in the Edwards limestone is by far the most important.

The permeability of most limestones as deposited is low. Small openings called primary openings are those that remain after consolidation. Limestones that are composed largely of fossil shells or skeletons of sea animals, particularly corals, are likely to contain primary openings. The more important openings, however, are developed after deposition by fracturing and solution along the fractures. Slight earth movements or shrinkage during consolidation can cause fractures in limestone. These fractures or joints generally are developed in two planes at a considerable angle from one another, and, if they intersect, continuous openings in a zigzag pattern may develop. The openings may be only as thick as a knife blade at the surface and still narrower at depth. These are the original passages from which larger channels are later developed by solution.

It is generally recognized that an increase in the carbon dioxide in meteoric waters increases the solvent action on limestones manyfold. Water acquires carbon dioxide while passing through the air and through soils containing decaying vegetable matter. As pointed out by Swinnerton 35/, the chemical process is complex, depending on a number of physical factors. Some idea of the solvent action of ground water on the limestones in Comal County may be obtained from the chemical character of the water that issues at Comal Springs. The dissolved solids in the water at the spring averages about 285 parts per million. (See table of chemical analyses.) The average flow of the springs over a period of about 20 years has been 323 cubic feet per second. (See p. 71 .) On this basis an average of more than 200 tons of rock material is carried away daily in solution by the water that issues from these springs.

Ordinarily the development of underground limestone reservoirs is related to surface drainage. When a thick, dense, soluble limestone, such as the Edwards limestone, has been elevated above the lines of regional drainage, the development of underground drainage channels progresses much in the same manner that surface drainage is developed from an initial stage to maturity. This

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33/ Meinzer, O. E., The occurrence of ground water in the United States, with a discussion of principles: U. S. Geol. Survey Water-Supply Paper 489, 1923; Outline of ground-water hydrology: U. S. Geol. Survey Water-Supply Paper 494, 1923; Physics of the earth, part 9, Hydrology, pp. 385-497, McGraw-Hill Book Co., Inc., New York, 1942.

Meinzer, O. E., and Wenzel, L. K., Physics of the earth, part 9, Hydrology, pp. 444-478, McGraw-Hill Book Co., Inc., New York, 1942.

34/ Wenzel, L. K., Methods for determining the permeability of water-bearing materials, with special reference to discharging-well methods: U. S. Geol. Survey Water-Supply Paper 887, 1942.

35/ Swinnerton, Allyn C., Physics of the earth, part 9, Hydrology, Mc-Graw-Hill Book Co., Inc., New York, pp. 658-660, 1932.

analogy has been described by Davis 36/, Swinnerton 37/, and Piper 38/. Just as the surface streams are first developed more rapidly along main drainage channels and grow by headward erosion, the underground streams in limestone are first ... larger and develop most rapidly in the vicinity of the main streams, and gradually work back to underground divides. In Comal County the normal development has been modified by faulting. It is believed that the main underground channels in the Edwards and Comanche Peak limestones that lead water toward Comal Springs are parallel to the lines of major faulting, which are more or less transverse to the direction of flow of the main surface streams.

Time is an important factor in the development of limestone reservoirs. It should be remembered (p.25 ) that before the Georgetown limestone was deposited, the Edwards limestone was elevated above sea level and was subject to solution by meteoric waters. The pattern of fractures which later became major fault lines probably started at that time.

The relation of the development of the Edwards limestone reservoir to the surface drainage during the encroachment of the Georgetown sea is not known. However, the outcrop area of the Edwards limestone was probably much larger during that time than it is now, as is indicated by the permeability of the upper part of the Edwards limestone in the San Antonio area 39/, now faulted down and covered by younger formations.

At the outcrop in Comal County, the Edwards limestone and the Comanche Peak limestone beneath it are thoroughly honeycombed from top to bottom. In the log of test hole 401 (see table of drillers' logs), drilled by the Corps of Engineers, U. S. Army, to the bottom of the Comanche Peak limestone, nearly all of the 237 feet of material was described as porous; the total footage of caves was 24 feet, the largest cave being 3 feet deep, between 179 and 182 feet.

In the lower member of the Glen Rose limestone, the earlier stages of the development of a limestone reservoir in relation to surface drainage lines is more clearly shown. This development could not progress rapidly until much of the cover of Edwards limestone and upper member of the Glen Rose limestone had been removed. This condition exists in western Comal County.

Although the Guadalupe River and Cibolo Creek have youthful characteristics (p.10 ), the wide meanders and broad terraces on the Guadalupe above Sattler and on the Cibolo above Bracken suggest that these streams have passed through mature stages and that the limestones in these areas have been exposed to erosion and underground solution since early Pleistocene time or possibly for a longer period. Along the main stream the lower Glen Rose is honeycombed at the surface and caverns have developed, particularly along Cibolo Creek, where the surface runoff is negligible except after very heavy rains (p. 45). However, in the interstream areas the lower Glen Rose limestone yields only small amounts of water.

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36/ Davis, W. M., Origin of limestone caverns: Geol. Soc. America Bull. vol. 41, pp. 475-628, 1930.

37/ Swinnerton, A. C., Origin of limestone caverns: Geol. Soc. America Bull. vol. 43, pp. 663-693, 1932.

38/ Piper, Arthur A., Ground water in north-central Tennessee: U. S. Geol. Survey Water-Supply Paper 660, pp. 79-86, 1932.

39/ Livingston, Penn, Sayre, A. N., and White, W. N., Water resources of the Edwards limestone in the San Antonio area, Texas, U. S. Geol. Survey Water-Supply Paper 773-B, 1936.

## Ground-water discharge

Comal Springs (no. 294).- Comal Springs have the largest average discharge of any known springs in the southwestern part of the United States. The average flow during the 19-year period 1928-46 was 324 second-feet or about 210,000,000 gallons a day. This is equivalent to 640 acre-feet a day or 235,000 acre-feet a year. It is greater than the average surface runoff from the 1,432 square miles drained by the Guadalupe River above the Spring Branch gaging station during the same period. The lowest recorded discharge of the springs was 245 second-feet (cubic feet a second), which was greater than the discharge of the Colorado River at Austin (drainage area 38,200 square miles) during dry periods before the Buchanan and Lake Travis reservoirs were put into operation. For example, the average daily flow of the river at Austin was less than 245 second-feet for periods of varying length aggregating 98 days during the water year from October 1929 to September 1930.

The discharge of the springs is better sustained than that of any other of the large springs of the Balcones fault zone; the minimum flow is about 58 percent of the maximum flow and about 76 percent of the average. The minimum, maximum, and average recorded discharge of the most important springs of the fault zone, including Comal Springs, together with the ratio of the minimum discharge to the maximum and average discharge are given in the table below:

Comparison of minimum, maximum, and average discharge of Comal Springs and other important springs of the Balcones fault zone, Texas

| Springs | Discharge in second-feet | | | Ratio of minimum to maximum discharge (percentage) | Ratio of minimum to average discharge (percentage) |
|---|---|---|---|---|---|
| | Minimum | Maximum | Average | | |
| Comal at New Braunfels | 245 | 420 | 324 | 58 | 76 |
| San Marcos at San Marcos | 51 | 286 | 153 | 18 | 33 |
| Barton at Austin | 12 | 139 | 41 | 8.7 | 30 |
| Las Moras near Brackettville | 5.8 | 60 | 22 | 9.6 | 27 |
| San Felipe 1/ at Del Rio | 41 | 150 | 76 | 27 | 54 |
| Goodenough 1/ near Comstock | 96 | 700± | 179 | 14 | 54 |

1/ In westward monoclinal extension of Balcones fault zone.

The water from Comal Springs issues crystal clear at a temperature of about 74° F. from the foot of the escarpment formed by the Comal Springs fault. The water has been observed after relatively long dry periods and after heavy rains, in winter and in summer, and no trace of turbidity has been detected. The maximum observed variation in temperature is not more than half a degree.

The water flows directly from crevices in the Edwards limestone at the sides and bottom of an artificial pool about 10 feet in diameter. The rising water produces very little doming in the surface of the pool, indicating that the water issues under very little pressure. There is no spectacular rush of water, no gas, and no deposition of travertine in the vicinity of the pools. A part of the water is led underground by a pipe to a large lake used for recreational purposes. Most of the water, however, is discharged into the channel of Dry Comal Creek to form Comal River which joins the Guadalupe River about a mile east of the springs and about 40 feet below the level of the springs.

The facts observed at Comal Springs reveal much of the story of ground water in Comal County. In order to account for such a large and constant volume of discharge, the conclusion is inescapable that the area of intake must be of the magnitude of many hundreds of square miles. In view of the limited area within the county that is favorable for rapid infiltration of rainfall or stream water to the ground-water reservoir supplying the spring, the source of some of the water must be beyond the corporate limits of the county. The sources of the ground water (areas of intake) are discussed on pages 40 to 47.

The lack of turbidity suggests that the water moves slowly underground and that a part of its course is through an intricate network of small openings rather than through large tubular caverns, so that the flow is retarded and sediment has an opportunity to settle out. The temperature of the water at the springs, which is 6 degrees higher than the average air temperature observed by the U. S. Weather Bureau at New Braunfels, suggests that the paths of circulation within the reservoir may reach depths of 300 to 500 feet below the surface.

Hueco Springs (no. 400).- Hueco Springs appear on the west side of the Guadalupe River about 3 miles north of Comal Springs. The water issues from stream gravels in two places, one about 400 and the other about 200 feet west of the river.

The westernmost spring comes to the surface at an altitude of about 645 feet and is about 10 feet above the bed of the river; the other spring is nearer the river and is about 4 feet higher than the stream bed. The springs appear to rise a few feet north of a fault having several hundred feet of displacement, the trace of which can be seen in the bed of the river. (See pl. 1). It is said that in dry years the springs are dry for months at a time. From August 1944 to February 1947 a period in which the average rainfall was exceptionally high, 25 discharge measurements showed a range in the flow of the springs from 13.2 to 96.0 second-feet or about 7 to 62 million gallons a day (see table and discussion by S. D. Breeding on p. 63 ).

In contrast to Comal Springs, the temperature of Hueco Springs fluctuates as much as 3 degrees. In 23 observations made between January 22, 1944 and December 30, 1945, the temperature ranged from 68° in winter to 71° in summer (see table on p. 54 ). The water is ordinarily clear but becomes slightly turbid during the first flow of water after heavy rains, particularly after a dry period. No gas issues from the water and no travertine deposits are found in the vicinity of the springs. The water is used by the owner, R. W. Gode, to operate a small power plant (pl. 4).

Other springs.- In addition to the Comal and Hueco Springs, a number of other springs were observed in the county, but it is believed that their occurrence is not related to the underground reservoir that supplies Comal Springs.

Two springs (nos. 58 and 59) issue from fault crevices in the lower Glen Rose limestone in the bed of the Guadalupe River about 2 miles southwest of Hancock. The springs make only a slight bulge in the surface of the stream and are most conspicuous when the river is muddy because the spring water is clear. The combined discharge of these two springs, computed from the difference in the discharge of the river above and below the springs, was 14 second-feet or about 54,000 gallons a minute on September 18, 1944 40/. The spring water at that time was reported to be much colder than the river water.

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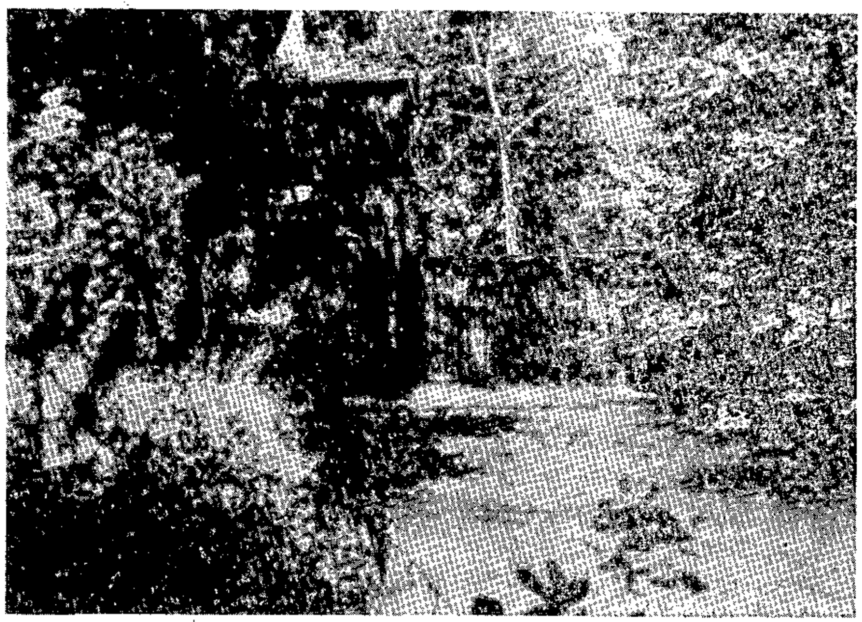
40/ Surface water supplies of the United States: U. S. Geol. Survey Water-Supply Paper 1008, p. 301, 1944.

A. Comal Springs



B. Private power plant below Hueco Springs using discharge from the West Springs.

Farther upstream, $3\frac{1}{2}$ miles west of Hancock, on the J. D. Nixon ranch, a spring (no. 35), called Big Spring, issues from solution cavities in the lower member of the Glen Rose limestone about 10 feet above the level of the river. Two discharge measurements 41/, made at periods of low flow of the river, indicate a flow of 3.9 second-feet (1,750 gallons a minute) on January 18, 1928, and 2.9 second-feet (1,290 gallons a minute) on February 21, 1929. The average discharge of the spring may be somewhat greater than is indicated by these measurements, which were made during periods of low rainfall.

Rebecca Creek Spring (no. 74), 9 miles northwest of Hancock, had an estimated discharge of 1,500 to 2,000 gallons a minute on October 7, 1943. The temperature of the water on that date was 70° F. The spring issues from fissures and solution cavities in the Cow Creek limestone member of the Travis Peak formation.

The discharge of Spring Branch, which enters the Guadalupe River near Spring Branch post office in the northwestern part of the county, is maintained by two springs, one at the head of the branch (no. 104), and the other a smaller spring (no. 114), about a mile downstream. Spring 110, on the H. C. Plumly ranch, issues from a cavern at the base of the lower Glen Rose limestone. Records of additional discharge measurements show a flow of 1.5 second-feet on January 18, 1928, and 0.9 second-foot February 20, 1929. When visited by the writer on March 28, 1945, the discharge was estimated to be about 11 second-feet or 5,000 gallons a minute. The lower spring (no. 114), visited on the same day, issues from a crevice in the Cow Creek limestone member of the Travis Peak formation at an estimated rate of 50 gallons a minute. It supplies a school house and a small community by means of a hydraulic ram.

Honey Creek Spring (no. 80), on the Weidner ranch, 7 miles northwest of Bulverde, flows from a cavern at the base of the Glen Rose limestone, near the contact with the underlying Travis Peak formation. On July 20, 1944, the discharge of the spring was estimated to be 1,000 to 1,500 gallons a minute, and the temperature of the water was 69° F.

One spring (no. 348) is believed to have its source in the Austin chalk, although the water rises through an opening in the Taylor marl. This spring, the property of the Altgelt Farm Association, is $2\frac{1}{4}$ miles southwest of New Braunfels. The average discharge of the spring is estimated to be 50 gallons a minute.

A fault spring (no. 410), on the south side of Bear Creek near the Bear Creek road, issues from the upper Glen Rose limestone, not far below the contact with the Edwards limestone. The water probably seeps from the Edwards limestone into the Glen Rose limestone along the fault plane. The flow was estimated to be 2,000 to 2,500 gallons a minute on March 28, 1945, but only 200 gallons a minute on September 29, 1945.

Eleven other springs (nos. 6, 14, 21, 27, 46, 49, 172, 176, 190, 193, and 203) which have maximum yields of less than 50 gallons a minute, are listed in the table of well and spring records. All of them issue from the Glen Rose limestone, generally from thin beds of fine-grained sandy marl. Some of the larger springs are associated with joint planes or faults with small displacements.

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41/ Surface water supply of the United States; U. S. Geol. Survey Water-Supply Paper 668, p. 76, 1931; U. S. Geol. Survey Water-Supply Paper 688, p. 75, 1932.

### Discharge from wells

Comparatively little water is withdrawn through wells from ground-water reservoirs in Comal County. The city of New Braunfels pumps from 1,000,000 to 2,000,000 gallons of water from two wells (nos. 402 and 403) in the Edwards limestone in the northern part of the city; and the Servtex Materials Company pumps an average of 1,250,000 gallons a day from a well (no. 381), also in Edwards limestone, in the western part of the county.

## GROUND-WATER RECHARGE

Ground water is derived chiefly from water that falls as rain or snow. A part of the precipitation runs off in streams; a part is returned to the atmosphere by evaporation and by transpiration of trees and other plants; and a part sinks into the zone of saturation, in which the openings in the rocks are filled with water. In a given drainage basin the proportion of the rainfall that is carried away directly by the streams can be accurately determined by stream gaging, but it is extremely difficult to compute directly for a large area the proportion that is consumed by evaporation and the proportion that sinks to the zone of saturation as recharge to the underground reservoirs. There are several reasons why recharge itself is difficult to compute, the principal ones being that the rate of recharge ranges widely from place to place, even in the same formation, and varies with the amount and intensity of the rainfall, as well as with the changes in the rate of loss from evaporation and transpiration.

In some water-table areas recharge to sand and gravel aquifers can be roughly estimated from the rise of water levels in a large number of observation wells following rains. This, however, is impossible in limestone aquifers because of the extreme irregularity in the distribution of the openings in the limestone. For example, the great rise and subsequent decline of water-levels recorded in several wells in Glen Rose limestone in Comal County was probably due to the fact that the openings in the limestone are very small and consequently a relatively small amount of local recharge produces a large rise in water levels. This undoubtedly is the case in several of the wells, as shown by the fact that a large decline in water-levels results from a small amount of pumping.

In some localities the increment of recharge from the larger streams to the ground-water reservoirs can be measured directly with fair accuracy by stream gaging. For example, it has been estimated from stream-flow records that the combined losses into the Edwards artesian reservoir in Uvalde and Medina Counties from the Nueces, Frio, Dry Frio, Sabinal, and Medina Rivers and Hondo Creek may average as much as 150,000 acre-feet annually 42/, 43/, the equivalent of a continuous flow of 207 second-feet or 134 million gallons a day. These estimates, of course, did not take into account the recharge in the inter-stream areas.

### Stream losses and gains

Records showing losses from streams and gains to streams from ground-water reservoirs are useful, but in the Comal County area comparisons of the records of the total runoff from the different drainage subdivisions provides a more adequate basis for estimating the order of magnitude of the total ground-water

42/ Sayre, A. N., Geology and ground-water resources of Uvalde and Medina Counties, Texas: U. S. Geol. Survey Water-Dupply Paper 678, p. 83, 1936.

43/ Livingston, Penn B., Sayre, A. N., and White, W. N., Water resources of the Edwards limestone in the San Antonio area, Texas: U. S. Geol. Survey Water-Supply Paper 773-B, p. 77, 1930.

recharge, especially if the data are correlated with the facts regarding the geology and opportunities for infiltration to the underground reservoir in the different sections.

As shown by the section on surface water by S. D. Breeding (pp. 61 to 47 ), most of Comal County is drained by Guadalupe River and Cibolo and Dry Comal Creeks.

Gaging stations have been in operation on the Guadalupe River at Comfort, Spring Branch, and New Braunfels for many years. Figure 1 shows graphically the discharge at the three stations from January 1939 to December 1942. The discharge varied over a wide range during the period, and at all stages except the very low stage of September and October 1940 it showed a fairly uniform increase at successive downstream stations. The loss during the period of low flow could be readily accounted for by losses from evaporation.

Above Comfort the Edwards limestone crops out in the higher parts of the drainage area, comprising about two-thirds of it, and the Glen Rose limestone is exposed in the lower parts; and a perennial flow of considerable magnitude is maintained by springs that issue from the Edwards limestone. The average runoff from this area of nearly 1,000 square miles was 110 acre-feet per year per square mile for the period from 1923 to 1932, and 138 acre-feet per year per square mile for the period from 1939 to 1946.

Between the stations at Comfort and Spring Branch, the river cuts deeper into the section, exposing the lower Glen Rose limestone and leaving remnants of the Edwards limestone on the hilltops. Near Spring Branch the upper and middle members of the Travis Peak formation are exposed in the bed of the stream, but the outcrop is terminated by a fault about 2½ miles upstream from the Spring Branch station. The average runoff from the drainage area of 1,432 square miles above Spring Branch for the period from 1923 to 1946 was 150 acre-feet per year per square mile.

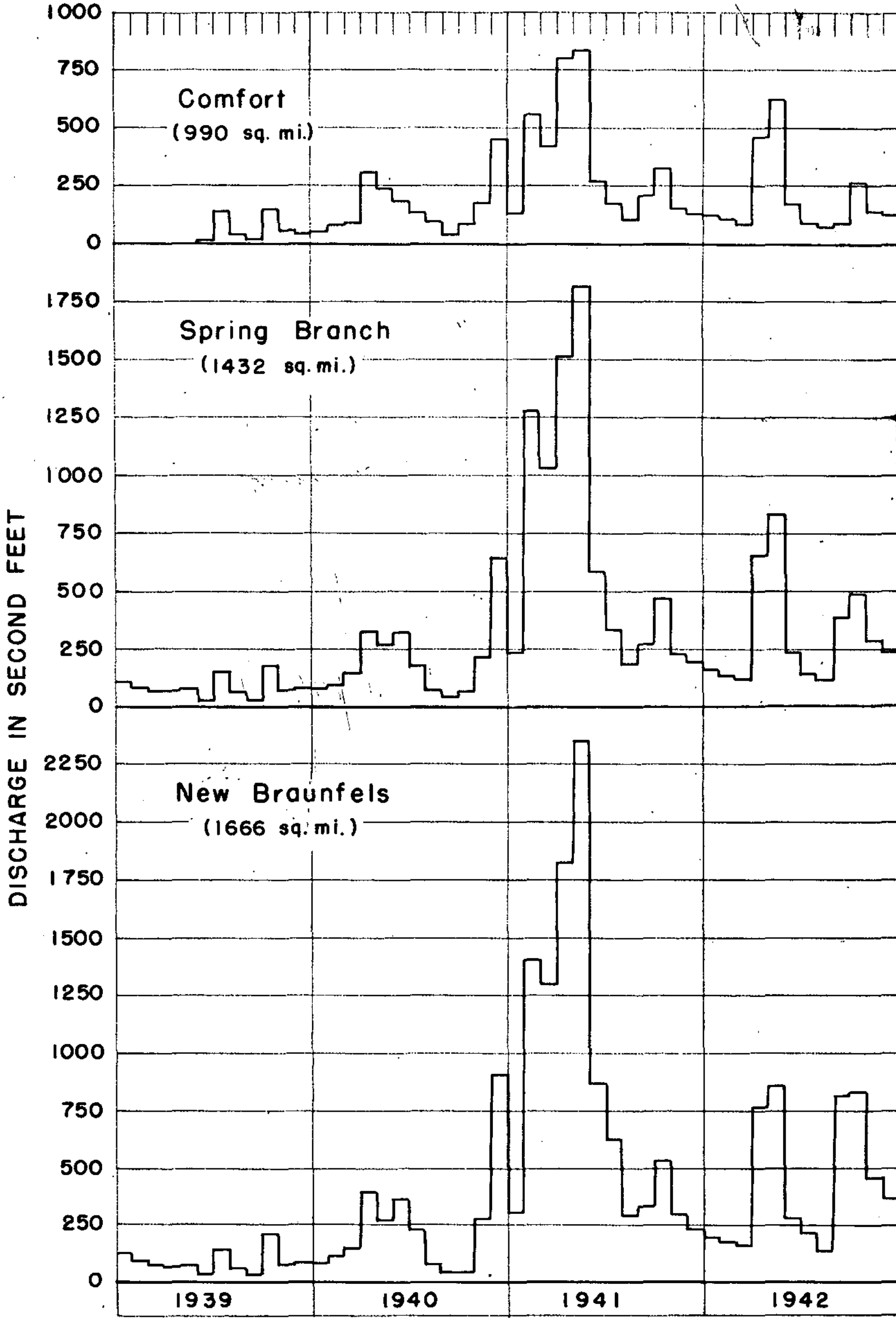


FIGURE I- AVERAGE MONTHLY DISCHARGE OF GUADALUPE RIVER AT COMFORT, SPRING BRANCH, AND NEW BRAUNFELS FROM 1939 TO 1942

Between Spring Branch and New Braunfels the Guadalupe River crosses successively younger formations, because of the series of down-faulted blocks, beginning with the lower member of the Glen Rose limestone at Spring Branch station and crossing the Edwards limestone at New Braunfels. At New Braunfels the average runoff for the years 1928-46 from the drainage area of 1,666 square miles was 180 acre-feet per year per square mile, and the average pickup between the two stations including the discharge of Hueco Springs, but not that of Comal Springs amounted to 69,040 acre-feet a year representing an average runoff of 295 acre-feet per square mile per year.

In addition to the discharge measurements at the regular stations, several series of measurements have been made at intermediate points during periods of low flow to determine the pickup or losses between stations. These are tabulated in the section on surface water, by S. D. Breeding on pages 61 to 74 .

The series of seepage measurements made on January 18-19, 1928, showed a net gain of 9.0 second-feet between the Comfort and Spring Branch stations and a net gain of 4.2 second-feet between the Spring Branch station and New Braunfels. The total net gain, therefore, was 13.2 second-feet. The series of February 20-22, 1929, showed a net gain of 3.0 second-feet between Comfort and Spring Branch and a net loss of 1.4 second-feet between Spring Branch and New Braunfels. The overall net gain for the two sections, therefore, was 1.6 second-feet. The discharge of the Guadalupe River at New Braunfels above Comal River for February 22, 1929 was 49 second-feet, and the discharge of Comal Springs for the same date was 270 second-feet.

Water levels in most of the wells along the Guadalupe River are above the level of the river except in the section of the river between the Hueco Springs fault and the Comal Springs fault, where the bed of the river is in the Edwards limestone. Here, however, the water-table gradient is eastward, away from Comal Springs. On the basis of the foregoing data it is concluded that very little, if any, water is lost from the surface flow of the Guadalupe River to the ground-water reservoir that supplies Comal Springs or Hueco Springs.

In contrast to the Guadalupe River, Cibolo Creek shows much evidence of large losses to the underground reservoirs along most of its course from Boerne to Selma, of which about 30 miles is in the Glen Rose limestone and about 5 miles at the lower end of the section is in the Edwards limestone.

Losses from Cibolo Creek have been observed as far upstream as the mouth of Balcones Creek. Approximately a hundred yards above the junction of the two creeks a crevice 18 inches wide crosses Balcones Creek. During periods of high stage, a portion of the water from Cibolo Creek backs upstream in the bed of Balcones Creek and disappears in the crevice. A concrete structure was built to prevent the loss of water, but the water succeeded in breaking through the crevice at the edge of the concrete. Downstream along the Cibolo, losses have been reported in the vicinity of the crossing of Highway 281 and have been observed by the writer in a pool about 5 miles east of Bulverde. Evidence of losses in the flood plain of the Cibolo may be seen on the O. Weidner farm, half a mile east of Highway 281, and on the R mpel farm, $4\frac{1}{2}$ miles east of Highway 281, in the form of small caves opening at the surface (pl. 2). In one cave the hard limestone at the mouth of the cave has been rounded and smoothed by the abrasive action of sand washed into the hole (pl. 2-A).

Three gaging stations were established on the Cibolo in March 1945 (fig. 2), and the brief records of discharge for two of these stations are given in section on surface water, on page 71 (table 7). Between the mouth of Balcones Creek, at the west corner of the county, and the Bulverde station (fig. 2) the bed of the creek is in the lower Glen Rose limestone and the losses in this part of the stream appear to be large. Between the Bulverde station and the Bracken station

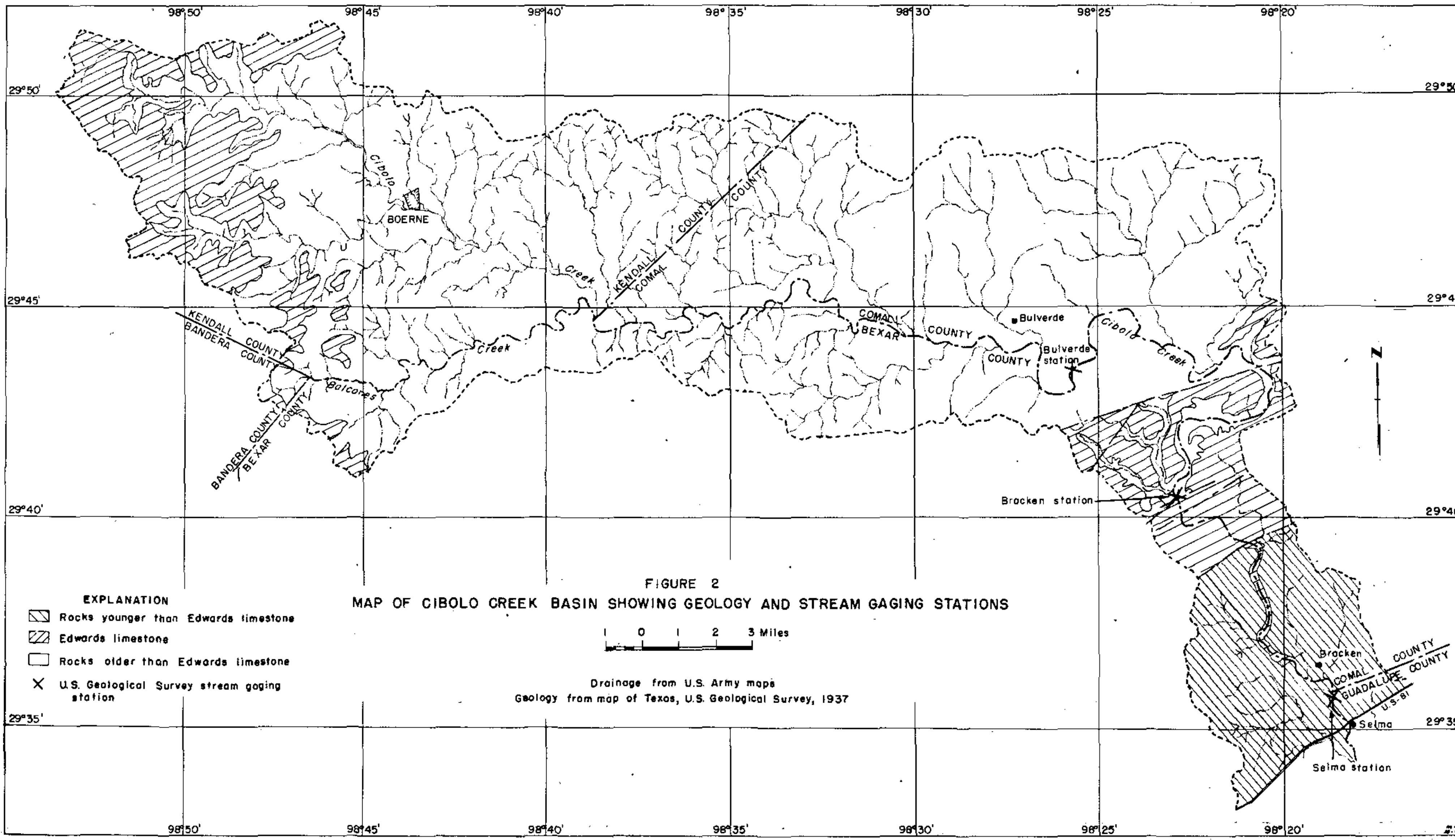


FIGURE 2

MAP OF CIBOLO CREEK BASIN SHOWING GEOLOGY AND STREAM GAGING STATIONS about 5 miles northwest of Bracken, the bed of Cibolo Creek is in the upper Glen Rose limestone and the losses in this area are relatively small, although some loss was observed by the writer at the edge of a pool about 8 miles northwest of Bracken. Between the Bracken station and the road crossing at Bracken the bed of the creek is in the Edwards limestone. Here the losses are believed to be large. The rock is honeycombed and has been broken by many small faults. Between the road crossing and the Selma station about 1 mile below the crossing, the bed is in the Austin chalk and the losses in this stretch are probably small.

A striking example of infiltration into the lower Glen Rose limestone above Bulverde station is shown in the records for the last 4 days of August 1946. Official rainfall records of the U. S. Weather Bureau are as follows:

(Precipitation in inches)

| 1946 August | Bulverde | Randolph Field | Boerne | New Braunfels |
|---|---|---|---|---|
| 28 | 1.05 | 0.17 | 1.30 | 1.56 |
| 29 | 3.80 | 2.57 | 4.79 | 3.06 |
| 30 | .67 | .26 | .19 | .77 |
| 31 | .06 | .04 | .01 | .10 |
| | 5.58 | 4.58 | 6.29 | 5.54 |

The heaviest precipitation occurred in the vicinity of Boerne in the headwaters of Cibolo Creek. The rains occurred after a relatively long dry period and it is probable that much of this water was intercepted by vegetation, by the wetting of soils and rock surfaces, by depressions that formed pools in the bed of the stream, and by the sands and gravels in the Leona formation that occur as broad terraces on either side of the Cibolo, but an estimated discharge of 300 second-feet was observed in the stream near the junction of Bexar, Kendall, and Comal Counties on August 29. As shown by the discharge records (see table 7, p.71 ), none of this water reached the station at Bulverde. It is believed that most of the water entered caverns in the lower Glen Rose limestone and thence passed laterally by underground channels into the Edwards limestone.

As indicated by its name, water seldom flows in the channel of Dry Comal Creek which drains the greater part of the outcrop area of the Edwards limestone north and west of New Braunfels.

According to the figures on runoff given by Breeding on page for the year beginning March 1, 1946, the runoff was as follows: 719.4 acre-feet per square mile from the area drained by Guadalupe River between the Spring Branch and New Braunfels gaging stations; 41.7 acre-feet per square mile from the basin of Cibolo Creek above Selma; and 177.5 acre-feet per square mile from the drainage basin of Comal River (excluding spring discharge). These values, expressed as depth of runoff in inches, are 13.5, 0.8, and 3.3 inches, respectively. Assuming a fairly uniform distribution of rainfall for the period, the large difference in runoff indicates that the rate of infiltration into the underlying reservoir from the basin of Comal River and Cibolo Creek above Selma is exceedingly high as compared with infiltration from the area drained by Guadalupe River between the Spring Branch and New Braunfels gaging stations.

Perhaps the most important objective in the study of ground-water in the Balcones fault zone is the delineation of the intake areas for Comal Spring. It is believed that the greater part of Comal County can be eliminated. The drainage area of 234 square miles between Spring Branch station and New Braunfels stations has already been eliminated as an important source because of small seepage losses and relatively high runoff.

No water can reach Comal Springs from the area east of the Guadalupe River because the hydraulic gradient in that area is toward the northeast (see p. 55 and fig. 6, p. 56). Southeast of the Comal Springs fault the Edwards limestone yields water of poor quality having an odor and taste of hydrogen sulfide whereas the water from Comal Springs is free from any trace of hydrogen sulfide. It follows that the channels through which the water moves toward Comal Springs lie northwest of the Comal Springs fault. This is also indicated by Livingston, Sayre, and White 44/ on the map of the San Antonio area showing a sharp northward turn in the gradient of the water surface in the vicinity of Bracken.

It is believed that Hueco Springs is supplied by water that enters the outcrop area of the Edwards limestone in the central part of the county, north of the Hueco Springs fault, and that this water is separated by the fault from the main body of water moving toward Comal Springs. Within the limits of Comal County, infiltration to the main reservoir supplying Comal Springs, therefore, is limited to the basins of Cibolo Creek and Dry Comal Creek, north of the Comal Springs fault. The entire infiltration area of these two streams is about 325 square miles, of which 280 square miles is in the basin of Cibolo Creek and 45 square miles in the basin of Dry Comal Creek. Of the total area 175 square miles lies within Comal County.

As mentioned on the preceding page simultaneous records of the runoff from these two basins and the basin of Guadalupe River between Spring Branch and New Braunfels for the one year beginning March 1, 1946 showed 719.4 acre-feet per square mile for the Guadalupe River, 41.7 for Cibolo Creek, and 177.5 for Dry Comal Creek. Assuming more or less similar distribution of rainfall and similar conditions for transpiration and evaporation, the difference in runoff per square mile between the Guadalupe Basin and that of the other two streams may be considered as showing the extent of infiltration into the underground reservoir. On this basis the total amount of infiltration from the three basins during the year was assfollows:

| | | |
|---|---|---|
| Guadalupe basin: | 0 | acre-feet |
| Cibolo basin: 719-42 = 677 a.f. per/sq.mi. x 280 sq.mi. = | 189,600 | acre-feet |
| Dry Comal basin: 719-178=541 a.f.per sq.mi.x 45 sq.mi. = | 24,300 | acre-feet |
| Total | 213,900 | acre-feet |

This is approximately 80 percent of the discharge of Comal Springs during the year which was 268,840 acre-feet. However, a part of the recharge for the year was still in storage at the end of the period, as indicated by a higher rate of discharge of the springs resulting from a higher water level in the limestone reservoir. Therefore, the two basins during the year probably contributed materially less than 80 percent of the flow of the springs.

If we use, as a basis for computation, the average rate of runoff from the Guadalupe River Basin between Spring Branch and New Braunfels gaging stations during the period 1928-46, which was 295 acre-feet per square mile per year or about 41 percent of the runoff in the year beginning March 1946, and assume that the runoff from Cibolo and Dry Comal Basins was proportionately less during the 19-year period than in 1946, the figure for average annual recharge to the underground reservoirs from the basins of Cibolo and Dry Comal Creeks is computed as follows:

| | | |
|---|---|---|
| Cibolo basin: (295-17) = 278 a.f.per sq.mi. x 280 sq. mi. = | 77,800 | acre-feet. |
| Dry Comal basin: (295-73) = 222 a.f.per sq.mi.x 45 sq.mi. = | 10,000 | acre-feet. |
| | 87,800 | acre-feet. |

44/ Livingston, Penn P., Sayre, A. N., and White, W. N., Water resources of the Edwards limestone in the San Antonio area, Texas: U.S.Geol. Survey Water-Supply Paper 773-B, 1936.

The average annual recharge for the two basins becomes 37,800 acre-feet, or about 57 percent of the average annual discharge of Comal Springs, which is about 235,000 acre-feet.

Further simultaneous records of the runoff from the three basins should throw additional light on the combined rate of recharge from Cibolo Creek, and Dry Comal Creek Basins. However, the geological information together with the runoff and seepage data already available seem to justify the conclusion that a relatively large part of the discharge of Comal Springs comes from sources outside of Comal County and the adjacent parts of Bexar and Kendall Counties drained by Cibolo Creek.

The water is not coming from the north, because the intake and transmission facilities are unfavorable in that direction; it is not coming from the east, because the hydraulic gradient shown by the altitude of the water level in wells (see p. ) slopes eastward from the springs; it is not coming from the south, because the route in that direction is closed by the Comal Springs fault. Therefore, it must be coming from the west and southwest and a major part of it must be coming from areas beyond the drainage basin of Cibolo Creek.

### Correlation of precipitation with rise and fall of water levels in wells and fluctuations in discharge of Comal Springs

Heavy rainfall causes the water levels in wells in the limestone reservoir to rise, indicating an increase in the volume of water in storage. As the water in storage increases, the discharge from Comal Springs also increases. Figure 3 shows the monthly precipitation near the spring at New Braunfels and at Boerne in the upper part of the drainage area of Cibolo Creek, about 35 miles west of the springs. Hydrographs of the fluctuations in the average monthly discharge of Comal Springs from 1932 to 1945, inclusive, and the monthly average water level in the Beverly Lodges well at San Antonio about 28 miles southwest of the springs, are also shown. The Beverly Lodges well is an artesian well in the Edwards limestone, 756 feet deep. The hydrograph of the water level in this well is the only long continuous record available in the area and seems to correlate with the variations in the discharge of Comal Springs. The water level in the well during the period of record has ranged from 34 to 71 feet below the land surface.

At times of heavy general rains such as those of the periods May-July 1935, May-September 1936, and July-September 1942, the water level in the Beverly Lodges well rises quickly after each rain and finally reaches a high level which may be maintained from 1 month to 2 months after the period of heavy precipitation.

