12-1978

Groundwater Levels in Nebraska, 1977

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By Michael J. Ellis, U.S. Geological Survey, and Darryll T. Pederson, Conservation and Survey Division / Nebraska Water Survey Paper Number 45 / Prepared in Cooperation with U.S. Geological Survey / Conservation and Survey Division, Institute of Agriculture and Natural Resources, The University of Nebraska–Lincoln

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Michael J. Ellis
U.S. Geological Survey
and
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Conservation and Survey Division

Nebraska Water Survey Paper Number 45

Prepared in cooperation with U.S. Geological Survey

Conservation and Survey Division
Institute of Agriculture and Natural Resources
The University of Nebraska–Lincoln

The Conservation and Survey Division of The University of Nebraska is the agency designated by statute to investigate and interpret the geologically related natural resources of the state, to make available to the public the results of these investigations, and to assist in the development and conservation of these resources.

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UNITED STATES GEOLOGICAL SURVEY
H. William Menard, Jr., Director

Water Resources Division
K. A. Mac Kichan, District Chief

December 1978

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Ord recorder well 35
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York recorder well 25

FACTORS FOR CONVERTING ENGLISH UNITS TO THE INTERNATIONAL SYSTEM OF UNITS (SI)

Multiply English units	*By*	*To obtain SI units*
	Length	
inches (in)	25.4	millimeters (mm)
feet or foot (ft)	.3048	meters (m)
miles (mi)	1.609	kilometers (km)
	Area	
acres	4047	square meters (m^2)
square miles (mi^2)	2.590	square kilometers (km^2)
	Volume	
acre-feet (acre-ft)	1233	cubic meters (m^3)
	Flow	
gallons per minute (gpm)	.00006309	cubic meters per second (m^3/s)

1.0 INTRODUCTION

This report summarizes data about groundwater-level changes in Nebraska during 1977 and includes other information pertinent to the water-level measurement program.

In 1930, the Conservation and Survey Division of The University of Nebraska and the U.S. Geological Survey started a cooperative water-level measurement program to observe and document on a continuing basis the fluctuations in the groundwater levels of Nebraska.

This report, the twenty-fourth annual report on Nebraska's groundwater levels, summarizes the 1977 water-level changes in Nebraska on a statewide basis and by major areas where significant changes from estimated predevelopment levels have occurred. It describes the availability of data on water levels, provides information on changes in the water-level measurement program during the year, and summarizes data on the two major causes of water-level changes—precipitation and groundwater use. Because of the large amount of available data, much of the information presented in this report is of a generalized nature. The maps showing areas where water levels have risen or declined are an interpretation of point-value data, and some areas may not be precisely delineated.

The primary objective of any water-level measurement program is to monitor groundwater-level fluctuations and to detect significant water-level changes in wells. For maximum effectiveness, a water-level measurement program should also include evaluation of the adequacy and accuracy of collected water-level information and provide a means for its storage, retrieval, and dissemination in a readily understandable format.

Important among the uses of data on groundwater levels in Nebraska are the following:

1. To indicate the amount of groundwater in storage and the availability of supplies.
2. To determine changes in the amount of groundwater in storage, caused by changes in the distribution and rate of groundwater withdrawals, for use in assessing the water-supply outlook.
3. To identify areas where groundwater levels are rising close to land surface, causing the possibility of waterlogging, or where they are declining toward limits of economic groundwater use.
4. To provide long-term records for use in evaluating the effectiveness of land-management and water-conservation programs.
5. To provide long-term records for correlating and evaluating the shorter records from project studies and assessing the validity of the project findings.
6. To provide data for use in estimating or determining certain hydrologic parameters such as rate and direction of groundwater movement, water loss by evapotranspiration, specific yield of aquifers, base flow of streams, sources and amounts of recharge, and locations and amounts of discharge.
7. To supply long-term records needed for testing hydrologic simulation models and assessing the validity of model assumptions and approximations.

Nebraska's water-level measurement program includes the collection of many more data than are presented in this report. These additional data are available, upon request, from the Conservation and Survey Division of The University of Nebraska–Lincoln.

2.0 CHANGES IN WATER LEVELS, 1977

Average water levels rose during 1977 in 73 of Nebraska's 93 counties.

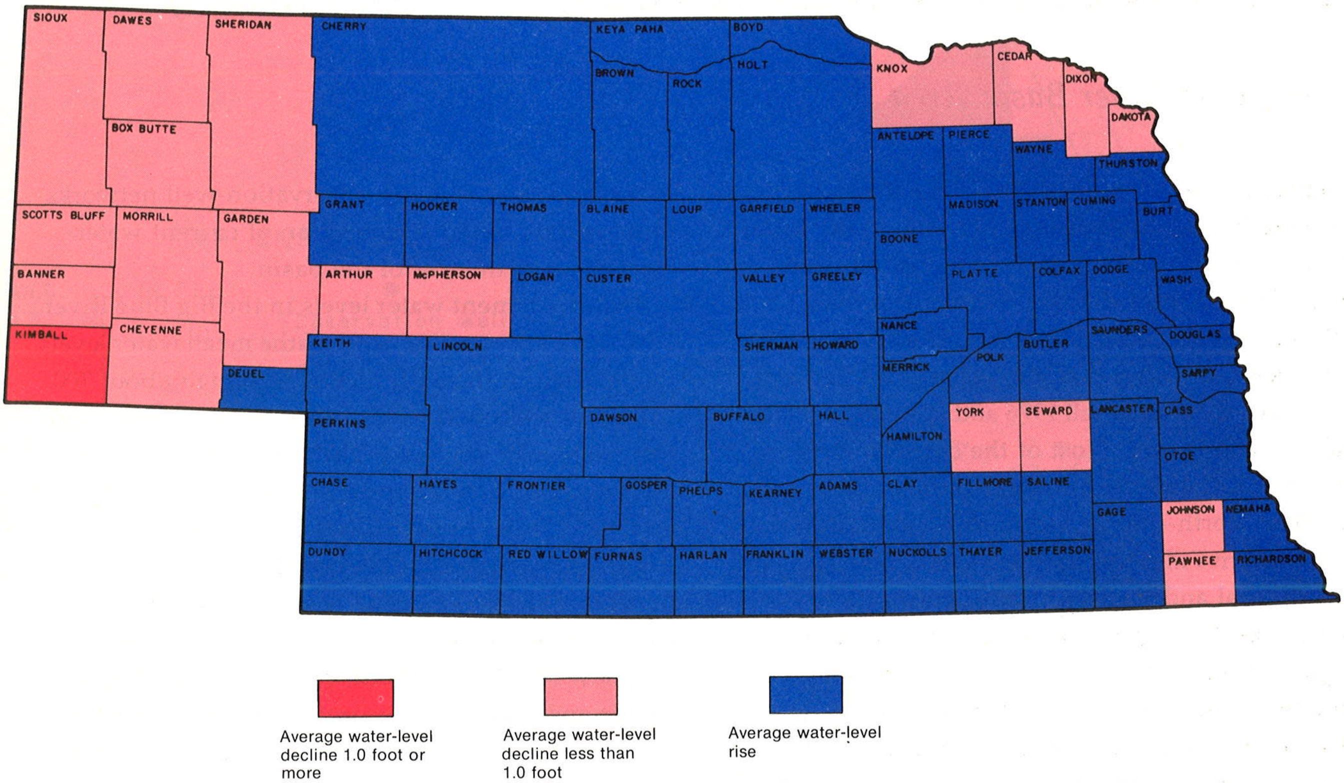
Average water levels in the fall of 1977 were higher than those in the fall of 1976 in 73 of Nebraska's 93 counties. Although most of the rises were less than 1.0 ft (0.305 m), they represent a significant change from the previous year when declines occurred in 91 counties. Most of the counties where average water levels declined in 1977 are located in the northeastern and western parts of the state. The greatest decline occurred in Kimball County where the average water-level change was slightly more than 1.0 ft (0.305 m).

A comparison of fall 1977 water levels with estimated predevelopment water levels made it possible to delineate most areas where water-resources development has resulted in significant declines or rises in water levels. Water-level data collected by natural resources districts in 1977 made it possible to delineate more accurately areas of significant water-level change in several parts of the state. Data are sufficient to describe the water-level declines that have occurred in the following six major areas: the Big Blue River basin, the Platte River Valley, Mira Valley, and the vicinities of O'Neill, Imperial, and Alliance. They are also sufficient to describe the significant water-level rises that have occurred in the Tri-County and Farwell areas. Other areas that had significant changes in water levels are not described separately in this report because sufficient data are not available for the accurate delineation of their extent or the precise description of the water-level changes that have occurred in such areas.

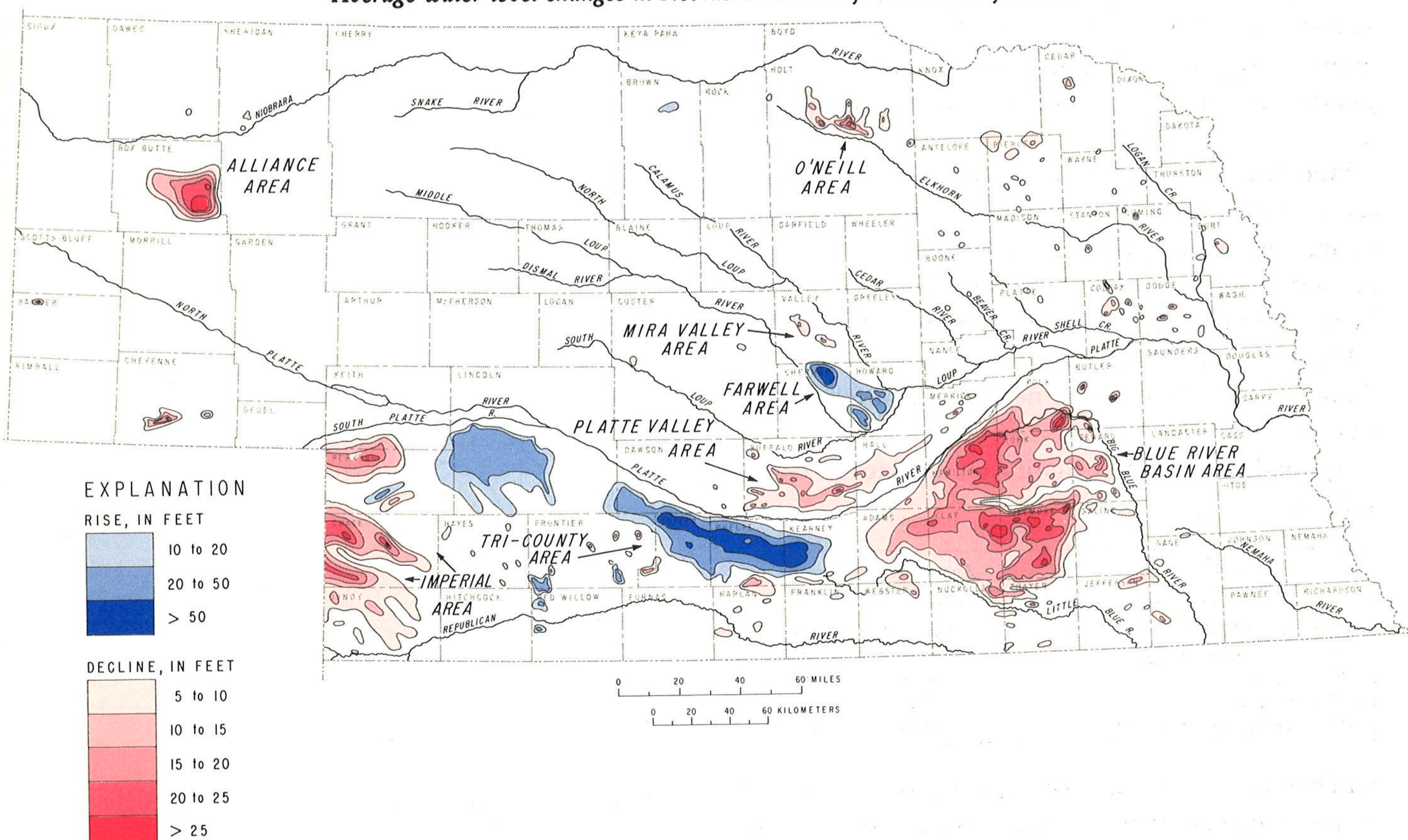
The period of record for many observation wells is too short to provide a satisfactory basis for determining long-term water-level changes. In this report, comparisons are made between the 1977 water level and the estimated predevelopment water level. The estimated predevelopment water level is the approximate average water level that existed in a well prior to any man-made development that has significantly affected water levels in the vicinity of that well. All available water-level data collected prior to or during the early stages of development were used to estimate the predevelopment water levels.

Before development by man, most groundwater systems are in a state of equilibrium—that is, long-term recharge is approximately balanced by long-term discharge. In Nebraska, this natural equilibrium of groundwater systems has been altered by: (1) increased discharge from wells for irrigation, (2) recharge from infiltration of surface water applied to irrigated crops or from deep percolation of seepage from the irrigation storage and distribution systems, (3) discharge to man-made drains, and (4) changes in land use that affect the amount of recharge an aquifer receives. In many parts of the state, water-level fluctuations resulting from natural conditions may be either masked or accentuated by water-level fluctuations resulting from man's activities. Judgment must therefore be exercised when evaluating the significance of water-level data.

The significance of any measured water level is dependent upon the many factors that cause water-level fluctuations. In Nebraska, where use of water for irrigation causes the most significant water-level fluctuations, most observation wells are measured in the spring and in the late fall. Measurements made in the spring are useful in determining amounts of groundwater in storage before irrigation starts each year. Measurements made in the fall are useful in evaluating the effects of annual water use for irrigation and for delineating more accurately problem areas or potential problem areas. The extent and magnitude of water-level changes generally are somewhat smaller if determined from measurements made in the spring. Therefore, in this report, measurements made in the fall are used in documenting both the annual and the long-term water-level changes. In the description of the Big Blue River basin area, however, the changes between estimated predevelopment water levels and spring 1977 levels are also shown.



Average water-level changes in Nebraska between fall 1976 and fall 1977



Significant rises and declines in Nebraska groundwater levels as of fall 1977

2.0 CHANGES IN WATER LEVELS, 1977 (continued)

2.1 Big Blue River Basin Area

Water levels measured in the Big Blue River basin area were higher in the fall of 1977 than in the fall of 1976 in about 75 percent of the observation wells. Although most water-level rises were less than 1.5 ft (0.455 m), rises of 2 to 5 ft (0.61 to 1.52 m) occurred in a few localities. Almost all the water-level declines that occurred between fall 1976 and fall 1977 were less than 1.0 ft (0.305 m). Most of the declines were in York, Seward, east-central and southeastern Hamilton, north-central and northwestern Thayer, southwestern Fillmore, northeastern Nuckolls, and south-central and southeastern Clay counties.

Available data indicate that, on the average, 15,465 irrigation wells in the area were pumped during 1977 at a rate of about 800 gpm (0.050 m^3/s) for 44 days between the middle of June and the end of August to irrigate about 95 acres (384 000 m^2). The average volume of water pumped per well was about 170 acre-feet (209 000 m^3). Thus, in 1977 more than 2.7 million acre-feet (3.30 km^3) of groundwater was pumped for irrigation in the Big Blue River basin area.

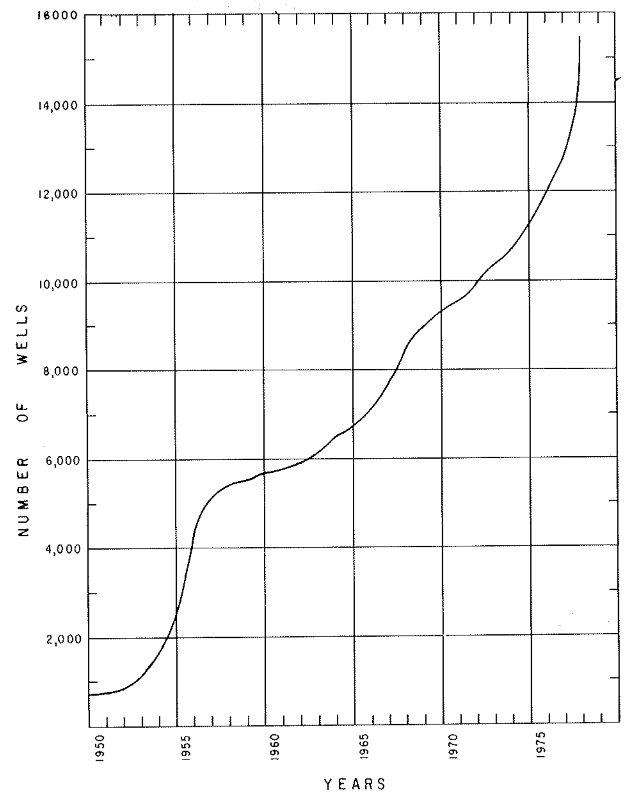
Pumping for irrigation during the past 27 years has caused water levels to decline more than 5.00 ft (1.52 m) from estimated predevelopment levels in an area of approximately 1.94 million acres (7 900 km^2). Maximum declines of slightly more than 40 ft (12.2 m) have occurred in a few wells located south of Sutton in Clay County and near Exeter in Fillmore County.

Approximate areas of significant declines in fall 1977 were:

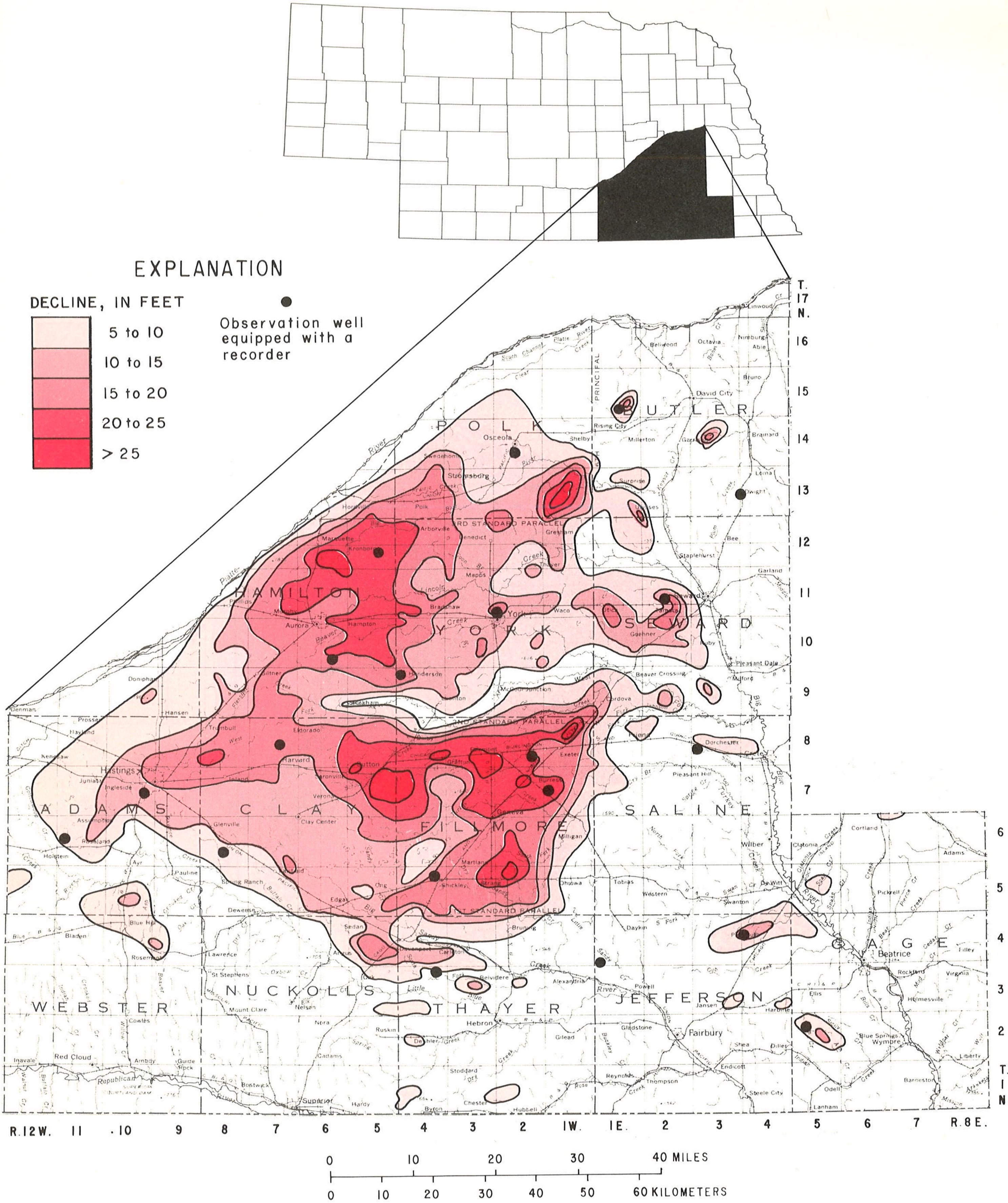
Amount of decline, in feet (meters, m)	Approximate area, in acres (square kilometers, km^2)	
5.00–10.00 (1.52–3.05)	696,000	(2 800)
10.00–15.00 (3.05–4.57)	595,000	(2 410)
15.00–20.00 (4.57–6.1)	418,000	(1 690)
20.00–25.00 (6.1–7.6)	207,000	(840)
25.00 or more (7.6 or more)	28,500	(115)

Sufficient data are available to give good definition of the estimated predevelopment water levels in most of the area, and existing observation-well networks provide data for good definition of current water-level changes in most of the basin.

Predevelopment water levels in the Big Blue River basin area are representative of the mean water levels that existed in the early 1950s. Although about 700 irrigation wells had been drilled prior to 1950, they were generally scattered. Thus, significant water-level declines had occurred in only a few small localities. Drought conditions from 1953 to 1956 triggered widespread development of groundwater for irrigation, and by 1957 approximately 5,300 irrigation wells had been drilled. This intensive groundwater development, coupled with drought conditions, started widespread water-level declines. Continued development has caused a progressive decline in water levels.



Cumulative total of registered irrigation wells in the Big Blue River basin area, 1950-77

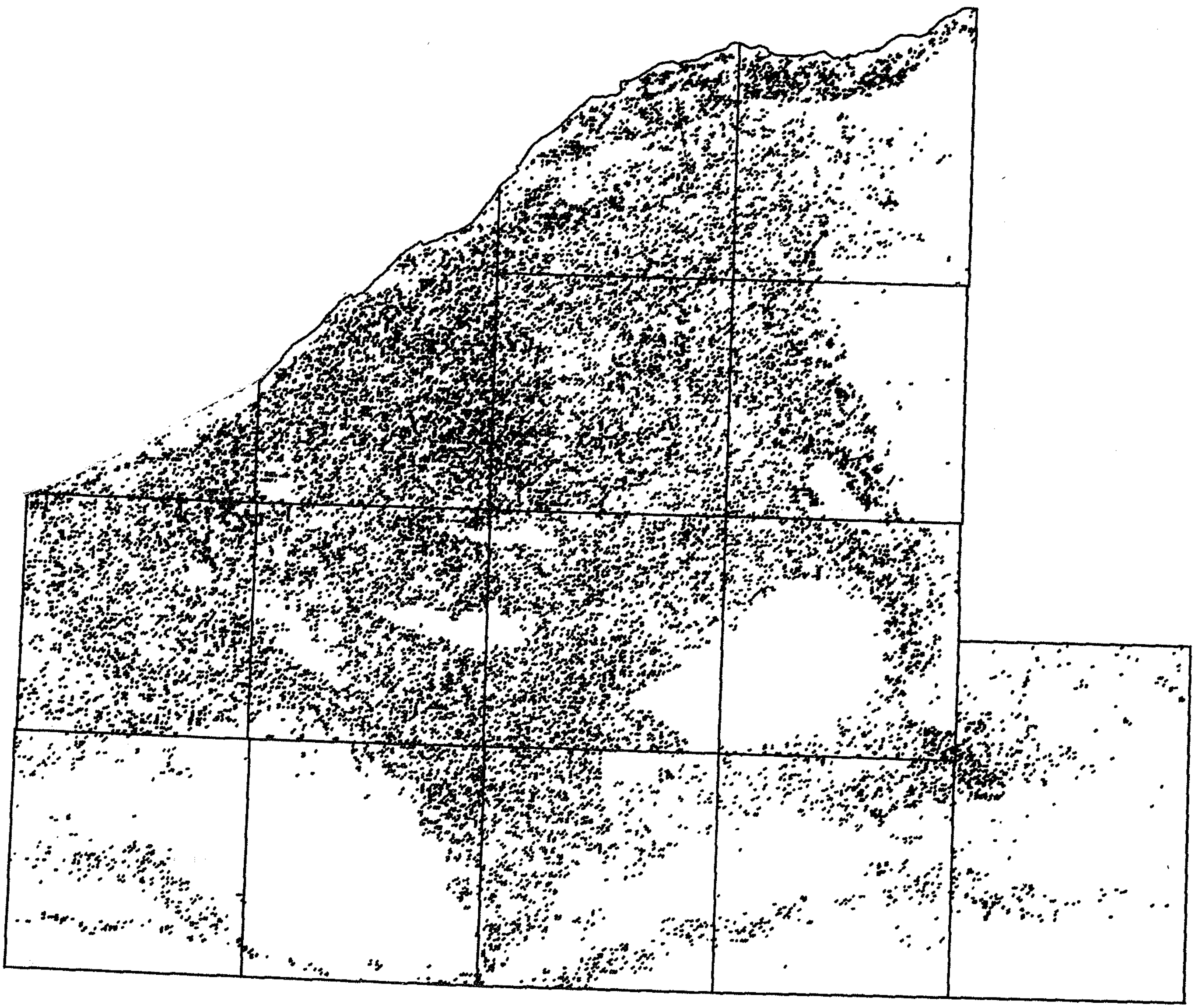


Areas of significant water-level change in the Big Blue River basin area, from 1950 to fall 1977

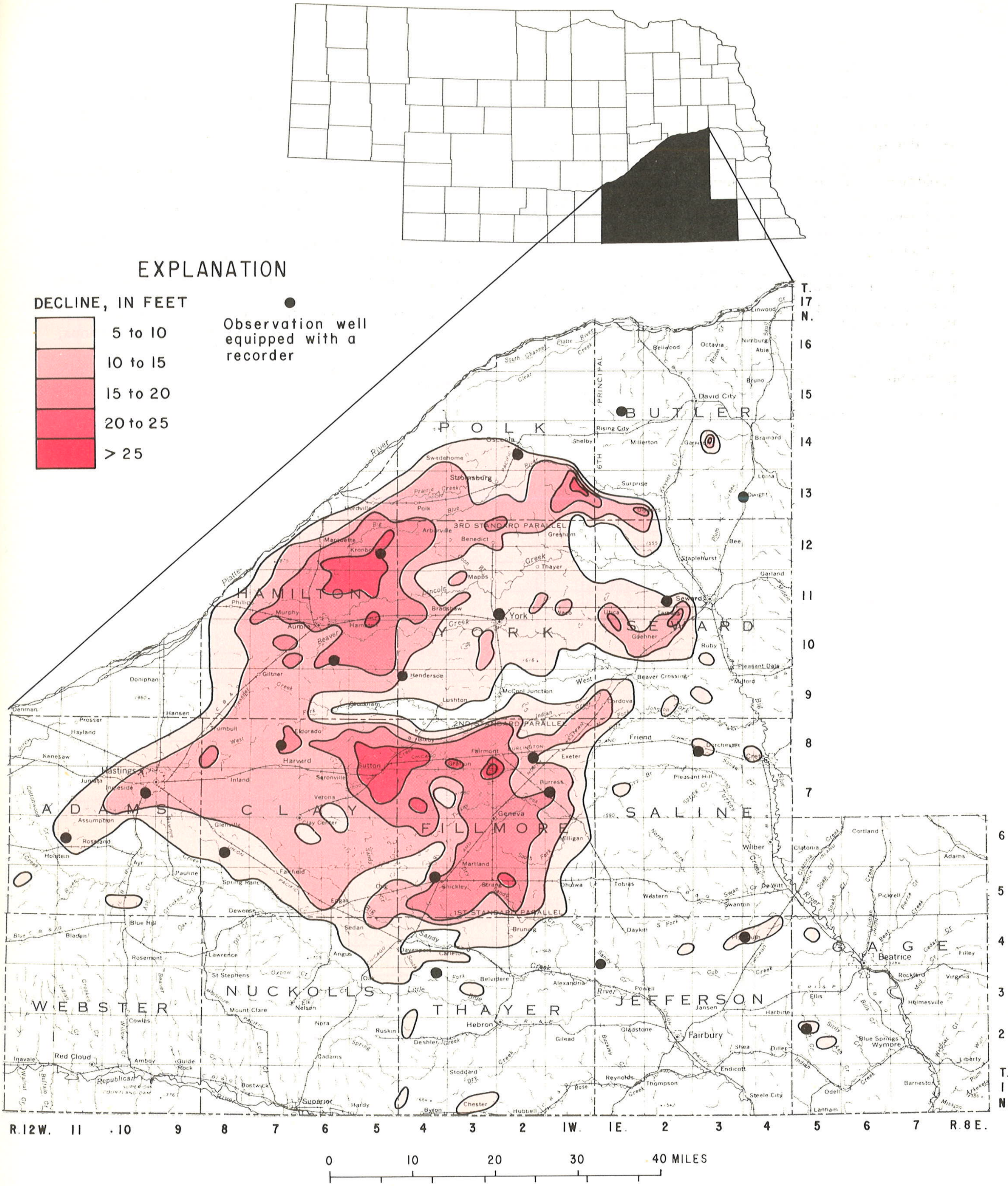
Irrigation wells have been drilled in almost all parts of the Big Blue River basin area where there is an adequate supply of groundwater and where limitations on irrigation development, imposed by such factors as land use, soil type, or topography, are not restrictive.

Approximate areas of significant declines in spring 1977 were:

Amount of decline, in feet (meters, m)	Approximate area, in acres (square kilometers, km²)	
5.00–10.00 (1.52–3.05)	690,000	(2 800)
10.00–15.00 (3.05–4.57)	570,000	(2 310)
15.00–20.00 (4.57–6.1)	279,000	(1 130)
20.00–25.00 (6.1–7.6)	56,000	(227)
25.00 or more (7.6 or more)	1,000	(4.05)



Location of registered irrigation wells in the Big Blue River basin area as of December 31, 1977



Areas of significant water-level change in the Big Blue River basin area, from 1950 to spring 1977

HASTINGS RECORDER WELL

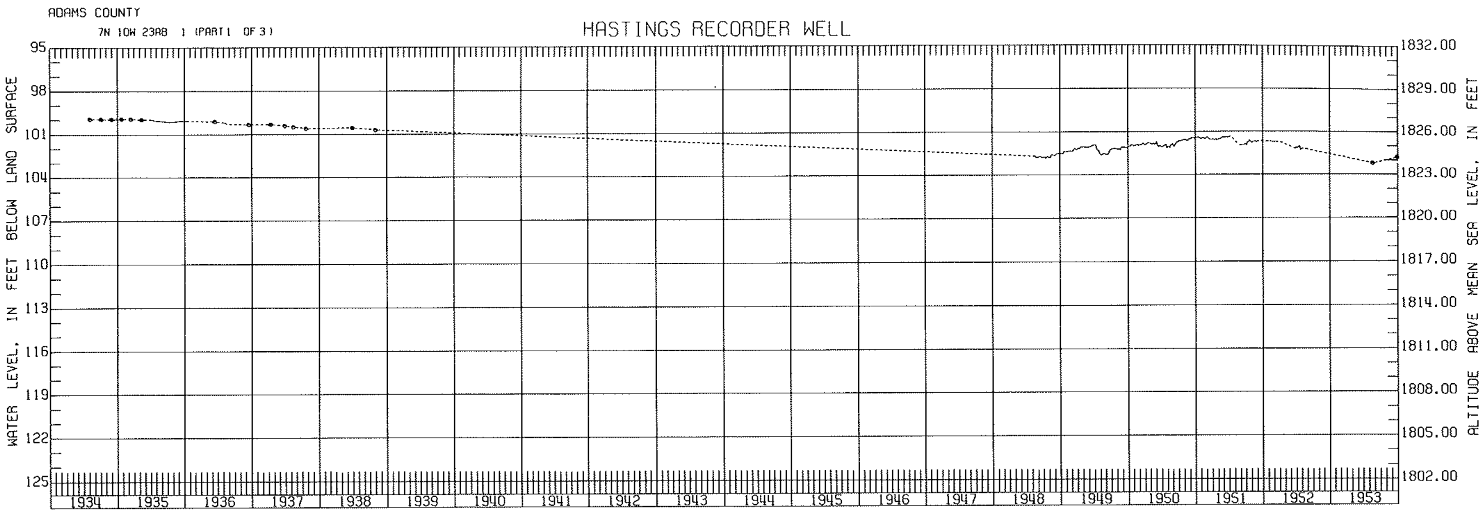
WATER-LEVEL RISE IN 1977

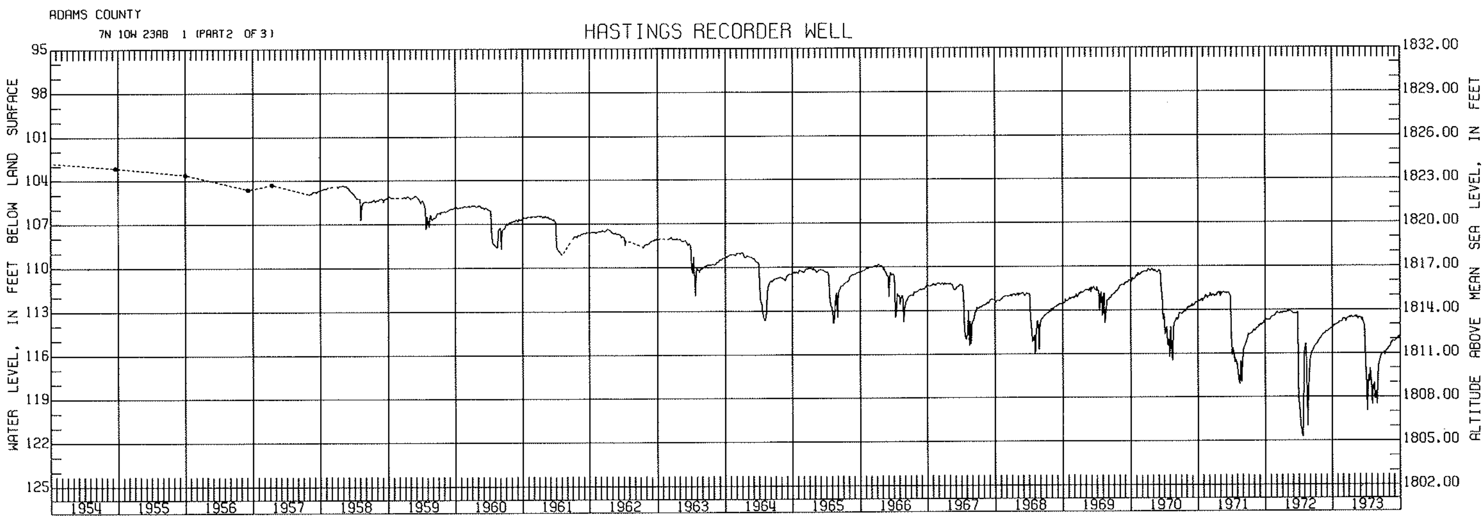
The net change in water level for 1977 was +0.51 ft (+0.155 m). For the second year in a row, there was less recovery than in previous years. Ordinarily, precipitation replenishes soil moisture and temporarily reduces the need for supplemental irrigation water. Although precipitation was below average in seven months, overall precipitation for the year was above average.

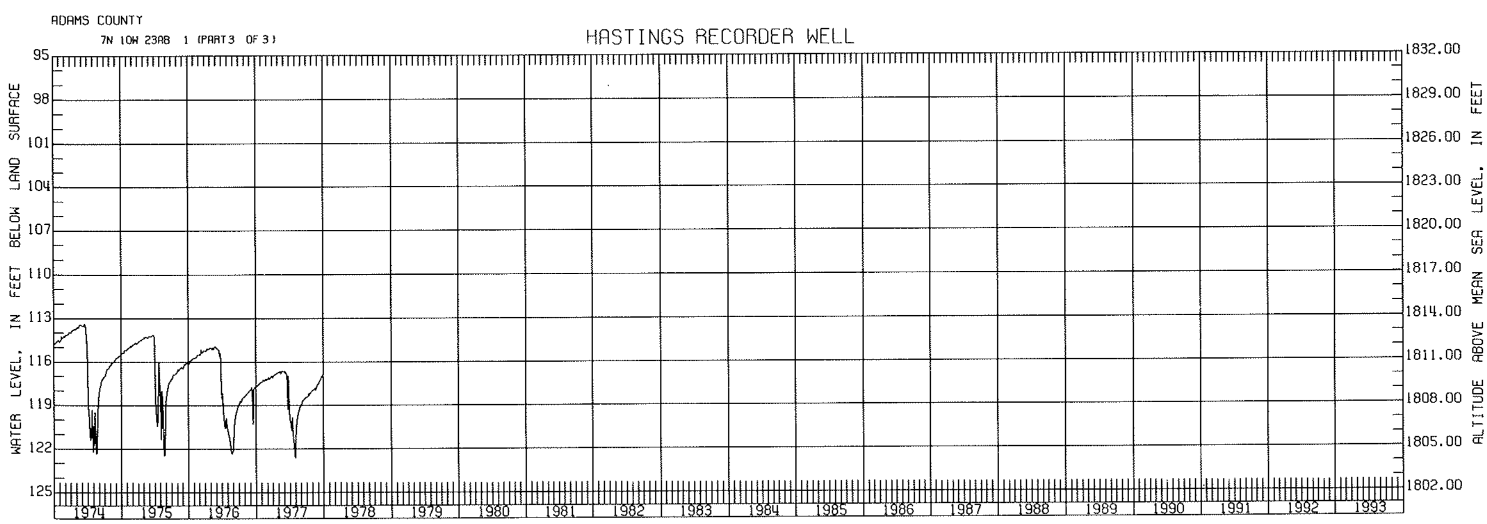
Most of the decline in the 1977 water level occurred in July and early August. This decline, although reaching the lowest level recorded—almost 123 ft (37.5 m)—and lasting overall the shortest length of time since 1969, covered less than two months. The steady, long-term water-level decline was interrupted during the wetter-than-normal 1965-66 period. The hydrograph shows water-level fluctuations characteristic of a semiconfined aquifer from which large amounts of water are pumped for irrigation and municipal purposes during summer months.

WELL DATA

Location: 0.5 mi (0.80 km) west of the west junction of Route 281 and Route 6 on the south side of Hastings
Depth: 155 ft (47.0 m)
Diameter: 8 in (203 mm)
Aquifer: Interbedded layers of gravel, sand, silt, and clay (undifferentiated Pleistocene deposits)
Water occurrence: Combination of unconfined and confined
Estimated predevelopment water level: 102 ft (31.0 m)
Net water-level change in 1977: +0.51 ft (+0.155 m)
Average annual net water-level change since 1934: −0.40 ft (0.122 m)
Development near well: Municipal wells, mainly to east and northeast, and irrigation wells in other directions; drilling of former began in mid-1930s, of latter in mid-1940s; average density of irrigation wells, 3.5/mi^2 (1.35/km^2)


ADAMS COUNTY
7N 10W 23AB 1 (PART 1 OF 3)
HASTINGS RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
95
98
101
104
107
110
113
116
119
122
125
1832.00
1829.00
1826.00
1823.00
1820.00
1817.00
1814.00
1811.00
1808.00
1805.00
1802.00
1934 1935 1936 1937 1938 1939 1940 1941 1942 1943 1944 1945 1946 1947 1948 1949 1950 1951 1952 1953


ADAMS COUNTY
7N 10W 23AB 1 (PART 2 OF 3)
HASTINGS RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
1954 1955 1956 1957 1958 1959 1960 1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973


ADAMS COUNTY
7N 10W 23AB 1 (PART 3 OF 3)
HASTINGS RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993

ROSELAND RECORDER WELL

SHORTEST PERIOD OF SUMMER DECLINE

The water level in this well declined below 103 ft (31.5 m) in July, but this lasted only a short time. The water level recovered rapidly before falling again in late July and early August. These two declines constitute the shortest time the water level was depressed during the summer, equaled only by the first year of record, 1969.

The net water-level change in 1977 was 0.67 ft (0.204 m). This contrasts with a long-term average annual decline of 0.40 ft (0.122 m) covering nine years of record. In 1976, the net water-level decline was nearly four times the average yearly decline since 1968. The water level reached a record low of over 104 ft (31.5 m) in that same year. Below-normal precipitation in 1976 was the probable cause for the greater rate of decline. The rise in 1977 reflects the increased precipitation in the area compared to 1976.

WELL DATA

Location: 1.5 mi (2.41 km) west and 1.5 mi (2.41 km) north of the southwest corner of the village of Roseland
Depth: 200 ft (61 m)
Diameter: 6 in (152 mm)
Aquifer: Moderately to highly permeable sand and gravel deposits interbedded with moderately impermeable clay layers (undifferentiated Pleistocene deposits)
Water occurrence: Combination of unconfined and confined
Estimated predevelopment water level: 77.0 ft (23.5 m)
Net water-level change in 1977: +0.67 ft (+0.204 m)
Average annual net water-level change since 1968: −0.40 ft (−0.122 m)
Development near well: Irrigation wells; initial development in late 1940s, periods of major development 1952-55 and 1965-67; average density of irrigation wells, 3.5/mi^2 (1.35/km^2)

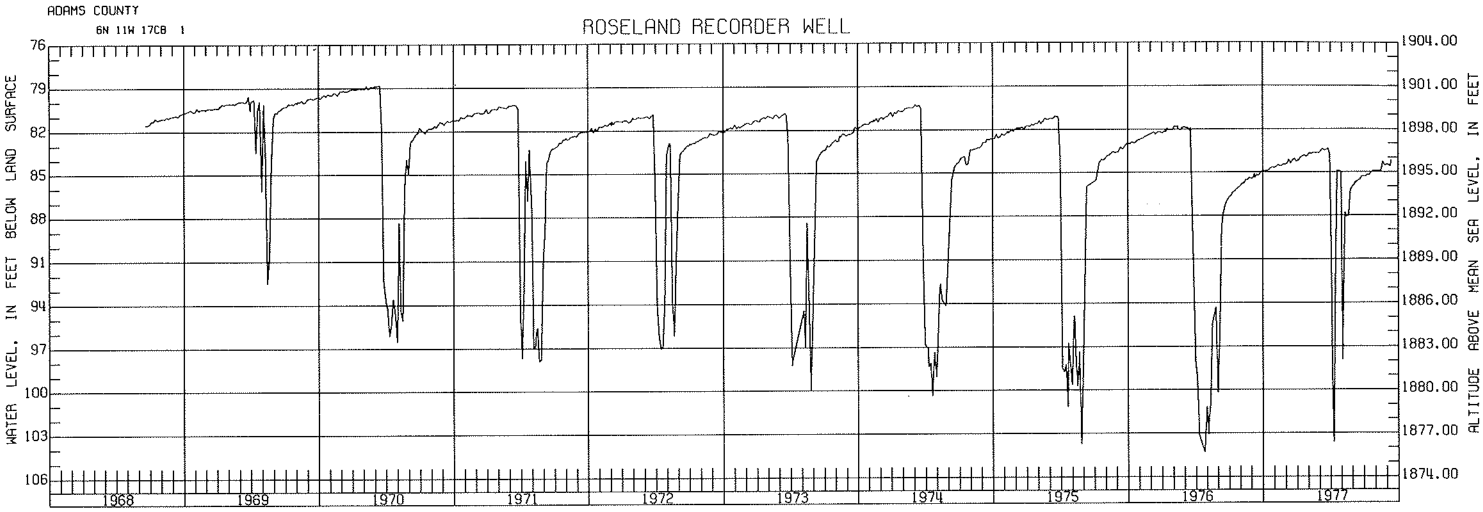
RISING CITY RECORDER WELL

RECORDER MOVED TO NEW WELL

A new well was drilled November 3, 1976, to replace the partially plugged old well. The new well, also 210 ft (64 m) deep, is located 6 ft (1.83 m) from the old well. The water level declined nearly 55 ft (16.8 m) during the summer of 1977 in the new well. This value more nearly reflects the seasonal stress on the aquifer in the immediate area. A sharp decline in the water level of the old well that started on November 3, 1976, was caused by the drilling of the new well.

