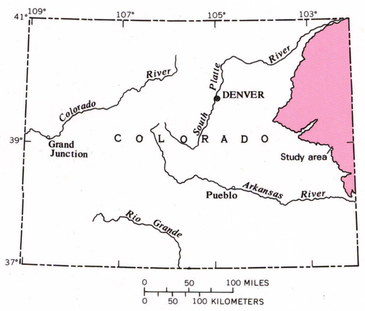

LOCATION OF STUDY AREA

INTRODUCTION

The northern High Plains of Colorado, an area of about 9,500 square miles in eastern part of the State (index map), is underlain by the Ogallala Formation of late Tertiary age. The northern High Plains of Colorado extends from the Colorado State line on the east to the edge of the Ogallala Formation on the north, west, and south. The Ogallala Formation is an unconsolidated or partly consolidated deposit of sand, gravel, clay, silt, and caliche.

The Ogallala aquifer consists of the Ogallala Formation and overlying Quaternary sediments and is the major source of water for irrigation as well as industrial, municipal, and domestic use. The aquifer may not be able to supply enough water in the future to support irrigated agriculture to the same extent as today because of declining water levels. A thorough understanding of the effects of pumpage on the Ogallala aquifer will be necessary to manage the water resources in the most beneficial manner.

Annual water-level data for the northern High Plains of Colorado are collected by the U.S. Geological Survey in cooperation with the Colorado Department of Natural Resources, Division of Water Resources, Office of the State Engineer. Measurements are made in the winter when water levels generally have recovered from pumping during the previous irrigation season. The map showing altitude and configuration of the water table was drawn using water-level measurements from the wells shown, the altitude and shape of the land surface, and the altitude of water in perennial streams. The predevelopment to 1980 water-level change map was prepared using the data points shown and the predevelopment and 1980 water-table map. The 1975 to 1980 water-level change map was prepared using the data points shown, a 1975 water-table map, and the 1980 water-table map. The 1975 to 1980 water-level change map is included in the report so a comparison can be made of recent water-level changes to total water-level changes.

ALTITUDE AND CONFIGURATION OF THE PREDEVELOPMENT AND 1980 WATER TABLE

The altitude of the water table ranges from a high of about 5,900 feet in the most western part of the northern High Plains to a low of about 3,400 feet along the Colorado State line in northeastern Sedgwick County and in east-central Yuma County. Ground water generally moves at right angles to the water-table contours from higher altitudes in the western part of the northern High Plains to lower altitudes in the east.

The configuration of the water table is governed by aquifer properties, the rate and location of ground-water recharge and discharge, and the shape of the bedrock surface. Water-table altitude contours in the eastern part of the northern High Plains are more widely spaced than in the western part because of the generally larger transmissivities of the Ogallala aquifer in the east. Eastward, or downgradient, bends in the water-table contours north of the Arikaree River in southwestern Yuma County and in northeastern Yuma County indicate relatively large rates of recharge. These areas are overlain by stabilized sand dunes and interdune areas of sandy soils which have high infiltration rates compared with finer soils found elsewhere in the northern High Plains. Westward, or upgradient, bends in the water-table contours along the North and South Forks of the Republican River indicate ground-water discharge from the Ogallala aquifer to the perennial reaches of these rivers. Upgradient bends along the intermittent reaches of the Arikaree River east of Cope indicate ground water is moving into the alluvium in the Arikaree River valley. The alluvium is mostly well-sorted sand and is more permeable than the Ogallala Formation.

The predevelopment water-table map was drawn using the earliest water-level measurements available. The years of these measurements ranged from 1948 to 1960. The following table shows the years of water-level measurements by county and the approximate number of irrigation wells in operation as of the last year of measurement. Generally, few irrigation wells were in operation or they had been operating only a short period of time so that the water-level measurements can be considered to represent the predevelopment or prepumping water table.