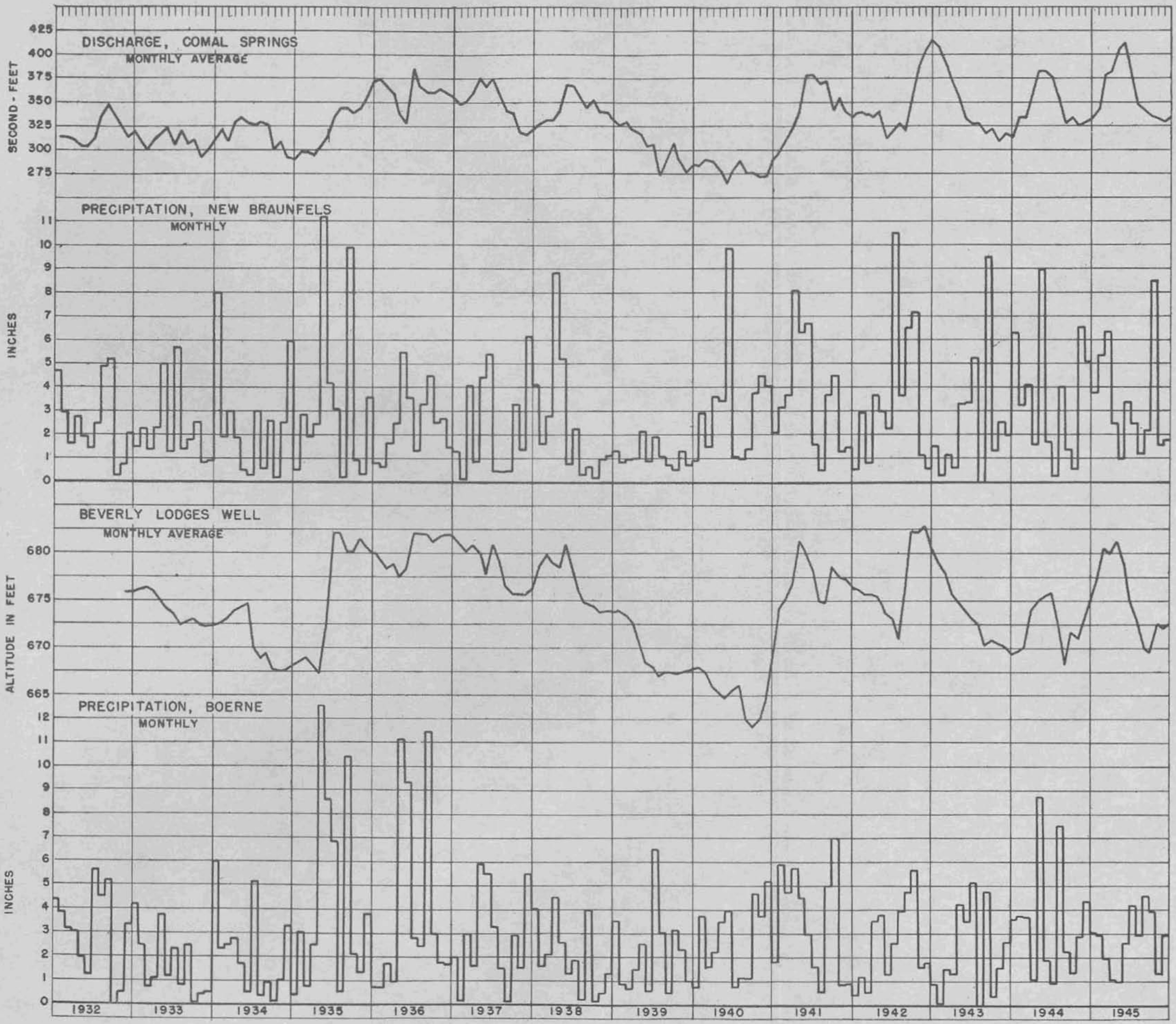


FIGURE 3- DISCHARGE OF COMAL SPRINGS, ALTITUDE OF WATER LEVEL IN BEVERLY LODGES WELL, SAN ANTONIO, AND PRECIPITATION BY MONTHS, 1932-45

The increase in the discharge of the Comal Springs after rains follows a pattern that is similar in most respects to that of the rise in the Beverly Lodges well, except that the rise in the water level in the well occurs much sooner than the increase in discharge of the springs. The lag is especially pronounced after a long period of drought, but is much less during wet periods. For example, the water level in the Beverly Lodges well rose nearly 9 feet in three stages immediately after each heavy rain between October 23 and December 13, 1940, preceded by a relatively dry period of 30 months. In contrast to this the discharge of Comal Springs, which was at an exceptionally low stage, remained practically unchanged aside from slight temporary increases throughout October, November, and the first half of December, and finally had a sustained increase of about 10 percent on December 18. Once a rise takes place, however it is likely to be sustained for weeks or months, even through periods of unusually low rainfall.

It will be observed that the rise in water level and increase in the discharge of the springs is not always proportional to the amount of precipitation. In 1935 the average precipitation at Boerne and New Braunfels was 47.30 inches. Heavy rains in May started an upward movement in the water level in the Beverly Lodges well, culminating 682 feet above sea level in July, whereas the peak in the discharge curve for Comal Springs did not come until January 1937, when it reached 375 second-feet. In 1942, after the relatively heavier rainfall of 1941, the average precipitation at Boerne and New Braunfels was 36.60 inches or 10.70 inches less than in 1935, yet the water level in the well rose to an altitude of nearly 681 feet and the discharge of Comal Springs at the end of the year was 418 second-feet or 43 second-feet greater than maximum discharge after the heavier rains of 1935. This is not surprising, however, as the surface runoff, and doubtless the ground-water recharge, varies with several factors besides the total rainfall.

The facts presented in this report suggest that Comal Springs is a point of discharge for an immense ground-water reservoir which also supplies the Beverly Lodges well at San Antonio, and that the discharge of the springs is proportional to the volume of water in the reservoir. The large size of the reservoir is indicated by its ability to absorb and contain sufficient water to supply Comal Springs for months of relatively dry weather without much change in the discharge.

The relationship among precipitation, water levels, and the discharge of Comal Springs is shown in greater detail in figure 4, which gives the daily precipitation at New Braunfels, the daily fluctuations in discharge of the springs, and a hydrograph of the daily water levels in well 263A for 1942. Well 263A is about 2½ miles west of Comal Springs, is 242 feet deep, and draws from the Edwards limestone. The hydrograph, obtained by means of a continuous recorder, shows the fluctuations in water levels under water-table conditions.

During the first half of 1942 there was a steady decline in water level in the well in response to relatively low rainfall. The decline was interrupted by several slight rises, notably in the second week of April, the last week of May, and the first week of July. The rise in both the water levels and the discharge of the springs began within a day or two after the rains but the general trend seemed to depend upon the backlog of storage in the reservoir. In spite of the low rainfall in November and December, the rises that occurred after heavy rains in September and October were maintained until the end of the year.

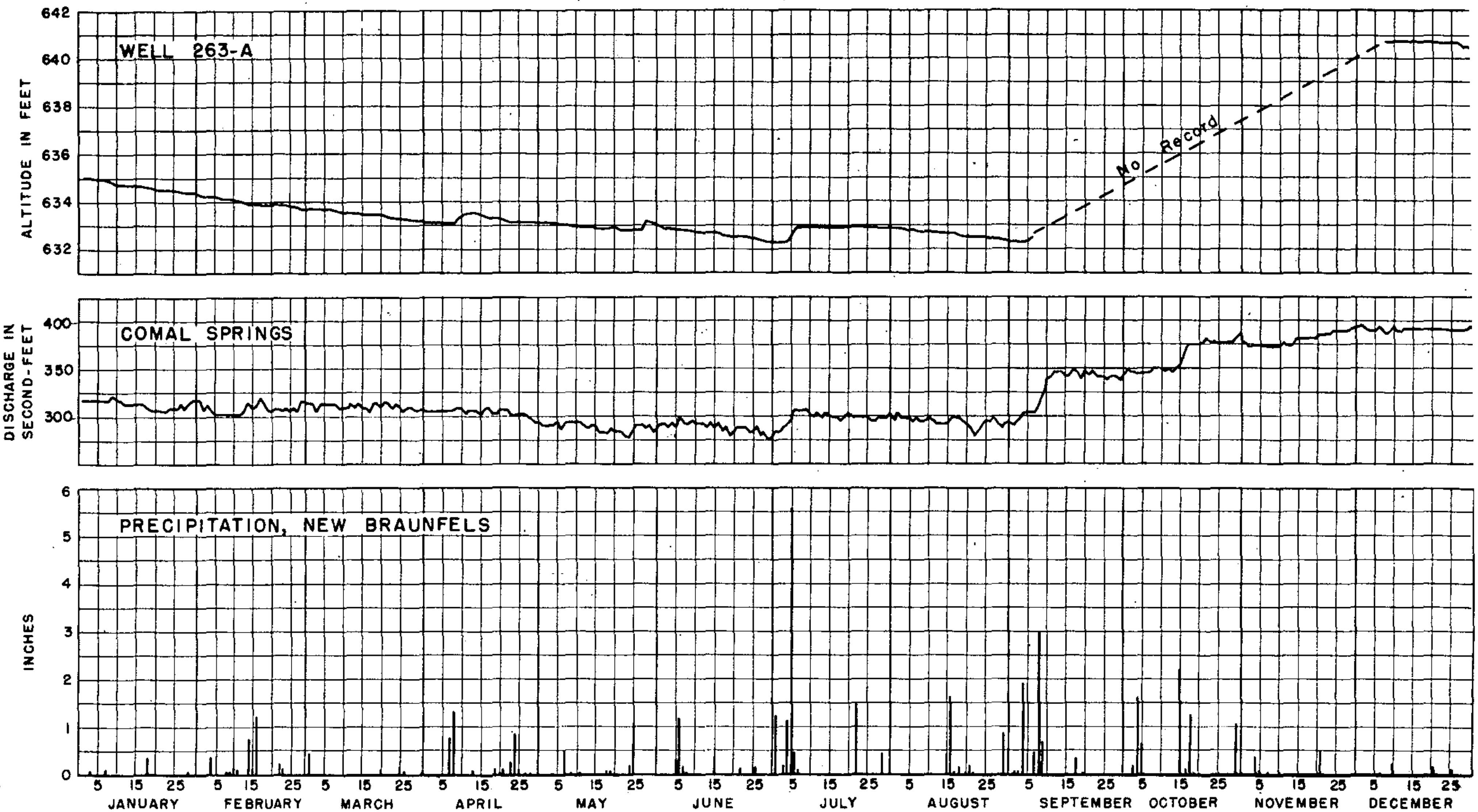


FIGURE 4 - DAILY DISCHARGE OF COMAL SPRINGS, RISE AND FALL OF WATER LEVEL IN WELL 263-A, AND PRECIPITATION, 1942

Both the monthly and daily charts suggest an analogy between the ground-water reservoir and an impounded stream. When a lake formed by an impounded stream is full, there is a slight but immediate increase in the discharge of the lake at the spillway when rain falls in the vicinity of the lake. This is small, however, compared with the peak discharge that comes later when the upper tributaries of the stream begin to pour into the lake from the larger drainage area.

Fluctuations of the water table

A number of wells in Comal County have been selected as permanent observation wells in which the depths to water have been measured periodically at intervals ranging from one month to one year since 1934. The records for 38 wells, which have been measured five times or more, are given in the tables on pages 115 to 128. Of the 38 wells, three draw water from the Pearsall formation, nine from the lower Glen Rose limestone, and 26 from the Edwards limestone.

The maximum difference between highest and lowest levels recorded in any of the Pearsall wells is 54.64 feet, the minimum is 20.87 feet, and the average is 37.60 feet; in the lower Glen Rose wells the maximum is 264.53 feet, the minimum 12.37 feet, and the average 95.60 feet; and in the Edwards limestone wells the maximum is 50.85 feet, the minimum 3.20 feet, and the average 16.80 feet.

Hydrographs for five of these wells are shown in figure 5. The graph for well 171 shows a range in water levels of 49.19 feet. The well is in the lower Glen Rose limestone is 248 feet deep, and is located in an interstream area about 3½ miles northeast of Bulverde. The water level can be lowered several feet by hand with a bucket and rope even though the lift is, at times, as much as 200 feet. The graph for well 118 gives the range between the maximum and minimum water levels of record as only 1.58 feet. This well is 9½ miles northeast of Bulverde and only about a quarter of a mile from the Guadalupe River. It also draws water from the lower Glen Rose limestone, at a depth of 108 feet. The well is equipped with a cylinder pump and windmill and there is no measurable drawdown in the water level when the windmill is turning rapidly. These two wells illustrate the difference in yield and water-level fluctuation between wells that are near the main lines of drainage and wells in the interstream areas where solution channels have been poorly developed.

The water-level fluctuations in wells 263A, 221, and 271 are more or less typical of those recorded in this area in Edwards limestone wells in the outcrop area of that limestone. The wells range in depth from 140 to 242 feet, and the fluctuations of water level in them are of moderate range. None of the five wells described in this and the preceding paragraph has been tested for yield, but no shortage of water has been reported from any of them. They are ranch wells and, with the exception of well 171, all could probably yield much more water than is used.

## MOVEMENT OF GROUND WATER

Introduction.- Ground water may be classified in regard to its origin as connate water or meteoric water. The water that is trapped in sediments at the time of their deposition is called connate water. This water may be a brine similar to present sea water, or even more concentrated. After the formation has been exposed to the surface, the sea water may be gradually flushed out and replaced by meteoric water (from rain or snow) that contains only such minerals as may be dissolved from the rock in the process of circulation. For example, the

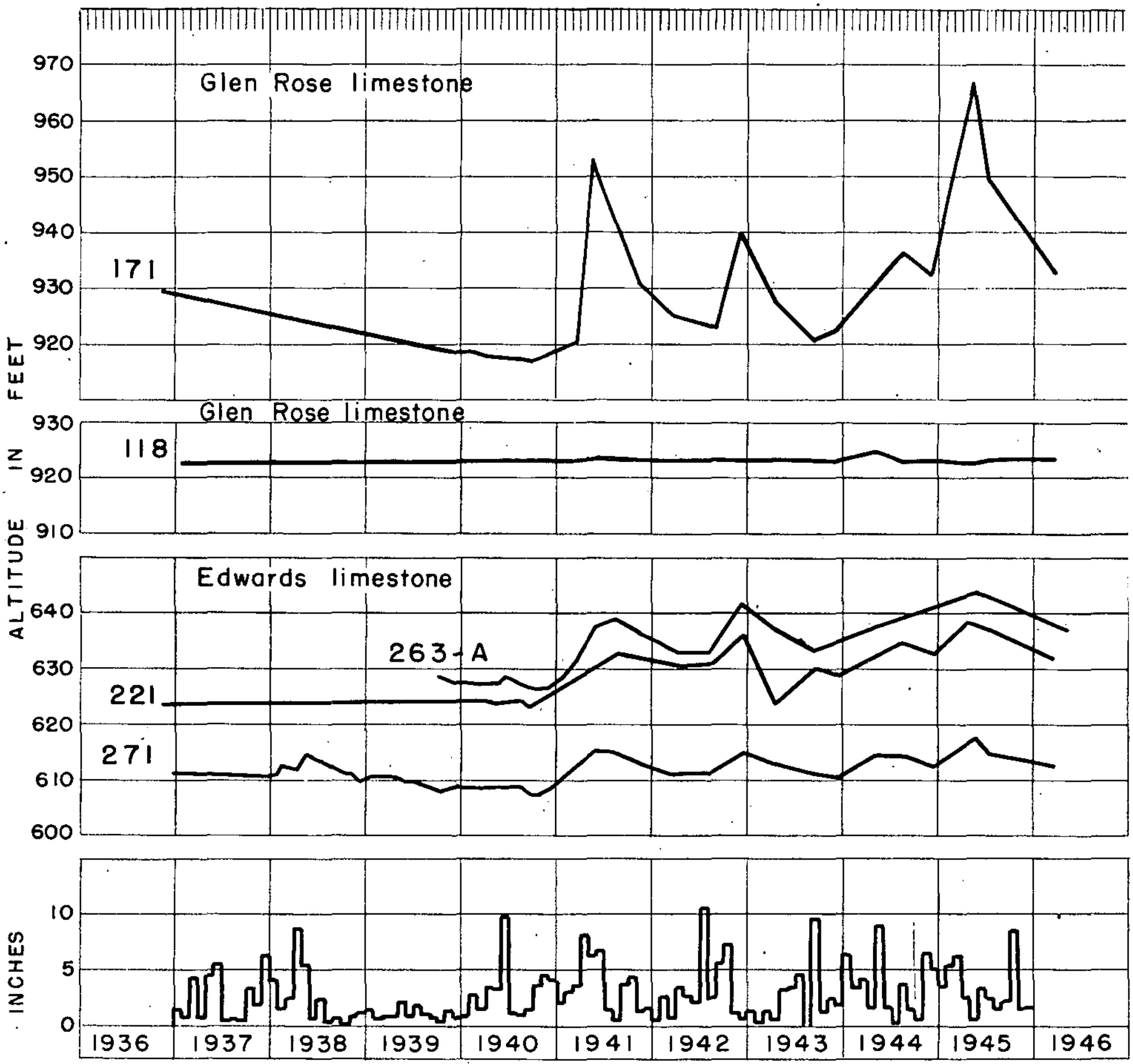


FIGURE 5-ALTITUDE OF WATER LEVELS IN WELLS IN EDWARDS AND GLEN ROSE LIMESTONES AND MONTHLY PRECIPITATION AT NEW BRAUNFELS FROM 1936 TO 1946

Edwards limestone yields potable water to Comal Springs but contains salt water, petroleum, and gas in the oil fields of Caldwell County. Intermediate between these two kinds of water is water of poor quality encountered in areas where the circulation of meteoric water is comparatively slow as a result of structural features or because of clay or shale beds between beds of limestone. South of the Comal Springs fault a number of wells (for example, nos, 395 and 428) have been drilled to the Edwards limestone but have been abandoned because the water is too highly mineralized or has a hydrogen sulfide odor. This is strong evidence that there is very little circulation of water in the Edwards south of the Comal Springs fault in Comal County. In Bexar County 45/, however, there is a large area not defined by any one fault that yields potable water.

In the upper member of the Glen Rose limestone many wells yield water of comparatively poor quality owing to the alternating beds of clay and shale that prevent the free circulation of meteoric water. In general, circulation decreases with depth and water obtained at great depths is likely to be of poor quality although there are many exceptions to this rule. Circulation of water in limestones may be retarded by natural puddling when solution channels become filled with clay or other detrital material carried into the formation by infiltrating meteoric waters after heavy rains. Weathering within the limestone usually produces a residue of red clay, which may also be washed into previously formed caverns. Beds of red clay are found in a number of places in the Edwards limestone. Natural puddling occurs, however, after connate waters have been flushed out of the limestone.

Rate of movement.- The lack of turbidity in the water that issues from Comal Springs suggests that the water moves slowly underground and that a part of its course is through an intricate network of small openings that retard the velocity of the water to the extent that sediments are not carried along as in open streams. Locally, however, at some distance from the springs constricted openings may cause turbulent flow. The temperature of the water from Comal Springs is constant at about 74° F., whereas the mean annual temperature of the air recorded by the U. S. Weather Bureau at New Braunfels is 68° F. This suggests that the paths of circulation within the reservoir may reach depths of 300 to 500 feet below the surface at no great distance from the spring.

The water from Hueco Springs, on the other hand, becomes slightly turbid after heavy rains and the temperature of the water fluctuates within a range from 3 to 6 degrees lower than that of Comal Springs. These conditions, together with the fact that the springs have a wide range in discharge, suggest that the springs are supplied by a ground-water reservoir that is quite separate from that supplying Comal Springs, and that the intake area for this reservoir is smaller and closer to the point of discharge than the intake area of the Comal Springs reservoir. The Hueco Springs fault (see p. 30 and pl. 5) is believed to divide the two reservoirs. This is indicated by a comparison between the altitudes of the water levels in Edwards wells on either side of the fault and the altitude of Hueco Springs. On the southeast side of the fault, in the vicinity of the spring the maximum altitudes of water levels on record in wells 221, 222, 226, and 398 are approximately 636, 637, 641, and 636 feet, respectively (see table of water levels), whereas the altitude of the lowest point of discharge for Hueco Springs is 645 feet. Just northwest of the fault the water level in well 224 has been recorded as high as 665 feet. Hueco Springs obviously could not be fed by a reservoir having a water level lower than the point of discharge, so that the reservoir must be northwest of the fault. It is not proved, however, that the fault acts as a barrier to the movement of ground water for the entire width of the county.

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45/ Livingston, Penn P., Sayre, A. N., and White, W. N., op. cit., p. 104, 1936.

Springs in the Balmorhea area of Texas are believed to be close to the intake area and it was observed by White, Gale and Nye 46/ that an increase in discharge was accompanied by a decrease in the temperature and in the mineralization of the water. In the following table the records of temperatures, hardness, and discharge measurements for Hueco Springs show no direct relationship among these factors.

| Date | Temperature of spring water (Degrees Fahrenheit) | Air temperatures (Degrees Fahrenheit) | Hardness as $CaCO_3$ a/ (Parts per million) | Discharge b/ in second-feet |
|---|---|---|---|---|
| 1944 | | | | |
| Jan. 22 | 70 | -- | 326 | -- |
| Sept. 14 | 71½ | -- | 260 | -- |
| Oct. 9 | 71 | -- | 333 | -- |
| Nov. 22 | -- | -- | 294 | -- |
| Dec. 5 c/ | 71 | 45 | 264 | -- |
| Dec. 7 | 71 | 45 | 316 | -- |
| Dec. 11 | 69 | 45 | -- | -- |
| Dec. 12 | 69 | 49 | -- | -- |
| Dec. 13 | 69 | 52 | -- | -- |
| Dec. 20 | 69 | 35 | -- | -- |
| 1945 | | | | |
| Jan. 8 | 69 | -- | -- | -- |
| Jan. 22 | 69 | 44 | 279 | 90.3 |
| Jan. 27 | 68 | 34 | -- | -- |
| Feb. 14 | 68 | -- | 322 | 92.4 |
| Mar. 5 | 68½ | -- | 288 | -- |
| Mar. 23 | 69 | -- | 308 | 80.4 |
| Apr. 1 | -- | -- | 286 | -- |
| Apr. 27 | 69 | -- | 337 | 84.5 |
| May 31 | 69½ | -- | 254 | 77.7 |
| July 5 | 70 | -- | 272 | 59.0 |
| Aug. 9 | 70 | -- | 221 | 32.1 |
| Sept. 13 | 70 | -- | 336 | 23.3 |
| Oct. 19 | 69½ | -- | 282 | 46.8 |
| Nov. 23 | 70 | -- | 326 | 17.6 |
| Dec. 20 | 70 | -- | -- | 16.5 |

a/ For more complete analyses see table of chemical analyses.
b/ More complete discharge data given on page
c/ About 8 hours after heavy rain.

Referring again to figures 3 and 4, the apparent lag in the increase in discharge of Comal Springs following heavy rains and rises in water levels does not mean that the water actually moves from the vicinity of San Antonio to Comal Springs within the 1 or 2 month period indicated by the lag. Only the change in head due to added added water in the intake area and in the reservoir itself is transmitted at this rate. The time required for the water that falls as rain on the intake area west of Comal County to reach Comal Springs would probably be expressed in years rather than in days or months. Much research has been directed toward the rate of movement of ground water, and with considerable success where the character and permeability of the materials that form the ground-water reservoirs are fairly uniform. As a result of this research methods have been developed by Thiem 47/ and Theis 48/ by which it

46/ White, W. N., Gale, H. S., and Nye, S. S., Geology and ground-water resources of the Balmorhea area of western Texas: U.S. Geol. Survey Water-Supply Paper 849-C, p. 100, 1941.

47/ Thiem, Gunter, Hydrologische Methoden, 56 pp., Leipzig, J. M. Gebhardt, 1906.

48/ Theis, C. V., The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using ground-water storage: Am. Geophys. Union Trans. 1935, pp. 519-524.

is possible to make quantitative estimates as to the possible yield of ground-water reservoirs. The methods are more generally applicable to sand and sandstone reservoirs because of the more nearly uniform character of such aquifers. The application of formulas for the determination of the permeability of the limestones in Comal County would be difficult not only because of the irregularities in the character of the openings in the limestones but because it is believed that the movement of the water may be under artesian conditions in a part of its course and under water-table conditions in other parts.

Direction of movement.- Figure 6 is a map of Comal County showing the locations of a number of observation wells in which the differences in head at the water table for the period July 1-17, 1945, are shown by the altitude of the water surface at each well. This was obtained by determining the altitude of the land surface at each well and subtracting therefrom the depth to water in the well.

In general, these records show that the water table in the Edwards limestone wells in Comal County slopes from the southwest boundary of the county toward the northeast boundary of the county although locally the gradients may not conform to this general direction (fig. 6). From this we may assume that some water enters Comal County from the Edwards limestone in Bexar County. Livingston, Sayre, and White 49/ show the slope of the artesian head for Edwards limestone wells in the San Antonio area in 1934. The general direction of the movement of water probably varies but little from time to time. As indicated by the contours on their map, the general slope of the pressure surface is southeastward but at the Comal County line the contours swing rather aburptly northward indicating an eastward slope of the pressure surface. In this area the water appears to move out from under its confining bed and continues northeastward under water-table conditions, as indicated by the relative elevations of the water surface shown on the map of the San Antonio area and in figure 6 of the present report. The fact that the chemical character of the water southeast of the Comal Springs fault is poor compared with the quality of the water that issues from Comal Springs is further proof that the main body of water flows along the north side of the fault under water-table conditions rather than on the downthrow side of the fault. This change in the direction of movement of the Edwards water was probably caused by structural uplift and transverse faulting in the vicinity of Bracken (see p. 31 ), which may have formed a barrier diverting the movement of water from its normal course in the artesian area. Following the general direction of the slope in Comal County, the water appears to move from the vicinity of Bracken toward and beyond Comal Springs. In the vicinity of the springs the slope is toward the springs from the north, west, and south, indicating a cone of depression caused by the discharge of the spring.

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49/ Livingston, Penn, Sayre, A. N., and White, W. N., Water resources of the Edwards limestone in the San Antonio area, Texas: U. S. Geol. Survey Water-Supply Paper 773, pl. 5, 1936.

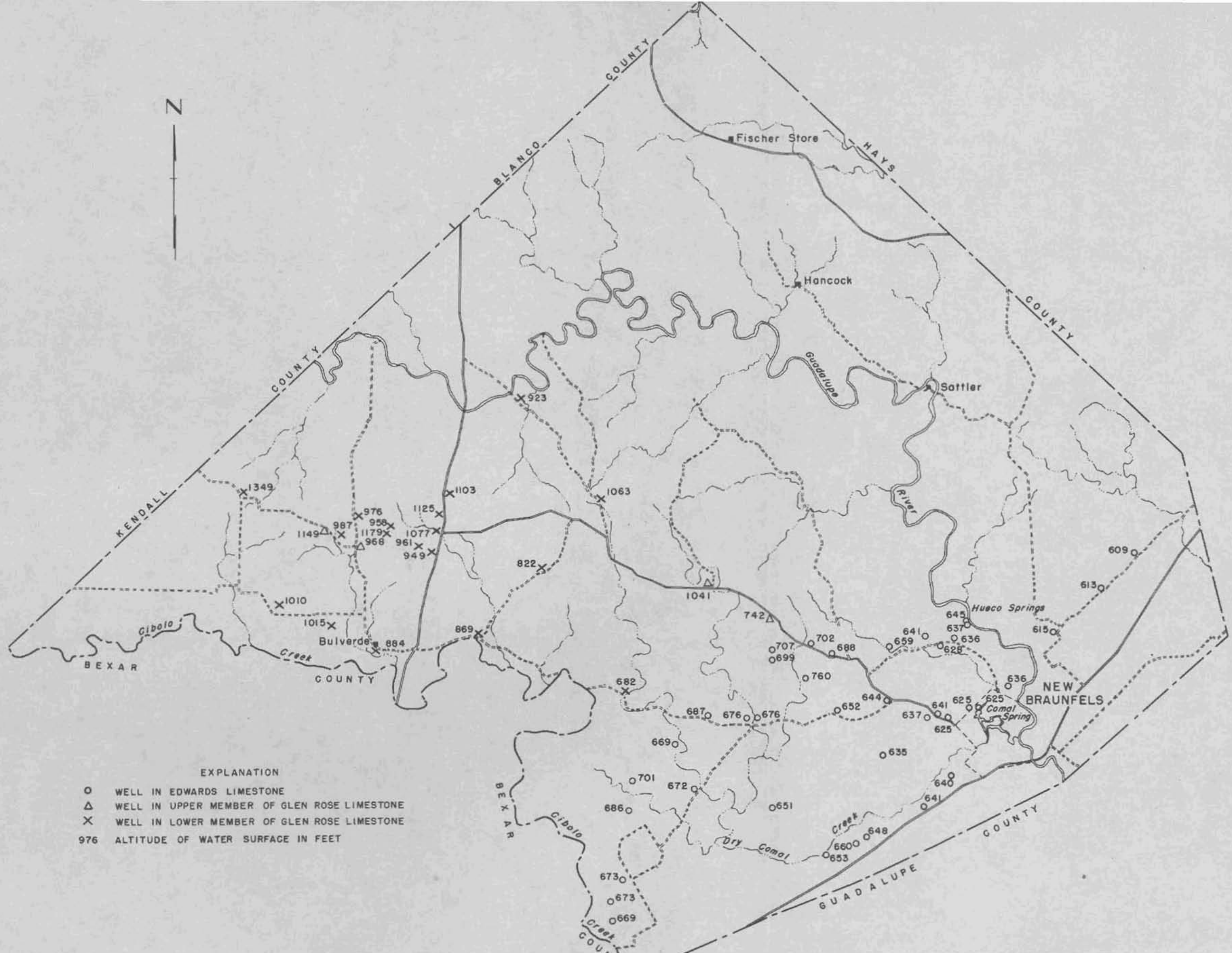


FIGURE 6 - ALTITUDE OF WATER IN WELLS IN EDWARDS AND GLEN ROSE LIMESTONES
JULY 1-17, 1945

In wells drawing from the Glen Rose limestone the altitude of the water levels indicate that the water table slopes eastward and southeastward toward the outcrop of the Edwards. On the divide between Cibolo Creek and the Guadalupe River, however, the Glen Rose wells show a pronounced irregularity in the altitude and slope of the water table. This is characteristic of the water table in limestones in which the solution channeling is poorly developed.

## SUMMARY OF CONCLUSIONS

The discharge of Comal Springs, which averages 323 second-feet, is maintained by a large reservoir in the Edwards limestone, supplemented by a smaller reservoir in the lower Glen Rose limestone. The great size of the Edwards reservoir is indicated by the remarkably constant rate of discharge of the springs, the uniform temperature and lack of turbidity of the water, and by the relation among fluctuation in discharge, rainfall, and rise and fall in water levels in wells.

It has been shown that recharge to the reservoir within Comal County is limited to parts of the drainage area of Cibolo and Comal Creeks, and that even under the most favorable conditions this recharge is too small to supply the springs. It is estimated that the entire drainage area of Comal Creek and Cibolo Creek contributes about one-third of the water that reaches Comal Springs; the balance, therefore, must come from areas to the west, beyond these drainage basins.

## METHOD OF WATER-WELL CONSTRUCTION

Most of the water wells in Comal County have been drilled by the cable-tool percussion method, which is described by Fiedler 50/. Ordinary farm and ranch wells are usually from 5 inches to 6 inches in diameter. Where casing is used the diameter of the hole is usually reduced slightly to provide a seat for the casing. Most wells that start in the Georgetown limestone or older formations, including in descending order the Edwards limestone, the Glen Rose limestone, and the Pearsall (Travis Peak) formation, do not require casing to prevent the caving of the softer beds. These are usually equipped with a short piece of galvanized iron casing to prevent soil from entering the well at the surface. Many uncased wells that have been drilled into these older formations are more than 50 years old and are still giving service. Some wells are equipped with one or two joints of wrought steel casing cemented from the surface of the ground to the bottom of the casing, allowing from 1 to 2 feet of the casing to protrude above the ground. This not only provides a seat for a water-pipe clamp but it affords better protection from pollution or surface contamination.

Wells that penetrate the Grayson (Del Rio) shale, however, must be cased to solid limestone at the time the well is drilled, owing to the fact that the clay in this formation will invariably cave as soon as it becomes wet.

Wells that are drilled in the Taylor marl or Anacacho limestone require casing. No caving beds are found in the underlying Austin chalk, but some clay beds in the Eagle Ford shale may cave if no casing is used.

In the Pleistocene alluvial deposits, the wells hav an average depth of less than 60 feet. A few of the older wells have been dug by hand and are lined with rock. Drilled wells obtaining water from the terraces require casing to prevent caving.

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50/ Fiedler, A. G., The construction and protection of drilled wells, U. S. Geol. Survey, mimeographed circular 1933.

Most farm or ranch wells are equipped with a 2-inch drop pipe and cylinder pump. The cylinder is usually 1-7/8 inches in diameter and is placed near the bottom of the 2-inch drop pipe, with a short piece of suction pipe below the cylinder. The bottom of the suction pipe extends almost the full depth of the well except in wells in which the yield and specific capacity (yield per unit of drawdown) are high. In many of these wells the cylinder is set 20 or 25 feet below the water surface, depending upon the seasonal fluctuation of the water table.

Windmills are extensively used for power, but some pumps are powered by 1½ to 5-horsepower gasoline engines. The wind is fairly dependable in Comal County, but emergency power or storage tanks holding 3 or 4 days' supply are needed in case the wind does not blow. Some ranchers equip their wells with a jack and pulley so that a tractor or automotive equipment can be used when the wind fails to provide adequate power. Recently, as a result of the growth of the rural electrification system, electric power is being used for pumping on several farms and ranches. Where large amounts of water are needed, such as for the public supply for the city of New Braunfels, wells of larger diameter are drilled and turbine-type pumps powered by electric motors are used.

## CHEMICAL CHARACTER OF THE WATER

By W. W. Hastings

Partial chemical analyses of water from 328 wells and springs in Comal County are given in the table of chemical analyses appended to this report. In addition, analyses of 44 samples collected periodically from Comal Springs (no. 294) and Hueco Springs (no. 400) are listed to show the possible relationship among the chemical character, the rate of discharge, and the temperature of the water. The data indicate no apparent pronounced differences in chemical composition or temperature of the water with changes in the rate of flow.

Most of the water obtained from wells in Comal County is acceptable for stock and domestic purposes but, because the water-bearing formations are largely limestones, the waters are moderately hard, generally above 200 parts per million. Calcium bicarbonate is normally the predominant mineral constituent in ground water of Comal County.

The wells in the Pearsall (Travis Peak) formation yield water that ranges in quality from exceptionally good, as shown by the analysis of the water from well 106, to water that is too highly mineralized for most purposes, such as the water from well 110. However, most wells in the Pearsall (Travis Peak) formation yield water containing less than 500 parts per million of dissolved solids.

Wells in the Glen Rose limestone generally yield water acceptable for domestic purposes. The more highly mineralized waters from the lower Glen Rose are high in sulfates and are very hard, as shown by the analyses of water from wells 63 and 130. Water in the upper Glen Rose in many wells is rather high in sulfates and hard, but most of the water had dissolved solids below 1,000 parts per million. An exception is found in the analysis of water from well 427, which is 1,200 feet deep and yields water having 4,170 parts per million of dissolved solids.

All the analyses of water from wells in the Edwards limestone northwest of the Comal Springs fault show that the water is of good quality; although the water is hard, dissolved solids are usually less than 500 parts per million. The wells (402 and 403) that supply the city of New Braunfels yield water that has an average hardness of 252 parts per million and dissolved solids of 282 parts per million. (See fig. 7.) The water supply has been approved by the State Board of Health for public consumption.

As previously stated, it is believed that the water southeast of the Comal Springs fault is of poor quality because the fault has prevented the free circulation of meteoric water in the Edwards limestone. In the Glen Rose limestones and in the Austin chalk, circulation is also the controlling factor in the quality of water. Where solution has developed a reservoir with a system of connecting passages permitting the free movmament of water characteristic limestone waters prevail, as illustrated by wells 184 and 402 in figure 7.

Water from the Leona formation of Pleistocene age is high in nitrate, as in well 363, but the nitrate content of the water differs widely from one well to another. It is frequently stated that high nitrates in well water indicate pollution from sources at or near the surface, but studies of waters in various parts of Texas indicate that Pleistocene formations may contain nitrate where there is no possibility of contamination.

The chemical composition of ground waters from several aquifers in Comal County is shown graphically in figure 7. The heights of the several sections correspond to the quantities of the ions, such as calcium, magnesium, chloride, etc., expressed in terms of equivalents per million. One equivalent per million corresponds to 20 parts per million of calcium, 12 of magnesium, 23 of sodium, 39 of potassium, 61 of bicarbonate, 48 of sulfate, 35.5 of chloride, 62 of nitrate, and 50 of hardness as calcium carbonate. The total hardness is the sum of the blocks for calcium and magnesium. As an illustration, if the bicarbonate block extends above the magnesium block, all the hardness is carbonate hardness; but if the top of the bicarbonate is lower than the top of the magnesium, part of the hardness is due to sulfate, or even chloride if the chloride extends below the top of the magnesium.

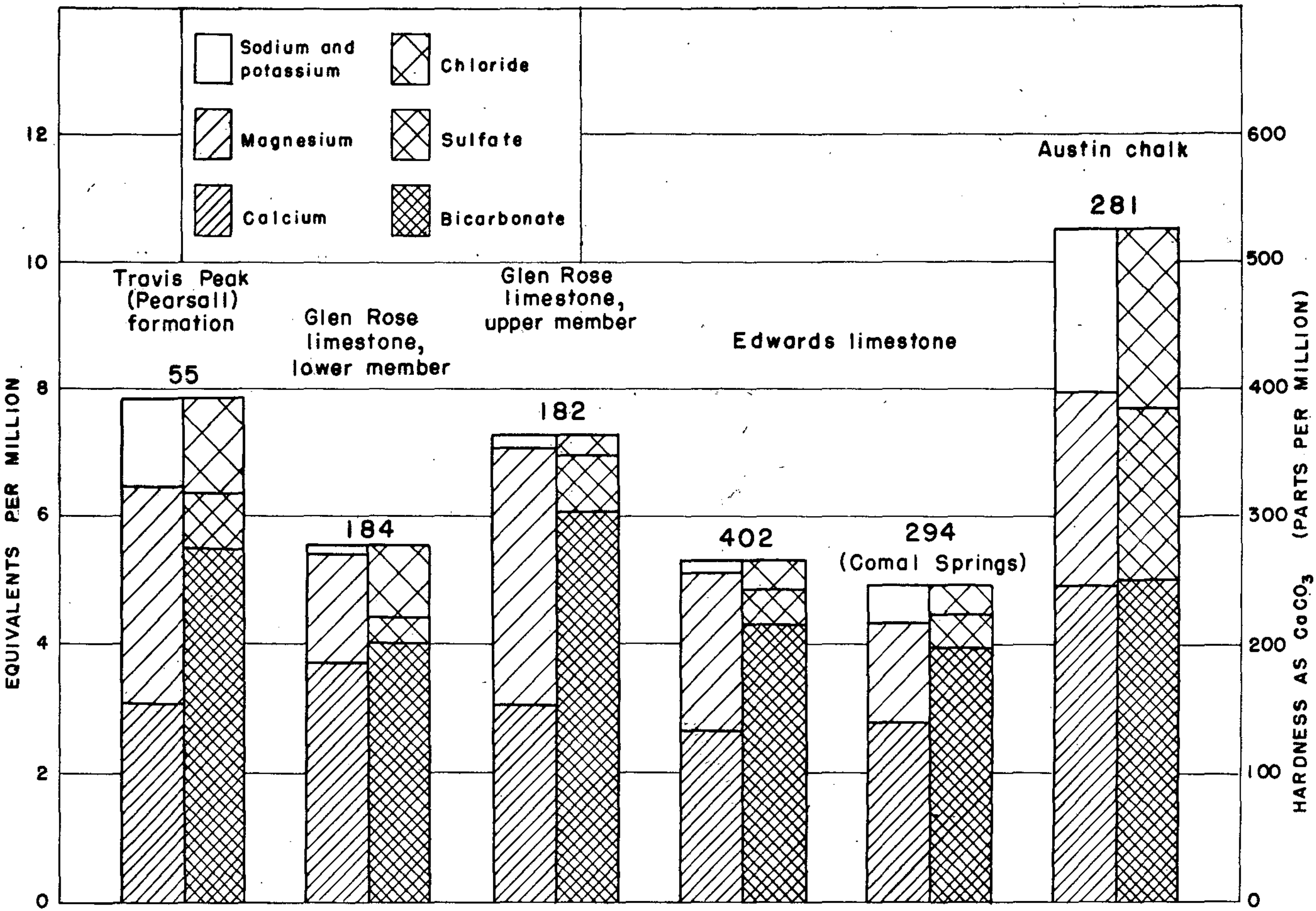


FIGURE 7-CHEMICAL CHARACTER OF GROUND WATER IN COMAL COUNTY

# SURFACE-WATER SUPPLIES

By

S. D. Breeding

Approximately 420 square miles of the 567 square miles in Comal County drains directly into Guadalupe River. About 60 square miles in the northeastern part of the county is drained by Blanco River, a tributary of San Marcos River which enters the Guadalupe at Gonzales about 60 miles below New Braunfels; and a strip of about 90 square miles along the southwestern border of the county is drained by Cibolo Creek, a tributary of San Antonio River.

Continuous records of the discharge of these streams were being obtained in Feburary 1947 at the following gaging stations except the Guadalupe River at New Braunfels, below Comal River, which was discontinued in 1927. All the stations except the one at Wimberley are in Comal County.

| Station | Drainage area (square miles) | Period of record |
|---|---|---|
| Guadalupe River near Spring Branch | 1,432 | June 1922 to ______ |
| Guadalupe River above Comal River at New Braunfels | 1,666 | December 1927 to ______ |
| Guadalupe River at New Braunfels (below Comal River) | 1,770 | January 1915 to Dec.1927 |
| Comal River at New Braunfels | 94* | December 1927 to ______ |
| Blanco River at Wimberley | 378 | August 1924 to September 1926 and June 1928 to ______ |
| Cibolo Creek near Bulverde | 198 | April 1946 to ______ |
| Cibolo Creek above Bracken | 251 | March 1946 to ______ |
| Cibolo Creek at Selma | 280 | March 1946 to ______ |

*Measurements include flow from Comal Springs to which this drainage area is not applicable.

These records were collected by the Surface Water Division of the United States Geological Survey in cooperation with the Texas State Board of Water Engineers, and have been published in Geological Survey Water-Supply Papers.

## Guadalupe River

The following table contains a few pertinent facts about the flow of Guadalupe River as measured at gaging stations in Comal County.

Table 1 - Runoff of Guadalupe River

| | Period of record (calendar years) | Average during period (acre-feet 51/ per day) | Average during 12 consecutive months of lowest flow (acre-feet per day) | Minimum in one day (acre-feet) |
|---|---|---|---|---|
| Spring Branch | 1923-46 | 588 | 96 | 5.6 |
| New Braunfels (above Comal River) | 1928-46 | 821 | 127 | 19 |
| New Braunfels (below Comal River) | 1916-27 | 1,486 | 682 | 536 |

51/ An acre-foot is the amount of water required to cover 1 acre to the depth of 1 foot and is equivalent to about 326,000 gallons.

Peak rates of flow recorded for Guadalupe River near Spring Branch during the period 1923-46 were 121,000 second-feet on July 3, 1932, and 114,000 second-feet on June 15, 1935. The minimum flow recorded was 2.2 second-feet on July 11, 1939. Peak rates of flow recorded for Guadalupe River at New Braunfels during the period 1916-46 were 95,200 second-feet on July 3, 1932, and 101,000 second-feet on June 15, 1935. Floods of considerably greater magnitude occurred in 1869 and in December 1913. The minimum flow recorded for Guadalupe River above Comal River at New Braunfels between 1928 and 1946 was 9.6 second-feet on July 9-11, 1939. As the floods in July 1932 and June 1935 originated above Spring Branch, the decrease in the peak rates of flow between Spring Branch and New Braunfels is considered to be due to temporary channel storage and to have no relation to possible losses to the ground-water reservoir.

