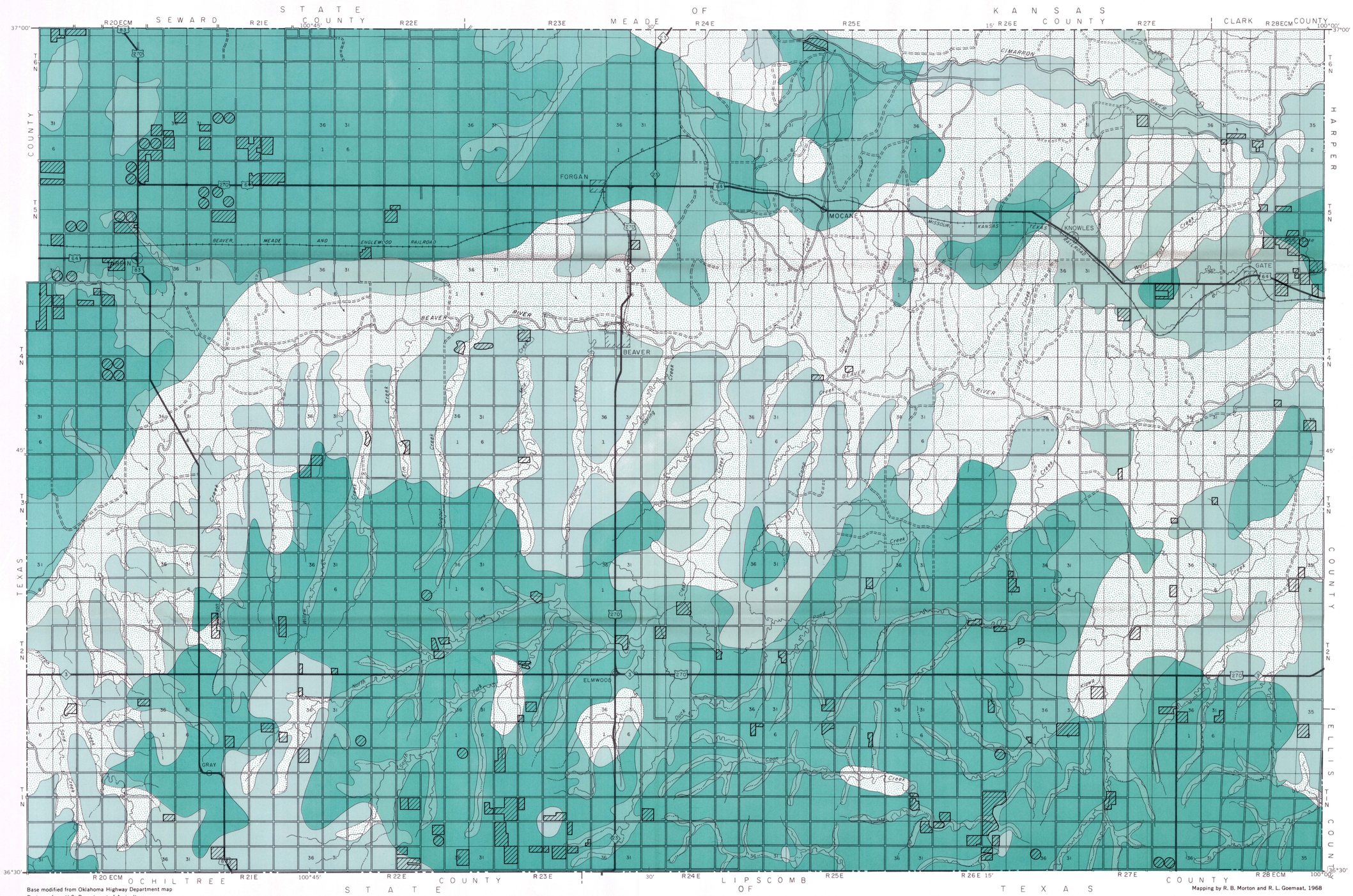
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
OKLAHOMA WATER RESOURCES BOARD