WELL DATA

Location: 2 mi (3.20 km) north of the northeast corner of Rising City
Depth: Old well, 210 ft (64 m); new well, 210 ft (64 m)
Diameter: Old well, 5 in (127 mm); new well 6 in (152 mm)
Aquifer: Sand and gravel below a thick clay layer (undifferentiated Pleistocene deposits)
Water occurrence: Confined
Estimated predevelopment water level: 91 ft (27.5 m)
Net water-level change in 1977: Not determinable
Average annual net water-level change: Not determinable
Development near well: Irrigation wells; peak development in the mid-1950s; average density of irrigation wells, 2.0/mi^2 (0.77/km^2)


ADAMS COUNTY
6N 11W 17CB 1
ROSELAND RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
76
79
82
85
88
91
94
97
100
103
106
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
1904.00
1901.00
1898.00
1895.00
1892.00
1889.00
1886.00
1883.00
1880.00
1877.00
1874.00
1968
1969
1970
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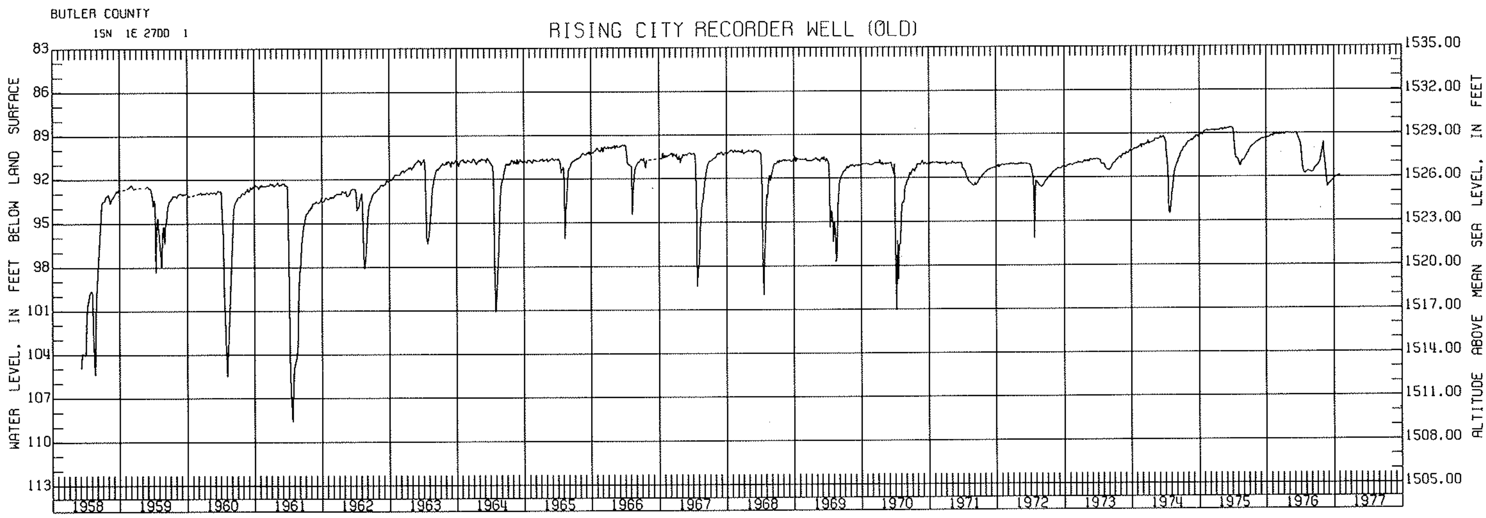
1972
1973
1974
1975
1976
1977


BUTLER COUNTY
15N 1E 27DD 1
RISING CITY RECORDER WELL (OLD)
WATER LEVEL, IN FEET BELOW LAND SURFACE
83
86
89
92
95
98
101
104
107
110
113
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
1535.00
1532.00
1529.00
1526.00
1523.00
1520.00
1517.00
1514.00
1511.00
1508.00
1505.00
1958
1959
1960
1961
1962
1963
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1965
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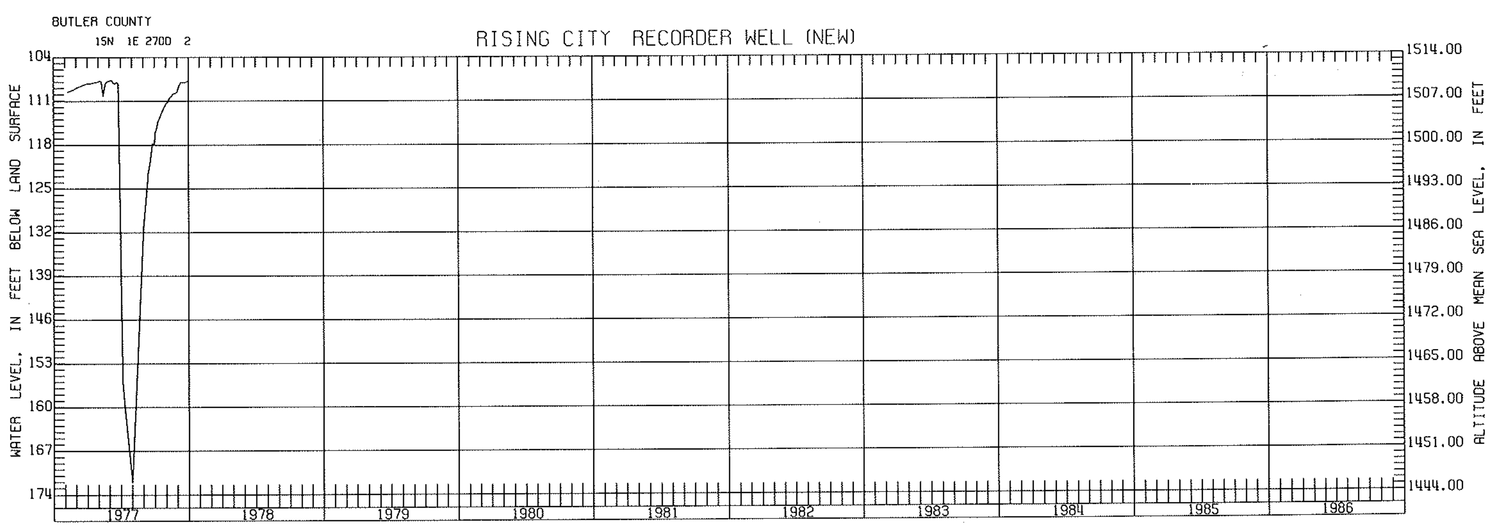
1973
1974
1975
1976
1977


BUTLER COUNTY
15N 1E 27DD 2
RISING CITY RECORDER WELL (NEW)
WATER LEVEL, IN FEET BELOW LAND SURFACE
104
111
118
125
132
139
146
153
160
167
174
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
1514.00
1507.00
1500.00
1493.00
1486.00
1479.00
1472.00
1465.00
1458.00
1451.00
1444.00
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986

DWIGHT RECORDER WELL

RECORDER INSTALLED ON ABANDONED WELL

On February 25, 1976, a water-level recorder was installed on this abandoned municipal well that had been drilled in April 1938. A second municipal well, drilled in 1967, now supplies water for the city of Dwight.

Because the timing mechanism of the recorder malfunctioned several times during the first year of operation, the record of the water-level fluctuation for that period was sporadic. For some months, the only water-level data available are steel-tape measurements made when the recorder was serviced. For the second year during July through September, the water level was at or below the top of the sediment that partially fills the well and no measurements could be made.

The sharp summer decline is largely traceable to heavy groundwater withdrawals.

WELL DATA

Location: 3 blocks north of the intersection of the principal east-west road and the north-south road that borders the western edge of Dwight
Depth: Originally 376 ft (115 m), now 237 ft (72 m)
Diameter: 10 in (254 mm) to a depth of 270 ft (82 m), then 8 in (203 mm)
Aquifer: Sand and gravel interbedded with and overlain by silt and clay (undifferentiated Pleistocene deposits)
Water occurrence: Confined
Estimated predevelopment level: 197 ft (60 m)
Net water-level change in 1977: No data
Average annual net water-level change since 1976: Not determinable
Development near well: Municipal well 0.9 mi (1.45 km) east of recorder well

GLENVILLE RECORDER WELL

WATER LEVEL RECOVERS IN 1977

Near-normal precipitation followed by above-normal precipitation in August replenished soil moisture and allowed irrigation wells to be shut down in August. Thus, water levels were drawn down less and started recovering sooner than usual, leading to a net water-level rise of 0.88 ft (0.270 m) in 1977. The partial recoveries from the water-level drawdown that occurred in the 1977 irrigation season coincided with rainy periods during which little or no water was pumped for irrigation.

The trend of year-end water levels in this well was downward from 1969 through 1972. Recharge from above-normal precipitation in 1973 resulted in a net water-level rise of about 1.0 ft (0.305 m). Since the end of 1973, the trend of year-end levels has again been downward until this year.

WELL DATA

Location: 2.25 mi (3.60 km) south and 1 mi (1.61 km) east of Glenville
Depth: 205 ft (62 m)
Diameter: 6 in (152 mm)
Aquifer: Sand and gravel (undifferentiated Pleistocene deposits)
Water occurrence: Unconfined
Estimated predevelopment water level: 93 ft (28.0 m)
Net water-level change in 1977: +0.88 ft (+0.270 m)
Average annual net water-level change since 1968: −0.40 ft (−0.122 m)
Development near well: Irrigation wells; earliest in 1948, rapid development in 1956-57, 1965-71, and 1975; average density of irrigation wells, 3/mi^2 (1.16/km^2)

HARVARD AIR BASE RECORDER WELL

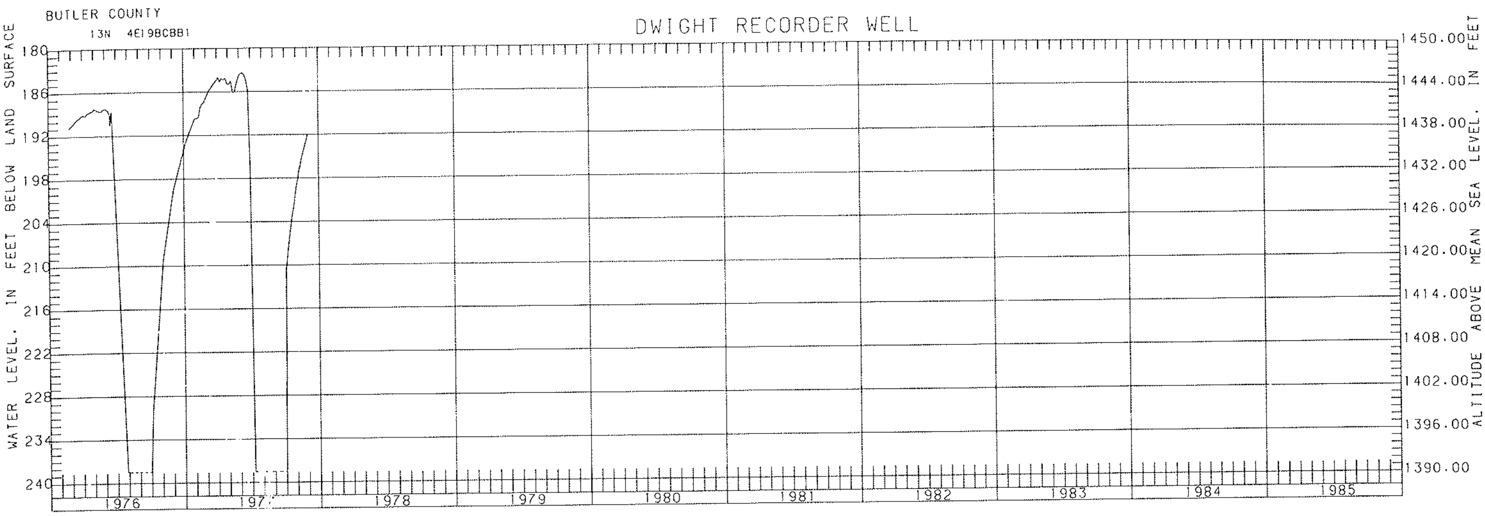
RECORD LOW WATER LEVEL IN 1977

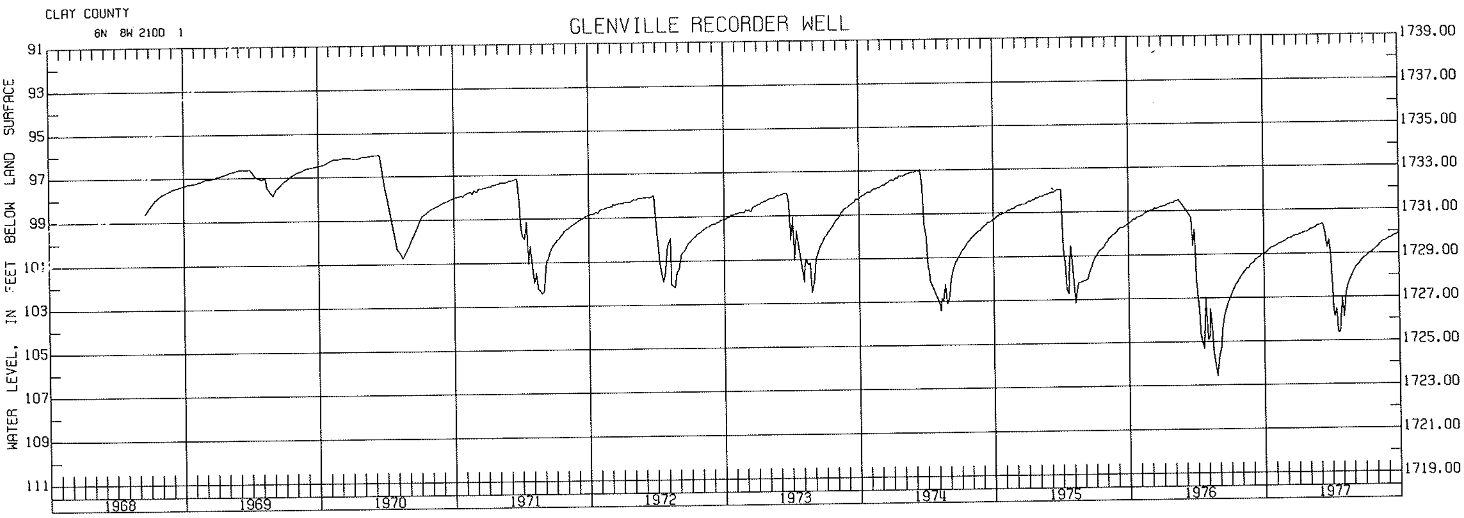
The water level in this well declined to a new low during July 1977. The decline was caused both by the need to pump large amounts of groundwater for irrigation and by little recharge during the period.

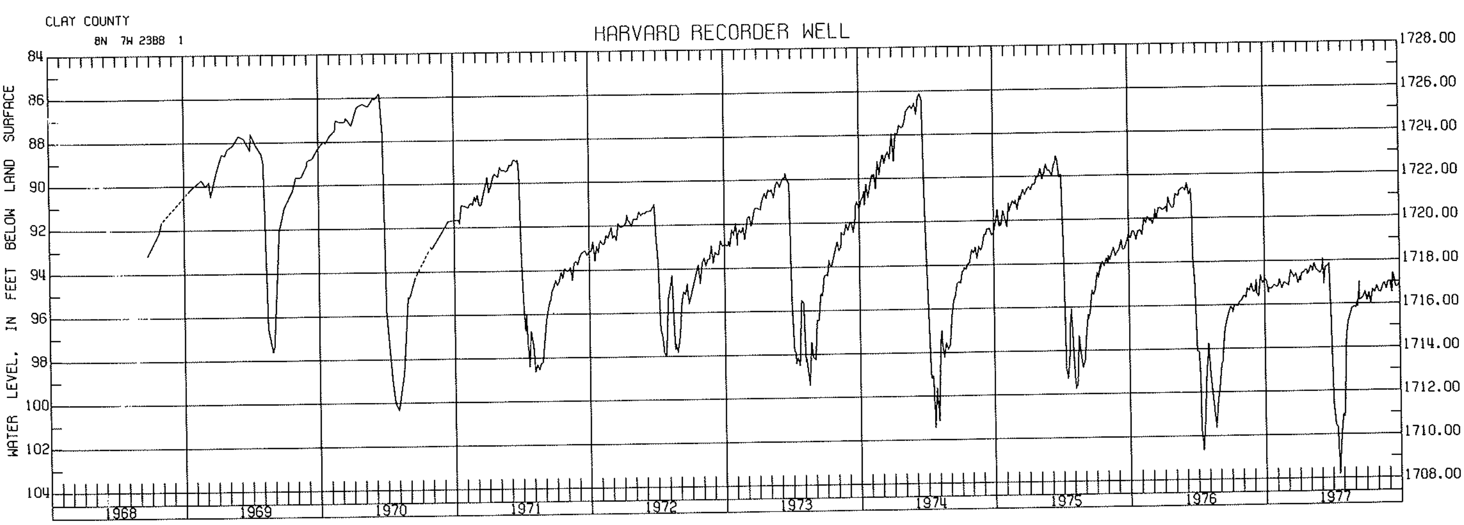
Since 1974, there has been a declining water-level trend. Many of the small water-level fluctuations shown on the hydrograph appear to be responses to changes in barometric pressure.

WELL DATA

Location: 2 mi (3.20 km) north and 0.25 mi (0.40 km) east of Harvard
Depth: 206 ft (63 m)
Diameter: 6 in (152 mm)
Aquifer: Layers of sand and gravel interbedded with layers of silt and clay (undifferentiated Pleistocene deposits)
Water occurrence: Combination of unconfined and confined
Estimated predevelopment water level: 79 ft (24.1 m)
Net water-level change in 1977: −0.20 ft (−0.061 m)
Average annual net water-level change since 1968: No significant trend
Development near well: Irrigation wells; earliest in 1935, rapid development in 1954-57 and 1971 to present; average density of irrigation wells, 3.0/mi^2 (1.16/km^2)


BUTLER COUNTY
13N 4E19BCBB1
DWIGHT RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
180
186
192
198
204
210
216
222
228
234
240
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
1450.00
1444.00
1438.00
1432.00
1426.00
1420.00
1414.00
1408.00
1402.00
1396.00
1390.00
1976
1978
1979
1980
1981
1982
1983
1984
1985


CLAY COUNTY
6N 8W 21DD 1
GLENVILLE RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
91
93
95
97
99
103
105
107
109
111
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
1739.00
1737.00
1735.00
1733.00
1731.00
1729.00
1727.00
1725.00
1723.00
1721.00
1719.00
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977


CLAY COUNTY
8N 7W 23BB 1
HARVARD RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
84
86
88
90
92
94
96
98
100
102
104
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
1728.00
1726.00
1724.00
1722.00
1720.00
1718.00
1716.00
1714.00
1712.00
1710.00
1708.00
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977

SHICKLEY RECORDER WELL

REPLACEMENT WELL COMPLETED

A replacement well for the previous Shickley well was drilled June 1, 1977. The location of the new well is in the Alfs Drilling Company building across the street from the village water tower. The recorder was switched to the new well the latter part of the year.

The long-term lowering of the water table in the immediate area can be attributed partly to year-round withdrawals for the water supply of Shickley and partly to seasonal withdrawals for irrigation in the surrounding area. Heaviest pumping for the Shickley water supply coincides with the summer irrigation season.

The cause of the sharp rise and fall of the hydrograph in March 1969 is not known.

WELL DATA

Location: Old well, 3 blocks west and 1.5 blocks north of fire station on principal north-south street in Shickley; new well in the Alfs Drilling Company building across the street to the east of Shickley's water tower

Depth: Old well, 91 ft (27.5 m); new well, 260 ft (79 m)

Diameter: Old well, 8 in (203 mm); new well, 5 in (127 mm)

Aquifer: Layers of sand and gravel interbedded with layers of clay (undifferentiated Pleistocene deposits)

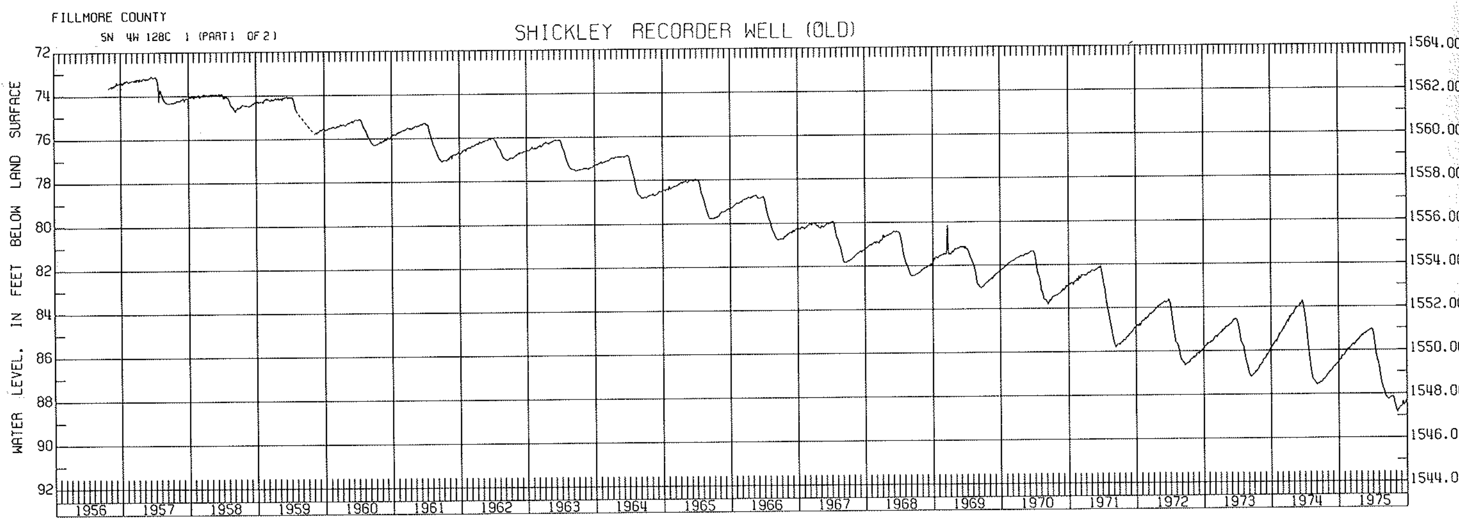
Water occurrence: Unconfined

Estimated predevelopment water level: Old well, 73 ft (22.3 m); new well, 72 ft (21.9 m)

Net water-level change in 1977: Not determinable

Average annual net water-level change since 1956: >-0.88 ft (>-0.270 m) to end of 1976

Development near well: Irrigation wells; earliest in 1940, peak development 1953–57; average density of irrigation wells, 4/mi^2 (1.54/km^2); two municipal wells, one completed in 1940 and the other in 1953, are located near the recorder well



BURRESS RECORDER WELL

UNUSUAL DECLINE IN LATE SEPTEMBER

Test pumping of a recently completed irrigation well appears to be the cause of a late September decline. Because of this late-season pumping, water levels had only partially recovered by year's end. The net water-level decline was thus greater than would be expected in a year when adequate precipitation supplemented soil moisture and less groundwater pumpage was needed compared to previous years.

The combination of unconfined and confined groundwater conditions accounts for the sharp water-level fluctuations that occur in response to the operation of nearby irrigation wells.

WELL DATA

Location: 2 mi (3.20 km) east and 1 mi (1.61 km) south of Burress (*Note:* called Geneva well in earlier reports)

Depth: 255 ft (78 m)

Diameter: 6 in (152 mm)

Aquifer: Layers of sand and gravel interbedded with numerous layers of clay (undifferentiated Pleistocene deposits)

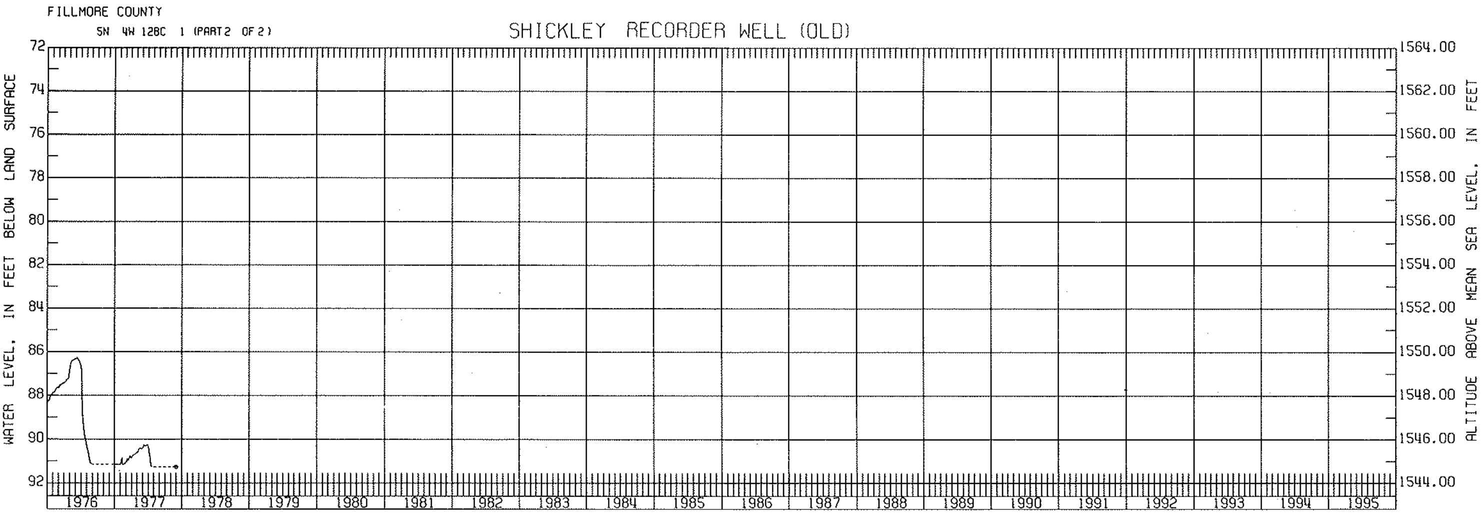
Water occurrence: Combination of unconfined and confined

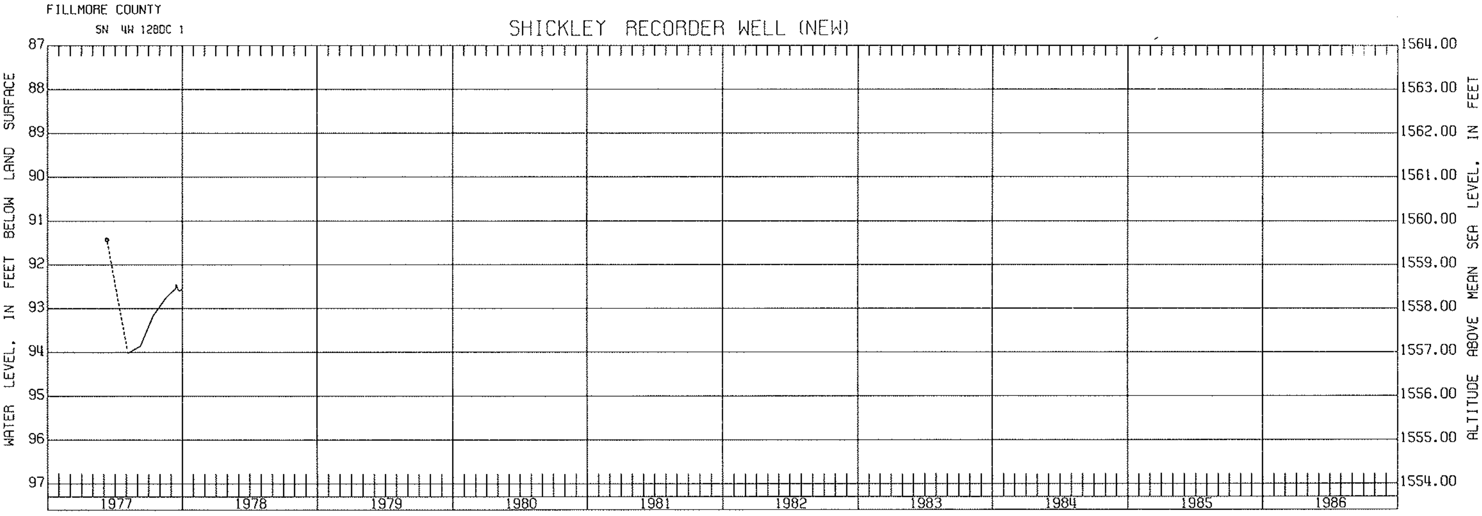
Estimated predevelopment water level: 57 ft (17.4 m)

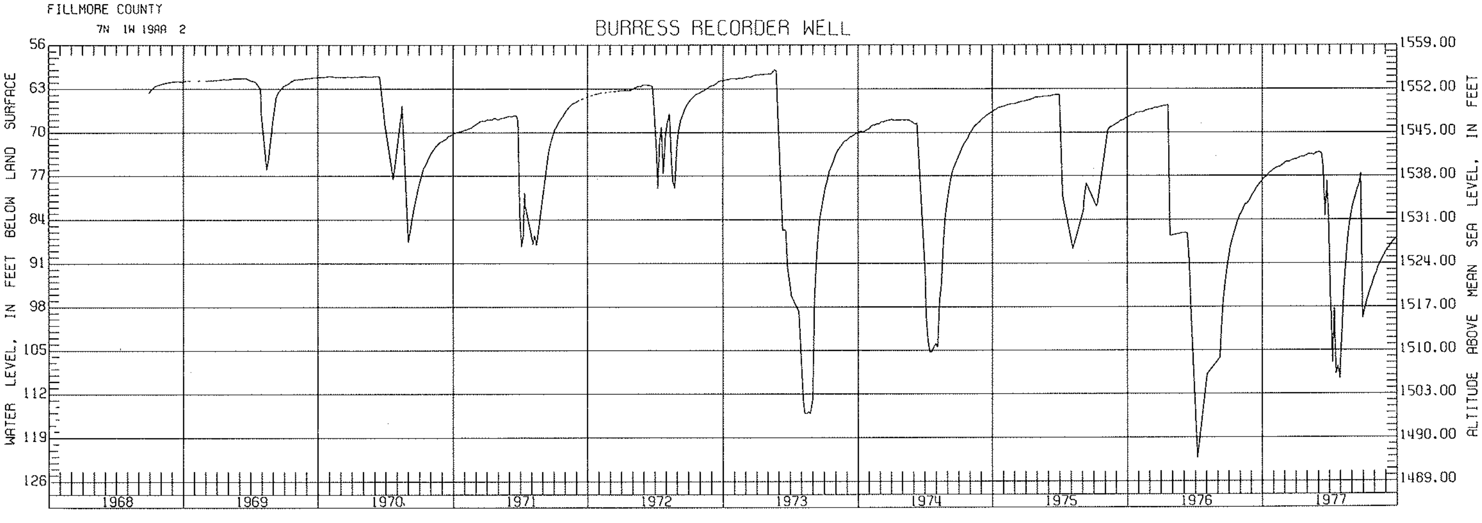
Net water-level change in 1977: -9.07 ft (-2.75 m)

Average annual net water-level change since 1968: Variable; no long-term rise or decline

Development near well: Irrigation wells; earliest in 1955, rapid development 1956-57 and 1965-66; operation of an irrigation well within a distance of 0.25 mi (0.40 km) began in 1973; average density of irrigation wells, 2.5/mi^2 (0.97/km^2)


FILLMORE COUNTY
5N 4W 12BC 1 (PART2 OF 2)
SHICKLEY RECORDER WELL (OLD)
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET


FILLMORE COUNTY
5N 4W 12BDC 1
SHICKLEY RECORDER WELL (NEW)
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET


FILLMORE COUNTY
7N 1W 19AA 2
BURRESS RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET

EXETER RECORDING WELL

RECHARGE CAUSES WATER-LEVEL RISE

Since 1956 the water level in the Exeter well has tended to rise because net recharge during the past few years has been greater than net downward leakage from the minor perched aquifer to the main aquifer. Net recharge to the minor aquifer has increased due to infiltration from applied irrigation water. In 1977, greater than normal amounts of precipitation fell throughout most of the period from March through November, contributing to the marked rise in the water level.

Leakage from the perched aquifer in which this well is completed to the deeper main aquifer probably accounts for most water-level declines. Although such downward leakage is continuous, water-level rises do occur at times when the rate of recharge from melting snow, spring precipitation, and applied irrigation water exceed the leakage rate.

The pattern of water-level fluctuations changes considerably from year to year because the ratio of recharge to downward leakage is variable and does not conform to a seasonal pattern. Water levels in this well are not representative of water levels in the principal aquifer.

WELL DATA

Location: 2.5 mi (4.00 km) west on Route 6 from the principal street of Exeter, then 0.4 mi (0.64 km) south on unmarked section-line road

Depth: 40 ft (12.2 m)

Diameter: 8 in (203 mm)

Aquifer: Wind-deposited silt underlain by sand and gravel (undifferentiated Pleistocene deposits)

Water occurrence: Unconfined

Estimated predevelopment water level: 24 ft (7.3 m)

Net water-level change in 1977: +4.45 ft (+1.36 m)

Average annual net water-level change since 1956: +0.68 ft (+0.207 m)

Development near well: No withdrawals of significance from perched aquifer. Lower confined aquifer is tapped by many irrigation wells, rapid development 1956-59 and 1964-69; average density of irrigation wells, 3.0/mi^2 (1.16/km^2)

ELLIS RECORDER WELL

WATER LEVEL REACHES NEW LOW IN 1977

Pumping from nearby irrigation wells is having a marked effect on water levels in this well. Since measurements began in 1968, the overall trend of the water level measured in this well has generally been downward, declining in seven of the nine years of record. Recovery from the record-setting July low resulted from above normal precipitation throughout most of the remainder of the year and cessation of withdrawal of groundwater for irrigation.

WELL DATA

Location: 4.4 mi (7.1 km) south of the intersection of Route 136 and the north-south section-line road in Ellis

Depth: 167 ft (51 m)

Diameter: 6 in (152 mm)

Aquifer: Sand and gravel (undifferentiated Pleistocene deposits)

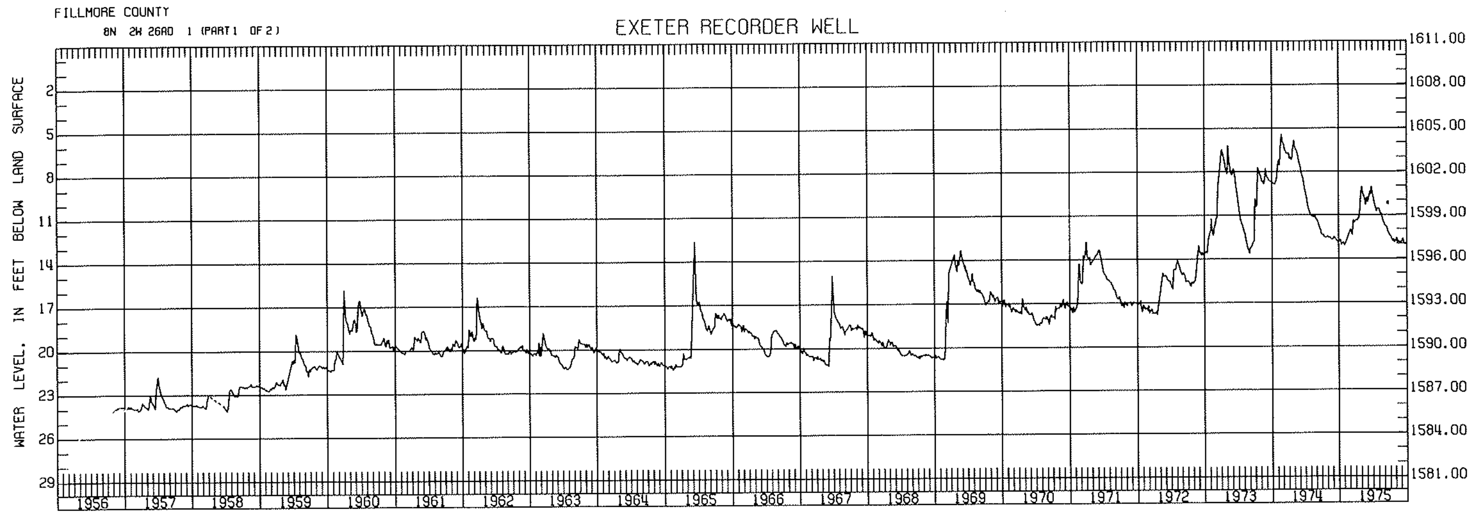
Water occurrence: Unconfined

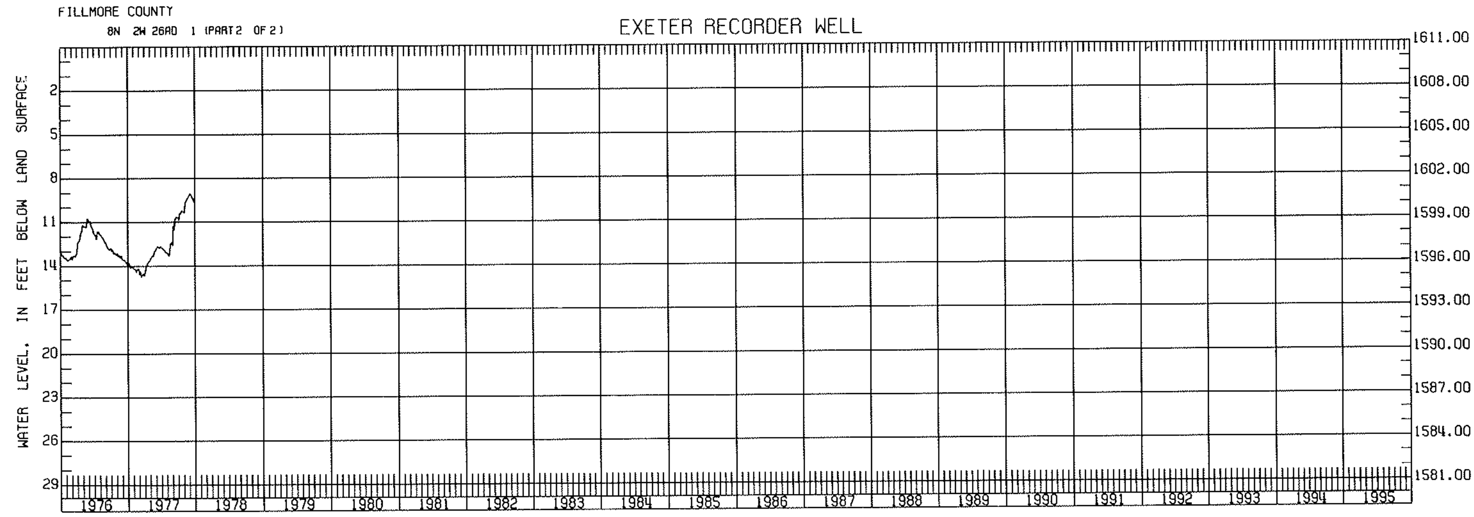
Estimated predevelopment water level: 73 ft (22.3 m)

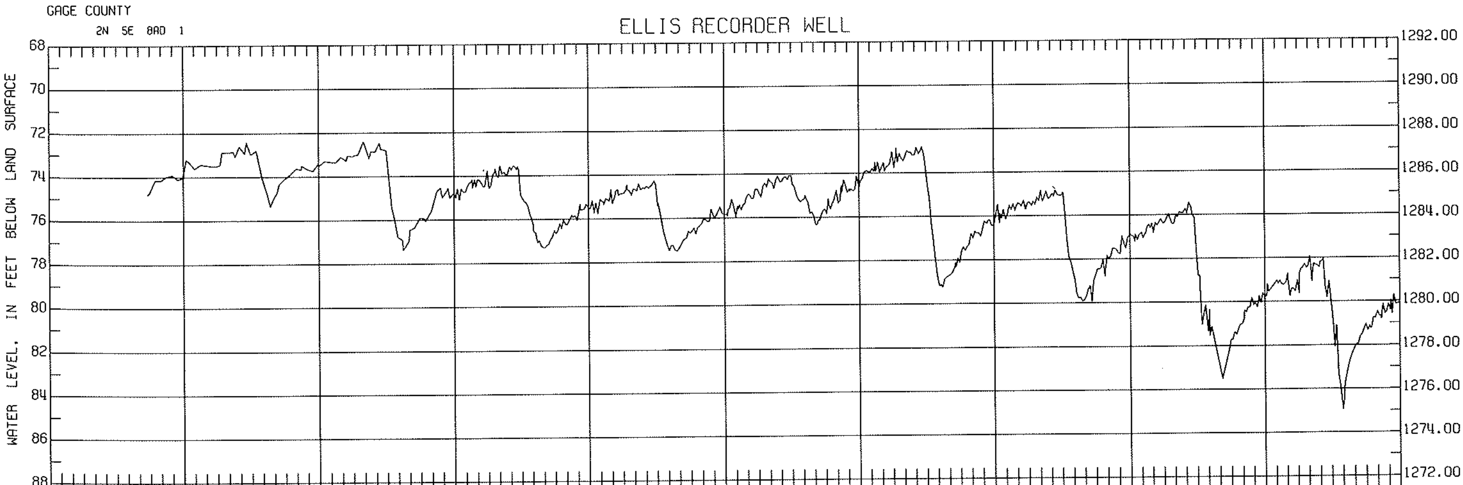
Net water-level change in 1977: −0.28 ft (−0.085 m)

Average annual net water-level change since 1968: −0.67 ft (−0.204 m)

Development near well: Irrigation wells; earliest well in 1956, rapid development in mid-1950s, mid-1960s, and mid-1970s; one of the two irrigation wells located about 0.25 mi (0.400 km) from the recorder well began operating in 1974 and the other in 1975; average density of irrigation wells, 1.5/mi^2 (0.58/km^2)


FILLMORE COUNTY
8N 2W 26AD 1 (PART 1 OF 2)
EXETER RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
2
5
8
11
14
17
20
23
26
29
1611.00
1608.00
1605.00
1602.00
1599.00
1596.00
1593.00
1590.00
1587.00
1584.00
1581.00
1956 1957 1958 1959 1960 1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975


FILLMORE COUNTY
8N 2W 26AD 1 (PART 2 OF 2)
EXETER RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
2
5
8
11
14
17
20
23
26
29
1611.00
1608.00
1605.00
1602.00
1599.00
1596.00
1593.00
1590.00
1587.00
1584.00
1581.00
1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995


GAGE COUNTY
2N 5E 8AD 1
ELLIS RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
68
70
72
74
76
78
80
82
84
86
88
1292.00
1290.00
1288.00
1286.00
1284.00
1282.00
1280.00
1278.00
1276.00
1274.00
1272.00
1968 1969 1970 1971 1972 1973 1974 1975 1976 1977

AURORA RECORDER WELL

SLIGHT WATER LEVEL RISE IN 1977

The lowest water level in this well was higher than the low water level in 1976. This change was caused in part by decreased groundwater withdrawals for irrigation during the growing season and by increased recharge from above-normal precipitation.

Pumping for irrigation accounts for most of the decline that, except for a net water-level rise in 1968-69, has been progressive since 1962.

WELL DATA

Location: 4 mi (6.4 km) south of junction of Route 14 and U.S. Highway 34 in Aurora, then 1.0 (1.61 km) east and 0.3 mi (0.480 km) south
Depth: 131 ft (40.0 m)
Diameter: 8 in (203 mm)
Aquifer: Layers of sand and gravel interbedded with layers of clay (undifferentiated Pleistocene deposits)
Water occurrence: Unconfined
Estimated predevelopment water level: 83 ft (25.0 m)
Net water-level change in 1977: +0.24 ft (+0.073 m)
Average annual net water-level change since 1956: −0.67 ft (−0.204 m)
Development near well: Irrigation wells; earliest in 1940, rapid development 1946–48, 1954–57, and 1965–67; average density of irrigation wells, 5.0/mi^2 (1.93/km^2)

KRONBORG RECORDER WELL

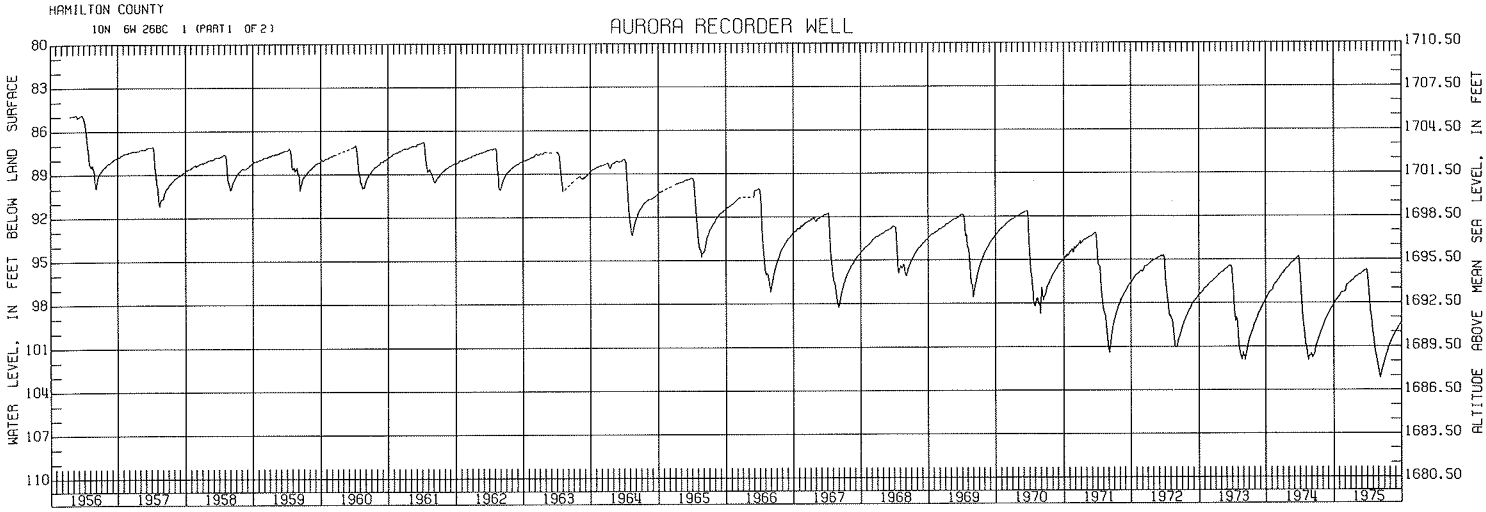
WATER LEVEL REACHES NEW LOW IN 1977

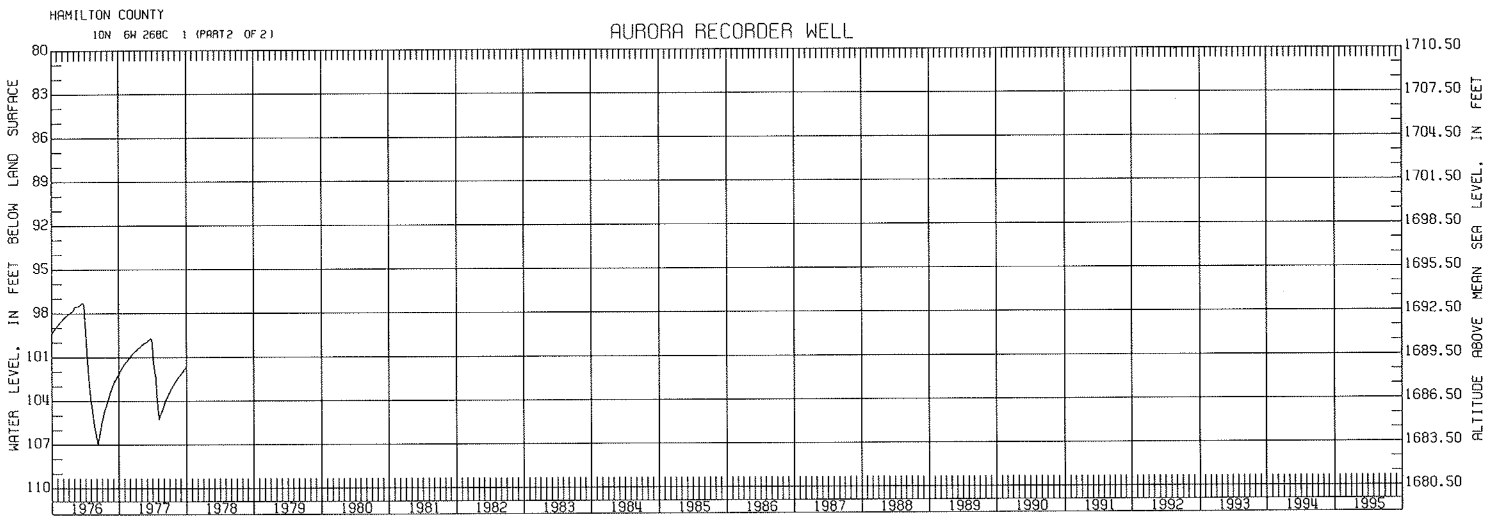
The water level in this well declined to a new low in July 1977 because large amounts of groundwater were pumped to replenish soil moisture during June and early July when less-than-normal precipitation fell. The recovery of the water level began in July and August when above-normal amounts of rainfall fell on the area. The net water-level change of −1.04 ft (−0.315 m) in 1977 reflects a decline of hydrostatic pressure within the aquifer.