Table 2 gives the annual discharge of Guadalupe River at the gaging stations near Spring Branch and at New Braunfels, above Comal River, and the runoff from the 234 square miles drained by the river between these stations (expressed in acre-feet and in depth in inches), together with the annual rainfall at New Braunfels and Fischer's Store for the years 1928 to 1946.

Table 2: Discharge of Guadalupe River near Spring Branch and at New Braunfels and pickup between stations; rainfall at Fischer's Store and New Braunfels, Texas, 1928-46

| Calendar year | Flow of Guadalupe River in acre-feet | | Runoff between Spring Branch and New Braunfels | | Rainfall in inches | |
|---|---|---|---|---|---|---|
| | Spring Branch | New Braunfels | Acre-feet | Depth in inches | Fischer's Store | New Braunfels |
| 1928 | 45,400 | 64,800 | 19,400 | 1.55 | 28.83 | 36.07 |
| 1929 | 143,000 | 208,000 | 65,000 | 5.21 | 40.60 | 40.15 |
| 1930 | 142,000 | 170,000 | 28,000 | 2.24 | 30.80 | 28.71 |
| 1931 | 235,000 | 336,000 | 100,000 | 8.09 | 32.57 | 31.58 |
| 1932 | 395,000 | 425,000 | 30,000 | 2.40 | 27.58 | 31.15 |
| 1933 | 102,000 | 114,000 | 12,000 | .96 | 26.90 | 26.75 |
| 1934 | 54,490 | 87,680 | 33,190 | 2.66 | 28.62 | 30.80 |
| 1935 | 459,800 | 573,700 | 113,900 | 9.13 | 42.07 | 41.67 |
| 1936 | 619,300 | 691,900 | 72,600 | 5.82 | 37.86 | 30.41 |
| 1937 | 181,200 | 233,400 | 52,200 | 4.18 | 28.94 | 29.19 |
| 1938 | 140,800 | 232,400 | 91,600 | 7.34 | 23.13 | 28.32 |
| 1939 | 60,310 | 64,580 | 4,270 | .34 | 29.53 | 13.35 |
| 1940 | 152,400 | 174,300 | 21,900 | 1.75 | 37.28 | 38.11 |
| 1941 | 485,100 | 620,600 | 135,500 | 10.86 | 36.02 | 42.99 |
| 1942 | 227,800 | 318,000 | 90,200 | 7.23 | 31.15 | 42.08 |
| 1943 | 98,570 | 136,300 | 37,730 | 2.99 | 22.83 | 29.93 |
| 1944 | 315,100 | 450,100 | 135,000 | 10.82 | 37.53 | 43.14 |
| 1945 | 302,200 | 420,700 | 118,500 | 9.49 | 35.30 | 39.38 |
| 1946 | 228,500 | 378,200 | 149,700 | 12.00 | 46.79 | 56.60 |
| AVERAGE 1928-46 | 230,900 | 300,000 | 69,040 | 5.53 | 32.86 | 34.75 |

During the 19-year period the minimum annual runoff from the drainage area between the two stations (234 square miles) was 0.34 inch or 18 acre-feet per square mile, the maximum runoff was 12.00 inches or 640 acre-feet per square mile, and the average was 5.53 inches or 295 acre-feet per square mile. The runoff from this area during periods of normal and low flow is considerably affected by the flow from several springs, of which the Hueco Springs are by far the largest. Results of 29 current-meter measurements of the flow of Hueco Springs, which enter Guadalupe River 3 miles above the gage at New Braunfels, show a discharge ranging from 0 to 96.0 second-feet. These measurements are listed in table 3.

Table 3: Discharge measurements, Hueco Springs, 3 miles north of New Braunfels, Texas

| Date | Discharge (second-feet) | Date | Discharge (second-feet) |
|---|---|---|---|
| July 31, 1924 | 37.7* | Nov. 22, 1945 | 17.6 |
| Jan. 19, 1928 | 0 | Dec. 20 | 16.5 |
| Feb. 22, 1929 | 0 | Jan. 24, 1946 | 38.0 |
| Oct. 8, 1937 | 1.5* | Mar. 1 | 71.4 |
| Aug. 4, 1944 | 61.0 | Apr. 4 | 71.3 |
| Sept. 18 | 58.6 | May 9 | 55.9 |
| Jan. 22, 1945 | 90.3 | June 14 | 54.4 |
| Feb. 16 | 92.4 | July 18 | 22.3 |
| Mar. 23 | 80.4 | Aug. 21 | 13.2 |
| Apr. 27 | 84.5 | Sept. 26 | 93.2 |
| May 31 | 77.7 | Oct. 31 | 88.8 |
| July 5 | 59.0 | Dec. 7 | 85.5 |
| Aug. 9 | 32.1 | Jan. 12, 1947 | 96.0 |
| Sept. 13 | 23.3 | Feb. 13 | 88.7 |
| Oct. 19 | 46.8 | | |

*West Spring only.

Most of the measurements in the foregoing table were made in 1944-46, when the rainfall was considerably above average. Precipitation during 1946 was more than 20 inches above the annual average at New Braunfels. Therefore, it is concluded that most of the measurements of discharge recorded in the table were considerably above average.

The following tables, 4, 5, and 6, show discharge measurements made to determine seepage losses and returns on Guadalupe River between the Comfort and New Braunfels gaging stations during periods of low flow in 1928 and 1929. The records show a net seepage gain of 0.3 second-feet in 1928 and a net seepage loss of 1.4 second-feet in 1929 between the Spring Branch and New Braunfels stations.

The seepage investigations in 1928 and 1929, as recorded in tables 4 and 5, show that the flow at New Braunfels was 2 to 4 second-feet greater than it was at Spring Branch. In these tables the discharge of Hueco Springs would be shown in the Elm Creek measurements, for which discharge measurements are recorded as zero, indicating that the springs were dry during both investigations.

In 1944 a seepage investigation was made between the Spring Branch and New Braunfels stations which showed a net gain of 98 second-feet between Spring Branch and New Braunfels, of which 61 second-feet came from Hueco Springs. Table 6 is a record of this investigation.

Table 4.- Discharge measurements to determine seepage on Guadalupe River from Comfort, Texas, to New Braunfels, Texas, in January 1928.
During the investigation the river was at a constant stage and the measurements represent the natural conditions.

| Date | Stream or diversion | Location | Approximate dist. (miles) from initial point | Discharge in second-feet: Main stream | Discharge in second-feet: Tributary | Discharge in second-feet: Gain or loss in section | Discharge in second-feet: Total gain or loss |
|---|---|---|---|---|---|---|---|
| 1928 | | | | | | | |
| Jan. 16 | Guadalupe River | At gaging station 2 miles above Comfort | 0.0 | 52.0 | | | |
| 16 | Cypress Creek | 1/4 mile above mouth at Comfort | 3.0 | | 1.5 | | |
| 16 | Holiday Creek | 1/8 mile above mouth [illegible] | 4.8 | | .3 | | |
| 16 | Guadalupe River | At railroad bridge near Comfort | 6.4 | 58.6 | | +4.8 | +4.8 |
| 16 | do. | At Waring | 12.2 | 58.7 | | + .1 | +4.9 |
| 17 | Joshua Creek | 2 miles above mouth near Waring | 16.0 | | 1.6 | | |
| 17 | Sister Creek | 1/2 mile above mouth near Sisterdale | 19.7 | | .4 | | |
| 17 | Guadalupe River | Just below mouth at Sister Creek near Sisterdale | 19.7 | 65.4 | | +4.7 | +9.6 |
| 17 | Wasp Creek | At mouth 6 miles below Sisterdale | 29.5 | | .2 | | |
| 17 | Sabino Creek | At mouth 8 miles northeast of Boerne | 31.2 | | .5 | | |
| 17 | Guadalupe River | Just below mouth of Sabino Creek at Ammans Crossing | 31.2 | 70.9 | | +4.8 | +14.4 |
| 17 | do. | At Schillers Crossing, 4 miles north of Bergheim | 45.6 | 68.3 | | -2.6 | +11.8 |
| 18 | Currys Creek | 1/2 mile above mouth, 4 miles above Spring Branch | 55.8 | | 2.6 | | |
| 18 | Guadalupe River | At Specks Crossing, 2.5 miles southwest of Spring Branch | 57.5 | 71.9 | | +1.0 | +12.8 |
| 18 | Spring Branch | 1-1/2 miles above mouth near Spring Branch | 59.0 | | 1.5 | | |

Table 4.- Continued

| Date | Stream or diversion | Location | Approximate dist. (miles) from initial point | Discharge in second-feet: Main stream | Discharge in second-feet: Trib-utary | Discharge in second-feet: Gain or loss in section | Discharge in second-feet: Total gain or loss |
|---|---|---|---|---|---|---|---|
| 1928 | Continued | | | | | | |
| Jan. 18 | Guadalupe River | At gaging station near Spring Branch | 61.7 | 73.5 | | + .1 | +12.9 |
| 18 | Big Spring | At Cranes Mill | 78.5 | | 3.9 | | |
| 18 | Guadalupe River | Just below Big Spring, at Cranes Mill | 78.5 | 72.3 | | -5.1 | + 7.8 |
| 18 | do. | 2 miles northeast of Sattler | 92.7 | 88.9 | | +16.6 | +24.4 |
| 19 | Jacobs Creek | At mouth 2 miles below Sattler | 95.9 | | .0 | | |
| 19 | Guadalupe River | 4 miles below Sattler | 97.4 | 83.2 | | -5.7 | +18.7 |
| 19 | Isaacs Creek | At mouth, 5-1/2 miles above New Braunfels | 103.5 | | .0 | | |
| 19 | Guadalupe River | 0.4 mile above Elm Creek near New Braunfels | 103.9 | 81.6 | | -1.6 | +17.1 |
| 19 | Elm Creek | At mouth near New Braunfels | 104.3 | | .0 | | |
| 19 | Guadalupe River | At new gage 1 mile above mouth of Comal River | 108.7 | 77.7 | | -3.9 | +13.2 |

NOTE.- Columns headed "Gain or loss in section" and "Total gain or loss" show values computed from discharge of main stream, tributaries, and diversions.



Sheet 2 of 2

Table 5.- Discharge measurements to determine seepage on Guadalupe River from Comfort, Texas, to New Braunfels, Texas, in February 1929.
During the investigation the river was at a constant stage and the measurements represent the natural conditions.

| Date | Stream or diversion | Location | Approximate dist. (miles) from initial point | Discharge in second-feet | | | |
|---|---|---|---|---|---|---|---|
| | | | | Main stream | Trib- utary | Gain or loss in section | Total gain or loss |
| 1929 | | | | | | | |
| Feb. 18 | Guadalupe River | Gaging station 2 miles above Comfort | 0 | 41.1 | | | |
| 18 | Cypress Creek | 1/4 mile above mouth at Comfort | 3.0 | | 0.2 | | |
| 18 | Holiday Creek | 1/4 mile above mouth below Comfort | 4.8 | | 0 | | |
| 18 | Guadalupe River | San Antonio and Aransas Pass Railway bridge near Comfort | 6.4 | 42.5 | | +1.2 | +1.2 |
| 18 | do. | Waring | 12.2 | 36.4 | | -6.1 | -4.9 |
| 19 | Joshua Creek | 2 miles above mouth near Waring | 16.0 | | .7 | | |
| 19 | Sister Creek | 1/2 mile above mouth near Sisterdale | 19.7 | | .2 | | |
| 19 | Guadalupe River | Just below mouth of creek at Sisterdale | 19.7 | 45.2 | | +7.9 | +3.0 |
| 19 | Wasp Creek | Mouth, about 6 miles below Sisterdale | 29.5 | | 0 | | |
| 19 | Guadalupe River | Just above mouth of Sabino Creek at Anmans crossing | 31.0 | 40.7 | | -4.5 | -1.5 |
| 19 | Sabino Creek | 1/4 mile above mouth 8 miles northeast of Boerne | 31.2 | | .3 | | |
| 19 | Guadalupe River | Unknown crossing about 4 miles north of Oberlys crossing | 34.2 | 38.2 | | -2.8 | -4.3 |
| 20 | do. | Schillers crossing 4 miles northeast of Bergheim | 45.6 | 43.0 | | +4.8 | +0.5 |
| 20 | Currys Creek | 1/2 mile above mouth, 4 miles above Spring Branch | 55.8 | | 1.0 | | |

Sheet 1 of 2

Table 5.- Continued

| Date | Stream or diversion | Location | Approximate dist. (miles) from initial point | Discharge in second-feet | | | |
|---|---|---|---|---|---|---|---|
| | | | | Main stream | Trib- utary | Gain or loss in section | Total gain or loss |
| 1929 continued | | | | | | | |
| Feb. 20 | Guadalupe River | Specks crossing 2.5 miles southwest of Spring Branch | 57.5 | 47.7 | | +3.7 | +4.2 |
| 20 | Spring Branch | 1-1/2 miles above mouth near Spring Branch | 59.0 | | .9 | | |
| 20 | Guadalupe River | Gaging station near Spring Branch | 61.7 | 47.4 | | -1.2 | +3.0 |
| 21 | do. | In Demijohn Bend east of Spring Branch | 73.3 | 34.3 | | -13.1 | -10.1 |
| 21 | Big Spring | Cranes Mill | 78.5 | | 2.9 | | |
| 21 | Guadalupe River | Below Big Spring at Cranes Mill | 78.5 | 39.2 | | +2.0 | -8.1 |
| 21 | do. | 5 miles northwest Sattlers Store near Craasies gin | 86.2 | 48.8 | | +9.6 | +1.5 |
| 22 | do. | 2 miles northeast of Sattlers Store | 94.0 | 48.2 | | - .6 | + .9 |
| 22 | Jacobs Creek | Mouth 2 miles below Sattlers Store | 95.9 | | .1 | | |
| 22 | Guadalupe River | 4 miles below Sattlers Store | 97.4 | 53.1 | | +4.8 | +5.7 |
| 22 | Isaacs Creek | Mouth about 5-1/2 miles above New Braunfels | 103.5 | | 0 | | |
| 22 | Guadalupe River | 2 miles above confluence of Elm Creek above New Braunfels | 104.1 | 53.0 | | - .1 | +5.6 |
| 22 | Elm Creek | Mouth near New Braunfels | 104.3 | | 0 | | |
| 22 | Guadalupe River | Above gaging station at New Braunfels | 108.7 | *49.0 | | -4.0 | +1.6 |

*Mean discharge for 24-hour period used because of fluctuation casued by Gode's small power plant.

NOTE.- Columns headed "Gain or loss in section" and "Total gain or loss" show values computed from discharge of main stream, tributaries, and diversions.

Sheet 2 of 2

Table 6.- Discharge measurements to determine seepage on Guadalupe River from Spring Branch, Tex., to New Braunfels, Tex., in August 1944.
During the investigation the river was at a constant stage and the measurements represent the natural conditions.

| Date | Stream | Location | Discharge in second-feet | | | |
|---|---|---|---|---|---|---|
| | | | Main stream | Tributary | Gain or loss in section | Total gain or loss |
| 1944 Aug. 3 | Guadalupe River | Lat. 29°51'40", long. 98°23'00", at gaging station near Spring Branch, Tex. | 92 | | | |
| 3 | do | Lat. 29°53'35", long. 98°14'40", 100 feet below Sorrel Creek and 1½ miles southwest of Hancock, Tex. | 102 | | +10 | +10 |
| 3 | do | Lat. 29°52'10", long. 98°11'25", 500 feet below Hidden Valley crossing and 1.8 miles northwest of Sattler, Tex. | 113 | | +11 | +21 |
| 3 | do | Lat. 29°48'35", long. 98°10'40", ½ mile below Bear Creek and 2.7 miles south-southwest of Sattler, Tex. | 119 | | + 6 | +27 |
| 4 | do | Lat. 29°45'50", long. 98°09'10", 0.7 mile above Isaac Creek, 0.8 mile above first crossing on New Braunfels-Sattler Road, and 4.6 miles northwest of New Braunfels, Tex. | 124 | | + 5 | +32 |
| 4 | Hueco Springs | Lat. 29°45'35", long. 98°03'25", 3.3 miles north of New Braunfels, Tex. | | 61.0 | | |
| 4 | Guadalupe River | Lat. 29°42'55", long. 98°06'40", at gaging station above Comal River at New Braunfels, Tex. | 190 | | + 5 | +37 |

NOTE.- Columns headed "Gain or loss in section" and "Total gain or loss" show values computed from discharge of main stream and tributaries.

## Comal Springs

A complete record of the flow of Comal River below Comal Springs is available since 1933. During the period 1933-46, the average flow of the river was 342 second-feet. Of this, it is estimated that an average of 333 second-feet came from Comal Springs; and an average of 9 second-feet was surface-water runoff, representing an annual runoff of 1.3 inches from the 94 square miles of drainage area above the station. The average rainfall at New Braunfels for the period 1933-46 was 35.19 inches, which is about 4 inches above normal for that place. The following table gives the monthly and annual discharge for Comal Springs for the years 1928-46, inclusive:

Table 7.- Monthly and annual discharge, in second-feet 1/, of Comal Springs at New Braunfels, Tex.

| Year | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1928 | *320 | *315 | *307 | 299 | *295 | *300 | 298 | *295 | *295 | 289 | 275 | 274 | 297 |
| 1929 | *283 | 277 | 280 | 282 | 274 | 273 | 277 | *275 | *300 | *320 | 310 | *300 | 288 |
| 1930 | 290 | 293 | 285 | 273 | 270 | 257 | 262 | *295 | *295 | 299 | 269 | 265 | 280 |
| 1931 | *260 | 260 | 269 | *280 | *316 | *337 | *330 | *341 | 345 | *336 | 322 | 329 | 310 |
| 1932 | 315 | 296 | 296 | *315 | 315 | *327 | *305 | *303 | 311 | *334 | *347 | *335 | 317 |
| 1933 | 324 | 316 | 321 | 311 | 299 | 311 | 340 | *325 | 305 | *320 | 306 | 311 | 316 |
| 1934 | 292 | 299 | 309 | *320 | 307 | *330 | 332 | 328 | 325 | *330 | 325 | 299 | 316 |
| 1935 | 309 | *287 | *287 | 296 | 297 | 294 | *300 | *310 | *330 | *343 | 342 | *335 | 311 |
| 1936 | *342 | 355 | 370 | 375 | 369 | 358 | 335 | *325 | *385 | *365 | 359 | *360 | 358 |
| 1937 | 366 | 361 | 354 | 348 | 351 | *362 | 375 | *365 | *375 | 359 | 341 | 337 | 358 |
| 1938 | 319 | 315 | *322 | *326 | 330 | 330 | *340 | *367 | 366 | 354 | 342 | 352 | 339 |
| 1939 | 340 | 338 | 331 | 324 | 329 | 320 | 31[illegible] | 304 | 305 | 270 | 289 | 303 | 314 |
| 1940 | 287 | 276 | 286 | 235 | 238 | 286 | *277 | *264 | *278 | 287 | 276 | 276 | 280 |
| 1941 | *271 | *271 | *287 | 297 | 313 | *322 | *340 | *377 | *377 | 358 | 361 | 342 | 326 |
| 1942 | *354 | 342 | 335 | 338 | *333 | 335 | *342 | *313 | 318 | *328 | 319 | *357 | 335 |
| 1943 | *388 | 405 | *416 | 408 | 390 | 374 | 356 | 333 | *328 | *328 | *317 | *322 | 364 |
| 1944 | 307 | 317 | 314 | *333 | 334 | *359 | 383 | *383 | 377 | 355 | 328 | 333 | 344 |
| 1945 | 325 | 314 | *333 | *344 | *378 | *382 | *406 | 414 | 376 | 346 | 341 | 335 | 358 |
| 1946 | *334 | 331 | 336 | 327 | *312 | *338 | 331 | *347 | *364 | 374 | *356 | *365 | 343 |
| Average | 317 | 314 | 318 | 320 | 321 | 326 | 329 | 330 | 334 | 331 | 322 | 323 | 324 |

* Partly estimated.
1/ 1 second-foot = 448.8 gallons a minute.

## Blanco River

The gaging station on Blanco River at Wimberley in Hays County records the runoff from a drainage area of 378 square miles, including 60 square miles in Comal County. Simultaneous records of the discharge of the Blanco River at Wimberley and the Guadalupe River at Spring Branch and New Braunfels (above Comal River) are available for the calendar years 1931-46. The average annual runoff from the Blanco River basin during this period was 233 acre-feet per square mile as compared with 321 acre-feet per square mile for the part of the Guadalupe River basin between the Spring Branch and New Braunfels stations (computed from the difference in the discharge recorded at the two stations).

## Comal Creek

Comal Creek drains 94 square miles above Comal Springs, all of which is in Comal County. Below Comal Springs the stream is called Comal River; above the springs it is called Dry Comal Creek. Figures for the runoff of Comal Creek are obtained by subtracting the flow of Comal Springs from the discharge of Comal River.

## Cibolo Creek

Cibolo Creek drains an area of 280 square miles above the Selma gaging station. The Selma, Bracken, and Bulverde stations were established on the Cibolo in March and April 1946 (see map, fig. 2). The unusually heavy rainfall during the period of March 1946 to January 1947 emphasized the rather remarkable differences in runoff for the various drainage basins in Comal County.

## Simultaneous records

Simultaneous records of the discharge of Dry Comal Creek and Cibolo Creek, as well as the discharge of Guadalupe River, are available for the 12-month period March 1946 to February 1947, at the Selma, Spring Branch, and New Braunfels stations. During this 12-month period the runoff of Cibolo Creek amounted to 11,680 acre-feet at Selma, representing a depth of 0.78-inch over the drainage area. The runoff of Comal Creek for the period was 16,690 acre-feet, representing a depth of 3.33 inches. In contrast to these low figures, the runoff of Guadalupe River from the drainage area between Spring Branch and New Braunfels amounted to 168,800 acre-feet, or a depth of 13.5 inches.

The rainfall during the period was 44.71 inches at Boerne, 53.09 inches at Bulverde, 44.62 inches at Fischer's Store, and 54.50 inches at New Braunfels. The normal annual rainfall for the area is about 30 inches.

The monthly rainfall at Boerne, Bulverde, Fischer's Store, and New Braunfels for March 1946 to February 1947; the monthly runoff of Cibolo Creek near Bulverde, May 1946 to February 1947, and at Selma, March 1946 to February 1947, of Dry Comal Creek at New Braunfels, and of the area tributary to Guadalupe River between Spring Branch and New Braunfels, March 1946 to February 1947, are given in table 8.

Table 8.- Rainfall and runoff, Comal County, 1946-47

| Month | Rainfall - Depth in inches | | | | Runoff in acre-feet per square mile | | | |
|---|---|---|---|---|---|---|---|---|
| | Boerne | Bulverde | Fischer's Store | New Braun-fels | Cibolo Creek | | Dry Comal Creek | Guadalupe River between Spring Branch and New Braunfels |
| | | | | | Bulverde | Selma | New Braunfels | |
| | | | | | Drainage area 198 square mi. | Drainage area 280 square mi. | Drainage area, 94 square mi. | Drainage area, 234 square mi. |
| Mar. 1946 | 1.93 | 5.07 | 4.95 | 3.96 | * | 0 | 3.30 | 72.99 |
| Apr. | 3.94 | 3.77 | 2.78 | 2.02 | * | 0 | 0 | 33.29 |
| May | 3.65 | 4.05 | 3.90 | 5.75 | 1.73 | 5.71 | 31.91 | 33.63 |
| June | 3.14 | 3.59 | 3.18 | 10.88 | 0 | .44 | 50.11 | 46.28 |
| July | 2.40 | .54 | 2.91 | 1.89 | 0 | 0 | 0 | 15.98 |
| Aug. | 6.62 | 5.33 | 3.82 | 7.14 | 0 | 0 | 2.02 | 13.12 |
| Sept. | 9.45 | 12.96 | 6.55 | 8.33 | 36.87 | 24.79 | 57.98 | 70.26 |
| Oct. | 4.22 | 2.53 | 1.50 | 3.47 | 3.63 | .28 | 1.91 | 75.21 |
| Nov. | 2.29 | 6.69 | 6.48 | 2.60 | 9.14 | 9.50 | 18.93 | 113.50 |
| Dec. | 2.61 | 3.77 | 3.60 | 3.21 | 1.83 | .95 | 1.81 | 98.59 |
| Jan. 1947 | 4.09 | 4.42 | 4.70 | 4.83 | 5.15 | .03 | 9.57 | 83.21 |
| Feb. | .37 | .37 | .25 | .42 | .01 | 0 | 0 | 63.29 |
| Totals | 44.71 | 53.09 | 44.62 | 54.50 | 58.36 | 41.70 | 177.54 | 719.35 |

* No record at Bulverde during March and April.

## Conclusion

The data show that an abundant and dependable supply of water is furnished by Comal Springs and the Guadalupe River below Comal Springs, and that considerable supplies of surface water are available from other streams in the county, but that storage will have to be provided if a large continuous supply of water is to be obtained from sources other than Comal Springs.

Records of wells and springs in Comal County, Texas
All wells are drilled unless noted in the remarks column

| Well | Distance from Hancock | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing formation |
|---|---|---|---|---|---|---|---|
| 1 | 8 miles northwest | C. L. Meserole | -- | -- | 5 | 60 | Glen Rose limestone, lower member |
| 2 | do. | do. | -- | Old | 217 | 6 | do. |
| 3 | do. | do. | -- | -- | 220 | 6 | do. |
| 4 | 5 miles northwest | E. Kaderli | E. Kaderli | 1914 | 265 | 6 | do. |
| 5 | do. | Emil Doell | Emil Doell | 1895 | 300 | 6 | do. |
| 6 | 5½ miles northwest | H. Fischer | H. Fischer | Old | 327 | 6 | Pearsall(?) formation |
| 7 | do. | R. O. Fischer | -- | -- | Spring | 48 | Glen Rose limestone, lower member |
| 8 | do. | W. O. Fischer | W. O. Fischer | 1922 | 218 | 6 | do. |
| 9 | 5 miles north | H. Pentermuehl | -- | Old | 275 | 6 | do. |
| 10 | 4½ miles north | Paul Schlameus | -- | Old | 253 | 6 | do. |
| 11 | 4 miles north | Hugo Halm | -- | Old | 49 | 6 | do. |
| 12 | 4 miles northeast | John A. Schlameus | -- | Old | 220 | 6 | do. |
| 13 | 3½ miles northwest | Otto Treuer | R. Page | Old | 350 | 6 | do. |
| 14 | do. | do. | -- | -- | Spring | -- | do. |
| 15 | 2¾ miles northwest | Carroll Hall | -- | -- | Spring | -- | do. |
| 16 | 2½ miles northwest | do. | R. Page | Old | 240 | 6 | do. |
| 17 | 3½ miles northeast | W. H. Stanley | -- | Old | 385 | 6 | do. |
| 18 | 2¾ miles northeast | do. | -- | Old | 320 | 6 | do. |
| 19 | 3½ miles northeast | Tom Sumners | -- | Old | 325 | 6 | do. |

a/ Measuring point was usually top of casing, top of pipe clamp or top of pump base or foundation.

b/ Method of lift; T, turbine; B, bucket; C, cylinder; G, gasoline engine; E, electric; W, windmill; H, hand. Number indicates horsepower.

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

| Well | Height of measuring point above ground (ft.)a/ | WATER LEVEL Below land surface (ft.) | Date of measurement | Method of lift b/ | Use of water c/ | Remarks |
|---|---|---|---|---|---|---|
| 1 | -- | -- | Nov. 13, 1936 | Flows | N | Dug well in bottom of creek, rock curb, seepage water only. |
| 2 | 0.0 | 155.7 | do. | C,W | S | Concrete curb and 10 feet steel casing at top. Water level measured while pumping. Continued pumping lowers water to level below suction pipe. |
| 3 | -- | d/200 | -- | C,W | S | Steel casing to 10 feet. |
| 4 | 0.7 | 36.1 | Nov. 13, 1936 | C,W | D,S | Concrete curb. |
| 5 | -- | d/160 | -- | C,W | D,S | Steel casing to 10 feet. |
| 6 | -- | 123.5 | Nov. 4, 1936 | C,G, 3 | D,S | Measuring point 0.7 foot below land surface. Steel casing to 20 feet. Deepened from 250 feet to 327 feet in 1908. Water from sandstone at 250 feet and from sand at 320-327 feet. |
| 7 | -- | -- | do. | C,W Flows | D,S | Estimated flow Nov. 4, 1936, 60 gallons a minute. Water level approximately 5 feet below land surface Sept. 13, 1943. |
| 8 | 0.0 | 175 | Dec. 31, 1936 | C,E, $1\frac{1}{2}$ | D,S | Steel casing to 15 feet. |
| 9 | 0.6 | 155.6 | Nov. 4, 1936 | C,W | D,S | |
| 10 | -- | d/ 85 | -- | C,W | D,S | |
| 11 | -- | d/ 16 | -- | C,W | D,S | |
| 12 | 0.9 | 47.1 | Dec. 3, 1936 | C,H | D,S | Steel casing to 30 feet. |
| 13 | 0.0 | 144.1 | Dec. 4, 1936 | C,W | D,S | |
| 14 | -- | -- | Dec. 31, 1930 | Flows | D | Estimated flow, 75 gallons a minute from 3 openings in limestone Dec. 31, 1936. |
| 15 | -- | -- | Nov. 4, 1936 | Flows | S | Estimated flow 20 gallons a minute on Nov. 4, 1936. Reported to flow about 6 months each year; dry on Sept.17, 1943. |
| 16 | 0.8 | 44.9 | do. | C,W | D,S | Steel casing to 22 feet. Water sands reported at 80 and 240 feet. |
| 17 | 1.0 | 139.4<br>154.5 | Dec. 31, 1936<br>Sept.18, 1944 | C,W | D,S | |
| 18 | 0.2 | 121.9 | Sept.18, 1944 | C,W | D,S | |
| 19 | 0.4 | 171 | Dec. 8, 1936 | C,W | S | |

c/ Use of water; Ind, industrial; P, public supply; D, domestic; S, stock; N, not used.
d/ Water level reported.

Records of wells and springs in Comal County--Continued

| Well | Distance from Hancock | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing formation |
|---|---|---|---|---|---|---|---|
| 21 | 2½ miles southeast | D. R. Semmes | -- | -- | Spring | -- | Glen Rose limestone, upper member |
| 22 | do. | do. | -- | Old | 110 | 6 | do. |
| 23 | 1 mile southeast | Max Linertz | -- | 1902 | 228 | 6 | Glen Rose limestone, lower member |
| 24 | In Hancock | Frank Gunther | -- | 1915 | 169 | 6 | do. |
| 25 | 5 miles northwest | H. C. Nelson | -- | Old | 325 | 6 | do. |
| 26 | 10 miles west | Fred and Richard Schaeferkoeter | W. Neugebeuer | 1906 | 125 | 6 | Pearsall formation |
| 27 | do. | do. | -- | -- | Spring | -- | Glen Rose limestone, lower member |
| 29 | 8½ miles west | Frank Porter | -- | 1890 | 226 | 6 | Pearsall formation |
| 30 | 8 miles west | Mrs. P. J. Remler Estate | Vogel and Paige | 1880 | 184 | 6 | do. |
| 31 | 7½ miles southwest | J. K. Baretta | -- | Old | 280 | 6 | do. |
| 32 | 6½ miles west | J. W. Heard | -- | Old | 100 | 6 | Pearsall(?) formation |
| 33 | 6 miles west | W. D. Hill | Tom Adare | -- | 140 | 6 | Pearsall formation |
| 34 | 5½ miles west | Ed. Koderli | Jesse Page | 1903 | 112 | 6 | do. |
| 35 | 4¼ miles west | J. D. Nixon | -- | -- | Spring | -- | Glen Rose limestone, lower member |
| 36 | 4 miles west | M. Engle | -- | Old | 96 | -- | do. |
| 37 | 7 miles southwest | A. J. Monier | -- | Old | 240 | 6 | do. |
| 38 | 6½ miles southwest | do. | -- | Old | 20 | 36 | do. |
| 39 | do. | do. | -- | Old | 50 | 24 | do. |
| 40 | 5 miles southwest | Mrs. D. N. Riegler | -- | 1906 | 260 | 6 | do. |
| 41 | 2 miles south | J. M. Block | -- | 1902 | 175 | 6 | do. |
| 42 | 3¾ miles southeast | Henry Fentermuehl | -- | Old | 300 | 6 | Pearsall formation |
| 43 | 4¾ miles southeast | Theo. Kraft | -- | 1896 | 428 | 6 | do. |
| 44 | 6½ miles east | George Faber | -- | Old | 250 | 6 | Glen Rose limestone, upper member |

| Well | Height of measuring point above ground (ft.) a/ | WATER LEVEL Below land surface (ft.) | Date of measurement | Method of lift b/ | Use of water c/ | Remarks |
|---|---|---|---|---|---|---|
| 21 | -- | -- | -- | -- | S | Small perennial spring. Seasonal fluctuation. |
| 22 | 2.1 | 11.3 | Dec. 31, 1936 | C,W | D,S | |
| 23 | 0.6 | 128.2 | Nov. 3, 1936 | C,W | D,S | |
| 24 | 0.8 | 87.2 | Nov. 4, 1936 | C,W | D,S | |
| 25 | 0.0 | -- | -- | C,W | D,S | Increase in yield obtained in 1942 by deepening from 300 to 325 feet. |
| 26 | 0.5 | 113.4 | Dec. 10, 1936 | C,W | D,S | Cased to 20 feet. Yield approximately one gallon a minute per foot of drawdown. |
| 27 | -- | -- | -- | None | D,S | Concrete basin. Estimated yield 50 gallons a minute. |
| 29 | 1.1 | 150.8 | Dec. 9, 1936 | None | N | Water reported Sept. 25, 1943, from blue clay at 220-226 feet. |
| 30 | 0.0 | 94.2 | Oct. 8, 1943 | C,W | D,S | Estimated yield 5 gallons a minute, cased to 10 feet. |
| 31 | 0.7 | 197.5 | Dec. 9, 1936 | C,W,G, 2 | D,S | Estimated yield, 10 gallons a minute. Two feet of casing. |
| 32 | 2.0 | 72.8 | Sept. 23, 1943 | C,W | D,S | Original depth reported 100 feet. |
| 33 | 0.6 | 64.1 | Dec. 9, 1936 | C,W | D,S | Water level recovered 5 feet in 15 minutes after pumping $3\frac{1}{2}$ gallons a minute for 3 hours. |
| 34 | 0.1 | 55.4 | do. | C,W | D,S | Galvanized 6-inch casing to 40 feet. |
| 35 | -- | -- | Nov. 13, 1936 | Flows | D,S | Bishop Spring; also called Gumtree Spring and Flugrath Spring. Measured flow 1,700 gallons a minute Jan. 18, 1938. |
| 36 | 1.3 | 40.9 | do. | C,W | D,S | |
| 37 | -- | d/ 190 | Sept, 1936 | None | N | Cased to 10 feet. |
| 38 | 3.0 | 4.7 | Dec. 15, 1936 | None | N | Dug well. |
| 39 | 0.3 | 2.1 | do. | B,H | D,S | Do. |
| 40 | 1.0 | 78.7 | Nov. 13, 1936 | C,W | D,S | |
| 41 | 0.4 | 41.0 | Dec. 31, 1936 | C,W | D,S | Cased to 8 feet. |
| 42 | 0.5 | 32.3 | Nov. 4, 1936 | C,W | D,S | Estimated capacity 2 gallons a minute. |
| 43 | 0.6 | 38.8<br>36.4 | Nov. 3, 1936<br>Nov. 11, 1944 | C,W | D,S | Deepened to present depth in 1905. Fine sand at 420 to 428 feet. Some water at 80 feet. |
| 44 | -- | -- | -- | C,W | D,S | Some water at 21 feet. |

Records of wells and springs in Comal County--Continued

| Well | Distance from Hancock | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing formation |
|---|---|---|---|---|---|---|---|
| 45 | 5½ miles southeast | V. and C. D. Prassel | -- | Old | 170 | 6 | Glen Rose limestone, upper member |
| 46 | 5 miles south | M. Leaghling | -- | -- | Spring | -- | Walnut clay |
| 48 | 5½ miles southwest | H. W. Kraft Estate | -- | Old | 69 | -- | Glen Rose limestone, lower member |
| 49 | do. | do. | -- | Old | Spring | -- | do. |
| 50 | 9 miles north | Adolph Preiss | Willie Fisher | Old | 121 | -- | do. |
| 51 | 7½ miles northwest | Eddie Pape | -- | Old | 89 | -- | do. |
| 52 | do. | C. L. Meserole | -- | 1940 | 226 | 6 | Pearsall(?) formation |
| 53 | do. | T. J. Byler | -- | -- | 930 | -- | Pearsall formation |
| 54 | 9½ miles northwest | Otto Schwope | Willie Rust | -- | 300 | -- | do. |
| 55 | 6½ miles west | Hugo Wunderlich | -- | 1910 | 142 | 6 | do. |
| 56 | do. | do. | -- | 1900 | 120 | -- | do. |
| 57 | 5½ miles west | Ben F. Wolle | -- | Old | 120 | -- | Glen Rose limestone, lower member |
| 58 | 1½ miles southwest | State of Texas | -- | -- | Spring | -- | do. |
| 59 | 1¼ miles southwest | do. | -- | -- | Spring | -- | do. |
| 60 | 1½ miles northwest | Mrs. T. P. Shelly | T. E. Owens | -- | 350 | -- | do. |
| 61 | 4¼ miles northeast | Tom Sumner | - Williams | 1941 | 374 | 6 | do. |
| 62 | 3½ miles east | H. E. Nessly | -- | Old | 101 | -- | Glen Rose limestone, upper member |
| 63 | 3¾ miles east | do. | E. B. Kutscher | 1944 | 154 | -- | Glen Rose limestone, lower member? |
| 64 | 4 miles southeast | do. | - Schmidt | 1944 | 101 | 5 | Glen Rose limestone, upper member |
| 65 | 6½ miles southeast | George Faber | E. B. Kutscher | 1941 | 455 | 6 | do. |
| 66 | do. | C. B. Crawford | -- | Old | 256 | 6 | do. |
| 67 | 7 miles southeast | do. | -- | Old | 200 | -- | do. |
| 68 | 5 miles southeast | Miss Carrie George | -- | 1890 | 100 | -- | Glen Rose limestone, lower member |

| Well | Height of measuring point above ground (ft.) a/ | WATER LEVEL Below land surface (ft.) | Date of measurement | Method of lift b/ | Use of water c/ | Remarks |
|---|---|---|---|---|---|---|
| 45 | 0.4 | 67.5 | Nov. 3, 1936 | C,W,G, 5 | D,S | Estimated capacity 3 gallons a minute. |
| 46 | -- | -- | do. | Flows | S | Small contact spring. |
| 48 | -- | 55.8 | Feb. 3, 1944 | C,W | S | |
| 49 | 1.7 | -- | Nov. 13, 1936 | Flows | D,S | One of a number of small springs along Tom Creek. Many cypress trees in ½ mile stretch up-stream from this spring. |
| 50 | -- | d/110 | -- | C,W | D,S | |
| 51 | 1.0 | 67 | Oct. 7, 1944 | C,W | D,S | |
| 52 | -- | d/125 | Sept. 4, 1944 | C,G | D,S | Temperature 71° F, has been pumped for 60 hours at 4 gallons a minute. |
| 53 | 0.5 | 154.4 | Oct. 3, 1944 | None | N | Oil test; upper 300 feet of casing removed. Water from sand at 240-260. Black rock reported at 550-600 feet. |
| 54 | -- | d/170 | -- | C,G | -- | Cylinder set at 280 feet; pump breaks suction in 2 hours when pumped at 5 gallons a minute. |
| 55 | -- | -- | -- | C,W,G | D,S | Cylinder set at 120 feet, has pumped all day at 5 gallons a minute. |
| 56 | -- | -- | -- | C,W | D,S | Cylinder set at 115 feet. |
| 57 | -- | d/ | -- | C,W | D,S | Pump breaks suction in one half hour of hard pumping. |
| 58 | -- | -- | -- | Flows | -- | From crevices in river bottom. Combined flow of this spring and No.59 on Sept.18,1944, 14 second-feet, about 6,300 gallons a minute. |
| 59 | -- | -- | -- | Flows | -- | |
| 60 | -- | d/162 | -- | C,W,G, ½ | D,S | |
| 61 | -- | d/190 | Oct. 30, 1944 | C,W,G | -- | Sands at 311 feet and 328-360 feet. |
| 62 | -- | d/ 40 | -- | C,W | S | Cylinder set at 70 feet. Yield reported small. |
| 63 | 0.7 | 41.0 | Dec. 8, 1944 | C,W | S | First water at 83 feet. Water from "shell rock" at 150 feet. |
| 64 | 1.0 | 15.93 | Nov. 9, 1944 | C,W | D,S | |
| 65 | 0.0 | 298.3 | May 19, 1945 | C,W | D,S | Some water at top of Walnut clay. See log. |
| 66 | 0.5 | 119.5 | Dec. 4, 1944 | C,W | S | |
| 67 | 2.0 | 192.0 | do. | C,W | S | |
| 68 | 1.5 | -- | -- | C,H | D,S | Water level one-half foot above land surface Dec.8,1944. |

