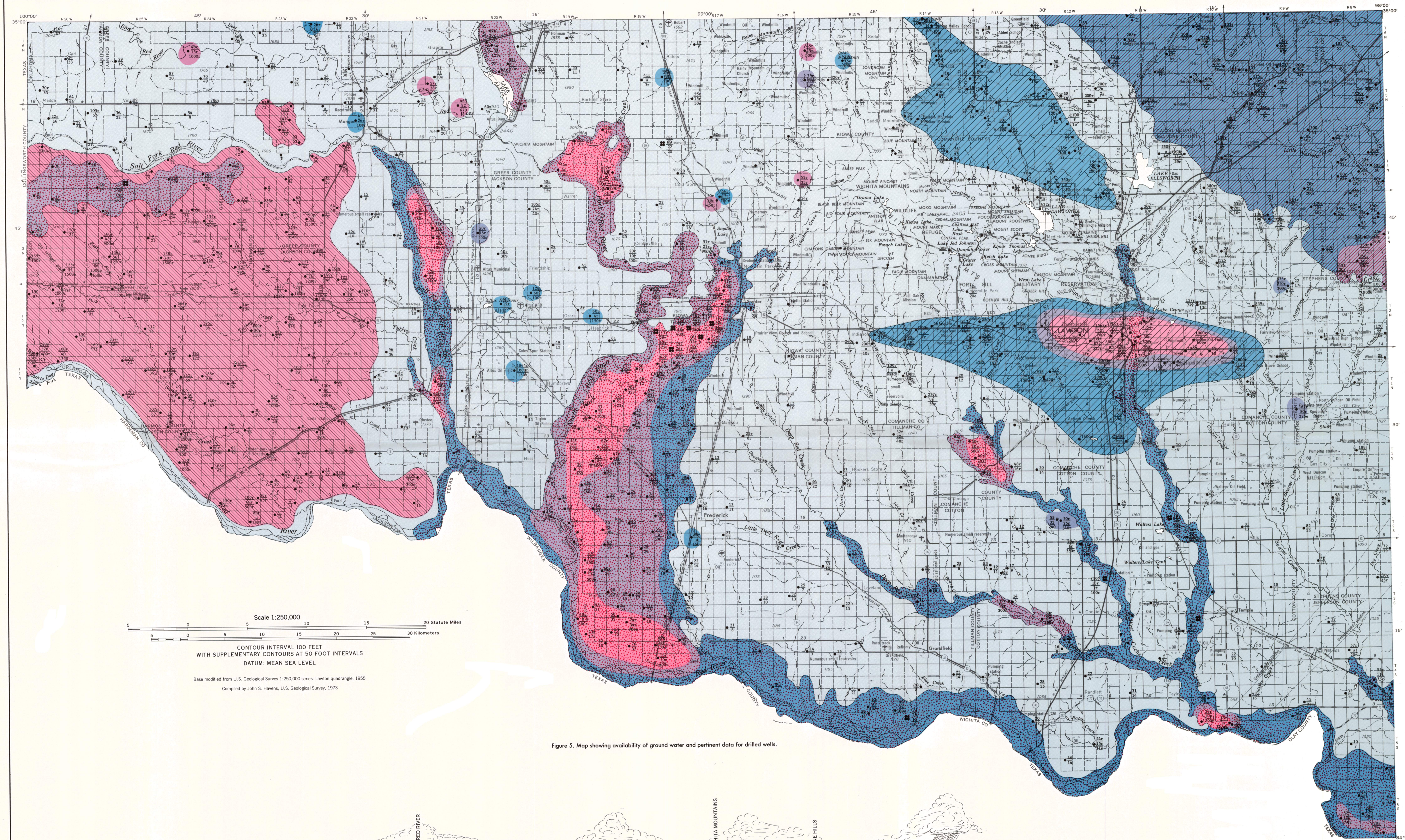

Figure 5. Map showing availability of ground water and pertinent data for drilled wells.

EXPLANATION

Principal Aquifers

Alluvium and terrace deposits

Deposits consist of stream-deposited sand, silt, and clay, generally with interbedded gravel, as much as 75 feet (23 m) thick. Sand and gravel tend to be coarser toward the base of the unit. The depth to water ranges from less than 1 foot (0.3 m) to about 50 feet (15 m). The saturated thickness ranges from less than 5 feet (1.5 m) to as much as 54 feet (16 m). The saturated layers of sand and gravel are thickest along West Cache Creek, the North Fork of the Red River, the Salt Fork of the Red River, and the Red River.

Rush Springs-Chickasha-Duncan aquifer

Sandstone, siltstone, and shale, 700 to 1,300 feet (210 to 400 m) thick. The depth to water ranges from 0 to 692 feet (210.9 m); a few wells flow at the surface. The saturated thickness ranges from 4 to 379 feet (1.2 to 115.5 m).