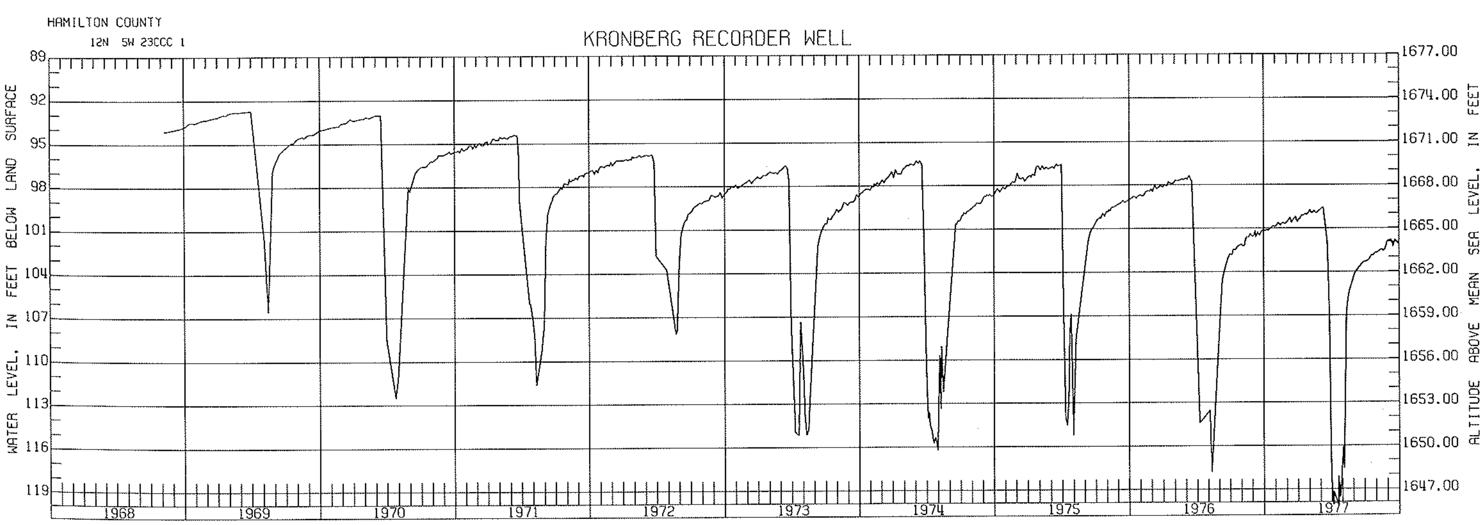
The sharp water-level response to pumping, the almost equally large and sharp recovery, and the many small fluctuations reflecting changes in barometric pressure are characteristic of a confined aquifer.

WELL DATA

Location: 4 mi (6.44 km) east and 1 mi (1.61 km) south of Kronborg
Depth: 189 ft (58 m)
Diameter: 6 in (152 mm)
Aquifer: Sand and gravel (undifferentiated Pleistocene deposits)
Water occurrence: Confined
Estimated predevelopment water level: 81 ft (24.7 m)
Net water-level change in 1977: −1.04 ft (−0.315 m)
Average annual net water-level change since 1968: −0.91 ft (−0.275 m)
Development near well: Irrigation wells; earliest in 1940, rapid development in 1953–56 and 1967; average density of irrigation wells, 4.5/mi^2 (1.74/km^2)


HAMILTON COUNTY
10N 6W 26BC 1 (PART1 OF 2)
AURORA RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
80
83
86
89
92
95
98
101
104
107
110
1710.50
1707.50
1704.50
1701.50
1698.50
1695.50
1692.50
1689.50
1686.50
1683.50
1680.50
1956 1957 1958 1959 1960 1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975


HAMILTON COUNTY
10N 6W 26BC 1 (PART2 OF 2)
AURORA RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
80
83
86
89
92
95
98
101
104
107
110
1710.50
1707.50
1704.50
1701.50
1698.50
1695.50
1692.50
1689.50
1686.50
1683.50
1680.50
1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995


HAMILTON COUNTY
12N 5W 23CCC 1
KRONBERG RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
89
92
95
98
101
104
107
110
113
116
119
1677.00
1674.00
1671.00
1668.00
1665.00
1662.00
1659.00
1656.00
1653.00
1650.00
1647.00
1968 1969 1970 1971 1972 1973 1974 1975 1976 1977

DAYKIN RECORDER WELL

NET WATER-LEVEL DECLINE IN 1977

Below-normal precipitation during June and July required heavy use of groundwater to supplement soil moisture. Recovery of the water level started in August when adequate rainfall reduced the need for irrigation. The range of water-level fluctuations in the well was about 0.9 ft (0.275 m). After trending slowly upward during the first half of the year, the water level dropped during June and July and then trended upward again, but fell short of the water level of December 31, 1976.

Pumping from nearby irrigation wells probably accounts for the small water-level decline that occurs in this well each summer. However, no long-term decline is apparent. Above-normal precipitation in late spring, early summer, and fall of 1973 resulted in a significant amount of recharge to the aquifer. This recharge caused the June 1974 water level to be the highest of record.

WELL DATA

Location: 3 mi (4.80 km) south and 3 mi (4.80 km) west of Daykin
Depth: 210 ft (64 m)
Diameter: 6 in (152 mm)
Aquifer: Sand and gravel (undifferentiated Pleistocene deposits)
Water occurrence: Unconfined
Estimated predevelopment water level: 74 ft (22.6 m)
Net water-level change in 1977: −0.37 ft (−0.113 m)
Average annual net water-level change: Variable; no long-term rise or decline
Development near well: Irrigation wells; earliest in 1956, rapid development mid-1960s and 1973 to present; average density of irrigation wells, 1.5/mi² (0.58/km²)

PLYMOUTH RECORDER WELL

SEASONAL DECLINE LESS IN 1977

Less groundwater was needed for irrigation in 1977 because more than average precipitation was received. As a result, the seasonal decline from spring to summer was less than that of last year. Also, the year-end water level was slightly higher than last year's. This too can be attributed to less pumpage during the summer and somewhat increased recharge.

Except for its small net rise in 1973 and 1977, the water level in this well continues to trend downward. The 1977 year-end water level was 6.58 ft (2.01 m) lower than the 1968 year-end level.

WELL DATA

Location: 2.5 mi (4.00 km) west and 0.25 mi (0.400 km) north of Plymouth
Depth: 237 ft (72 m)
Diameter: 6 in (152 mm)
Aquifer: Sand and gravel (undifferentiated Pleistocene deposits)
Water occurrence: Unconfined
Estimated predevelopment water level: 107 ft (32.5 m)
Net water-level change in 1977: +0.03 ft (+0.009 1 m)
Average annual net water-level change since 1968: −0.73 ft (−0.223 m)
Development near well: Irrigation wells; earliest in 1956, rapid development 1956–57 and 1966–68; average density of irrigation wells, 2.5/mi² (0.97/km²)

OSCEOLA RECORDER WELL

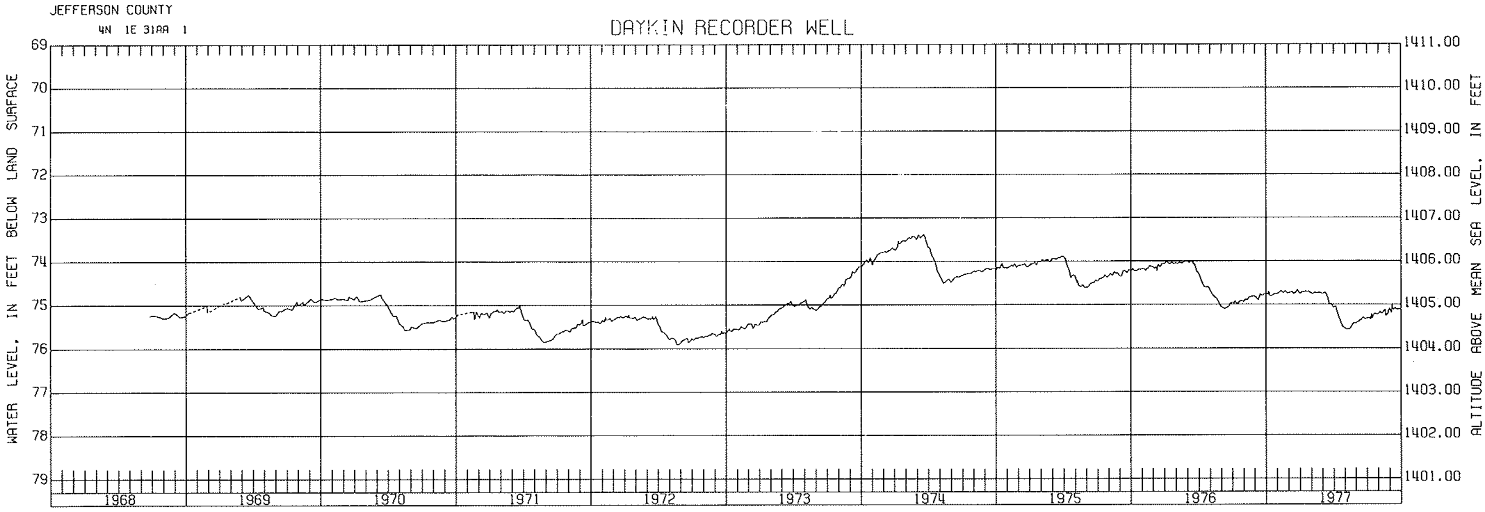
SMALL NET WATER-LEVEL CHANGE IN 1977

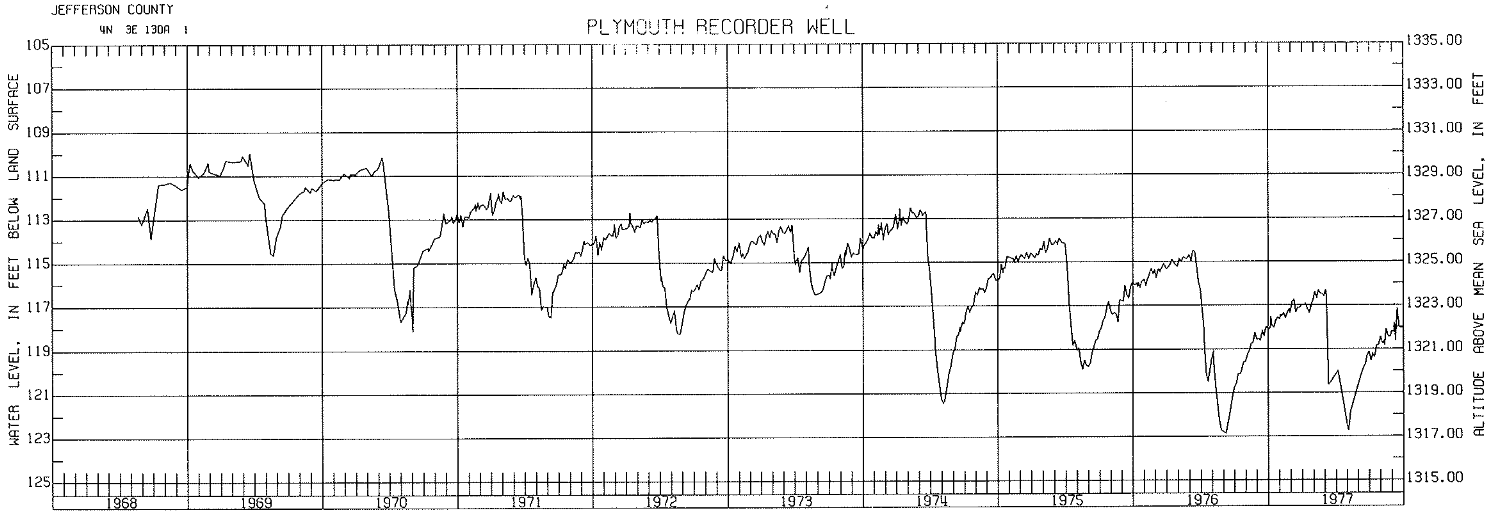
Despite a water-level decline of 16 ft (4.90 m) during the summer, the year-end water level in this well was nearly the same as that of 1976. Pumping from nearby wells interrupted by rainy periods caused large fluctuations in the water level. Significantly greater than normal amounts of precipitation in May and August helped to provide soil moisture and groundwater recharge. This resulted in less pumping and a higher water level in subsequent months.

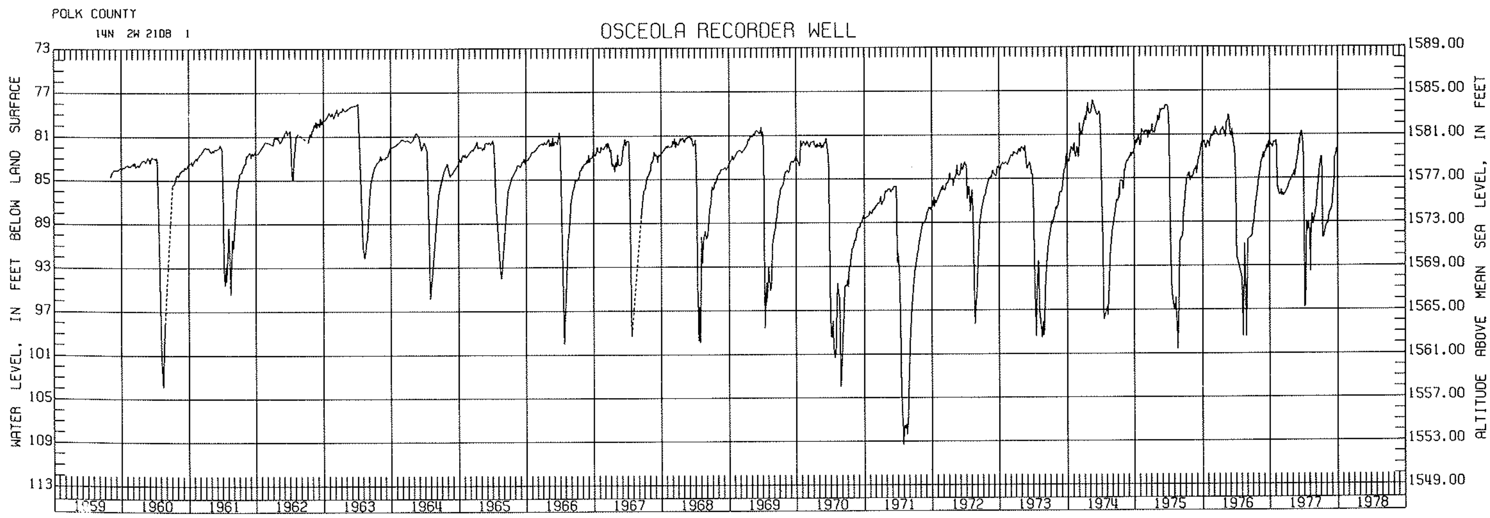
Confinement of the water under hydrostatic pressure accounts for the sharp drops of the water level in response to nearby pumping and also for the rapid recoveries from the effects of the pumping. Even though large amounts of water have been pumped annually from nearby wells for about two decades, the 1977 year-end water level was only 2.36 ft (0.72 m) lower than the estimated predevelopment water level.

WELL DATA

Location: Northeast corner of Polk County Fairgrounds south of Osceola
Depth: 180 ft (55 m)
Diameter: 5 in (127 mm)
Aquifer: Layers of sand and gravel interbedded with layers of silt and clay (undifferentiated Pleistocene deposits)
Water occurrence: Confined
Estimated predevelopment water level: 80 ft (24.4 m)
Net water-level change in 1977: +0.42 ft (+0.128 m)
Average annual net water-level change since 1959: Variable; no long-term rise or decline
Development near well: Irrigation wells; earliest in 1951, peak development 1955-57; average density of irrigation wells, 2.5/mi² (0.97/km²); three Osceola municipal wells completed in 1951, 1956, 1972


JEFFERSON COUNTY
4N 1E 31AA 1
DAYKIN RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
69
70
71
72
73
74
75
76
77
78
79
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
1411.00
1410.00
1409.00
1408.00
1407.00
1406.00
1405.00
1404.00
1403.00
1402.00
1401.00
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977


JEFFERSON COUNTY
4N 3E 13DA 1
PLYMOUTH RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
105
107
109
111
113
115
117
119
121
123
125
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
1335.00
1333.00
1331.00
1329.00
1327.00
1325.00
1323.00
1321.00
1319.00
1317.00
1315.00
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977


POLK COUNTY
14N 2W 21DB 1
OSCEOLA RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
73
77
81
85
89
93
97
101
105
109
113
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
1589.00
1585.00
1581.00
1577.00
1573.00
1569.00
1565.00
1561.00
1557.00
1553.00
1549.00
1960
1961
1962
1963
1964
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978

DORCHESTER RECORDER WELL

DOWNWARD TREND REDUCED

Because of adequate precipitation during the latter part of the growing season, irrigators used less groundwater to maintain soil moisture in 1977. This led to an earlier recovery of water level. A net water-level decline of 0.14 ft (0.042 5 m) was recorded for the year after a record water-level low in August.

The long-term water-level trend in this well has been downward. Recharge from above-normal precipitation in 1973 caused a temporary reversal of the downward trend. The average rate of decline for the last few years was reduced by the above-normal precipitation of 1977.

WELL DATA

Location: West edge of Dorchester, on west side of Route 15 between U.S. Highway 6 and Route 33
Depth: 151 ft (46.0 m)
Diameter: 5 in (127 mm)
Aquifer: Layers of sand and gravel interbedded with layers of silt and clay (undifferentiated Pleistocene deposits)
Water occurrence: Combination of unconfined and confined
Estimated predevelopment water level: 97 ft (29.5 m)
Net water-level change in 1977: −0.14 ft (−0.042 5 m)
Average annual net water-level change since 1959: −0.30 ft (−0.091 m)
Development near well: Irrigation wells; earliest in 1945, peak development in 1955-57; average density of irrigation wells, 4.5/mi^2 (1.74/km^2)

SEWARD RECORDER WELL

WATER LEVEL REACHES RECORD LOW

The 1977 late-summer water level in this well was the lowest recorded to date. The year-end water level (also a record low) was 0.32 ft (0.098 m) lower than the 1976 year-end level. The decline from spring levels was less this year because of above-normal precipitation. Pumping from nearby irrigation wells was the main cause of the summertime water-level decline.

Although the water-level record for this well began in 1958, not until 1966 did a general downward trend set in. Since then, the trend has been downward except in 1973 and 1974, when small net water-level rises were recorded. The 1977 year-end water level was 9.01 ft (2.75 m) lower than the year-end level of 1958.

WELL DATA

Location: 4.5 mi (7.2 km) west of Seward, on Route 2 and Route 34
Depth: 123 ft (37.5 m)
Diameter: 5 in (127 mm)
Aquifer: Sand and gravel (undifferentiated Pleistocene deposits)
Water occurrence: Unconfined
Estimated predevelopment water level: 74 ft (22.6 m)
Net water-level change in 1977: −0.32 ft (−0.098 m)
Average annual net water-level change since 1958: −0.47 ft (−0.143 m)
Development near well: Irrigation wells; earliest in 1953, rapid development 1953-57; average density of irrigation wells, 2.5/mi^2 (0.97/km^2)

CARLETON RECORDER WELL

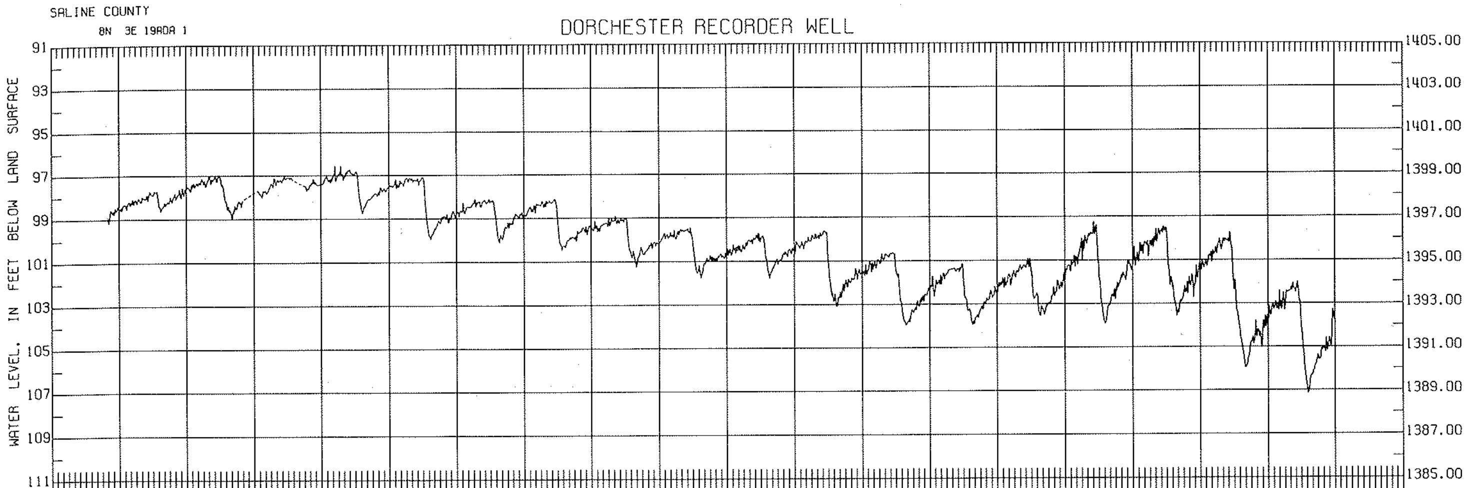
WATER LEVEL NEAR RECORD LOW

The 1977 water level reached a low of almost 136 ft (41.5 m) below land surface. This was surpassed only by the record low set in 1971 of a little over 136 ft (41.5 m). A slight rise in year-end water level of 0.62 ft (0.189 m) was recorded. The slightly higher reading was caused by the greater length of time for water-level recovery in 1977. Above-normal precipitation in August permitted early cessation of pumping for irrigation.

The year-end water levels in this well trended downward from 1969 to 1972 and from 1974 to 1976. The net rise that occurred in 1973 was caused by recharge from above-normal precipitation. Because this well taps a confined aquifer, water-level responses to pumping of nearby wells are both rapid and large.

WELL DATA

Location: 2 mi (3.20 km) south and 2.5 mi (4.00 km) west of Carleton
Depth: 195 ft (59 m)
Diameter: 6 in (152 mm)
Aquifer: Layers of sand and gravel interbedded with layers of clay (undifferentiated Pleistocene deposits)
Water occurrence: Confined
Estimated predevelopment water level: 95 ft (29.0 m)
Net water-level change in 1977: +0.62 ft (+0.189 m)
Average annual net water-level change since 1968: −0.40 ft (−0.122 m)
Development near well: Irrigation wells; earliest in 1954, rapid development 1955-57, 1964-68, and 1975; average density of irrigation wells, 3.5/mi^2 (1.35/km^2)


SALINE COUNTY
8N 3E 19ADA 1
DORCHESTER RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
91
93
95
97
99
101
103
105
107
109
111
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
1405.00
1403.00
1401.00
1399.00
1397.00
1395.00
1393.00
1391.00
1389.00
1387.00
1385.00
1959
1960
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1962
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1964
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1966
1967
1968
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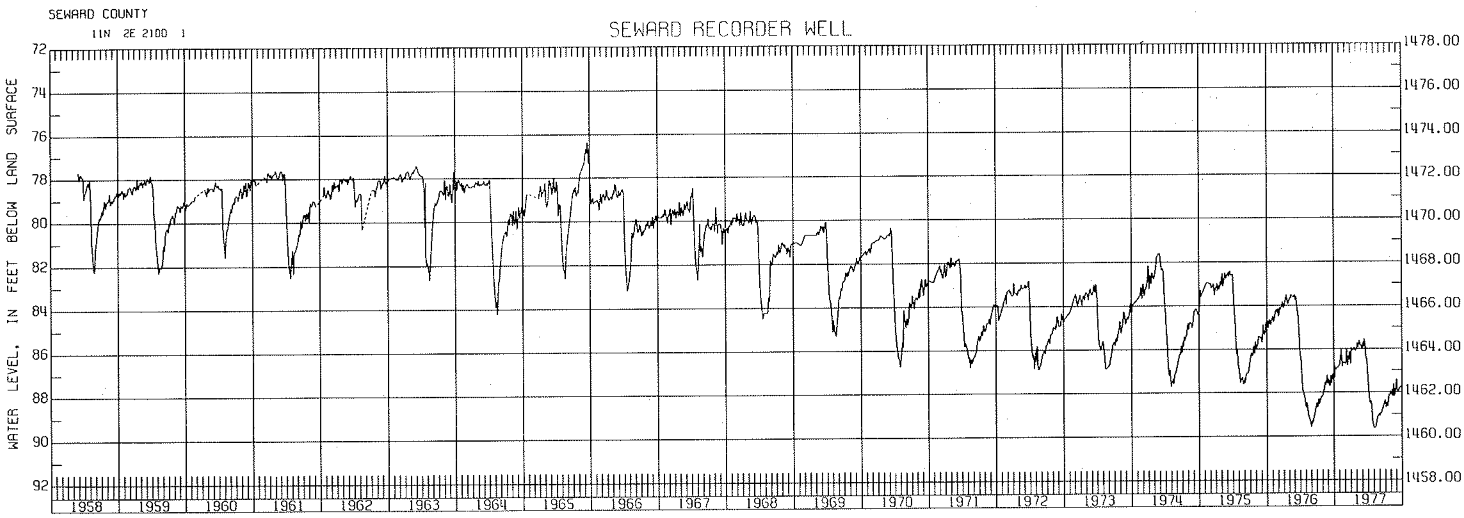
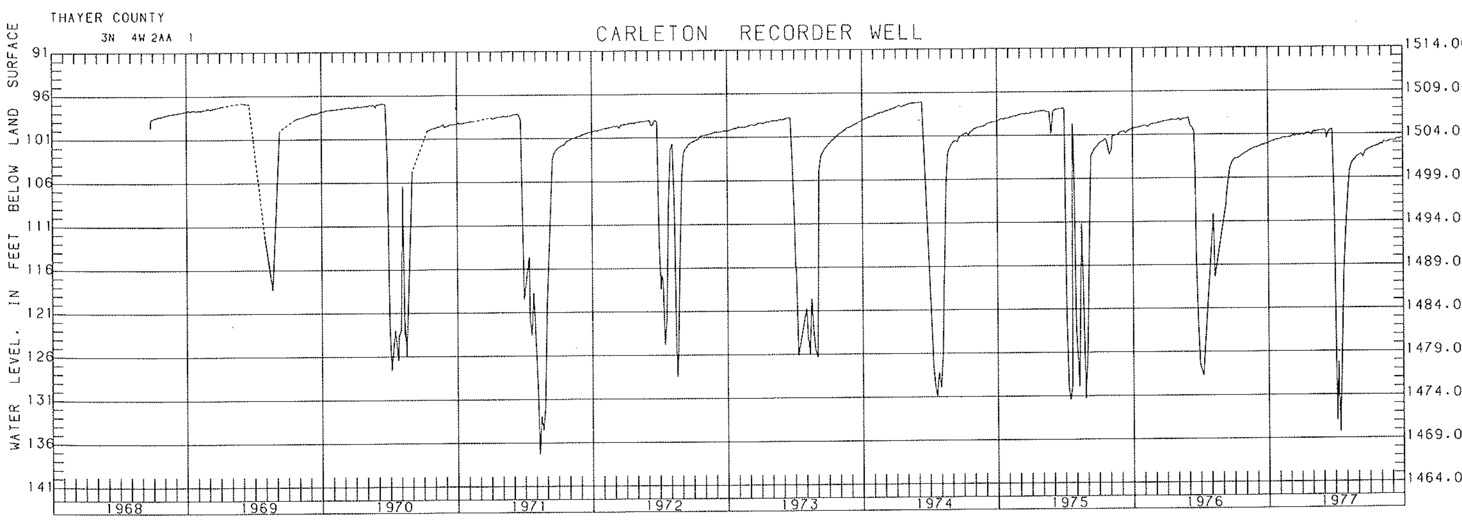
1972
1973
1974
1975
1976
1977
1978


SEWARD COUNTY
11N 2E 21DD 1
SEWARD RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
72
74
76
78
80
82
84
86
88
90
92
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
1478.00
1476.00
1474.00
1472.00
1470.00
1468.00
1466.00
1464.00
1462.00
1460.00
1458.00
1958
1959
1960
1961
1962
1963
1964
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977


THAYER COUNTY
3N 4W 2AA 1
CARLETON RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
91
96
101
106
111
116
121
126
131
136
141
1514.00
1509.00
1504.00
1499.00
1494.00
1489.00
1484.00
1479.00
1474.00
1469.00
1464.00
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977

HENDERSON RECORDER WELL

MINOR WATER-LEVEL RECOVERY

The water level in this well was higher at the end of the year than at the beginning. The annual summer decline was also less. Because of above-normal precipitation, less groundwater was used for irrigation. Also greater recharge probably occurred.

Between 1960 and 1968, the water-level trend in the well was downward. During the years 1968 and 1969, the net water-level change was upward. From 1970 through 1977, the trend was downward again except for a slight reversal in 1973 and 1977. The 1977 year-end water level was 10.47 ft (3.20 m) lower than the 1959 year-end water level.

WELL DATA

Location: 0.5 mi (0.80 km) south of Henderson
Depth: 171 ft (52 m)
Diameter: 18 in (455 mm)
Aquifer: Sand and gravel (undifferentiated Pleistocene deposits)
Water occurrence: Unconfined
Estimated predevelopment water level: 80 ft (24.4 m)
Net water-level change in 1977: +0.79 ft (+0.241 m)
Average annual net water-level change since 1959: −0.58 ft (−0.177 m)
Development near well: Irrigation wells; earliest in 1953, rapid development 1953-57 and 1964-67; average density of irrigation wells, 7.0/mi² (2.70/km²); two Henderson public-supply wells drilled in 1949 and 1959

YORK RECORDER WELL

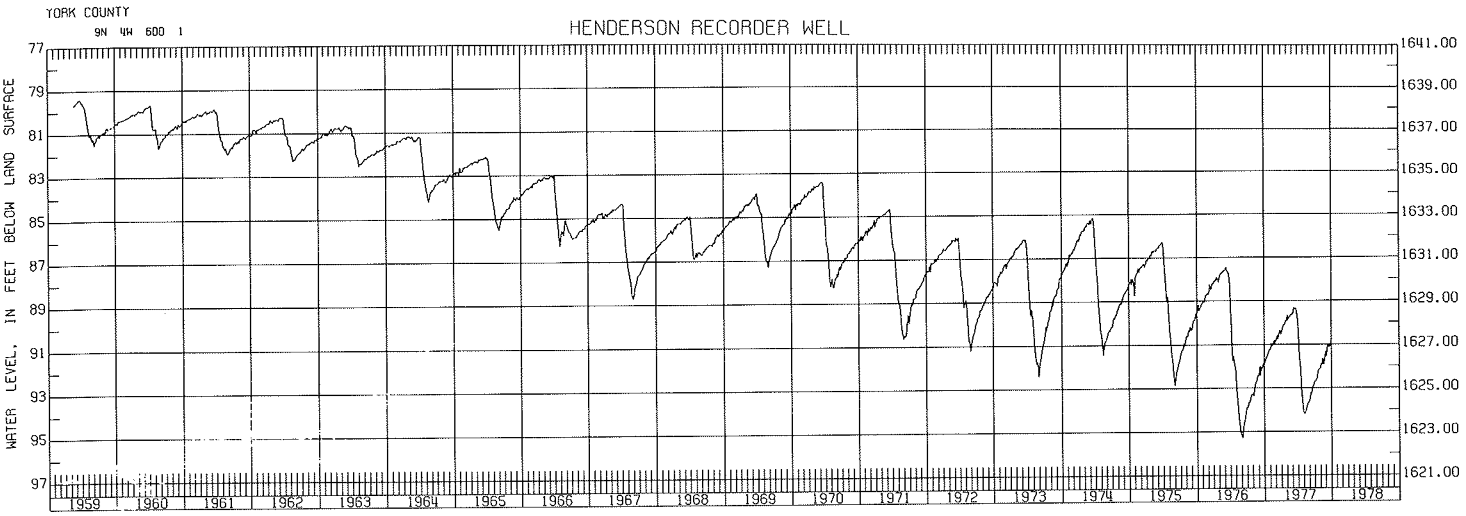
SUMMER WATER-LEVEL DECLINE LESS IN 1977

Although the water level reached its lowest point since 1974, the low summer level did not remain low as long nor fluctuate as much as it did during the summer of 1976. The water level recovered in the fall of 1977 to nearly that of the previous spring. Over the period of record, however, the water level reflects a slow downward trend. This downward trend has continued at least since 1969, although a leveling off and a small rise did occur from 1972 to early 1974. It is interesting to note that some of the largest summer declines were recorded during this period. Net water-level rises during the stable period of 1972-74 occurred in response to above-normal amounts of precipitation, recharging the groundwater system. The increasing annual declines of the water level probably are the result of increased amounts of groundwater withdrawals.

The original well was replaced by a new well 101 ft (31.0 m) deeper in 1969. Because the new well is deeper, it now measures the water level in a deeper aquifer where water is confined by overlying clay layers. Because of this, water-level fluctuations are greater in the new well than they were in the old well.

WELL DATA

Location: South edge of York County Fairgrounds on the north side of York
Depth: Old well, 102 ft (31.0 m); new well, 203 ft (62 m)
Diameter: 8 in (203 mm)
Aquifer; Old well, sand and gravel (undifferentiated Pleistocene deposits); new well, layers of sand and gravel interbedded with layers of clay (undifferentiated Pleistocene deposits)
Water occurrence: Old well, unconfined; new well, combination of unconfined and confined
Estimated predevelopment water level: Old well, 84 ft (25.5 m); new well, 85 ft (26.0 m)
Net water-level change in 1977: −0.27 ft (−0.082 m)
Average annual net water-level change: 1957-69, −0.58 ft (−0.177 m); since 1969, −0.04 ft (−0.012 2 m)
Development near well: Irrigation wells; earliest in 1949, rapid development 1953-57 and 1960-64; average density of irrigation wells, 5.0/mi² (1.93/km²); also six public-supply wells for York, earliest in 1935


YORK COUNTY
9N 4W 6DD 1
HENDERSON RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
77
79
81
83
85
87
89
91
93
95
97
1641.00
1639.00
1637.00
1635.00
1633.00
1631.00
1629.00
1627.00
1625.00
1623.00
1621.00
1959
1960
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1963
1964
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1968
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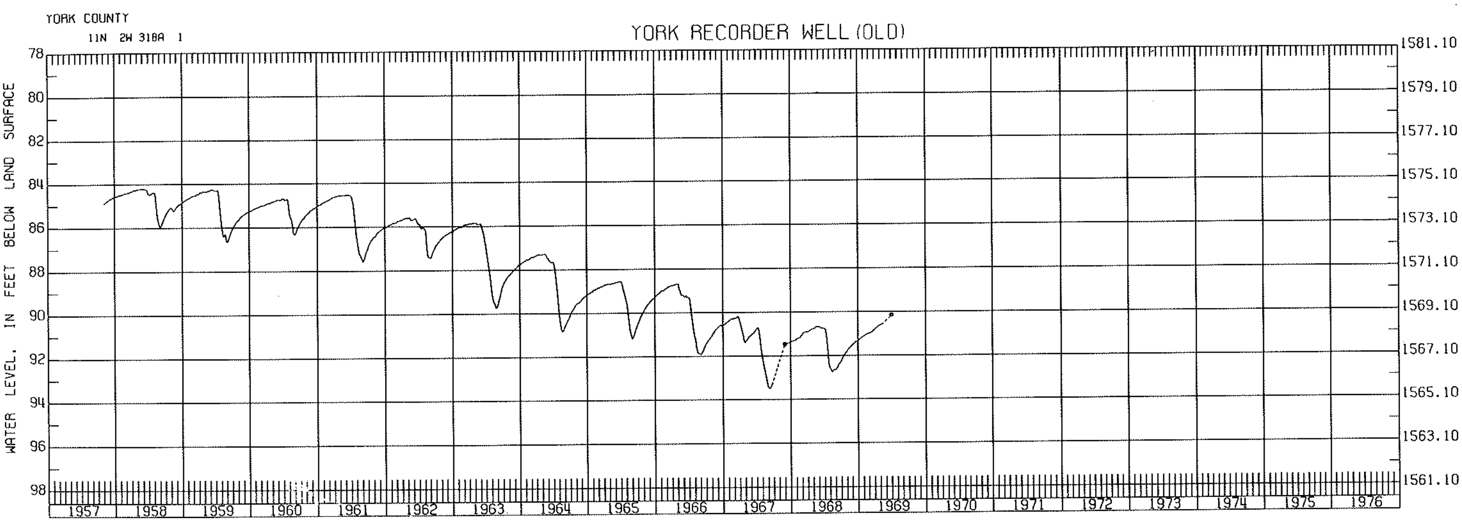
1971
1972
1973
1974
1975
1976
1977
1978


YORK COUNTY
11N 2W 31BA 1
YORK RECORDER WELL (OLD)
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
78
80
82
84
86
88
90
92
94
96
98
1581.10
1579.10
1577.10
1575.10
1573.10
1571.10
1569.10
1567.10
1565.10
1563.10
1561.10
1957
1958
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1966
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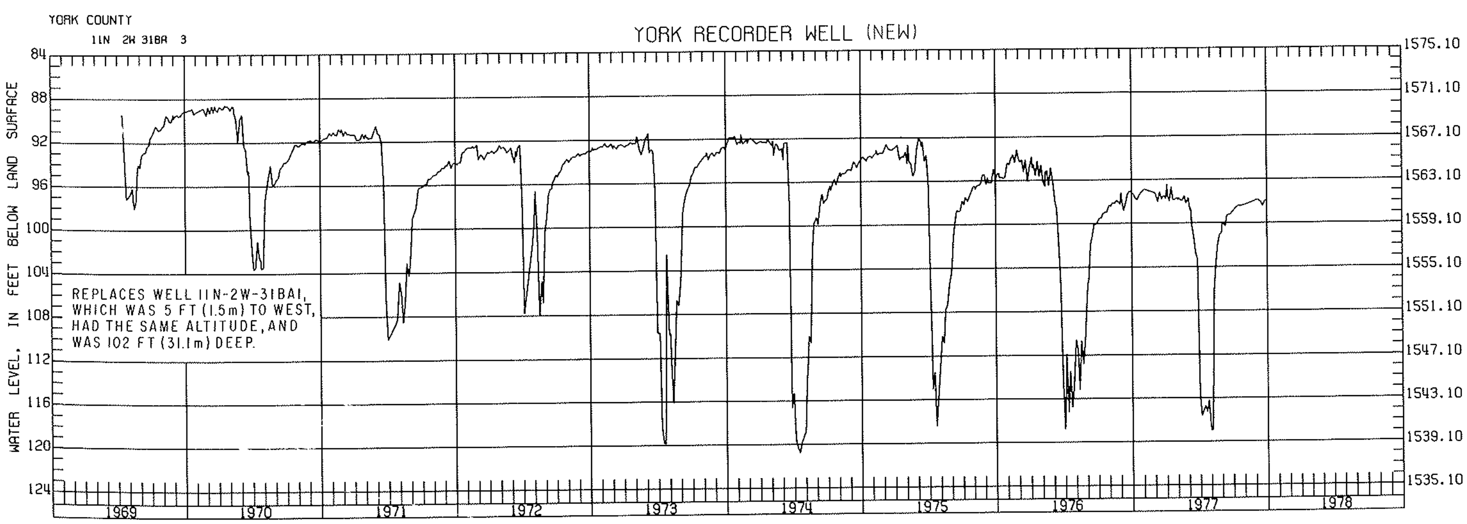
1972
1973
1974
1975
1976


YORK COUNTY
11N 2W 31BA 3
YORK RECORDER WELL (NEW)
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
REPLACES WELL 11N-2W-31BA1, WHICH WAS 5 FT (1.5m) TO WEST, HAD THE SAME ALTITUDE, AND WAS 102 FT (31.1m) DEEP.
84
88
92
96
100
104
108
112
116
120
124
1575.10
1571.10
1567.10
1563.10
1559.10
1555.10
1551.10
1547.10
1543.10
1539.10
1535.10
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978

2.2 Platte River Valley Area

Water levels in the Platte River Valley area between fall 1976 and fall 1977 generally rose from 0.1 ft (0.030 5 m) to 3.0 ft (0.92 m). A few water levels rose more than 3.0 ft (0.91 m) and a few declined slightly. In the lowlands adjacent to the Platte and Wood rivers in Merrick, Hall, and eastern Buffalo counties, almost all water levels were between 0.1 ft (0.030 5 m) and 2.5 ft (0.76 m) higher. Water levels in the upland parts of the area generally were lower than in 1976. In the uplands of Dawson County and west-central Buffalo County, most water levels declined 0.1 to 1.0 ft (0.030 5 to 0.305 m). Declines of 0.1 to 1.4 ft (0.030 5 to 0.425 m) were common north of the Wood River in Buffalo County; however, water levels rose 1.0 ft (0.305 m) or more in a few wells. In the Prairie Creek and Silver Creek drainage basins of Hall and Merrick counties, water-level rises of 1.0 to 2.0 ft (0.305 to 0.61 m) were common and locally were more than 3.0 ft (0.91 m).

Declines of 5 ft (1.52 m) or more from estimated predevelopment water levels occurred in an area of about 347,000 acres (1 400 km^2). The maximum observed decline of 21.5 ft (6.5 m) occurred north of Gibbon in Buffalo County.

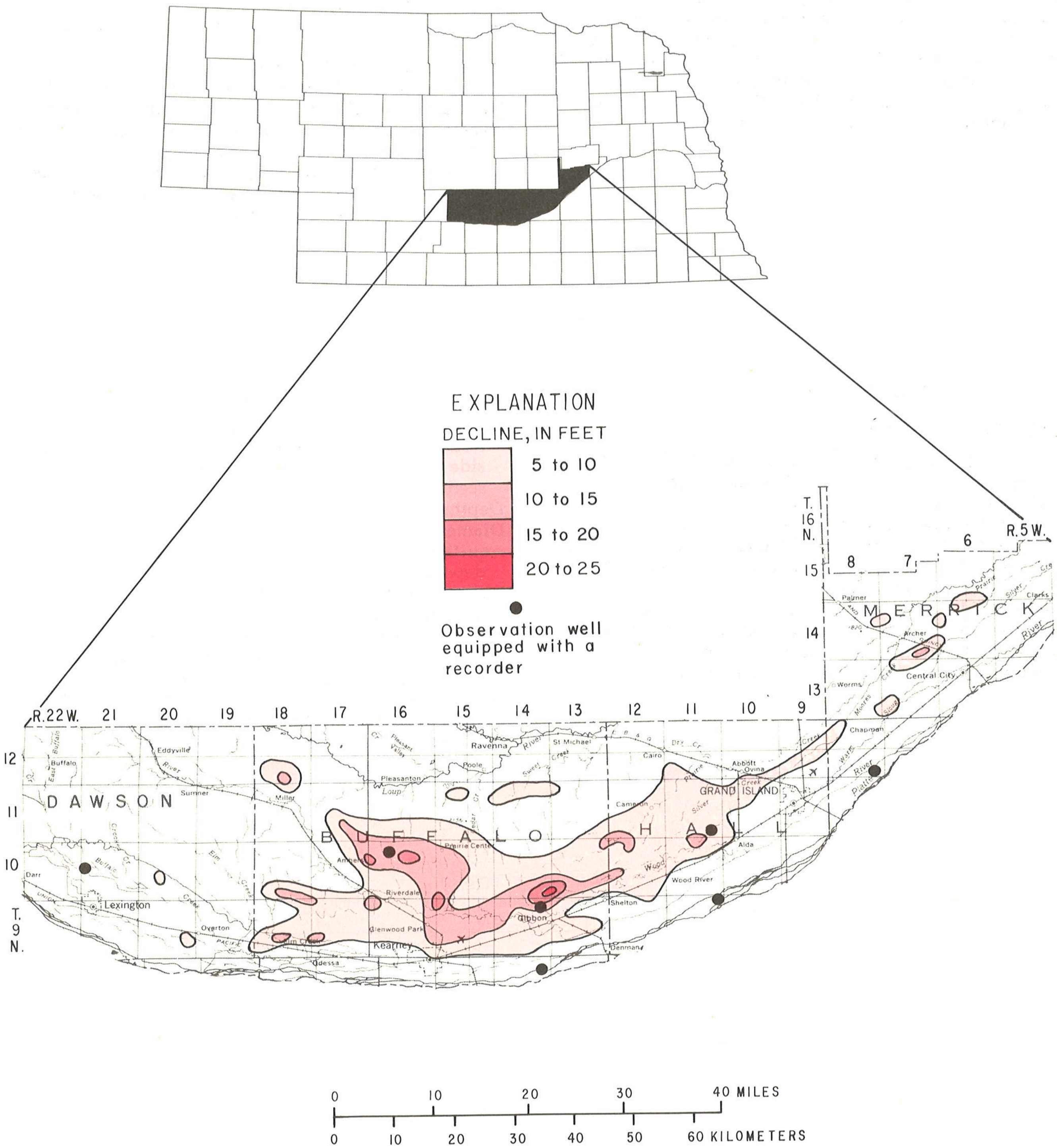
Approximate areas of significant declines in fall 1977 were:

Amount of decline, in feet (meters, m)	Approximate area, in acres (square kilometers, km^2)	
5.00–10.00 (1.52–3.05)	264,000	(1 070)
10.00–15.00 (3.05–4.57)	76,300	(310)
15.00–20.00 (4.57–6.1)	6,200	(25.0)
20.00–25.00 (6.1–7.6)	680	(2.75)

In the lowlands adjacent to the Platte and Wood rivers, estimated predevelopment water levels are the approximate water levels that existed in the early 1930s. In the uplands, estimated predevelopment water levels are the approximate water levels that existed prior to 1951.