The 1980 water-table contours are shifted to the west, or upgradient, in many cases, as compared to the predevelopment contours. The upgradient shift in the contours indicates a decline in the water table, mainly caused by pumping for irrigation. In a few places away from the areas of irrigation, such as in Logan County and western Sedgwick County, water levels have risen and the contours have shifted to the east, or downgradient.

WATER-LEVEL CHANGES

The water-level change maps show that about 40 percent of the northern High Plains did not have a significant change (less than 2 feet) in water levels from predevelopment conditions to 1980 and about 52 percent of the area had an insignificant change in water levels from 1975 to 1980. Areas in southern Cheyenne, eastern Kiowa, western Kit Carson, Logan, western Sedgwick, and northwestern Washington Counties had more than a 2-foot water-level rise from predevelopment conditions to 1980. Two small areas in Logan County showed a similar rise from 1975 to 1980. These water-level rises may be due to increased recharge caused by dry-land farming and terracing fields to retain runoff, by leakage from perched water tables caused by well drilling which may have perforated the confining layers, or by a longterm increase in precipitation.

About 50 percent of the northern High Plains had a significant decline in water levels (more than 2 feet) from predevelopment conditions to 1980. About 47 percent of the area had a significant decline from 1975 to 1980. Most of the irrigated area of the northern High Plains experienced a water-level decline of more than 10 feet from predevelopment conditions to 1980. Areas with the largest water-level declines are along the Kiowa-Prowers County line (50 to 60 feet), in east-central Cheyenne County (40 to 50 feet), and near Burlington in Kit Carson County (40 to 50 feet).

Along the Kiowa-Prowers County line, water levels have declined more than 20 feet from 1975 to 1980 and more than 50 feet from predevelopment conditions to 1980. The large decline in this area is cause by pumping for irrigation from saturated materials that thin rapidly away from the irrigated area so the total amount of water in storage is small. Many irrigation wells in this area are now unused or are used to irrigate wheat which requires relatively small amounts of water.

In east-central Cheyenne County, water-levels declined about 20 feet since 1975 and more than 40 feet from predevelopment conditions to 1980. Large numbers of irrigation wells have been drilled in this area since 1970.

Near Burlington in eastern Kit Carson County, water levels declined more than 40 feet from predevelopment conditions to 1980 and from 10 to 20 feet from 1975 to 1980. Most irrigation wells in this area were drilled between 1960 and 1970.

One area in western Sedgwick and northwestern Phillips Counties had a rise in water levels from predevelopment conditions to 1980, but had a decline in water levels from 1975 to 1980. This was caused by pumping from irrigation wells, most of which were drilled after 1975.

Years of the water-level measurements used to construct the predevelopment water-table map, and the approximate number of irrigation wells in operation as of the last year of measurement

County	Years of water-level measurements	Approximate number of irrigation wells in operation as of the last year of water-level measurement
Cheyenne--------	1959-1960	10
Kiowa----------	1960	5
Kit Carson[1]-------	1948-1959	155
Lincoln----------	1959	10
Logan----------	1951-1953	2
Phillips----------	1951-1953	20
Prowers----------	1957-1958	10
Sedgwick--------	1952-1953	4
Washington[2]-----	1950-1957	85
Yuma[3]----------	1950-1957	120

[1]Most water levels measured in 1954 and 1955. There were about 105 irrigation wells in operation before 1956.
[2]Most of the irrigation wells in operation before 1957 were drilled in the Arikaree River valley in southeastern Washington County.
[3]Most of the irrigation wells in operation before 1957 were drilled in the southern quarter of Yuma County.