HYDROLOGIC INVESTIGATIONS
ATLAS HA-450 (SHEET 3 OF 3)



Base modified from Oklahoma Highway Department map
Drainage from U.S. Department of Agriculture aerial photographs, 1941

Mapping by R. B. Morton and R. L. Goemaat, 1968

SCALE 1:125 000

2 0 2 4 6 8 10 MILES

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1973 MAGNETIC DECLINATION FOR THIS SHEET VARIES FROM 10°00' EASTERLY FOR THE EAST EDGE TO 10°30' EASTERLY FOR THE WEST EDGE

MAP SHOWING FAVORABILITY FOR IRRIGATION DEVELOPMENT, JANUARY 1968

EXPLANATION

Areas with sufficient thickness of saturated materials and with topography generally favorable for irrigation development

Areas with sufficient thickness of saturated materials but with topography less favorable for irrigation development

Areas with limited thickness of saturated materials but with topography favorable for irrigation development

Areas with limited thickness of saturated materials and with topography less favorable for irrigation development

Irrigated acreage, January, 1968
Rectangular pattern–flood irrigated. Circular pattern–sprinkler irrigated

FAVORABILITY FOR IRRIGATION DEVELOPMENT

Many factors influence favorability for irrigation development. Included are saturated thickness, topography, transmissivity, soil types, water quality, and possibly others of lesser importance.

Water quality is not included in the map showing favorability for irrigation because most irrigation water obtained from the Ogallala Formation or the alluvium is of acceptable quality.

Soil types in Beaver County and other farming information are described in publications listed in the references.

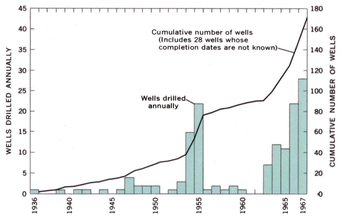
IRRIGATION DEVELOPMENT

The first significant increase in irrigation development in the county was in 1954 and 1955, when 37 wells were drilled. The most recent drilling expansion began in 1963 and is the most sustained increase in the history of the county. Almost as many irrigation wells have been completed since the end of 1962 as were drilled prior to that time (see graph showing irrigation development).

Irrigation development is affected by several factors. Two of the more significant ones are the prevailing degree of prosperity of the agriculture industry and past drought experiences of the industry members. The sharp rise in the number of irrigation wells drilled in 1954 and 1955 coincides with a period of decreasing precipitation and declining water levels in much of Beaver County.

The amount of irrigation water used in 1967 is not known; however, an estimate, based on an average water application of 1.4 acre-feet per acre (Marine and Schoff, 1962, p. 40) and a total of 19,000 acres irrigated during 1967, (Duffin, 1967, p. 2) indicates that 26,600 acre-feet of ground water was applied in Beaver County for irrigation in 1967. Computations by Marine and Schoff (1962, p. 43) show the relative amounts of pumpage from wells according to use for 1959; approximately the same percentage distribution is representative for use in 1967.

	Acre-feet 1959	*Approx. percent of total*
Irrigation	16,000	90
Public supply	400	2
Industrial	370	2
Domestic and stock	1,100	6
Total (rounded)	18,000	100



GRAPH SHOWING IRRIGATION DEVELOPMENT

WATER-LEVEL FLUCTUATIONS

Water-level fluctuations can be long term, seasonal, daily, or brief. Only long-term and seasonal fluctuations are considered in this report because they are the most important in Beaver County. Long-term and seasonal water-level fluctuations are the result of storage changes caused by recharge to and discharge from the aquifer. Hydrographs for selected wells are shown for different localities in Beaver County.

The time necessary for deeply percolating water to reach the water table is determined mostly by the ability of the overlying material to transmit water and by the depth of the water table below land surface. The time interval between a period of precipitation and a rise in water level is called lag time, and the amount can be estimated by comparison of a well hydrograph with an appropriate precipitation graph. In Beaver County, studies by Marine and Schoff (1962, p. 46) indicate that the precipitation graph most acceptable for approximating lag time is the graph of the 5-year moving average of precipitation. Each annual point on the graph is the average precipitation for the preceding 5 years.