Although the significant water-level declines in the area are the result of irrigation pumpage, the amount of decline is closely related to the amount of recharge the aquifer receives. In localities where the water table is less than 30 ft (9.1 m) below land surface, infiltration and deep percolation of water from heavy rains or floods may put more ground-water into storage in a few days time than is withdrawn by pumping and natural discharge during an entire irrigation season. In years when precipitation is deficient, water levels decline because groundwater pumpage for irrigation is more than normal and recharge to the groundwater system is less than normal. Throughout much of the lowland parts of the area, where both the longest and heaviest groundwater development has taken place, no long-term progressive water-level declines have developed because the aquifer is readily recharged by precipitation and river seepage. However, in the uplands north of the Wood River in Buffalo County, where the depth to water in many wells is greater than 100 ft (30.5 m), the water level in some wells has declined progressively since at least 1968.

Except for the uplands north and west of Lexington in Dawson County, sufficient data are available to give good definition of estimated predevelopment water levels, and existing water-level measurement programs provide data for good definition of current water-level changes.



Areas of significant water-level change in the Platte River valley area from predevelopment levels to fall 1977

GIBBON INTERCHANGE WELL

NO SIGNIFICANT WATER-LEVEL CHANGE

A net water-level rise of 0.10 ft (0.030 5 m) was recorded during 1977. This slight change continues the trend that has characterized the water level in this well since 1971.

During the year, water-level fluctuations ranged from 2 to 3 ft (0.61 to 0.91 m). Recharge from precipitation, use of water by vegetation, evaporation from sandpit ponds, changes in the stage of the Platte River, and pumping of water for irrigation caused the fluctuations.

WELL DATA

Location: 1.3 mi (2.09 km) south of the Gibbon Interchange on Interstate 80; on island in Platte River
Depth: 6 ft (1.83 m)
Diameter: 6 in (152 mm)
Aquifer: Sand and gravel (undifferentiated Pleistocene deposits)
Water occurrence: Unconfined
Estimated predevelopment water level: 4 ft (1.22 m)
Net water-level change in 1977: +0.10 ft (+0.030 5 m)
Average annual net water-level change since 1971: Not significant; no long-term rise or decline
Development near well: Irrigation wells; six irrigation wells on same island (first drilled in 1935 and last in 1974); average density of irrigation wells, 2.5/mi^2 (0.97/km^2)

GIBBON RECORDER WELL

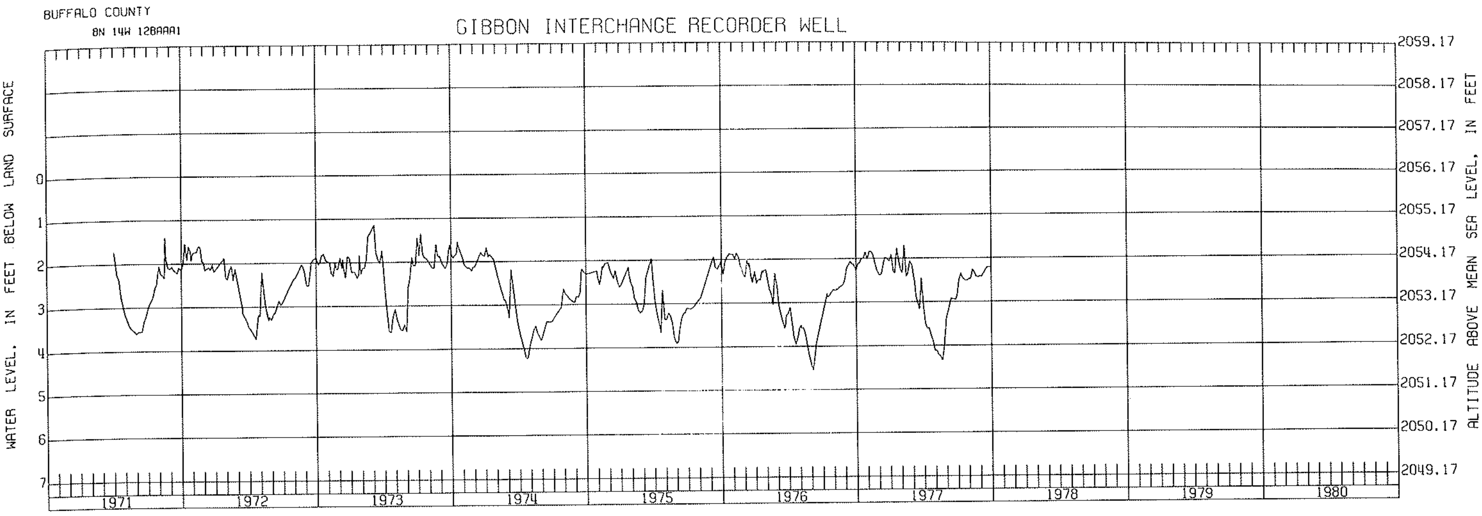
1977 WATER LEVEL UP 1.04 FEET

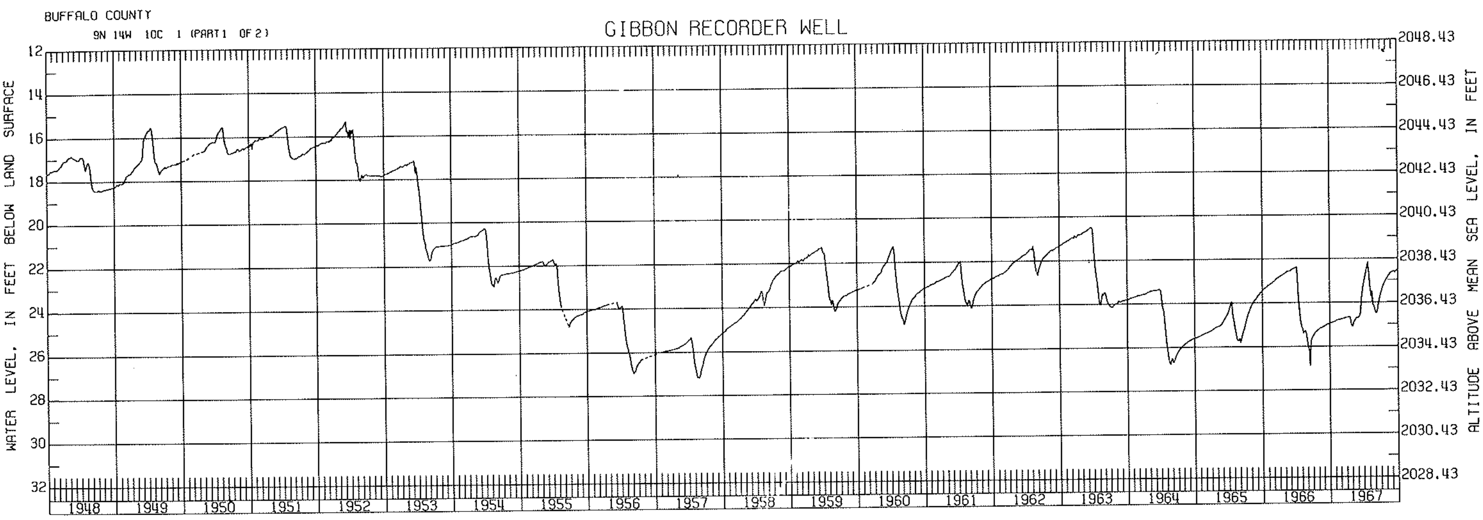
Reduced groundwater withdrawals required to replenish soil-moisture levels during 1977 coupled with increased recharge resulting from above-normal precipitation caused a net water-level rise of 1.04 ft (0.315 m) in this well.

The water level in this well historically declines during the summer irrigation season and rises progressively during succeeding months. It also fluctuates in response to periods of below-normal precipitation, as in 1952-57, and to periods of above-normal precipitation, as in 1967-69. No long-term trend in water-level changes has been established because the aquifer is readily recharged.

WELL DATA

Location: 1.3 mi (2.09 km) north of the intersection of Route 30 and the north-south range-line road on the east side of Gibbon, then 0.5 mi (0.80 km) west on section-line road
Depth: 37.5 ft (11.4 m)
Diameter: 8 in (203 mm)
Aquifer: Sand and gravel (undifferentiated Pleistocene deposits)
Water occurrence: Unconfined
Estimated predevelopment water level: 17.0 ft (5.2 m)
Net water-level change in 1977: +1.04 ft (+0.315 m)
Average annual net water-level change since 1946: Not significant; no long-term rise or decline
Development near well: Irrigation wells; first wells 1935, rapid development 1935, 1944, 1956, and 1971 to present; average density of irrigation wells, 11.0/mi^2 (4.25/km^2)


BUFFALO COUNTY
8N 14W 12BAAA1
GIBBON INTERCHANGE RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
0
1
2
3
4
5
6
7
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
2059.17
2058.17
2057.17
2056.17
2055.17
2054.17
2053.17
2052.17
2051.17
2050.17
2049.17
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980


BUFFALO COUNTY
9N 14W 10C 1 (PART1 OF 2)
GIBBON RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
12
14
16
18
20
22
24
26
28
30
32
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
2048.43
2046.43
2044.43
2042.43
2040.43
2038.43
2036.43
2034.43
2032.43
2030.43
2028.43
1948
1949
1950
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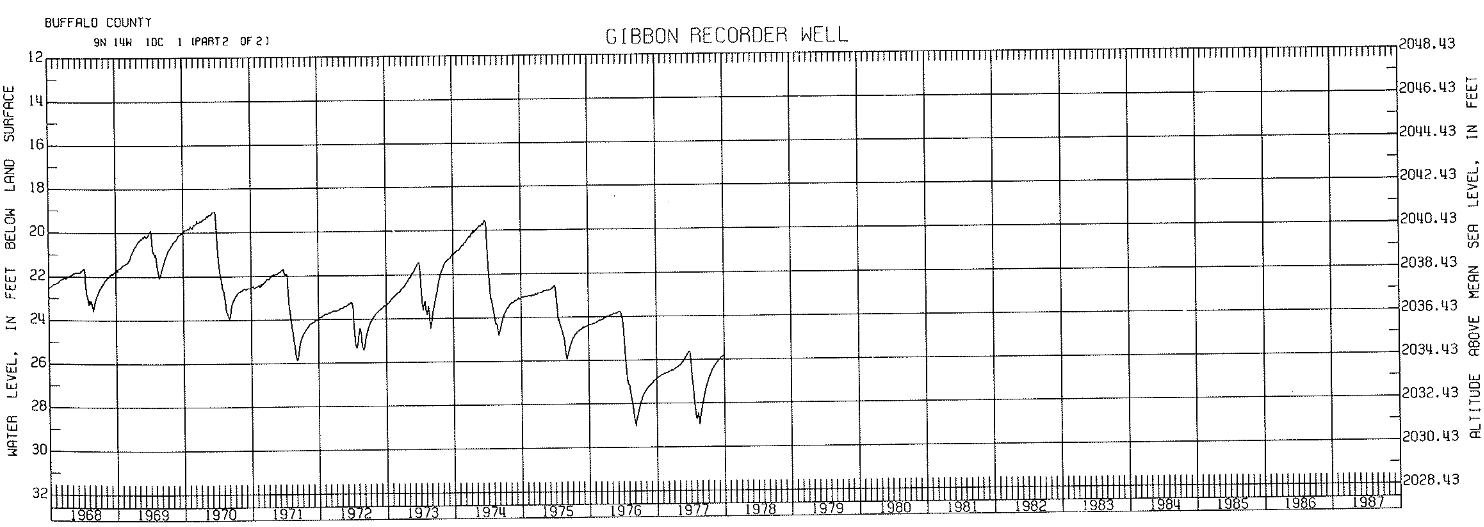
1962
1963
1964
1965
1966
1967


BUFFALO COUNTY
9N 14W 10C 1 (PART2 OF 2)
GIBBON RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
12
14
16
18
20
22
24
26
28
30
32
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
2048.43
2046.43
2044.43
2042.43
2040.43
2038.43
2036.43
2034.43
2032.43
2030.43
2028.43
1968
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1985
1986
1987

RIVERDALE RECORDER WELL

PRONOUNCED DECLINES CONTINUE

The water-level in this well continues to reflect an increased seasonal drawdown during the summer months. Beginning in late June and continuing into early August, the water level dropped more than 8 ft (2.44 m) before beginning its recovery. Summer irrigation's effect on the aquifer has been most pronounced since 1975, although the water levels have shown a general decline both seasonally and annually since the well was installed in 1968.

Heavy pumping of nearby irrigation wells to supply water during the summer probably is the principal reason for the greater drawdown. Available data indicate that the pronounced water-level fluctuations in response to intermittent pumping during June, July, and August may be because most of the groundwater pumped during this period is from a confined portion of the aquifer.

WELL DATA

Location: 5 mi (8.0 km) north from Riverdale on section-line road, then 0.4 mi (0.64 km) east along section-line road
Depth: 240 ft (73 m)
Diameter: 6 in (152 mm)
Aquifer: Layers of sand and gravel interbedded with layers of fine-textured sediment (Ogallala Formation)
Water occurrence: Combination of unconfined and confined
Estimated predevelopment water level: 107.0 ft (32.5 m)
Net water-level change in 1977: −0.22 ft (−0.067 m)
Average annual net water-level change since 1968: −0.91 ft (−0.275 m)
Development near well: Irrigation wells; most development in the 1950s, several in the 1960s and 1970s; average density of irrigation wells, 3.0/mi^2 (1.16/km^2)

LEXINGTON RECORDER WELL

LARGE WATER-LEVEL RISE IN 1977

Above-normal precipitation and a corresponding reduction in pumping led to large water-level rise in 1977. The water table in the vicinity of the well fluctuates in response to recharge from precipitation, seepage from irrigation canals and applied irrigation water, groundwater withdrawals for irrigation, and water uptake by deep-rooted vegetation, particularly alfalfa.

No long-term water-level trend can be detected in this area of conjunctive use of surface water and groundwater for irrigation. The pattern of fluctuations differs markedly from year to year, neither the highest nor lowest water levels occurring at any given time of the year.

WELL DATA

Location: 3.5 mi (5.6 km) north of the intersection of Route 21 and U.S. Highway 30 in Lexington
Depth: 120 ft (36.5 m)
Diameter: 6 in (152 mm)
Aquifer: Layers of sand and gravel interbedded with layers of silt and clay (Ogallala Formation)
Water occurrence: Combination of unconfined and confined
Estimated predevelopment water level: 11 ft (3.35 m)
Net water-level change in 1977: +2.61 ft (+0.80 m)
Average annual net water-level change: Variable; no long-term rise or decline
Development near well: Irrigation wells; earliest in 1935, peak development 1938, late 1940s and early 1950s; average density of wells, 5.5/mi^2 (2.12/km^2); land irrigated by groundwater interspersed with land irrigated by water diverted from the Platte River

ALDA INTERCHANGE RECORDER WELL

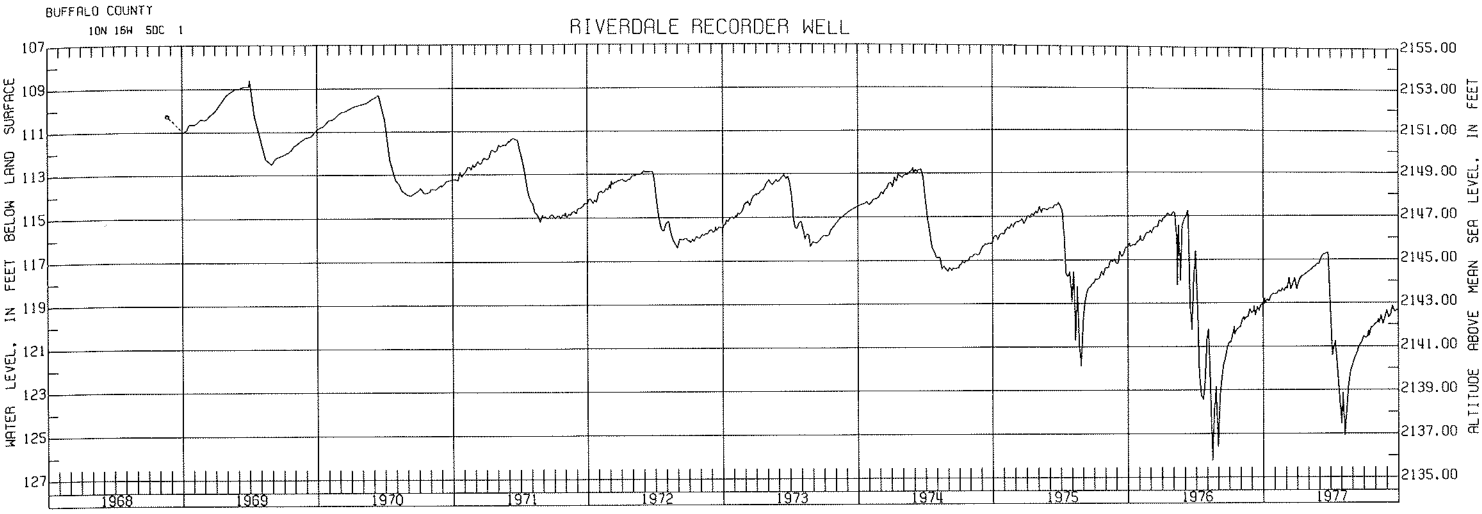
SEASONAL FACTORS CONTROL WATER LEVEL

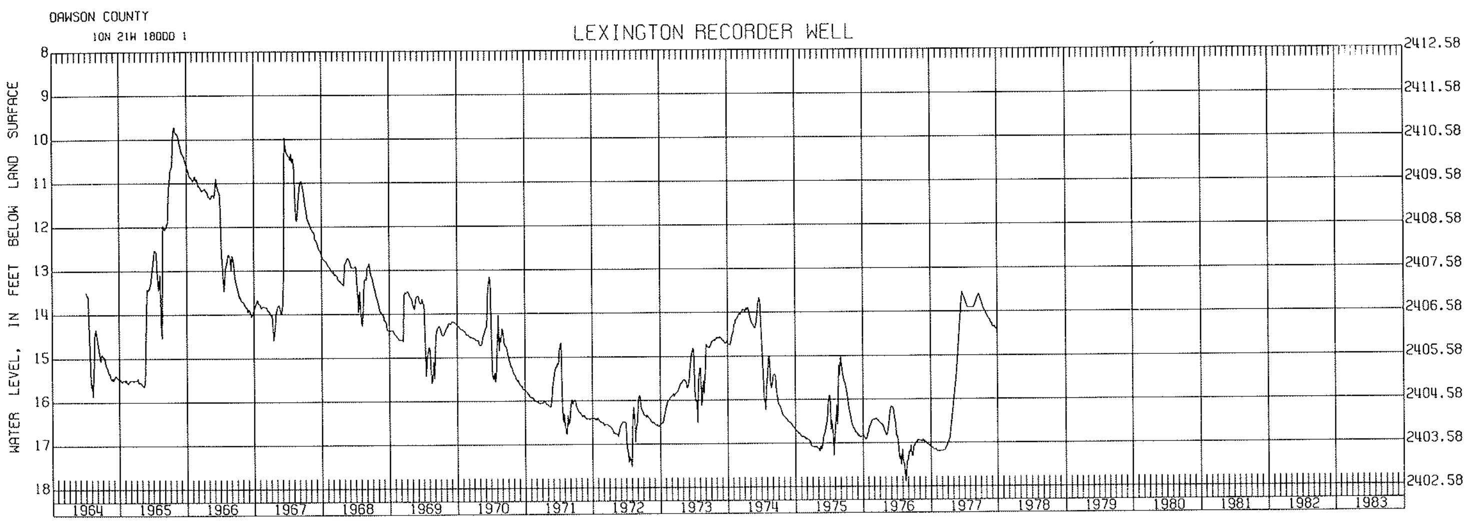
During the first four months of each year, when the depth to water in this well is around 4 ft (1.22 m), the water level is controlled mainly by the stage of the Platte River. Beginning in May and continuing to the first part of September, the water level declines because of groundwater use by vegetation and direct evaporation. When the growing season ends, the water begins to rise and by year's end water levels had returned to average. The peaks on the hydrograph indicate times when water from snowmelt or precipitation recharged the aquifer.

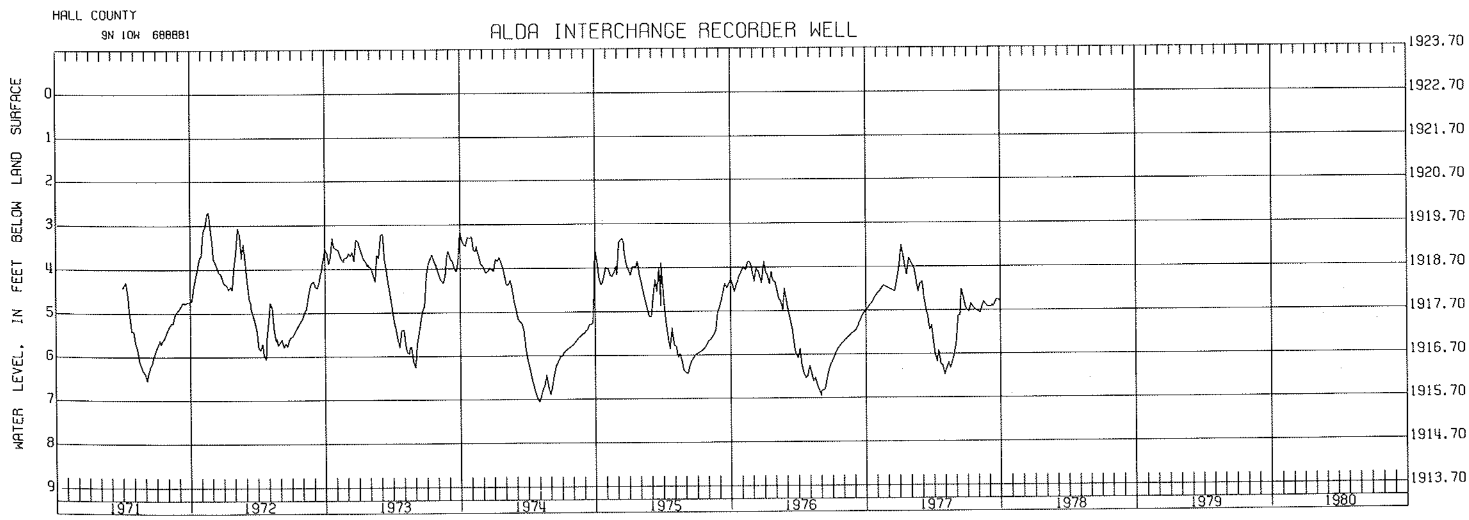
As long as the Platte River continues to flow in the vicinity of this well, the average water level probably will remain stable.

WELL DATA

Location: 0.85 mi (1.37 km) south of the Alda Interchange on Interstate 80; well is on Shoemaker Island between middle and south channels of the Platte River
Depth: 13.2 ft (4.00 m)
Diameter: 6 in (152 mm)
Aquifer: Sand and gravel (undifferentiated Pleistocene and Holocene deposits)
Water occurrence: Unconfined
Estimated predevelopment water level: 5 ft (1.52 m)
Net water-level change in 1977: +0.13 ft (+0.039 5 m)
Average annual net water-level change: Variable; no long-term rise or decline
Development near well: Irrigation wells; earliest in 1935, rapid development 1953-57, 1967-68, and 1975; average density of irrigation wells, 3.0/mi^2 (1.16/km^2); nearby pumping for irrigation has little effect on the water level in the well


BUFFALO COUNTY
10N 16W 5DC 1
RIVERDALE RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
107
109
111
113
115
117
119
121
123
125
127
2155.00
2153.00
2151.00
2149.00
2147.00
2145.00
2143.00
2141.00
2139.00
2137.00
2135.00
1968 1969 1970 1971 1972 1973 1974 1975 1976 1977


DAWSON COUNTY
10N 21W 18DDD 1
LEXINGTON RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
8
9
10
11
12
13
14
15
16
17
18
2412.58
2411.58
2410.58
2409.58
2408.58
2407.58
2406.58
2405.58
2404.58
2403.58
2402.58
1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983


HALL COUNTY
9N 10W 6BBBB1
ALDA INTERCHANGE RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
0
1
2
3
4
5
6
7
8
9
1923.70
1922.70
1921.70
1920.70
1919.70
1918.70
1917.70
1916.70
1915.70
1914.70
1913.70
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980

ALDA RECORDER WELL

WATER LEVEL UP IN 1977

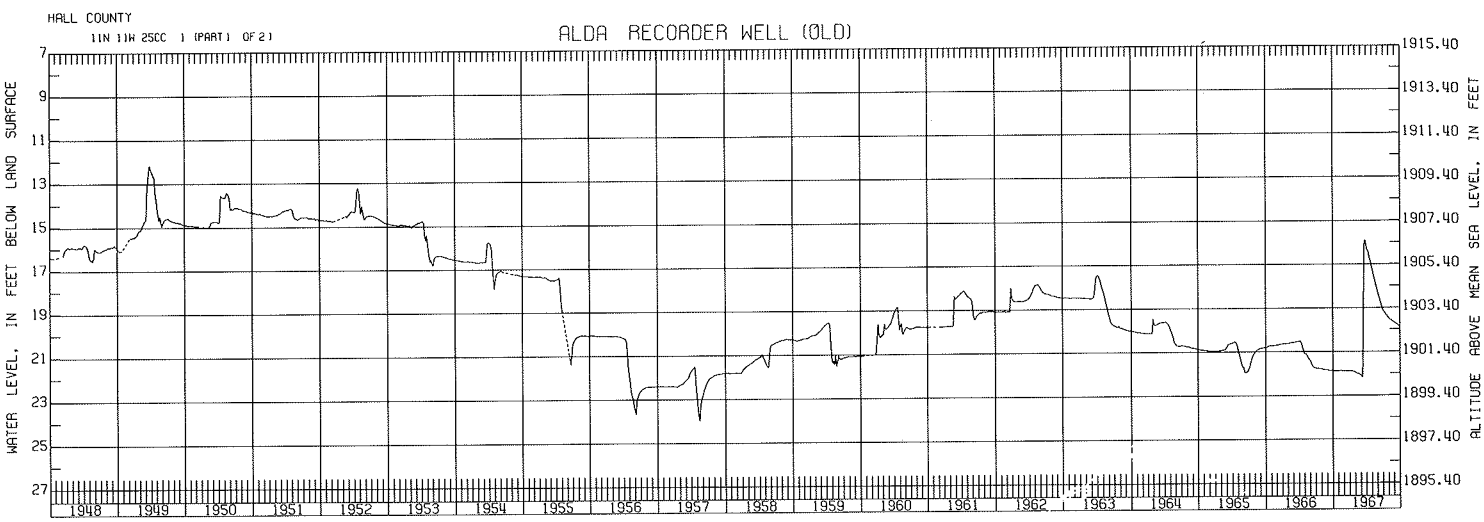
After remaining nearly steady at a depth slightly greater than 23 ft (7.0 m) for eight months, the water level in this well rose and then declined nearly 1 ft (0.305 m) during the irrigation season. The sharp rise on October 5 was caused by injection of water during the drilling of a replacement observation well a few feet to the north.

During the past nine years the water level has fluctuated within a range of about 4 ft (1.22 m). The 1977 year-end water level was the second lowest recorded for year's end and a record low for all seasonal readings.

The sharp water-level rise of a little more than 6 ft (1.83 m) in June 1967 was caused by recharge from excessive rainfall that produced extensive flooding in central Hall County.

WELL DATA

Location: 1.0 mi (1.61 km) north and 2.0 mi (3.20 km) west of Alda
Depth: Old well, 37 ft (11.3 m); new well, 65 ft (19.8 m)
Diameter: Old well, 8 in (203 mm); new well, 6 in (152 mm)
Aquifer: Sand and gravel (undifferentiated Pleistocene deposits)
Water occurrence: Unconfined
Estimated predevelopment water level: 15.0 ft (4.55 m)
Net water-level change in 1977: Old well, +0.66 ft (+0.201 m); new well, no data
Average annual net water-level change since 1948: Variable; no long-term rise or decline
Development near well: Irrigation wells, mostly to southeast, south, and southwest; earliest in 1935, rapid development 1935-39, 1942-45, and 1956; average density of wells, 3.0/mi² (1.16/km²)



CHAPMAN RECORDER WELL

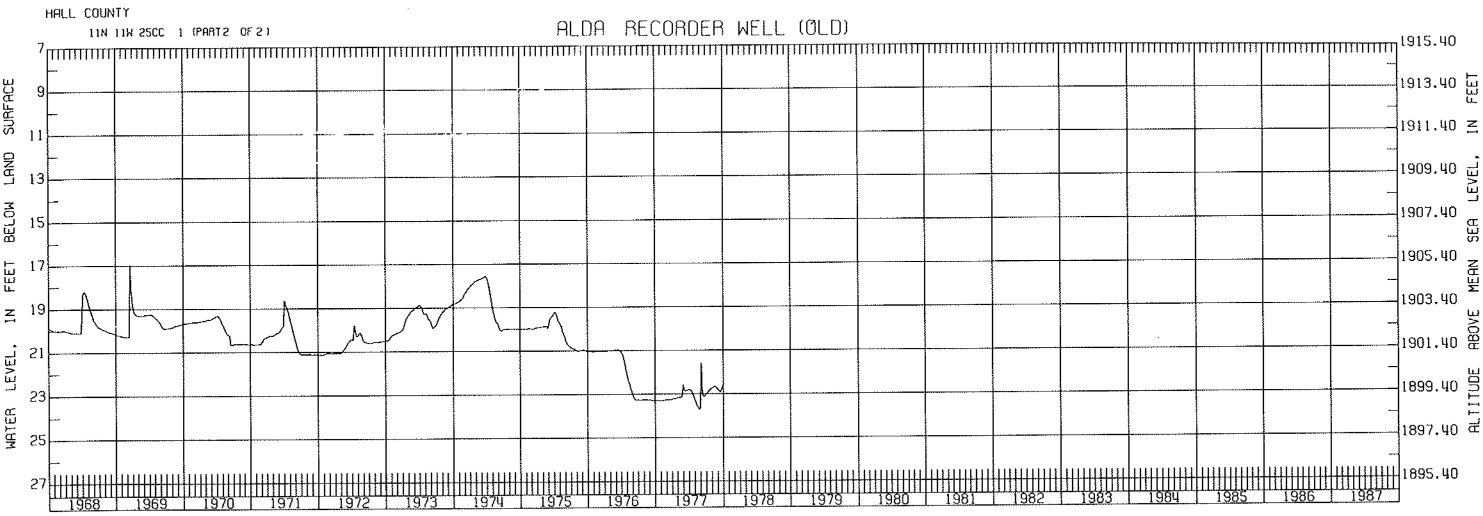
WATER-LEVEL FLUCTUATIONS REMAIN NORMAL

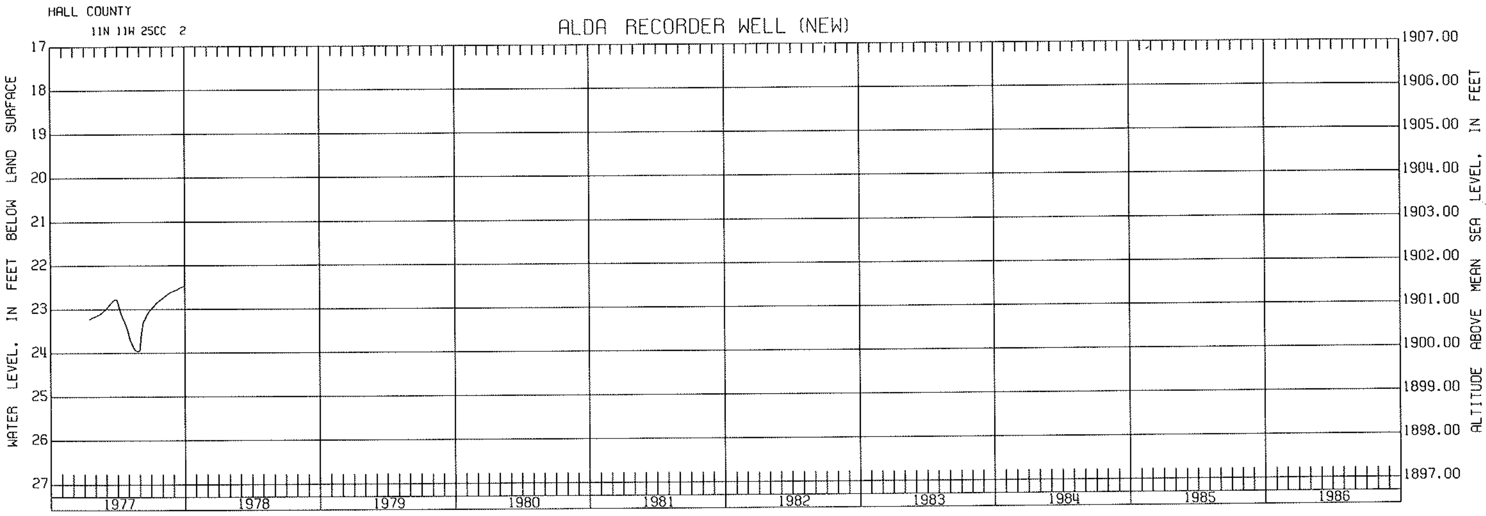
The water level in this well rose and declined several times during 1977. Changes in water level were more abrupt than in 1976. The three major peaks were associated with precipitation periods. Although the level was 0.38 ft (0.116 m) higher at the end of the year than at the beginning, the net change does not indicate a trend.

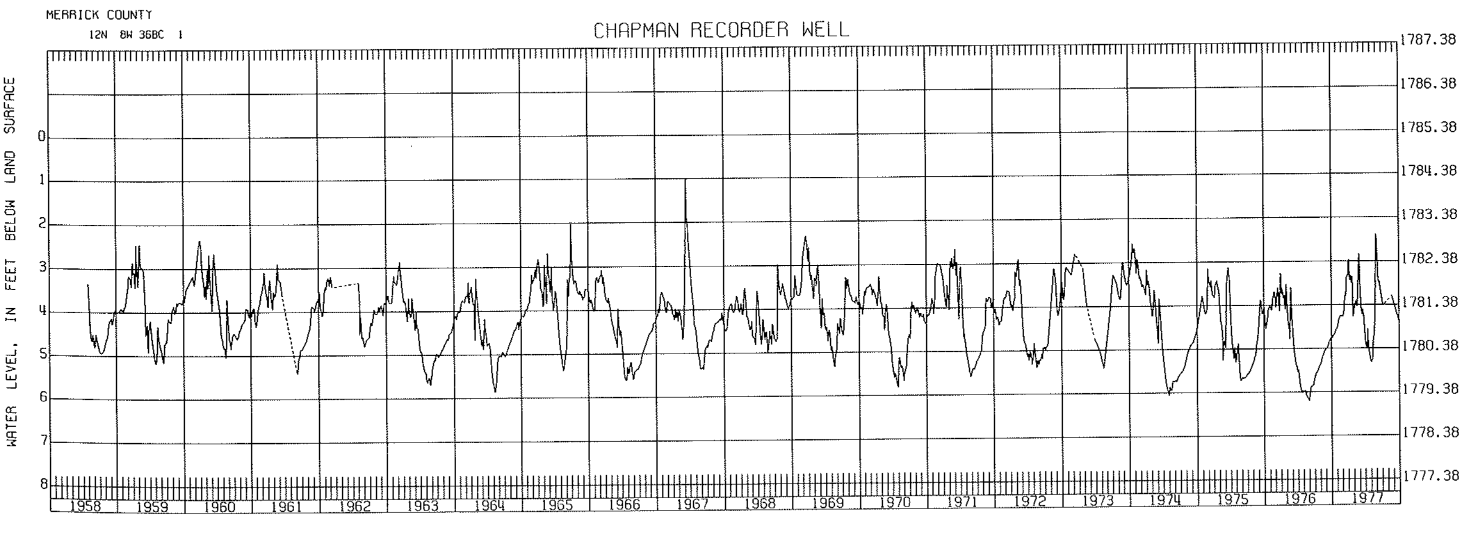
Since 1958 all year-end water levels except two have been between 3.5 ft (1.07 m) and 4.5 ft (1.37 m), even though the high water level for the year generally is between 2.5 and 3.0 ft (0.76 and 0.91 m) and the low water level for the year generally is between 5 and 6 ft (1.52 and 1.83 m). Recharge from precipitation causes most of the sharp water-level rises, and consumption of groundwater by evapotranspiration causes water-level declines during the growing season. Because the nearby Wood and Platte rivers are sources of recharge when the adjacent water table is lowered, the water-level trend in this well is not likely to change significantly.

WELL DATA

Location: 2 mi (3.20 km) southwest of the intersection of the main street in Chapman and U.S. Highway 30, then 2.6 mi (4.20 km) south
Depth: 7.75 ft (2.36 m)
Diameter: 6 in (152 mm)
Aquifer: Sand and gravel (undifferentiated Pleistocene deposits)
Water occurrence: Unconfined
Estimated predevelopment water level: 4.0 ft (1.22 m)
Net water-level change in 1977: +0.38 ft (+0.116 m)
Average annual net water-level change since 1958: Variable; no long-term rise or decline
Development near well: Irrigation wells; earliest in 1943, peak development in 1957-58; average density of irrigation wells, 1.0/mi² (0.385/km²)


HALL COUNTY
11N 11W 25CC 1 (PART 2 OF 2)
ALDA RECORDER WELL (OLD)
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
7
9
11
13
15
17
19
21
23
25
27
1915.40
1913.40
1911.40
1909.40
1907.40
1905.40
1903.40
1901.40
1899.40
1897.40
1895.40
1968 1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987


HALL COUNTY
11N 11W 25CC 2
ALDA RECORDER WELL (NEW)
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
17
18
19
20
21
22
23
24
25
26
27
1907.00
1906.00
1905.00
1904.00
1903.00
1902.00
1901.00
1900.00
1899.00
1898.00
1897.00
1977 1978 1979 1980 1981 1982 1983 1984 1985 1986


MERRICK COUNTY
12N 8W 36BC 1
CHAPMAN RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
0
1
2
3
4
5
6
7
8
1787.38
1786.38
1785.38
1784.38
1783.38
1782.38
1781.38
1780.38
1779.38
1778.38
1777.38
1958 1959 1960 1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975 1976 1977

2.0 CHANGES IN WATER LEVELS, 1977 (continued)

2.3 *Mira Valley Area*

Water levels in the Mira Valley area generally rose between 0.2 ft and 4.0 ft (0.061 to 1.22 m) between fall 1976 and fall of 1977. The average rise was about 2.8 ft (0.85 m).

In the fall of 1977 water-level declines of 5 ft (1.52 m) or more from estimated predevelopment levels occurred in an area of approximately 22,700 acres (92 km²). The maximum amount of decline from estimated predevelopment levels, less than 12 ft (3.65 m), occurred in the area of decline located between the North Branch and South Branch of Mira Creek.

Approximate areas of significant declines in fall 1977 are given below:

Amount of decline, in feet (meters, m)	Approximate area, in acres (square kilometers, km²)	
5.00–10.00 (1.52–3.05)	20,700	(84)
10.00–15.00 (3.05–4.55)	2,000	(8.1)

Estimated predevelopment water levels in the Mira Valley area are the approximate water levels that existed prior to 1957.

Analysis of existing water-level data indicates that groundwater withdrawals for irrigation in the area have become large enough to cause net water-level declines in most years when precipitation is near or below normal. However, soils in the valley are permeable and the aquifer is readily recharged during periods of heavy rainfall. In fall 1973, for example, precipitation was markedly above normal and all water levels in the area rose. In none of the wells was the water level more than 5 ft (1.52 m) lower than estimated predevelopment levels, and in a few wells water levels were even higher than predevelopment levels.

Sufficient data are available to define estimated predevelopment levels in the area fairly well. However, some data collected from the observation-well network that existed in the area prior to 1975 may not be representative of water-level conditions in the principal aquifers of the area.

ORD RECORDER WELL

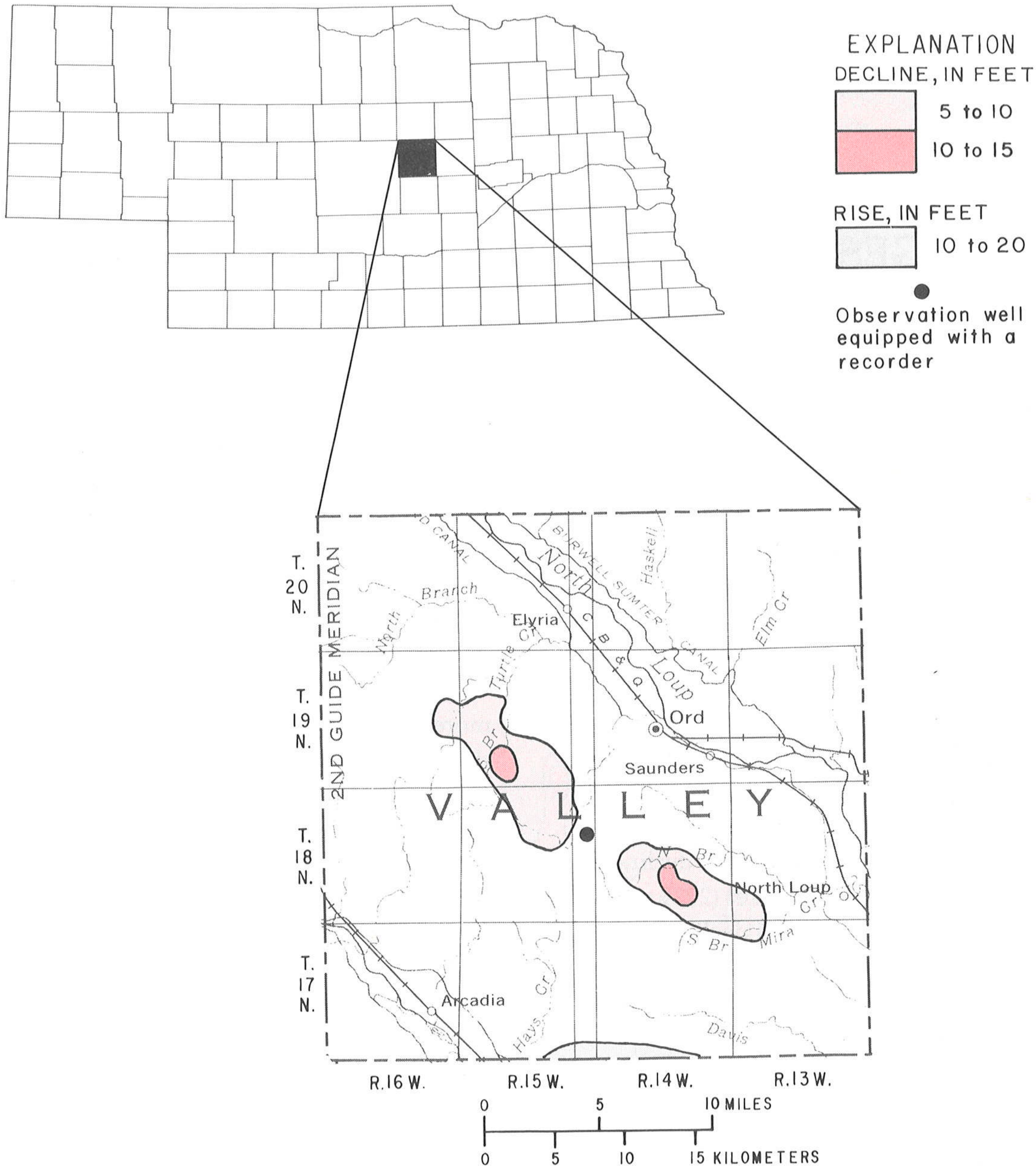
SUMMER LOW ABOVE THAT OF PREVIOUS 5 YEARS

The 1977 low water level for this well was the highest since the recorder well began operation in 1972. The length of time during which the summer decline occurred was noticeably less as well. Also, a net rise of 2.64 ft (0.80 m) was recorded for 1977.

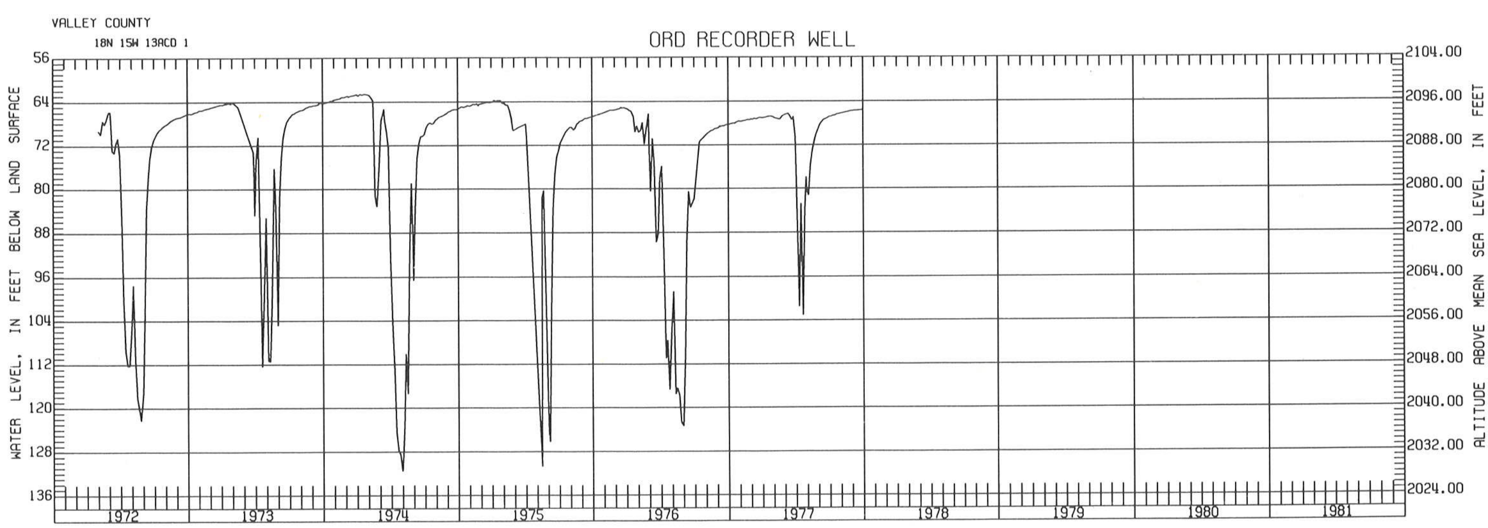
Operation of nearby irrigation wells causes the summertime water-level fluctuations in this well. The sharpness and magnitude of the responses result from confinement of the water under hydrostatic pressure. Of the five years of record, the first year was characterized by a net water-level rise and the next three years by net water-level declines. Levels near the end of 1977 show that the short-term decline in water levels may be slowing.