Records of wells and springs in Comal County--Continued

| Well | Distance from Hancock | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing formation |
|---|---|---|---|---|---|---|---|
| 69 | $4\frac{1}{2}$ miles southeast | Otto Krause | Frank Guntner | 1929 | 221 | 6 | Glen Rose limestone, lower member |
| 70 | $2\frac{1}{2}$ miles southeast | Miss Elsie Leuhlfing | Willie Fischer | 1898 | 102 | -- | do. |
| 71 | 4 miles south | O. C. Trout | Frank Gunther | 1923 | 108 | -- | do. |
| 72 | $2\frac{1}{2}$ miles northwest | D. C. McIver | -- | -- | Spring | -- | do. |
| 73 | $3\frac{1}{2}$ miles northwest | Willard Hill | -- | -- | 410 | -- | Pearsall formation |
| 74 | 9 miles northwest | H. B. Thompson | -- | -- | Spring | -- | Travis Peak formation |
| 75 | 7 miles southwest | A. J. Monier | E. B. Kutscher | 1943 | 297 | -- | Glen Rose limestone, lower member |
| 76 | 5 miles southeast | E. S. Schroeder | -- | 1900 | 60 | 6 | Glen Rose limestone, upper member |
| | Distance from Bulverde | | | | | | |
| 77 | 10 miles northeast | H. A. Knippe | E. B. Kutscher | 1937 | 220 | 6 | Pearsall formation |
| 78 | 12 miles northeast | J. W. Heard | T. E. Owens | -- | 244 | 6 | Glen Rose limestone, lower member |
| 79 | 8 miles northeast | Joe S. Sheldon | E. B. Kutscher | 1943 | 344 | 5 | do. |
| 80 | 7 miles northwest | - Weidner | -- | -- | Spring | -- | do. |
| 81 | 5 miles northwest | T. R. Derst | -- | Old | 225 | -- | Glen Rose limestone, upper member |
| 82 | do. | Laubach Bros. | Oscar Dietz | 1914 | 650 | 6 | Pearsall formation |
| 83 | 4 miles northwest | Alfred H. Scheel | -- | 1897 | 305 | -- | Glen Rose limestone, upper member |
| 84 | 3 miles north | Henry Wehe | A. Scheel | -- | -- | -- | -- |
| 85 | $3\frac{3}{4}$ miles northeast | Herman Kneupper | -- | Old | 320 | 6 | Glen Rose limestone, lower member |
| 86 | $4\frac{1}{4}$ miles northeast | H. A. Bagby | -- | 1941 | -- | 6 | do. |
| 87 | $6\frac{1}{2}$ miles northeast | Milton Y. Jones | -- | -- | 437 | 6 | do. |

| Well | Height of measuring point above ground (ft.) a/ | WATER LEVEL Below land surface (ft.) | Date of measurement | Method of lift b/ | Use of water c/ | Remarks |
|---|---|---|---|---|---|---|
| 69 | -- | -- | -- | Flows | D,S | Irrigates small garden. Flows about 3 gallons a minute from 4-inch pipe about 3 feet above land surface Sept. 29, 1944. |
| 70 | -- | d/ 57 | -- | C,W | D,S | |
| 71 | -- | d/ 78 | -- | C,W | D,S | |
| 72 | -- | -- | -- | Flows | S | Water flows from crevice in limestone at fault. Reported dry in 1925. Temperature 64°F Nov. 10, 1944. |
| 73 | -- | -- | -- | C,W | S | |
| 74 | -- | -- | -- | Flows | D,S | Rebecca Creek Spring. Estimated yield 1,500 to 2,000 gallons a minute, temperature 70° F, Oct. 7, 1943. |
| 75 | -- | 260 | -- | C,W | D,S | Water reported from blue rock at 287 feet. See log. |
| 76 | -- | d/ 55 | -- | C,W,G, ½ | D,S | |
| Distance from Bulverde | | | | | | |
| 77 | -- | d/100 | -- | C,W | D,S | Tested 24 hours at 10 gallons a minute. Water from sand at 196-220 feet; struck dark blue rock at 220 feet. |
| 78 | -- | -- | -- | C,W | S | Casing: 6-inch from 140 to 180 feet. |
| 79 | 1.0 | 317.1 | Sept. 23, 1943 | C,W | D,S | Seep at 60 feet; main water-bearing sand at 338-344 feet. Cased to 60 feet. |
| 80 | -- | -- | -- | Flows | S | Estimated flow 1,000 to 1,500 gallons a minute from cavern 6-8 feet above creek level. Temperature 69° F. July 20, 1944. Honey Creek Spring. |
| 81 | 0.5 | 138.6 | May 16, 1945 | C,W | D,S | |
| 82 | 1.0 | 320.2 | do. | C,W | D,S | Cased to 60 ft. Not enough water at 400 ft.; deepened to 650 ft. in 1930. |
| 83 | 0.0 | 123.0<br>98.7 | May 17, 1945<br>July 12, 1945 | None | N | Altitude of land surface 1411.6.<br>Altitude of land surface 1247.5. |
| 84 | 0.5 | 178.7<br>220.8 | May 31, 1945<br>July 5, 1945 | C,W | D,S | Altitude of land surface, 1189.1. |
| 85 | 1.0 | 223.7<br>245.7 | May 17, 1945<br>July 5, 1945 | C,W | D,S | Altitude of land surface, 1206.5. |
| 86 | 1.0 | 68.3<br>68.8<br>68.9 | May 17, 1945<br>July 5, 1945<br>July 12, 1945 | C,H. | D,S | Altitude of land surface, 1145.8. |
| 87 | 1.2 | 259.8<br>300.5 | May 26, 1945<br>July 11, 1945 | C,G | D,S | Recovered 3.8 feet in 5 minutes after pumping one half hour at 3 gallons a minute. Altitude of land surface 1121.3. |

Records of wells and springs in Comal County--Continued

| Well | Distance from Bulverde | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing formation |
|---|---|---|---|---|---|---|---|
| 88 | 7½ miles northeast | Walter Schaeffer | -- | -- | 816 | 6 | Pearsall formation |
| 89 | 6½ miles east | Richard Hitzfelder | -- | 1935 | 630 | 6 | Glen Rose limestone, lower member |
| 90 | 7 miles east | - Tian | Ed. Schmidt | 1934 | 630 | 6 | do. |
| 91 | 10 miles southeast | Melvin Westorfer | E. B. Kutscher | 1945 | 507 | 5 | do. |
| 92 | 10 miles northeast | A. J. Welser | R. (Bob) Johnson | 1937 | 747 | 6 | Pearsall formation |
| 93 | 9 miles northeast | do. | San Antonio M. & S. Co. | 1941 | 450 | 6 | Glen Rose limestone, lower member |
| 94 | 10½ miles southeast | Ad. Eickmann | -- | -- | 320 | 6 | Edwards limestone |
| 95 | 9 miles southeast | Charles Wuest | Henry Schwab | 1911 | 320 | 6½ | do. |
| 96 | 9½ miles southeast | Louis Forsage | Herman Moos | 1907 | 363 | 6 | do. |
| 97 | 1½ miles west | August Klar | Fritz Rust | 1918 | 385 | -- | Glen Rose limestone, lower member |
| 98 | 3½ miles west | Vincent Laubach | -- | -- | 300 | -- | do. |
| 99 | 11½ miles west | Ralph Fair | -- | -- | 240 | -- | do. |
| 102 | 12½ miles north | Ed. Gass | -- | Old | 140 | 6 | Pearsall formation |
| 103 | 10½ miles north | Arno Knibbe | -- | 1885 | 124 | 6 | do. |
| 104 | 11½ miles north | H. C. Plumly | -- | -- | Spring | -- | Glen Rose limestone, lower member |
| 105 | 11 miles north | Erich Specht | -- | 1926 | 75 | 6 | do. |
| 106 | do. | do. | Ed. Adair | 1932 | 412 | 6 | Pearsall formation |
| 107 | 10½ miles north | William Neugebeuer | -- | 1886 | 163 | 6 | do. |

| Well | Height of measuring point above ground (ft.) a/ | WATER LEVEL Below land surface (ft.) | Date of measurement | Method of lift b/ | Use of water c/ | Remarks |
|---|---|---|---|---|---|---|
| 88 | -- | -- | -- | C,W | D,S | Cylinder set at about 700 feet. Water level more than 470 feet below surface Jan.22, 1945. |
| 89 | -- | d/530 | -- | C,W | S | |
| 90 | -- | -- | -- | C,W | S | |
| 91 | 0.5 | 239.5 | May 4, 1945 | C,W | S | Deepened from 360 to 507 ft. in 1945. Increase in yield. Altitude of land surface, 964.1. |
| | | 282.9 | July 11, 1945 | | | |
| 92 | 0.1 | 401.0 | May 25, 1945 | C,W | S | See log. |
| 93 | 0.1 | 289.9 | do. | C,W | S | |
| 94 | 0.5 | 225.5 | Apr. 18, 1945 | C,W | D,S | Altitude of land surface, 930.6. |
| | | 247.1 | May 18, 1945 | | | |
| | | 260.9 | July 3, 1945 | | | |
| 95 | 0.5 | 266.8 | Apr. 27, 1945 | C,W | D,S | Originally drilled to 1,240 feet and cased to 1,100 feet, $6\frac{1}{2}$-inch casing perforated from 260 to 320 feet, $2\frac{1}{4}$-inch cylinder set at about 295 feet. Altitude of land surface 976.9. |
| | | 276.3 | May 18, 1945 | | | |
| | | 276.1 | July 4, 1945 | | | |
| 96 | 0.5 | 305.1 | May 5, 1945 | C,W | D,S | Altitude of land surface, 993.4. |
| | | 303.9 | May 18, 1945 | | | |
| | | 307.0 | July 4, 1945 | | | |
| 97 | 1.0 | 107.7 | May 4, 1945 | C,W | D,S | Heavy pumping breaks suction, Altitude of land surface, 1143.4. |
| | | 112.8 | May 18, 1945 | | | |
| | | 128.1 | July 5, 1945 | | | |
| 98 | 1.0 | 188.7 | May 11, 1945 | C,W | D,S | Altitude of land surface, 1264.3. |
| | | 188.7 | May 19, 1945 | | | |
| | | 208.0 | May 24, 1945 | | | |
| | | 253.8 | July 5, 1945 | | | |
| 99 | -- | d/100 | -- | C,W | D,S | No indication of exhaustion after being pumped 18 hours with power pump having $2\frac{3}{4}$-inch cylinder and 12-inch stroke. |
| 102 | 0.5 | 50.3 | Dec. 9, 1936 | C,W | D,S | Breaks suction easily. |
| | | 84.0 | Sept. 25, 1943 | | | |
| 103 | -- | 43 | -- | C,W | D,S | |
| 104 | -- | -- | -- | Flows | D,S | Spring Branch Spring. Flows from cavernous limestone. Temperature 70°F, Jan. 18, 1943. Volume varies with rainfall. Estimated flow 5,000 gallons a minute, Mar. 28, 1945. |
| 105 | 1.2 | 63.5 | Nov. 20, 1936 | C,W | D,S | |
| | | 61.5 | Jan. 18, 1943 | | | |
| 106 | 0.6 | 177.3 | Nov. 20, 1936 | C,W | D,S | Cased to about 325 feet. Cylinder set at 250 feet, twenty feet east of well 105. |
| 107 | 0.4 | 45.4 | do. | C,W | D,S | Some water reported from blue clay at 69 feet. |

Records of wells and springs in Comal County--Continued

| Well | Distance from Bulverde | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing formation |
|---|---|---|---|---|---|---|---|
| 108 | 10½ miles north | Arno Knibbe | -- | 1900 | 225 | 6 | Pearsall formation |
| 109 | do. | D. L. Knibbe | -- | Old | 120 | 6 | do. |
| 110 | do. | Alfred Jonas | -- | Old | 280 | 6 | do. |
| 111 | do. | Edwin Elbel | -- | Old | 100 | 6 | Glen Rose limestone, lower member |
| 112 | 8½ miles northeast | Alvin Gass | -- | Old | 78 | 6 | -- |
| 113 | 10 miles north | Alfred Gass | -- | 1918 | 175 | -- | Pearsall formation |
| 114 | 10½ miles north | Harry Knibbe | -- | -- | Spring | -- | Travis Peak formation |
| 115 | 10 miles north | William Specht | -- | -- | 250 | 6 | Pearsall formation |
| 116 | 8½ miles northeast | Ed. Bartels | -- | 1886 | 80 | 6 | -- |
| 117 | 9 miles northeast | Alfred Beirrle | -- | 1928 | 157 | 6 | Pearsall formation |
| 118 | 9½ miles northeast | Roland Benzeil | -- | 1901 | 108 | 6 | Glen Rose limestone, lower member |
| 119 | do. | Mrs. John Stricker | -- | Old | 200 | 6 | Pearsall formation |
| 120 | 8 miles northeast | Alfred Marek | -- | 1935 | 380 | 6 | do. |
| 121 | 8 miles north | William Gast | -- | Old | 115 | 6 | -- |
| 122 | 9 miles north | Erich Specht | -- | Old | 200 | 6 | Pearsall formation |
| 123 | 5 miles north | Alfred Wehe | A. Brown | 1901 | 350 | -- | do. |
| 124 | 6½ miles northeast | Ed Kuebel | -- | 1916 | 210 | 6 | Glen Rose limestone, lower member |
| 125 | 8 miles northeast | Joe E. Sheldon | -- | Old | 450 | 6 | Pearsall formation |
| 126 | 9½ miles northeast | Julius Bremer | -- | 1906 | 185 | 6 | Glen Rose limestone, lower member. |
| 127 | 8½ miles northeast | A. J. Walser | -- | Old | 475 | 6 | do. |
| 128 | do. | do. | -- | -- | 85 | 6 | Glen Rose limestone, upper member. |
| 129 | 7½ miles northeast | Joe E. Sheldon | -- | -- | 350 | 6 | do. |
| 130 | 7 miles northeast | R. P. Holt | -- | Old | 620 | 6 | Glen Rose limestone, lower member. |
| 131 | 5½ miles northeast | J. J. Arrechea | -- | Old | 300 | 6 | do. |

| Well | Height of measuring point above ground (ft.) a/ | WATER LEVEL Below land surface (ft.) | Date of measurement | Method of lift b/ | Use of water c/ | Remarks |
|---|---|---|---|---|---|---|
| 108 | 1.1 | 111.5 | Dec. 10, 1936 | C,W | D,S | Water has slight sulphur odor. |
| 109 | 2.2 | 46.2 | do. | C,W | D,S | |
| 110 | 0.3 | 113.5 | do. | C,W | S | |
| 111 | 1.2 | 60.1<br>66.3 | Dec. 9, 1936<br>Oct. 8, 1943 | C,W | D,S | On river terrace; some of the water may come from alluvium. |
| 112 | 0.0 | 67.4 | Dec. 6, 1943 | C,W | D,S | Auxiliary electric motor, 1/3 horsepower. |
| 113 | 0.0 | 58.1 | Nov. 20, 1936 | C,W | D,S | |
| 114 | -- | -- | -- | Flows | -- | Hydraulic ram pumps water to school and near-by houses, water flows from crevice in limestone. |
| 115 | 2.6 | 58.0 | Nov. 20, 1936 | C,W | D,S | Cased to bottom. Water from sandstone at 240-245 feet. Originally 70 feet; failed in 1891. Deepened to 250 feet in 1933. |
| 116 | 0.8 | 65.8 | Dec. 10, 1936 | C,W | D,S | |
| 117 | 0.0 | 119.1 | Nov. 20, 1936 | C,W | D,S | Water from sandstone at 150-157 feet. See table of water levels. |
| 118 | 0.5 | 93.0 | Jan. 26, 1937 | C,W | D,S | Cased to 20 feet. See table of water levels. |
| 119 | 0.2 | 166.7 | Nov. 19, 1936 | C,W | D,S | See table of water levels. |
| 120 | 0.8 | 74.0 | Nov. 16, 1936 | C,W | D,S | See table of water levels. Water reported from honey-comb limestone at 330-380 feet. |
| 121 | 0.6 | 106.5 | Nov. 27, 1936 | C,W | D,S | Yield reported small. |
| 122 | 0.5 | 157.3 | do. | C,W | D,S | |
| 123 | -- | d/315 | -- | C,W | D,S | |
| 124 | 0.9 | 168.0 | Nov. 16, 1936 | C,W | D,S | |
| 125 | 0.3 | 278.1 | Nov. 2, 1936 | C,W,G, 2 | D,S | Drawdown 8 feet when pumped at 2 gallons a minute. |
| 126 | 0.0 | 85.0 | Nov. 25, 1936 | C,G, $1\frac{1}{2}$ | D,S | |
| 127 | 0.5 | 236.3<br>234.3<br>239.7 | Nov. 2, 1936<br>May 17, 1945<br>July 12, 1945 | C,W | D,S | Altitude of land surface, 1303.1. |
| 128 | 0.3 | 14.3 | Nov. 2, 1945 | C,W | D,S | |
| 129 | 3.0 | 258.6 | Nov. 25, 1936 | C,W | S | |
| 130 | -- | -- | -- | C,W | D,S | Water level reported more than 300 feet below land surface. |
| 131 | 1.0 | 116.8 | Nov. 16, 1936 | C,W,G, $1\frac{1}{4}$ | D,S | Slight sulphur odor. See table of water levels. |

Records of wells and springs in Comal County--Continued

| Well | Distance from Bulverde | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing formation |
|---|---|---|---|---|---|---|---|
| 132 | 5½ miles northwest | Alex P. Scheel | -- | 1913 | 350 | -- | Glen Rose limestone, lower member |
| 133 | do. | Eugene Scheel | Schwertz and Nickols | 1898 | 280 | 6 | do. |
| 134 | 6½ miles northwest | E. A. Moos | -- | 1922 | 96 | 6 | do. |
| 136 | 9 miles northwest | Mrs. Emma Sauer | -- | Old | 218 | 6 | do. |
| 137 | 10 miles west | G. S. McFarland | -- | Old | 300 | 6 | do. |
| 138 | 9 miles west | Bruno Klar | -- | 1860 | 25 | 36 | do. |
| 139 | 6 miles west | Joseph Offer | -- | -- | 200 | -- | do. |
| 140 | 6 miles northwest | F. Neugebauer | -- | 1885 | 300 | 6 | do. |
| 141 | 5½ miles west | George Bros. | -- | 1885 | 216 | 6 | do. |
| 142 | do. | Mrs. C. L. Ellsworth | -- | Old | 217 | -- | do. |
| 143 | 4 miles west | Aug. Scholz Est. | -- | 1906 | 236 | 6 | do. |
| 144 | do. | do. | R. Schwartz | 1906 | 265 | 6 | do. |
| 145 | 4½ miles northwest | Mrs. Chas. Erben | - Brown | 1895 | 235 | 6 | do. |
| 146 | 4¾ miles northwest | E. A. Laubach | -- | Old | 350 | 6 | do. |
| 147 | do. | do. | -- | Old | 25 | 36 | do. |
| 148 | 4 miles northwest | Aug. Scheel | -- | 1870 | 15 | 36 | do. |
| 149 | 3¾ miles northwest | do. | -- | 1892 | 318 | -- | do. |
| 150 | 4¼ miles north | L. A. Allen | -- | Old | 480 | -- | do. |
| 151 | 3¾ miles north | O. Wehe | -- | Old | 350 | -- | do. |
| 152 | 3½ miles north | do. | -- | Old | 110 | -- | do. |
| 153 | 4½ miles north | J. A. Laubach | -- | 1896 | 60 | 6 | do. |
| 154 | do. | do. | -- | Old | 25 | 36 | do. |
| 155 | 5 miles northeast | George Fronne | -- | Old | 185 | 6 | do. |
| 156 | 3½ miles northeast | Alex Licata | -- | Old | 360 | 6 | do. |

| Well | Height of measuring point above ground (ft.) a/ | WATER LEVEL Below land surface (ft.) | Date of measurement | Method of lift b/ | Use of water c/ | Remarks |
|---|---|---|---|---|---|---|
| 132 | -- | -- | -- | C,W | D,S | Water level reported more than 300 feet below land surface. |
| 133 | 0.6 | 133.9 | Dec. 7, 1936 | C,W,G, 2 | D,S | |
| 134 | 0.7 | 53.4<br>52.0<br>54.0 | Dec. 7, 1936<br>May 16, 1945<br>July 12, 1945 | C,W | D,S | Altitude of land surface, 1403.2. |
| 136 | 0.3 | 210.1 | Dec. 23, 1936 | C,W | D,S | Cased to 6 feet. |
| 137 | 0.0 | 124.6 | do. | C,W | D,S | Cased to 10 feet. |
| 138 | 1.0 | 13.7 | do. | C,W | D,S | Well flows in wet seasons. |
| 139 | 0.0 | 125.6 | do. | C,W | D,S | |
| 140 | 1.0 | 135.5 | Dec. 7, 1936 | C,W | D,S | |
| 141 | -- | d/180 | -- | C,G | D,S | Well has been pumped 10 hours at 7 gallons a minute with tractor. |
| 142 | -- | 187.3 | Dec. 23, 1936 | C,G, 3 | D,S | |
| 143 | 0.2 | 216.0 | Nov. 30, 1936 | C,W | D,S | Cased to 5 feet. |
| 144 | 0.4 | 209.3 | do. | C,W | S | |
| 145 | -- | d/220 | -- | C,W | D,S | |
| 146 | -- | d/250 | -- | C,W | D,S | |
| 147 | 2.9 | 6.4 | -- | C,W | S | Dug well. |
| 148 | 2.0 | 7.0 | -- | C,W | N | Do. |
| 149 | 0.7 | 262.8<br>241.9<br>269.3 | Dec. 7, 1936<br>May 18, 1945<br>July 12, 1945 | C,W,G, 1½ | D,S | Altitude of land surface, 1256.4. |
| 150 | 1.0 | 248.0<br>312.5<br>322.1 | Nov. 21, 1936<br>May 3, 1945<br>July 5, 1945 | C,W,G, 2 | D,S | Altitude of land surface, 1298.5. |
| 151 | 1.0 | 277.4<br>302.8 | May 17, 1945<br>July 12, 1945 | C,W | D,S | Altitude of land surface, 1261.2. |
| 152 | 0.4 | 67.4<br>69.8<br>70.4 | Nov. 29, 1936<br>May 17, 1945<br>July 12, 1945 | C,W | S | Altitude of land surface, 1249.6. |
| 153 | 0.0 | 33.4 | Nov. 27, 1936 | C,W | D,S | |
| 154 | 1.3 | 8.3 | do. | C,H | N | |
| 155 | 0.7 | 83.0 | Dec. 10, 1936 | C,W | D,S | See table of water levels. |
| 156 | -- | d/240 | -- | C,W | S | |

Records of wells and springs in Comal County--Continued

| Well | Distance from Bulverde | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing formation |
|---|---|---|---|---|---|---|---|
| 157 | 7 miles northeast | W. E. Green | -- | Old | 635 | 6 | Glen Rose limestone, lower member |
| 158 | 8½ miles northeast | O. A. Doeppenschmidt | -- | Old | 446 | -- | do. |
| 159 | do. | do. | -- | Old | 615 | 6 | do. |
| 160 | do. | do. | -- | Old | 80 | 8 | Glen Rose limestone, upper member |
| 161 | 10½ miles northeast | do. | -- | Old | -- | 6 | do. |
| 162 | 10 miles northeast | H. Conrads | -- | 1937 | 208 | -- | do. |
| 163 | 8½ miles northeast | do. | -- | 1933 | 240 | 6 | do. |
| 164 | 8 miles northeast | B. Stapper | -- | 1882 | 480 | 6 | do. |
| 165 | 7 miles northeast | Ed. Adam | -- | Old | 24 | 36 | do. |
| 166 | do. | do. | -- | 1885 | 600 | 6 | Glen Rose limestone, lower member |
| 167 | 4¼ miles northeast | Clemens Scholz | -- | Old | 245 | 6 | Glen Rose limestone, upper member |
| 168 | 4 miles northeast | G. W. Kurz | -- | Old | 348 | 6 | Glen Rose limestone, lower member |
| 169 | do. | Benno Bose | -- | 1892 | 348 | 6 | do. |
| 170 | 3 miles northeast | Arthur Hitzfelder | -- | 1890 | 414 | 6 | do. |
| 171 | 3¾ miles northeast | Mrs. Mattie Shelburne | -- | 1935 | 248 | 8 | do. |
| 172 | 3 miles north | V. F. Moos | -- | Old | 320 | -- | do. |
| 173 | 2¼ miles north | Edgar Bremer | -- | 1890 | 100 | 6 | do. |
| 174 | 2 miles northwest | Mrs. M. K. Hohmen | -- | Old | 30 | 6 | do. |
| 175 | 2¾ miles northwest | do. | -- | 1886 | 315 | 6 | do. |
| 176 | 2½ miles northwest | do. | -- | -- | Spring | -- | do. |
| 177 | 3¼ miles northwest | Paul Kurz | -- | Old | 300 | 6 | do. |
| 178 | 4½ miles northwest | Herman Laubach | - Dietz | 1930 | 750 | -- | Pearsall formation |
| 179 | 2½ miles west | W. O. Stahl | -- | Old | 308 | 6 | Glen Rose limestone, lower member |

| Well | Height of measuring point above ground (ft.) a/ | WATER LEVEL Below land surface (ft.) | Date of measurement | Method of lift b/ | Use of water c/ | Remarks |
|---|---|---|---|---|---|---|
| 157 | -- | -- | -- | C,W | D,S | |
| 158 | -- | 288.4 | May 31, 1945 | C,E | D,S | Deepened from 383 ft. to 446 ft. in 1944, by E.B.Kutscher. Yield was increased. Altitude of land surface 1247.9. |
| 159 | -- | -- | -- | C,W | D,S | Water level reported more than 300 feet below land surface. |
| 160 | -- | 46.4 | Nov. 2, 1936 | B | -- | |
| 161 | -- | 24.4 | do. | C,W | D,S | |
| 162 | 0.6 | 131.4 | Apr. 6, 1945 | C,W | S | Well may be drawing also from Edwards limestone. See table of water levels. |
| 163 | -- | -- | -- | C,G 6 | D,S | Water level more than 300 feet below surface Nov.2, 1936. |
| 164 | -- | -- | -- | C,W | D,S | Do. |
| 165 | 0.0 | 9.0 | Dec. 11, 1936 | C,H | S | Dug well. Overflows during wet season. |
| 166 | -- | -- | -- | C,W,G, 4 | D,S | Water level more than 300 feet below surface Dec. 11, 1936. |
| 167 | -- | 227.3 | do. | C,W | D,S | |
| 168 | -- | d/311 | -- | C,W,G, 3 | D,S | Water from gray sandstone at 338-348 feet. Cased to 20 feet. |
| 169 | -- | d/320 | -- | C,W | D,S | Pump equipped with jack for use with tractor. Water from gray sandstone at 300-320 feet. |
| 170 | 0.7 | 289.4 | Dec. 15, 1936 | C,G | D,S | Tractor used for pumping. |
| 171 | 0.4 | 228.5 | Nov. 16, 1936 | None | N | See table of water-level measurements. |
| 172 | 0.2 | 262.1 | Nov. 27, 1936 | C,W | D,S | |
| 173 | 0.6 | 85.3 | Nov. 21, 1936 | C,W,G, 1½ | D,S | Cased to 10 feet. |
| 174 | 0.8 | 10.8 | Nov. 30, 1936 | None | N | |
| 175 | 0.5 | 247.1 | do. | C,W,G, 7 | D,S | |
| 176 | -- | -- | -- | Flows | D | Estimated flow 40-50 gallons a minute, Feb. 22, 1945. |
| 177 | 0.5 | 264.1 | Nov. 30, 1936 | C,W | D,S | |
| 178 | 0.6 | 243.6<br>95.2<br>95.2 | Nov. 30, 1936<br>May 19, 1945<br>May 24, 1945 | C,W | D,S | Water level reported 150 feet below land surface when drilled, Cylinder lowered several times. Water reported from blue clay at 680-700 feet. Altitude of land surface, 1413.4. |
| 179 | 0.4 | 88.1 | Nov. 27, 1936 | C,W,G | D,S | Draw-down more than 200 feet at 8 gallons a minute. |

Records of wells and springs in Comal County--Continued

| Well | Distance from Bulverde | Owner | Driller | Date com-pleted | Depth of well (ft.) | Diameter of well (in.) | Water-bearing formation |
|---|---|---|---|---|---|---|---|
| 180 | 1½ miles west | Philip Lux | -- | 1924 | 348 | 6 | Glen Rose limestone, lower member |
| 181 | 1 mile southwest | Mrs. William Scholz | -- | 1896 | 360 | 6 | do. |
| 182 | ½ mile southwest | Aug. Scholz | -- | 1896 | 336 | 6 | do. |
| 183 | In Bulverde | Aug. Wehe | - Vogues | Old | 375 | 6 | do. |
| 184 | 1¼ miles east | Charles Willig | -- | 1914 | 371 | 6 | do. |
| 185 | 2 miles east | Mrs. Anita Lux | -- | -- | 320 | 6 | do. |
| 186 | 2½ miles east | Elmer Kleck | -- | -- | 450 | 6 | do. |
| 187 | 3¼ miles east | Adolph Kappelmann | -- | -- | 444 | 6 | do. |
| 188 | 3½ miles east | Adam Meyer Estate | -- | Old | 90 | 6 | Glen Rose limestone, upper member |
| 189 | 5 miles east | Otto Hitzfelder | -- | Old | 15 | 36 | do. |
| 190 | do. | do. | -- | -- | Spring | -- | do. |
| 191 | 5½ miles east | do. | - Schwartz | 1900 | 381 | 6 | do. |
| 192 | 6 miles east | - Tian | -- | -- | Spring | -- | do. |
| 193 | 6½ miles east | do. | -- | -- | 200+ | 6 | do. |
| 194 | 8 miles east | William Zeucher | -- | 1922 | 535 | 6 | do. |
| 195 | 11 miles northeast | Robert Heimer | -- | 1926 | 178 | 6 | do. |
| 196 | do. | Adolph Henne | - Williams | 1943 | 302 | 6 | do. |
| 197 | 11½ miles northeast | Henry Rompel | E. B. Kutcher | 1939 | 240 | 6 | do. |
| 198 | 11 miles northeast | H. Conrads | -- | -- | -- | -- | -- |
| | Distance from New Braunfels | | | | | | |
| 201 | 12 miles north | C. B. Crawford | -- | Old | 290 | -- | Edwards limestone |
| 202 | 9½ miles northwest | H. Kanz | -- | Old | 50 | -- | Alluvium |

| Well | Height of measuring point above ground (ft.) a/ | WATER LEVEL: Below land surface (ft.) | WATER LEVEL: Date of measurement | Method of lift b/ | Use of water c/ | Remarks |
| --- | --- | --- | --- | --- | --- | --- |
| 180 | -- | 141.4 | Nov. 27, 1936 | C,W,G, 4 | D,S | Cased to 10 feet. |
| 181 | -- | d/250 | -- | C,W | D,S | |
| 182 | -- | d/300 | -- | C,W,G, 1½ | D,S | Yellow sand reported at 334-336 feet. Cased to 16 feet. |
| 183 | 0.2 | 217.8 | Nov. 12, 1936 | C,W | D,S | Cased to 40 feet. See table of water-level measurements. |
| 184 | 1.0 | 213.1 | do. | C,W | D,S | Cased to 60 feet. See table of water-level measurements. |
| 185 | -- | d/280 | -- | C,W | D,S | |
| 186 | -- | d/250+ | -- | C,W | D,S | Cased to 50 feet. |
| 187 | 0.8 | 61.4<br>94.1<br>147.0 | May 4, 1945<br>May 18, 1945<br>July 11, 1945 | C,W | D,S | Altitude of land surface, 1015.3. |
| 188 | 0.3 | 48.9 | Nov. 12, 1936 | C,W | D,S | |
| 189 | 0.7 | 10.2 | do. | C,W | D,S | Dug well; 12 feet of caliche reported at surface underlain by limestone. |
| 190 | -- | -- | -- | Flows | S | Seep spring. Maximum flow reported 60 gallons a minute. |
| 191 | -- | d/160 | -- | C,W | D,S | Cased to 10 feet. Water reported from sand at 373-375 feet. |
| 192 | -- | -- | -- | Flows | S | Small fault spring in bottom of Cibolo Creek. |
| 193 | 0.2 | 153.7 | Nov. 12, 1936 | C,G, 6 | D,S | See table of water-level measurements. |
| 194 | -- | d/121 | -- | C,W,G, 4 | D,S | Cased to 6 feet. |
| 195 | 0.7 | 49.3 | July 5, 1945 | C,E,G, 1¾ | D,S | See table of water-level measurements. |
| 196 | 0.7 | 51.3<br>55.7 | Sept. 21, 1943<br>May 19, 1945 | C,E, 2 | D | Altitude of land surface, 1085.8. |
| 197 | -- | d/210 | -- | C,W | S | Driller reports Edwards limestone to 103 feet. Only enough water in Edwards for drilling. Yield reported 2 gallons a minute from sand at 228-240 feet. See log. |
| 198 | 1.0 | 227.0 | May 31, 1945 | C,W | S | Water level rose 6.35 ft. in 15 minutes after turning off windmill. Altitude of land surface, 1231.0. |
| Distance from New Braunfels | | | | | | |
| 201 | 0.5 | 232.5 | Dec. 14, 1944 | C,W | D,S | Well probably penetrates part of Upper Glen Rose limestone. |
| 202 | 1.2 | 42.7 | Nov. 4, 1936 | C,H | S | Dug well in Guadalupe River bottoms. |

Records of wells and springs in Comal County--Continued

| Well | Distance from New Braunfels | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing formation |
|---|---|---|---|---|---|---|---|
| 203 | 10 miles northwest | H. Conrads | -- | -- | Spring | -- | Edwards limestone |
| 204 | 11 miles northwest | do. | -- | Old | 180 | -- | Glen Rose limestone, upper member |
| 206 | 11 miles west | A. Kebelmacher | -- | -- | 475 | 6 | do. |
| 207 | 13 miles west | Ed Reeh | -- | Old | 325 | -- | Edwards limestone |
| 208 | 12½ miles west | do. | -- | -- | 400 | -- | do. |
| 209 | 12 miles southwest | do. | -- | 1918 | 390 | -- | do. |
| 210 | 9½ miles west | Paul Tonne | -- | 1929 | 320 | -- | do. |
| 211 | 9 miles west | Otto Ohlrich | -- | 1897 | 350 | 6 | Edwards limestone |
| 212 | 9 miles northwest | E. Herbst | -- | Old | 425 | 6 | Glen Rose limestone, upper member |
| 213 | 6½ miles northwest | B. Borchers | -- | 1902 | 402 | -- | Edwards limestone |
| 214 | do. | Paul Dietz | -- | Old | 300 | 6 | do. |
| 215 | 5½ miles northwest | Jerome Schumann | Alex Fabian | 1915 | 365 | 6 | do. |
| 216 | 6½ miles northwest | Alwin Jahns | -- | 1906 | 300 | 6 | do. |
| 217 | 6 miles northwest | H. D. Stronberg | -- | -- | Spring | -- | do. |
| 218 | 7½ miles north | R. Wright and U. Haarman | -- | -- | 15 | 36 | -- |
| 219 | 8½ miles north | E. T. Leckey | -- | 1911 | 500 | 6 | Edwards limestone |
| 220 | 8 miles northeast | Albert Pfeuffer | -- | Old | 400 | 6 | do. |
| 221 | 3½ miles northwest | Albert Simon | -- | 1931 | 186 | 6 | do. |
| 222 | do. | William Kraft | -- | 1906 | 190 | 6 | do. |
| 223 | 3¾ miles northwest | L. S. Davis | -- | -- | 320 | 6 | do. |
| 224 | 4½ miles northwest | F. D. Hutcheson | -- | Old | 251 | 6 | do. |
| 225 | 4 miles northwest | W. H. Harborth Estate | -- | 1895 | 265 | 6 | do. |
| 226 | 4½ miles northwest | Henry Heise | -- | 1923 | 290 | 6 | do. |

| Well | Height of measuring point above ground (ft.) a/ | WATER LEVEL Below land surface (ft.) | Date of measurement | Method of lift b/ | Use of water c/ | Remarks |
|---|---|---|---|---|---|---|
| 203 | -- | -- | -- | Flows | D,S | Measured flow 1½ gallons a minute Nov. 5, 1936; 20 feet above bed of Bear Creek. |
| 204 | -- | d/100 | -- | C,W | S | |
| 206 | -- | d/400 | -- | C,G, 2 | D,S | Tested 24 hours at 6 gallons a minute. |
| 207 | 0.0 | 156.6<br>250.3 | Dec. 1, 1936<br>May 18, 1945 | None | N | |
| 208 | 0.9 | 242.0 | Dec. 1, 1936 | C,W | N | |
| 209 | -- | d/360 | -- | C,W | D,S | Cave in limestone reported at 360 feet. |
| 210 | 0.5 | 255.6 | Nov. 9, 1936 | C,W | D,S | See table of water-level measurements. |
| 211 | 0.7 | 195.7 | do. | C,W,G, 1½ | D,S | |
| 212 | -- | d/200 | -- | C,W | D,S | Edwards limestone at surface. Cylinder set at 350 feet. |
| 213 | -- | d/332 | -- | C,W,G, 1½ | D,S | |
| 214 | 0.2 | 251.5 | Nov. 15, 1936 | C,W | D,S | |
| 215 | -- | d/285 | -- | C,W,G, 3 | -- | Cased to 10 feet. |
| 216 | 0.7 | 272.3 | Jan. 18, 1936 | C,W | D,S | |
| 217 | -- | -- | -- | Flows | N | Yield estimated one gallon a minute Nov. 5, 1936. |
| 218 | 2.0 | 6.9 | Oct. 22, 1936 | B,H | D,S | Dug well, Circle Dot ranch. |
| 219 | -- | -- | -- | C,W,G, 6 | D,S | Water level reported more than 300 feet below land surface. |
| 220 | -- | -- | -- | C,G, 6 | D,S | Water level reported more than 300 feet below land surface. Reported yield 16 gallons a minute with pump having 3-inch cylinder and 21-inch stroke. |
| 221 | 1.0 | 157.0 | July 2, 1945 | C,W | D,S | See table of water-level measurements. Cased to 134 feet; cave at 160 feet and blue shale at 180-190 feet. |
| 222 | 0.5 | 161.0 | Oct. 28, 1945 | C,W | D,S | See table of water-level measurements. |
| 223 | 0.9 | 211.1 | Dec. 21, 1945 | C,W | D,S | Do. |
| 224 | 0.8 | 229.9 | do. | C,W | D,S | Do. |
| 225 | 1.1 | 187.0 | Dec. 28, 1936 | C,W | D,S | |
| 226 | 0.5 | 295.2 | Dec. 21, 1936 | C,W | D,S | See table of water-level measurements. |

Records of wells and springs in Comal County--Continued

| Well | Distance from New Braunfels | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing formation |
|---|---|---|---|---|---|---|---|
| 227 | 4½ miles northwest | Herman Borchers | -- | Old | 300 | 6 | Edwards limestone |
| 229 | do. | Edward Nowotny | -- | Old | 325 | 6 | do. |
| 230 | 4¾ miles northwest | Hilmar Doehne | -- | Old | 265 | 6 | Edwards limestone? |
| 231 | 5 miles west | Gus Vogel | -- | 1915 | 325 | 6 | Edwards limestone |
| 232 | 6½ miles west | Krueger Bros. | -- | Old | 250 | 6 | do. |
| 233 | 7½ miles west | Richard Gesche | -- | 1902 | 313 | 6 | do. |
| 234 | 8½ miles west | Otto Ohlrich | -- | Old | 265 | 6 | do. |
| 236 | 9 miles west | - Kopplin | -- | Old | -- | 36 | -- |
| 237 | 10 miles west | Eugene Krause | -- | -- | 288 | 6 | Edwards limestone |
| 238 | do. | Herman Tonne | -- | 1901 | 295 | 6 | do. |
| 239 | 11 miles southwest | Elder Dierks | Frank Hillert | 1932 | 45 | 6 | -- |
| 240 | 11½ miles southwest | H. Blank | -- | 1926 | 240 | 6 | Edwards limestone |
| 241 | 12 miles southwest | Willie Georg | -- | 1925 | 322 | 6 | do. |
| 242 | 13½ miles southwest | Ernest Georg | -- | Old | -- | 6 | do. |
| 243 | 13 miles southwest | Edward Gerhardt Estate | -- | -- | 326 | 6 | do. |
| 244 | 13½ miles southwest | Lena Binzeil Estate | -- | -- | 240 | 8 | do. |
| 245 | 14 miles southwest | Lavine Hoffman | -- | Old | 215 | 6 | do. |
| 246 | 13½ miles southwest | Henry Schmidt | -- | 1880 | 50 | 36 | Leona formation |
| 247 | do. | Henry W. Simon | H. T. Schwab | 1905 | 246 | 6 | Edwards limestone |
| 248 | 13 miles southwest | A. B. Burkhardt | Charles Donoubauer | 1910 | 250 | 6 | do. |
| 249 | 12 miles southwest | Edgar Burkhardt | -- | Old | 180 | 6 | do. |
| 250 | 11 miles southwest | Glen Wilson | -- | Old | -- | 6 | do. |
| 251 | 7½ miles southwest | Schaeffer Bros. | -- | Old | 255 | 6 | do. |

| Well | Height of measuring point above ground (ft.) a/ | WATER LEVEL Below land surface (ft.) | Date of measurement | Method of lift b/ | Use of water c/ | Remarks |
|---|---|---|---|---|---|---|
| 227 | 0.5 | 248.8 | July 6, 1945 | C,G,3 | D,S | |
| 229 | -- | d/300 | -- | C,W,G,6 | D,S | |
| 230 | 0.5 | 214.1<br>241.2 | May 23, 1945<br>July 3, 1945 | C,W | D,S | Altitude of land surface, 894.0. |
| 231 | -- | -- | -- | C,W | D,S | Caves reported at 80 feet and 120 feet. |
| 232 | 0.4 | 188.7 | Jan. 25, 1937 | C,W,G,4 | D,S | See table of water-level measurements. |
| 233 | 1.0 | 259.9 | Dec. 16, 1936 | C,W | D,S | do. |
| 234 | -- | d/250 | Nov. 9, 1936 | C,W,G,4 | D,S | |
| 236 | 1.0 | 23.3 | Jan. 27, 1937 | C,W | D,S | Dug well; rock curb. |
| 237 | 1.4 | 250.1 | Oct. 11, 1933 | C,G 7 | D,S | See table of water-level measurements. |
| 238 | -- | -- | -- | C,W | D,S | Water level reported more than 200 feet below land surface. |
| 239 | 0.6 | 20.0 | Nov. 24, 1936 | C,W | -- | Cased to 35 feet. Water encountered in red sand at 30 feet. Irrigates small garden. |
| 240 | 0.8 | 296.7 | do. | C,W | D,S | |
| 241 | -- | d/300 | -- | C,G | D,S | Cased to 315 feet. Large cave reported at 300 feet. |
| 242 | 0.3 | 231.0 | Dec. 17, 1936 | C,W | S | Depth reported more than 320 feet. |
| 243 | 0.3 | 306.8<br>291.1<br>290.5<br>294.5 | Oct. 11, 1933<br>May 5, 1945<br>May 18, 1945<br>July 4, 1945 | C,W | D,S | Altitude of land surface, 967.4. |
| 244 | 0.8 | 174.3<br>174.6<br>165.8<br>170.7 | Dec. 17, 1936<br>May 5, 1945<br>May 18, 1945<br>July 4, 1945 | C,W | D,S | Altitude of land surface, 844.2. |
| 245 | 0.6 | 151.3 | Dec. 17, 1936 | C,W | D,S | |
| 246 | 1.5 | 41.9 | do. | C,W | D,S | Dug well; water from terrace deposits of Cibolo Creek. |
| 247 | 1.5 | 130.2<br>129.9<br>130.8 | Dec. 17, 1936<br>May 5, 1945<br>May 18, 1945 | C,W | D,S | Cased to 200 feet. Altitude of land surface, 800.1. |
| 248 | 1.0 | 148.2 | Dec. 26, 1936 | C,W | D,S | Has been pumped with gasoline engine 24 hours. |
| 249 | 0.5 | 169.0 | Nov. 24, 1936 | C,W | D,S | |
| 250 | -- | -- | -- | C,W | D,S | Water level more than 242 feet below land surface. |
| 251 | 0.7 | 241.6 | May 28, 1934 | C,W,G,3 | D,S | See table of water-level measurements. |