The degree of correlation between well hydrographs in the Ogallala Formation and the 5-year moving average depends upon many factors including the depth to the water table and the accessibility of streams for receiving ground-water discharge. The wells in sec. 2, T. 5 N., R. 20 E. and in sec. 12, T. 5 N., R. 21 E., are in a generally flat, undissected upland plain. The average depth to water in the former is approximately 150 feet and in the latter, is 187 feet. Lag time for the two wells is about 9 to 10 years. Because of long lag time and the undissected topography, water levels generally have continued to rise since the 1950–60 dry cycle. By contrast, the other four Ogallala wells are near streams in dissected areas where the relief from the land surface to the stream bed is equal to or greater than the average depth to water during the past 30 years. The average depths to water range from about 40 to 75 feet. The lag time is about 0.5 to 2 years. Because of the short lag time, water levels rose soon after precipitation began to increase in 1940. With a decrease in precipitation beginning in 1951, water levels soon started to decline. By contrast with the two wells in the plains area, the decline in water levels in the other four wells may be explained mostly by discharge from the ground-water body into streams. The fact that the wet cycle from 1960–66, as shown by the 5-year moving average, correlates poorly with the hydrographs of the four-well group is explained partly by natural discharge into nearby streams coupled with less precipitation over a shorter period than in the preceding 1940–50 wet cycle. Approximately 110 irrigation wells were completed from about 1953 to 1966 which is three times the number completed prior to 1953. The increase in irrigation wells plus the total use of irrigation water in the county and adjoining areas, may have helped diminish the rise in water levels during the 1960–66 wet cycle. Generally, levels in the Ogallala Formation show a net long-term rise since the 1933–39 drought.

Water levels in wells in the alluvium fluctuate more than in the other hydrologic units because the water level is near the land surface, the alluvium usually is highly permeable, evapotranspiration is great, and some of the recharge is from streamflow. Water-level changes in the alluvium do not correlate conclusively with any one of the foregoing factors but appear to correlate best with the quarterly average of streamflow. Lag time may be as much as 2 months (Marine and Schoff, 1962, p. 49–50).

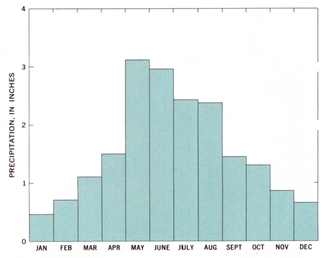
Permian red beds are recharged by the overlying unconsolidated deposits and by direct precipitation on the outcrops. Few wells are completed in the red beds and no hydrographs are available for a well producing from the red beds; consequently, little is known about water-level fluctuations in these rocks.

PRECIPITATION AT BEAVER

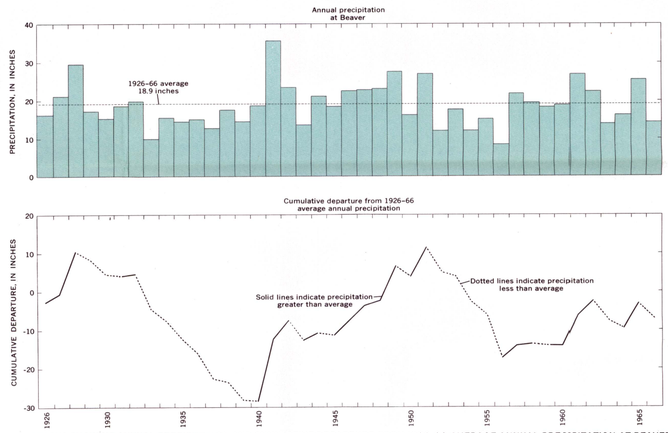
The wettest year shown on the annual precipitation graph was 1941 with 35.3 inches of precipitation and the driest year was 1956 with 8.4 inches.