WELL DATA

Location: 6.5 mi (10.5 km) southwest of Ord on Route 70, then 0.25 mi (0.400 km) west
Depth: 289 ft (88 m)
Diameter: 18 in (455 mm)
Aquifer: Layers of sandstone interbedded with layers of clay (Ogallala Formation)
Water occurrence: Confined
Estimated predevelopment water level: 51 ft (15.5 m)
Net water-level change in 1977: +2.64 ft (+0.80 m)
Average annual net water-level change since 1972: Variable; period of record too short for definition of long-term trend
Development near well: Irrigation wells; earliest in 1948, rapid development 1956-57, 1962-68, and 1971-73; average density of irrigation wells, 2.5/mi² (0.97/km²)



Areas of significant water-level change in the Mira Valley area, from 1957 to fall 1977



2.0 CHANGES IN WATER LEVELS, 1977 (continued)

2.4 O'Neill Area

Water levels measured in the O'Neill area during the fall of 1977 averaged 0.39 ft (0.119 m) higher than those measured during the fall of 1976. In the area north and immediately east of Atkinson, most water levels rose 0.8 to 1.6 ft (0.244 to 0.490 m). Throughout the rest of the area, water-level changes generally ranged from declines of 1.5 ft (0.455 m) to rises of more than 1.0 ft (0.305 m).

Water-level declines of 5 ft (1.52 m) or more from estimated predevelopment levels occurred in approximately 89,000 acres (360 km^2). Three major parts of the area and the significant declines that occurred in them are: about 25,000 acres (101 km^2) north and east of Atkinson, maximum decline of about 19 ft (5.8 m); about 50,000 acres (202 km^2) north of Emmett and O'Neill, maximum decline of slightly more than 22 ft (6.7 m); and about 10,300 acres (41.5 km^2) south of the site of the old town of Opportunity, maximum decline of almost 13 ft (3.95 m).

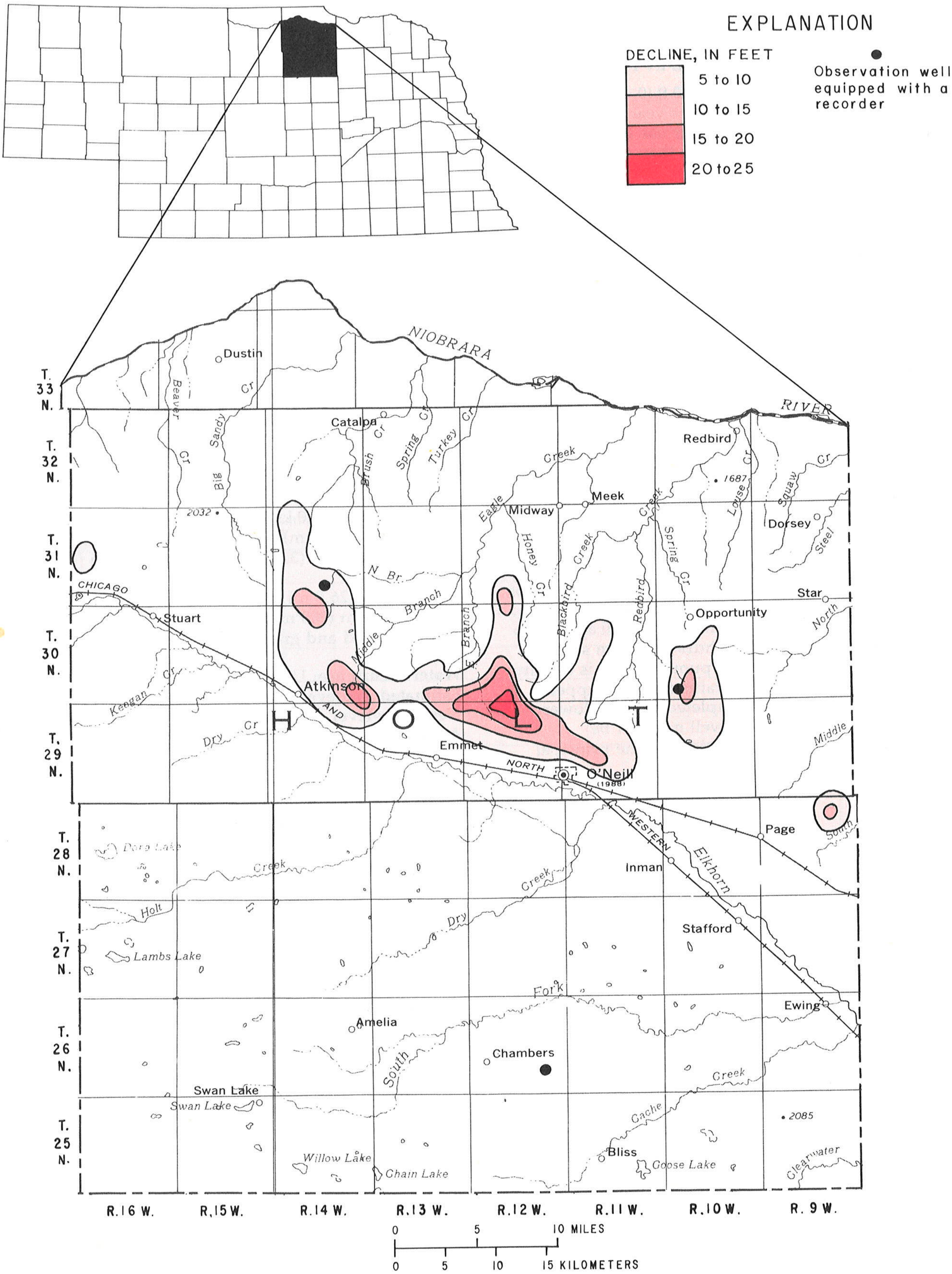
Approximate areas of significant declines in fall 1977 are:

Amount of decline, in feet (meters, m)	Approximate area, in acres (square kilometers, km^2)	
5.00–10.00 (1.52–3.05)	67,000	(270)
10.00–15.00 (3.05–4.57)	15,000	(61)
15.00–20.00 (4.57–6.1)	5,400	(21.9)
20.00–25.00 (6.1–7.6)	1,100	(4.45)

Estimated predevelopment water levels in the area are the approximate water levels prior to 1957.

Withdrawal of water for irrigation has caused water levels to trend progressively downward since 1964 in some parts of the area; however, recharge from precipitation has occasionally resulted in short-term water-level rises or has lessened the rate of water-level decline. Available data indicate that the water level in some wells declined 5 ft (1.52 m) or more during the drought of the mid-1950s and that the water levels in many wells rose more than 2 ft (0.61 m) between 1970 and 1974 when precipitation in the area was above normal. Groundwater withdrawals for irrigation are enough in much of the area to cause water-level declines during most years when precipitation is near normal or below normal. However, if precipitation for the year is above normal or if precipitation is above normal during the irrigation season, water levels in most wells rise in response to recharge of the aquifer and less-than-normal pumpage.

Sufficient data are available for fairly accurate estimation of predevelopment water levels in the area, and the existing observation-well network provides adequate data for evaluation of current water-level changes. Prior to 1975, however, observation wells were too few to define adequately the water-level changes in many parts of the area.



Areas of significant water-level change in the O'Neill area, from 1957 to fall 1977

CHAMBERS RECORDER WELL

NET ANNUAL WATER-LEVEL RISE IN 1977

The water level in this well was 1.63 ft (0.495 m) higher at year's end than at the beginning of the year. Recharge from precipitation and consumptive water use by vegetation probably affect the water level more than does the pumping of nearby wells.

The Chambers well is in an area having highly permeable sandy soil and a water table within the reach of plant roots. For these reasons, its water level is unlikely to decline progressively unless drought conditions persist for several years.

WELL DATA

Location: 3.5 mi (5.6 km) east of Chambers on Route 95
Depth: 140 ft (42.5 m)
Diameter: 5 in (127 mm)
Aquifer: Sand and gravel (undifferentiated Pleistocene deposits)
Water occurrence: Unconfined
Estimated predevelopment water level: 6.0 ft (1.83 m)
Net water-level change in 1977: +1.63 ft (+0.495 m)
Average annual net water-level change since 1972: −0.02 ft (−0.006 1 m)
Development near well: Irrigation wells; earliest in 1970, peak development 1970-71; average density of irrigation wells, 1.0/mi² (0.385/km²)

O'NEILL RECORDER WELL

LONG-TERM WATER-LEVEL DECLINE CONTINUES

The long-term water-level decline in this well continued in 1977. Adequate precipitation during August shortened the irrigation season and thus reduced the total amount of water pumped for irrigation and the decline for the year.

The long-term water-level decline in this well appears to be the result of groundwater withdrawals from several nearby wells. Because most of the pumping in this vicinity is from a lower aquifer, water drains from the upper aquifer in which the well is completed into the lower. Water-level fluctuations in this well may not be representative of seasonal fluctuations in the principal aquifer in the area.

WELL DATA

Location: 2 mi (3.20 km) east on paved road from O'Neill, then 2 mi (3.20 km) north, 4 mi (6.4 km) east, 2 mi (3.20 km) north, 2 mi (3.20 km) east, and 0.5 mi (0.80 km) north
Depth: 85 ft (26.0 m)
Diameter: 8 in (203 mm)
Aquifer: Sand and gravel (undifferentiated Pleistocene deposits)
Water occurrence: Unconfined
Estimated predevelopment water level: 35 ft (10.7 m)
Net water-level change in 1977: −1.17 ft (−0.355 m)
Average annual net water-level change since 1966: −1.29 ft (−0.395 m)
Development near well: Irrigation wells; earliest in 1965, rapid development 1965–68 and 1975 to present; average density of wells, 2.5/mi² (0.97/km²); all producing wells tap water-bearing sediments that are separated by a clay layer from the higher sand and gravel penetrated by the recorder well.

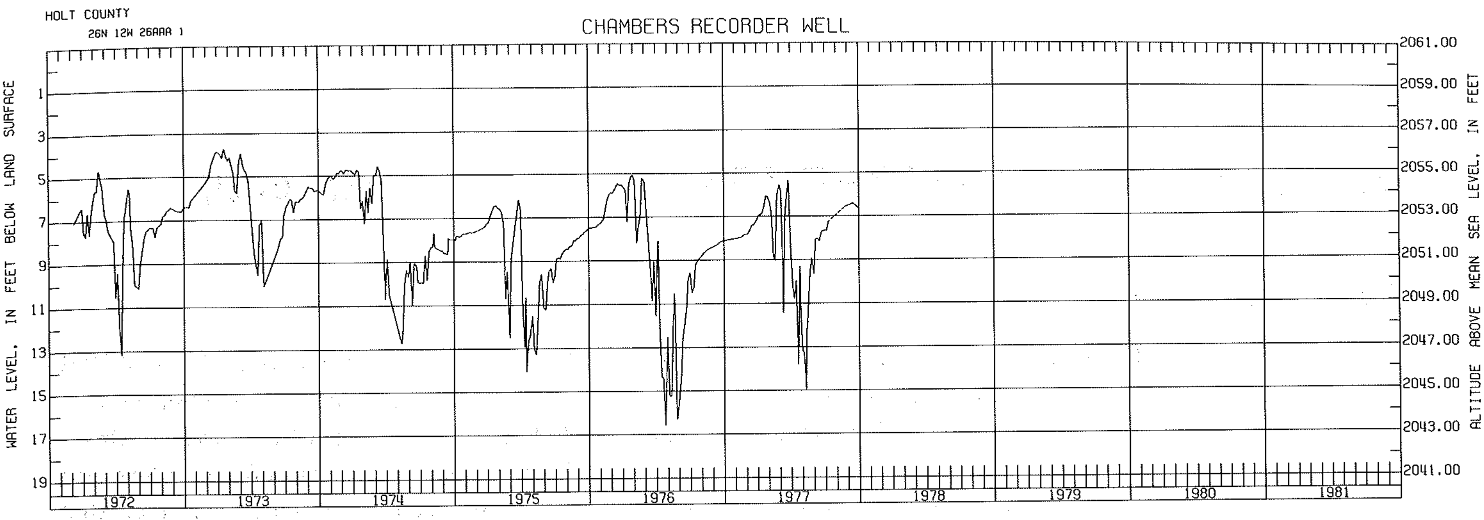
ATKINSON RECORDER WELL

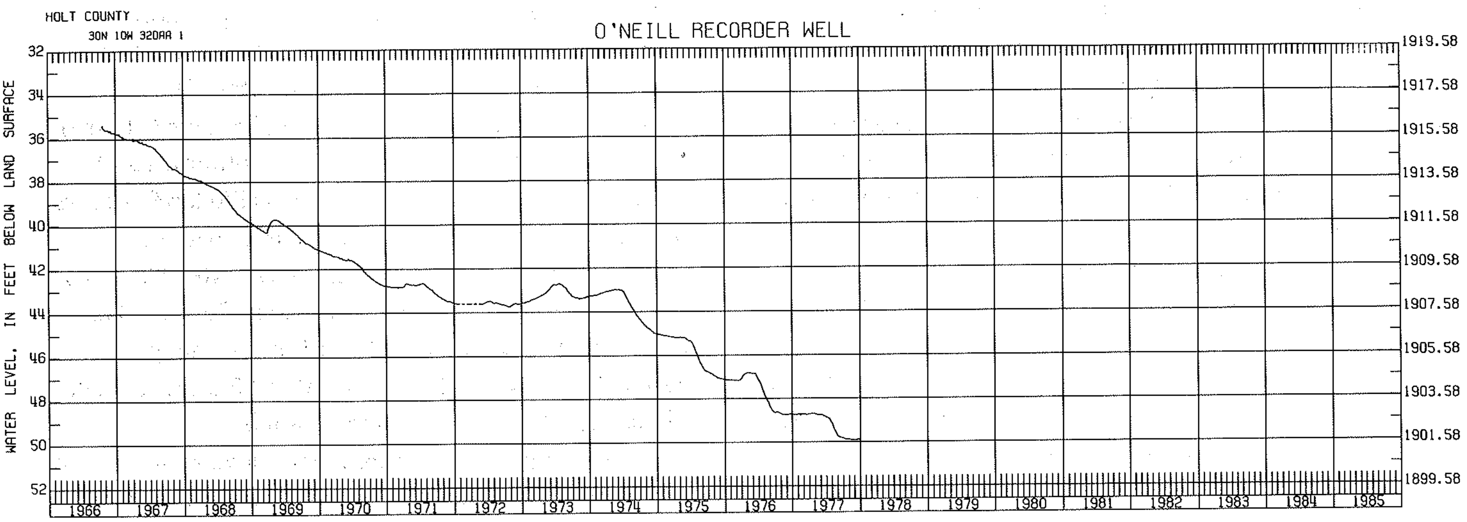
WATER LEVEL RISES SLIGHTLY

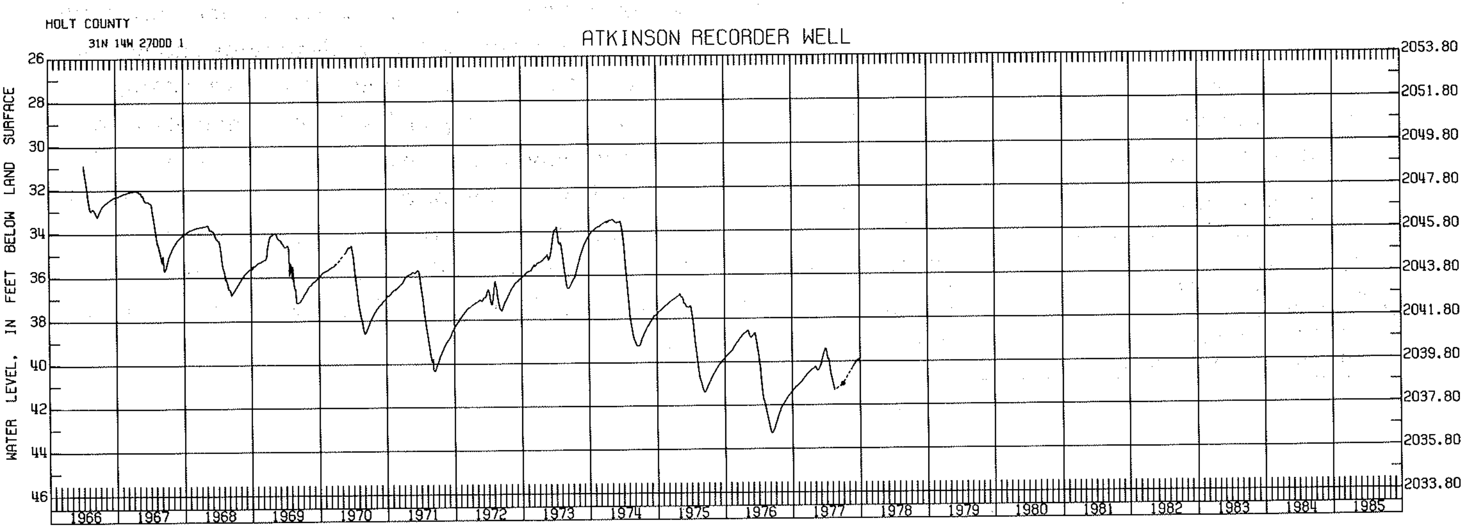
Prior to 1977 the water level in this well trended downward from 1966 through 1971, then upward for two years before reverting downward. Greater-than-normal recharge to the aquifer in combination with less pumping for irrigation accounts for net water-level rises in 1972, 1973, and 1977.

WELL DATA

Location: 6 mi (9.7 km) north of Atkinson on Route 11, then 2 mi (3.20 km) east
Depth: 72 ft (21.9 m)
Diameter: 8 in (203 mm)
Aquifer: Sand and gravel (undifferentiated Pleistocene deposits)
Water occurrence: Unconfined
Estimated predevelopment water level: 32 ft (9.8 m)
Net water-level change in 1977: +1.68 ft (+0.51 m)
Average annual net water-level change since 1966: −0.69 ft (−0.210 m)
Development near well: Irrigation wells; earliest in 1955, rapid development 1957 and 1964–67; average density of irrigation wells, 4.0/mi² (1.54/km²)


HOLT COUNTY
26N 12W 26AAA 1
CHAMBERS RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
1 3 5 7 9 11 13 15 17 19
2061.00 2059.00 2057.00 2055.00 2053.00 2051.00 2049.00 2047.00 2045.00 2043.00 2041.00
1972 1973 1974 1975 1976 1977 1978 1979 1980 1981


HOLT COUNTY
30N 10W 32DAA 1
O'NEILL RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
32 34 36 38 40 42 44 46 48 50 52
1919.58 1917.58 1915.58 1913.58 1911.58 1909.58 1907.58 1905.58 1903.58 1901.58 1899.58
1966 1967 1968 1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985


HOLT COUNTY
31N 14W 27DDD 1
ATKINSON RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
26 28 30 32 34 36 38 40 42 44 46
2053.80 2051.80 2049.80 2047.80 2045.80 2043.80 2041.80 2039.80 2037.80 2035.80 2033.80
1966 1967 1968 1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985

2.0 CHANGES IN WATER LEVELS, 1977 (continued)

2.5 Imperial Area

Water levels declined throughout much of the Imperial area between fall 1976 and fall 1977. In Chase County, where the most intensive long-term development of groundwater for irrigation has taken place, most declines were between 1.0 and 5.0 ft (0.305 and 1.52 m). Water levels in the uplands north of the Republican River in Dundy County were generally 0.7 to 2.0 ft (0.213 to 0.61 m) lower. In Perkins County most declines were between 0.6 and 2.0 ft (0.18 and 0.61 m); however, in those parts of Perkins County where there has been a long-term rising water-level trend, the water-level change between fall 1976 and fall 1977 was a rise of 1.0 ft (0.305 m) or more.

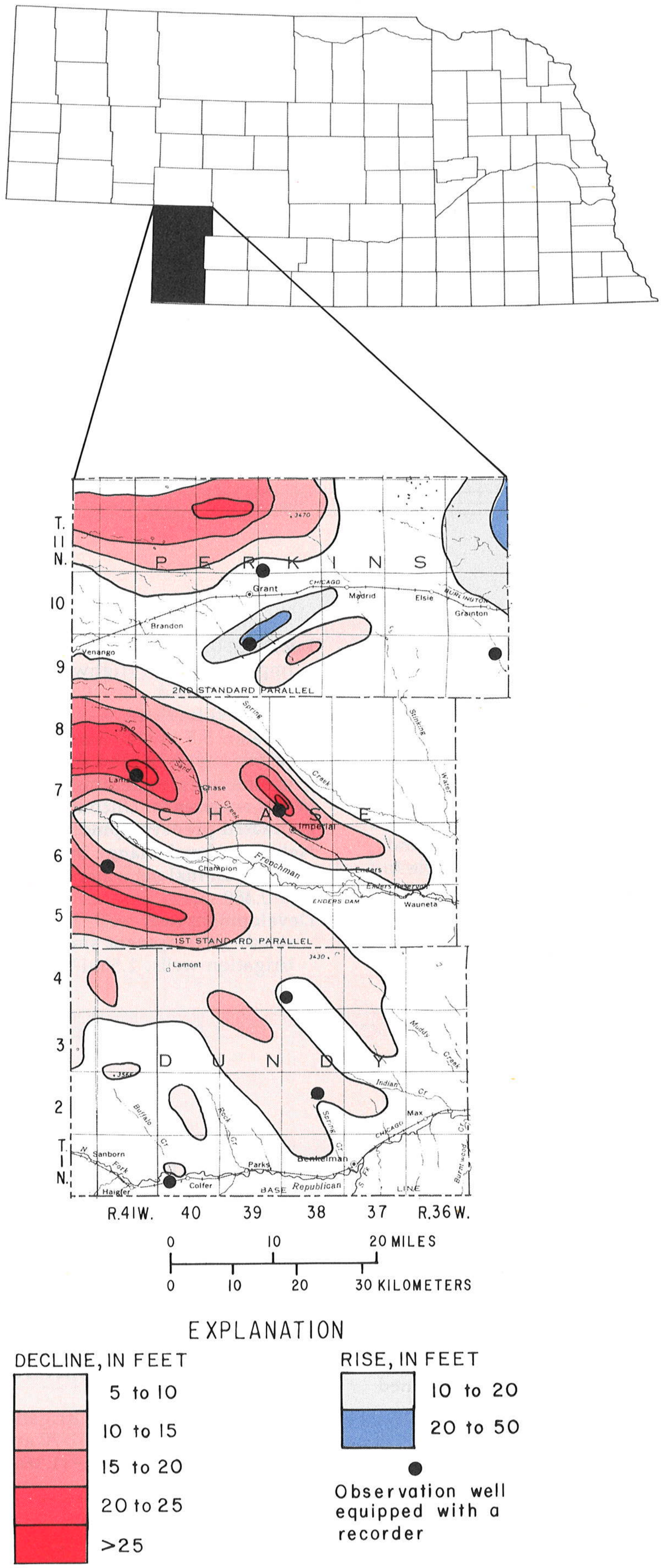
Significant changes from estimated predevelopment water levels have occurred in approximately 785,000 acres (3 200 km²) of the area. Water levels have declined 5 ft (1.52 m) or more in about 723,000 acres (2 905 km²) and have risen 10 ft (3.05 m) or more in about 62,000 acres (250 km²). Declines from estimated predevelopment water levels ranged from 5 to 20 ft (1.52 to 6.1 m) in most of the area, but locally in Chase and northwestern Perkins counties declines have ranged from 25 ft (7.6 m) to more than 35 ft (10.7 m).

Approximate areas of water-level declines from estimated predevelopment water levels in the Imperial area in the fall of 1977 were:

Amount of decline, in feet (meters, m)	Approximate area, in acres (square kilometers, km²)	
5.00–10.00 (1.52–3.05)	393,000	(1 590)
10.00–15.00 (3.05–4.57)	172,000	(700)
15.00–20.00 (4.57–6.1)	109,000	(440)
20.00–25.00 (6.1–7.6)	46,000	(186)
25.00 or more (7.6 or more)	2,500	(10.1)

During the past 27 years, a water-level rise of 10 ft (3.05 m) or more from estimated predevelopment water levels has occurred in south-central Perkins County. The cause of this rise is not fully understood but may be related to changes in land use. Tracts that were native-grass grazing land have been converted to cultivated farmland. This change in land use may have resulted in decreased evapotranspiration from fallow land, thus increasing the amount of water available to recharge the aquifer. The maximum amount of rise in this 20,000-acre (81 km²) area is more than 33 ft (10.1 m). Another area of water-level rise, about 42,000 acres (170 km²), occurs in eastern Perkins County. This area extends eastward and includes approximately 400,000 acres (1 620 km²) in southwestern Lincoln County. This rise is probably due to infiltration and deep percolation of water from Sutherland Reservoir, Lake Maloney, and their associated canals.

Estimated predevelopment water levels for wells in the Imperial area are the approximate water levels prior to 1953. Sufficient data are available to give good definition of the estimated predevelopment water levels in most of the area, and measurements from existing observation wells provide enough data for fair definition of current water-level changes. Because periodic water-level measurements were made in only a few observation wells prior to 1974, data for evaluation of historical water-level changes are limited. Evaluation of the available data, however, indicates that a downward water-level trend started about 1966 in heavily developed parts of the area.



Areas of significant water-level change in the Imperial area, from 1953 to fall 1977

CHAMPION RECORDER WELL

WATER LEVEL DROPS BELOW 44 FEET

The water level in this well reached a new low in September, almost 2.0 ft (0.61 m) below the level that set a record low the previous summer. The abrupt fluctuations of the water level in 1977 are attributed to intermittent pumping in May before plant growth and to pumping for irrigation during the growing season.

Withdrawals for irrigation have caused lowering of the water table in the vicinity of the well. Reduced groundwater withdrawals during the above-normal precipitation of 1973 temporarily slowed the rate of water-table decline. Additional irrigation development in the area plus heavy withdrawals because of below-normal precipitation have accelerated the rate of decline in the last three years.

WELL DATA

Location: 12.25 mi (19.7 km) west of the west edge of Champion
Depth: 180 ft (55 m)
Diameter: 5 in (127 mm)
Aquifer: Layers of sand and gravel interbedded with layers of fine-textured sediment (Ogallala Formation)
Water occurrence: Unconfined
Estimated predevelopment water level: 30 ft (9.1 m)
Net water-level change in 1977: −1.83 ft (−0.56 m)
Average annual net water-level change since 1972: −1.48 ft (−0.450 m)
Development near well: Irrigation wells; earliest in 1944, most of development mid-1950s and since 1966; average density of irrigation wells, 3.0/mi² (1.16/km²)

IMPERIAL RECORDER WELL

WATER LEVEL DECLINES TO 87 FEET

The water level in this well reached a new low during August 1977. This level was 2 ft (0.61 m) lower than the lowest level during the previous summer. The major summer declines were the result of heavy groundwater withdrawals for irrigation.

The water level in this well has trended downward since 1964. Periods 1964-67 and 1971-72 were characterized by a slower average rate of decline than periods 1968-70 and 1972-76. Reduced groundwater withdrawals traceable to above-normal precipitation accounted for the earlier periods and additional development plus greater withdrawals per well accounted for the latter periods.

WELL DATA

Location: 0.5 mi (0.80 km) north and 1 mi (1.61 km) west of Imperial on U.S. Highway 6, then 0.5 mi (0.80 km) north on gravel road
Depth: 230 ft (70 m)
Diameter: 5.5 in (140 mm)
Aquifer: Layers of sand and gravel interbedded with layers of fine-textured sediment (Ogallala Formation)
Water occurrence: Unconfined
Estimated predevelopment water level: 56.0 ft (17.1 m)
Net water-level change in 1977: −1.36 ft (−0.415 m)
Average annual net water-level change since 1964: −1.57 ft (−0.480 m)
Development near well: Irrigation wells; earliest in 1949, steady development since 1964; average density of irrigation wells, 2.5/mi² (0.97/km²)

LAMAR RECORDER WELL

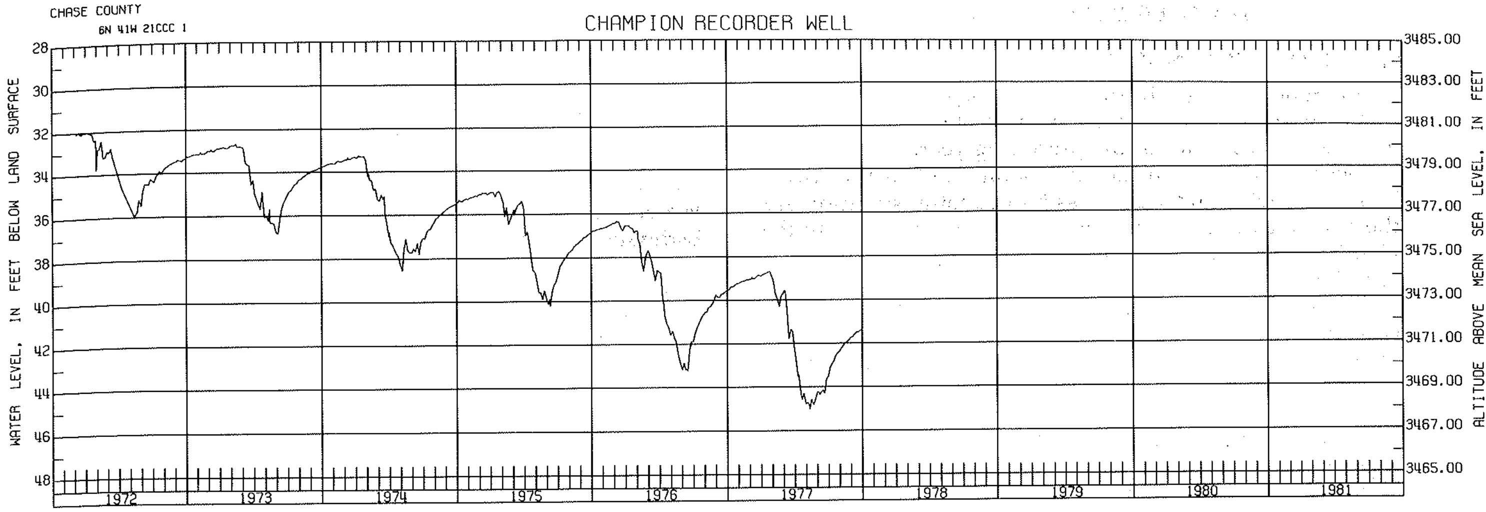
SUMMER WATER LEVEL FALLS TO RECORD LOW

The water level in this well during July 1977 fell below 91 ft (27.5 m), continuing the pattern of seasonal and overall decline. Rainfall accounted for the temporary recovery of the water level in July and August. Because of below-normal precipitation, large amounts of groundwater were withdrawn for irrigation during the summer growing season.

The large amplitude of the water-level fluctuations in response to pumping from nearby wells reflects confined groundwater conditions at this location. Reduction of artesian pressure in the aquifer is indicated by the declining water-level trend.

WELL DATA

Location: 2 mi (3.20 km) east and 0.5 mi (0.80 km) north of Lamar
Depth: 192 ft (59 m)
Diameter: 5 in (127 mm)
Aquifer: Layers of sand and gravel interbedded with layers of clay (Ogallala Formation)
Water occurrence: Confined
Estimated predevelopment water level: 50.5 ft (15.4 m)
Net water-level change in 1977: −0.84 ft (−0.255 m)
Average annual net water-level change since 1973: −2.60 ft (−0.79 m)
Development near well: Irrigation wells; earliest in 1963, major development 1967-70 and 1975; average density of irrigation wells, 3.0/mi² (1.16/km²)


CHASE COUNTY
6N 41W 21CCC 1
CHAMPION RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
28
30
32
34
36
38
40
42
44
46
48
3485.00
3483.00
3481.00
3479.00
3477.00
3475.00
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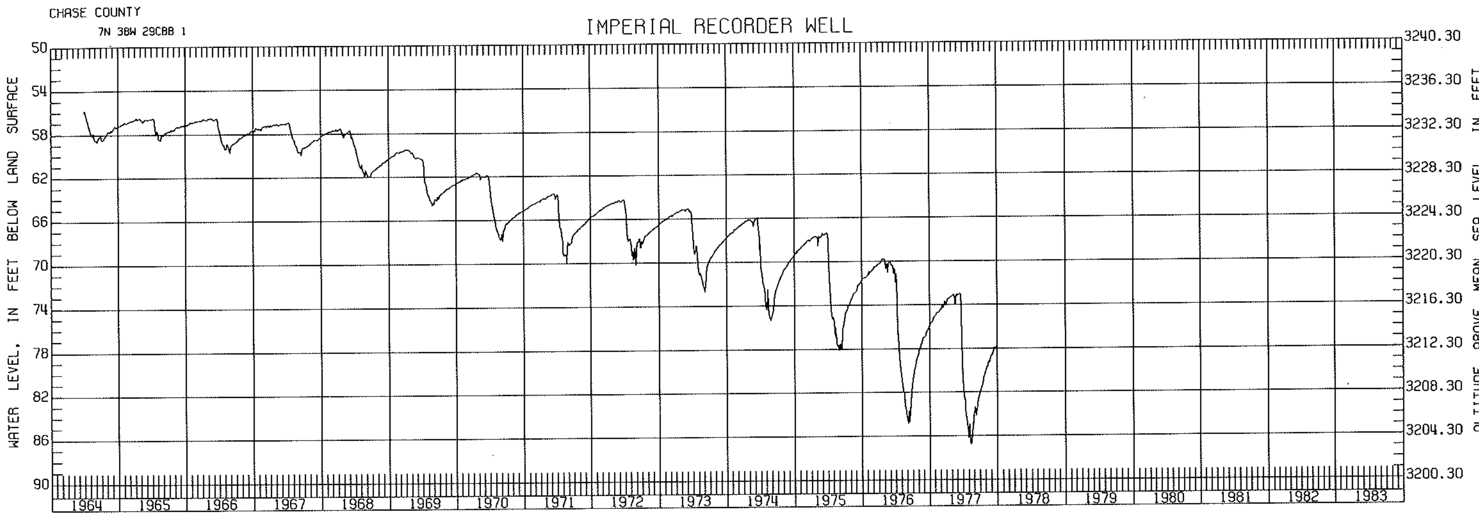
1981


CHASE COUNTY
7N 38W 29CBB 1
IMPERIAL RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
50
54
58
62
66
70
74
78
82
86
90
3240.30
3236.30
3232.30
3228.30
3224.30
3220.30
3216.30
3212.30
3208.30
3204.30
3200.30
1964
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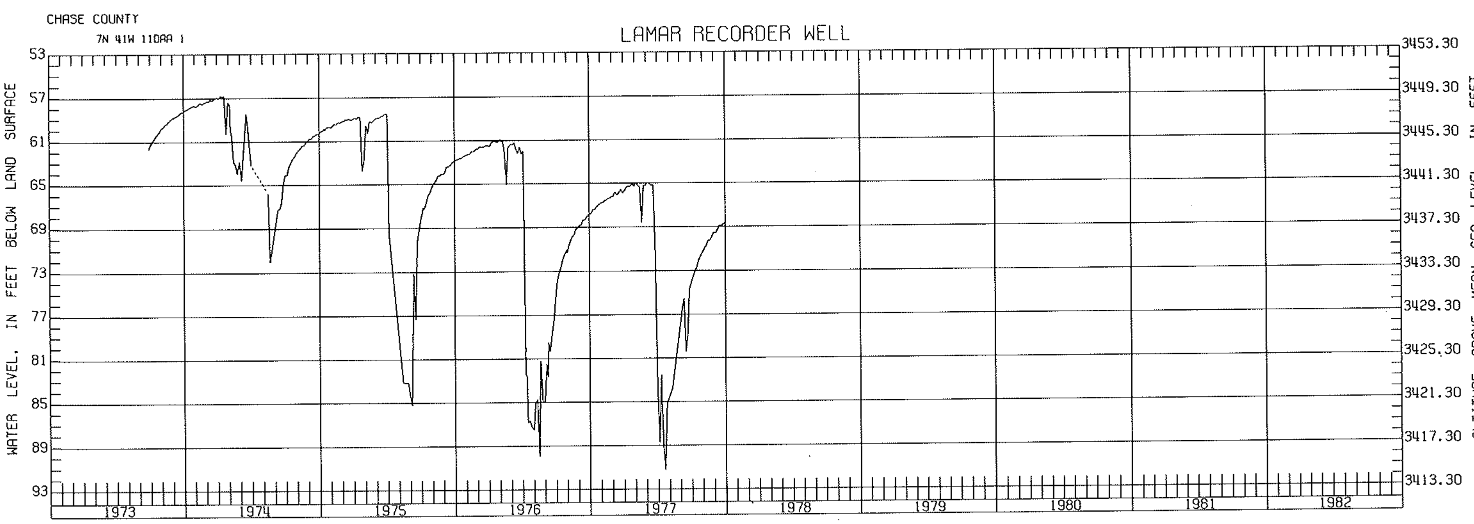
1983


CHASE COUNTY
7N 41W 11DAA 1
LAMAR RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
53
57
61
65
69
73
77
81
85
89
93
3453.30
3449.30
3445.30
3441.30
3437.30
3433.30
3429.30
3425.30
3421.30
3417.30
3413.30
1973
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1982

HAIGLER RECORDER WELL

SMALL DECLINE IN 1977

The depth to water in this well at the end of 1977 was 0.14 ft (0.042 5 m) lower than at the end of 1976. Summer decline was less than in the preceding year.

Recharge from precipitation, operation of two nearby irrigation wells, and water loss by evapotranspiration are the main factors controlling water-table fluctuations in the vicinity of the well. Changes in river stage may be an additional factor.

The average water level in the well is currently about 5 ft (1.52 m) lower than in the first four years of the 30-year record. A distinct drop in average water level occurred when the second irrigation well began operation.

Recording of water-level fluctuations in the old Haigler well was discontinued in mid-1975, after it became apparent that water-level fluctuations in the new well matched those in the old.

WELL DATA

Location: 3.5 mi (5.6 km) east of Haigler on U.S. Highway 34, then 0.5 mi (0.80 km) north; well is within 0.5 mi (0.80 km) of Republican River

Depth: Old well, 21 ft (6.4 m); new well, 49 ft (14.9 m)

Diameter: Old well, 8 in (203 mm); new well, 6 in (152 mm)

Aquifer: Sand and gravel (alluvial deposits)

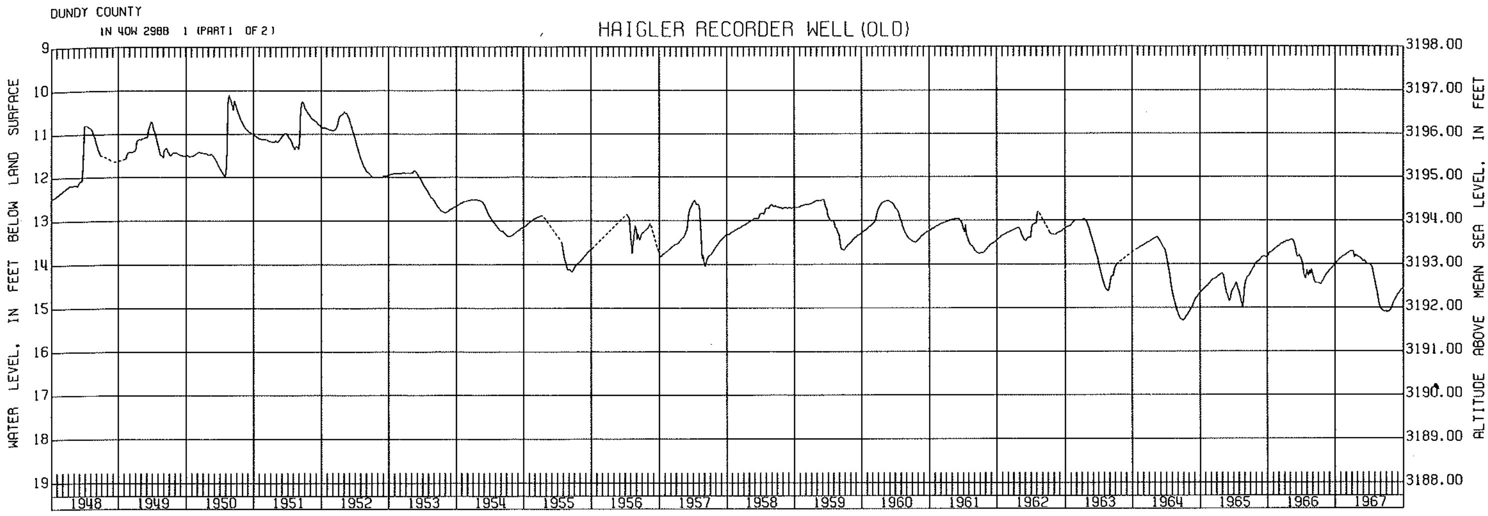
Water occurrence: Unconfined

Estimated predevelopment water level: Old well, 12 ft (3.65 m); new well, 10 ft (3.05 m)

Net water-level change in 1977: −0.14 ft (−0.042 5 m)

Average annual net water-level change since 1948: Variable; net declines in some years, net rises in others

Development near well: Irrigation wells; average density, 0.5/mi^2 (0.193/km^2)


DUNDY COUNTY
1N 40W 29BB 1 (PART 1 OF 2)
HAIGLER RECORDER WELL (OLD)
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
9
10
11
12
13
14
15
16
17
18
19
3198.00
3197.00
3196.00
3195.00
3194.00
3193.00
3192.00
3191.00
3190.00
3189.00
3188.00
1948
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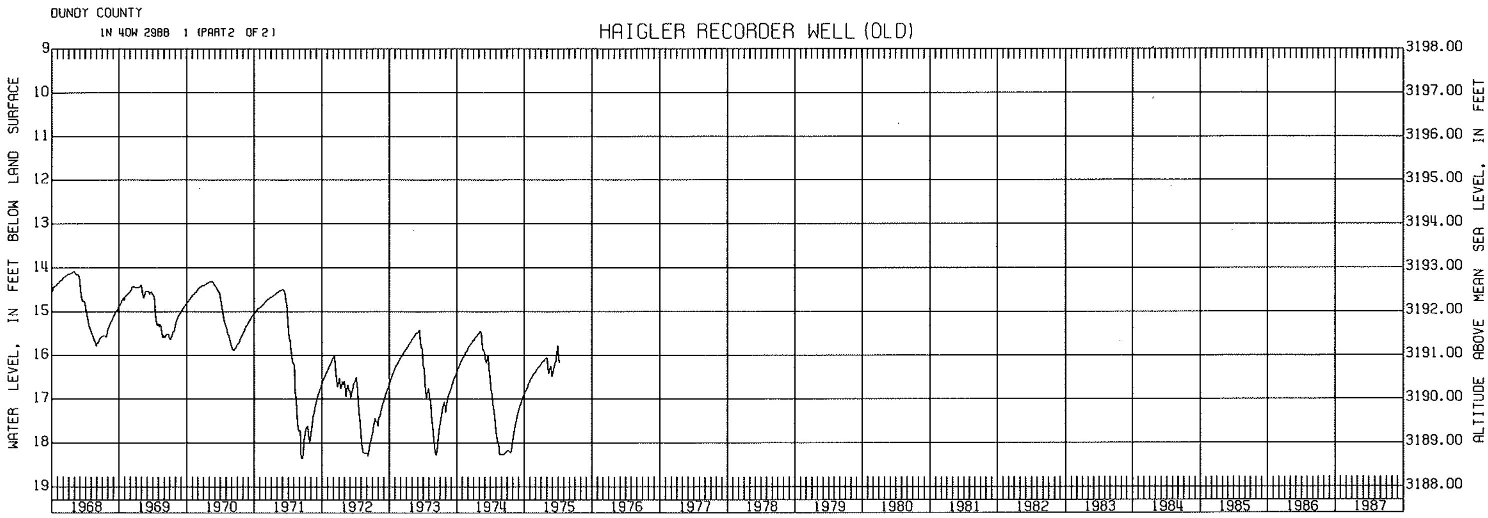
1967


DUNDY COUNTY
1N 40W 29BB 1 (PART 2 OF 2)
HAIGLER RECORDER WELL (OLD)
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
9
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3198.00
3197.00
3196.00
3195.00
3194.00
3193.00
3192.00
3191.00
3190.00
3189.00
3188.00
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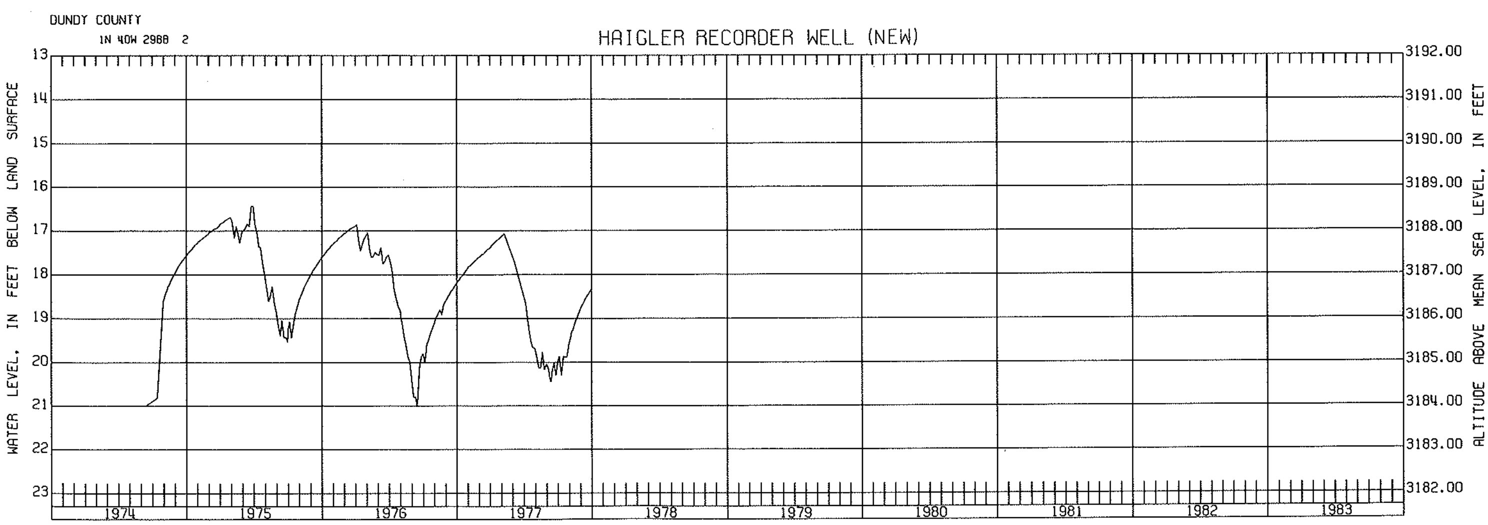
DUNDY COUNTY
1N 40W 29BB 2
HAIGLER RECORDER WELL (NEW)
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
13
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15
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17
18
19
20
21
22
23
3192.00
3191.00
3190.00
3189.00
3188.00
3187.00
3186.00
3185.00
3184.00
3183.00
3182.00
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1983

BENKELMAN RECORDER WELL

WATER LEVEL REACHES NEW LOW IN 1977

Water levels in this well dropped below 93 ft (28.5 m) in August. The new low continues the pattern of each summer's low being lower than that of the preceding summer. The net water-level decline in 1977 was significantly greater than the average annual net decline in the five-year period of record.