Records of wells and springs in Comal County--Continued

| Well | Distance from New Braunfels | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing formation |
|---|---|---|---|---|---|---|---|
| 252 | 8 miles west | Herman Vogel | Emil Fey | 1916 | 300 | 6 | Edwards limestone |
| 253 | $7\frac{3}{4}$ miles west | Herbert Kruesler | -- | 1900 | 300 | 6 | do. |
| 254 | 8 miles west | Henry Ludwig | - Schumann | 1934 | 375 | 6 | do. |
| 255 | $7\frac{1}{2}$ miles west | Rubin Moeller | -- | 1919 | 330 | 6 | do. |
| 256 | 6 miles west | Mrs. William Hillert | -- | 1915 | 390 | 6 | do. |
| 258 | do. | R. J. Haug | -- | 1865 | 50 | 36 | do. |
| 259 | do. | do. | -- | 1906 | 420 | -- | do. |
| 260 | $5\frac{1}{2}$ miles west | Hilmar Staats | -- | 1895 | 450 | 6 | do. |
| 261 | 5 miles west | O. C. Brehmer | -- | 1898 | 304 | 6 | do. |
| 262 | $4\frac{1}{4}$ miles west | Ed. C. Heidrich | Frank Hillert | 1922 | 340 | 8 | do. |
| 263A | $3\frac{1}{2}$ miles west | Walter Kappelmacher | -- | 1932 | 242 | 8 | do. |
| 264 | do. | Ed. Dischinger | Frank Hillert | 1925 | 305 | 6 | do. |
| 265 | $2\frac{1}{2}$ miles west | R. R. Coreth | -- | -- | 290 | 8 | do. |
| 266 | $1\frac{1}{2}$ miles northwest | A. Swanson | -- | 1936 | 152 | 6 | do. |
| 268 | 4 miles northeast | Albert Hantzmann | C. A. Corring | 1900 | 175 | 6 | do. |
| 269 | $4\frac{3}{4}$ miles northeast | Jack Kretzmeyer | -- | -- | 168 | 6 | do. |
| 270 | 5 miles northeast | Alvin Kraft | - Owens | 1932 | 138 | 6 | do. |
| 271 | 4 miles northeast | Albert Wallhoeffer | -- | 1901 | 140 | 6 | do. |
| 272 | $4\frac{1}{2}$ miles northeast | Bruno Raabe | -- | Old | -- | 6 | do. |
| 273 | $5\frac{1}{2}$ miles northeast | C. Conrads | -- | -- | 145 | 6 | do. |
| 274 | 6 miles northeast | Chas. Soechting | -- | 1896 | 210 | 6 | do. |

| Well | Height of measuring point above ground (ft.) a/ | WATER LEVEL Below land surface (ft.) | Date of measurement | Method of lift b/ | Use of water c/ | Remarks |
|---|---|---|---|---|---|---|
| 252 | 0.9 | 252.7 | Jan. 21, 1937 | C,W | D,S | |
| 253 | 0.6 | 273.5 | Nov. 24, 1936 | C,W,G,6 | D,S | Cased to 70 feet. |
| 254 | 0.5 | 221.5<br>231.9<br>244.5 | Apr. 13, 1945<br>May 18, 1945<br>July 11, 1945 | C,W,G,2 | D,S | Casing to 220 feet. See log. Altitude of land surface, 920.9. |
| 255 | -- | d/300 | -- | C,G | D,S | |
| 256 | -- | d/330 | -- | C,G,2 | D,S | |
| 258 | 3.5 | 7.4<br>12.5 | Oct. 26, 1936<br>Dec. 13, 1943 | H,B | N | Well was overflowing April 13, 1935. |
| 259 | -- | d/400 | -- | C,G | D,S | |
| 260 | -- | d/300 | -- | C,G,3 | D,S | Cased to 130 feet. |
| 261 | 0.5 | 283.5 | May 25, 1934 | C,W | D,S | See table of water-level measurements. |
| 262 | -- | d/328 | -- | C,W | D,S | Reported that water supply encountered near the surface was lost at 200 feet. Deepened from 335 feet to 340 feet in 1941. Cased to 150 feet. |
| 263A | 0.8 | 223.9 | May 1, 1944 | C,E | D | See figures 4 and 5, and table of water-level measurements. |
| 264 | -- | d/293 | -- | C,G,2 | D,S | |
| 265 | 1.0 | 272.<br>273.0 | May 23, 1945<br>July 2, 1945 | C,W | D,S | Altitude of land surface, 909.9. |
| 266 | 1.0 | 100.8 | Jan. 6, 1937 | C,W | D,S | See log and table of water-level measurements. Said to have been tested with boiler at 60 gallons a minute for 6 hours without lowering water-level. |
| 268 | 0.4 | 150.4 | Oct. 22, 1936 | C,W | D,S | Cased to 77 feet. Cave 10 feet deep reported at 150-160 feet. Water at 162 feet. |
| 269 | 0.9 | 150.9<br>151.4 | Sept. 22, 1936<br>Oct. 22, 1936 | C,W | D,S | |
| 270 | 0.2 | 132.2 | Oct. 21, 1936 | C,W | D,S | |
| 271 | 0.6 | 89.6 | Dec. 30, 1936 | C,W | D,S | Drawdown 3.5 feet when pumped at ½ gallon a minute. See table of water-level measurements. |
| 272 | 1.5 | 153.8 | do. | C,W | D,S | |
| 273 | 1.1 | 126.9 | Oct. 20, 1936 | C,W | D,S | Drawdown 8.5 feet when pumped at 3 gallons a minute. |
| 274 | 1.0 | 157.5 | Jan. 5, 1937 | C,W,G,2 | D,S | Casing to 200 feet. See table of water-level measurements. |

Records of wells and springs in Comal County--Continued

| Well | Distance from New Braunfels | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing formation |
|---|---|---|---|---|---|---|---|
| 275 | 9 miles northeast | Erich Rosenthal | -- | 1901 | 230 | 6 | Edwards limestone |
| 276 | do. | Charlie Crawford | -- | Old | -- | 6 | do. |
| 277 | 6½ miles northeast | Erich Rosenthal | -- | 1898 | 212 | -- | do. |
| 278 | 7½ miles northeast | O. E. Gruene | -- | Old | 210 | 6 | do. |
| 279 | 8½ miles northeast | William Posey | -- | 1891 | 160 | 6 | -- |
| 280 | 9½ miles northeast | Hilmar Doehne | -- | Old | 250 | 6 | Edwards limestone |
| 281 | 9 miles northeast | Travis Tate | -- | -- | 152 | -- | Austin chalk |
| 282 | 10 miles northeast | Phoenix Life Insurance Co. | -- | -- | 145 | 6 | do. |
| 283 | 9 miles northeast | Emil Preusser | -- | -- | 330 | 6 | Edwards limestone |
| 284 | 8 miles northeast | Carl Kutscher Estate | -- | 1930 | 50 | 36 | Taylor marl(?) |
| 285 | 5 miles northeast | H. Mittendorf | -- | 1925 | 32 | 36 | Leona formation |
| 287 | 3¾ miles northeast | Arthur Bartels | -- | -- | 65 | 36 | do. |
| 288 | 2½ miles northeast | Iwan Wellhoefer | -- | -- | Spring | -- | do. |
| 289 | 1¾ miles northeast | William D. Wiemers | -- | Old | 80 | 6 | Edwards limestone |
| 291 | 2 miles northeast | Bruno Preiss | - Gunther | -- | 65 | 6 | do. |
| 292 | 2 miles north | Max Linnartz | -- | 1912 | 85 | 6 | do. |
| 293 | 1¼ miles northwest | Dean Word | -- | -- | -- | 6 | do. |
| 294 | 1 mile northwest | City of New Braunfels | -- | -- | Spring | -- | do. |
| 295 | ¾ mile west | Mrs. Meta Penshorn | -- | Old | 25 | 36 | -- |
| 296 | 2½ miles west | Max Altgelt | -- | 1934 | 345 | 8 | Edwards limestone |
| 297 | 4¼ miles southwest | U. S. Gypsum Co. | -- | 1925 | 125 | -- | do. |
| 298 | 4¾ miles west | J. R. Coreth | -- | -- | 275 | 6 | do. |
| 299 | 6 miles southwest | William Fey | P. Schumann | Old | 89 | 6 | -- |
| 300 | 4½ miles southwest | Roland Welsch | do. | 1934 | 372 | 6 | Edwards limestone(?) |

| Well | Height of measuring point above ground (ft.) a/ | WATER LEVEL Below land surface (ft.) | Date of measurement | Method of lift b/ | Use of water c/ | Remarks |
|---|---|---|---|---|---|---|
| 275 | -- | d/165 | -- | C,W | D,S | |
| 276 | 0.0 | 202.4 | Dec. 30, 1936 | C,W,G, 3 | D,S | |
| 277 | 0.0 | 189.9 | Jan. 5, 1937 | C,W | D,S | |
| 278. | 1.0 | 146.2 | Oct. 20, 1936 | C,W | S | See table of water-level measurements. |
| 279 | 0.9 | 130.7 | Oct. 21, 1936 | C,W | D,S | Drawdown 7 feet when pumped at $2\frac{1}{2}$ gallons a minute. |
| 280 | 0.9 | 97.2 | Jan. 5, 1937 | C,W | D,S | |
| 281 | 0.6 | 27.5 | do. | C,W | S | |
| 282 | 0.3 | 114.1 | Oct. 21, 1936 | C,W | D,S | Drawdown 14 feet when pumped at 2 gallons a minute. |
| 283 | 2.1 | 12.1 | Jan. 5, 1937 | C,W | N | Water has sulphur odor. |
| 284 | 0.9 | 37.4 | Oct. 21, 1936 | C,W | D,S | Dug well. Water from blue clay. |
| 285 | 0.0 | 12.0 | do. | C,W | D,S | Water from yellow joint clay at 23 feet; blue clay encountered at 32 feet. |
| 287 | 1.0 | 47.6 | Oct. 22, 1936 | C,W | D,S | Dug well. Said to have been drilled to 600 feet and plugged because water was salty and sulphurous. |
| 288 | -- | -- | -- | C,W | D,S | Flows from alluvium in east bank of Guadalupe River. Estimated flow 25 gallons a minute Sept. 29, 1943. |
| 289 | 1.4 | 47.1 | Dec. 30, 1936 | C,W,G, 3 | D,S | |
| 291 | 1.1 | 53.0 | Oct. 21, 1936 | C,W | D,S | See table of water-level measurements. |
| 292 | 1.3 | 54.0 | Oct. 28, 1936 | C,W | D,S | |
| 293 | 1.1 | 119.5 | Jan. 6, 1937 | C,W | D,S | See table of water-level measurements. |
| 294 | -- | -- | -- | Flows | -- | Comal Springs. See table of discharge measurements. p.71 Alt. of land surface, 623.1. |
| 295 | 0.2 | 8.1 | Dec. 22, 1936 | C,W | D,S | Dug well; rock curb. |
| 296 | 0.8 | 52.5<br>57.7 | Dec. 4, 1936<br>Dec. 20, 1943 | C,G, 4 | D,S | Blue clay reported from 50 feet to 345 feet. |
| 297 | 0.0 | 51.1 | Dec. 4, 1936 | None | N | Yellow clay reported at 58-62 feet. |
| 298 | 2.5 | 228.2<br>235.0 | May 25, 1934<br>July 2, 1945 | C,W | S | Altitude of land surface, 869.6. |
| 299 | 0.1 | 66.3 | Dec. 4, 1936 | C,W | S | |
| 300 | 1.6 | 38.2<br>32.1 | May 25, 1934<br>Dec. 4, 1936 | C,W | D,S | Blue clay reported from top to bottom. |

Records of wells and springs in Comal County--Continued

| Well | Distance from New Braunfels | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing formation |
|---|---|---|---|---|---|---|---|
| 305 | 7½ miles southwest | Joseph Friesenhahn | -- | 1895 | 360 | 6 | Edwards limestone |
| 306 | 8 miles southwest | Oscar Jones | -- | 1890 | 360 | 6 | do. |
| 307 | 8½ miles southwest | Adolph Mueller | -- | 1911 | 160 | 6 | do. |
| 308 | do. | Westley Hierholzer | -- | Old | 117 | 6 | do. |
| 309 | 9 miles southwest | Servtex and Metal Co. | -- | -- | 125 | 6 | do. |
| 311 | 10½ miles southwest | Robert Hierholzer | -- | Old | 130 | 6 | do. |
| 312 | 11 miles southwest | Otto Klaerner | -- | Old | 109 | 6 | do. |
| 313 | 11½ miles southwest | R. P. Schneider | -- | 1928 | 192 | 6 | do. |
| 314 | 11 miles southwest | - Rogers | -- | 1925 | 225 | 6 | do. |
| 315 | 12 miles southwest | Herbert Riedel | -- | Old | 306 | 5 | do. |
| 316 | 13½ miles southwest | Joe Gleitz | -- | -- | 310 | 6 | do. |
| 317 | do. | do. | | Old | 200 | 6 | Austin chalk (?) |
| 318 | 11½ miles southwest | Walter Mueller | -- | 1910 | 476 | 6-4½ | Edwards limestone |
| 319 | 8½ miles southwest | Percy Hansman | -- | -- | 350 | 6 | do. |
| 320 | 9½ miles southwest | Jack Alesci | -- | Old | 400 | 6 | do. |
| 322 | 7½ miles southwest | Fred Schwab | -- | -- | 38 | 36 | Taylor marl (?) |
| 323 | do. | Albert Rechner | -- | 1911 | 130 | 6 | Austin chalk |
| 325 | 7 miles southwest | Bruno Schwab | -- | 1916 | 150 | 6 | do. |
| 326 | do. | William Schaeffer | -- | -- | 300 | 4 | Edwards limestone |
| 328 | 6½ miles southwest | Alvin Schaeffer | -- | 1900 | 360 | 6 | do. |
| 329 | 7 miles southwest | Gus Klaener | -- | 1914 | 131 | 6 | Austin chalk |
| 332 | 6 miles southwest | Ben Jahn | -- | Old | 395 | 6 | Edwards limestone |
| 333 | do. | O. Penshorn | -- | Old | 428 | 6 | do. |
| 336 | 5½ miles southwest | A. W. Feick | Paul Schumann | Old | 700 | 6 | do. |

| Well | Height of measuring point above ground (ft.) a/ | WATER LEVEL Below land surface (ft.) | Date of measurement | Method of lift b/ | Use of water c/ | Remarks |
|---|---|---|---|---|---|---|
| 305 | 0.0 | 56.1 | Dec. 18, 1936 | C,W,G, 2 | D,S | Cased to 40 feet, cylinder set at 125 feet. |
| 306 | 1.2 | 67.2 | do. | C,W | D | Cylinder set at 130 feet. Pump breaks suction at high speed. |
| 307 | 0.9 | 86.8<br>94.3 | Dec. 18, 1936<br>Dec. 21, 1943 | C,W | D,S | No sulphur taste or odor. |
| 308 | 0.7 | 80.9 | Dec. 19, 1936 | C,W | D,S | Cased to 40 feet. |
| 309 | 0.0 | 79.4<br>87.7 | Dec. 19, 1936<br>Dec. 21, 1943 | None | N | |
| 311 | 0.7 | 125.0 | Dec. 19, 1936 | C,W | D,S | |
| 312 | 1.0 | 80.2 | Oct. 26, 1936 | C,W | D,S | |
| 313 | 0.6 | 118.8 | do. | C,W | D,S | |
| 314 | 0.2 | 133.0 | Dec. 17, 1936 | None | N | |
| 315 | 0.0 | 141.5 | May 24, 1936 | None | N | |
| 316 | 1.5 | 100.2 | Dec. 12, 1936 | C,W | D,S | In Guadalupe County. Edwards limestone reported at 225 feet. Slight sulphur odor. See table of water-level measurements. |
| 317 | 0.5 | 76.2 | Oct. 2, 1932 | None | N | In Guadalupe County. Sulphur odor reported. See table of water-level measurements. |
| 318 | 1.1 | 155.0<br>149.3 | Nov. 24, 1936<br>Dec. 6, 1944 | C,W | D,S | Casing: 20 feet of 6-inch, 450 feet of $4\frac{1}{2}$-inch. Water at 455-457 feet. |
| 319 | 1.2 | 134.0 | May 24, 1934 | C,W | S | Sulphur odor. See table of water-level measurements. |
| 320 | 0.8 | 63.0 | Nov. 24, 1936 | C,E, $\frac{1}{2}$ | D,S | |
| 322 | 2.1 | 23.0 | do. | C,W | D,S | |
| 323 | 0.7 | 68.6 | Dec. 1, 1936 | C,W | D,S | Casing to 50 feet. |
| 325 | 1.0 | 16.0 | do. | C,W,G, 4 | D,S | Casing to 20 feet. Slight sulphur odor. |
| 326 | 1.1 | 35.1 | May 24, 1934 | C,W | S | See table of water-level measurements. Slight sulphur odor. |
| 328 | 0.4 | 31.9 | Dec. 16, 1936 | C,W | D,S | Sulphur odor. |
| 329 | 1.1 | 46.7 | Dec. 4, 1936 | C,W | S | Do. |
| 332 | 1.1 | 79.6 | Dec. 18, 1936 | C,W | S | Sulphur odor. See table of water-level measurements. |
| 333 | 0.8 | 53.0 | May 28, 1934 | C,W | D,S | Slight sulphur odor. See table of water-level measurements. |
| 336 | 0.7 | 69.7 | do. | C,W | D,S | Sulphur odor. See table of water-level measurements. |

Records of wells and springs in Comal County--Continued

| Well | Distance from New Braunfels | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing formation |
|---|---|---|---|---|---|---|---|
| 337 | 5 miles southwest | William Strateman | -- | Old | -- | -- | -- |
| 339 | 4 miles southwest | Otto Reinartz | -- | Old | 463 | -- | Edwards limestone |
| 342 | 4¾ miles southwest | W. E. F. Eilers | -- | Old | 240 | 6 | do. |
| 346 | 2½ miles southwest | A. H. Werner | -- | 1900 | 148 | 6 | Austin chalk(?) |
| 347 | 3 miles southwest | Paul Schneider | -- | Old | 503 | 6 | Edwards limestone |
| 348 | 2¼ miles southwest | Altgelt Farm Association | -- | -- | Spring | -- | Austin chalk(?) |
| 349 | 2 miles southwest | Max Welther | -- | 1898 | 31 | 36 | Taylor marl(?) |
| 352 | 2 miles east | Erwin Soefje | -- | Old | 427 | 6 | Edwards limestone |
| 355 | 2 miles northeast | Ad. Tausch | -- | Old | -- | 36 | Leona formation |
| 356 | 2¼ miles northeast | A. H. Hoffer | -- | 1915 | 24 | 36 | do. |
| 359 | 3 miles northeast | Albert Soefje | -- | 1895 | 57 | 36 | do. |
| 360 | 5½ miles northeast | H. Kickeritz | -- | 1933 | 36 | 6 | Taylor marl(?) |
| 361 | 4¼ miles northeast | Emma Rose | -- | -- | 32 | 60 | Leona formation |
| 362 | 4 miles east | R. Kraft | -- | Old | 40 | 36 | do. |
| 363 | 3½ miles east | August Timmerman | -- | Old | 50 | 36 | do. |
| 364 | do. | E. W. Mueller | -- | 1918 | 35 | 36 | do. |
| 367 | 2½ miles southeast | Mrs. H. Oelkers | -- | Old | 40 | 36 | do. |
| 368 | 2¾ miles southeast | D. Werner | -- | Old | 30 | 60 | do. |
| 372 | 3 miles southwest | Ernst Voight | -- | 1898 | 510 | 6 | Edwards limestone |
| 373 | 3½ miles southwest | L. Jentsch | -- | Old | 485 | 6 | do. |
| 374 | 3¾ miles southwest | Gus Reinarz | -- | -- | 500 | 6 | do. |
| 375 | do. | F. A. Burket | -- | Old | 450 | 6 | do. |
| 377 | 4½ miles southwest | Erwin R. Goebel | -- | 1924 | 498 | 6 | do. |
| 378 | 3½ miles southwest | Hanno Welsch | -- | Old | 542 | 6 | do. |

| Well | Height of measuring point above ground (ft.) a/ | WATER LEVEL Below land surface (ft.) | Date of measurement | Method of lift b/ | Use of water c/ | Remarks |
|---|---|---|---|---|---|---|
| 337 | 0.5 | 60.3 | Jan. 6, 1937 | C,W | S | Sulphur odor. |
| 339 | 0.0 | 15.9 | May 24, 1934 | None | N | Sulphur odor. See table of water-level measurements. |
| 342 | 1.0 | 24.9 | Oct. 27, 1936 | C,W | D,S | Do. |
| 346 | 2.1 | 0.1 | Dec. 4, 1936 | C,G | D,S | Well flows as much as 3 feet above ground in wet seasons. |
| 347 | 0.7 | 7.1 | do. | C,W | D,S | Slight sulphur odor. |
| 348 | -- | -- | -- | Flows | S | Estimated average flow 50 gallons a minute. Has been pumped at 700 gallons a minute for irrigation. |
| 349 | 0.5 | 28.4 | Oct. 27, 1936 | C,W | D,S | Dug well. |
| 352 | 0.0 | 30.8 | Dec. 1, 1943 | None | N | Strong odor of sulphur. |
| 355 | 1.4 | 21.2 | Jan. 7, 1936 | C,W | D,S | Dug well, rock curb. |
| 356 | 0.7 | 24.4 | Nov. 18, 1936 | C,W | D,S | Dug well, brick curb, water from gravel at 23-24 feet. |
| 359 | 0.4 | 52.4<br>52.3 | Oct. 20, 1936<br>Dec. 3, 1943 | C,W | D,S | Dug well, rock curb. Water from gravel at 55-57 feet. |
| 360 | 0.2 | 28.0 | Nov. 18, 1936 | C,H | N | Water from yellow clay at 36 feet. Supply fails in dry seasons. |
| 361 | 0.2 | 33.7 | do. | C,W | D,S | Dug well, brick curb to 8 feet. Water from gravel at 30-32 feet. See log. |
| 362 | 3.2 | 34.7 | do. | B,H | D,S | Dug well, concrete curb. |
| 363 | 3.1 | 41.1<br>41.5 | Nov. 18, 1936<br>Nov. 30, 1943 | C,W | D,S | Dug well, rock curb. |
| 364 | 1.4 | 34.5 | Oct. 10, 1936 | C,W | D,S | Dug well. Irrigates garden. |
| 367 | 2.2 | 34.1<br>30.2 | Oct. 10, 1936<br>Nov. 30, 1943 | C,W | D,S | Dug well, brick curb. |
| 368 | 0.5 | 25.6 | Oct. 10, 1936 | C,W | D,S | Dug well. |
| 372 | 2.2 | 73.8 | Oct. 26, 1936 | C,W | S | Sulphur odor. |
| 373 | 1.5 | 16.4 | Dec. 4, 1936 | C,W | S | Sulphur odor. Estimated yield 1 gallon a minute. See table of water-level measurements. |
| 374 | 0.9 | 29.3 | do. | C,W | S | Sulphur odor. |
| 375 | 0.6 | 92.7 | Oct. 26, 1936 | C,W | S | Cased to 450 feet. Sulphur odor. |
| 377 | 0.0 | 52.3 | Jan. 6, 1937 | C,G | S | Sulphur odor. |
| 378 | 1.4 | 113.7 | do. | C,W | D,S | Do. |

Records of wells and springs in Comal County--Continued

| Well | Distance from New Braunfels | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing formation |
|---|---|---|---|---|---|---|---|
| 379 | 13 miles southwest | Missouri & Pacific R. R. | McMasters and Pomeroy | 1900 | 292 | 8 | Edwards limestone |
| 380 | 14 miles southwest | Paul J. Marbach | Valentine and Friesenhahn | 1920 | 185 | 6 | do. |
| 381 | 9½ miles southwest | Servtex and Materials Co. | Ed. Gerfers | 1941 | 160 | 30-15 | do. |
| 383 | 4 miles southwest | Charles Mergele | Edmund Wehe | -- | 611 | 5 | do. |
| 384 | 2½ miles southwest | Harry Dover | -- | -- | 300 | -- | do. |
| 385 | 7½ miles northwest | H. W. Dietz | Doehne Bros. | 1900 | 306 | 6 | do. |
| 386 | do. | do. | Frank Hillert | 1926 | 314 | 6 | do. |
| 387 | 8 miles northwest | E. J. Heidrick | -- | Old | 350 | 6 | Glen Rose limestone, upper member |
| 388 | 6½ miles northwest | do. | R. Johnson | 1937 | 1,867 | -- | -- |
| 389 | do. | do. | E. B. Kutscher | 1938 | 405 | 6 | Edwards limestone |
| 390 | 6 miles northwest | Henry Rehe | -- | -- | -- | 6 | do. |
| 393 | 2 miles southwest | Walter Sippel | -- | Old | 502 | 6 | do. |
| 394 | do. | Arthur Bergfeld | Paul Schumen | 1927 | -- | -- | Edwards limestone (?) |
| 395 | 2¼ miles southwest | W. S. Suttle | E. B. Kutscher | 1935 | 610 | 6 | Edwards limestone |
| 396 | 2 miles west | Altgelt Farm Association | do. | 1939 | 335 | 6 | do. |
| 397 | 1¾ miles west | Marvin Scheel | -- | 1938 | 220 | 6 | do. |
| 398 | 4 miles north | R. W. Gode | -- | -- | 90 | -- | Edwards limestone(?) |

| Well | Height of measuring point above ground (ft.) a/ | WATER LEVEL Below land surface (ft.) | Date of measurement | Method of lift b/ | Use of water | Remarks |
|---|---|---|---|---|---|---|
| 379 | 0.7 | 131.5 | May 5, 1945 | C,G, 1½ | D | Casing: 8-inch from surface to bottom; brass wire screen from 220 to 240 feet, perforated casing from 272 to 292 feet. Supplies railroad community. |
| 380 | 0.6 | 130.6<br>132.0<br>135.3 | May 5, 1945<br>May 18, 1945<br>July 4, 1945 | C,W | D,S | Water from 165 to 185 feet. Altitude of land surface, 804.6. |
| 381 | -- | -- | -- | T,E, 50 | Ind | Casing: 15 feet of 30-inch, 30 feet of 15-inch. Pumped 700 gallons a minute, 22 hours daily except Sunday for two years. |
| 383 | 0.0 | 63.9 | Aug. 20, 1940 | C,E, ¾ | D,S | Irrigates small garden. |
| 384 | -- | d/ 51 | -- | C,W | D,S | |
| 385 | 0.0 | 268.0<br>269.2<br>269.3 | Apr. 27, 1945<br>May 19, 1945<br>July 4, 1945 | None | N | Altitude of land surface, 968.1. |
| 386 | 0.5 | 289.0<br>289.0<br>291.6 | Apr. 27, 1945<br>May 19, 1945<br>July 4, 1945 | C,W | D,S | Altitude of land surface, 998.8. |
| 387 | 0.5 | 244.0<br>254.1<br>255.9 | Apr. 28, 1945<br>May 19, 1945<br>July 4, 1945 | C,W | D,S | Altitude of land surface, 998.2. |
| 388 | -- | -- | -- | None | N | Large supply of water reported at 800-1,000 feet. See log. |
| 389 | 0.5 | 302.4<br>303.0 | May 19, 1945<br>July 4, 1945 | C,W | S | Reported yield 20 gallons a minute. Altitude of land surface, 1005.2. |
| 390 | 0.5 | 274.6<br>289.8<br>297.9 | Apr. 13, 1945<br>May 16, 1945<br>July 4, 1945 | C,G, 2 | S | Altitude of land surface, 966.44. |
| 393 | 0.5 | 16.0<br>6.6<br>7.9<br>9.0 | Dec. 20, 1943<br>May 30, 1945<br>July 4, 1945<br>July 13, 1945 | C,W | D,S | Drawdown approximately 20 feet when pumped at 2 to 3 gallons a minute. Slight odor of sulphur. Altitude of land surface 049.2 |
| 394 | -- | d/ 20 | -- | C,G | Ind | Formerly supplied hosiery mill. Slight sulphur odor. |
| 395 | -- | d/ 90 | -- | None | N | Formerly supplied suburban community. Strong sulphur odor. See log. |
| 396 | -- | d/ 15 | -- | T,E, ½ | D,S | First water at 282 feet; stronger flow at 326-330 feet. Casing: 287 feet of 5-inch. Alt. of land surface [illegible] |
| 397 | 1.0 | 204.7<br>200.9<br>202.2 | Dec. 20, 1943<br>May 17, 1945<br>July 2, 1945 | C,W | D,S | Altitude of land surface, 843.5. |
| 398 | 0.7 | 38.8<br>36.8<br>37.2<br>38.8 | Apr. 13, 1945<br>May 16, 1945<br>May 23, 1945<br>July 2, 1945 | C,W | D,S | Altitude of land surface, 675.5. |

Records of wells and spring in Comal County--Continued

| Well | Distance from New Braunfels | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing formation |
|---|---|---|---|---|---|---|---|
| 399 | 4 miles north | John Karbach | -- | 1893 | 181 | 6 | Edwards limestone |
| 400 | 4¼ miles north | R. W. Gode | -- | -- | Spring | -- | -- |
| 401 | 5 miles northwest | -- Bretzke | -- | 1938 | 237 | 4 | Edwards limestone |
| 402 | 1½ miles north | City of New Braunfels | -- Cravens | 1941 | 116 | 12 | do. |
| 403 | do. | do. | do. | 1941 | 102 | -- | do. |
| 410 | 9½ miles northwest | Bear Creek Ranch Association | -- | -- | Spring | -- | Glen Rose limestone, upper member |
| 411 | 8½ miles northwest | Fred R. Loth | E. B. Kutscher | 1944 | 297 | -- | do. |
| 413 | 8 miles north | Udo Haarman and R. Wright | do. | 1937 | 440 | 6 | Edwards limestone |
| 414 | 7½ miles north | do. | do. | 1937 | 335 | 6 | do. |
| 415 | 9½ miles north | do. | -- | Old | 640 | 6 | do. |
| 416 | 10½ miles northeast | do. | E. B. Kutscher | -- | 440 | 6 | do. |
| 417 | 7 miles north | Edward Lackey | do. | 1937 | -- | -- | do. |
| 418 | 1¾ miles south | W. G. Startz | -- | 1938 | 27 | 48 | Leona formation |
| 419 | 3¼ miles northeast | Mrs. B. Gruene Estate | Killam and Hicks | 1939 | 2,350 | 10-5 | -- |
| 420 | do. | Mrs. Lydia Kirmse | -- | Old | 65 | 36 | Leona formation |
| 421 | 9 miles northeast | Jesse Posey | -- | Old | 280 | 6 | Edwards limestone |

| Well | Height of measuring point above ground (ft.) a/ | WATER LEVEL Below land surface (ft.) | WATER LEVEL Date of measurement | Method of lift b/ | Use of water c/ | Remarks |
|---|---|---|---|---|---|---|
| 399 | 0.8 | 173.3 | Dec. 20, 1937 | C,W,G, $1\frac{1}{2}$ | D,S | See table of water-level measurements. |
| 400 | -- | -- | -- | Flows | Power | Hueco Springs, also spelled Waco and Husco. Two openings, altitudes of land surfaces, 657.9 and 652.2. Temperature varies from 68°F in winter to $71\frac{1}{2}$°F in summer. See p.54 for flow measurements. |
| 401 | -- | -- | -- | -- | -- | U. S. Army Engineers test well. Cored from top to bottom; $2\frac{1}{4}$-inch core. See log. Altitude of land surface 894.8. |
| 402 | -- | -- | -- | T,E, 100, 75 | -- | Public supply, City of New Braunfels No.1, 30 feet south of No.2. Casing:12-inch to 58 feet; Cemented by Haliburton Oil Well Cementing Co;open hole, 58 feet to bottom.Drawdown 7 feet after pumping 12 hours at 2,300 gallons a minute with 2 centrifugal pumps.See log. |
| 403 | -- | -- | -- | T,E, 100, 40 | -- | Public supply,City of New Braunfels No.2.Casing:8-inch to 58 feet,open hole to bottom. |
| 410 | -- | -- | -- | Flows | S | Estimated flow 200 gallons a minute,Sept.29,1943;2,000-2,500 gallons a minute,March 28,1945. Fault Spring. |
| 411 | -- | d/ 60 | -- | C,W | D,S | Estimated yield 500 gallons a day; bottom of suction pipe set 285 feet. |
| 413 | 0.5 | 350+ | Dec. 15, 1945 | C,W | S | Circle Dot ranch well 3. Probably drilled into Glen Rose limestone. |
| 414 | -- | -- | -- | C,W | S | Circle Dot ranch No. 4. |
| 415 | -- | -- | -- | C,W | D,S | Circle Dot ranch no. 1 Headquarters well. Probably be drilled into Glen Rose limestone. |
| 416 | -- | -- | -- | C,W | S | Circle Dot ranch No. 2 probably drilled into Glen Rose limestone. Bottom of suction pipe set at 400 feet. |
| 417 | -- | -- | -- | C,W | S | |
| 418 | 1.0 | 20.4 | Nov. 30, 1943 | C,W | D,S, Ind | Dug well; used at slaughter house. |
| 419 | -- | -- | -- | None | N | Oil test. Altitude of land surface 688 feet, reported by Killem and Hicks. See log. |
| 420 | 2.0 | 54.3 | Dec. 3, 1943 | C,W | D,S | Dug well, rock curb. Water from gravel at 58-65 feet. |
| 421 | 0.0 | d/255 | -- | C,W | D,S | See log. |

Records of wells and springs in Comal County--Continued

| Well | Distance from New Braunfels | Owner | Driller | Date completed | Depth of well (ft.) | Diameter of well (in.) | Water-bearing formation |
|---|---|---|---|---|---|---|---|
| 422 | 11½ miles northeast | R. Wegner | -- | 1890 | 380 | 4 | Edwards limestone |
| 423 | 9 miles north | Alfred Pentermuhl | E. B. Kutscher | 1937 | -- | -- | do. |
| 424 | 11 miles northeast | R. R. Williams | do. | 1943 | 422 | 6 | do. |
| 425 | 9½ miles northeast | Missouri & Pacific R. R. | do. | 1944 | 140 | 6 | Austin chalk |
| 426 | 3¼ miles northeast | H. J. Ludwig | -- | 1898 | 55 | 36 | Leona formation |
| 427 | In New Braunfels | Clements Estate | -- | -- | 1,200 | -- | Glen Rose limestone(?) lower member |
| 428 | 7 miles east | A. Brinkoetter | E. B. Kutscher | 1930 | 920 | -- | Edwards limestone |
| 429 | 8½ miles northwest | Oscar C. Brehmer | do. | 1946 | 601 | 6 | Glen Rose limestone, upper member |

a/ Measuring point was usually top of casing, top of pipe clamp or top of pump base or foundation.

b/ Method of lift: T, turbine; B, bucket; C, cylinder; G, gasoline engine; E, electric; W, windmill; H, hand. Number indicates horsepower.

| Well | Height of measuring point above ground (ft.) a/ | WATER LEVEL | | Method of lift b/ | Use of water c/ | Remarks |
|---|---|---|---|---|---|---|
| | | Below land surface (ft.) | Date of measurement | | | |
| 422 | 13.3 | 337.8 | Mar. 11, 1943 | None | N | Altitude of land surface, 942.5. |
| 423 | -- | -- | -- | C,W | S | Water level more than 340 feet below surface Dec.14,1944. |
| 424 | -- | -- | -- | C,W | S | Well penetrates upper part of Glen Rose limestone. See log. Water level approximately 370 feet below surface Dec. 1, 1943. Estimated yield 3 gallons a minute. |
| 425 | -- | -- | Dec. 25, 1944 | Flows C,H | D | Casing: 18 feet of 6-inch cemented in Austin chalk. Supplies railroad community. Estimated flow Dec. 25, 1944, 3 gallons a minute. Does not flow in dry seasons. |
| 426 | -- | d/ 49 | -- | C,W | D,S | Dug well, brick curb. Has supplied eight families at one time. |
| 427 | -- | -- | -- | Flows | N | Estimated flow 100 gallons a minute in 1941. |
| 428 | -- | d/ 90 | -- | None | N | Some water reported from Austin chalk. Sulphur water from Edwards limestone at 912 feet. |
| 429 | 0.5 | d/275 | -- | C,W | D,S | Reported yield 15 gallons a minute from sand at 585-601 feet. Walnut clay reported at 365 feet. |

c/ Use of water: Ind, industrial; P, public supply; D, domestic; S, stock; N, not used.

d/ Water level reported.

Table of drillers' logs, Comal County, Texas

#### Well 65

George Faber, 6½ miles southeast of Hancock.

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Dobie | 10 | 10 |
| Boulders | 20 | 30 |
| Red boulders | 23 | 53 |
| Yellow clay (water at 87 feet) | 83 | 130 |
| Blue clay and limestone | 20 | 150 |
| Yellow clay and limestone | 55 | 205 |
| Blue gray limestone | 45 | 250 |
| Gray and blue limestone | 205 | 455 |

#### Well 75

A. J. Monier, 7 miles southwest of Hancock.

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Hard yellow limestone | 15 | 15 |
| Blue marl | 5 | 20 |
| Clay and marl, light blue | 5 | 25 |
| Light gray soft limestone | 5 | 30 |
| Light blue clay | 20 | 50 |
| Hard white limestone | 5 | 55 |
| Slightly pink limestone | 10 | 65 |
| Light grey marl | 30 | 95 |
| Dark blue marl | 6 | 101 |
| Alternating beds of limestone and marl, water at 287 feet | 196 | 297 |

#### Well 92

A. J. Welser, 10 miles northeast of Hancock.

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Surface | 1 | 1 |
| Broken limestone and clay | 44 | 45 |
| Blue limestone | 64 | 109 |
| Blue gray chalk and limestone | 121 | 230 |
| Blue chalk and limestone | 100 | 330 |
| Gray limestone | 85 | 415 |
| Chalky limestone and clay | 5 | 420 |

#### Well 92--Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Sticky gray shale with beds of limestone | 140 | 560 |
| Sticky clay | 11 | 571 |
| Blue limestone | 24 | 595 |
| Sticky shale | 5 | 600 |
| Yellow limestone | 100 | 700 |
| Grey shells | 35 | 735 |
| Black and white sandstone | 12 | 747 |

#### Well 197

Henry Rompel, 11½ miles northeast of Bulverde.

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Soil | 17 | 17 |
| Boulders | 8 | 25 |
| Boulders and clay | 25 | 50 |
| Sandy clay, hard, seep water | 22 | 72 |
| Cave | 2 | 74 |
| Hard limestone | 29 | 103 |
| Hard white rock, enough water for drilling | 32 | 135 |
| Yellow clay | 75 | 210 |
| Blue clay | 18 | 228 |
| Sand | 12 | 240 |

#### Well 255

Rubin Moeller, 7½ miles west of New Braunfels.

