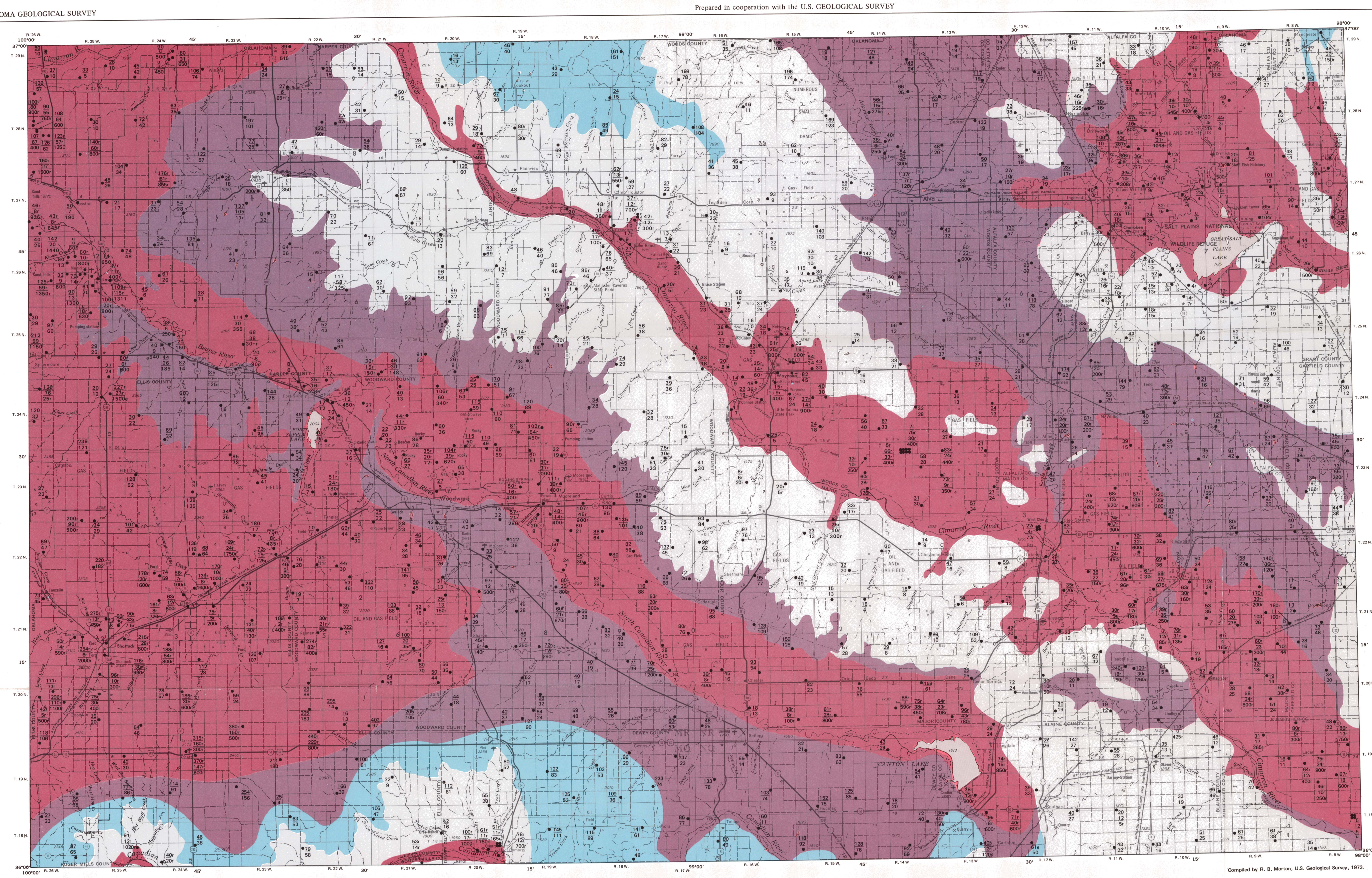


Base from U.S. Geological Survey 1:250,000 series: Woodward Quadrangle, 1955, revised 1971.

Compiled by R. B. Morton, U.S. Geological Survey, 1973.

Scale 1:250,000

5 0 5 10 15 20 Statute Miles

5 0 5 10 15 20 25 30 Kilometers

DATUM: MEAN SEA LEVEL

FIGURE 3: MAP SHOWING AVAILABILITY OF GROUND WATER.

E X P L A N A T I O N

RANGE IN WELL YIELDS, IN GALLONS PER MINUTE

More than 300

Water in these areas is derived mostly from the thick sand and gravel of the alluvial and terrace deposits adjacent to major streams and from similar deposits belonging to the Ogallala Formation and overlying Pleistocene deposits. Most irrigation wells are in these areas. The Whitehorse Group supplies water to some high-yield wells in a limited area in northwestern Harper County.