WELL DATA

Location: 6.25 mi (10.1 km) north of junction of Route 34 and Route 61 near Benkelman, then 2.5 mi (4.00 km) west
Depth: 180 ft (55 m)
Diameter: 5 in (127 mm)
Aquifer: Layers of sand and gravel interbedded with layers of fine-textured sediments (Ogallala Formation)
Water occurrence: Unconfined
Estimated predevelopment water level: 84 ft (25.5 m)
Net water-level change in 1977: −2.08 ft (−0.63 m)
Average annual net water-level change since 1972: −1.03 ft (−0.315 m)
Development near well: Irrigation wells; earliest in 1953, most development since 1969; average density of irrigation wells, 2.5/mi^2 (0.97/km^2)

ENDERS RECORDER WELL

WATER-LEVEL DECLINE CONTINUES

The 1977 net water-level decline in this well was the same as that of 1975 and nearly twice the average annual net decline for the five-year record. Pumping of nearby wells probably accounts for most water-level changes in this well.

WELL DATA

Location: 9 mi (14.5 km) south of Enders, on Route 61, then 7 mi (11.3 km) west, and 2.5 mi (4.00 km) south
Depth: 180 ft (55 m)
Diamster: 5 in (127 mm)
Aquifer: Layers of sand and gravel interbedded with layers of clay (Ogallala Formation)
Water occurrence: Unconfined
Estimated predevelopment water level: 46 ft (14.0 m)
Net water-level change in 1977: −1.00 ft (−0.30 m)
Average annual net water-level change since 1972: −0.65 ft (−0.198 m)
Development near well: Irrigation wells; earliest, 1956; average density of irrigation wells, 0.5/mi^2 (0.193/km^2)

GRAINTON RECORDER WELL

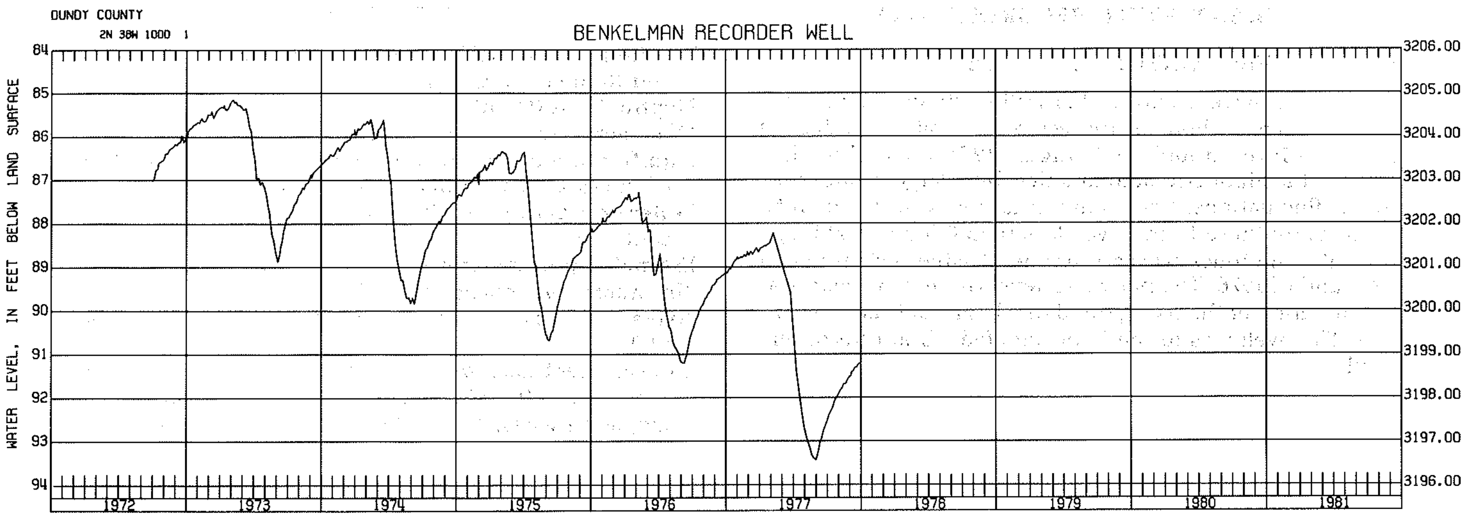
AVERAGE WATER LEVELS LOWER THAN 1976

The 1977 seasonal water-level low was slightly higher than that of 1976. However, it was much below the 1975 seasonal water-level low. Also, the water level at year's end was lower than that of 1976.

Greater-than-normal pumping from nearby irrigation wells, little recharge during the below-normal precipitation of the last few years, and increasing development probably accounts for the decline of water levels in this area.

WELL DATA

Location: 5.8 mi (9.3 km) south of Grainton
Depth: 298 ft (91 m)
Diameter: 5 in (127 mm)
Aquifer: Layers of sand and gravel interbedded with layers of fine-textured sediment (Ogallala Formation)
Water occurrence: Combination of unconfined and confined
Estimated predevelopment water level: 165 ft (50 m)
Net water-level change in 1977: −0.77 ft (−0.235 m)
Average annual net water-level change since 1975: −1.10 ft (−0.335 m)
Development near well: Irrigation wells, none closer than 0.75 mi (1.21 km); earliest in 1952, others in 1956, 1957, 1969, and 1975; average density of irrigation wells, 0.5/mi^2 (0.193/km^2)


DUNDY COUNTY
2N 38W 10DD 1
BENKELMAN RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
84
85
86
87
88
89
90
91
92
93
94
3206.00
3205.00
3204.00
3203.00
3202.00
3201.00
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1972
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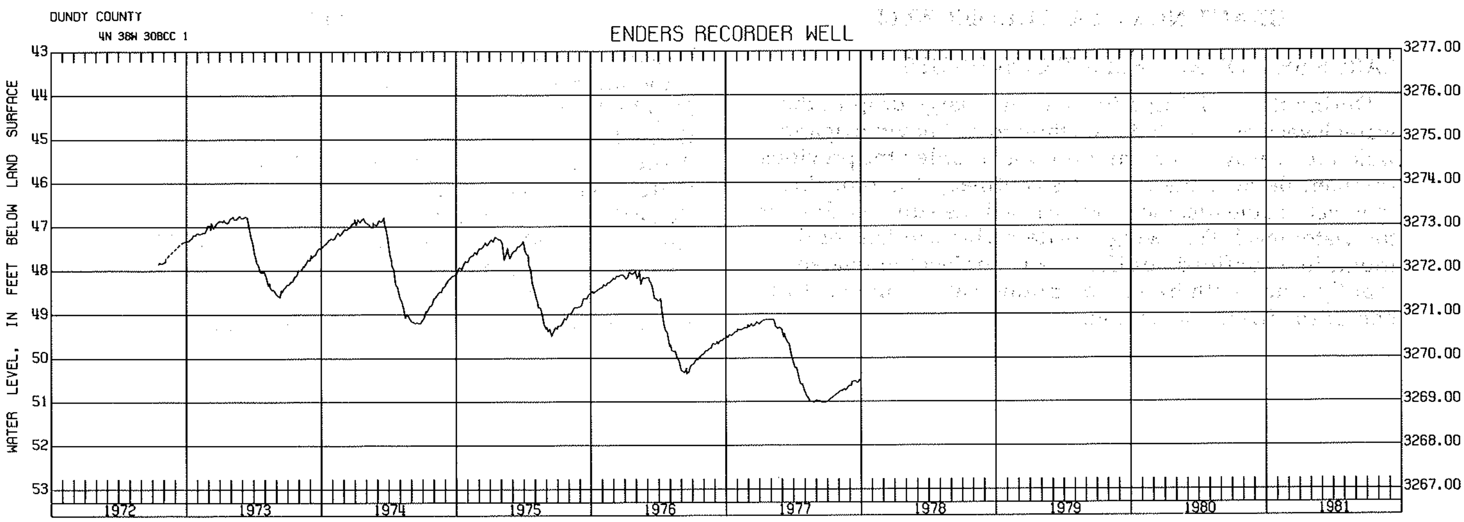
DUNDY COUNTY
4N 38W 30BCC 1
ENDERS RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
43
44
45
46
47
48
49
50
51
52
53
3277.00
3276.00
3275.00
3274.00
3273.00
3272.00
3271.00
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1972
1973
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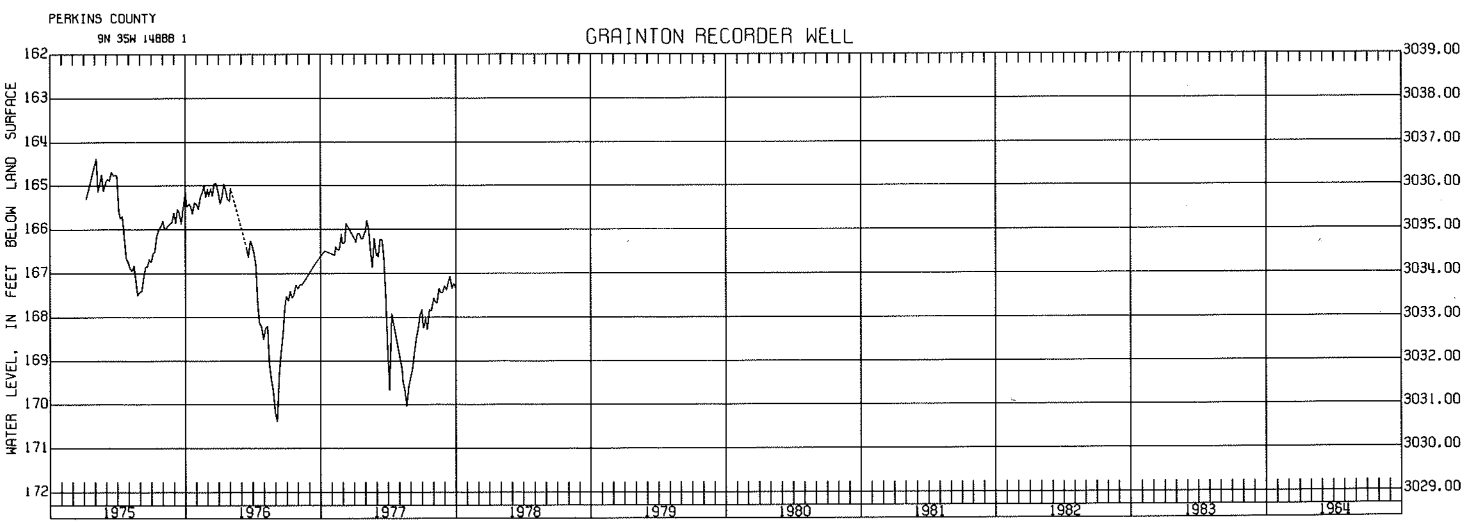

PERKINS COUNTY
9N 35W 14BBB 1
GRAINTON RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
162
163
164
165
166
167
168
169
170
171
172
3039.00
3038.00
3037.00
3036.00
3035.00
3034.00
3033.00
3032.00
3031.00
3030.00
3029.00
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984

GRANT SOUTH RECORDER WELL

WATER LEVEL CONTINUES TO RISE

The water-level trend in this well fluctuated within a narrow range without an appreciable overall rise or decline from late 1976 through mid-August 1977, after which it recorded a slight rise accompanied by a large number of minor fluctuations. Irrigation withdrawals in the vicinity, particularly those from a well less than 0.5 mi (0.80 km) distant, sometimes causes a summer decline such as that of 1975 and of 1976. The net water-level rise for the year is a continuation of the rising trend that began at least 25 years ago. This well was formerly designated "Grant Recorder Well."

WELL DATA

Location: 4.8 mi (7.7 km) south of the junction of Route 23 and Route 61 in Grant
Depth: 225 ft (69 m)
Diameter: 5 in (127 mm)
Aquifer: Layers of sand and gravel interbedded with layers of fine-textured sediments (Ogallala Formation)
Water occurrence: Combination of unconfined and confined
Estimated predevelopment water level: 142 ft (43.0 m)
Net water-level change in 1977: +0.27 ft (+0.082 m)
Average annual net water-level change since 1974: +0.85 ft (+0.260 m)
Development near well: Irrigation wells; earliest in 1969, others in 1971, 1972, and 1973; average density of irrigation wells, 1.0/mi^2 (0.385/km^2)

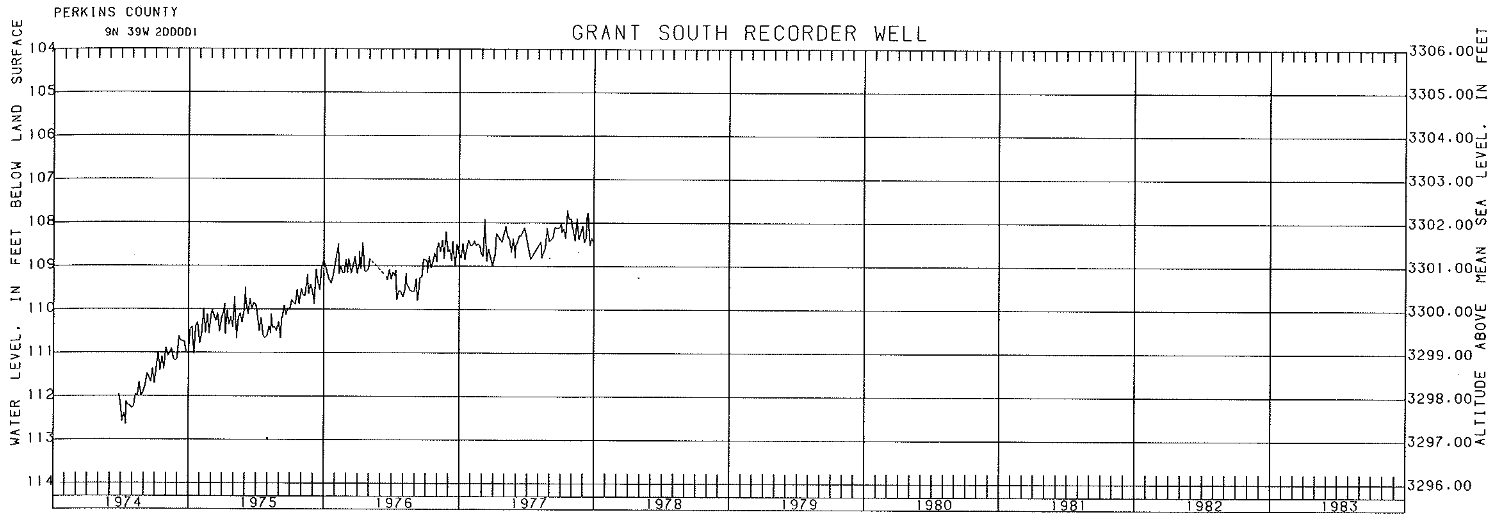
GRANT NORTH RECORDER WELL

LARGE SEASONAL DECLINE CONTINUES

During the 1977 irrigation season, a large drop in the water level was recorded even though no known irrigation wells are nearby. A similar drop was recorded the previous summer. Because the aquifer is confined, it is probable that wells some distance away caused the summer drop of the water level. Following a pattern characteristic of that found in a confined aquifer, the water level recovered rapidly when withdrawals of groundwater stopped at the end of the irrigation season.

WELL DATA

Location: 8.3 mi (13.4 km) north and 1 mi (1.61 km) east of the intersection of Route 23 with Route 61 in Grant
Depth: 255 ft (78 m)
Diameter: 5 in (127 mm)
Aquifer: Sand and gravel (Ogallala Formation)
Water occurrence: Confined
Estimated predevelopment water level: 173 ft (53 m)
Net water-level change in 1977: −0.13 ft (−0.039 5 m)
Average annual net water-level change since 1975: −0.13 ft (−0.039 5 m)
Development near well: No registered wells


PERKINS COUNTY
9N 39W 2DDDD1
GRANT SOUTH RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
104
105
106
107
108
109
110
111
112
113
114
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
3306.00
3305.00
3304.00
3303.00
3302.00
3301.00
3300.00
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3298.00
3297.00
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1974
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1976
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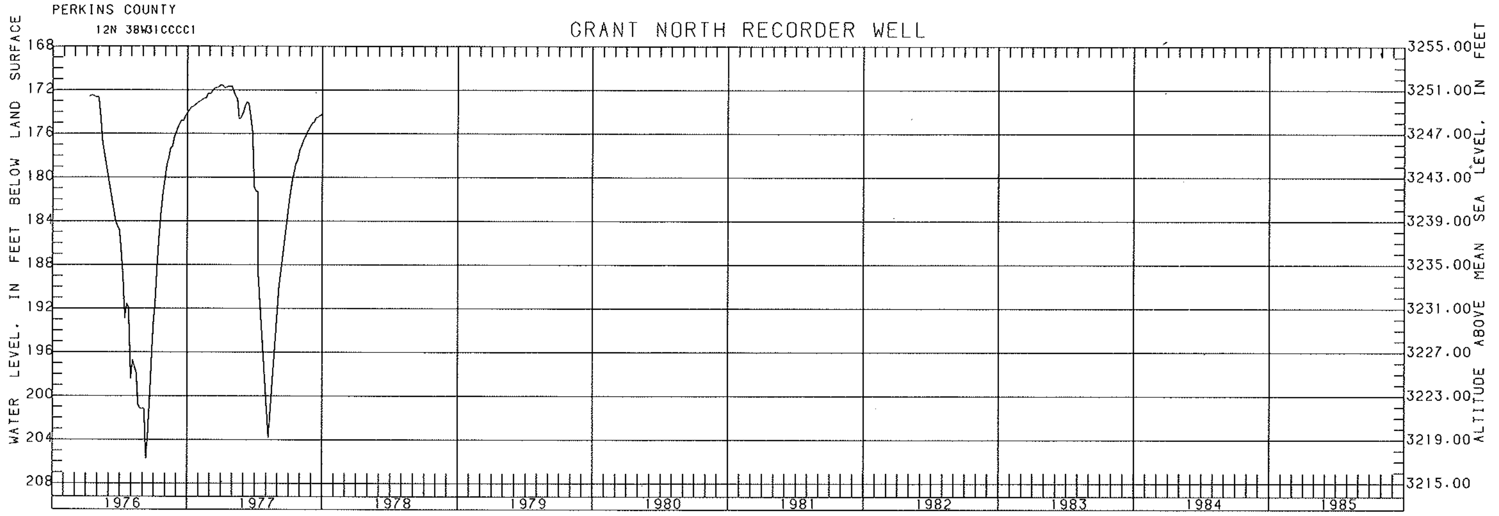
1982
1983


PERKINS COUNTY
12N 38W31CCCC1
GRANT NORTH RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
168
172
176
180
184
188
192
196
200
204
208
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
3255.00
3251.00
3247.00
3243.00
3239.00
3235.00
3231.00
3227.00
3223.00
3219.00
3215.00
1976
1977
1978
1979
1980
1981
1982
1983
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1985

2.6 Alliance Area

Water-level changes in the Alliance area between fall 1976 and fall 1977 generally ranged 2.0 ft (0.61 m) lower to 4.0 ft (1.22 m) higher in the eight observation wells for which data are available. Water-level changes were quite localized south of Alliance, along the eastern border of Box Butte County, and in the western part of the county, with the water level rising in some wells and declining in others. North and northwest of Alliance, where declines of more than 30 ft (9.1 m) from estimated predevelopment water levels have taken place since 1946, most water levels declined 1.0 ft (0.305 m) or more.

Progressive water-level declines are occurring throughout most of the area where there is intensive groundwater development for irrigation. The first irrigation wells in the area were drilled in about 1935, and by 1946 about 9,000 acres (36.5 km²) were being irrigated with water pumped from 69 wells. Most of these wells were located north of Alliance in T. 25 N., Rs. 47 and 48 W. Available data indicate that pumpage between 1938 and 1946 did not cause any significant water-level declines. However, in 1950 progressive water-level declines started in a few localities and by 1955 declines were occurring throughout nearly all of the area where large amounts of groundwater were being pumped for irrigation.

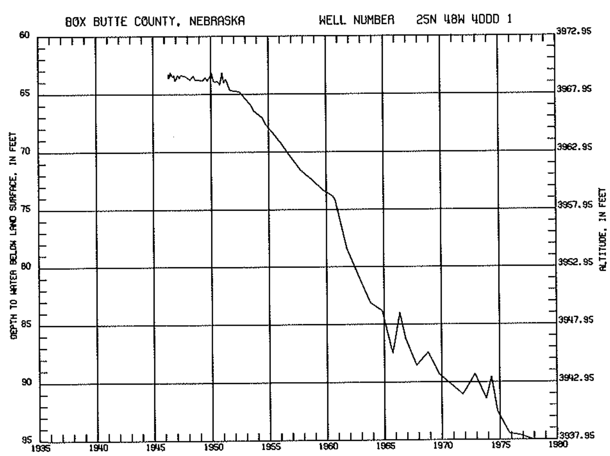
Since 1946, declines of 5 ft (1.52 m) or more from estimated predevelopment water levels have occurred in an area of about 210,000 acres (850 km²). The maximum known water-level decline, almost 53 ft (16.2 m) from estimated predevelopment water levels, was in an observation well about 3 mi (4.80 km) north of Alliance.

Approximate areas of significant water-level declines from estimated predevelopment water levels in fall 1977 were:

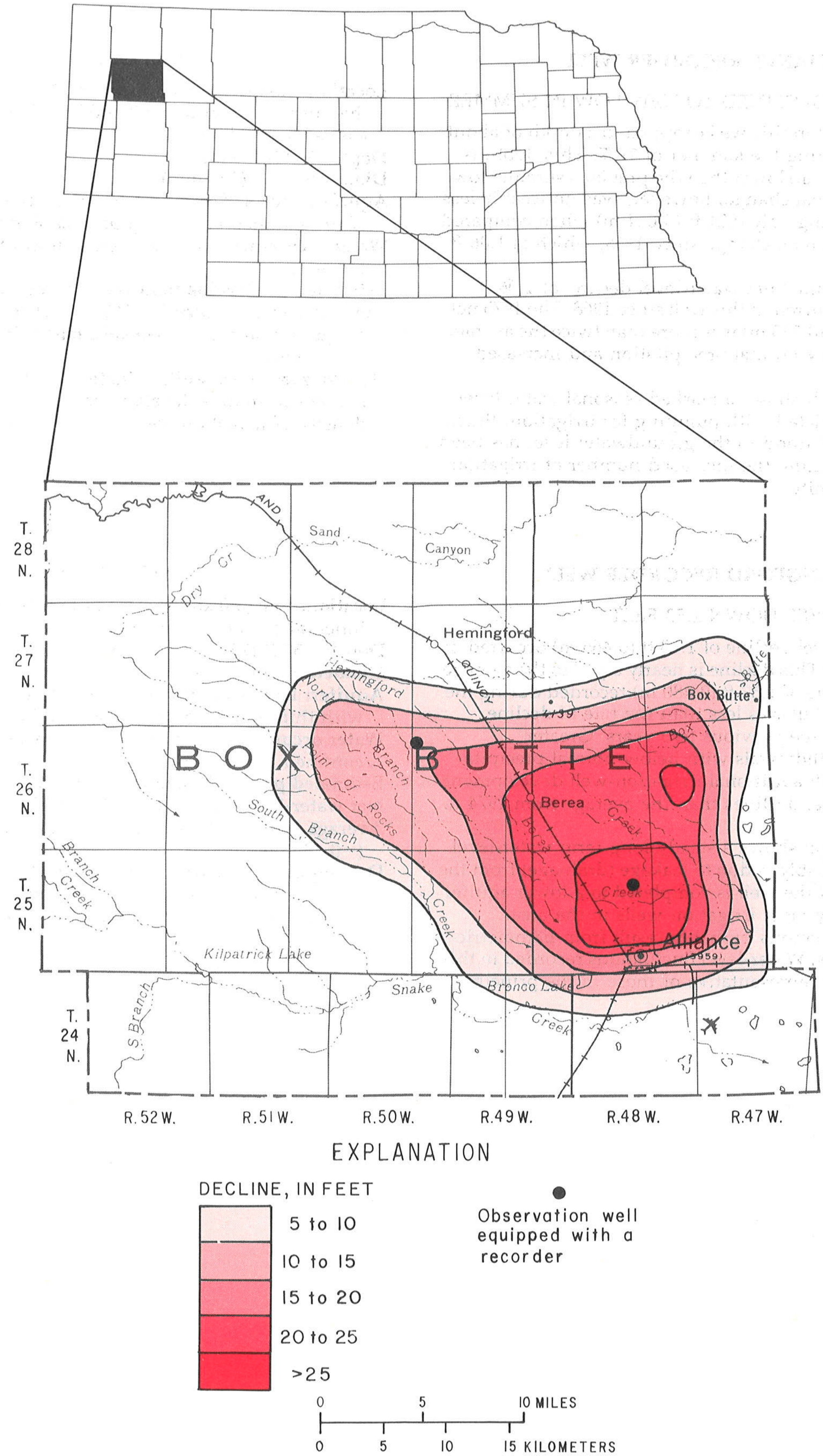
Amount of decline, in feet (meters, m)	Approximate area, in acres (square kilometers, km²)	
5.00–10.00 (1.52–3.05)	59,200	(240)
10.00–15.00 (3.05–4.57)	60,900	(246)
15.00–20.00 (4.57–6.1)	33,300	(135)
20.00–25.00 (6.1–7.6)	39,400	(159)
25.00 or more (7.6 or more)	17,300	(70)

Approximate water levels prior to 1947 are used as the estimated predevelopment water levels in this area.

Sufficient data are available for good estimates of predevelopment water levels, but the existing fall water-level measurement programs provide sufficient data for definition of current water-level changes in only part of the area.



Long-term hydrograph in the Alliance area



Areas of significant water-level change in the Alliance area, from 1946 to fall 1977

ALLIANCE RECORDER WELL

WATER LEVEL DECLINED TO NEW LOW IN SUMMER

The water level in this well dropped to a depth of about 70 ft (21.3 m) during the summer of 1977. This depth is about 0.8 ft (0.244 m) lower than the previous summer low. The average annual change, however, was noticeably less this year, dropping only 0.21 ft (0.064 m) when compared to the average annual change since 1968, which is 1.06 ft (0.325 m).

An average annual net water-level decline of 1.06 ft (0.325 m) has occurred in this well since 1968. The 1975 net decline of 2.47 ft (0.753 m) was more than twice the average and reflects below-normal precipitation and increased pumpage.

The hydrograph shows a marked seasonal water-level drawdown associated with pumping for irrigation. Since 1975, the general trend in the groundwater level has been downward, reflecting the increased number of irrigation wells in the vicinity.

WELL DATA

Location: 3.5 mi (5.6 km) north and 1 mi (1.61 km) west of the intersection of Route 2 and U.S. Highway 385 at the east edge of Alliance.
Depth: 260 ft (79 m)
Diameter: 6 in (152 mm)
Aquifer: Layers of sand and gravel interbedded with layers of fine-grained sediment (Ogallala Formation)
Water occurrence: Combination of unconfined and confined
Estimated predevelopment water level: 17 ft (5.2 m)
Net water-level change in 1977: −0.21 ft (−0.064 m)
Average annual net water-level change since 1968: −1.06 ft (−0.325 m)
Development near well: Irrigation wells; earliest in 1946, nearly continuous development since then; average density of irrigation wells, 3.5/mi^2 (1.35/km^2)

HEMINGFORD RECORDER WELL

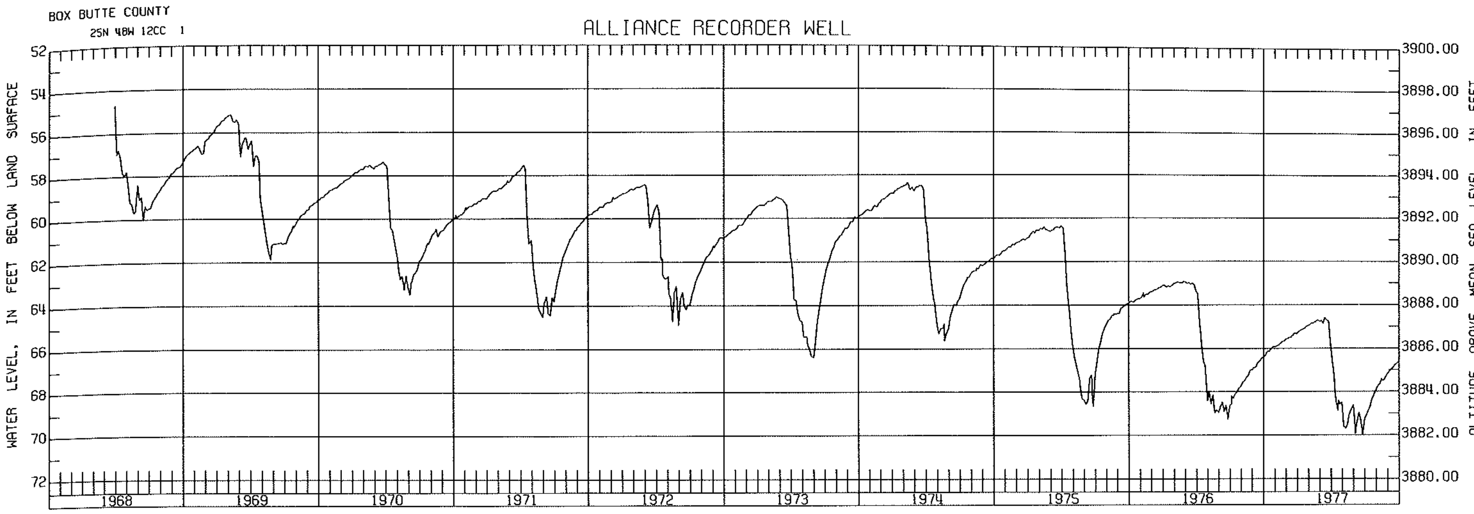
1977 WATER LEVEL DOWN 1.53 FEET

A net water-level decline of 1.53 ft (0.465 m) occurred in this well in 1977. This decline is nearly equal to the average annual net decline of 1.57 ft (0.480 m) recorded during the past eight years but was less than the rate of decline recorded during the previous two years. Greater groundwater withdrawals with below-normal precipitation coupled with additional irrigation-well development caused greater net declines than the average from 1974 to 1976.

The hydrograph shows a steady long-term water-level decline that probably is due to leakage (drainage) from the aquifer in which the well is completed to a lower aquifer that is tapped by most irrigation wells in the area. Short-term fluctuations probably result from barometric-pressure changes. Water-level fluctuations recorded in this well may not be representative of those in the principal aquifer.

WELL DATA

Location: 5 mi (8.0 km) south and 1 mi (1.61 km) west of the junction of Route 2 and Route 87 in Hemingford
Depth: 259 ft (79 m)
Diameter: 6 in (152 mm)
Aquifer: Layers of very fine grained sand interbedded with thin tightly cemented layers (Arikaree Formation)
Water occurrence: Combination of unconfined and confined
Estimated predevelopment water level: 134 ft (41.0 m)
Net water-level change in 1977: −1.53 ft (−0.465 m)
Average annual net water-level change since 1969: −1.57 ft (−0.480 m)
Development near well: Irrigation wells; earliest in 1940s, rapid development in early 1950s and mid-1960s; average density of irrigation wells, 1.5/mi^2 (0.58/km^2)


BOX BUTTE COUNTY
25N 48W 12CC 1
ALLIANCE RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
52
54
56
58
60
62
64
66
68
70
72
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
3900.00
3898.00
3896.00
3894.00
3892.00
3890.00
3888.00
3886.00
3884.00
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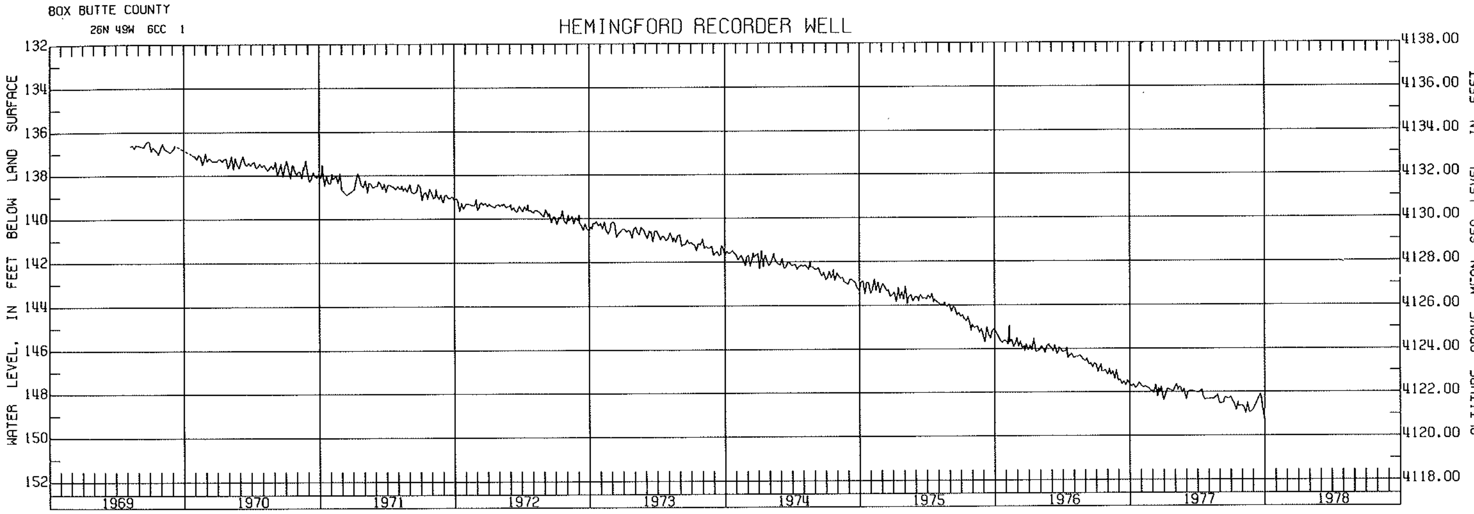
BOX BUTTE COUNTY
26N 49W 6CC 1
HEMINGFORD RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
132
134
136
138
140
142
144
146
148
150
152
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
4138.00
4136.00
4134.00
4132.00
4130.00
4128.00
4126.00
4124.00
4122.00
4120.00
4118.00
1969
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2.0 CHANGES IN WATER LEVELS, 1977 (continued)

2.7 Tri-County Area

A considerable range of water-level changes was recorded between fall 1976 and fall 1977 in some parts of the Tri-County area. In Kearney County, water-level changes ranged from a rise of 2.5 ft (0.76 m) to a decline of 5.1 ft (1.55 m), and the average water-level change in the county's 47 observation wells was a rise of almost 0.4 ft (0.122 m). In Phelps County, the changes ranged from a rise of 2.7 ft (0.82 m) to a decline of 4.0 ft (1.22 m), with the average change in 83 observation wells being a rise of 0.3 ft (0.091 m). The extremes in water-level changes, quite localized in occurrence, probably are related to local differences in amounts or times of groundwater pumpage for irrigation.

The water-level rise in the Tri-County area is the greatest water-level rise that has occurred in any part of Nebraska. In this area, water diverted from the North Platte River has been used for irrigation since about 1940. Infiltration and deep percolation of water from the distribution system and water applied to crops has raised the water table 10 ft (3.05 m) or more from its estimated predevelopment level beneath approximately 622,000 acres (2 500 km²). The greatest known water-level rise from predevelopment level, about 98 ft (30.0 m), was about 6.5 mi (10.5 km) north-northwest of Holdrege in Phelps County. Maximum known rises in the other counties in the area are approximately 65 ft (19.8 m) in Kearney County, slightly more than 80 ft (24.4 m) in Gosper County, and slightly more than 20 ft (6.1 m) in Dawson County.

Approximate areas of significant water-level rises in fall 1977 were:

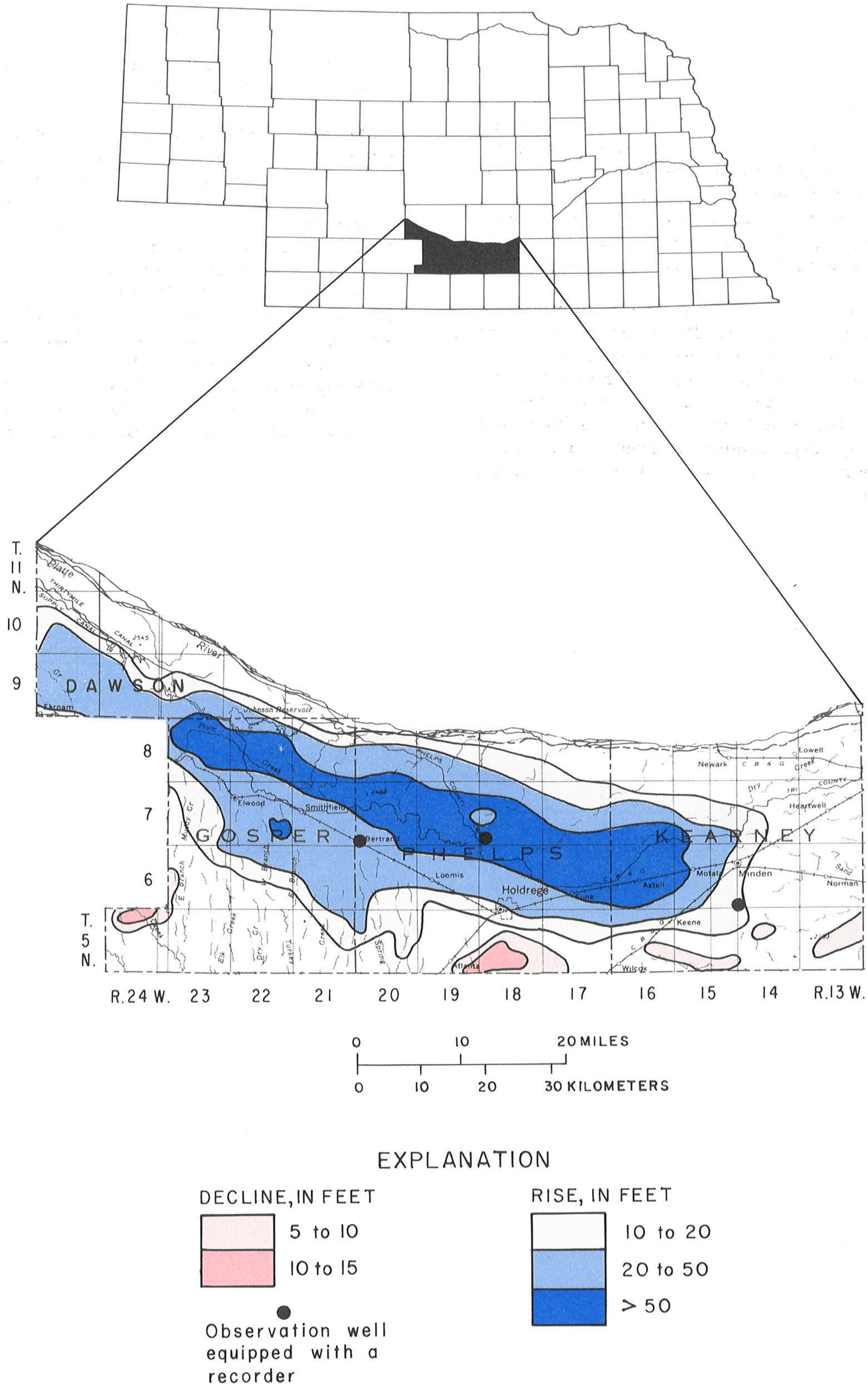
Amount of rise, in feet (meters, m)	Approximate area, in acres (square kilometers, km²)	
10.00–20.00 (3.05–6.1)	195,000	(790)
20.00–50.00 (6.1–15.2)	276,000	(1 120)
50.00 or more (15.2 or more)	158,000	(640)

Estimated predevelopment water levels approximate average water levels prior to 1940.

Use of groundwater for irrigation plus pumping of groundwater into the Tri-County Supply Canal has slowed the rate of water-level rise in many parts of the area. In one locality where large quantities of groundwater are pumped into the canal, water levels have been lowered more than 5 ft (1.52 m) since about 1970. In some parts of the area, the water table has risen so high that natural groundwater discharge into streams and evapotranspiration losses have stabilized water levels.

In southern Kearney and southeastern Phelps counties, declines of 5 ft (1.52 m) or more from estimated predevelopment water levels have occurred in areas totaling about 31,000 acres (125 km²) because of the increased use of groundwater for irrigation in recent years.

Data for estimation of predevelopment water levels are generally adequate. However, good evaluations of area-wide water-level changes during the period 1940 to 1947 cannot be made because of insufficient data. Since 1947, water-level measurement programs have provided enough data for a good evaluation of historic water-level changes and definition of current water-level changes.



Areas of significant water-level change in the Tri-County area, from 1940 to fall 1977

MINDEN RECORDER WELL

NEW WATER-LEVEL LOW REACHED IN 1977

In addition to reaching a new summer low, the year-end water level in this well was 0.05 ft (0.015 2 m) lower than at the end of the preceding year. The several sharp water-level declines in the well during the summer months were caused by pumping from nearby wells. Confinement of the water under pressure accounts for the rapid declines caused by pumping in the near vicinity and for the very rapid recovery when pumping stops either temporarily or seasonally.

The water level in this well during the nonpumping season is estimated to be about 18 ft (5.5 m) higher than it was before river water diverted for irrigation by the Central Nebraska Public Power and Irrigation District became an important source of recharge to the aquifer. Now that groundwater withdrawals in the Minden area have increased greatly, summer water-level declines are greater and the rising water-level trend has slowed to an almost negligible rate.

WELL DATA

Location: 4.5 mi (7.2 km) south and 2.5 mi (4.00 km) west of the junction of Route 10 and U.S. Highway 34 near Minden

Depth: Old well, 122 ft (37.0 m); new well, 210 ft (64 m)

Diameter: Old well, 6 in (152 mm); new well, 6 in (152 mm)

Aquifer: Layers of sand and gravel interbedded with layers of clay and sandy clay (undifferentiated Pleistocene deposits)

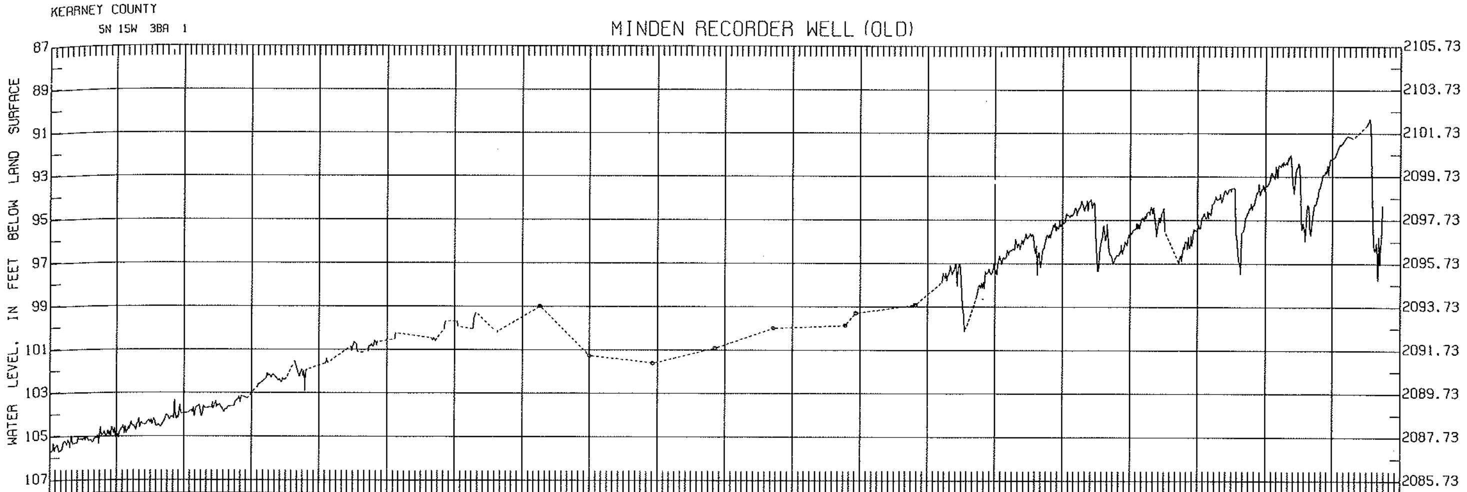
Water occurrence: Confined

Estimated predevelopment water level: Old well, 113 ft (34.5 m); new well, 103 ft (31.5 m)

Net water-level change in 1977: −0.05 ft (−0.015 2 m)

Average annual net water-level change since 1968 (new well only): +0.11 ft (+0.033 5 m)

Development near well: Irrigation wells; earliest in 1946, rapid development mid-1950s and from 1970 to present; average density of irrigation wells, 2.5/mi² (0.97/km²)


KEARNEY COUNTY
5N 15W 3BA 1
MINDEN RECORDER WELL (OLD)
WATER LEVEL, IN FEET BELOW LAND SURFACE
87
89
91
93
95
97
99
101
103
105
107
2105.73
2103.73
2101.73
2099.73
2097.73
2095.73
2093.73
2091.73
2089.73
2087.73
2085.73
1948
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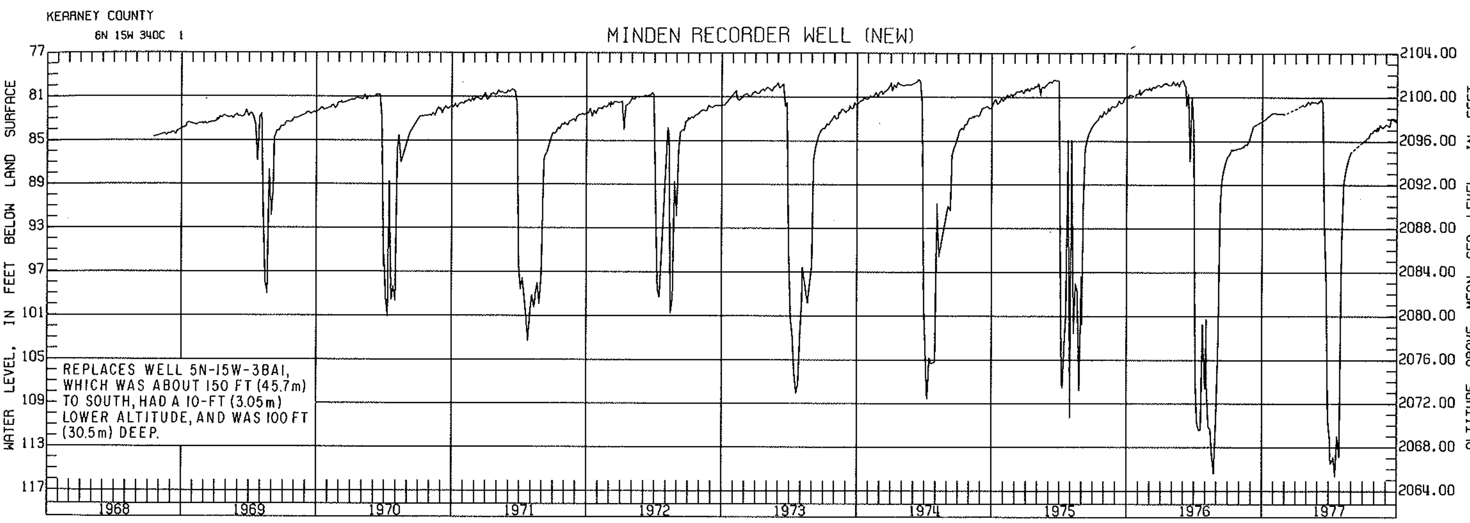
1962
1963
1964
1965
1966
1967


KEARNEY COUNTY
6N 15W 34DC 1
MINDEN RECORDER WELL (NEW)
WATER LEVEL, IN FEET BELOW LAND SURFACE
77
81
85
89
93
97
101
105
109
113
117
2104.00
2100.00
2096.00
2092.00
2088.00
2084.00
2080.00
2076.00
2072.00
2068.00
2064.00
REPLACES WELL 5N-15W-3BA1, WHICH WAS ABOUT 150 FT (45.7m) TO SOUTH, HAD A 10-FT (3.05m) LOWER ALTITUDE, AND WAS 100 FT (30.5m) DEEP.
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977

HOLDREGE RECORDER WELL

WATER LEVEL RISES IN SUMMER

Although there was a net water-level decline for 1977 in this well, the water level was up throughout much of 1977, reaching a new three-year high in August. The end of irrigation for the season coupled with below-normal September precipitation marked the beginning of the usual fall-season decline, resulting in a net water-level decline for 1977. Above-normal precipitation in 1969, 1973, and 1976 resulted in less of a water-level decline during the fall and in an annual net water-level rise for those years.

