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Explanation of Water-level Hydrographs

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NEBRASKA GEONOTES

EXPLANATION OF WATER-LEVEL HYDROGRAPHS

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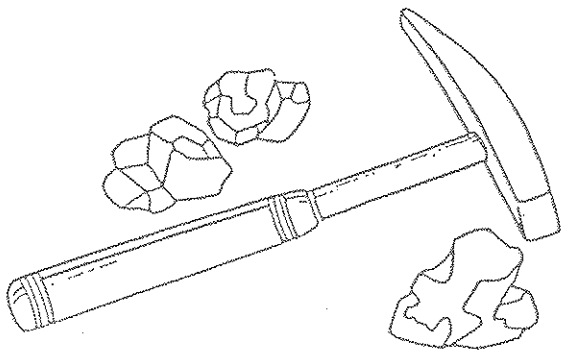

NEBRASKA GEOLOGICAL SURVEY

Conservation and Survey Division
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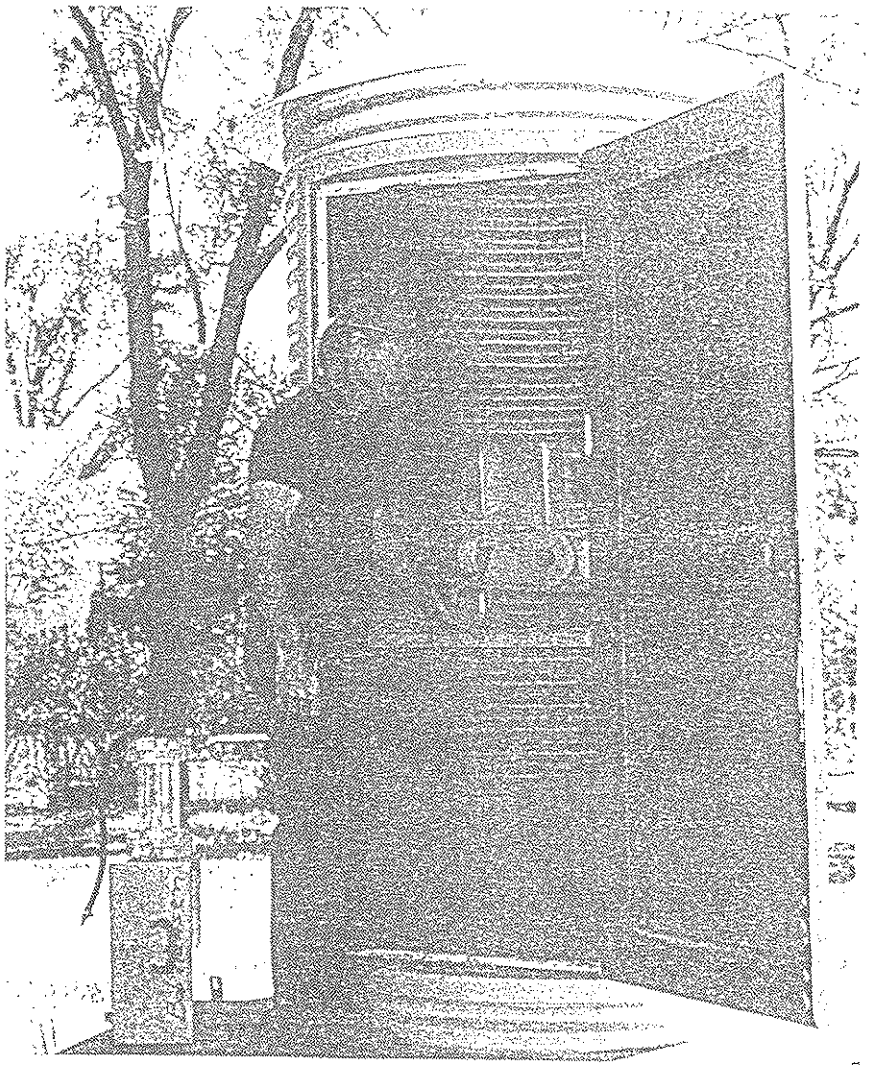
Explanation of Water-Level Hydrographs

Hydrographs are used to illustrate seasonal and long-term water-level fluctuations in key wells that represent hydrologic conditions at various locations in each division. The observation wells selected include those with continuous recorders and others that are measured periodically. In recorder wells, a float system or an electronic sensor is used to detect depths to water, which are recorded graphically on a chart or digitally on punched tape or in an electronic data logger. Periodic measurements are made annually (in the fall), semiannually (in the spring and fall), or monthly. Only limited data from continuous recorders can be stored, so only the lowest daily value for every fifth day and the end of the month is stored in computer files. Hydrographs for recorder wells provide a detailed record of the water-level changes. Hydrographs of wells measured periodically may not show extremes in water-level fluctuations as well as those with continuous recorders, but they provide important information on long-term water-level trends. The bottom of a hydrograph, of course, does not represent the bottom of the aquifer. The full range of water-level fluctuations, in most wells, usually is only a fraction of the thickness of the aquifer.