Dog Creek-Blaine-Flowerpot aquifer

Cavernous gypsum and anhydrite, with interbedded shale and dolomite, 350 to 600 feet (107 to 180 m) thick. The depth to water ranges from 4 to 131 feet (1.2 to 39.9 m).

Arbuckle-Timbered Hills aquifer

Limestone and dolomite, interbedded with shale, 5,000 to 6,000 feet (1,500 to 1,800 m) thick. The depth to water ranges from 0 to 149 feet (43 m).

Well Yield, Range in Gallons per Minute (Litres per Second)

300 to 2,500 (19 to 158)

150 to 300 (9.5 to 19)

25 to 150 (1.6 to 9.5)

0 to 25 (0 to 1.6)

Approximate boundary for principal aquifer. In the area outlined, wells generally yield more than 25 gal/min (1.6 l/s). Individual wells in any area may yield more or less water than the range shown, depending on local hydrologic conditions.

u
Information unknown

r
Information reported

e
Estimated yield

f
Well flows

$\frac{465}{\frac{22}{670}}$

Well

Upper number is depth of well, in feet; middle number is depth to water, in feet below land surface; lower number is well yield, in gallons per minute. Where only two numbers are shown, they are well depth and depth to water.

(17)
28r
12r
525r

Well field

Upper number is number of wells in field; second number is average depth, in feet; third number is average water level, in feet below land surface; bottom number is average yield, in gallons per minute.

100

Spring

Number beside spring symbol is yield, in gallons per minute.

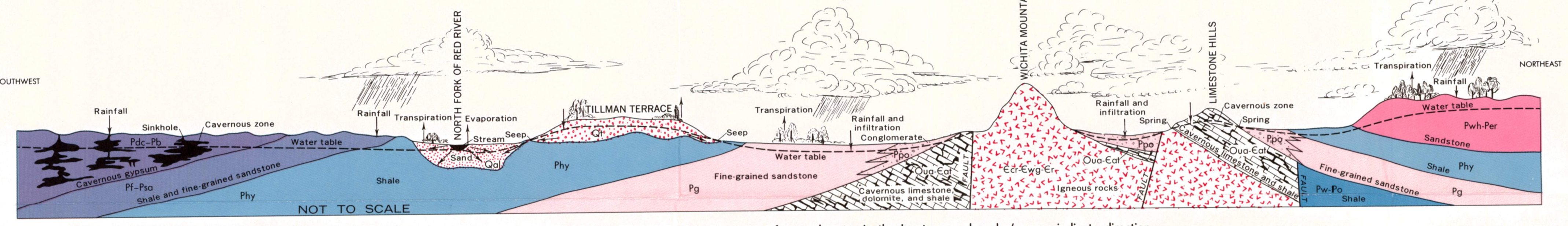

Figure 4. Diagrammatic section showing the possible occurrence of ground water in the Lawton quadrangle (arrows indicate direction of water movement; see figure 2, geologic map, for explanation of geologic formations represented by symbols).

