TEXAS BOARD OF WATER ENGINEERS

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BULLETIN 5410

GROUND-WATER DEVELOPMENT IN THE SOUTHERN HIGH PLAINS OF TEXAS, 1953

By

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United States Geological Survey

Prepared cooperatively by the Geological Survey,
United States Department of the Interior

July 1954

CONTENTS

ILLUSTRATIONS

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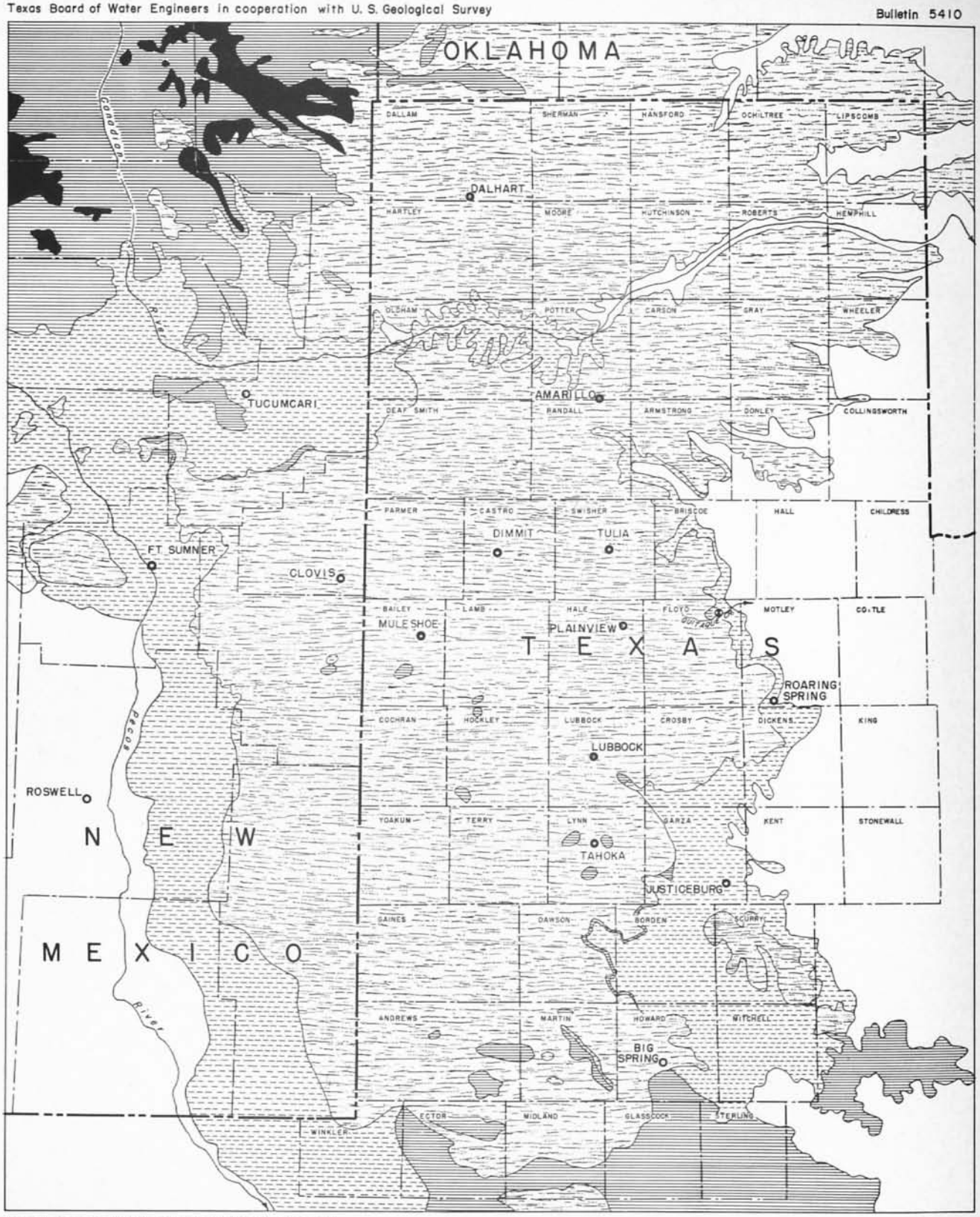
INTRODUCTION