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Limestone | 270 | 270 |
| Yellow clay | 10 | 280 |
| Limestone | 50 | 330 |

#### Well 266

A. Swanson, 1½ miles northwest of New Braunfels.

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Gravel and red clay | 28 | 28 |
| Hard limestone | 52 | 80 |
| Red clay | 40 | 120 |
| Hard limestone | 8 | 128 |
| Coarse honeycomb (water) | 4 | 132 |
| Hard limestone | 16 | 148 |
| Very coarse honeycombed limestone, water | 4 | 152 |

Table of drillers' logs, Comal County--Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| **Well 361** | | |
| Emma Rose, 4¼ miles northeast of New Braunfels. | | |
| Top soil | 3 | 3 |
| Yellow clay and gravel | 25 | 28 |
| Blue shale | 2 | 30 |
| Gravel | 2 | 32 |
| **Well 388** | | |
| E. J. Heidrick, 6½ miles northwest of New Braunfels. | | |
| Surface | 2 | 2 |
| Hard limestone, Edwards | 10 | 12 |
| Hard boulder | 2 | 14 |
| Red clay | 2 | 16 |
| Boulder, hard | 4 | 20 |
| Dobie | 8 | 28 |
| Boulder, hard | 6 | 34 |
| Dobie | 22 | 56 |
| Rock, hard | 4 | 60 |
| Cave, no returns | 3 | 63 |
| Limestone | 32 | 95 |
| Hard rock | 10 | 105 |
| Dry sand | 10 | 115 |
| Hard rock | 2 | 117 |
| Honeycomb rock | 3 | 120 |
| Hard limestone | 20 | 140 |
| Red clay | 4 | 144 |
| Pink lime | 11 | 155 |
| Red clay | 5 | 160 |
| Red dobie | 4 | 164 |
| Red clay | 16 | 180 |
| Cave, no returns | 10 | 190 |
| White limestone | 105 | 295 |
| Blue limestone | 25 | 320 |
| Yellow clay | 75 | 395 |
| Blue limestone | 261 | 656 |
| Glen Rose | 237 | 893 |
| Blue and grey limestone | 85 | 978 |
| Brown limestone (gas) | 85 | 1063 |
| Trinity? | 99 | 1162 |
| Blue mud | 16 | 1178 |
| Blue limestone | 102 | 1280 |
| Blue mud, water sand | 62 | 1342 |
| Gray limestone (sulphur water at 1363 feet) | 21 | 1363 |
| Green shale | 153 | 1516 |
| Gray limestone | 2 | 1518 |
| Red bed | 182 | 1700 |

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| **Well 388--Continued** | | |
| Limestone | 66 | 1766 |
| Red bed | .5 | 1771 |
| Blue limestone | 24 | 1795 |
| Black limestone | 20 | 1815 |
| Schist | 52 | 1867 |
| **Well 395** | | |
| W. S. Suttle, 2¼ miles southwest of New Braunfels. | | |
| Yellow clay | 60 | 60 |
| Blue clay | 255 | 305 |
| Austin chalk | 150 | 455 |
| Eagle Ford | 15 | 470 |
| Buda | 70 | 540 |
| Del Rio | 40 | 580 |
| Georgetown | 20 | 600 |
| Edwards | 5 | 610 |
| **Well 401*** | | |
| Bretzke, 5 miles northwest of New Braunfels. Core test, U. S. Army, Corps of Engineers. | | |
| Limestone, lower 4.0 feet ... soft | 6 | 6 |
| Limestone, slightly porous | 0.5 | 6.5 |
| Limestone with chert inclusions | 0.7 | 7.2 |
| White chalky limestone, slightly porous | 3.6 | 10.8 |
| White porous limestone, pores coated with iron oxide, small chert inclusions at 12.2 | 2.2 | 13.0 |
| Iron stained, brown limestone | 0.5 | 13.5 |
| Light grey limestone, small cavity at 16.0 | 0.5 | 16.0 |
| Porous limestone | 5.0 | 21.0 |
| Light grey porous limestone | 1.0 | 22.0 |
| Gray porous limestone, pores colored by iron oxide | 3.6 | 25.6 |
| Gray limestone, non-porous | 2.4 | 28.0 |
| Porous limestone | 1.4 | 29.4 |
| Gray limestone, slightly porous | 2.1 | 31.5 |

(Continued on next page)

Table of drillers' logs, Comal County--Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Well 401*--Continued | | |
| Porous light grey limestone, pores stained with iron oxide | 1.5 | 33.0 |
| Grey limestone | 1.4 | 34.4 |
| Gray porous limestone | 0.6 | 35.0 |
| Brown-gray limestone, chert at 37.0 | 2.0 | 37.0 |
| Gray limestone | 7.0 | 44.0 |
| Cavity partially filled with red clay | 1.0 | 45.0 |
| Gray, very porous limestone, slightly cavernous | 12.0 | 57.0 |
| Porous limestone with cavities 2 and 3 inches deep | 21.0 | 78.0 |
| Gray porous limestone | 9.0 | 87.0 |
| Grey limestone, non-porous | 2.7 | 89.7 |
| Cavity | 0.3 | 90.0 |
| Porous gray limestone | 3.0 | 93.0 |
| Cavity | 0.8 | 93.8 |
| Porous gray limestone | 2.2 | 96.0 |
| Cavity | 1.0 | 97.0 |
| Porous limestone | 1.0 | 98.0 |
| Cavity | 1.0 | 99.0 |
| Grey porous limestone | 8.0 | 107.0 |
| Cavity | 0.8 | 107.8 |
| Gray porous limestone | 2.2 | 110.0 |
| Cavity | 1.8 | 111.8 |
| Porous limestone, cavern crystals | 1.0 | 112.8 |
| Porous grey limestone, cavern crystals | 6.8 | 119.6 |
| Grey limestone | 1.6 | 121.2 |
| Porous limestone | 0.8 | 122.0 |
| Gray slightly porous limestone | 3.0 | 125.0 |
| Grey limestone | 4.1 | 129.1 |
| Grey porous limestone | 0.4 | 129.5 |
| Grey limestone | 0.5 | 131.0 |
| Gray slightly porous limestone, chert at 131.3 | 2.6 | 133.6 |
| Dark grey porous limestone, pores stained with iron oxide | 3.4 | 137.0 |
| Chert | 0.1 | 137.1 |
| Cavity | 4.0 | 140.1 |
| Dark grey, crystalline, porous, limestone, chert seems at 141.0 | 0.9 | 141.0 |
| Gray crystalline limestone, slightly porous | 6.8 | 147.8 |
| Gray porous limestone | 2.2 | 150.0 |

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Well 401*--Continued | | |
| Cavity | 0.8 | 150.8 |
| Grey porous limestone | 1.2 | 152.0 |
| Cavity | 1.0 | 153.0 |
| Grey porous limestone | 2.0 | 155.0 |
| Cavity | 1.0 | 156.0 |
| Porous limestone | 2.0 | 158.0 |
| Cavity | 1.0 | 159.0 |
| Porous limestone | 1.0 | 160.0 |
| Cavity | 0.8 | 160.8 |
| Very porous limestone | 4.2 | 165.0 |
| Cavity | 1.0 | 166.0 |
| Grey porous limestone | 3.0 | 169.0 |
| Cavity | 1.0 | 170.0 |
| Brown and grey porous limestone | 2.0 | 172.0 |
| Cavity | 0.7 | 172.7 |
| Grey porous limestone | 1.3 | 174.0 |
| Cavity | 0.9 | 174.9 |
| Very porous limestone | 1.1 | 176.0 |
| Cavity | 3.0 | 179.0 |
| Brown, very porous limestone | 1.0 | 180.0 |
| Cavity | 0.7 | 180.7 |
| Porous limestone, stained with iron oxide | 1.3 | 182.0 |
| Brown, very porous limestone, cherty | 3.3 | 185.3 |
| Cavity | 0.8 | 186.1 |
| Brown porous limestone with chert | 7.5 | 193.6 |
| Cavity | 0.4 | 194.0 |
| Grey porous limestone | 3.0 | 197.0 |
| Cavity | 2.0 | 199.0 |
| Brown porous limestone | 4.0 | 203.0 |
| Cavity | 0.7 | 203.7 |
| Grey porous limestone, chert inclusions | 0.3 | 204.0 |
| Grey porous limestone | 2.1 | 206.1 |
| Grey limestone | 1.4 | 207.5 |
| Brown porous limestone | 2.5 | 210.0 |
| Gray limestone | 1.4 | 211.4 |
| Porous grey limestone | 1.6 | 213.0 |
| Porous crystalline limestone | 3.0 | 216.0 |
| Porous limestone | 2.0 | 218.0 |
| Cavity | 0.9 | 218.9 |
| Grey porous limestone | 5.2 | 224.1 |
| Cavity | 0.5 | 224.6 |
| Brown porous limestone, large calcite crystals | 7.4 | 232.0 |
| Cavity | 0.9 | 232.9 |
| Brown porous limestone | 1.1 | 234.0 |
| Cavity | 1.0 | 235.0 |
| Gray, porous, broken, cherty limestone | 2.0 | 237.0 |

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Table of drillers' logs, Comal County--Continued

Well 402

City of New Braunfels, $1\frac{1}{2}$ miles north of New Braunfels.

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Surface rock | 9 | 9 |
| Red clay | 6 | 15 |
| Gravel(water) | 13 | 28 |
| Georgetown limestone | 30 | 58 |
| Edwards limestone | 58 | 116 |

Well 419 , partial log

Mrs. B. Gruene Est., $3\frac{1}{4}$ miles northeast of New Braunfels.

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Taylor marl | 292 | 292 |
| Austin chalk | 193 | 485 |
| Eagle Ford shale | 20 | 505 |
| Buda limestone | 35 | 540 |
| Grayson(Del Rio) shale | 40 | 580 |
| Georgetown limestone | 20 | 600 |
| Edwards and Comanche Peak limestones | 459 | 1059 |
| Glen Rose limestone | ? | ? |
| TOTAL DEPTH | | 2350 |

Well 420

Mrs. Lydia Kirmse, $3\frac{1}{4}$ miles northeast of New Braunfels.

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Sand | 5 | 5 |
| Gravel, hard | 2 | 7 |
| Sand, clay and gravel | 58 | 65 |

Well 424

R. R. Williams, 11 miles northeast of New Braunfels.

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Edwards limestone | 220 | 220 |
| Caves-red-no water | 40 | 260 |
| White rock | 10 | 270 |
| Yellow clay and mud | 25 | 295 |
| White limestone(hard) | 15 | 310 |
| Yellow marl | 40 | 350 |
| Blue shale and blue limestone, water at 200, 365, 400 and 420 feet | 70 | 420 |

Records of water levels in observation wells in Comal County, Texas

Altitudes of water levels are referred to mean sea level, U. S. Coast and Geodetic Survey datum.

117

Alfred Beierle, 9 miles northeast of Bulverde. Measuring point, top of casing, altitude 1006.57 feet, level with land-surface datum.

| Date | Water level in feet below land surface | Altitude of water level | Date | Water level in feet below land surface | Altitude of water level |
|---|---|---|---|---|---|
| 1936, Nov. 20 | 119.10 | 887.47 | 1940, Sept. 27 | 126.72 | 879.85 |
| 1939, Oct. 11 | 124.98 | 881.59 | Oct. 29 | 125.77 | 880.80 |
| Dec. 19 | 132.68 | 873.89 | Dec. 5 | 131.25 | 875.32 |
| 1940, Jan. 29 | 134.07 | 872.50 | 1941, Jan. 24 | 131.77 | 874.80 |
| Feb. 27 | 135.06 | 871.51 | 1942, Apr. 3 | 129.33 | 877.24 |
| Mar. 26 | 130.88 | 875.69 | 1943, Sept. 10 | 123.24 | 883.33 |
| Apr. 30 | 131.39 | 875.18 | Dec. 20 | 122.87 | 883.70 |
| May 23 | 130.80 | 875.77 | 1945, May 17 | 95.30 | 911.27 |
| July 1 | 133.26 | 873.31 | July 12 | 102.± | 904.57 |
| July 26 | 147.94 | 858.63 | 1946, Mar. 20 | 120.46 | 886.11 |
| Aug. 28 | 128.96 | 877.61 | | | |

118

Roland Benzeil, 9.5 miles northeast of Bulverde. Measuring point, top of iron pipe clamp, altitude 1016.65 feet, 0.8 foot above land-surface datum.

| | | | | | |
|---|---|---|---|---|---|
| 1937, Jan. 26 | 92.70 | 923.15 | 1941, Mar. 25 | 92.61 | 923.24 |
| 1939, Oct. 11 | 92.70 | 923.15 | May 22 | 92.08 | 923.77 |
| Dec. 19 | 92.72 | 923.13 | Nov. 18 | 92.66 | 923.19 |
| 1940, Jan. 29 | 92.69 | 923.16 | 1942, Apr. 3 | 92.73 | 923.12 |
| Feb. 27 | 92.72 | 923.13 | Aug. 7 | 92.68 | 923.17 |
| Mar. 26 | 92.69 | 923.16 | Dec. 8 | 92.64 | 923.21 |
| Apr. 30 | 92.69 | 923.16 | 1943, Apr. 19 | 92.65 | 923.20 |
| May 29 | 92.69 | 923.16 | Sept. 10 | 92.66 | 923.19 |
| July 1 | 92.71 | 923.14 | Dec. 20 | 92.67 | 923.18 |
| July 26 | 92.74 | 923.11 | 1944, May 2 | 91.16 | 924.69 |
| Aug. 28 | 92.67 | 923.18 | Aug. 24 | 92.63 | 923.22 |
| Sept. 27 | 92.68 | 923.17 | Dec. 18 | 92.63 | 923.22 |
| Oct. 29 | 92.68 | 923.17 | 1945, May 17 | 93.00 | 922.85 |
| Dec. 5 | 92.69 | 923.16 | July 12 | 92.63 | 923.22 |
| 1941, Jan. 24 | 92.66 | 923.19 | 1946, Mar. 20 | 92.61 | 923.24 |

119

Mrs. John Stricker, 9.5 miles northeast of Bulverde. Measuring point, top of concrete block, altitude 1031.88 feet, 0.2 foot above land-surface datum.

| | | | | | |
|---|---|---|---|---|---|
| 1936, Nov. 19 | 166.70 | 894.98 | 1940, Apr. 30 | 173.67 | 858.01 |
| 1939, Oct. 11 | 172.47 | 859.21 | May 23 | 173.74 | 857.94 |
| Dec. 19 | 173.13 | 858.55 | June 27 | 173.86 | 857.82 |
| 1940, Jan. 29 | 173.35 | 858.33 | July 25 | 173.92 | 857.76 |
| Feb. 27 | 173.33 | 858.35 | Aug. 27 | 173.93 | 857.75 |
| Mar. 26 | 173.66 | 858.02 | Sept. 26 | 174.04 | 857.64 |

(continued on next page)

Records of water levels in observation wells in Comal County--Continued

119(continued)

| Date | | Water level in feet below land surface | Altitude of water level | Date | | Water level in feet below land surface | Altitude of water level |
|---|---|---|---|---|---|---|---|
| 1940, | Oct. 28 | 173.79 | 857.89 | 1943, | Apr. 19 | 167.85 | 863.83 |
| | Dec. 5 | 174.13 | 857.55 | | Sept.10 | 170.89 | 860.79 |
| 1941, | Jan. 24 | 173.94 | 857.74 | | Dec. 20 | 171.37 | 860.31 |
| | Mar. 25 | 172.27 | 859.41 | 1944 | May 2 | 166.82 | 864.86 |
| | May 22 | 167.18 | 864.50 | | Aug. 24 | 155.55 | 876.13 |
| | Nov. 18 | 162.92 | 868.76 | | Dec. 18 | 161.29 | 870.39 |
| 1942 | Apr. 3 | 168.48 | 863.20 | 1945 | May 17 | 138.40 | 893.28 |
| | Aug. 7 | 171.46 | 860.22 | | July 12 | 138.80 | 892.88 |
| | Dec. 8 | 165.72 | 865.96 | 1946 | Mar. 20 | 162.75 | 868.93 |

120

Albert Marek, 8 miles northeast of Bulverde. Measuring point, hole in bottom of pipe clamp, raised 0.2 foot in November 1941 and is now 1.0 foot above land surface datum and 1030.34 feet above mean sea level.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1936, | Nov. 16 | 74.10 | 955.24 | 1940, | Oct. 29 | 83.40 | 945.94 |
| 1939, | Oct. 29 | 77.77 | 951.57 | | Dec. 5 | 75.06 | 954.28 |
| | Dec. 19 | 78.13 | 951.21 | 1941, | May 22 | 67.03 | 962.31 |
| 1940, | Jan. 29 | 77.80 | 951.54 | | Nov. 18 | 75.15 | 954.39 |
| | Feb. 28 | 79.51 | 949.83 | 1942, | Apr. 3 | 79.88 | 949.66 |
| | Mar. 26 | 80.15 | 949.19 | | Dec. 8 | 73.33 | 956.21 |
| | Apr. 30 | 80.08 | 949.28 | 1943, | Apr. 19 | 76.19 | 953.35 |
| | May 23 | 80.20 | 949.14 | | Sept.10 | 75.83 | 953.71 |
| | June 27 | 85.33 | 944.01 | | Dec. 20 | 76.31 | 953.03 |
| | July 25 | 82.05 | 947.29 | 1944, | Dec. 18 | 72.96 | 956.38 |
| | Aug. 27 | 87.90 | 941.44 | 1945, | May 17 | 72.90 | 945.44 |
| | Aug. 28 | 83.26 | 946.08 | | July 12 | 76.40 | 951.94 |
| | Sept.26 | 81.87 | 947.37 | 1946 | Mar. 20 | 72.64 | 956.70 |

131

J. J. Arreches, 5.5 miles northeast of Bulverde. Measuring point, top of iron pipe clamp, altitude 1205.97 feet, 1.5 feet above land-surface datum.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1936, | Nov. 16 | 116.30 | 1088.17 | 1941, | Jan. 24 | 119.23 | 1085.24 |
| 1939, | Oct. 12 | 117.76 | 1086.71 | | Mar. 25 | 116.00 | 1088.47 |
| 1940, | Jan. 29 | 118.41 | 1086.06 | | Nov. 18 | 109.80 | 1094.67 |
| | Feb. 27 | 118.61 | 1085.86 | 1942, | Apr. 3 | 112.53 | 1091.94 |
| | Mar. 26 | 118.84 | 1085.63 | | Aug. 7 | 114.39 | 1090.08 |
| | Apr. 30 | 119.08 | 1085.39 | | Dec. 8 | 109.56 | 1094.91 |
| | May 29 | 119.26 | 1085.21 | 1943, | Apr. 19 | 111.98 | 1092.49 |
| | June 27 | 119.32 | 1085.15 | | Sept.10 | 115.58 | 1088.89 |
| | July 25 | 119.33 | 1085.14 | | Dec. 20 | 116.19 | 1088.28 |
| | Aug. 27 | 119.48 | 1084.99 | 1944, | Aug. 24 | 106.82 | 1097.65 |
| | Sept.27 | 119.71 | 1084.76 | | Dec. 18 | 109.88 | 1094.59 |
| | Oct. 29 | 119.87 | 1084.60 | 1945, | July 12 | 101.88 | 1102.59 |
| | Dec. 5 | 120.02 | 1084.45 | 1946, | Mar. 20 | 108.68 | 1095.79 |

Records of water levels in observation wells in Comal County--Continued

155

George Fronne, 5 miles northeast of Bulverde. Measuring point, top of wood pipe clamp, altitude 1242.14 feet, 0.7 foot above land-surface datum.

| Date | Water level in feet below land surface | Altitude of water level | Date | Water level in feet below land surface | Altitude of water level |
|---|---|---|---|---|---|
| 1936, Dec. 10 | 83.00 | 1158.44 | 1940, Oct. 28 | 115.96 | 1125.48 |
| 1939, Jan. 29 | 120.30 | 1121.30 | 1941, Jan. 29 | 115.83 | 1125.61 |
| Oct. 12 | 114.85 | 1126.59 | Mar. 25 | 41.40 | 1200.04 |
| Dec. 19 | 115.89 | 1125.55 | May 22 | 42.47 | 1198.97 |
| 1940, Feb. 28 | 115.61 | 1125.83 | 1942, Apr. 3 | 85.30 | 1156.14 |
| Mar. 26 | 115.90 | 1125.54 | 1943, Sept. 11 | 116.04 | 1125.40 |
| May 23 | 115.95 | 1125.49 | Dec. 20 | 115.48 | 1125.96 |
| July 1 | 116.03 | 1125.41 | 1944, Aug. 24 | 119.52 | 1121.92 |
| July 25 | 115.92 | 1125.52 | 1945, May 17 | 114.70 | 1126.74 |
| Aug. 27 | 116.00 | 1125.44 | July 12 | 116.60 | 1124.84 |
| Sept. 26 | 116.12 | 1125.32 | 1946 Mar. 20 | 113.1 | 1128.34 |

162

H. Conrads, 10 miles northeast of Bulverde. Measuring point, top of pipe clamp, altitude 1174.66 feet, 0.6 foot above land-surface datum.

| | | | | | |
|---|---|---|---|---|---|
| 1940, Jan. 29 | 139.11 | 1034.95 | 1941, May 22 | 132.80 | 1041.26 |
| Feb. 27 | 139.25 | 1034.81 | Nov. 18 | 138.20 | 1035.86 |
| Mar. 26 | 139.48 | 1034.58 | 1942, Dec. 8 | 136.5 | 1037.56 |
| Apr. 29 | 139.41 | 1034.65 | 1943, Apr. 19 | 138.68 | 1035.38 |
| May 23 | 139.39 | 1034.67 | Nov. 29 | 141.32 | 1032.74 |
| July 1 | 137.79 | 1036.27 | 1944, Aug. 24 | 138.59 | 1035.47 |
| Aug. 27 | 148.44 | 1025.62 | Dec. 18 | 136.62 | 1036.94 |
| Sept. 27 | 139.91 | 1034.15 | 1945, Apr. 6 | 131.40 | 1042.66 |
| Oct. 28 | 139.45 | 1034.61 | May 17 | 137.40 | 1036.66 |
| 1941, Jan. 29 | 138.39 | 1035.67 | July 5 | 139.50± | 1034.56 |
| Mar. 25 | 132.11 | 1041.95 | 1946, Mar. 19 | 134.4 | 1039.66 |

171

Mrs. Mattie Shelburne, 3.75 miles northeast of Bulverde. Measuring point, top of 8-inch casing, altitude 1157.44 feet, 0.5 foot above land-surface datum.

| | | | | | |
|---|---|---|---|---|---|
| 1936, Nov. 16 | 228.4 | 928.54 | 1941, Mar. 25 | 226.60 | 930.34 |
| 1939, Oct. 12 | 238.16 | 918.78 | May 22 | 204.00 | 952.94 |
| Dec. 19 | 238.44 | 918.50 | Nov. 19 | 226.46 | 930.48 |
| 1940, Jan. 29 | 238.53 | 918.41 | 1942, Apr. 3 | 232.41 | 924.53 |
| Feb. 28 | 238.61 | 918.33 | Aug. 7 | 233.86 | 923.08 |
| Mar. 26 | 238.95 | 917.99 | Dec. 8 | 217.54 | 939.40 |
| Apr. 30 | 238.97 | 917.97 | 1943, Apr. 19 | 229.41 | 927.53 |
| May 23 | 239.04 | 917.90 | Sept. 11 | 236.03 | 920.91 |
| June 27 | 239.21 | 917.73 | Dec. 20 | 234.50 | 922.44 |
| July 25 | 239.19 | 917.75 | 1944, Aug. 24 | 220.27 | 936.67 |
| Aug. 27 | 239.33 | 917.61 | Dec. 18 | 223.78 | 933.16 |
| Sept. 26 | 239.69 | 917.25 | 1945, May 18 | 190.50 | 966.44 |
| Oct. 28 | 239.40 | 917.54 | July 5 | 207.75 | 949.19 |
| Dec. 5 | 238.85 | 918.09 | 1946, Mar. 20 | 224.55 | 932.39 |
| 1941, Jan. 24 | 237.56 | 919.38 | | | |

Records of water levels in observation wells in Comal County, Texas

## 183

Aug. Wehe, in Bulverde. Measuring point, top of wood pipe clamp, altitude 1096.71 feet, 0.5 foot above land-surface datum.

| Date | Water level in feet below land surface | Altitude of water level | Date | Water level in feet below land surface | Altitude of water level |
|---|---|---|---|---|---|
| 1936, Nov. 12 | 217.50 | 878.71 | 1941, May 22 | 44.40 | 1051.81 |
| 1939, Oct. 11 | 286.04 | 810.17 | 1943, Sept. 11 | 265.31 | 830.90 |
| 1940, Jan. 29 | 281.02 | 815.19 | Dec. 20 | 271.17 | 825.04 |
| Feb. 27 | 278.21 | 818.00 | 1945, May 18 | 121.80 | 974.41 |
| May 23 | 278.47 | 817.74 | July 5 | 211.90 | 884.31 |
| July 1 | 276.94 | 819.27 | 1946, Mar. 20 | 217.14 | 879.07 |
| Aug. 27 | 282.55 | 813.66 | | | |

## 184

Charles Willig, 1.75 miles east of Bulverde. Measuring point, top of iron pipe clamp, altitude 1053.40 feet, 1.0 foot above land-surface datum.

| Date | Water level in feet below land surface | Altitude of water level | Date | Water level in feet below land surface | Altitude of water level |
|---|---|---|---|---|---|
| 1936, Nov. 12 | 213.10 | 839.30 | 1941, Mar. 25 | 83.28 | 969.12 |
| 1939, Oct. 11 | 322.09 | 730.31 | Mar. 25 | 83.4 | 969.00 |
| Dec. 19 | 322.35 | 730.05 | May 22 | 60.47 | 991.93 |
| 1940, Jan. 30 | 325.00 | 727.40 | 1943, Apr. 19 | 270.00 | 782.40 |
| Feb. 27 | 322.17 | 730.23 | Sept. 11 | 286.24 | 766.16 |
| June 27 | 323.44 | 728.96 | 1944, Dec. 18 | 136.94 | 915.46 |
| July 25 | 322.41 | 729.99 | 1945, May 4 | 79.00 | 973.40 |
| Oct. 29 | 322.25 | 730.15 | May 18 | 111.00 | 941.40 |
| 1941, Jan. 29 | 298.35 | 754.05 | 1946, Mar. 20 | 183.4 | 869.00 |

## 193

… - Tian, 6.5 miles east of Bulverde. Measuring point, top of casing, altitude 956.14 feet, 0.2 foot above land-surface datum.

| Date | Water level in feet below land surface | Altitude of water level | Date | Water level in feet below land surface | Altitude of water level |
|---|---|---|---|---|---|
| 1936, Nov. 12 | 153.7 | 802.24 | 1940, Aug. 27 | 224.88 | 730.13 |
| 1939, Oct. 12 | 226.55 | 729.39 | Sept. 26 | 225.81 | 730.13 |
| Dec. 19 | 224.75 | 731.19 | Oct. 29 | 225.77 | 730.17 |
| 1940, Jan. 30 | 225.13 | 730.81 | Dec. 25 | 216.92 | 739.02 |
| Feb. 28 | 224.51 | 731.43 | 1941, Jan. 24 | 201.11 | 754.83 |
| Apr. 30 | 225.11 | 730.83 | Mar. 25 | 79.86 | 876.08 |
| May 23 | 224.57 | 731.37 | May 22 | 49.30 | 906.64 |
| June 27 | 223.55 | 732.39 | Nov. 19 | 180.03 | 775.91 |
| July 25 | 225.61 | 730.33 | 1942, Apr. 3 | 213.30 | 742.64 |

(continued on next page)

Records of water levels in observation wells in Comal County--Continued

193(continued)

| Date | Water level in feet below land surface | Altitude of water level | Date | Water level in feet below land surface | Altitude of water level |
|---|---|---|---|---|---|
| 1942, Aug. 7 | 216.24 | 739.70 | 1943, Sept.11 | 208.14 | 747.80 |
| Dec. 8 | 100.07 | 855.87 | Dec. 20 | 220.04 | 735.90 |
| 1943, Apr. 19 | 201.47 | 754.47 | | | |

195

Robert Heimer, 11 miles northeast of Bulverde. Measuring point, top of iron pipe clamp, altitude 1091.03 feet, 0.7 foot above land-surface datum.

| | | | | | |
|---|---|---|---|---|---|
| 1940, Jan. 29 | 49.30 | 1041.03 | 1940, Oct. 29 | 49.35 | 1040.98 |
| Feb. 27 | 49.35 | 1040.98 | Dec. 6 | 49.28 | 1041.05 |
| Apr. 29 | 49.35 | 1040.98 | 1943, Sept.10 | 49.11 | 1041.22 |
| June 27 | 49.27 | 1041.06 | 1945, May 19 | 49.70 | 1040.63 |
| Sept.26 | 61.48 | 1028.85 | July 5 | 49.32 | 1041.01 |
| Sept.27 | 49.36 | 1040.97 | | | |

210

Paul Tonne, 9.5 miles west of New Braunfels. Measuring point, top of iron pipe clamp, altitude 954.56 feet, 0.5 foot above land-surface datum.

| | | | | | |
|---|---|---|---|---|---|
| 1936, Nov. 9 | 255.64 | 698.42 | 1945, May 18 | 254.10 | 699.96 |
| 1937, Jan. 10 | 254.87 | 699.19 | July 11 | 266.90 | 687.16 |
| 1945, May 4 | 246.00 | 708.06 | | | |

221

Albert Simon, 3.5 miles northwest of New Braunfels. Measuring point, top of iron pipe clamp, altitude 793.99 feet, 1.0 foot above land-surface datum.

| | | | | | |
|---|---|---|---|---|---|
| 1936, Nov. 3 | 170 | 622.99 | 1942, Dec. 7 | 157.73 | 635.26 |
| 1939, Dec. 19 | 169.46 | 623.53 | 1943, Apr. 19 | 161.09 | 631.90 |
| 1940, Jan. 29 | 169.71 | 623.28 | Sept.10 | 162.99 | 630.00 |
| Mar. 26 | 169.89 | 623.10 | Dec. 20 | 165.00 | 627.99 |
| Apr. 29 | 169.73 | 623.26 | 1944, Apr. 30 | 165.90 | 627.09 |
| May 24 | 169.96 | 623.03 | Aug. 23 | 159.19 | 633.80 |
| Aug. 28 | 169.64 | 623.35 | Dec. 18 | 161.04 | 631.95 |
| Sept.23 | 170.20 | 622.79 | 1945, May 23 | 155.72 | 637.27 |
| 1941, Aug. 15 | 161.33 | 631.66 | July 2 | 157.05 | 635.94 |
| 1942, Apr. 9 | 163.91 | 629.08 | 1946, Mar. 19 | 161.94 | 631.05 |
| Aug. 7 | 163.09 | 629.90 | | | |

Records of water levels in observation wells in Comal County--Continued

222

William Kraft, 3.5 miles northwest of New Braunfels. Measuring point, top of pipe clamp, altitude 807.00 feet, 0.5 foot above land-surface datum.

| Date | Water level in feet below land surface | Altitude of water level | Date | Water level in feet below land surface | Altitude of water level |
|---|---|---|---|---|---|
| 1939, Dec. 19 | 182.50 | 624.00 | 1941, Nov. 19 | 174.41 | 632.09 |
| 1940, Jan. 29 | 182.71 | 623.79 | 1942, Mar. 6 | 176.72 | 629.78 |
| Feb. 27 | 182.82 | 623.68 | Apr. 9 | 177.24 | 629.26 |
| Mar. 26 | 182.99 | 623.51 | Aug. 7 | 176.73 | 629.77 |
| Apr. 29 | 182.87 | 623.63 | Dec. 7 | 170.46 | 636.04 |
| May 24 | 183.04 | 623.46 | 1943, Apr. 19 | 174.58 | 631.92 |
| July 1 | 181.96 | 624.54 | Sept.10 | 176.76 | 629.74 |
| July 29 | 181.99 | 624.51 | Dec. 20 | 178.59 | 627.91 |
| Aug. 28 | 182.79 | 623.71 | 1944, Apr. 30 | 173.10 | 633.40 |
| Sept.23 | 183.28 | 623.22 | Aug. 23 | 172.50 | 634.00 |
| Oct. 29 | 183.62 | 622.88 | Dec. 18 | 174.58 | 631.92 |
| 1941, Jan. 24 | 181.50 | 625.00 | 1945, Apr. 23 | 168.68 | 637.82 |
| Mar. 28 | 178.43 | 628.07 | July 3 | 170.50 | 636.00 |
| May 23 | 172.53 | 633.97 | 1946, Mar. 19 | 175.30 | 631.20 |

223

L. S. Davis, 3.75 miles northwest of New Braunfels. Measuring point, top of iron pipe clamp, altitude 840.97 feet, 0.9 foot above land-surface datum.

| | | | | | |
|---|---|---|---|---|---|
| 1936, Dec. 21 | 211.08 | 628.99 | 1941, Jan. 29 | 212.99 | 627.08 |
| 1939, Dec. 19 | 214.03 | 626.04 | Aug. 15 | 203.05 | 637.02 |
| 1940, Jan. 29 | 214.33 | 625.74 | Nov. 18 | 204.75 | 635.32 |
| Feb. 27 | 215.66 | 624.41 | 1942, Mar. 6 | 207.41 | 632.66 |
| Mar. 26 | 215.33 | 624.74 | Apr. 9 | 208.04 | 632.03 |
| Apr. 29 | 214.72 | 625.35 | Aug. 7 | 206.21 | 633.86 |
| May 24 | 214.84 | 625.23 | Dec. 7 | 199.47 | 640.60 |
| July 1 | 214.07 | 626.00 | 1943, Sept.10 | 206.92 | 633.15 |
| July 26 | 213.48 | 626.59 | 1944, Dec. 18 | 209.89 | 630.18 |
| Aug. 28 | 214.30 | 625.77 | 1945, Apr. 23 | 197.55 | 642.52 |
| Oct. 29 | 215.19 | 624.88 | July 6 | 199.18 | 640.89 |
| Dec. 5 | 215.06 | 625.01 | 1946, Mar. 19 | 209.08 | 630.99 |

224

F. D. Hutcheson, 4.5 miles northwest of New Braunfels. Measuring point, top of wood pipe clamp, altitude 849.87 feet, 0.7 foot above land-surface datum.

| | | | | | |
|---|---|---|---|---|---|
| 1936, Dec. 31 | 229.98 | 619.19 | 1945, May 23 | 183.50 | 665.67 |
| 1937, Dec. 18 | 212.36 | 636.81 | July 3 | 190.00 | 659.17 |
| 1945, Apr. 13 | 179.10 | 670.07 | | | |

Records of water levels in observation wells in Comal County--Continued

226

Henry Heise, 4.5 miles northwest of New Braunfels. Measuring point, top of iron pipe clamp, altitude 879.09 feet, 0.5 foot above land-surface datum.

| Date | Water level in feet below land surface | Altitude of water level | Date | Water level in feet below land surface | Altitude of water level |
|---|---|---|---|---|---|
| 1936, Dec. 21 | 259.2 | 619.39 | 1940, July 1 | 249.68 | 628.91 |
| 1939, Oct. 9 | 261.40 | 617.19 | Oct. 29 | 251.25 | 627.34 |
| Dec. 18 | 249.58 | 629.01 | Dec. 5 | 251.31 | 627.28 |
| 1940, Jan. 29 | 250.07 | 628.52 | 1941, May 23 | 236.89 | 641.70 |
| Feb. 27 | 250.32 | 628.27 | Aug. 15 | 236.64 | 641.95 |
| Mar. 26 | 250.57 | 628.02 | 1942, Apr. 9 | 242.21 | 636.38 |

232

Krueger Brothers, 6.5 miles west of New Braunfels. Measuring point, top of iron pipe clamp, altitude 942.19 feet, 0.4 foot above land-surface datum.

| | | | | | |
|---|---|---|---|---|---|
| 1937, Jan. 25 | 188.75 | 753.04 | 1941, Nov. 18 | 177.36 | 764.43 |
| 1939, Oct. 10 | 171.89 | 769.90 | 1942, Mar. 6 | 172.81 | 768.98 |
| 1940, Jan. 29 | 179.90 | 761.89 | Apr. 3 | 180.42 | 761.37 |
| Feb. 27 | 175.49 | 766.30 | Aug. 7 | 176.62 | 765.17 |
| Apr. 29 | 177.54 | 764.25 | Dec. 8 | 177.21 | 764.58 |
| May 23 | 180.37 | 761.42 | 1943, Apr. 19 | 167.92 | 773.87 |
| June 27 | 180.93 | 760.86 | Sept. 10 | 167.70 | 774.09 |
| July 26 | 182.46 | 759.33 | Dec. 20 | 174.36 | 767.43 |
| Aug. 27 | 178.43 | 763.36 | 1944, May 1 | 177.03 | 764.76 |
| Sept. 26 | 176.87 | 764.92 | Aug. 24 | 175.19 | 766.60 |
| Oct. 28 | 184.91 | 756.88 | Dec. 18 | 176.28 | 765.51 |
| Dec. 5 | 187.22 | 754.57 | 1945, May 18 | 182.40 | 759.39 |
| 1941, Jan. 24 | 175.16 | 766.63 | July 4 | 181.48 | 760.31 |
| Mar. 25 | 170.54 | 771.25 | 1946, Mar. 19 | 168.00 | 773.79 |
| May 22 | 168.19 | 773.60 | | | |

233

Richard Gesche, 7.5 miles west of New Braunfels. Measuring point, top of casing, altitude 917.65 feet, 1.0 foot above land-surface datum.

| | | | | | |
|---|---|---|---|---|---|
| 1933, Oct. 11 | 267.35 | 649.30 | 1945, May 24 | 233.00 | 683.65 |
| 1936, Dec. 16 | 259.82 | 656.83 | July 3 | 240.48 | 676.17 |

237

Eugene Krause, 10 miles west of New Braunfels. Measuring point, top of concrete block, altitude 905.07 feet, 0.8 foot above land-surface datum.

| | | | | | |
|---|---|---|---|---|---|
| 1933, Oct. 11 | 259.71 | 644.56 | 1945, May 25 | 229.80 | 674.47 |
| 1936, May 25 | 255.54 | 648.73 | July 3 | 232.05 | 672.22 |

Records of water levels in observation wells in Comal County--Continued

251

Schaeffer Brothers, 7.5 miles southwest of New Braunfels. Measuring point, top of pipe clamp, altitude 886.80 feet, 0.66 foot above land-surface datum.

| Date | Water level in feet below land surface | Altitude of water level | Date | Water level in feet below land surface | Altitude of water level |
|---|---|---|---|---|---|
| 1934, May 28 | 241.69 | 644.45 | 1945, May 25 | 231.84 | 654.30 |
| 1936, Dec. 18 | 243.50 | 642.64 | July 13 | 234.74 | 651.40 |

261

O. C. Brehmer, 5 miles west of New Braunfels. Measuring point, top of steel casing, altitude 917.33 feet, 0.46 foot above land-surface datum.

| | | | | | |
|---|---|---|---|---|---|
| 1934, May 25 | 283.63 | 633.24 | 1945, May 23 | 262.14 | 654.73 |
| 1936, Dec. 1 | 278.53 | 638.34 | July 13 | 265.04 | 651.83 |
| 1937, Jan. 10 | 278.37 | 638.50 | | | |

263A

Walter Kappelmacher, 3.5 miles west of New Braunfels. Measuring point, top of $8\frac{1}{4}$-inch casing, altitude 862.38 feet, 0.7 foot above land-surface datum.

| | | | | | |
|---|---|---|---|---|---|
| 1939, Oct. 10 | 233.09 | 628.59 | 1941, Aug. 14 | 223.22 | 638.46 |
| Dec. 18 | 233.80 | 627.88 | Nov. 19 | 225.58 | 636.10 |
| 1940, Jan. 29 | 234.05 | 627.63 | 1942, Jan. 14 | 226.90 | 634.78 |
| Feb. 28 | 234.19 | 627.49 | Mar. 6 | 227.92 | 633.76 |
| Mar. 26 | 234.42 | 627.26 | Apr. 3 | 228.50 | 633.18 |
| Apr. 29 | 234.42 | 627.26 | Aug. 7 | 228.82 | 632.86 |
| May 23 | 234.28 | 627.40 | Dec. 7 | 220.85 | 640.83 |
| June 27 | 233.48 | 628.20 | Dec. 8 | 220.86 | 640.82 |
| July 26 | 233.84 | 627.84 | 1943, Apr. 19 | 224.61 | 637.07 |
| Aug. 27 | 234.41 | 627.27 | Apr. 29 | 224.91 | 636.77 |
| Sept. 23 | 234.85 | 626.83 | Sept. 10 | 227.85 | 633.83 |
| Oct. 29 | 235.27 | 626.41 | 1944, May 1 | 223.98 | 637.70 |
| Dec. 5 | 235.30 | 626.38 | 1945, May 24 | 217.80 | 643.88 |
| 1941, Jan. 24 | 233.64 | 628.04 | July 3 | 219.10 | 643.58 |
| Mar. 28 | 229.87 | 631.81 | 1946, May 19 | 225.1 | 636.58 |

266

A. Swenson, 1.5 miles northwest of New Braunfels. Measuring point, top of iron pipe clamp, altitude 737.05 feet, 1.0 foot above land-surface datum.

| | | | | | |
|---|---|---|---|---|---|
| 1937, Jan. 6 | 100.80 | 635.25 | 1945, May 24 | 110.34 | 625.71 |
| 1945, Apr. 13 | 110.09 | 625.96 | July 2 | 110.85 | 625.20 |
| May 19 | 110.06 | 625.99 | | | |

Records of water levels in observation wells in Comal County--Continued

271

Albert Wallhoefer, 4 miles northeast of New Braunfels. Measuring point, top of wood pipe clamp, altitude 701.24 feet, 0.64 foot above land-surface datum.

| Date | Water level in feet below land surface | Altitude of water level | Date | Water level in feet below land surface | Altitude of water level |
|---|---|---|---|---|---|
| 1936, Dec. 30 | 89.60 | 611.00 | 1940, May 29 | 92.36 | 608.24 |
| 1937, Dec. 15 | 90.11 | 610.49 | June 27 | 92.01 | 608.59 |
| 1938, Jan. 22 | 89.51 | 611.09 | July 29 | 91.86 | 608.74 |
| Feb. 2 | 88.23 | 612.37 | Aug. 27 | 92.31 | 608.29 |
| Mar. 30 | 88.36 | 612.24 | Sept.27 | 92.68 | 607.92 |
| Apr. 22 | 88.56 | 612.04 | Oct. 29 | 92.79 | 607.81 |
| May 18 | 86.40 | 614.20 | Dec. 5 | 92.13 | 608.47 |
| June 22 | 86.86 | 613.74 | 1941, Jan. 24 | 90.58 | 610.02 |
| July 20 | 87.44 | 613.16 | May 23 | 85.19 | 615.41 |
| Sept.29 | 88.98 | 611.62 | Aug. 8 | 85.92 | 614.68 |
| Nov. 22 | 89.38 | 611.22 | Nov. 18 | 87.84 | 612.76 |
| Dec. 13 | 90.76 | 609.84 | 1942, Mar. 6 | 89.31 | 611.29 |
| 1939, Jan. 24 | 90.09 | 610.51 | Apr. 3 | 89.56 | 611.04 |
| Feb. 28 | 90.16 | 610.44 | Aug. 7 | 89.41 | 611.19 |
| Mar. 28 | 90.18 | 610.42 | Dec. 4 | 85.23 | 615.37 |
| Apr. 23 | 90.41 | 610.19 | 1943, Apr. 19 | 88.23 | 612.37 |
| May 26 | 90.91 | 609.69 | Sept.10 | 88.81 | 611.79 |
| July 3 | 90.74 | 609.86 | Dec. 20 | 90.07 | 610.53 |
| Oct. 4 | 92.57 | 608.03 | 1944, Apr. 30 | 86.57 | 614.03 |
| Dec. 18 | 91.78 | 608.82 | Aug. 23 | 86.50 | 614.10 |
| 1940, Jan. 23 | 92.22 | 608.38 | Dec. 18 | 87.76 | 612.84 |
| Feb. 27 | 92.40 | 608.20 | 1945, May 22 | 83.64 | 616.96 |
| Mar. 22 | 92.48 | 608.12 | July 6 | 85.23 | 615.37 |
| Apr. 27 | 92.38 | 608.22 | 1946, Mar. 20 | 88.48 | 612.12 |

