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Water-Level Changes in the High Plains Aquifer--Predevelopment to 1992

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EXTENT AND DESCRIPTION OF THE HIGH PLAINS AQUIFER

The High Plains aquifer is an extensive volume of saturated, generally unconsolidated, deposits underlying the High Plains region. This aquifer formerly was known as the Ogallala aquifer, but the different geologic units and ages of the deposits constituting the aquifer necessitated a more inclusive designation. The High Plains aquifer consists mainly of one or more hydraulically connected geologic units of late Tertiary or Quaternary age; the Ogallala Formation is generally the principal unit (Gutentag and others, 1984, p. 8). The High Plains aquifer underlies about 174,050 square miles in parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming (table 1).

The High Plains is a remnant of an alluvial plain that once extended eastward from the ancestral Rocky Mountains. The formation of the plain was followed by periods of uplift, when streams eroded the deposits near the mountain front. This erosion isolated the plain from the mountains in all areas except in the area known as the Gangplank in southeastern Wyoming (Thornbury, 1956, p. 288). In some places the original plain was dissected by eroding streams, but in other areas, Quaternary sediments were deposited on the plain. In much of the Northern High Plains, Quaternary sediments consist of wind-deposited silt, known as loess, and dune sands.

The two oldest geologic units included in the High Plains aquifer are the Brule Formation and Arikaree Group (table 2). The Brule consists mainly of massive well-cemented siltstone. In most areas, the permeability of the Brule is too slight to transmit water in sufficient quantities to provide an economic supply of water to wells and is not considered part of the High Plains aquifer. In parts of Colorado, Wyoming, and western Nebraska, however, the Brule Formation is fractured and yields water in large enough quantities to wells to be considered a part of the High Plains aquifer (Gutentag and others, 1984). The Arikaree Group was deposited after the Brule Formation and consists of massive fine-grained sandstone that generally does not yield large quantities of water. The Arikaree, however, is an important local source of water in parts of the northwestern High Plains in Nebraska, South Dakota, and Wyoming.

The Ogallala Formation was deposited after the Arikaree Group by streams flowing from the ancestral Rocky Mountains. The Ogallala is the principal water-yielding unit of the High Plains aquifer throughout most of the High Plains and is composed of a variety of materials, including clay, silt, sand, and gravel. The Ogallala generally yields large quantities of water to wells.

Sand dunes were formed on the older High Plains deposits in several areas. The most extensive of these areas is the Sand Hills of north-central Nebraska, where the sand deposits in places exceed 300 feet in thickness, and in Kansas south of the Arkansas River. The dunes subsequently were stabilized by vegetation, but major dune formation continued until about 1,500 years before the present (Swinehart, 1989). Where the dune sand is saturated and hydraulically connected to the other units of the High Plains aquifer, it is considered part of the aquifer and generally yields large quantities of water to wells.

During Quaternary time, streams eroded older formations and re-deposited the resulting sediment as valley fill and alluvial material. Present-day streams continue to erode and deposit sediment. Where the stream deposits are saturated and hydraulically connected to the other units of the High Plains aquifer, they are considered to be part of the High Plains aquifer.

The deposits of Quaternary age are widespread and are locally important sources of water. However, only in Kansas, Nebraska, and New Mexico are the Quaternary deposits an areally substantial part of the High Plains aquifer. The intensive irrigation in the Platte River Valley of central Nebraska is based largely on ground water exclusively from Quaternary deposits (Peckenpaugh and Dugan, 1983; Peckenpaugh and others, 1987).

FACTORS AFFECTING WATER-LEVEL CHANGE

If the High Plains aquifer were unaffected by human activities, it would be in a state of equilibrium in which natural discharge from the