LOCATION AND EXTENT OF AREA

The Texas High Plains consists of an area of about 35,000 square miles extending from the Oklahoma Panhandle southward to Ector, Midland, and Glasscock Counties, and from the New Mexico line eastward to the prominent escarpment or "break of the plains". The deeply incised Canadian River divides the Texas High Plains into two hydrologic provinces, the North Plains and the southern High Plains. (See fig. 1.) The ground-water development is largely concentrated in the principal irrigated region of the southern High Plains, which encompasses about 6,800,000 acres and extends from Amarillo southward to Tahoka in Lynn County. However, in 1952 and 1953 a large number of irrigation wells were drilled in the more southerly counties and in the North Plains.

PURPOSE AND SCOPE OF THIS REPORT

This report is one of a series of annual progress reports summarizing the development of the ground-water resources of the Texas High Plains. The purpose of the report is to make available the data regarding ground-water withdrawals and the fluctuation of water levels during the year 1953.



From geologic map of United States, U. S. Geological Survey, 1932.

EXPLANATION

- Ogallala formation — TERTIARY
- Igneous rocks — TERTIARY
- Undifferentiated rocks — CRETACEOUS
- Dockum group — TRIASSIC
- Undifferentiated rocks — PERMIAN
- Stream-gaging station on Quitaque Creek

25 0 25 50 75 100 Miles

FIGURE 1.- Geologic map of the High Plains in Texas and adjacent areas.

The investigation is a part of the statewide cooperative program of the United States Geological Survey and the Texas Board of Water Engineers. The project is under the administrative direction of A. N. Sayre, Chief of the Ground Water Branch of the U. S. Geological Survey, and under the direct supervision of R. W. Sundstrom, District Engineer in charge of cooperative work in Texas.

PRECIPITATION

Near-drought conditions continued during 1953. Records of the United States Weather Bureau from stations at Dimmitt, Muleshoe, Plainview, and Tulia show that precipitation in 1953 averaged 11.25 inches, or 55 percent of normal. Approximately 64 percent of the precipitation occurred during the 5-month period May to September, inclusive, which comprises the principal growing season. Records of the daily precipitation at these five stations indicate that some moisture fell during 51 days of 1953. Of this precipitation 85 percent fell in amounts less than 0.5 inch per day, 11 percent fell in amounts ranging from 0.5 to 0.99 inch per day, and 4 percent fell in amounts greater than 1.0 inch per day.

According to records of the U. S. Weather Bureau, the precipitation in 1953 at Dimmitt and Tulia was the lowest of record. Precipitation has been recorded at Dimmitt since 1923 and at Tulia since 1896.

GROUND-WATER DEVELOPMENT

In 1953 the development of the ground-water resources in the Texas High Plains increased at a rate unsurpassed since pumping began in 1911. In 1940 about 2,180 wells were used to irrigate approximately 250,000 acres. By the end of 1950, approximately 14,500 wells were in use and about 1,900,000 acres were irrigated. The area irrigated in the entire High Plains increased from 2¼ million acres in 1952 to 3 million acres in 1953, an increase of about one-third. Essentially all the water is pumped from the Ogallala formation, the deposit of sand, gravel, clay, and caliche that underlies and forms the High Plains.

During 1953 about 6,000 wells were drilled - 35 percent more than during the preceding 2-year period 1951-52, and of these wells more than 85 percent were drilled in the principal irrigated region of the southern High Plains. By the end of 1953 about 24,500 wells were in use or available for use, of which 93 percent, or 23,000, were in the principal irrigated region. Of the remaining 1,500 wells, about 1,000 were in the more southerly counties of the High Plains and about 500 in the North Plains. The area irrigated in the principal irrigated region increased from 2,150,000 acres in 1952 to 2,900,000 acres during 1953.