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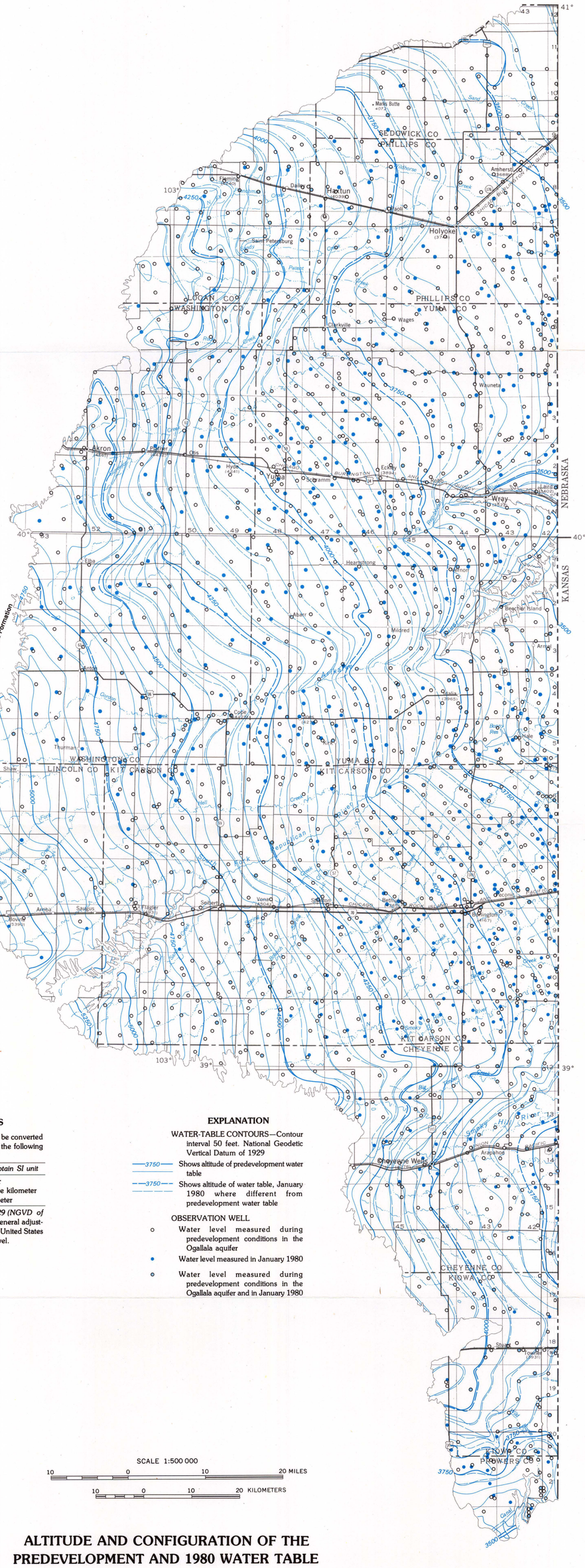
CONVERSION FACTORS

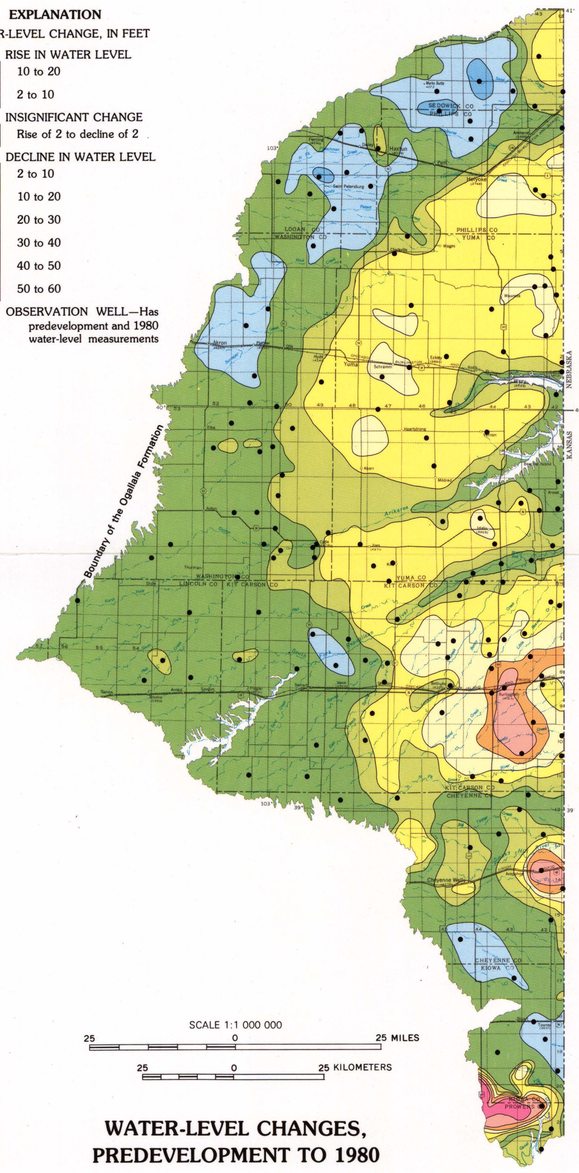
Inch-pound units used in this report may be converted to SI (International System) units by use of the following conversion factors:

Multiply inch-pound unit	*By*	*To obtain SI unit*
foot	0.3048	meter
square mile	2.590	square kilometer
mile	1.609	kilometer

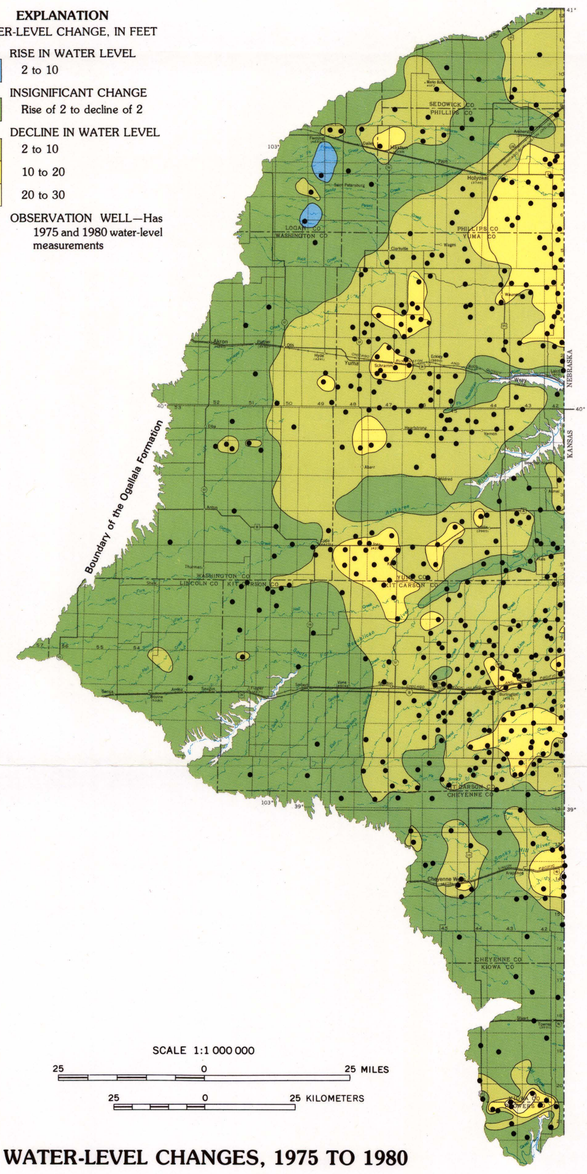
National Geodetic Vertical Datum of 1929 (NGVD of 1929): A geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called mean sea level.



ALTITUDE AND CONFIGURATION OF THE PREDEVELOPMENT AND 1980 WATER TABLE



WATER-LEVEL CHANGES, PREDEVELOPMENT TO 1980



WATER-LEVEL CHANGES, 1975 TO 1980

INTERIOR—GEOLOGICAL SURVEY, RESTON, VA—1983—W82389

Base from U.S. Geological Survey
State base map 1:500 000, 1969

PREDEVELOPMENT AND 1980 WATER TABLE IN THE NORTHERN HIGH PLAINS OF COLORADO; AND WATER-LEVEL CHANGES, PREDEVELOPMENT TO 1980, AND 1975 TO 1980

By
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1983

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