Since 1940, the volume of groundwater beneath Gosper, Phelps, and Kearney counties has been increased significantly by seepage of Platte River water diverted into the area for irrigation. This increase is indicated by the rise of the water level in the well. Many of the small water-level fluctuations probably are responses to changes in barometric pressure.

WELL DATA

Location: 6 mi (9.7 km) north and 1 mi (1.61 km) west of the intersection of U.S. Highways 34 and 6 with U.S. Highway 183 in Holdrege
Depth: 150 ft (45.5 m)
Diameter: 6 in (152 mm)
Aquifer: Layers of sand and gravel interbedded with layers of silt and clay (undifferentiated Pleistocene deposits)
Water occurrence: Combination of unconfined and confined
Estimated predevelopment water level: 100 ft (30.5 m)
Net water-level change in 1977: −0.36 ft (−0.110 m)
Average annual net water-level change since 1968: Variable, no long-term rise or decline
Development near well: Irrigation wells; earliest in 1955; average density of wells, 1.0/mi² (0.385/km²); Phelps County Canal of Central Nebraska Public Power and Irrigation District about 1.25 mi (2.01 km) to southwest

BERTRAND RECORDER WELL

NET WATER-LEVEL DECLINE IN 1977

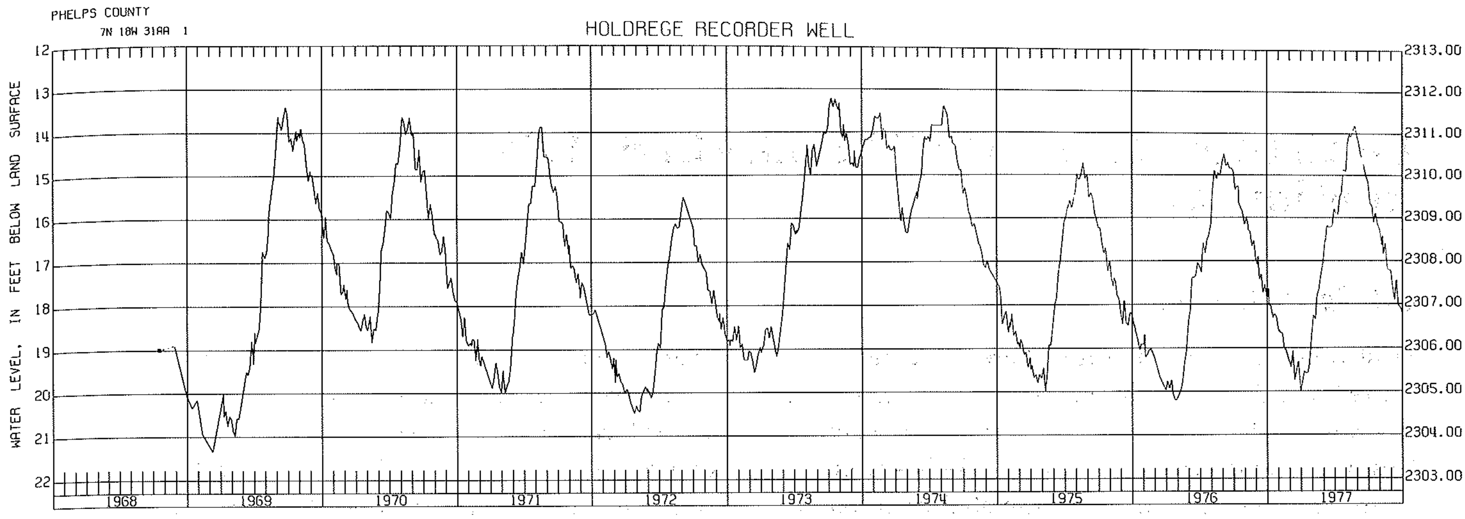
The year-end water level in this well was 0.51 ft (0.155 m) lower than the 1976 year-end level. This is the second year of a reversal of the long-term water-level rise in the well. A major cause of the reversal was below-normal precipitation during the last few years, which led to increased pumping during the irrigation season and less-than-normal recharge.

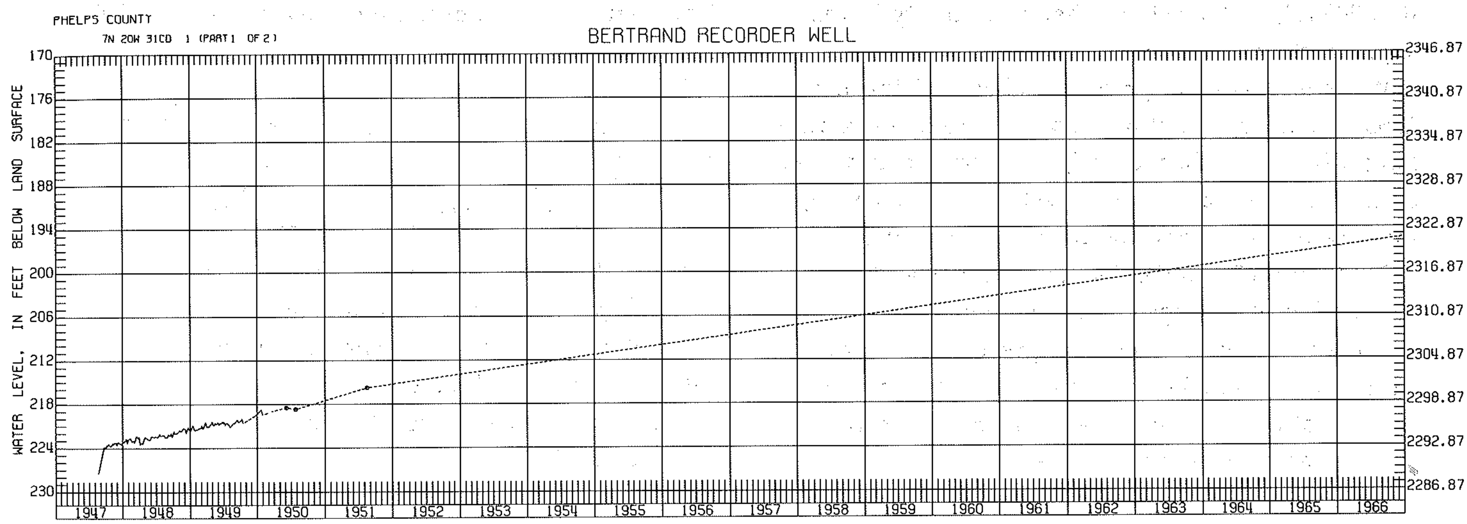
Since 1947 the water-level trend in this well has been upward. This is due to recharge from irrigation water diverted from the Platte River. Of interest are the lack of summertime water-level declines when water levels were first recorded in 1948–49 and the marked summertime declines in 1969–77. Pumping from irrigation wells has caused the rising water-level trend to slow significantly during the last few years.

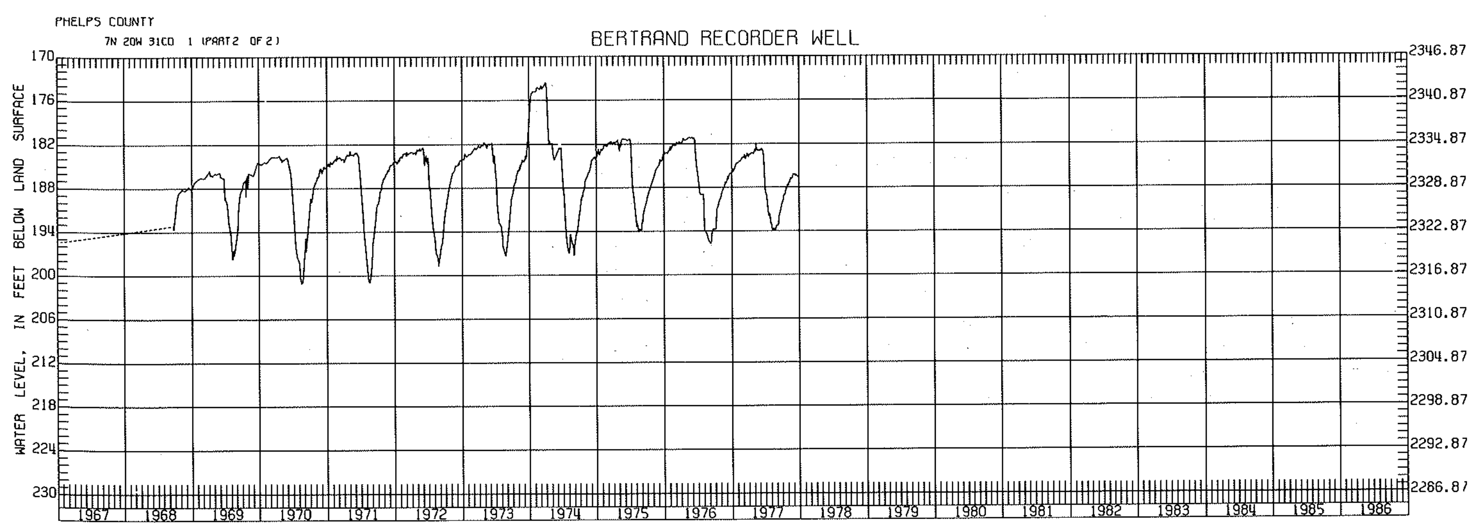
The temporary high water level from late December 1973 until the end of March 1974 is difficult to explain. Heavy rains occurred during the fall of 1973 and the soil was saturated when it became frozen for the winter, creating conditions that ordinarily do not exist at this well's location.

WELL DATA

Location: In equipment yard of Central Nebraska Public Power and Irrigation District at Bertrand
Depth: 241 ft (73 m)
Diameter: 6 in (152 mm)
Aquifer: Layers of sand and gravel interbedded with layers of fine-grained sediments (undifferentiated Pleistocene deposits)
Water occurrence: Combination of unconfined and confined
Estimated predevelopment water level: 232 ft (71 m)
Net water-level change in 1977: −0.51 ft (−0.155 m)
Average annual net water-level change since 1948: +1.47 ft (+0.450 m)
Development near well: Irrigation wells; earliest in 1935; average density of wells, 3.0/mi² (1.16/km²); irrigation lateral of the Central Nebraska Public Power and Irrigation District about 0.5 mi (0.80 km) to northeast


PHELPS COUNTY
7N 18W 31AA 1
HOLDREGE RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977


PHELPS COUNTY
7N 20W 31CD 1 (PART 1 OF 2)
BERTRAND RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET


PHELPS COUNTY
7N 20W 31CD 1 (PART 2 OF 2)
BERTRAND RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET

2.0 CHANGES IN WATER LEVELS, 1977 (continued)

2.8 Farwell Area

Most water levels in the Farwell area rose between fall 1976 and fall 1977. The largest measured rises, 1.2 to 2.8 ft (0.365 to 0.85 m), were in those parts of Howard County where the water table has risen more than 20 ft (6.1 m) from estimated predevelopment water levels. Elsewhere in the area the net annual water-level change was a rise of less than 1.0 ft (0.305 m), and locally in Sherman County it was a slight decline.

Water levels in the Farwell area began rising about 1963, when water first was diverted from the Middle Loup River to the Farwell Irrigation Project; and rises of 10 ft (3.05 m) or more from estimated predevelopment water levels have occurred beneath about 175,000 acres (710 km^2). The rises are caused by deep percolation of seepage from the irrigation storage and distribution systems. The greatest water-level rises, more than 75 ft (22.9 m), have been in the vicinity of the Sherman Reservoir; however, the current rate of rise there is so slow that most water-level changes now are caused by fluctuations in reservoir stage. In parts of Howard County, water-level rises of almost 50 ft (15.2 m) have occurred to date and available data indicate no slowing in the rate of water-level rise, which has been almost constant for the past 10 years.

Approximate areas of significant water-level rises from estimated predevelopment water levels in fall 1977 were:

Amount of rise, in feet (meters, m)	Approximate area, in acres (square kilometers, km^2)	
10.00–20.00 (3.05–6.1)	113,000	(455)
20.00–50.00 (6.1–15.2)	48,000	(194)
50.00 or more (15.2 or more)	14,600	(59)

Estimated predevelopment water levels in the area are the approximate water levels prior to 1963.

Available data for the area provide a good basis for estimating predevelopment water levels, historical water-level changes since 1963, and current water-level changes.

DANNEBROG RECORDER WELL

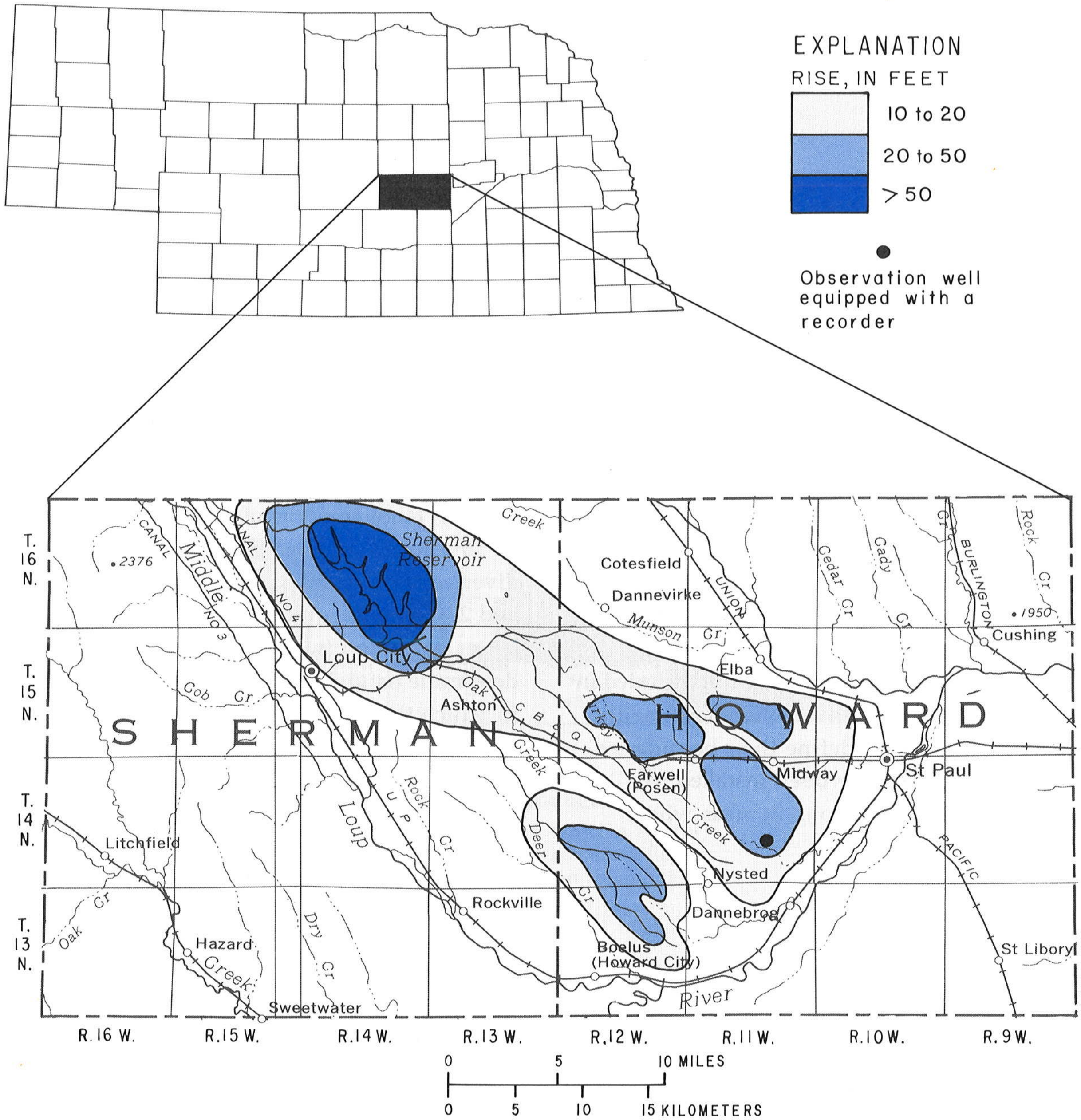
RISING WATER-LEVEL TREND CONTINUES IN 1977

The year-end water level in the Dannebrog well was higher than at any year's end during the nine years of record. The net water-level rise in 1977 was greater than the net rise in previous years. Intermittent pumping from a nearby stock well caused sharp, minor water-level fluctuations, mostly during summer and early fall. Larger than normal amounts of precipitation throughout nearly the entire year, but especially during the latter half of 1977, also contributed to the general rise in water levels.

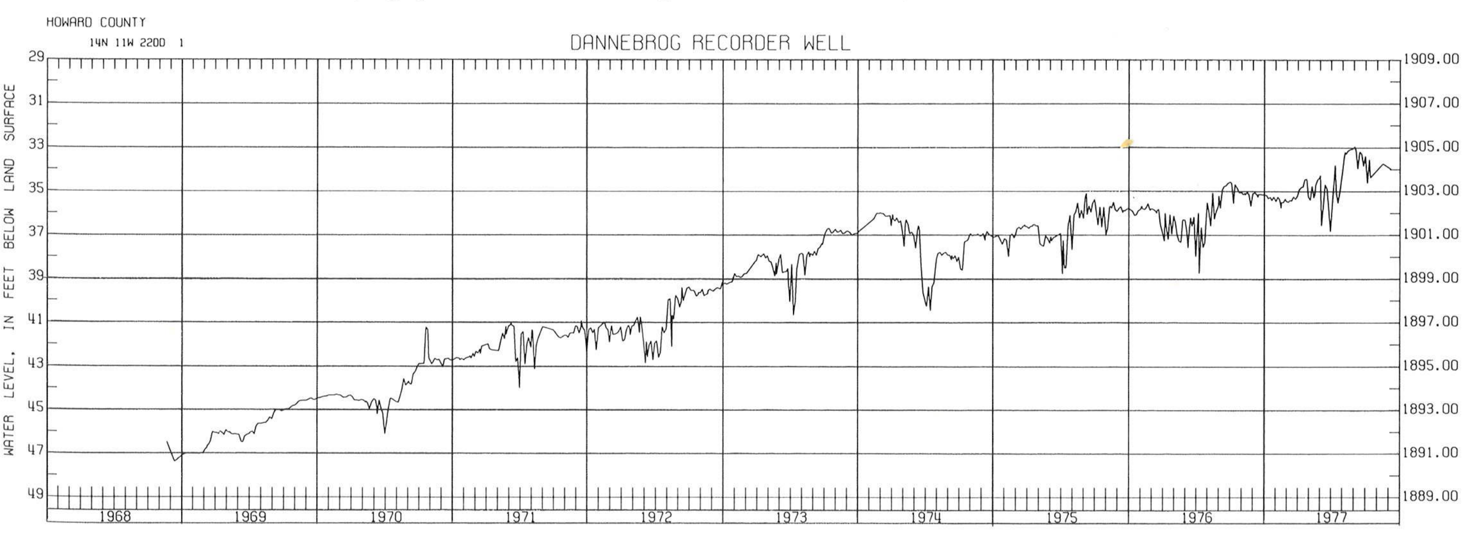
Recharge from surface water diverted for irrigation on Farwell Project lands accounts for the rising water-level trend in this well since recording of water-level changes began in 1968.

WELL DATA

Location: 3 mi (4.80 km) north of Dannebrog on Route 11
Depth: 260 ft (79 m)
Diameter: 6 in (152 mm)
Aquifer: Sand layers interbedded with fine-textured layers (Ogallala Formation)
Water occurrence: Unconfined
Estimated predevelopment water level: 62 ft (18.9 m)
Net water-level change in 1977: +1.13 ft (+0.345 m)
Average annual net water-level change since 1968: +1.45 ft (+0.440 m)
Development near well: One irrigation well about 1.1 mi (1.77 km) west-northwest (completed in 1954); one stock well 250 ft (76 m) northwest



Areas of significant water-level change in the Farwell area, from 1963 to fall 1977

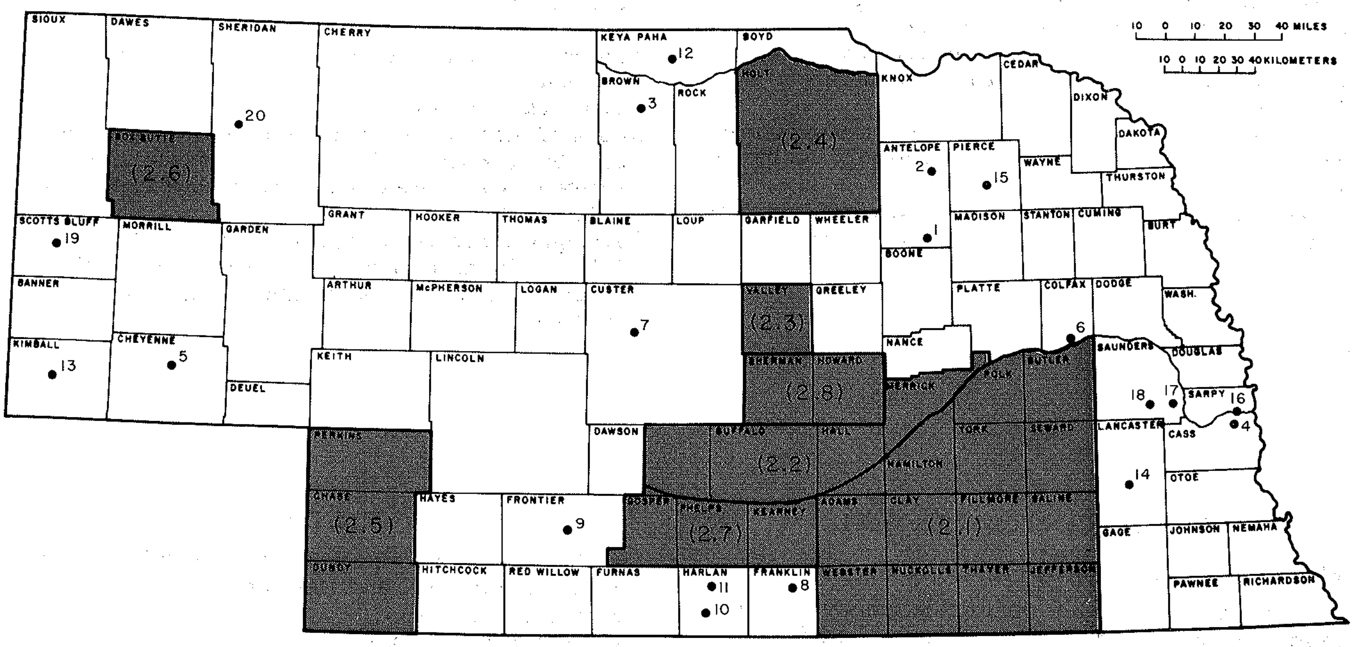


2.0 CHANGES IN WATER LEVELS, 1977 (continued)

2.9 Hydrographs for Recorder Wells in Other Parts of Nebraska

Twenty recorder wells are located outside of the areas described in sections 2.1 through 2.8 of this report. Hydrographs for these recorder wells show water-level fluctuations in response to a variety of hydrologic conditions. Some of the wells are in or near areas where significant changes from estimated predevelopment water levels have occurred (wells 1, 3, 8, 10, and 11). More detailed descriptions of water-level changes in these areas are not included in this report because the areas are relatively small and/or data are too few to define their boundaries.

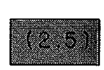
Other recorder wells have been installed to monitor water-level fluctuations in areas where significant water-level declines may occur because of large-scale groundwater development and/or unusual hydrogeologic conditions (wells 2, 5, 7, 9, 12, 13, 15, and 18); large amounts of groundwater are pumped for municipal supplies (wells 4, 16, and 17); water diverted from streams is used for irrigation (wells 19 and 20); stream-aquifer interrelationships need better definition (well 6); and data are needed to determine natural recharge rates to a bedrock aquifer in which the hydrostatic head has been lowered by long-term withdrawals for municipal supply (well 14).



•9
Recorder Well location

Recorder well for which a hydrograph showing water-level fluctuations is included in this section

1. Elgin recorder well, Antelope County
2. Brunswick recorder well, Antelope County
3. Ainsworth recorder well, Brown County
4. MUD Number 4 recorder well, Cass County
5. Gurley recorder well, Cheyenne County
6. Schuyler recorder well, Colfax County
7. Merna recorder well, Custer County
8. Upland recorder well, Franklin County
9. Orafino recorder well, Frontier County
10. Alma recorder well, Harlan County
11. Ragan recorder well, Harlan County
12. Sprinview recorder well, Keya Paha County
13. Kimball recorder well, Kimball County
14. Van Dorn recorder well, Lancaster County
15. Osmond recorder well, Pierce County
16. MUD Number 3 recorder well, Sarpy County
17. Ashland recorder well, Saunders County
18. Mead recorder well, Saunders County
19. Scottsbluff recorder well, Scotts Bluff County
20. Mirage Flats recorder well, Sheridan County



Area for which a more detailed description of water-level changes is given in another section of this report. The section, indicated by the number in parentheses, includes hydrographs for all recorder wells in the area.

Location of recorder wells in other parts of Nebraska

ELGIN RECORDER WELL

SUMMER WATER LEVEL REACHES NEW LOW

The summer water level in this well dropped to a new low during 1977, second possibly to 1976 when the recorder malfunctioned and the lowest level reached in the well that year was not recorded. The maximum low in 1977 was below 115 ft (35.0 m).

The general rate of water-level decline decreased during the wetter-than-normal years of 1972 and 1973 but has increased since then.

Because the aquifer is confined, the water level responds sharply to the pumping of nearby irrigation wells.

WELL DATA

Location: 3.2 mi (5.1 km) south of Elgin on Route 17, then 3.5 mi (5.6 km) east
Depth: 225 ft (69 m)
Diameter: 6 in (152 mm)
Aquifer: Sand and gravel overlain by fine-grained sand and silt
Water occurrence: Confined
Estimated predevelopment water level: 102 ft (31.0 m)
Net water-level change in 1977: +0.40 ft (+0.122 m)
Average annual net water-level change since 1968: −0.42 ft (−0.128 m)
Development near well: Irrigation wells; first development 1957, additional development mostly in 1966, 1970, and 1976; average density of irrigation wells, 1.5/mi^2 (0.58/km^2)

BRUNSWICK RECORDER WELL

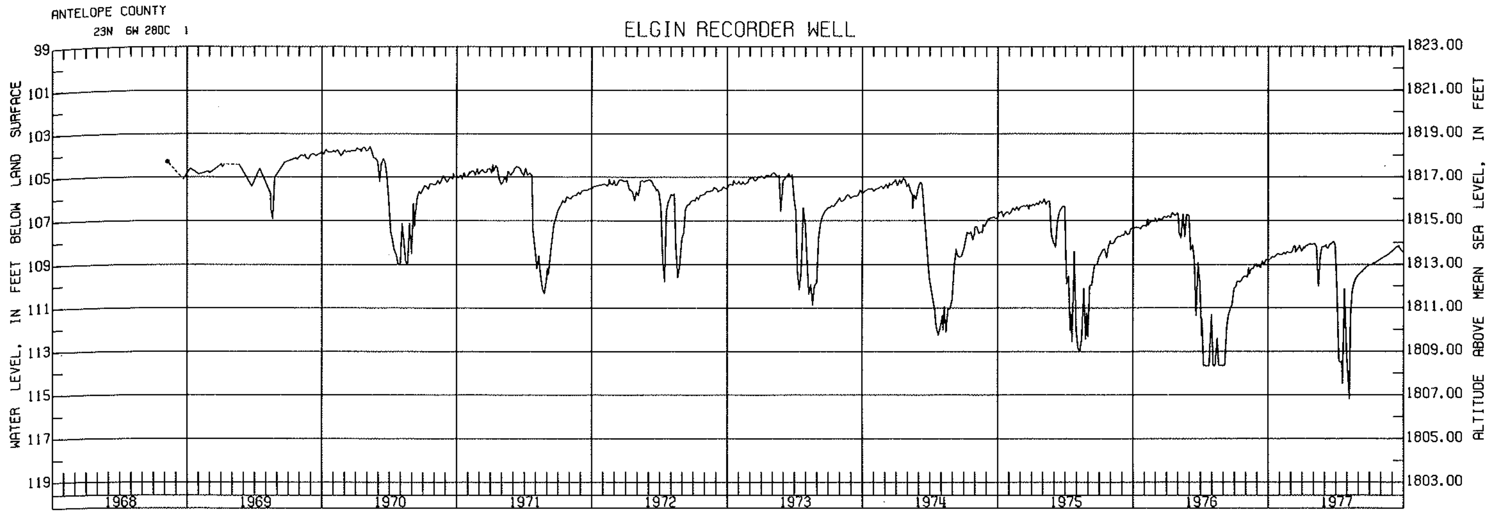
WATER LEVEL CONTINUES DECLINE

A net water-level decline occurred in this well for the third consecutive year. These declines reversed the rising water-level trend that began in late 1972 and continued to mid-1974. Recent irrigation-well development with heavy pumping during the summer droughts of 1975 and 1976 accounts for most of the change in the water-level trend. Six irrigation wells were registered in the immediate area during 1977.

Periods of above-normal precipitation are reflected by short-term water-level rises. Growing-season declines during the past four summers were more pronounced than formerly because groundwater withdrawals for irrigation were greater in those seasons.

WELL DATA

Location: 3 mi (4.80 km) east of the principal north-south street in Brunswick, and 1 mi (1.61 km) south
Depth: 195 ft (59 m)
Diameter: 6 in (152 mm)
Aquifer: Sand and gravel (undifferentiated Pleistocene deposits)
Water occurrence: Unconfined
Estimated predevelopment water level: 90 ft (27.5 m)
Net water-level change in 1977: −0.84 ft (−0.255 m)
Average annual net water-level change since 1968: −0.43 ft (−0.131 m)
Development near well: Irrigation wells; first development early 1950s, major development 1970s; average density of irrigation wells, 3.0/mi^2 (1.16/km^2)


ANTELOPE COUNTY
23N 6W 28DC 1
ELGIN RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
99
101
103
105
107
109
111
113
115
117
119
1823.00
1821.00
1819.00
1817.00
1815.00
1813.00
1811.00
1809.00
1807.00
1805.00
1803.00
1968
1969
1970
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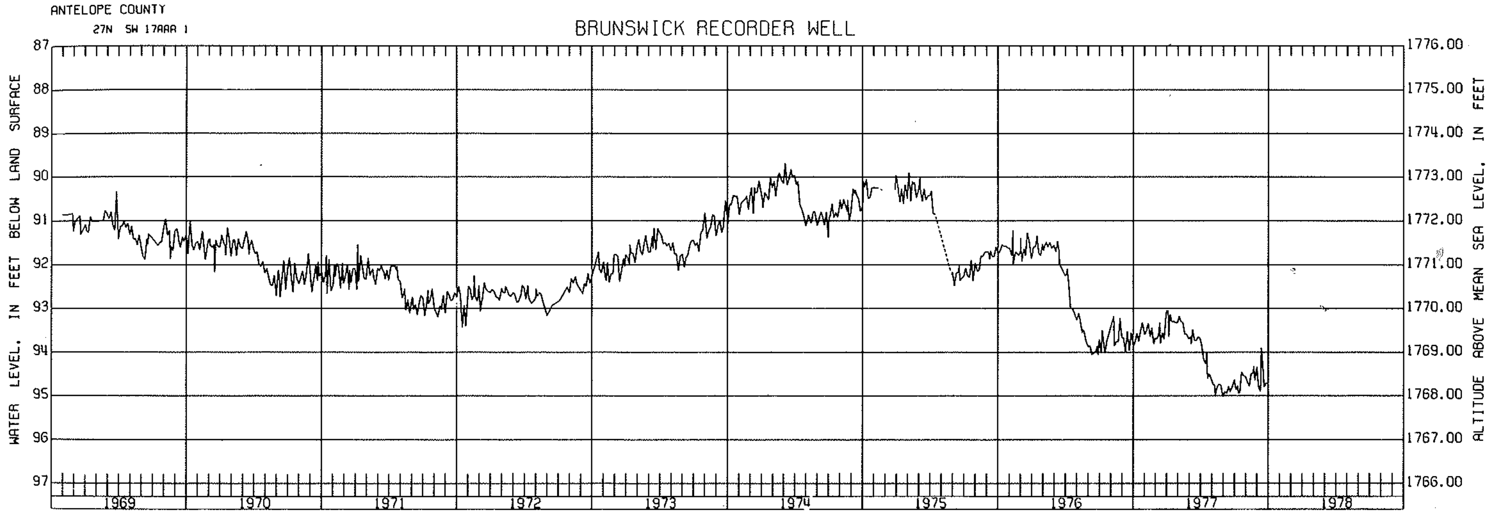
1973
1974
1975
1976
1977


ANTELOPE COUNTY
27N 5W 17AAA 1
BRUNSWICK RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
87
88
89
90
91
92
93
94
95
96
97
1776.00
1775.00
1774.00
1773.00
1772.00
1771.00
1770.00
1769.00
1768.00
1767.00
1766.00
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978

AINSWORTH RECORDER WELL

WATER LEVEL REBOUNDS

The water level recovered dramatically in this well after declining for three successive years because recharge from precipitation was greater and pumping for irrigation was less than usual. In recent time, only in 1974 has the water level been as high as now. The only other recorded high similar to these two was in 1952. Declines occurred in 1953–56, 1963–65, and 1974–76 when recharge from precipitation was less than usual. The decline in 1953–56 also coincided with peak development of irrigation wells in this area.

Except for January and June, precipitation in 1977 was above normal and probably contributed a large part toward the higher water levels. Rises in the water level were also recorded during the above-normal precipitation years of 1951 and 1962. The accelerated rise that began in 1971 and continued through 1973 probably is related more to recharge from irrigation than to recharge from precipitation. Part of the Ainsworth Irrigation Project is a short distance northwest of the recorder well.

WELL DATA

Location: 1.2 mi (1.93 km) east of the junction of U.S. Highway 20 and Route 7 in Ainsworth
Depth: 52 ft (15.8 m)
Diameter: 6 in (152 mm)
Aquifer: Sand and gravel (undifferentiated Pleistocene deposits)
Water occurrence: Unconfined
Estimated predevelopment water level: 36 ft (11.0 m)
Net water-level change in 1977: +3.0 ft (+0.91 m)
Average annual net water-level change since 1947: Not significant; no long-term rise or decline
Development near well: Irrigation wells; earliest in 1939, peak development in mid-1950s; density of irrigation wells, 2.5/mi^2 (0.97/km^2)

MUD NUMBER 4 RECORDER WELL

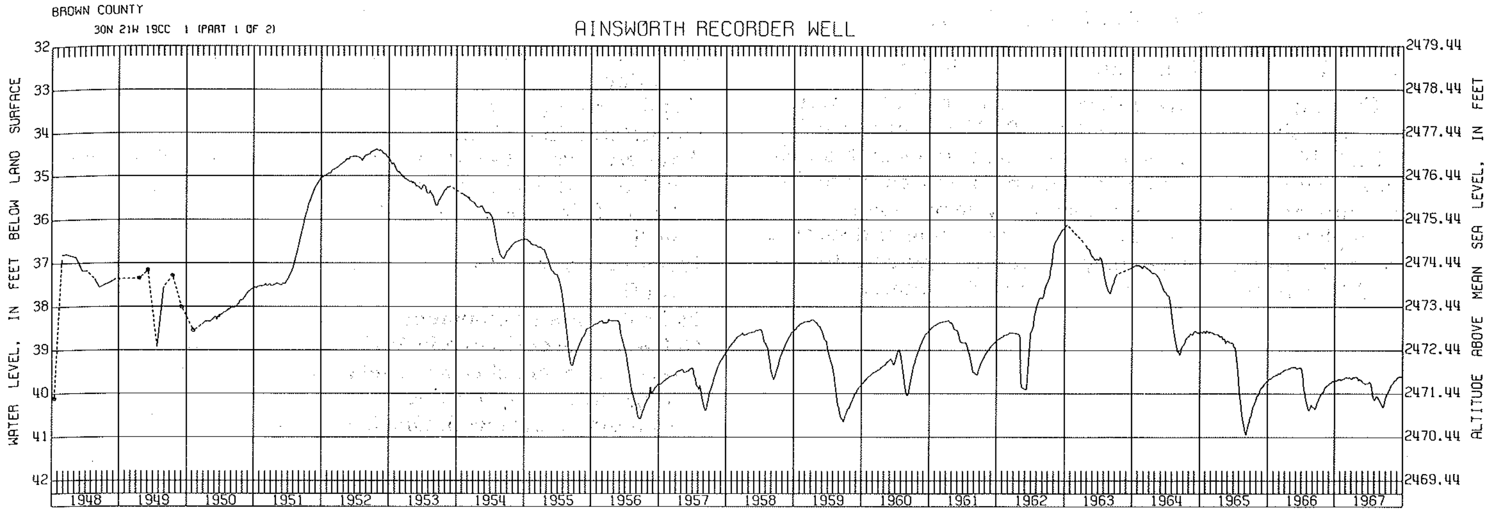
WATER LEVEL HIGHER AT END OF 1977

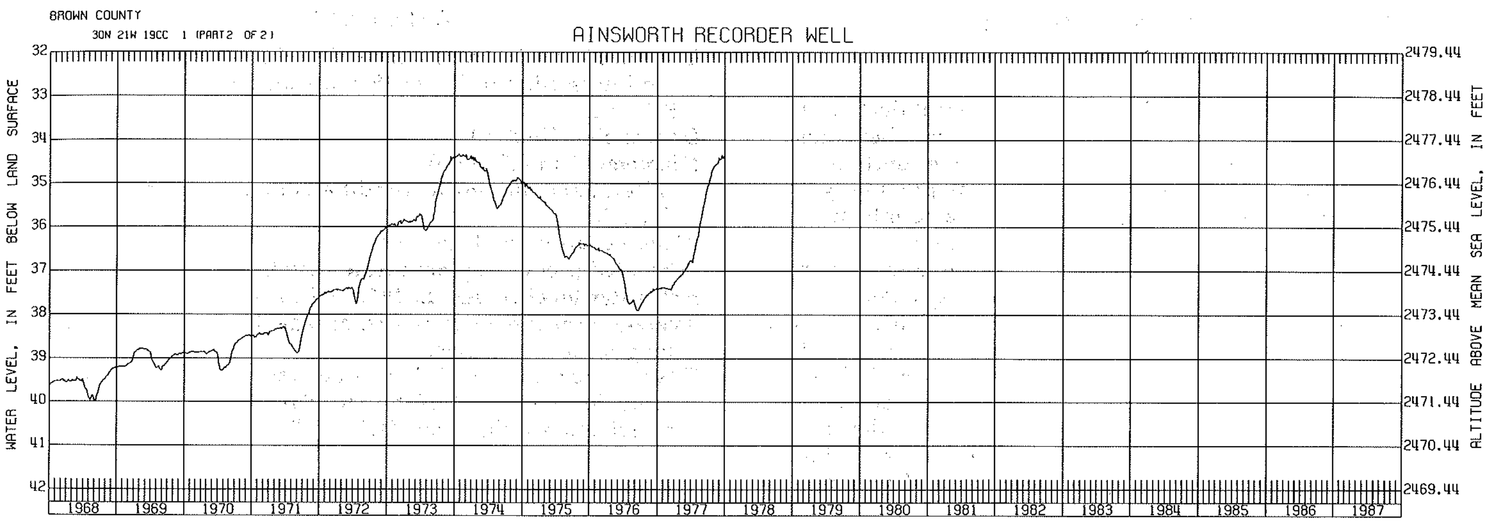
A net water-level rise of 0.70 ft (0.213 m) occurred during 1977 in this well. Water-level fluctuations were much smaller in 1977 compared to most years.

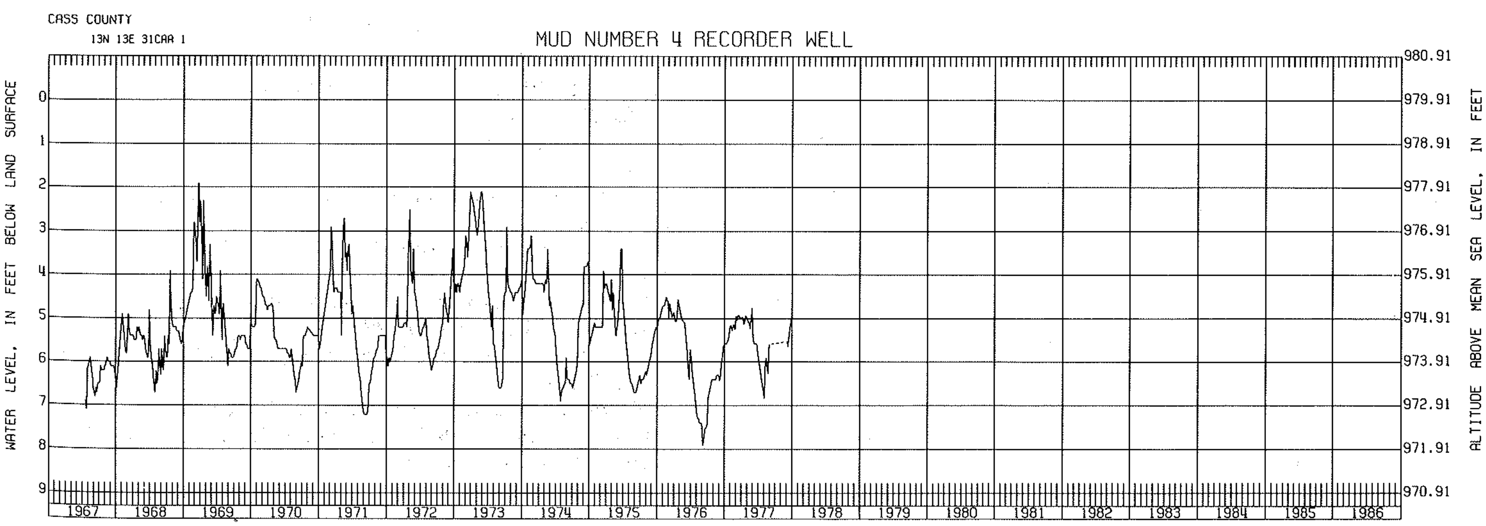
The water level responds primarily to changes in the stage of the Platte River and partially to pumping in the MUD well field, an important source of water for the city of Omaha. Lower river stages in combination with higher demands for water during the summer produce the significant seasonal water-level decline.

WELL DATA

Location: 4.5 mi (7.2 km) west of Plattsmouth, then 2.5 mi (4.00 km) north and 0.25 mi (0.400 km) west along the south bank of the Platte River; well is on north side of the railroad track
Depth: Not known
Diameter: Not known
Aquifer: Sand and gravel (Platte River alluvium)
Water occurrence: Unconfined
Estimated predevelopment water level: 4.5 ft (1.37 m)
Net water-level change in 1977: +0.70 ft (+0.213 m)
Average annual net water-level change since 1967: Not significant; no long-term rising or declining trend
Development near well: Well field for Metropolitan Utilities District of Omaha


BROWN COUNTY
30N 21W 19CC 1 (PART 1 OF 2)
AINSWORTH RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
32 33 34 35 36 37 38 39 40 41 42
2479.44 2478.44 2477.44 2476.44 2475.44 2474.44 2473.44 2472.44 2471.44 2470.44 2469.44
1948 1949 1950 1951 1952 1953 1954 1955 1956 1957 1958 1959 1960 1961 1962 1963 1964 1965 1966 1967


BROWN COUNTY
30N 21W 19CC 1 (PART 2 OF 2)
AINSWORTH RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
32 33 34 35 36 37 38 39 40 41 42
2479.44 2478.44 2477.44 2476.44 2475.44 2474.44 2473.44 2472.44 2471.44 2470.44 2469.44
1968 1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987


CASS COUNTY
13N 13E 31CAA 1
MUD NUMBER 4 RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
0 1 2 3 4 5 6 7 8 9
980.91 979.91 978.91 977.91 976.91 975.91 974.91 973.91 972.91 971.91 970.91
1967 1968 1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986

GURLEY RECORDER WELL

NO LARGE WATER-LEVEL FLUCTUATIONS

The amplitude of water-level fluctuations in this well was only slightly more than 0.7 ft (0.213 m) during 1977.

Probably most of the water-level fluctuations in this well reflect barometric pressure variations produced by high-pressure and low-pressure weather systems moving through the area. The lack of long-term rising or declining trends indicates that discharge from the aquifer at this locality is in balance with recharge to the aquifer.