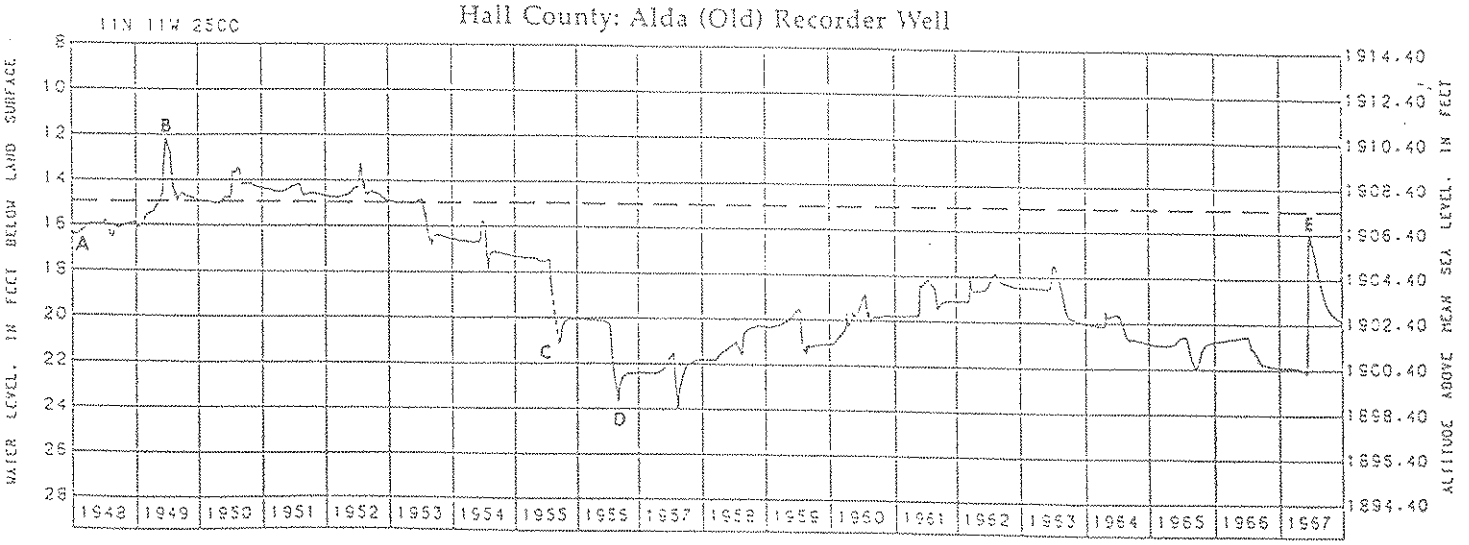
An annotated hydrograph of a 20-year segment (1948-67) of the record for the Alda (old) recorder well is used to show some of the interpretations possible with hydrographs. This well is located in Hall County about 2 miles west-northwest of Alda. The complete record of this well and the Alda (new) recorder well is in the section on the Central Division. Water-level rises in this well were due principally to recharge from infiltrating precipitation. Except for small volumes of water withdrawn occasionally to ensure that the well screen was clear, water was not pumped from this well, so declines were due to pumping from nearby wells and natural discharge. In this well, as in many wells in Nebraska, water levels generally were highest in late spring, declined during the growing season, and began to rise again in October or November. When large volumes of water were pumped from nearby wells, the growing-season declines and fall recoveries were more pronounced. When the water level is higher at the end of the year than at the beginning, the difference indicates a net gain in groundwater storage; conversely, when the water level is lower, the difference indicates a net loss. Changes in water levels are not equal to changes in the volume of groundwater stored. Because groundwater occurs only in the pore spaces between the rock grains of the aquifer (about 30 to 35 percent by volume), a 3-foot change in water levels is equal to about a 1-foot change in the volume of water stored.

At the beginning of the annotated hydrograph shown for the Alda (old) recorder well, the depth to water was a little greater than 16 feet (A), or a little more than 1 foot lower than the estimated predevelopment water level (bold dashed line). Abrupt water-level rises occurred near the middle of many years, such as 1949 (B) and 1967 (E), because of major precipitation. On June 15, 1967, 7-10 inches of rain fell and caused the 1967 rise; it also caused flooding in the area. During the first 5 years of water-level records, depths to water at the end of each year were nearly the same as at the beginning. This indicates that discharge from the aquifer by natural processes and by pumping from wells was about equal to recharge from infiltrating precipitation. From 1953 through 1956, a drought, water-level declines due to natural discharge and to pumping for irrigation exceeded recharge from precipitation. As a result, year-end depths to water were lower than at the start of each year; during this period, the net water-level decline was 7.5 feet. Both 1955 and 1956 were very dry, and fall water-level recoveries were small following large water-level declines caused by irrigation pumping (C and D). During the following 6 years (1957-62), recharge from ample precipitation and less irrigation pumping combined to result in a net water-level rise of about 4 feet. During 1963-66, year-end depths to water again were progressively lower; but in 1967 the year-end water level was 2 feet higher than at the beginning of the year. Although water levels in the Alda (new) recorder well were as low as 26 feet in 1981, by the end of 1986 they were almost the same as the 1948 levels in the Alda (old) recorder well. Readers interested in examples of hydrographs that show confined, unconfined and perched aquifers should see the section, "Examples of Water-Level Hydrographs," in the 1987 report, "Groundwater Levels in Nebraska, 1986."

A water-level hydrograph provides a graphic representation of water-level fluctuations.



Bob Hansen, basic-data supervisor with the Conservation and Survey Division, gets ready to make a water-level measurement.



Annotated example of a water-level hydrograph

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