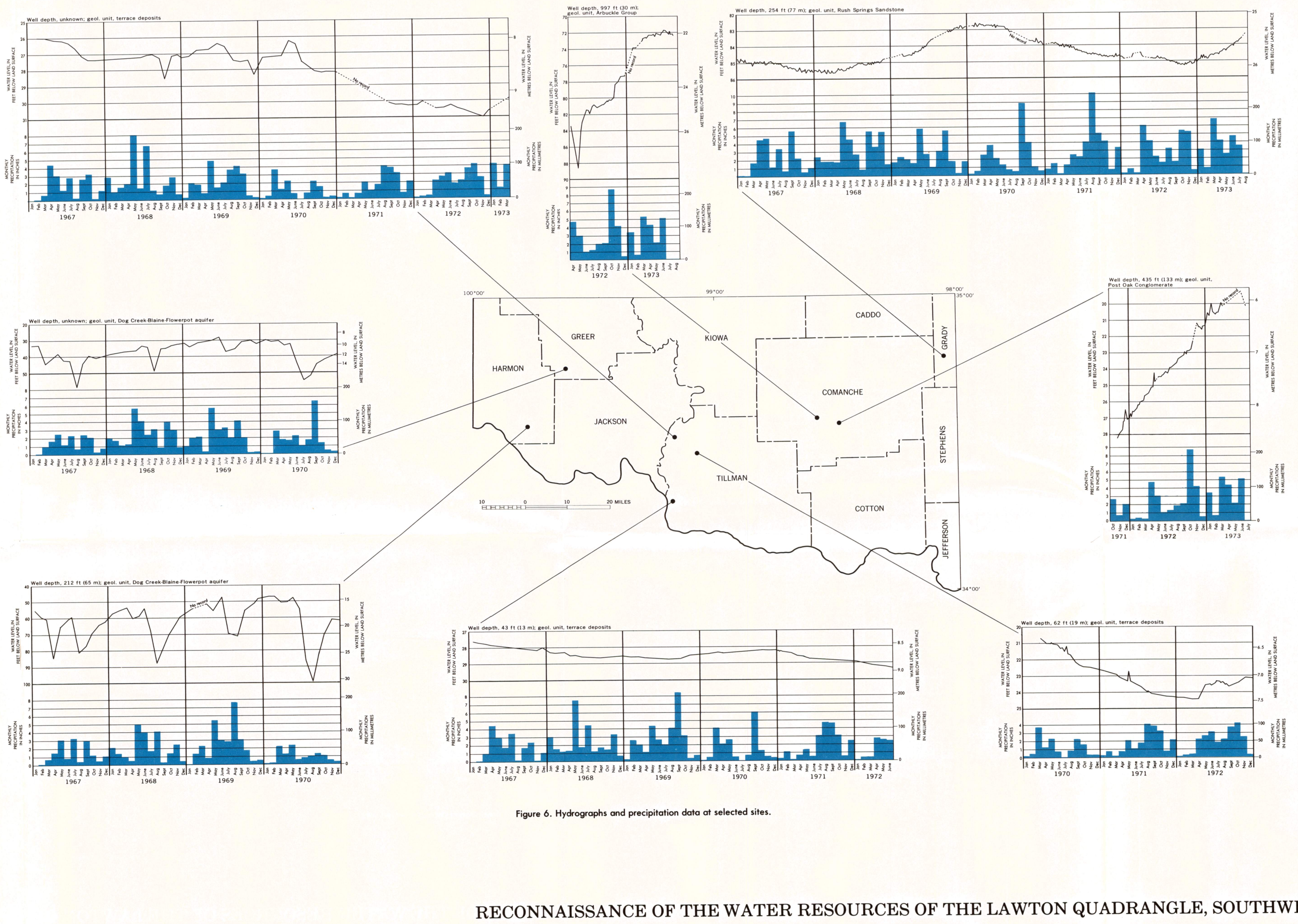

Figure 6. Hydrographs and precipitation data at selected sites.

AVAILABILITY OF GROUND WATER

Geohydrologic Setting

The occurrence and movement of ground water in the Lawton quadrangle, illustrated by figure 4, is controlled largely by climate and geology. Climate, particularly the amount and distribution of precipitation, plays an important role in determining the amount of ground-water recharge to the various aquifers. Geology, particularly the composition of the rocks, is significant in determining the amount of water that can be stored and transmitted through the aquifers.

Average annual precipitation in the Lawton quadrangle ranges from about 22 inches (560 mm) in the western part to about 33 inches (840 mm) in the eastern part. Of these amounts, part runs off immediately, part is lost by evaporation and transpiration, and part percolates downward to recharge the ground-water reservoir. Although winter is the driest season, with about 12 percent of the total annual precipitation, most recharge probably takes place then, because evaporation and transpiration are at a minimum.

Recharge to alluvium and terrace deposits in Tillman County was estimated by Barclay and Burton (1953, p. 22) to be about 12 percent of the annual precipitation. Based on a 64-year average annual precipitation at Frederick of about 26 inches (660 mm), annual recharge amounts to about 3 inches (80 mm) a year. Recharge to the Dog Creek-Blaine-Flowerpot aquifer in Harmon, Jackson, and Greer Counties was estimated by Steele and Barclay (1965, p. 51) at about 6 percent of the total annual precipitation. The 50-year average annual precipitation at Hollis is about 23 inches (580 mm); 6 percent of this amount is about 1 inch (25 mm). Recharge to the Rush Springs Sandstone was estimated by Tanaka and Davis (1963, p. 34) at about 10 percent of the annual precipitation of 28 inches (710 mm) or slightly less than 3 inches (80 mm). Recharge to the Arbuckle-Timbered Hills aquifer probably is less than 1 percent of the average annual precipitation.

The ability of rocks to store and transmit water depends largely on their composition, which in turn determines the size, interconnection, and shape of openings within the rocks. Rocks such as shale or clay transmit water slowly through poorly interconnected, small openings; thus, wells in these rocks yield little water. Sandstone and gravel generally transmit water freely, and these rocks yield water more readily. However, where the sandstone is well cemented, the ability of the rock to store and transmit water is reduced. Carbonate rocks such as limestone and dolomite, and soluble rocks such as gypsum and anhydrite, have little initial permeability, but enlargement of openings along fractures through solution of the rock by moving ground water may produce relatively large openings that transmit water readily. Depending on the size and number of openings penetrated, wells in limestone or gypsum may yield large quantities of water.