274

Charles Soechting, 6 miles northeast of New Braunfels. Measuring point, top of steel casing, altitude 759.31 feet, 1.0 foot above land-surface datum.

| | | | | | |
|---|---|---|---|---|---|
| 1937, Jan. 5 | 157.53 | 600.78 | 1939, Jan. 24 | 151.83 | 606.48 |
| Dec. 15 | 151.49 | 606.82 | Feb. 28 | 154.21 | 604.10 |
| 1938, Jan. 21 | 149.81 | 608.50 | Mar. 28 | 152.91 | 605.40 |
| Feb. 2 | 151.49 | 606.82 | Apr. 23 | 152.75 | 605.56 |
| Mar. 30 | 149.06 | 609.25 | May 26 | 152.86 | 605.45 |
| Apr. 22 | 149.29 | 609.02 | July 3 | 152.50 | 605.81 |
| May 18 | 146.67 | 611.64 | Oct. 4 | 153.73 | 604.58 |
| June 22 | 146.78 | 611.53 | Dec. 18 | 156.02 | 602.29 |
| July 20 | 148.13 | 610.18 | 1940, Jan. 23 | 155.10 | 603.21 |
| Aug. 26 | 150.50 | 607.81 | Feb. 27 | 154.91 | 603.40 |
| Sept.28 | 149.12 | 609.19 | Mar. 22 | 155.17 | 603.14 |
| Nov. 2 | 150.79 | 607.52 | Apr. 29 | 154.52 | 603.79 |
| Dec. 13 | 151.20 | 607.11 | June 27 | 154.82 | 603.49 |

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Records of water levels in observation wells in Comal County--Continued

274(continued)

| Date | Water level in feet below land surface | Altitude of water level | Date | Water level in feet below land surface | Altitude of water level |
|---|---|---|---|---|---|
| 1940, Aug. 27 | 154.45 | 603.86 | 1943, Sept.10 | 149.72 | 608.59 |
| Oct. 30 | 155.71 | 602.60 | Dec. 20 | 151.36 | 606.95 |
| 1941, Jan. 24 | 152.22 | 606.09 | 1944, Apr. 30 | 146.40 | 611.91 |
| Mar. 27 | 149.85 | 608.46 | Aug. 23 | 146.65 | 611.66 |
| Nov. 18 | 148.23 | 610.08 | Dec. 18 | 148.51 | 609.80 |
| 1942, Mar. 6 | 150.33 | 607.98 | 1945, May 23 | 144.08 | 614.23 |
| Apr. 9 | 150.94 | 607.37 | July 6 | 145.60 | 612.71 |
| Aug. 7 | 150.81 | 607.50 | 1946, Mar. 20 | 149.42 | 608.59 |
| Dec. 4 | 145.32 | 612.99 | | | |

[illegible]

O. E. Gruene, 7.5 miles northeast of New Braunfels. Measuring point, top of steel casing, altitude 753.31 feet, 0.61 foot above land-surface datum.

| | | | | | |
|---|---|---|---|---|---|
| 1936, Oct. 20 | 146.63 | 606.07 | 1940, May 24 | 152.24 | 600.46 |
| 1937, Dec. 6 | 149.04 | 603.66 | July 1 | 151.34 | 601.36 |
| 1938, Jan. 21 | 148.15 | 604.55 | July 27 | 151.21 | 601.49 |
| Feb. 2 | 146.34 | 606.36 | Aug. 27 | 151.89 | 600.81 |
| Mar. 30 | 146.62 | 606.08 | Sept.27 | 152.56 | 600.14 |
| Apr. 22 | 146.77 | 605.93 | Oct. 29 | 152.76 | 599.94 |
| May 18 | 143.89 | 608.81 | Dec. 5 | 151.50 | 601.20 |
| June 22 | 144.46 | 608.24 | 1941, Jan. 24 | 149.19 | 603.51 |
| July 20 | 145.46 | 607.24 | Mar. 27 | 146.55 | 606.15 |
| Sept.28 | 148.43 | 604.27 | May 23 | 142.35 | 610.35 |
| Nov. 2 | 148.00 | 604.70 | Nov. 18 | 145.86 | 606.84 |
| Dec. 13 | 148.50 | 604.20 | 1942, Mar. 6 | 147.75 | 604.95 |
| 1939, Jan. 24 | 148.99 | 603.71 | Apr. 3 | 148.25 | 604.45 |
| Feb. 28 | 148.99 | 603.71 | 1943, Apr. 19 | 146.51 | 606.19 |
| Mar. 22 | 149.41 | 603.29 | Sept.10 | 147.16 | 605.54 |
| Apr. 22 | 149.68 | 603.02 | Dec. 20 | 148.71 | 603.99 |
| May 26 | 149.99 | 602.71 | 1944, Apr. 30 | 144.03 | 608.67 |
| July 3 | 150.37 | 602.33 | Aug. 23 | 144.01 | 608.69 |
| Oct. 5 | 151.33 | 601.37 | Dec. 18 | 145.63 | 607.07 |
| 1940, Jan. 23 | 151.97 | 600.73 | 1945, May 22 | 141.01 | 611.69 |
| Feb. 27 | 152.08 | 600.62 | July 6 | 143.25 | 609.45 |
| Mar. 22 | 152.23 | 600.47 | 1946, Mar. 20 | 146.93 | 605.77 |
| Apr. 29 | 152.32 | 600.38 | | | |

291

Bruno Preiss, 2 miles northeast of New Braunfels. Measuring point, top of steel pipe clamp, altitude 673.32 feet, 1.15 feet above land-surface datum.

| | | | | | |
|---|---|---|---|---|---|
| 1936, Oct. 21 | 51.23 | 620.94 | 1938, Feb. 2 | 51.43 | 620.74 |
| 1937, Dec. 6 | 52.93 | 619.24 | Mar. 30 | 51.53 | 620.64 |
| 1938, Jan. 21 | 52.39 | 619.78 | May 18 | 49.76 | 622.41 |

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Records of water levels in observation wells in Comal County--Continued

291(continued)

| Date | Water level in feet below land surface | Altitude of water level | Date | Water level in feet below land surface | Altitude of water level |
|---|---|---|---|---|---|
| 1938, July 19 | 51.23 | 620.94 | 1940, Sept. 23 | 55.42 | 616.75 |
| Aug. 26 | 51.80 | 620.37 | Oct. 28 | 55.43 | 616.74 |
| Sept. 28 | 52.22 | 619.95 | Dec. 5 | 54.80 | 617.37 |
| Nov. 2 | 52.57 | 619.60 | 1941, Jan. 24 | 53.76 | 618.41 |
| Dec. 12 | 52.77 | 619.40 | Mar. 28 | 52.18 | 619.99 |
| 1939, Jan. 24 | 53.02 | 619.15 | May 23 | 49.47 | 622.70 |
| Feb. 28 | 53.26 | 618.91 | Aug. 8 | 50.44 | 621.73 |
| Mar. 28 | 53.37 | 618.80 | Nov. 14 | 51.41 | 620.76 |
| Apr. 23 | 53.64 | 618.53 | 1942, Mar. 6 | 52.46 | 619.71 |
| May 26 | 53.89 | 618.28 | Apr. 3 | 52.73 | 619.44 |
| July 3 | 55.01 | 617.16 | Aug. 7 | 52.71 | 619.46 |
| Oct. 5 | 54.65 | 617.52 | Dec. 4 | 49.57 | 622.60 |
| Dec. 18 | 54.78 | 617.39 | 1943, Apr. 19 | 51.77 | 620.40 |
| 1940, Jan. 24 | 54.85 | 617.32 | Sept. 10 | 52.49 | 619.68 |
| Feb. 27 | 54.95 | 617.22 | Dec. 20 | 55.82 | 616.35 |
| Mar. 22 | 55.04 | 617.13 | 1944, Apr. 30 | 50.93 | 621.24 |
| Apr. 27 | 54.99 | 617.18 | Aug. 23 | 51.26 | 620.91 |
| June 27 | 54.53 | 617.64 | Dec. 19 | 51.51 | 620.66 |
| July 29 | 54.72 | 617.45 | 1945, May 23 | 49.97 | 622.20 |
| Aug. 27 | 55.18 | 616.99 | July 6 | 50.09 | 622.08 |
| | | | 1946, Mar. 20 | 51.96 | 620.21 |

293

Dean Word, 1.25 miles northwest of New Braunfels. Measuring point, top of iron pipe clamp, altitude 748.93 feet, 1.1 feet above land-surface datum.

| | | | | | |
|---|---|---|---|---|---|
| 1937, Jan. 6 | 119.55 | 628.28 | 1945, May 24 | 122.30 | 625.53 |
| 1945, Apr. 13 | 121.90 | 625.93 | July 2 | 122.75 | 625.08 |
| May 19 | 122.10 | 625.73 | | | |

319

Percy Hansman, 8.5 miles southwest of New Braunfels. Measuring point, top of wood blocks, altitude 787.78 feet, 1.25 feet above land-surface datum.

| | | | | | |
|---|---|---|---|---|---|
| 1934, May 24 | 133.93 | 622.60 | 1937, Jan. 7 | 128.88 | 657.65 |
| 1936, Dec. 3 | 127.36 | 659.17 | | | |

326

William Sheeffer, 7 miles southwest of New Braunfels. Measuring point, top of wood pipe clamp, raised 0.44 foot January 30, 1940 and is now 1.54 feet above land-surface and 685.99 feet above mean sea level.

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Records of water levels in observation wells in Comal County--Continued

326(continued)

| Date | Water level in feet below land surface | Altitude of water level | Date | Water level in feet below land surface | Altitude of water level |
|---|---|---|---|---|---|
| 1934, May 24 | 34.48 | 649.97 | 1940, June 21 | 38.12 | 646.33 |
| 1937, Jan. 7 | 28.48 | 655.97 | July 25 | 38.34 | 646.11 |
| 1938, Jan. 21 | 30.41 | 654.04 | Aug. 28 | 40.34 | 644.11 |
| Feb. 2 | 29.00 | 655.45 | Sept. 24 | 40.54 | 643.91 |
| Mar. 30 | 29.37 | 655.08 | Oct. 29 | 39.76 | 644.69 |
| Apr. 22 | 29.61 | 654.84 | Dec. 4 | 38.48 | 645.97 |
| May 19 | 27.47 | 656.98 | 1941, Jan. 29 | 36.64 | 647.81 |
| June 23 | 29.44 | 655.01 | Mar. 25 | 31.93 | 652.52 |
| July 20 | 30.93 | 653.52 | May 23 | 27.38 | 657.07 |
| Aug. 25 | 33.00 | 651.45 | Aug. 7 | 30.52 | 653.93 |
| Sept. 28 | 32.45 | 652.00 | Nov. 14 | 30.40 | 654.05 |
| 1939, Jan. 24 | 33.45 | 651.00 | 1942, Mar. 6 | 31.66 | 652.79 |
| Feb. 28 | 34.88 | 649.57 | Apr. 9 | 32.27 | 652.18 |
| Mar. 28 | 34.29 | 650.16 | Aug. 7 | 33.94 | 650.51 |
| Apr. 23 | 35.67 | 648.78 | 1943, Apr. 20 | 31.26 | 653.19 |
| May 26 | 36.78 | 647.67 | Sept. 10 | 34.24 | 650.21 |
| July 3 | 38.65 | 645.80 | Dec. 21 | 35.06 | 649.39 |
| Oct. 5 | 38.57 | 645.88 | 1944, Aug. 24 | 35.19 | 649.26 |
| 1940, Jan. 30 | 37.37 | 647.08 | Dec. 19 | 31.97 | 652.48 |
| Feb. 20 | 37.53 | 646.92 | 1945, May 23 | 28.32 | 656.13 |
| Mar. 22 | 38.42 | 646.03 | July 4 | 30.90 | 653.55 |
| Apr. 26 | 38.84 | 645.61 | 1946, Mar. 19 | 32.94 | 651.51 |
| May 23 | 38.95 | 645.50 | | | |

332

Ben Jahn, 6 miles southwest of New Braunfels. Measuring point, top of pipe clamp, altitude 729.63 feet, 1.0 foot above land-surface datum.

| | | | | | |
|---|---|---|---|---|---|
| 1934, May 28 | 82.86 | 645.77 | 1935, Nov. 21 | 77.14 | 651.49 |
| Oct. 8 | 85.24 | 643.39 | 1936, Jan. 19 | 78.21 | 650.42 |
| 1935, Aug. 9 | 73.63 | 655.00 | Dec. 18 | 79.61 | 649.02 |

333

O. Penshorn, 6 miles southwest of New Braunfels. Measuring point, top of iron pipe clamp, raised 0.85 foot Dec. 1936 and is now 0.85 foot above land surface and 695.52 feet above mean sea level.

| | | | | | |
|---|---|---|---|---|---|
| 1934, May 28 | 53.00 | 641.67 | 1936, Jan. 19 | 31.92 | 662.75 |
| Oct. 9 | 43.25 | 651.42 | Dec. 3 | 29.49 | 665.18 |
| 1935, Aug. 10 | 35.50 | 659.17 | 1937, Jan. 7 | 36.58 | 658.09 |
| Nov. 21 | 30.96 | 663.71 | 1945, July 13 | 34.58 | 660.09 |

Records of water levels in observation wells in Comal County--Continued

336

A. W. Feick, 5.5 miles southwest of New Braunfels. Measuring point, top of steel casing, altitude 728.87 feet, 0.74 foot above land-surface datum.

| Date | Water level in feet below land surface | Altitude of water level | Date | Water level in feet below land surface | Altitude of water level |
|---|---|---|---|---|---|
| 1934, May 28 | 69.94 | 658.19 | 1940, Apr. 30 | 86.94 | 641.19 |
| 1936, Oct. 26 | 77.08 | 651.05 | May 23 | 87.46 | 640.67 |
| 1937, Dec. 15 | 80.52 | 647.61 | June 21 | 86.97 | 641.16 |
| 1938, Jan. 21 | 79.43 | 648.70 | July 25 | 86.81 | 641.32 |
| Feb. 2 | 77.85 | 650.28 | Aug. 28 | 88.40 | 639.73 |
| Mar. 30 | 78.13 | 650.00 | Sept.26 | 88.75 | 639.38 |
| Apr. 22 | 78.87 | 649.26 | Oct. 29 | 88.63 | 639.50 |
| May 19 | 76.83 | 651.30 | Dec. 4 | 87.31 | 640.82 |
| June 23 | 78.16 | 649.97 | 1941, Jan. 29 | 85.37 | 642.76 |
| July 20 | 80.00 | 648.13 | Mar. 25 | 81.78 | 646.35 |
| Aug. 25 | 80.76 | 647.37 | May 23 | 78.14 | 649.99 |
| Sept.28 | 82.66 | 645.47 | Aug. 7 | 79.72 | 648.41 |
| Dec. 12 | 82.18 | 645.95 | Nov. 14 | 79.77 | 648.36 |
| 1939, Jan. 24 | 83.20 | 644.93 | 1942, Mar. 6 | 81.19 | 646.94 |
| Feb. 28 | 82.66 | 645.47 | Apr. 9 | 81.69 | 646.44 |
| Mar. 28 | 83.26 | 644.87 | Aug. 6 | 82.61 | 645.52 |
| Apr. 22 | 84.18 | 643.95 | Dec. 3 | 76.70 | 651.43 |
| May 26 | 84.94 | 643.19 | 1943, Apr. 20 | 80.67 | 647.46 |
| July 3 | 86.96 | 641.17 | Sept.10 | 84.11 | 644.02 |
| Oct. 5 | 86.60 | 641.53 | Dec. 21 | 84.19 | 643.94 |
| Dec. 19 | 86.05 | 642.08 | 1944, Aug. 24 | 83.97 | 644.16 |
| 1940, Jan. 30 | 85.72 | 642.41 | Dec. 19 | 81.87 | 646.26 |
| Feb. 20 | 86.07 | 642.06 | 1945, May 23 | 78.44 | 649.69 |
| Mar. 22 | 86.74 | 641.39 | July 4 | 80.05 | 648.08 |
| | | | 1946, Mar. 19 | 83.66 | 644.47 |

339

Otto Reinartz, 4 miles southwest of New Braunfels. Measuring point, land surface, altitude 666.77 feet.

| | | | | | |
|---|---|---|---|---|---|
| 1934, May 24 | 15.90 | 650.87 | 1935, Aug. 10 | 15.00 | 651.77 |
| Oct. 8 | 19.07 | 647.70 | 1936, Dec. 3 | 9.41 | 657.36 |
| 1935, Aug. 6 | 15.90 | 650.87 | | | |

373

L. Jentsch, 3.5 miles southwest of New Braunfels. Measuring point, top of casing, altitude 662.95 feet, 1.5 feet above land-surface datum.

| | | | | | |
|---|---|---|---|---|---|
| 1936, Dec. 4 | 16.44 | 645.01 | 1938, Mar. 30 | 18.33 | 643.12 |
| 1937, Dec. 15 | 19.99 | 641.46 | Apr. 22 | 18.95 | 642.50 |
| 1938, Jan. 21 | 19.46 | 641.99 | May 19 | 17.25 | 644.20 |
| Feb. 2 | 18.27 | 643.18 | 1939, Jan. 25 | 21.87 | 639.58 |

(continued on next page)

Records of water levels in observation wells in Comal County--Continued

373 (continued)

| Date | | Water level in feet below land surface | Altitude of water level | Date | | Water level in feet below land surface | Altitude of water level |
|---|---|---|---|---|---|---|---|
| 1939, | Apr. 23 | 23.41 | 638.04 | 1941, | Nov. 14 | 19.81 | 641.64 |
| | May 26 | 23.90 | 637.55 | 1942, | Mar. 6 | 21.10 | 640.35 |
| | July 3 | 24.65 | 636.80 | | Apr. 9 | 20.34 | 641.11 |
| | Oct. 5 | 25.13 | 636.32 | | Aug. 7 | 22.19 | 639.26 |
| 1940, | Mar. 22 | 25.41 | 636.04 | | Dec. 3 | 16.82 | 644.63 |
| | Apr. 26 | 24.94 | 636.51 | 1943, | Apr. 20 | 20.36 | 641.09 |
| | May 23 | 26.00 | 635.45 | | Dec. 21 | 23.11 | 638.34 |
| | Sept. 24 | 27.02 | 634.43 | 1944, | Aug. 24 | 22.98 | 638.47 |
| | Oct. 29 | 27.06 | 634.39 | | Dec. 19 | 21.61 | 639.84 |
| 1941, | Jan. 29 | 24.45 | 637.00 | 1945, | May 23 | 18.83 | 642.62 |
| | Mar. 25 | 21.39 | 640.06 | | July 13 | 20.14 | 641.31 |
| | May 23 | 17.33 | 643.12 | 1946, | Mar. 19 | 22.24 | 639.21 |
| | Aug. 11 | 19.76 | 641.69 | | | | |

399

John Karbach, 4 miles north of New Braunfels. Measuring point, top of steel pipe clamp, altitude 784.57 feet, 0.8 foot above land-surface datum.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1937, | Dec. 20 | 173.32 | 610.45 | 1940, | May 28 | 176.18 | 607.59 |
| 1938, | Jan. 22 | 172.50 | 611.27 | | June 25 | 175.78 | 607.99 |
| | Feb. 2 | 170.90 | 612.87 | | July 29 | 175.47 | 608.30 |
| | Mar. 30 | 171.14 | 612.63 | | Aug. 27 | 176.01 | 607.76 |
| | Apr. 22 | 171.46 | 612.31 | | Sept. 23 | 176.50 | 607.27 |
| | May 19 | 168.76 | 615.01 | | Oct. 28 | 176.74 | 607.03 |
| | June 23 | 169.39 | 614.38 | | Dec. 6 | 175.88 | 607.89 |
| | July 20 | 169.93 | 613.84 | 1941, | Jan. 29 | 173.85 | 609.92 |
| | Aug. 30 | 171.20 | 612.57 | | Mar. 27 | 171.80 | 611.97 |
| | Sept. 28 | 176.52 | 607.25 | | May 23 | 167.33 | 616.44 |
| | Dec. 12 | 172.21 | 611.56 | | Aug. 8 | 168.18 | 615.59 |
| 1939, | Jan. 25 | 173.29 | 610.48 | | Nov. 19 | 170.12 | 613.65 |
| | Apr. 22 | 173.98 | 609.79 | 1942, | Mar. 6 | 172.30 | 611.47 |
| | May 26 | 174.26 | 609.51 | | Apr. 9 | 172.68 | 611.09 |
| | July 3 | 174.68 | 609.09 | | Aug. 3 | 172.45 | 611.32 |
| | Dec. 20 | 176.04 | 607.73 | | Dec. 7 | 167.36 | 616.41 |
| 1940, | Jan. 24 | 176.19 | 607.58 | 1943, | Apr. 19 | 171.01 | 612.76 |
| | Feb. 28 | 176.97 | 606.80 | | Dec. 20 | 173.22 | 610.55 |
| | Mar. 22 | 176.35 | 607.42 | 1944, | Dec. 19 | 170.37 | 613.40 |
| | Apr. 30 | 176.19 | 607.58 | 1945, | May 23 | 165.71 | 618.06 |
| | | | | 1946, | Mar. 20 | 171.42 | 612.35 |

Partial analyses of water from wells and springs in Comal County, Texas

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

| Well | Owner | Depth of well (ft.) | Date of collection | Total dissolved solids | Calcium (Ca) | Magnesium (Mg) | Sodium and Potassium (Na + K) (calc.) | Bicarbonate ($HCO_3$) | Sulfate ($SO_4$) | Chloride (Cl) | Fluoride (F) | Nitrate ($NO_3$) | Total hardness as $CaCO_3$ (calc.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Pearsall (Travis Peak) formation** | | | | | | | | | | | | |
| 6 | H. Fischer | 327 | Nov. 4, 1936 | 178 | – | –– | – | 146 | 20 | 19 | – | – | – |
| 30 | Mrs.P.J.Remler Est. | 184 | Dec. 9, 1936 | 329 | 21 | 38 | 55 | 311 | 42 | 20 | – | 0 | 208 |
| 31 | J. K. Baretta | 280 | do. | 168 | 23 | 24 | 6 | 122 | 28 | 27 | – | b/ | 155 |
| 32 | J. W. Heard | 100 | do. | 360 | 118 | 16 | 1 | 470 | 16 | 11 | – | – | 360 |
| 33 | W. D. Hill | 120 | do. | 196 | – | – | – | 153 | 28 | 20 | – | – | – |
| 34 | Ed. Kaderli | 112 | do. | 193 | 27 | 24 | 14 | 183 | 20 | 18 | – | – | 165 |
| 42 | Henry Pantermuehl | 300 | Nov. 4, 1936 | 1,557 | – | – | – | 317 | 870 | 41 | – | – | – |
| 43 | Theo. Kraft | 428 | Nov. 3, 1936 | 504 | 72 | 57 | 32 | 378 | 138 | 19 | – | – | 412 |
| 53 | T. J. Byler | 930 | Oct. 10, 1944 | – | – | – | – | 129 | c/60 | 39 | – | – | d/246 |
| 54 | Otto Schwope | 300 | Oct. 7, 1943 | 504 | 110 | 32 | 37 | 418 | c/60 | 57 | – | 1.8 | 406 |
| 55 | Hugo Wunderlich | 142 | Oct. 6, 1943 | 394 | 63 | 40 | 32 | 322 | c/36 | 64 | – | 0.2 | 322 |
| 56 | do. | 120 | do. | 589 | 115 | 25 | 55 | 355 | c/28 | 59 | – | 132 | 390 |
| 56 | do. | 120 | May 3, 1943 | 457 | – | – | – | 292 | c/ 6 | 38 | – | 112 | 394 |
| 73 | Willard Hill | 410 | Jan. 20, 1944 | — | – | – | – | 324 | 146 | 20 | – | 1.0 | – |
| 74 | H.B.Thompson | Spring | Oct. 7, 1943 | 329 | 84 | 24 | 11 | 352 | c/17 | 16 | – | 3.8 | 308 |
| 74 | do. | Spring | Mar. 28, 1945 | – | – | – | – | 271 | c/ 9 | 13 | – | 1.8 | d/201 |
| 88 | Walter Schaeffer | 816 | Jan. 22, 1945 | – | – | – | – | 328 | c/210 | 17 | – | – | d/258 |
| 102 | Ed Gass | 140 | Dec. 9, 1936 | 174 | – | – | – | 116 | 26 | 27 | – | – | – |
| 103 | Arno Knibbe | 124 | Dec. 10, 1936 | 437 | 168 | 19 | – | 317 | 47 | 47 | – | b/ | 497 |
| 106 | Frich Specht | 412 | Nov. 20, 1936 | 105 | 20 | 12 | 5 | 92 | 0 | 23 | – | – | 97 |
| 107 | Wm.Neugebauer | 163 | do. | 445 | – | – | – | 445 | 35 | 19 | – | 0 | – |
| 108 | Arno Knibbe | 225 | Dec. 10, 1936 | 512 | 85 | 26 | 66 | 214 | 93 | 137 | – | 0 | 321 |
| 109 | D. L. Knibbe | 120 | do. | 340 | – | – | – | 183 | 103 | 28 | – | – | – |
| 110 | Alfred Jonas | 280 | do. | 1,348 | 71 | 71 | 325 | 171 | 237 | 560 | – | 0 | 469 |
| 113 | Alfred Gass | 175 | Nov. 20, 1936 | 598 | 43 | 47 | 108 | 171 | 138 | 178 | – | – | 299 |

a/ Sulfate less than 10 parts per million.
b/ Nitrate less than 20 parts per million.
c/ Turbidity.
d/ Hardness determined by soap method.
* Asterisk indicates doubtful geological classification
\+ May include Comanche Peak limestone in some wells.

Partial analyses of water from wells and springs in Comal County -- Continued
(Results are in parts per million)

| Well | Owner | Depth of well (ft.) | Date of collection | Total dissolved solids | Calcium (Ca) | Magnesium (Mg) | Sodium and Potassium (Na + K) (calc.) | Bicarbonate ($HCO_3$) | Sulfate ($SO_4$) | Chloride (Cl) | Fluoride (F) | Nitrate ($NO_3$) | Total hardness as $CaCO_3$ (calc.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Pearsall (Trevis Peak) formation | | | | | | | | | |
| 114 | Harry Knibbe | Spring | Nov. 20, 1936 | 136 | 23 | 17 | 8 | 140 | 0 | 19 | – | 0 | 125 |
| 115 | Wm. Specht | 250 | do. | 248 | 52 | 42 | – | 159 | 35 | 41 | – | b/ | 301 |
| *116 | Ed. Bartels | 80 | Dec. 10, 1936 | 336 | – | – | – | 323 | 28 | 20 | – | – | – |
| 117 | Alfred Beierle | 157 | Nov. 20, 1936 | 148 | 11 | 1 | 50 | 134 | 0 | 20 | – | – | 30 |
| 119 | Mrs. John Stricker | 200 | Nov. 19, 1936 | 230 | 51 | 25 | 6 | 268 | 0 | 16 | – | 0 | 230 |
| 120 | Albert Marek | 380 | Nov. 16, 1936 | 339 | 115 | 9 | 8 | 403 | 0 | 9 | – | – | 326 |
| 122 | Erich Specht | 200 | Nov. 27, 1936 | 394 | 27 | 44 | 60 | 262 | 71 | 63 | – | – | 247 |
| 123 | Alfred Wehe | 350 | Nov. 21, 1936 | 237 | 70 | 20 | – | 98 | 35 | 64 | – | b/ | 257 |
| *125 | Joe E. Sheldon | 450 | Nov. 2, 1936 | 203 | – | – | – | 220 | 0 | 15 | – | – | – |
| 178 | Herman Laubach | 750 | Nov. 30, 1936 | 486 | 39 | 71 | 26 | 226 | 209 | 30 | – | – | 389 |
| 178 | do. | 750 | May 11, 1945 | 724 | 116 | 49 | 26 | 388 | 121 | 47 | – | 47 | 491 |
| | | | | Lower Glen Rose limestone | | | | | | | | | |
| 1 | C. L. Meserole | 5 | Nov. 13, 1936 | 251 | 76 | 17 | 0 | 290 | 0 | 15 | – | 0 | 260 |
| 2 | do. | 217 | do. | 250 | 56 | 24 | 11 | 293 | 0 | 15 | – | – | 237 |
| 2 | do. | 217 | Dec. 14, 1944 | – | – | – | – | 338 | a/ 3 | 10 | – | – | d/294 |
| 3 | do. | 220 | Nov. 13, 1936 | 227 | – | – | – | 250 | 0 | 14 | – | – | – |
| 4 | E. Kaderli | 265 | Oct. —, 1943 | 612 | 102 | 37 | 67 | 381 | 181 | 37 | – | 0.2 | 406 |
| 5 | Emil Doell | 300 | Dec. 31, 1936 | 166 | – | – | – | 134 | 12 | 25 | – | 0 | – |
| 7 | R. O. Fischer | Spring | do. | 301 | 101 | 9 | 6 | 342 | 0 | 17 | – | – | 291 |
| 8 | W. O. Fischer | 218 | do. | 293 | – | – | – | 323 | 0 | 18 | – | 0 | – |
| 9 | H. Cantermuehl | 275 | Nov. 4, 1936 | 276 | – | – | – | 244 | 39 | 13 | – | – | – |
| 12 | John A. Schlameus | 220 | Dec. 8, 1936 | 290 | – | – | – | 195 | 71 | 19 | – | 0 | – |
| 13 | Otto Treuer | 350 | Dec. 4, 1936 | 389 | 60 | 57 | – | 230 | 114 | 35 | – | b/ | 385 |
| 14 | do. | Spring | Dec. 31, 1936 | 177 | 41 | 9 | 15 | 159 | 16 | 13 | – | – | 140 |
| 15 | Carroll Hall | Spring | Nov. 4, 1936 | 228 | 74 | 13 | 0 | 256 | 0 | 15 | – | – | 238 |
| 16 | do. | 240 | do. | 258 | 65 | 14 | 17 | 256 | 16 | 20 | – | 0 | 213 |

a/ Sulfate less than 10 parts per million.
b/ Nitrate less than 20 parts per million.
c/ Turbidity.
d/ Hardness determined by soap method.
* Asterisk indicates doubtful geological classification.
+ May include Comanche Peak limestone in some wells.

Partial analyses of water from wells and springs in Comal County — Continued
(Results are in parts per million)

| Well | Owner | Depth of well (ft.) | Date of collection | Total dissolved solids | Calcium (Ca) | Magnesium (Mg) | Sodium and Potassium (Na + K) (calc.) | Bicarbonate ($HCO_3$) | Sulfate ($SO_4$) | Chloride (Cl) | Fluoride (F) | Nitrate ($NO_3$) | Total hardness as $CaCO_3$ (calc.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Lower Glen Rose limestone** | | | | | | | | | | | | |
| 17 | W. H. Stanley | 385 | Dec. 31, 1936 | 295 | 32 | 42 | 22 | 275 | 42 | 22 | – | 0 | 251 |
| 18 | do. | 320 | Dec. 8, 1936 | 431 | 63 | 55 | 21 | 378 | 83 | 23 | – | 0 | 384 |
| 19 | Tom Sumners | 325 | do. | 455 | 42 | 73 | 18 | 329 | 138 | 22 | – | 0 | 406 |
| 23 | Max Linartz | 228 | Nov. 3, 1936 | 446 | 68 | 49 | 27 | 329 | 103 | 37 | – | – | 370 |
| 24 | Frank Gunther | 169 | Nov. 4, 1936 | 166 | 25 | 23 | 7 | 165 | 16 | 14 | – | – | 155 |
| 25 | H. C. Nelson | 300 | Nov. 13, 1936 | 176 | 46 | 10 | 10 | 183 | 0 | 20 | – | – | 157 |
| 25 | do. | 325 | Oct. --, 1943 | 287 | 66 | 32 | 4.1 | 349 | c/ 1 | 12 | – | 0.2 | 296 |
| 27 | Fred and Richard Schaeferkoiter | Spring | Dec. 10, 1936 | 141 | 36 | 10 | 6 | 146 | 0 | 17 | – | b/ | 132 |
| 35 | J. D. Nixon | Spring | Nov. 13, 1936 | 323 | 94 | 19 | 9 | 372 | 0 | 18 | – | 0 | 312 |
| 37 | A. J. Monier | 240 | Dec. 15, 1936 | 335 | – | – | – | 329 | 26 | 13 | – | 0 | – |
| 38 | do. | 20 | do. | 154 | – | – | – | 146 | 0 | 22 | – | – | – |
| 39 | do. | 50 | do. | 289 | – | – | – | 311 | 0 | 22 | – | – | – |
| 40 | Mrs.D.N.Riegler | 260 | Nov. 13, 1936 | 338 | – | – | – | 372 | 0 | 21 | – | – | – |
| 41 | J. M. Bleck | 175 | Dec. 31, 1936 | 144 | – | – | – | 92 | 20 | 26 | – | – | – |
| 46 | M. Leaghling | Spring | Nov. 5, 1936 | 174 | – | – | – | 165 | 10 | 16 | – | – | – |
| 48 | H.W.Kraft Est. | 69 | Nov. 13, 1936 | 218 | – | – | – | 232 | 0 | 18 | – | – | – |
| 49 | do. | Spring | Nov. 16, 1936 | 265 | 70 | 19 | 7 | 275 | 16 | 18 | – | 0 | 252 |
| 50 | Adolph Preiss | 121 | Oct. 4, 1944 | – | – | – | – | 148 | c/ 7 | 12 | – | – | d/249 |
| 51 | Eddie Pape | 89 | Oct. 10, 1944 | – | – | – | – | 169 | c/11 | 11 | – | – | d/273 |
| 58 | State of Texas | Spring | Aug. --, 1944 | 338 | 98 | 16 | 9.0 | 340 | c/14 | 16 | – | 18 | 310 |
| 60 | Mrs.T.P.Shelly | 350 | Nov. 9, 1944 | 483 | 88 | 41 | 9.0 | 390 | 66 | 14 | – | 0 | 388 |
| 61 | Tom Sumner | 374 | Oct. 30, 1944 | 820 | 77 | 106 | 26 | 420 | 305 | 16 | – | 0 | 628 |
| *63 | H. E. Nessly | 154 | Dec. 8, 1944 | 2,140 | 326 | 220 | 17 | 360 | 1,330 | 17 | – | 0 | 1,720 |
| 68 | Miss Carrie George | 100 | do. | – | – | – | – | 277 | c/350± | 13 | – | – | d/1,130 |
| 69 | Otto Krause | 221 | Sept.29, 1944 | – | – | – | – | 245 | c/2,200± | 10 | – | 0.2 | – |
| 70 | Miss Elsie Leuhlfing | 102 | Jan. 31, 1945 | 322 | – | – | – | 314 | c/ 10 | 10 | – | – | 304 |
| 71 | O. C. Trout | 108 | Feb. 1, 1945 | 333 | – | – | – | 313 | c/ 20 | 9.0 | – | 1.2 | 314 |

a/ Sulfate less than 10 parts per million.
b/ Nitrate less than 20 parts per million.
c/ Turbidity.
d/ Hardness determined by soap method.
* Asterisk indicates doubtful geological classification.
\+ May include Comanche Peak limestone in some wells.

Partial analyses of water from wells and springs in Comal County—Continued
(Results are in parts per million)

| Well | Owner | Depth of well (ft.) | Date of collection | Total dissolved solids | Calcium (Ca) | Magnesium (Mg) | Sodium and Potassium (Na + K) (calc.) | Bicarbonate ($HCO_3$) | Sulfate ($SO_4$) | Chloride (Cl) | Fluoride (F) | Nitrate ($NO_3$) | Total hardness as $CaCO_3$ (calc.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Lower Glen Rose limestone | | | | | | | | | |
| 72 | D. C. McIver | Spring | Nov. 10, 1944 | 274 | 72 | 11 | 2.8 | 239 | 11 | 14 | – | 4.6 | 224 |
| 75 | A. J. Monier | 297 | Dec. 21, 1944 | – | – | – | – | 324 | c/14 | 12 | – | – | d/264 |
| 78 | J. W. Heard | 244 | do. | – | – | – | – | 284 | c/11 | 13 | – | – | d/246 |
| 79 | Joe S. Sheldon | 344 | Sept.23, 1943 | 355 | 72 | 39 | 8.5 | 353 | c/36 | 17 | – | 9.0 | 340 |
| 80 | — Weidner | Spring | July 19, 1944 | 322 | 107 | 7.8 | 9.0 | 352 | c/ 4 | 16 | – | 4.5 | 299 |
| 87 | Milton Y. Jones | 437 | May 30, 1945 | – | – | – | – | 335 | c/ 8 | 10 | – | – | d/195 |
| 89 | Richard Hitzfelder | 630 | Jan. 22, 1945 | – | – | – | – | 334 | c/ 3 | 10 | – | – | d/264 |
| 90 | — Tian | 630 | Feb. 28, 1945 | – | – | – | – | 314 | c/28 | 97 | – | 0 | d/435 |
| 91 | Melvin Westerfer | 507 | Sept.19, 1944 | – | – | – | – | 232 | c/1,400+ | 12 | – | 0 | – |
| 104 | H. C. Plumly | Spring | Nov. 20, 1936 | 121 | 26 | 12 | 6 | 122 | 0 | 17 | – | 0 | 112 |
| 104 | do. | Spring | Mar. 28, 1945 | – | – | – | – | 308 | c/ 9 | 14 | – | 8.2 | d/212 |
| 105 | Erich Specht | 75 | Nov. 20, 1936 | 110 | – | – | – | 98 | 0 | 19 | – | – | – |
| 111 | Edwin Elbel | 100 | Dec. 9, 1936 | 190 | – | – | – | 165 | 16 | 21 | – | – | – |
| 113 | Roland Benzeil | 108 | Jan. 26, 1937 | 323 | – | – | – | 250 | 24 | 54 | – | – | – |
| *121 | Wm. Gast | 115 | Nov. 27, 1936 | 102 | – | – | – | 92 | 0 | 17 | – | – | – |
| 124 | Ed. Kuebel | 210 | Nov. 16, 1936 | 194 | – | – | – | 195 | 0 | 22 | – | – | – |
| 126 | Julius Bremer | 135 | Nov. 25, 1936 | 302 | 54 | 49 | – | 372 | 0 | 16 | – | 0 | 335 |
| 128 | A. J. Walser | 85 | Nov. 2, 1936 | 224 | – | – | – | 183 | 24 | 26 | – | – | – |
| *130 | R. P. Holt | 620 | Dec. 11, 1936 | 2,608 | 346 | 201 | 179 | 232 | 1,642 | 126 | – | 0 | 1,689 |
| 131 | J. J. Arrechea | 300 | Nov. 16, 1936 | 214 | 66 | 7 | 10 | 244 | 0 | 11 | – | – | 194 |
| 132 | Alex P. Scheel | 350 | Dec. 7, 1936 | 293 | 83 | 23 | 1 | 342 | 0 | 18 | – | 0 | 304 |
| 133 | Eugene Scheel | 230 | do. | 131 | – | – | – | 122 | 0 | 20 | – | 0 | – |
| 134 | E. A. Moos | 96 | do. | 391 | – | – | – | 415 | 12 | 22 | – | – | – |
| 136 | Mrs. Emma Sauer | 218 | Dec. 23, 1936 | 222 | – | – | – | 226 | 12 | 13 | – | 0 | – |
| 137 | G. S. McFarland | 300 | do. | 261 | 51 | 24 | 13 | 275 | 20 | 13 | – | 0 | 225 |
| 138 | Bruno Klar | 25 | do. | 313 | – | – | – | 354 | 0 | 15 | – | – | – |
| 139 | Joseph Offer | 200 | do. | 357 | 85 | 26 | 17 | 366 | 32 | 17 | – | 0 | 321 |
| 140 | F.Neugebauer | 300 | Dec. 7, 1936 | 158 | 19 | 23 | 10 | 159 | 12 | 16 | – | – | 144 |
| 141 | George Bros. | 216 | Dec. 23, 1936 | 328 | – | – | – | 354 | 8 | 17 | – | 0 | – |

a/ Sulfate less than 10 parts per million.
b/ Nitrate less than 20 parts per million.
c/ Turbidity.
d/ Hardness determined by soap method.
* Asterisk indicates doubtful geological classification.
\+ May include Comanche Peak limestone in some wells.