On the basis of these estimates, it appears that in the principal irrigated region there has been a slight decrease in the number of acres irrigated per well. It is reported that a large number of irrigators have been compelled to drill supplementary wells to obtain enough water. This may be attributed to the low rainfall, which increased the need for pumped water, or to the decline in yield of some of the older wells.

WITHDRAWALS OF GROUND WATER

Estimates of the withdrawals of ground water in the High Plains are based on the number of acres irrigated, the duty of water per acre, including rainfall, and the operating time as obtained from data on consumption of electricity.

Since 1938 the withdrawals of ground water from the Ogallala formation have increased each year except during those periods (principally 1941) when precipitation was above normal and the demand for irrigation was relatively light. Owing to drought conditions, the withdrawals of ground water for irrigation, municipal, domestic, and industrial supplies increased from an estimated 3,750,000 acre-feet in 1952 to approximately 4,800,000 acre-feet (4,280,000,000 gpd) in 1953, or about 28 percent. Of the pumpage in 1953, approximately 90 percent or 4,300,000 acre-feet was withdrawn in the principal irrigated region, an increase of about 1,100,000 acre-feet. About 75,000 acre-feet or about 2 percent of the total was withdrawn for municipal and industrial use.

Since 1938 approximately 16 million acre-feet of ground water has been pumped, of which more than 60 percent has been pumped since 1950. Assuming a specific yield of 15 percent, the withdrawals of ground water in 1953 unwatered 32 million acre-feet of saturated material and the withdrawals since 1938 have unwatered about 105 million acre-feet.

DECLINE OF WATER LEVELS

Water levels, measured in a network of about 500 observation wells in January, February, and March before pumping begins, provide the basis for estimating the net loss or gain in storage for each year of operation. Prior to 1943, irrigation was concentrated in relatively small areas and the declines of the water levels in wells were confined largely to those areas. Since 1943, however, irrigation has spread out to form one large district, which in the principal irrigated region in the southern High Plains embraces all or parts of 19 counties.

During 1953 the water levels in most of the 476 widely distributed observation wells were at their lowest level since 1938, when records began in most of the wells. Records show that in 1953 the numerical net average decline of water levels was 4.9 feet, as compared with 3.9 feet in 1952. The available data show that in Floyd County the average net decline in 71 wells was 6.3 feet, compared with 5.3 feet in 1952. The maximum decline recorded during 1953 was 11.9 feet, which occurred in the area of concentrated pumping in west-central Floyd County.

Contours of water-level declines in the High Plains from January 1953 to January 1954 are shown in figure 2. The map shows that the areas in which the decline was 2 feet or more has spread out to form one large area embracing about 4,200,000 acres or more than 60 percent of the underground reservoir as designated under State law. On the basis of the average decline within each county, the total net amount of material unwatered was determined to be 28,000,000 acre-feet. The loss in storage, assuming a specific yield of 15 percent is as follows:

$$28{,}000{,}000 \times 0.15 = 4{,}200{,}000 \text{ acre-feet}$$

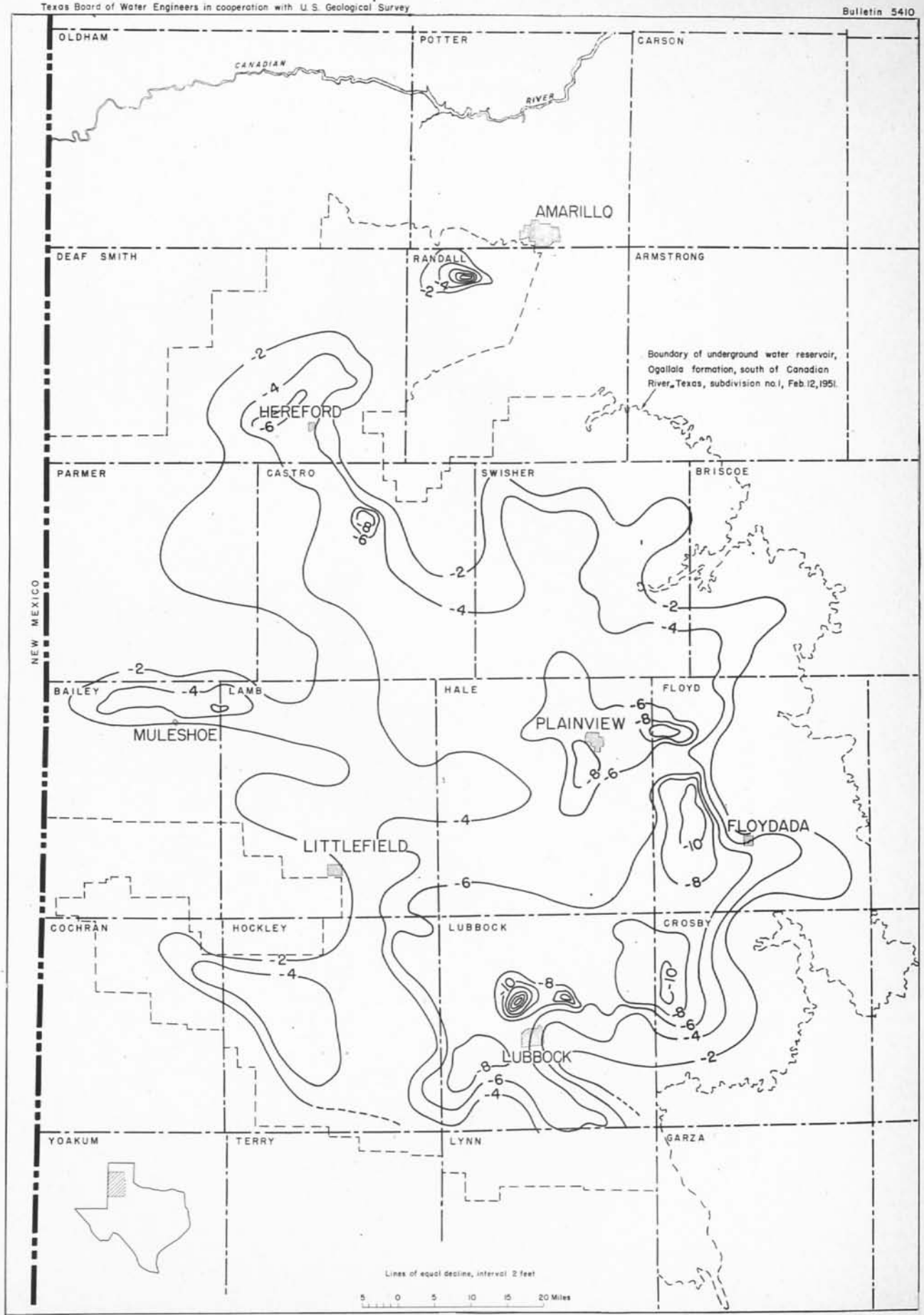


FIGURE 2.-Approximate decline of the water table in the southern High Plains of Texas, January 1953 to January 1954.

This total checks very well with the figure of 4,300,000 acre-feet derived from the pumpage inventory. It shows that the assumed figure of 15 percent for specific yield is very close to the true value. It shows also that the great bulk of the water pumped in 1953, like that in previous years, was derived from storage.

The pumping has not been distributed uniformly over the area but has been greatest in certain districts. As a result, water levels have declined as much as 67 feet in an area of a few square miles southeast of Plainview and from 50 to 60 feet in the areas southwest of Amarillo and around Lubbock.

Although it is in those areas of concentrated pumping that the greatest unwatering of material has taken place, attention should be directed to those areas where the water-level decline has been somewhat less, but where the saturated thickness has been reduced the most percentagewise because it was less at the beginning. In the southern part of Lubbock County the saturated thickness before pumping began in 1938 was considerably less than the average throughout the southern High Plains. By January 1954 the continued decline of water levels had reduced the saturated thickness by roughly one-half.

As the water levels decline, it becomes increasingly important to regard the declines in water levels in terms of the thickness of the remaining saturated material. Areas such as those in the southern part of Lubbock County and southeast of Plainview, where the Ogallala formation is relatively thin, can be expected to experience diminishing yields sooner than the areas where the saturated sands are thicker.