Ground-water movement in the Lawton quadrangle generally is from the uplands toward streams. Ground water is discharged by seepage to streams, by evaporation and transpiration to the atmosphere, and by pumpage from wells. During dry periods, base flow in streams is maintained by seepage from adjoining aquifers. During wet periods, when the stream levels are higher than the water table in adjacent aquifers, water from the streams recharges the aquifer.

Principal Aquifers and Their Use

Information used to determine the availability of ground water (fig. 5) was gathered in the field and from published and unpublished data. Field information consisted of depth to water, well-construction and completion data, and reported well yields. Reported data on irrigation and industrial wells were provided by the Oklahoma Water Resources Board. The U.S. Public Health Service provided drillers' logs and data on domestic wells drilled in Caddo, Comanche, and Kiowa Counties.

Figures for the availability of water from the principal aquifers (fig. 5), in terms of well yields, are based on the assumptions that (1) well yields from a particular aquifer are similar throughout its extent provided that the lithology and saturated thickness remain fairly constant, and (2) wells penetrate the total thickness of the aquifer. Individual wells differ from the defined limits of yield depending on well completion and local hydrologic conditions.

The principal aquifers that furnish water for municipal, industrial, and irrigation use in the Lawton quadrangle are: (1) unconsolidated alluvium and terrace deposits, (2) the Rush Springs-Chickasha-Duncan aquifer, (3) the Dog Creek-Blaine-Flowerpot aquifer, and (4) the Arbuckle-Timbered Hills aquifer.

Unconsolidated alluvium and terrace deposits are major sources of water for irrigation and municipal supply in Tillman County. Similar deposits are the source of water for municipal, rural-water district, irrigation, and industrial supply along the North Fork of the Red River and its tributaries. Many rural domestic wells obtain water from shallow wells in alluvium of local stream channels.

The Rush Springs-Chickasha-Duncan aquifer furnishes water for domestic and some industrial supplies in the northeastern part of the quadrangle. This aquifer is also a major source of water for irrigation north of the study area.

The Dog Creek-Blaine-Flowerpot aquifer is the major source of water for irrigation in Harmon, Jackson, and Greer Counties in the western part of the quadrangle.

Limestone and dolomite of the Arbuckle-Timbered Hills aquifer are exposed at the surface in the Limestone Hills area of Comanche, Kiowa, and Caddo Counties, and in this area wells and springs provide water for domestic use and a rural-water district. This aquifer yields water for industrial uses south of the Wichita Mountains, in the vicinity of Lawton and Cache.

WATER-LEVEL FLUCTUATIONS

Water-level fluctuations reflect recharge to and discharge from an aquifer. In general, water levels rise during winter and early spring when most recharge occurs and discharge is least. Water levels decline during summer and early fall in response to discharge by seepage to streams and because of evapotranspiration. Pumping for irrigation is a major cause of annual and long-term water-level declines in some aquifers in parts of the Lawton quadrangle.

Annual water-level fluctuations are well shown by the hydrograph of a well in the Dog Creek-Blaine-Flowerpot aquifer in southern Harmon County (fig. 6). The summer decline in this well is accentuated by heavy pumping nearby. The water level in the Dog Creek-Blaine-Flowerpot aquifer in southwestern Harmon County shows similar, but less pronounced, annual fluctuations.

The hydrographs of water levels in three wells in terrace deposits in Tillman County all demonstrate a long-term water-level decline. This decline is the result of heavy and prolonged pumping for irrigation. Measurements made by the Oklahoma Water Resources Board show that in some areas the water level in the terrace deposits has declined as much as 20 feet (6.1 m) from 1953 to 1973. Conversely, in areas of little or no pumping water levels have risen as much as 10 feet (3 m).

Minor fluctuations of water levels in some aquifers such as the Rush Springs in Grady County are largely the result of changes in barometric pressure. Similar short-term rises and declines of the well in Post Oak Conglomerate in Comanche County probably are caused by locally intense thunderstorms.

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Barclay, J. E., and Burton, L. C., 1953, Ground-water resources of the terrace deposits and alluvium of western Tillman County, Oklahoma: Oklahoma Planning and Resources Board, Division of Water Resources Bulletin 12, 71 p.

Steele, C. E., and Barclay, J. E., 1965, Ground-water resources of Harmon County and adjacent parts of Greer and Jackson Counties, Oklahoma: Oklahoma Water Resources Board Bulletin 29, 96 p.

Tanaka, H. H., and Davis, L. V., 1963, Ground-water resources of the Rush Springs Sandstone in the Caddo County area, Oklahoma: Oklahoma Geological Survey Circular 61, 63 p.

RECONNAISSANCE OF THE WATER RESOURCES OF THE LAWTON QUADRANGLE, SOUTHWESTERN OKLAHOMA

By

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U.S. Geological Survey

1977