Precipitation trends during the 41 years are illustrated by the graph of cumulative departure from the average. An occasional very dry or very wet year usually affects the amount of water in storage less than an extended period in which precipitation is moderately above or below the long-term average.

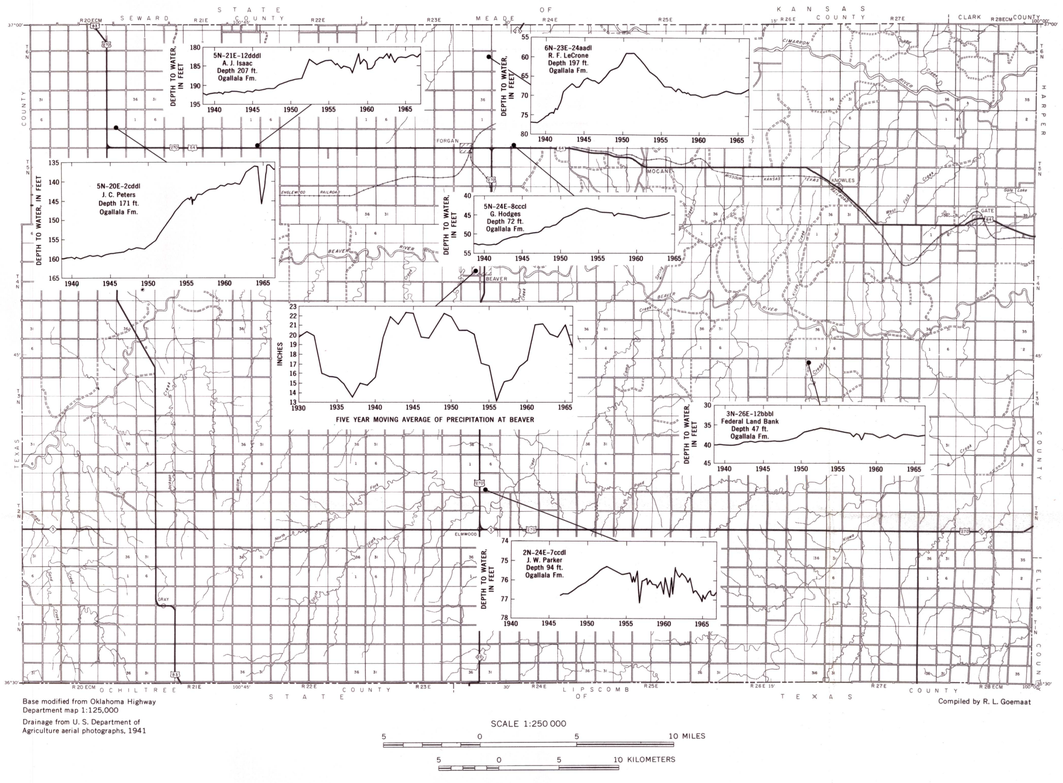
The wettest months shown on the monthly precipitation graph for the 41 years were May to August when 57.8 percent of the annual precipitation fell whereas during the driest months, December and January, 5.8 percent of the annual precipitation fell.



GRAPH SHOWING AVERAGE MONTHLY PRECIPITATION AT BEAVER, 1926–66



GRAPHS SHOWING ANNUAL PRECIPITATION AND CUMULATIVE DEPARTURE FROM 1926-66 AVERAGE ANNUAL PRECIPITATION AT BEAVER



Base modified from Oklahoma Highway Department map 1:125,000
Drainage from U. S. Department of Agriculture aerial photographs, 1941

Compiled by R. L. Goemaat

SCALE 1:250 000

5 0 5 10 MILES

5 0 5 10 KILOMETERS

HYDROGRAPHS SHOWING WATER-LEVEL FLUCTUATIONS IN SELECTED WELLS

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D.C.—1973—W71224

RECONNAISSANCE OF THE WATER RESOURCES OF BEAVER COUNTY, OKLAHOMA

By
R. B. Morton and R. L. Goemaat

1973