150-300

Water in these areas is derived mostly from the Whitehorse Group, the Cedar Hills Sandstone of the El Reno Group, and from some alluvial and terrace deposits.

25-150

Water in these areas is derived mostly from the thin sand and gravel of some alluvial and terrace deposits, the Ogallala Formation, and from some parts of the Whitehorse Group.

Less than 25

Water in these areas is derived mostly from thin alluvial and terrace deposits, the Cloud Chief Formation, some parts of the Whitehorse Group, and the basal Cedar Hills Sandstone of the El Reno Group. The other formations of the El Reno Group and the Bison Formation, the Salt Plain Formation, the Kingman Formation, and the Fairmont Shale of the Hennessey Group yield small amounts of water at most places.

• 79 / 32 / 110

Well

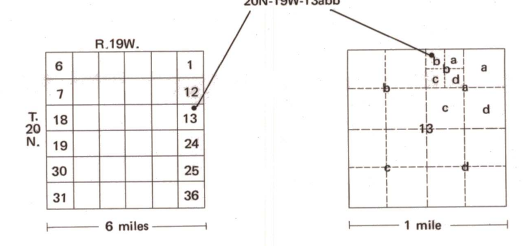
Upper number is depth of well, in feet; middle number is depth to water, in feet below land surface; lower number is yield of well, in gallons per minute. If two numbers separated by a single line are shown, the values are well depth and water level.

7r / 75r / 30r / 400r

Well field

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

e = estimated
t = well flows most of the time
r = reported
u = unknown
+ = minimum value