Partial analyses of water from wells and springs in Comal County--Continued
(Results are in parts per million)

| Well | Owner | Depth of well (ft.) | Date of collection | Total dissolved solids | Calcium (Ca) | Magnesium (Mg) | Sodium and Potassium (Na + K) (calc. ) | Bicarbonate ($HCO_3$) | Sulfate ($SO_4$) | Chloride (Cl) | Fluoride (F) | Nitrate ($NO_3$) | Total hardness as $CaCO_3$ (calc.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Lower Glen Rose limestone | | | | | | | | | |
| 142 | Mrs.C.L.Ellsworth | 217 | Dec. 23, 1936 | 151 | – | – | – | 134 | 16 | 12 | – | 0 | – |
| 143 | Aug. Scholz Est. | 236 | Nov. 30, 1936 | 165 | – | – | – | 177 | 0 | 13 | – | 0 | – |
| 144 | do. | 265 | do. | 226 | 32 | 31 | 12 | 238 | 20 | 14 | – | – | 209 |
| 145 | Mrs.Chas.Erben | 235 | Dec. 7, 1936 | 200 | – | – | – | 171 | 26 | 15 | – | 0 | – |
| 146 | E. A. Laubach | 350 | do. | 164 | 24 | 26 | 3 | 171 | 12 | 15 | – | 0 | 166 |
| 147 | do. | 25 | do. | 139 | – | – | – | 92 | 24 | 19 | – | – | – |
| 148 | Aug. Scheel | 15 | do. | 385 | – | – | – | 390 | 24 | 20 | – | – | – |
| 149 | do. | 318 | do. | 360 | – | – | – | 342 | 23 | 26 | – | b/ | – |
| 150 | L. A. Allen | 480 | Nov. 21, 1936 | 173 | 45 | 18 | – | 85 | 24 | 44 | – | b/ | 186 |
| 151 | O. Wehe | 350 | Nov. 27, 1936 | 142 | 12 | 18 | 21 | 153 | 0 | 16 | – | – | 101 |
| 152 | do. | 110 | do. | 112 | – | – | – | 110 | 0 | 14 | – | – | – |
| 153 | J. A. Laubach | 60 | do. | 298 | – | – | – | 232 | 28 | 44 | – | – | – |
| 154 | do. | 25 | do. | 217 | – | – | – | 238 | 0 | 14 | – | – | – |
| 155 | George Fronne | 185 | Dec. 10, 1936 | 263 | – | – | – | 220 | 32 | 24 | – | – | – |
| 156 | Alex Licata | 360 | Dec. 11, 1936 | 200 | 62 | 18 | 0 | 220 | 0 | 12 | – | 0 | 232 |
| 157 | W. E. Green | 635 | do. | 314 | 77 | 24 | 12 | 336 | 24 | 12 | – | 0 | 290 |
| 158 | O.A.Doeppenschmidt | 446 | Jan. 26, 1937 | 368 | 52 | 57 | 8 | 378 | 53 | 12 | – | 0 | 365 |
| 159 | do. | 615 | Nov. 2, 1936 | 742 | 151 | 62 | 11 | 336 | 323 | 15 | – | – | 633 |
| 166 | Ed. Adam | 600 | Dec. 11, 1936 | 481 | 97 | 45 | 10 | 329 | 150 | 17 | – | 0 | 428 |
| 167 | Clemens Scholz | 245 | do. | 219 | 18 | 36 | 16 | 220 | 28 | 13 | – | 0 | 192 |
| 168 | G. W. Kurz | 348 | do. | 138 | 30 | 13 | 7 | 146 | 0 | 16 | – | 0 | 128 |
| 169 | Benno Bose | 348 | do. | 235 | 69 | 17 | 1 | 268 | 0 | 16 | – | 0 | 240 |
| 170 | Arthur Hitzfelder | 414 | Dec. 15, 1936 | 312 | – | – | – | 281 | 36 | 20 | – | 0 | – |
| 171 | Mrs. Mattie Shelburne | 248 | Nov. 16, 1936 | 302 | – | – | – | 342 | 0 | 14 | – | – | – |
| 172 | V. F. Moos | 320 | Nov. 27, 1936 | 281 | 78 | 13 | 14 | 293 | 20 | 12 | – | – | 248 |
| 173 | Edgar Nremer | 100 | Nov. 21, 1936 | 111 | – | – | – | 98 | 0 | 20 | – | – | – |
| 174 | Mrs.M.K.Hohman | 30 | Nov. 30, 1936 | 113 | – | – | – | 110 | 0 | 15 | – | – | – |
| 175 | do. | 315 | do. | 240 | 36 | 30 | 13 | 226 | 36 | 14 | – | – | 213 |
| 176 | do. | Spring | do. | 265 | 86 | 10 | 6 | 305 | 0 | 13 | – | 0 | 256 |

a/ Sulfate less than 10 parts per million.
b/ Nitrate less than 20 parts per million.
c/ Turbidity.
d/ Hardness determined by soap method.
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\+ May include Comanche Peak limestone in some wells.

Partial analyses of water from wells and springs in Comal County—Continued
(Results are in parts per million)

| Well | Owner | Depth of well (ft.) | Date of collection | Total dissolved solids | Calcium (Ca) | Magnesium (Mg) | Sodium and Potassium (Na + K) (calc.) | Bicarbonate ($HCO_3$) | Sulfate ($SO_4$) | Chloride (Cl) | Fluoride (F) | Nitrate ($NO_3$) | Total hardness as $CaCO_3$ (calc.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | **Lower Glen Rose limestone** | | | | | | | | | |
| 177 | Paul Kurz | 300 | Nov. 30, 1936 | 334 | – | – | – | 336 | 24 | 16 | – | 0 | – |
| 182 | Aug. Scholz | 336 | Nov. 27, 1936 | 278 | 74 | 21 | 3 | 244 | 19 | 41 | – | 0 | 272 |
| 183 | Aug. Wehe | 375 | Nov. 12, 1936 | 357 | – | – | – | 305 | 39 | 33 | – | – | – |
| 184 | Chas. Willig | 371 | do. | 584 | 91 | 72 | 15 | 421 | 185 | 14 | – | – | 524 |
| 185 | Mrs. Anita Lux | 320 | Dec. 15, 1936 | 169 | – | – | – | 140 | 24 | 13 | – | 0 | – |
| 186 | Elmer Kleck | 450 | do. | 574 | 117 | 46 | 19 | 348 | 195 | 26 | – | 0 | – |
| *427 | — | 1,200 | Aug. 20, 1941 | 4,170 | 390 | 220 | 737 | 319 | 1,467 | 1,200 | – | – | 1,878 |
| | | | | **Upper Glen Rose limestone** | | | | | | | | | |
| 21 | D. R. Semmes | Spring | Dec. 31, 1936 | 187 | 30 | 21 | 13 | 189 | 16 | 14 | – | 0 | 163 |
| 22 | do. | 110 | do. | 223 | 55 | 24 | 0 | 256 | 0 | 18 | – | – | 235 |
| 44 | George Faber | 250 | Dec. 8, 1936 | 227 | 34 | 36 | – | 207 | 40 | 15 | – | 0 | 232 |
| 45 | V. and C.D. Prassel | 170 | Nov. 3, 1936 | 777 | – | – | – | 293 | 366 | 12 | – | – | – |
| 62 | H. F. Nessle | 101 | Dec. 8, 1944 | 372 | 61 | 50 | 3.4 | 370 | 43 | 12 | – | 0.2 | 358 |
| * 64 | do. | 101 | Nov. 9, 1944 | – | – | – | – | 338 | c/320 | 14 | – | – | d/606 |
| 65 | George Faber | 455 | Nov. 26, 1944 | – | – | – | – | 336 | c/ 24 | 10 | – | – | d/172 |
| 66 | C.B. Crawford | 256 | Dec. 14, 1944 | – | – | – | – | 242 | c/ 12 | 15 | – | – | d/312 |
| 67 | do. | 200 | do. | – | – | – | – | 250 | c/ 55 | 10 | – | – | d/294 |
| 76 | E.S. Schroeder | 60 | Nov. 22, 1944 | – | – | – | – | 380 | c/ 28 | 16 | – | – | d/246 |
| 161 | O.A. Doeppenschmidt | – | Nov. 2, 1936 | 394 | – | – | – | 390 | 28 | 22 | – | – | – |
| 162 | H. Conrads | 208 | Jan. 26, 1937 | 400 | 72 | 49 | 12 | 390 | 55 | 20 | – | b/ | 380 |
| 162 | do. | 208 | Apr. 6, 1945 | 298 | 59 | 33 | 6.2 | 330 | c/ 7 | 12 | – | 1.5 | 282 |
| 164 | B. Stapper | 480 | Nov. 2, 1936 | 634 | 98 | 75 | 7 | 287 | 299 | 14 | – | – | 551 |
| 167 | Clemens Scholz | 245 | Dec. 11, 1936 | 219 | 18 | 36 | 16 | 220 | 28 | 13 | – | 0 | 192 |
| 188 | Adam Myer Est. | 90 | Nov. 15, 1936 | 348 | 144 | 4 | – | 268 | 0 | 68 | – | b/ | 378 |
| 189 | Otto Hitzfelder | 15 | Nov. 11, 1936 | 180 | – | – | – | 171 | 12 | 15 | – | – | – |
| 190 | do. | Spring | Nov. 15, 1936 | 297 | 95 | 10 | 9 | 342 | 0 | 15 | – | 0 | 281 |
| 191 | do. | 321 | Nov. 12, 1936 | 911 | – | – | – | 67 | 590 | 13 | – | – | – |

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Partial analyses of water from wells and springs in Comal County--Continued
(Results are in parts per million)

| Well | Owner | Depth of well (ft.) | Date of collection | Total dissolved solids | Calcium (Ca) | Magnesium (Mg) | Sodium and Potassium (Na + K) (calc.) | Bicarbonate ($HCO_3$) | Sulfate ($SO_4$) | Chloride (Cl) | Fluoride (F) | Nitrate ($NO_3$) | Total hardness as $CaCO_3$ (calc.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Upper Glen Rose limestone | | | | | | | | | |
| 192 | -- Tian | Spring | Nov. 12, 1936 | 143 | 51 | 10 | - | 159 | 0 | 4 | - | b/ | 171 |
| 193 | do. | 200+ | do. | 1,277 | - | - | - | 299 | 716 | 11 | - | - | - |
| 194 | Wm. Zeucher | 535 | do. | 593 | 122 | 48 | 10 | 293 | 250 | 9 | - | - | 501 |
| 195 | Robert Heimer | 178 | Nov. 2, 1936 | 230 | 58 | 23 | 2 | 281 | 0 | 9 | - | - | 239 |
| 204 | H. Conrads | 180 | Jan. 26, 1937 | 414 | - | - | - | 384 | 28 | 38 | - | - | - |
| 206 | A. Kabelmacher | 475 | Nov. 9, 1936 | 222 | - | - | - | 189 | 35 | 11 | - | - | - |
| 212 | E. Herbst | 425 | Jan. 25, 1937 | 264 | 56 | 30 | 5 | 287 | 18 | 14 | - | 0 | 263 |
| 230 | Hilmar Doehne | 265 | Jan. 18, 1937 | 180 | 35 | 15 | 13 | 171 | 20 | 13 | - | 0 | 150 |
| 337 | E. J. Heidrick | 350 | Apr. 28, 1945 | 463 | - | - | - | 233 | 66 | 23 | - | 77 | 354 |
| *413 | Udo Haarman and R. Wright | 440 | Dec. 15, 1944 | - | - | - | - | 280 | c/ 2 | 19 | - | - | d/300 |
| 415 | do. | 640 | Dec. 14, 1944 | - | - | - | - | 264 | c/ 2 | 8.0 | - | - | d/234 |
| 429 | O. C. Brehmer | 601 | Feb. 1, 1947 | 291 | 60 | 32 | 1.4 | 316 | 12 | 9.0 | - | b/ | 281 |
| | | | | Edwards limestone | | | | | | | | | |
| 95 | Chas. Wuest | 320 | May 10, 1945 | 430 | 117 | 20 | 2.8 | 314 | c/ 6 | 35 | - | 83 | 374 |
| 201 | C.B. Crawford | 290 | Nov. 3, 1936 | 303 | - | - | - | 305 | 24 | 12 | - | - | - |
| 203 | H. Conrads | Spring | Nov. 5, 1936 | 172 | 27 | 26 | 5 | 201 | 0 | 15 | - | - | - |
| 207 | Ed Reeh | 325 | Dec. 1, 1936 | 49 | - | - | - | 12 | 0 | 25 | - | b/ | - |
| 209 | do. | 390 | do. | 142 | - | - | - | 153 | 0 | 11 | - | 0 | - |
| 210 | Paul Tonne | 320 | Nov. 9, 1936 | 239 | 59 | 17 | 14 | 281 | 0 | 11 | - | - | 215 |
| 211 | Otto Ohlrich | 350 | do. | 741 | 212 | 29 | - | 329 | 295 | 43 | - | b/ | 648 |
| 213 | B. Borchers | 402 | Nov. 2, 1936 | 183 | - | - | - | 183 | 0 | 21 | - | - | - |
| 214 | Paul Dietz | 300 | Nov. 5, 1936 | 237 | 52 | 31 | - | 293 | 0 | 10 | - | b/ | 259 |
| 215 | Jerome Schumann | 365 | Jan. 18, 1937 | 261 | 64 | 28 | 2 | 317 | 0 | 11 | - | 0 | 272 |
| 216 | Alwin Jahns | 300 | do. | 195 | 48 | 21 | - | 232 | 0 | 12 | - | 0 | 208 |
| 217 | H.D. Stronberg | Spring | Nov. 5, 1936 | 232 | 45 | 25 | 13 | 275 | 0 | 14 | - | - | 216 |
| 219 | F. T. Lackey | 500 | Nov. 3, 1936 | 234 | 64 | 19 | 3 | 281 | 0 | 10 | - | - | 237 |
| 220 | Albert Pfeuffer | 400 | do. | 279 | 83 | 18 | 3 | 329 | 0 | 13 | - | - | 281 |
| 221 | Albert Simon | 186 | Dec. 21, 1936 | 286 | - | - | - | 305 | 12 | 12 | - | - | |

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\+ May include Comanche Peak limestone in some wells.

Partial analyses of water from wells and springs in Comal County--Continued
(Results are in parts per million)

| Well | Owner | Depth of well (ft.) | Date of collection | Total dissolved solids | Calcium (Ca) | Magnesium (Mg) | Sodium and Potassium (Na + K) (calc.) | Bicarbonate ($HCO_3$) | Sulfate ($SO_4$) | Chloride (Cl) | Fluoride (F) | Nitrate ($NO_3$) | Total hardness as $CaCO_3$ (calc.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Edwards limestone | | | | | | | | | |
| 222 | Wm. Kraft | 190 | Oct. 28, 1936 | 266 | 33 | 15 | - | 268 | 12 | 24 | - | b/ | 270 |
| 223 | L. S. Davis | 320 | Dec. 21, 1936 | 206 | - | - | - | 207 | 12 | 12 | - | b/ | - |
| 224 | F.D.Hutcheson | 251 | do. | 291 | - | - | - | 311 | 12 | 12 | - | 0 | - |
| 225 | W.H.Harborth Est. | 265 | Oct. 28, 1936 | 421 | 86 | 20 | 35 | 207 | 130 | 48 | - | - | 298 |
| 226 | Henry Heise | 290 | Dec. 21, 1936 | 304 | 91 | 16 | 6 | 336 | 12 | 14 | - | 0 | 295 |
| 227 | Herman Borcher | 300 | Oct. 28, 1936 | 228 | 69 | 18 | - | 256 | 0 | 15 | - | - | 246 |
| 229 | Edward Nowothy | 325 | Dec. 22, 1936 | 240 | 59 | 16 | 12 | 250 | 16 | 14 | - | 0 | 215 |
| 231 | Gus Vogel | 325 | do. | 285 | 85 | 18 | 1 | 311 | 16 | 12 | - | 0 | 286 |
| 232 | Krueger Bros. | 250 | Jan. 25, 1937 | 296 | 94 | 11 | 4 | 281 | 22 | 27 | - | 0 | 282 |
| 233 | Richard Gesche | 313 | Dec. 16, 1936 | 345 | 141 | 9 | - | 329 | 0 | 33 | - | b/ | 391 |
| 234 | Otto Ohlrich | 265 | Nov. 9, 1936 | 298 | - | - | - | 348 | 0 | 8 | - | - | - |
| *237 | Eugene Krause | 288 | Oct. 26, 1936 | 130 | 34 | 6 | 5 | 79 | 31 | 15 | - | - | 108 |
| 242 | Ernst George | - | Dec. 17, 1936 | 143 | - | - | - | 159 | 0 | 8 | - | - | - |
| 243 | Edw.Gerhardt Est. | 326 | do. | 241 | - | - | - | 275 | 0 | 10 | - | 0 | - |
| 244 | Lena Binzeil Est. | 240 | do. | 243 | - | - | - | 281 | 0 | 8 | - | 0 | - |
| 245 | Lavine Hoffman | 215 | do. | 136 | - | - | - | 146 | 0 | 10 | - | - | - |
| 247 | Henry W. Simon | 245 | do. | 266 | 83 | 17 | 0 | 293 | 8 | 14 | - | 0 | 275 |
| 248 | A.B.Burkhardt | 250 | Oct. 26, 1936 | 278 | - | - | - | 299 | 12 | 10 | - | - | - |
| 249 | Edgar Burkhardt | 180 | Nov. 24, 1936 | 265 | - | - | - | 293 | 0 | 16 | - | 0 | - |
| 250 | Glen Wilson | - | Dec. 19, 1936 | 448 | - | - | - | 323 | 75 | 49 | - | - | - |
| 251 | Schaeffer Bros. | 255 | Dec. 18, 1936 | 318 | 118 | 7 | - | 372 | 0 | 10 | - | 0 | 324 |
| 252 | Herman Vogel | 300 | Jan. 21, 1937 | 235 | 80 | 7 | 3 | 244 | 0 | 25 | - | 0 | 229 |
| 253 | Herbert Kreusler | 300 | Nov. 24, 1936 | 198 | - | - | - | 214 | 0 | 15 | - | 0 | - |
| 254 | Henry Ludwig | 375 | Jan. 21, 1937 | 329 | 111 | 10 | 6 | 390 | 0 | 10 | - | 0 | 320 |
| 255 | Rubin Moeller | 330 | do. | 280 | 119 | 8 | - | 73 | 51 | 66 | - | b/ | 305 |
| 256 | Mrs.Wm.Hillert | 390 | Nov. 9, 1936 | 212 | - | - | - | 238 | 0 | 11 | - | - | - |
| 258 | R. J. Haug | 50 | Oct. 27, 1936 | 516 | - | - | - | 500 | 35 | 36 | - | - | - |
| 259 | do. | 420 | do. | 331 | 81 | 24 | 13 | 317 | 31 | 26 | - | - | 300 |
| 260 | Hilmar Staats | 450 | Dec. 22, 1936 | 253 | 47 | 26 | 13 | 244 | 32 | 15 | - | 0 | 226 |

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Partial analyses of water from wells and springs in Comal County--Continued
(Results are in parts per million)

| Well | Owner | Depth of well (ft.) | Date of collection | Total dissolved solids | Calcium (Ca) | Magnesium (Mg) | Sodium and Potassium (Na + K) (calc.) | Bicarbonate ($HCO_3$) | Sulfate ($SO_4$) | Chloride (Cl) | Fluoride (F) | Nitrate ($NO_3$) | Total hardness as $CaCO_3$ (calc.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Edwards limestone | | | | | | | | | |
| 261 | O. C. Brehmer | 304 | Dec. 1, 1936 | 139 | – | – | – | 116 | 0 | 28 | – | b/ | – |
| 262 | Ed.C.Heidrich | 340 | Oct. 27, 1936 | 120 | 35 | 8 | – | 122 | 0 | 16 | – | b/ | 120 |
| 263A | Walter Kappelmacher | 242 | Sept.15, 1944 | – | – | – | – | 330 | c/13 | 14 | – | 73 | d/420 |
| 265 | R. R. Coreth | 290 | Dec. 16, 1936 | 304 | – | – | – | 311 | 20 | 13 | – | 0 | – |
| 268 | Albert Hantzmann | 175 | Oct. 22, 1936 | 162 | 33 | 17 | 6 | 153 | 16 | 15 | – | – | 150 |
| 269 | Jack Kretzmeyer | 168 | do. | 303 | 82 | 19 | 10 | 317 | 20 | 16 | – | – | 282 |
| 270 | Alvin Kraft | 138 | Oct. 21, 1936 | 253 | 60 | 19 | 12 | 256 | 20 | 16 | – | – | 227 |
| 271 | Albert Wallhoeffer | 140 | Dec. 30, 1936 | 309 | – | – | – | 293 | 30 | 17 | – | – | – |
| 272 | Brund Raabe | – | do. | 303 | – | – | – | 293 | 26 | 17 | – | – | – |
| 273 | C. Conrads | 145 | Oct. 20, 1936 | 319 | 73 | 25 | 15 | 311 | 35 | 18 | – | – | 285 |
| 274 | Chas.Soechting | 210 | Jan. 5, 1937 | 714 | – | – | – | 354 | 213 | 78 | – | 0 | – |
| 275 | Erich Rosenthal | 230 | do. | 380 | 76 | 21 | 38 | 305 | 65 | 30 | – | 0 | 278 |
| 277 | do. | 212 | do. | 310 | – | – | – | 287 | 32 | 19 | – | 0 | – |
| 278 | O. F. Gruene | 210 | Oct. 20, 1936 | 856 | 112 | 59 | 98 | 159 | 307 | 202 | – | – | 521 |
| 279 | Wm. Posey | 160 | Oct. 21, 1936 | 697 | 79 | 55 | 94 | 311 | 197 | 119 | – | – | 424 |
| 280 | Hilmar Doehner | 250 | Jan. 5, 1937 | 564 | – | – | – | 268 | 162 | 73 | – | 0 | – |
| 283 | Emil Preusser | 330 | do. | 981 | 24 | 29 | 289 | 201 | 326 | 214 | – | 0 | 178 |
| 289 | Wm.D.Wiemers | 80 | Dec. 30, 1936 | 287 | 68 | 15 | 21 | 268 | 32 | 19 | – | – | 234 |
| 294 | City of New Braunfels | Spring | Oct. 27, 1936 | 253 | 56 | 19 | 15 | 244 | 26 | 17 | – | – | 219 |
| 294 | do. | Spring | Apr. 10, 1938 | 267 | 75 | 17 | 3.3 | 266 | 23 | 13 | – | 5.0 | 257 |
| 294 | do. | Spring | June 24, 1941 | 271 | 63 | 17 | 18 | 272 | 23 | 12 | – | 3.7 | 227 |
| 294 | do. | Spring | Aug. 13, 1941 | – | – | – | – | 272 | c/23 | 11 | – | – | – |
| 294 | do. | Spring | Sept.16, 1941 | 280 | 73 | 17 | 28 | 264 | 24 | 12 | 0.1 | 4.4 | 202 |
| 294 | do. | Spring | Apr. 2, 1942 | 288 | 70 | 17 | 11 | 274 | 22 | 12 | 0.1 | 4.0 | 244 |
| 294 | do. | Spring | Jan. 10, 1944 | 280 | 78 | 17 | 5.5 | 280 | 23 | 13 | – | 5.5 | 264 |
| 294 | do. | Spring | Jan. 22, 1944 | 287 | 74 | 16 | 9.2 | 270 | 23 | 12 | 0.4 | 5.5 | 250 |
| 294 | do. | Spring | Sept.14, 1944 | – | 86 | 23 | – | – | – | – | – | – | 309 |
| 294 | do. | Spring | Oct. 11, 1944 | – | 81 | 22 | – | – | – | – | – | – | 292 |

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| Well | Owner | Depth of well (ft.) | Date of collection | Total dissolved solids | Calcium (Ca) | Magnesium (Mg) | Sodium and Potassium (Na + K) (calc.) | Bicarbonate ($HCO_3$) | Sulfate ($SO_4$) | Chloride (Cl) | Fluoride (F) | Nitrate ($NO_3$) | Total hardness as $CaCO_3$ (calc.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Edwards limestone | | | | | | | | | |
| 294 | City of New Braunfels | Spring | Nov. 22, 1944 | – | 102 | 13 | – | – | – | – | – | – | 308 |
| 294 | do. | Spring | Jan. 22, 1945 | – | 74 | 17 | – | – | – | – | – | – | 254 |
| 294 | do. | Spring | Feb. 14, 1945 | – | 82 | 18 | – | – | – | – | – | – | 278 |
| 294 | do. | Spring | Mar. 5, 1945 | – | 72 | 17 | – | – | – | – | – | – | 250 |
| 294 | do. | Spring | Mar. 23, 1945 | – | 78 | 18 | – | – | – | – | – | – | 268 |
| 294 | do. | Spring | Apr. 28, 1945 | – | 43 | 18 | – | – | – | – | – | – | 182 |
| 294 | do. | Spring | May 31, 1945 | – | 75 | 18 | – | – | – | – | – | – | 261 |
| 294 | do. | Spring | July 6, 1945 | – | 75 | 16 | – | – | – | – | – | – | 253 |
| 294 | do. | Spring | Sept. 13, 1945 | – | 77 | 17 | – | – | – | – | – | – | 262 |
| 294 | do. | Spring | Oct. 9, 1945 | 292 | 76 | 18 | 2.8 | 274 | 20 | – | – | 5.6 | 264 |
| 294 | do. | Spring | Oct. 18, 1945 | – | 76 | 19 | – | – | c/423 | – | – | – | 268 |
| 294 | do. | Spring | Nov. 23, 1945 | – | 50 | 16 | – | – | c/ 1.5 | – | – | – | 191 |
| 294 | do. | Spring | Sept. 13, 1945 | – | 80 | 19 | – | – | – | – | – | – | 278 |
| 295 | Mrs. Meta Penshorn | 25 | Dec. 22, 1936 | 285 | – | – | – | 268 | 23 | 16 | – | – | – |
| 296 | Max Altgelt | 345 | Dec. 4, 1936 | 203 | – | – | – | 128 | 47 | 20 | – | 0 | – |
| 297 | U.S. Gypsum Co. | 125 | do. | 262 | 50 | 18 | 25 | 244 | 32 | 17 | – | – | 202 |
| 298 | R. R. Coreth | 275 | Dec. 16, 1936 | 288 | 99 | 9 | 3 | 336 | 0 | 12 | – | 0 | 286 |
| 299 | Wm. Fey | 89 | Dec. 5, 1936 | 169 | – | – | – | 183 | 0 | 12 | – | – | – |
| *300 | Roland Welsch | 372 | Dec. 4, 1936 | 314 | 49 | 25 | 37 | 281 | 43 | 22 | – | – | 226 |
| 305 | Joseph Friesenhahn | 360 | Dec. 18, 1936 | 412 | – | – | – | 200 | 103 | 55 | – | 0 | – |
| 306 | Oscar Jonas | 360 | do. | 296 | – | – | – | 281 | 26 | 19 | – | 0 | – |
| 307 | Adolph Mueller | 160 | do. | 181 | – | – | – | 140 | 26 | 19 | – | – | – |
| 308 | Westley Hier Holzer | 117 | Dec. 19, 1936 | 344 | 88 | 13 | 64 | 311 | 12 | 14 | – | – | 273 |
| 309 | Servtex and Metal Co. | 125 | do. | 256 | 79 | 14 | 4 | 299 | 0 | 12 | – | – | 254 |
| 311 | Robert Hierholzer | 130 | do. | 193 | – | – | – | 189 | 16 | 10 | – | – | – |
| 312 | Otto Klaerner | 109 | Oct. 26, 1936 | 260 | – | – | – | 293 | 0 | 13 | – | – | – |
| 313 | R. P. Schneider | 192 | do. | 278 | 60 | 12 | 33 | 250 | 20 | 30 | – | – | 197 |

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| Well | Owner | Depth of well (ft.) | Date of collection | Total dissolved solids | Calcium (Ca) | Magnesium (Mg) | Sodium and Potassium (Na + K) (calc.) | Bicarbonate ($HCO_3$) | Sulfate ($SO_4$) | Chloride (Cl) | Fluoride (F) | Nitrate ($NO_3$) | Total hardness as $CaCO_3$ (calc.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Edwards limestone | | | | | | | | | |
| 314 | — Rogers | 225 | Dec. 17, 1936 | 336 | – | – | – | 232 | 49 | 49 | – | b/ | – |
| 315 | Herbert Riedel | 306 | do. | 321 | 85 | 15 | 16 | 281 | 40 | 27 | – | 0 | 275 |
| 316 | Joe Sleitz | 310 | Dec. 12, 1936 | 298 | – | – | – | 232 | 42 | 31 | – | 0 | – |
| 318 | Walter Mueller | 476 | Nov. 24, 1936 | 194 | 30 | 19 | 14 | 122 | 51 | 20 | – | – | 152 |
| 319 | Percy Hansman | 350 | Dec. 3, 1936 | 617 | 72 | 57 | 85 | 439 | 63 | 124 | – | – | 416 |
| 320 | Jack Alesci | 400 | Nov. 24, 1936 | 305 | 102 | 7 | 3 | 232 | 31 | 48 | – | – | 284 |
| 326 | Wm. Schaeffer | 300 | Dec. 3, 1936 | 233 | 33 | 28 | 16 | 195 | 32 | 28 | – | – | 198 |
| 328 | Alvin Schaeffer | 360 | Dec. 16, 1936 | 758 | 58 | 66 | 136 | 360 | 99 | 222 | – | 0 | 416 |
| 332 | Ben Jahn | 395 | Dec. 18, 1936 | 1,020 | 82 | 75 | 190 | 378 | 197 | 290 | – | 0 | 512 |
| 333 | O. Penshorn | 428 | Dec. 3, 1936 | 2,081 | 339 | 84 | 223 | 79 | 971 | 425 | – | – | 1,192 |
| 336 | A. W. Feick | 700 | Oct. 26, 1936 | 425 | 58 | 36 | 54 | 293 | 47 | 86 | – | – | 292 |
| 337 | Wm. Strateman | – | Jan. 6, 1937 | 1,576 | – | – | – | 226 | 375 | 550 | – | – | – |
| 339 | Otto Reinartz | 463 | Dec. 3, 1936 | 101 | 29 | 2 | 9 | 110 | 0 | 7 | – | – | 81 |
| 342 | W.E.F.Eilers | 240 | Oct. 27, 1936 | 302 | 11 | 24 | 73 | 299 | 24 | 18 | – | – | 125 |
| 347 | Paul Schneider | 503 | Dec. 4, 1936 | 368 | 27 | 38 | 57 | 220 | 75 | 63 | – | – | 224 |
| 352 | Edwin Soefje | 427 | Jan. 6, 1937 | 3,852 | 334 | 209 | 701 | 207 | 1,306 | 1,200 | – | b/ | 1,694 |
| 355 | Ad. Tausch | – | do. | 281 | – | – | – | 262 | 32 | 13 | – | – | – |
| 356 | A. H. Hoffer | 24 | Nov. 18, 1936 | 234 | – | – | – | 268 | 0 | 9 | – | – | – |
| 359 | Albert Soefje | 57 | Oct. 20, 1936 | 386 | – | – | – | 403 | 0 | 36 | – | – | – |
| 372 | Ernst Voight | 510 | Oct. 26, 1936 | 1,148 | 119 | 72 | 194 | 354 | 287 | 302 | – | – | 594 |
| 373 | L. Jentsch | 485 | Dec. 4, 1936 | 1,647 | 114 | 107 | 322 | 207 | 422 | 580 | – | – | 726 |
| 374 | Gus Reinarz | 500 | do. | 1,983 | 156 | 117 | 387 | 281 | 505 | 680 | – | – | 872 |
| 375 | F. A. Burket | 450 | Oct. 26, 1936 | 1,957 | 166 | 110 | 380 | 348 | 500 | 630 | – | – | 868 |
| 377 | Erwin R. Goebel | 498 | Jan. 6, 1937 | 2,300 | 236 | 136 | 390 | 293 | 574 | 820 | – | b/ | 1,148 |
| 378 | Hanno Welsch | 542 | do. | 1,019 | 132 | 33 | 193 | 348 | 245 | 245 | – | 0 | 466 |
| 381 | Servtex and Materials Co. | 160 | Sept. 19, 1944 | 282 | 82 | 12 | 5.8 | 290 | 7.7 | 11 | – | 6.8 | 254 |
| 383 | Charles Mergele | 611 | Sept. 16, 1941 | 540 | 43 | 26 | 109 | 288 | 94 | 83 | 0.5 | 0 | 214 |
| 383 | do. | 611 | Dec. --, 1944 | – | – | – | – | 502 | c/85 | 345 | – | – | d/260 |
| 384 | Harry Dauer | 300 | Dec. 6, 1944 | – | – | – | – | 218 | c/40 | 15 | – | – | d/249 |

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\+ May include Comanche Peak limestone in some wells.

Partial analyses of water from wells and springs in Comal County--Continued
(Results are in parts per million)

| Well | Owner | Depth of well (ft.) | Date of collection | Total dissolved solids | Calcium (Ca) | Magnesium (Mg) | Sodium and Potassium (Na + K) (calc.) | Bicarbonate ($HCO_3$) | Sulfate ($SO_4$) | Chloride (Cl) | Fluoride (F) | Nitrate ($NO_3$) | Total hardness as $CaCO_3$ (calc.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 386 | | | | | | | | | | | | | |
| | | | | Edwards limestone | | | | | | | | | |
| 386 | H. W. Dietz | 314 | Dec. 4, 1944 | 414 | 106 | 76 | 23 | 260 | c/4 | 21 | – | 124 | 296 |
| 393 | Walter Sippel | 502 | Jan. 22, 1944 | 360 | 56 | 33 | 33 | 256 | 58 | 54 | – | 0.2 | 276 |
| 394 | Arthur Bergfeld | – | Dec. 3, 1943 | 370 | 66 | 32 | 27 | 262 | 59 | 56 | – | 0.5 | 296 |
| 396 | Altgelt Farm Association | 335 | Dec. 20, 1943 | 265 | 74 | 17 | 3.9 | 266 | c/22 | 14 | – | 3.2 | 254 |
| 400 | R. W. Gade | Spring | June 24, 1941 | 322 | 97 | 11 | 13 | 334 | 11 | 16 | – | 9.8 | 287 |
| 400 | do. | Spring | Aug. 13, 1941 | – | – | – | – | 334 | c/11 | 12 | – | – | – |
| 400 | do. | Spring | Sept.16, 1941 | 320 | 102 | 14 | 1.6 | 334 | 13 | 13 | 0.2 | 12 | 312 |
| 400 | do. | Spring | Jan. 22, 1944 | 335 | 109 | 13 | 2.5 | 358 | c/ 9 | 13 | – | 12 | 326 |
| 400 | do. | Spring | Sept.14, 1944 | 291 | 88 | 9.8 | 0.7 | 282 | 6.7 | 12 | – | 8.0 | 260 |
| 400 | do. | Spring | Oct. 9, 1944 | – | 107 | 16 | – | – | – | – | – | – | 333 |
| 400 | do. | Spring | Nov. 22, 1944 | – | 98 | 12 | – | – | – | – | – | – | 294 |
| 400 | do. | Spring | Dec. 5, 1944 | – | 76 | 18 | – | – | – | – | – | – | 264 |
| 400 | do. | Spring | Dec. 7, 1944 | – | 100 | 16 | – | – | – | – | – | – | 316 |
| 400 | do. | Spring | Jan. 22, 1945 | – | 96 | 9.6 | – | – | – | – | – | – | 279 |
| 400 | do. | Spring | Feb. 14, 1945 | – | 109 | 12 | – | – | – | 11 | – | – | 322 |
| 400 | do. | Spring | Mar. 5, 1945 | – | 99 | 10 | – | – | – | – | – | – | 288 |
| 400 | do. | Spring | Mar. 23, 1945 | – | 107 | 10 | – | – | c/ 2 | – | – | – | 308 |
| 400 | do. | Spring | Apr. 1, 1945 | – | 98 | 10 | – | – | – | – | – | – | 286 |
| 400 | do. | Spring | Apr. 27, 1945 | – | 112 | 14 | – | – | – | – | – | – | 337 |
| 400 | do. | Spring | May 31, 1945 | – | 79 | 14 | – | – | – | – | – | – | 254 |
| 400 | do. | Spring | July 5, 1945 | – | 86 | 14 | – | – | – | – | – | – | 272 |
| 400 | do. | Spring | July 9, 1945 | – | 64 | 15 | – | – | – | – | – | – | 221 |
| 400 | do. | Spring | Sept.13, 1945 | – | 102 | 20 | – | – | – | – | – | 1.5 | 336 |
| 400 | do. | Spring | Oct. 19, 1945 | – | 93 | 12 | – | – | c/11 | – | – | – | 282 |
| 400 | do. | Spring | do. | 317 | 89 | 11 | 2.8 | 294 | c/ 8 | 10 | – | 12 | 267 |
| 400 | do. | Spring | Nov. 23, 1945 | – | 104 | 16 | – | – | c/ 3.0 | – | – | – | 326 |
| 402 | City of New Braunfels | 116 | Dec. 4, 1943 | 281 | 73 | 17 | 6.7 | 263 | 24 | 14 | 0.2 | 5.8 | 252 |
| 403 | do. | 102 | do. | 283 | 73 | 17 | 5.5 | 261 | 24 | 13 | 0.2 | 5.5 | 252 |

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Partial analyses of water from wells and springs in Comal County--Continued
(Results are in parts per million)

| Well | Owner | Depth of well (ft.) | Date of collection | Total dissolved solids | Calcium (Ca) | Magnesium (Mg) | Sodium and Potassium (Na + K) (calc.) | Bicarbonate ($HCO_3$) | Sulfate ($SO_4$) | Chloride (Cl) | Fluoride (F) | Nitrate ($NO_3$) | Total hardness as $CaCO_3$ (calc.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Edwards limestone** | | | | | | | | | | | | |
| 410 | Bear Creek Ranch Association | Spring | Sept. 29, 1943 | 294 | 80 | 21 | 5.8 | 325 | c/ 3 | 14 | - | 5.2 | 286 |
| 414 | Udo Haarman and R. Wright | 333 | Dec. 15, 1944 | - | - | - | - | 248 | c/ 4 | 10 | - | - | d/282 |
| 417 | Edward Lackey | 440 | do. | - | - | - | - | 242 | c/ 3 | 12 | - | - | d/294 |
| 421 | Jesse Posey | 280 | do. | - | - | - | - | 172 | c/65 | 11 | - | - | d/228 |
| | **Austin chalk** | | | | | | | | | | | | |
| 281 | Travis Tate | 152 | Jan. 6, 1937 | 573 | 99 | 37 | 58 | 305 | 130 | 99 | - | 0 | 398 |
| 282 | Phoenix Life Insurance Co. | 145 | Oct. 21, 1936 | 648 | 111 | 32 | 77 | 275 | 169 | 124 | - | - | 410 |
| *317 | Joe Gleitz | 200 | Dec. 12, 1936 | 225 | - | - | - | 165 | 39 | 22 | - | 0 | - |
| 323 | Albert Richner | 130 | Dec. 1, 1936 | 547 | - | - | - | 85 | 170 | 151 | - | - | - |
| 325 | Brund Schwab | 150 | Dec. 18, 1936 | 368 | - | - | - | 287 | 40 | 49 | - | - | - |
| 329 | Gus Klaener | 131 | Dec. 4, 1936 | 2,220 | - | - | - | 128 | 908 | 530 | - | - | - |
| *346 | A. H. Werner | 148 | do. | 553 | - | - | - | 329 | 130 | 63 | - | - | - |
| *348 | Altgelt Farm Association | Spring | do. | 270 | - | - | - | 171 | 71 | 19 | - | - | - |
| 348 | do. | Spring | Aug. 20, 1941 | 298 | 72 | 19 | 30 | 269 | 27 | 15 | - | 3.0 | 208 |
| 348 | do. | Spring | Dec. 20, 1943 | 260 | 72 | 18 | 3.2 | 268 | c/17 | 15 | - | 2.8 | 254 |
| 425 | Missouri Pacific R.R. | 140 | Dec. 22, 1944 | 394 | 109 | 11 | - | 319 | 35 | 20 | - | 17 | 317 |

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Partial analyses of water from wells and springs in Comal County--Continued
(Results are in parts per million)

| Well | Owner | Depth of well (ft.) | Date of collection | Total dissolved solids | Calcium (Ca) | Magnesium (Mg) | Sodium and Potassium (Na + K) (calc.) | Bicarbonate ($HCO_3$) | Sulfate ($SO_4$) | Chloride (Cl) | Fluoride (F) | Nitrate ($NO_3$) | Total hardness as $CaCO_3$ (calc.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Taylor marl | | | | | | | | | |
| *284 | Carl Kutscher Est. | 50 | Oct. 21, 1936 | 680 | - | - | - | 458 | 98 | 106 | - | - | - |
| *322 | Fred Schwab | 38 | Dec. 16, 1936 | 604 | 91 | 22 | 106 | 390 | 118 | 75 | - | - | 319 |
| *349 | Max Walther | 31 | Oct. 27, 1936 | 329 | - | - | - | 323 | 24 | 19 | - | - | - |
| *360 | H. Kickeritz | 36 | Nov. 18, 1936 | 792 | 132 | 33 | 104 | 354 | 248 | 101 | - | - | 460 |
| | | | | Leona formation | | | | | | | | | |
| 246 | Henry Schmidt | 50 | Dec. 17, 1936 | 207 | 93 | 2 | - | 146 | 8 | 32 | - | b/ | 241 |
| 285 | H. Mittendorf | 32 | Oct. 21, 1936 | 228 | 78 | 6 | 5 | 256 | 0 | 13 | - | - | 218 |
| 287 | Arthur Bartels | 65 | Oct. 22, 1936 | 352 | - | - | - | 256 | 0 | 91 | - | - | - |
| 288 | Iwan Wallhoefer Spring | | Dec. 30, 1936 | 260 | 94 | 7 | - | 232 | 24 | 21 | - | 0 | 264 |
| 355 | Ad. Tausch | - | Jan. 6, 1937 | 281 | - | - | - | 262 | 32 | 13 | - | - | - |
| 356 | A. H. Hoffer | 24 | Nov. 18, 1936 | 234 | - | - | - | 268 | 0 | 9 | - | - | - |
| 359 | Albert Soefji | 57 | Oct. 20, 1943 | 386 | - | - | - | 403 | 0 | 36 | - | - | - |
| 359 | do. | 57 | Dec. 3, 1943 | - | - | - | - | 270 | c/ 4 | 72 | - | 165 | - |
| 361 | Emma Rose | 32 | Nov. 18, 1936 | 519 | - | - | - | 268 | 59 | 138 | - | - | - |
| 362 | R. Kraft | 40 | do. | 239 | - | - | - | 250 | 0 | 0 | - | - | - |
| 363 | August Timmerman | 50 | do. | 238 | - | - | - | 256 | 0 | 0 | - | - | - |
| 363 | do. | 50 | Dec. 3, 1943 | - | - | - | - | 240 | c/10 | 21 | - | 90 | - |
| 364 | E. W. Mueller | 35 | Oct. 10, 1936 | 163 | - | - | - | 134 | 0 | 34 | - | - | - |
| 367 | Mrs. H. Oelkers | 40 | do. | 257 | - | - | - | 250 | 0 | 33 | - | - | - |
| 368 | D. Werner | 30 | do. | 291 | 106 | 6 | - | 244 | 35 | 24 | - | b/ | 288 |
| 418 | W. G. Startz | 27 | Dec. 3, 1943 | - | - | - | - | 272 | c/20 | 15 | - | 82 | - |
| 420 | Mrs. Lidia Kirmse | 65 | do. | 467 | 112 | 10 | 40 | 302 | c/ 8 | 52 | - | 96 | 320 |

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# GEOLOGIC MAP OF COMAL COUNTY, TEXAS
## SHOWING LOCATION OF RECORDED WELLS AND SPRINGS