WELL NUMBERING SYSTEM USED IN OKLAHOMA

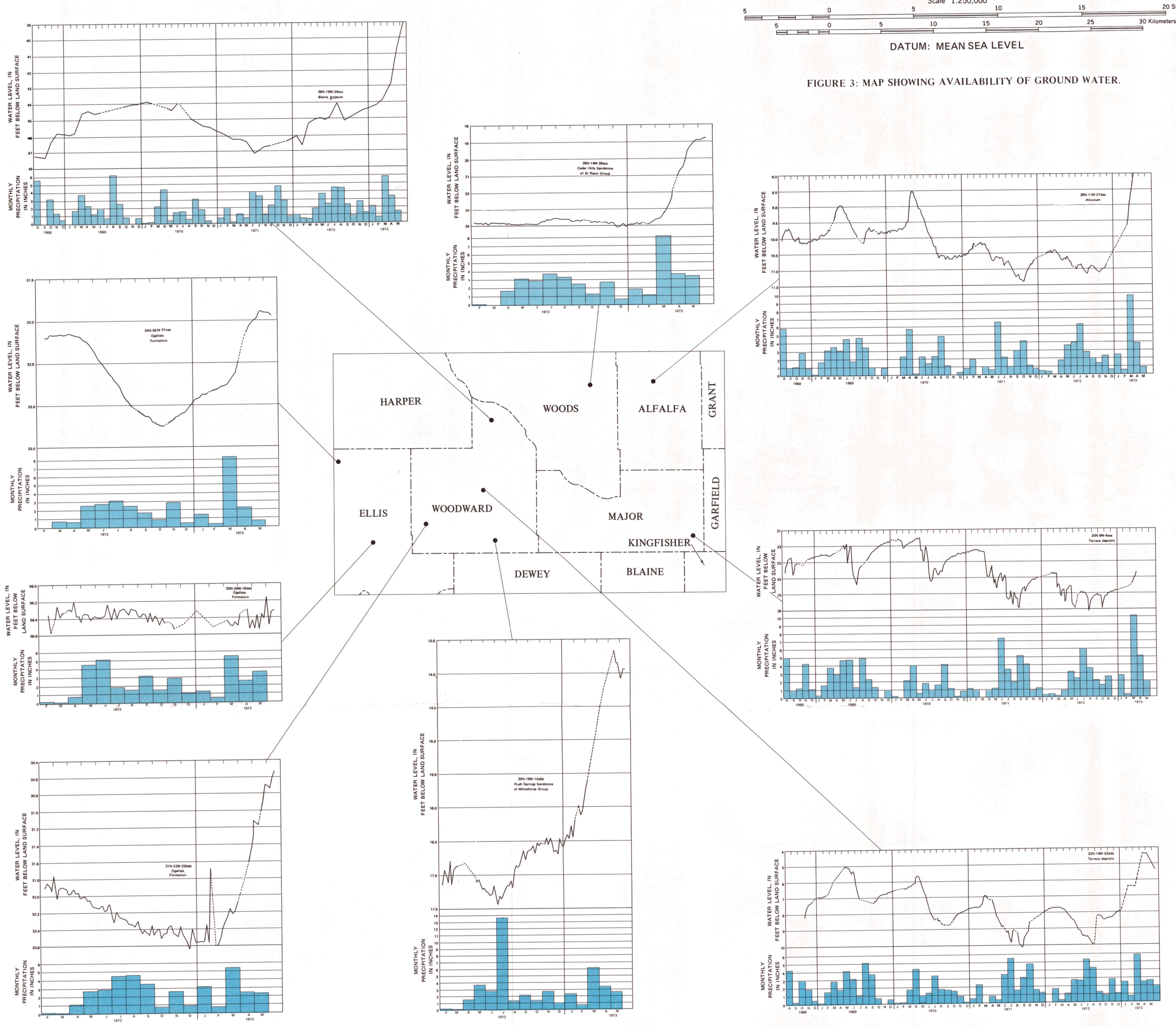


FIGURE 4: HYDROGRAPHS OF WATER LEVELS IN SELECTED WELLS AND BARGRAPHS OF PRECIPITATION.

AVAILABILITY OF GROUND WATER

Well yield is dependent on many factors, including the type of rock in which a well is completed, the saturated thickness of the rock, and the well design. Generally, the type of rock is particularly significant, because the capacity of rocks to transmit water depends on the number, size, shape, and arrangement of openings in them. Water moves very slowly through fine-grained rocks such as siltstone and shale, because the openings between the rock particles are too small to transmit water freely; yields of wells penetrating these rocks are small. Water moves freely through coarse-grained sandstone and gravel, and yields of wells penetrating these rocks are relatively large. Delineation of well-yield areas in figure 3 was accomplished bv assuming that wells fully penetrated the most productive aquifer in each area. In nearly all cases, the most productive aquifer lies at the surface, but in some places wells must pass through relatively impermeable surface rocks in order to reach an aquifer. Locally, individual wells in any of the areas may yield more or less water than is indicated for that area. Such variations usually are the result of local differences in rock type and permeability, local variations in saturated thickness, and in the type of well construction and pumping equipment.

Data on the availability of ground water was mostly from reported well yields supplied by well drillers or land owners, to a limited extent by metered yields furnished by the U.S. Soil Conservation Service, and by estimates based on geology.

Water users in the Woodward Quadrangle rely heavily on ground water as the principal water supply; therefore, a detailed evaluation of the Ogallala Formation and terrace and alluvial deposits is needed in certain areas. Similar studies are needed for the Whitehorse Group and the Cedar Hills Sandstone aquifers, which are significant sources of water locally but require additional evaluation to assess their full potential.

WATER-LEVEL FLUCTUATIONS

Ground water in the Woodward Quadrangle is derived almost entirely from precipitation falling directly on the area. The average annual precipitation ranges from about 21 inches in the western part to 28 inches in the eastern part of the quadrangle. According to Wood and Stacy (1965), an average of about 8 percent of average annual precipitation at Woodward for 1957-62 became ground-water recharge. Assuming this percentage to be valid for the entire quadrangle, from west to east approximately 1.7 to 2.2 inches of average annual precipitation in the Woodward Quadrangle is available annually to recharge the ground-water reservoir. The remaining 18.8 to 22.8 inches becomes streamflow or is returned to the atmosphere annually through evaporation and transpiration.

Although most rain falls during the spring and summer months, most ground-water recharge takes place during late winter and early spring when vegetation is dead or dormant and evaporation and transpiration are at a minimum. Thus water levels are highest in early spring and begin to decline in late spring or early summer. Water levels continue to decline during the summer and into autumn, when they are at their lowest level. In late autumn they begin to rise as evaporation and transpiration decrease. Most of the hydrographs in figure 4 show this annual pattern. The cycle, however, may be interrupted by short-term events such as either a rise of water levels caused by abnormally heavy rains during the summer months or continued declines during spring and early summer owing to deficient rainfall during that period.

Response of the water level to precipitation is influenced most significantly by depth to the water table and permeability of the overlying rock. Generally, the shallower the water table and greater the permeability, the quicker the response. A study of the long-term trend of water levels is not one of the purposes of the report. However, four of the hydrographs show a 58-month record; two of the hydrographs show water levels in terrace deposits, one in alluvium and one in the Blaine gypsum. The hydrographs for wells in the terrace and alluvium show a 4-year net water-level decline caused by pumpage in excess of recharge. This trend, however, was interrupted by above-normal precipitation during the spring of 1973, and an abrupt rise of water levels during early 1973 is shown by almost all the hydrographs.

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RECONNAISSANCE OF THE WATER RESOURCES OF THE WOODWARD QUADRANGLE, NORTHWESTERN OKLAHOMA

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