WELL DATA

Location: 2 mi (3.20 km) north and 1 mi (1.61 km) west of Gurley
Depth: 360 ft (110 m)
Diameter: 5 in (127 mm)
Aquifer: Layers of sand and gravel interbedded with layers of fine-textured material (Ogallala Formation); thick layer of clay about 100 ft (30.5 m) above water level in well
Water occurrence: Combination of unconfined and confined
Estimated predevelopment water level: 221 ft (67 m)
Net water-level change in 1977: −0.25 ft (−0.076 m)
Average annual net water-level change: Not significant; no long-term rise or decline
Development near well: One irrigation well drilled in 1976

SCHUYLER RECORDER WELL

WATER LEVEL HIGHEST SINCE 1973

Except for a decline in July, no significant declines in water levels were recorded in 1977. The water level rose during the spring and, except for a summer decline, maintained a water level higher than any previously recorded since the spring of 1974. High amounts of precipitation probably contributed toward less dependence on groundwater for irrigation and greater amounts of recharge to the groundwater system.

Because the water table in the vicinity of this well is at shallow depth, uptake of groundwater by deep-rooted vegetation accounts for part of the water-level decline during the growing season. Pumping from irrigation wells in the vicinity accounts for most of the remainder. In addition to infiltrating precipitation, seepage from Lost Creek during high stages may be a source of recharge.

WELL DATA

Location: 2 mi (3.20 km) west and 2 mi (3.20 km) south of the intersection of Route 15 and U.S. Highway 30 in Schuyler
Depth: 55 ft (16.8 m)
Diameter: 6 in (152 mm)
Aquifer: Sand and gravel (undifferentiated Pleistocene deposits)
Water occurrence: Unconfined
Estimated predevelopment water level: 7.5 ft (2.29 m)
Net water-level change in 1977: +1.31 ft (+0.400 m)
Average annual net water-level change: Not significant; no long-term rise or decline
Development near well: Irrigation wells; earliest in 1939, rapid development 1954–57 and 1967–70; average density of irrigation wells, $4/mi^2$ ($1.54/km^2$)

MERNA RECORDER WELL

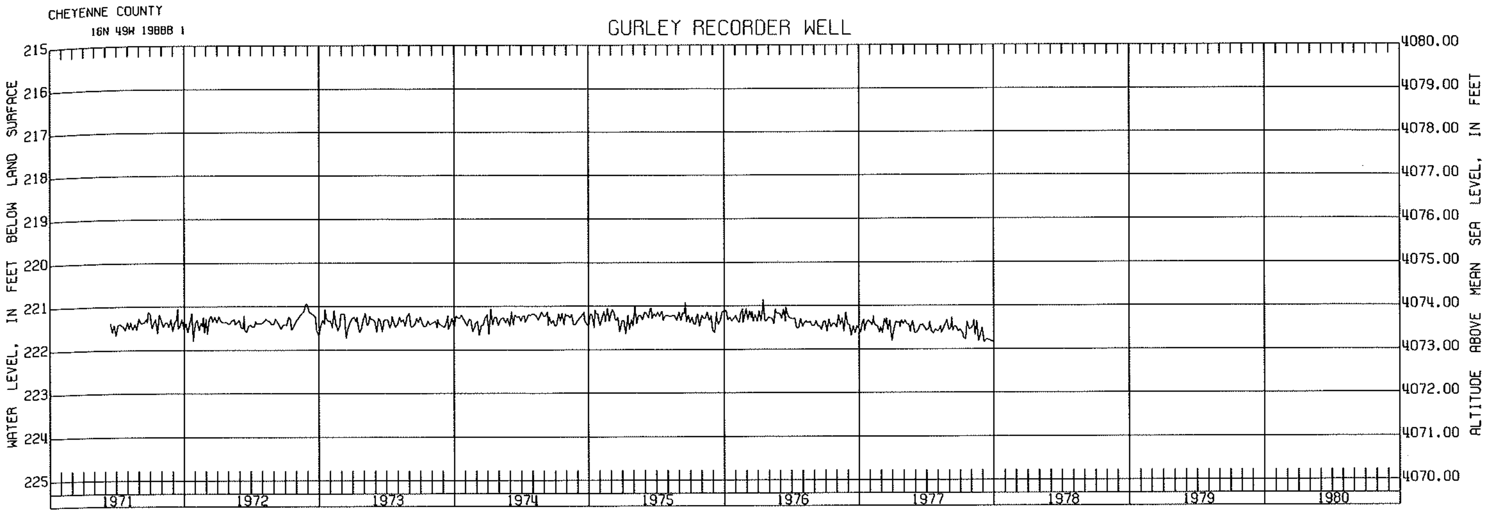
YEAR-END WATER LEVEL HIGHEST IN FIVE YEARS

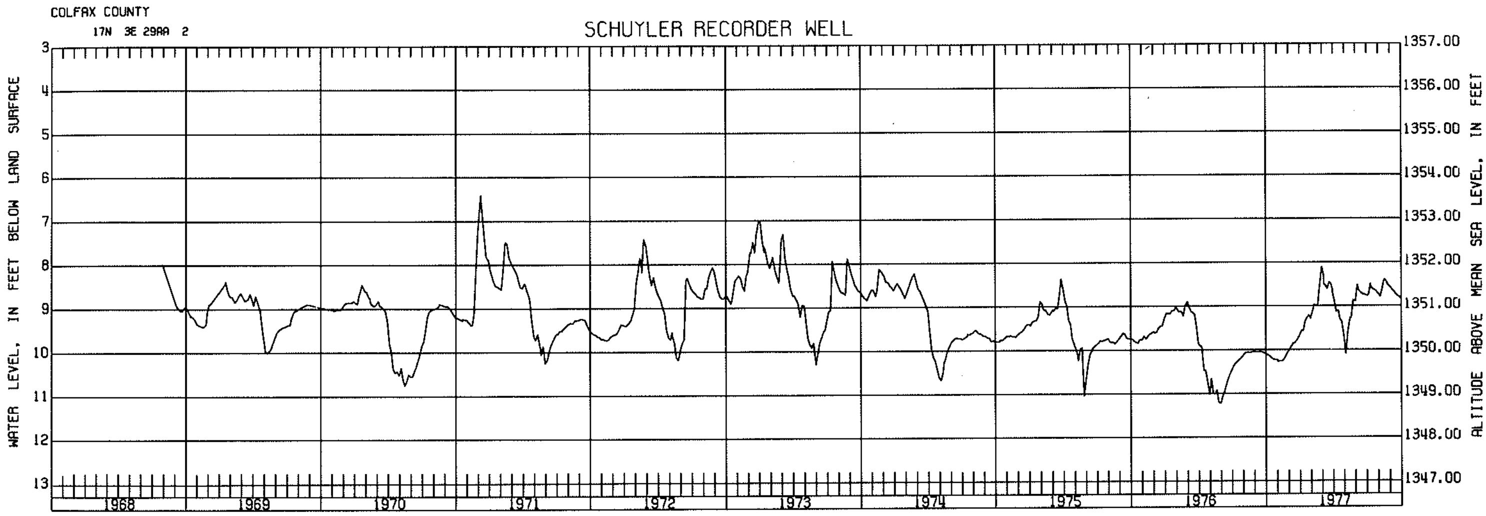
Above-normal precipitation resulting in increased recharge caused water levels in this well to rise to the highest year-end reading for the period of record. Operation of nearby irrigation wells causes seasonal drawdowns in this well. Intermittent pumping in July and August resulted in a succession of sharp water-level fluctuations. The low water level reached in the last part of August was lower than any previous summer low except for the summer of 1976. At year's end, the water level was 2.24 ft (0.68 m) higher than at the end of 1976.

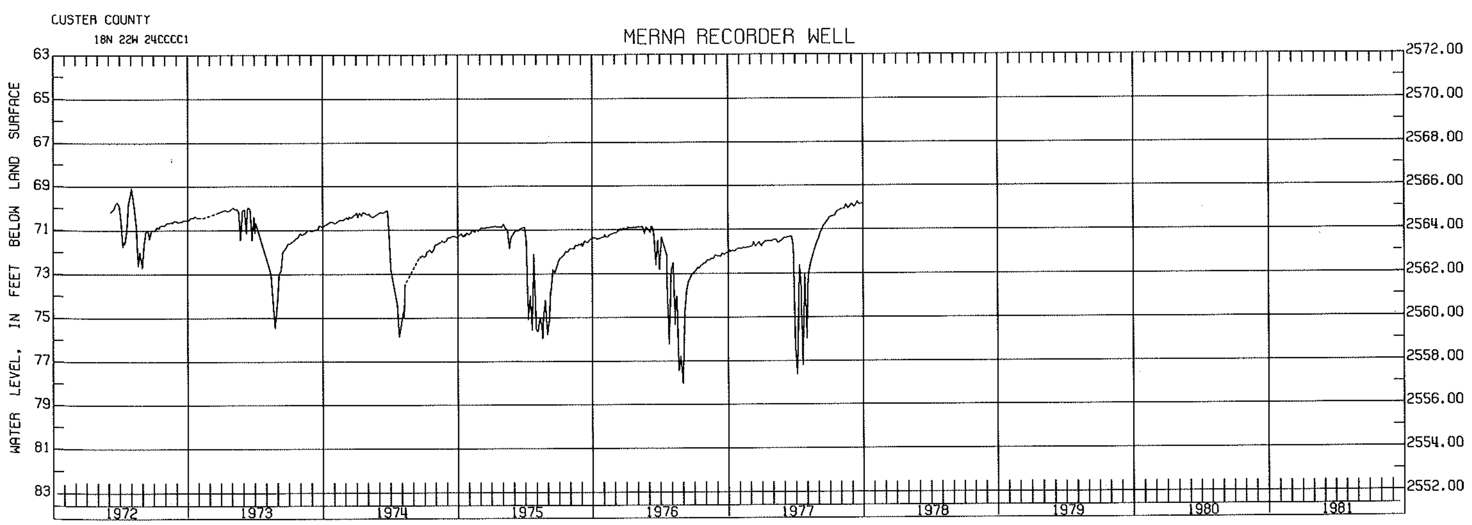
Comparison of year-end water levels indicates that a general downward trend may be in progress, even though above-normal precipitation during 1977 temporarily interrupted that trend.

WELL DATA

Location: 2 mi (3.20 km) north of the intersection of Routes 70 and 92 with Route 2 at the west edge of Merna, then 2 mi (3.20 km) west
Depth: 179 ft (55 m)
Diameter: 5 in (127 mm)
Aquifer: Sand and gravel (undifferentiated Pleistocene deposits)
Water occurrence: Combination of unconfined and confined
Estimated predevelopment water level: 68 ft (20.7 m)
Net water-level change in 1977: +2.24 ft (+0.68 m)
Average annual net water-level change since 1972: +0.14 ft (+0.042 5 m)
Development near well: Irrigation wells; earliest in 1953, rapid development 1973–74; average density of irrigation wells, $2.0/mi^2$ ($0.77/km^2$)


CHEYENNE COUNTY
16N 49W 19BBB 1
GURLEY RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
215
216
217
218
219
220
221
222
223
224
225
4080.00
4079.00
4078.00
4077.00
4076.00
4075.00
4074.00
4073.00
4072.00
4071.00
4070.00
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980


COLFAX COUNTY
17N 3E 29AA 2
SCHUYLER RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
3
4
5
6
7
8
9
10
11
12
13
1357.00
1356.00
1355.00
1354.00
1353.00
1352.00
1351.00
1350.00
1349.00
1348.00
1347.00
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977


CUSTER COUNTY
18N 22W 24CCCC1
MERNA RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
63
65
67
69
71
73
75
77
79
81
83
2572.00
2570.00
2568.00
2566.00
2564.00
2562.00
2560.00
2558.00
2556.00
2554.00
2552.00
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981

UPLAND RECORDER WELL

NEAR RECORD LOW WATER LEVEL IN 1977

Pumping from nearby irrigation wells caused the usual pronounced seasonal water-level decline in this well. The summer's low water level, reached in August, was the second lowest level recorded in this well. Above normal precipitation in August replenished soil moisture to the point that irrigation pumping was stopped and seasonal recovery of the water level began. The year-end level was 0.18 ft (0.055 m) lower than the 1977 year-end level, which was the lowest previously recorded. Probably many of the minor water-level fluctuations are responses to changes in barometric pressure.

Except in 1972, when the net water-level change for the year was a slight rise, all annual net water-level changes have been declines.

WELL DATA

Location: 1 mi (1.61 km) east and 2 mi (3.20 km) south of Upland
Depth: 265 ft (81 m)
Diameter: 6 in (152 mm)
Aquifer: Layers of sand and gravel interbedded with layers of clay (Ogallala Formation)
Water occurrence: Confined
Estimated predevelopment water level: 170 ft (52 m)
Net water-level change in 1977: −0.18 ft (−0.055 m)
Average annual net water-level change since 1968: −0.75 ft (−0.229 m)
Development near well: Irrigation wells; earliest in 1952, rapid development in mid-1950s and 1974–75; average density of irrigation wells, 3.0/mi² (1.16/km²)

ORAFINO RECORDER WELL

NET WATER-LEVEL DECLINE IN 1977

The water level declined 1.14 ft (0.345 m) during the second year of operation of this well. This continues the trend of the first full year of record. The average decline for the two years of record is −1.08 ft (−0.330 m).

Cretaceous age bedrock is found in the immediate vicinity of the well at a higher elevation than in the surrounding area. Also, most nearby irrigation wells are screened at a lower elevation. It appears that slow movement of water to these wells in response to seasonal pumping causes the more rapid drop of water during the latter half of the year and the general annual decline.

WELL DATA

Location: 1 mi (1.61 km) north and 3.8 mi (6.1 km) east of Orafino on north side of road
Depth: 154 ft (47.0 m)
Diameter: 6 in (152 mm)
Aquifer: Sand and gravel (Ogallala Formation)
Water occurrence: Unconfined
Estimated predevelopment water level: Not determined
Net water-level change in 1977: −1.14 ft (−0.345 m)
Average annual net water-level change since 1975: −1.08 ft (−0.330 m)
Development near well: Irrigation wells; earliest in 1956; density of irrigation wells, 1.0/mi² (0.385/km²)

ALMA RECORDER WELL

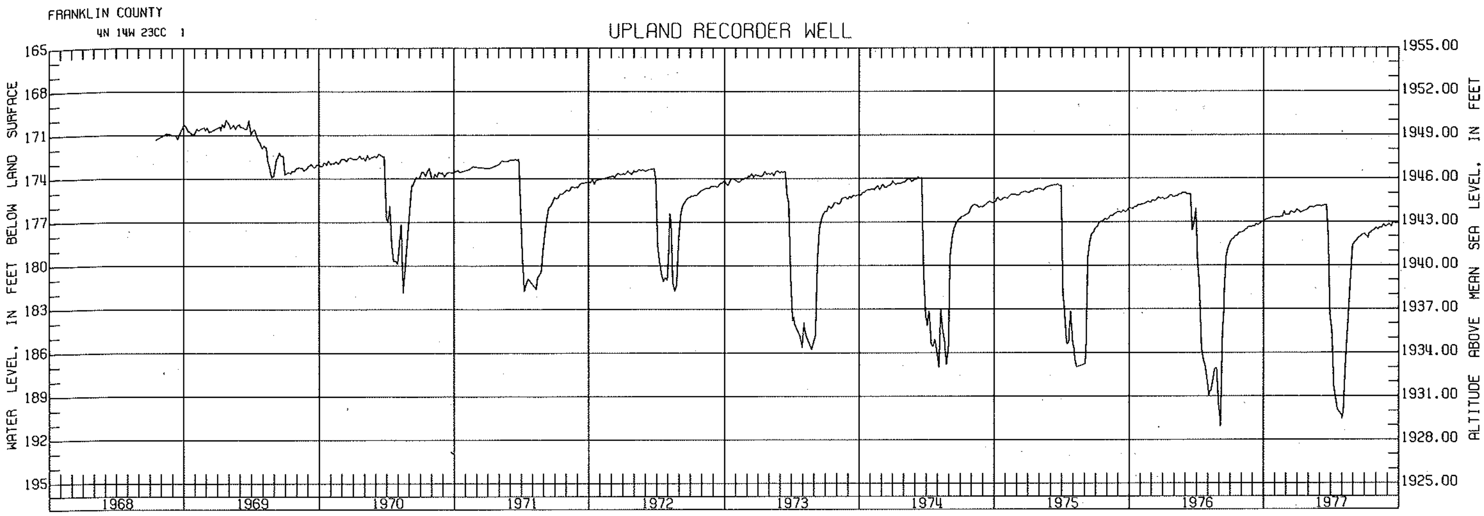
NET WATER-LEVEL DECLINE IN 1977

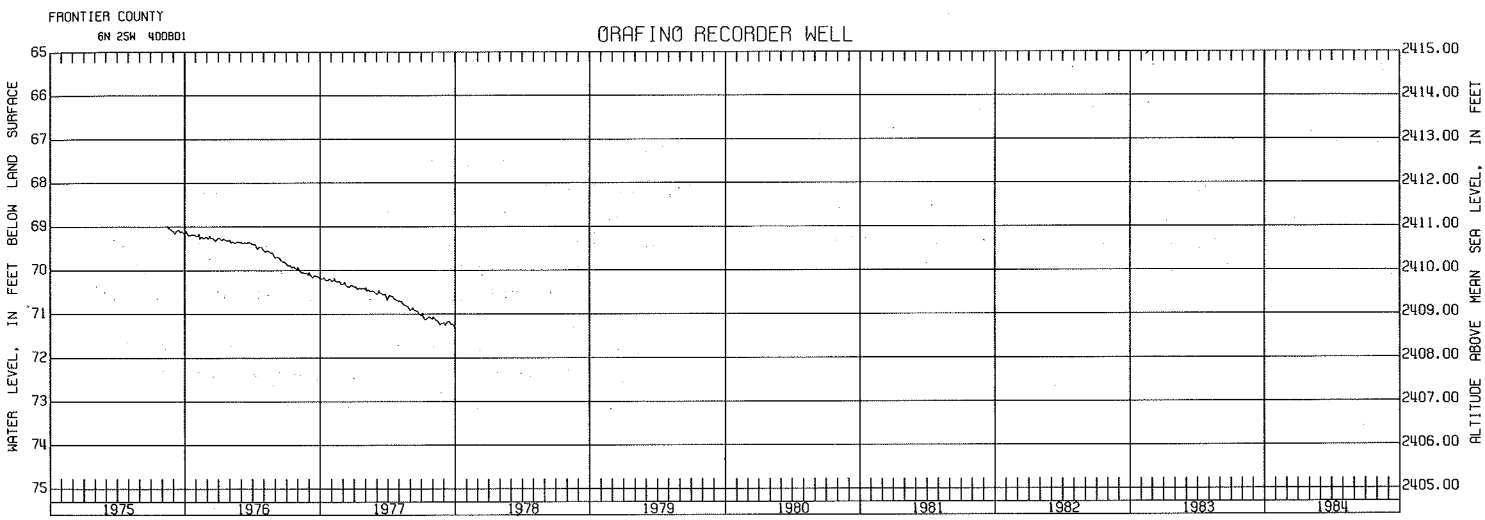
The net water-level decline in 1977 was 0.51 ft (0.155 m) or 1.5 times the average annual net water-level change of 0.34 ft (0.104 m) since 1964. This reflects, in part, the below-normal precipitation of June and July. Little recharge to the aquifer occurred and heavy pumping was required to maintain soil moisture. Recovery of the water level in this well began earlier this year when above-normal precipitation began replenishing soil moisture in August. Because groundwater in the vicinity of this well is confined, large and sharp water-level responses are caused by pumping from nearby irrigation wells.

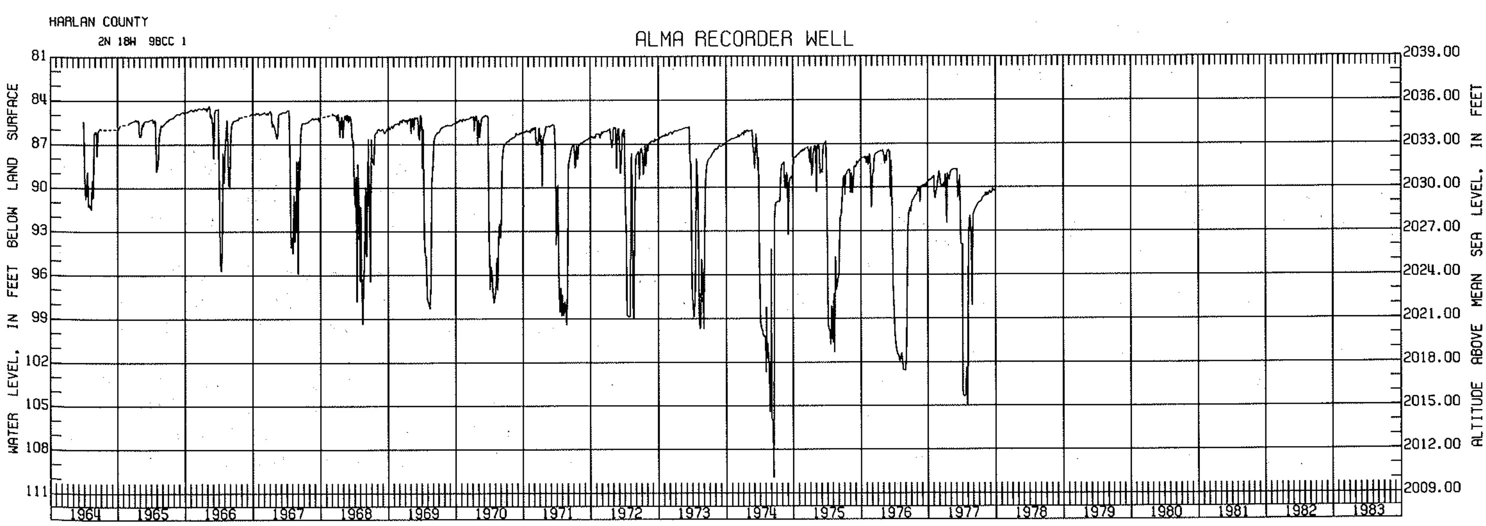
A decline of hydrostatic pressure within the aquifer at this well's location is apparent from the fairly gradual lowering of year-end and spring high-water levels since 1965. The net decline in 1974 was much larger than in any earlier year of record.

WELL DATA

Location: 3.5 mi (5.6 km) north of the junction of Route 3 and U.S. Highway 183 in Alma
Depth: 170 ft (52 m)
Diameter: 6 in (152 mm)
Aquifer: Sand and gravel overlain by fine-textured sediment (undifferentiated Pleistocene deposits)
Water occurrence: Confined
Estimated predevelopment water level: 85 ft (26.0 m)
Net water-level change in 1977: −0.51 ft (−0.155 m)
Average annual net water-level change since 1964: −0.34 ft (−0.104 m)
Development near well: Irrigation wells; earliest in 1945, rapid development 1966-68 and 1972 to present; density of irrigation wells, 2.5/mi² (0.97/km²)


FRANKLIN COUNTY
4N 14W 23CC 1
UPLAND RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
165
168
171
174
177
180
183
186
189
192
195
1955.00
1952.00
1949.00
1946.00
1943.00
1940.00
1937.00
1934.00
1931.00
1928.00
1925.00
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977


FRONTIER COUNTY
6N 25W 4DDBD1
ØRAFINO RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
65
66
67
68
69
70
71
72
73
74
75
2415.00
2414.00
2413.00
2412.00
2411.00
2410.00
2409.00
2408.00
2407.00
2406.00
2405.00
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984


HARLAN COUNTY
2N 18W 9BCC 1
ALMA RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
81
84
87
90
93
96
99
102
105
108
111
2039.00
2036.00
2033.00
2030.00
2027.00
2024.00
2021.00
2018.00
2015.00
2012.00
2009.00
1964
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983

RAGAN RECORDER WELL

1977 WATER-LEVEL LOW SETS NEW RECORD

Although the water-level fluctuation pattern in this well during 1977 resembled that of the last seven years, the lowest water level of summer 1977 was more than 1.5 ft (0.455 m) lower than at comparable times in any preceding year. Fall and winter water levels did not recover to those reached in earlier years, continuing their long-term downward trend. Heavy pumping to replenish soil moisture caused the greater-than-normal decline.

The yearly decline and partial recovery of water levels in this well are characteristic of areas where groundwater in the vicinity of the well is unconfined. Following the summer irrigation season, the water level rises until the next year when pumping for irrigation causes another decline. Because the groundwater being pumped is not fully replaced by recharge to the aquifer, the recovery of the water level in this well is not as much as in the previous year, and each summer decline is greater than that of the preceding year.

WELL DATA

Location: 2 mi (3.20 km) west and 0.5 mi (0.80 km) north of Ragan
Depth: 315 ft (96 m)
Diameter: 6 in (152 mm)
Aquifer: Layers of sand and gravel interbedded with thin layers of clay
Water occurrence: Unconfined
Estimated predevelopment water level: 176 ft (54 m)
Net water-level change in 1977: −0.74 ft (−0.226 m)
Average annual net water-level change since 1968: −0.70 ft (−0.213 m)
Development near well: Irrigation wells; earliest in 1954, rapid development 1956 and 1966; average density of irrigation wells, 1.5/mi^2 (0.58/km^2)

SPRINGVIEW RECORDER WELL

WATER-LEVEL DECLINE CONTINUES

A net water-level decline of 0.75 ft (0.229 m) was recorded during this second full year of operation. Heavy withdrawals for irrigation during the below-normal precipitation of the last several years probably were a major factor causing the net water-level declines for the last two years. Not enough data are available to determine if this represents the beginning of a long-term decline.

WELL DATA

Location: 1 mi (1.61 km) south and 1.7 mi (2.75 km) east of the intersection of Route 12 and the principal east-west road in Springview
Depth: 240 ft (73 m)
Diameter: 5 in (127 mm)
Aquifer: Sand and gravel (Ogallala Formation)
Water occurrence: Unconfined
Estimated predevelopment water level: 91 ft (27.5 m)
Net water-level change in 1977: −0.75 ft (−0.229 m)
Average annual net water-level change since 1975: −0.97 ft (−0.295 m)
Development near well: Irrigation wells; earliest 1973; municipal wells; earliest 1935; average density of high-capacity wells, 0.5/mi^2 (0.193/km^2)

KIMBALL RECORDER WELL

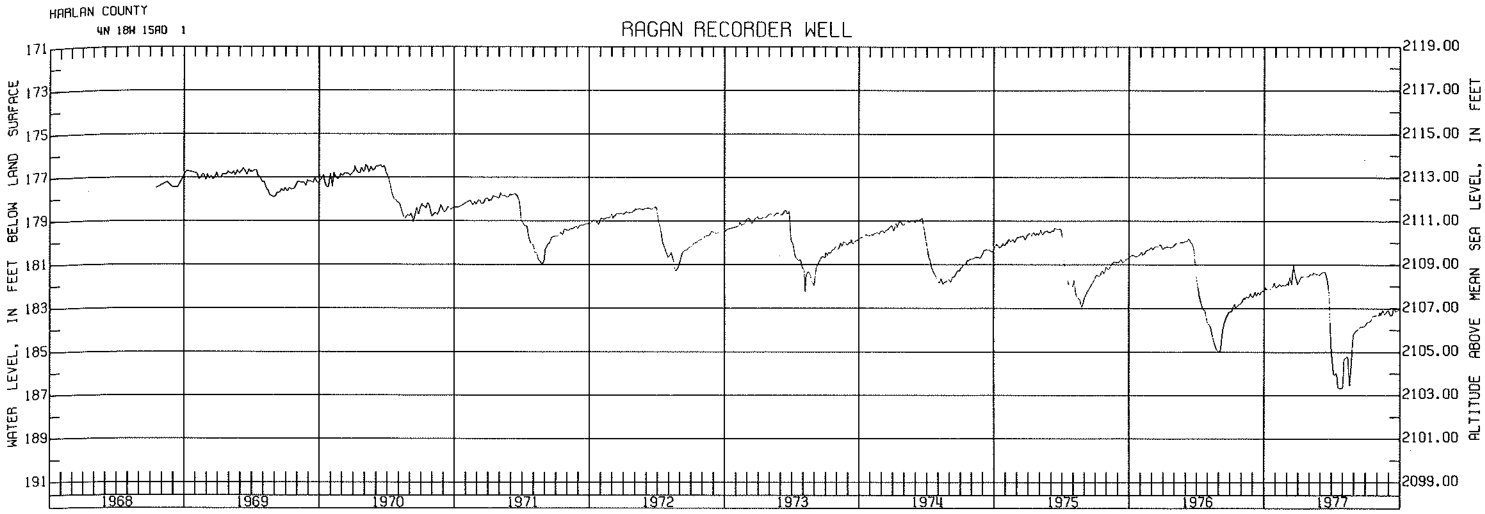
SHARP WATER LEVEL DECLINES IN 1977

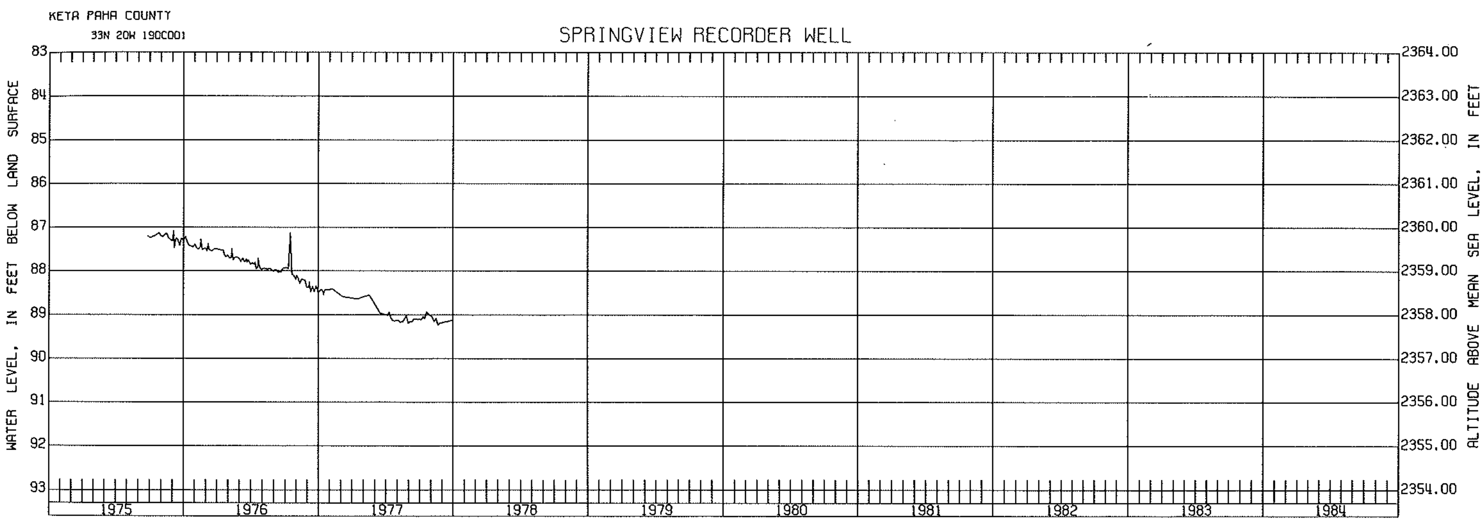
Several cycles of water-level decline and recovery were recorded in this well during 1977. The initial decline was probably caused by pumping for early irrigation. Summer precipitation supplements soil moisture and pumping for irrigation is temporarily suspended at various times during the summer months. This is indicated by the abrupt rises in water level. A record low water level was reached in July. In 1977 little recharge occurred and large amounts of water were pumped because of the below-normal precipitation during the growing season. This is reflected by the 1977 net water-level decline of more than double the average annual net water-level decline since 1972.

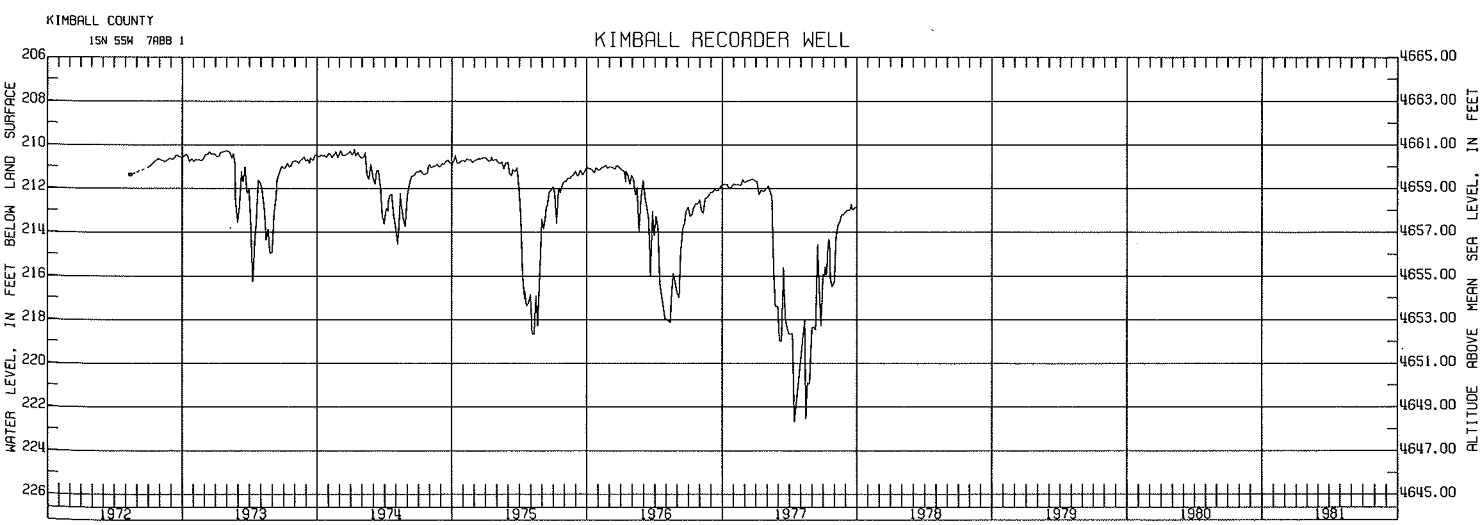
Confinement of the water accounts for the large water-level declines in response to nearby pumping and for the rapid water-level recoveries when pumping stops.

WELL DATA

Location: 4 mi (6.4 km) north and 0.5 mi (0.80 km) west of Kimball
Depth: 314 ft (96 m)
Diameter: 5 in (127 mm)
Aquifer: Layers of sand and gravel interbedded with layers of fine-textured sediment (Ogallala Formation)
Water occurrence: Combination of unconfined and confined
Estimated predevelopment water level: 210 ft (64 m)
Net water-level change in 1977: −1.07 ft (−0.325 m)
Average annual net water-level change since 1972: −0.45 ft (−0.137 m)
Development near well: Three irrigation wells, one about 0.7 mi (1.13 km) to the southeast drilled in 1960, one about 1.2 mi (1.93 km) to the southwest drilled in 1970, and one about 1.8 mi (2.90 km) to the south-southeast


HARLAN COUNTY
4N 18W 15AD 1
RAGAN RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
171
173
175
177
179
181
183
185
187
189
191
2119.00
2117.00
2115.00
2113.00
2111.00
2109.00
2107.00
2105.00
2103.00
2101.00
2099.00
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977


KEYA PAHA COUNTY
33N 20W 19DCDD1
SPRINGVIEW RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
83
84
85
86
87
88
89
90
91
92
93
2364.00
2363.00
2362.00
2361.00
2360.00
2359.00
2358.00
2357.00
2356.00
2355.00
2354.00
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984


KIMBALL COUNTY
15N 55W 7ABB 1
KIMBALL RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
206
208
210
212
214
216
218
220
222
224
226
4665.00
4663.00
4661.00
4659.00
4657.00
4655.00
4653.00
4651.00
4649.00
4647.00
4645.00
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981

VAN DORN RECORDER WELL

INSIGNIFICANT NET WATER-LEVEL CHANGE IN 1977

Numerous small water-level fluctuations—many more than shown by the hydrograph—occur in this well. These small fluctuations are not the result of recharge to and withdrawals from the aquifer but, instead, are responses to changes in hydrostatic pressure within the aquifer. Most such changes are related to frequent changes in atmospheric pressure, but a few are due to infrequent transmissions of shock waves from earthquake epicenters. The nearly horizontal trend of the water level throughout 1977 indicates that no large change in hydrostatic pressure occurred during the year.

A rising trend characterizes this well's water-level record from 1956 to mid-1974. The water-level rise of about 17.5 ft (5.3 m) during that period indicates a significant increase in hydrostatic pressure due partly to recovery from the long-term withdrawals from the aquifer for the Lincoln water supply and partly to recharge from precipitation.

WELL DATA

Location: In Irvingdale Park on the north side of Van Dorn Street between 19th and 20th Streets in Lincoln
Depth: 170 ft (52 m)
Diameter: 16 in (406 mm)
Aquifer: Sandstone (Dakota Group)
Water occurrence: Confined
Estimated predevelopment water level: 35 ft (10.7 m)
Net water-level change in 1977: +0.16 ft (+0.049 0 m)
Average annual net water-level change since 1951: +0.61 ft (+0.186 m)
Development near well: None; well formerly one of several pumped for Lincoln water supply

OSMOND RECORDER WELL

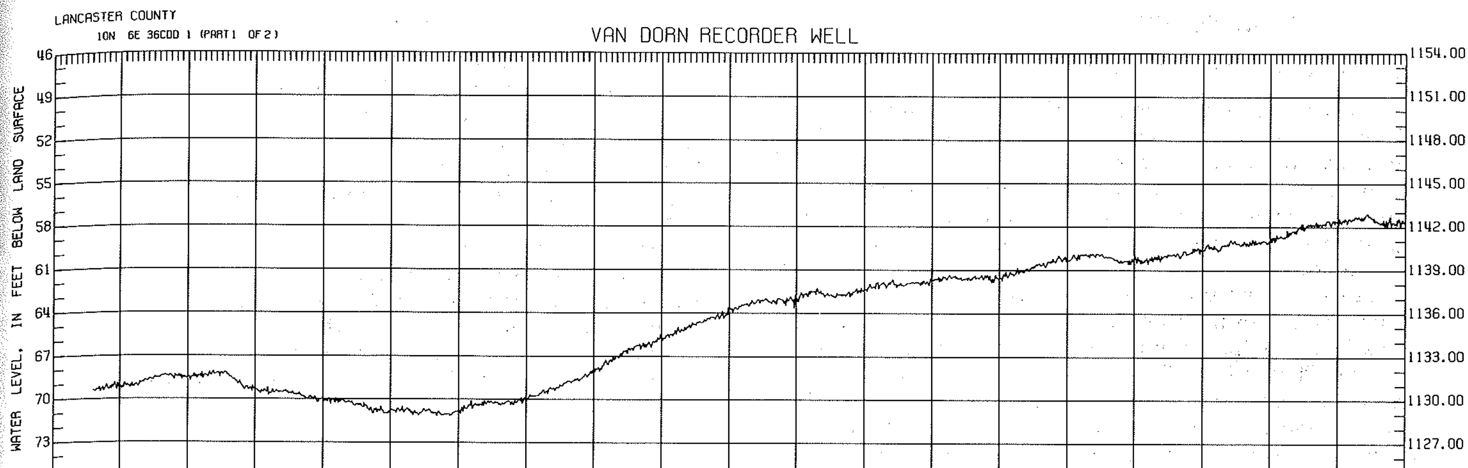
NO NET CHANGE OF WATER LEVEL

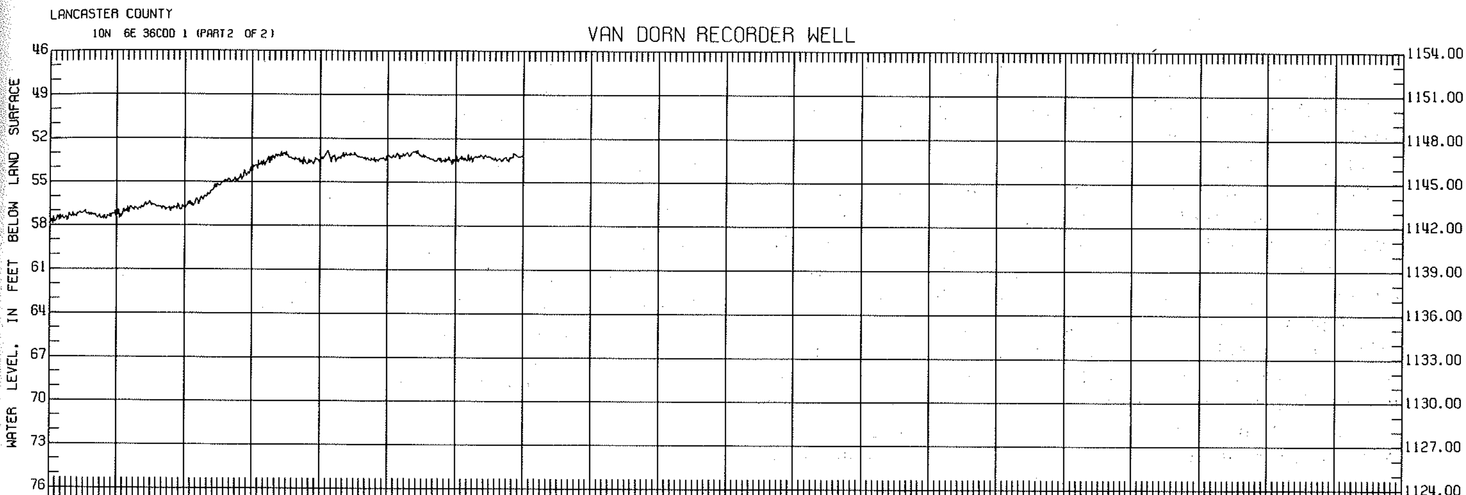
There was no significant net change in water level for 1977 although a large drop was recorded during the summer. Pumping from four nearby irrigation wells drilled in 1974 and 1975 and also from older irrigation wells in the vicinity has caused the water level to drop much lower in the summertime since 1975. The net water-level rise for the year of 0.04 ft (0.012 2 m) interrupts the declines for the preceding three years. Increased precipitation during 1977 reduced the demand for irrigation water. This is the probable cause of the interruption of the longer term trend.

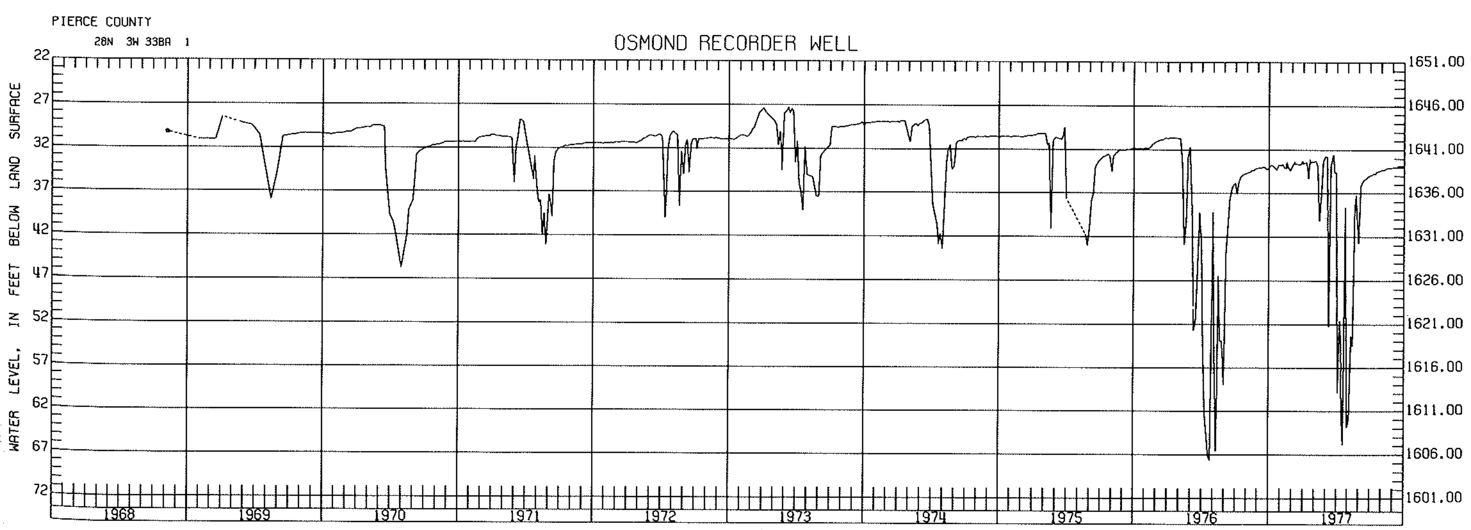
Large summertime water-level declines occurred in some years before the nearby irrigation well was drilled. The sharpness of the declines and subsequent recoveries are evidence that water in the aquifer is confined.

WELL DATA

Location: 3.6 mi (5.8 km) west of the northwest corner of Osmond
Depth: 121 ft (37.0 m)
Diameter: 6 in (152 mm)
Aquifer: Layers of sand and gravel interbedded with layers of silt and clay (undifferentiated Pleistocene deposits)
Water occurrence: Confined
Estimated predevelopment water level: 29 ft (8.8 m)
Net water-level change in 1977: +0.04 ft (+0.012 2 m)
Average annual net water-level change since 1968: −0.37 ft (−0.113 m)
Development near well: Irrigation wells; earliest in 1954, rapid development 1975; average density of irrigation wells, 2.0/mi^2 (0.77/km^2)


LANCASTER COUNTY
10N 6E 36CDD 1 (PART 1 OF 2)
VAN DORN RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
46 49 52 55 58 61 64 67 70 73 76
1154.00 1151.00 1148.00 1145.00 1142.00 1139.00 1136.00 1133.00 1130.00 1127.00 1124.00
1951 1952 1953 1954 1955 1956 1957 1958 1959 1960 1961 1962 1963 1964 1965 1966 1967 1968 1969 1970


LANCASTER COUNTY
10N 6E 36CDD 1 (PART 2 OF 2)
VAN DORN RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
46 49 52 55 58 61 64 67 70 73 76
1154.00 1151.00 1148.00 1145.00 1142.00 1139.00 1136.00 1133.00 1130.00 1127.00 1124.00
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990


PIERCE COUNTY
28N 3W 33BA 1
OSMOND RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
22 27 32 37 42 47 52 57 62 67 72
1651.00 1646.00 1641.00 1636.00 1631.00 1626.00 1621.00 1616.00 1611.00 1606.00 1601.00
1968 1969 1970 1971 1972 1973 1974 1975 1976 1977

MUD NUMBER 3 RECORDER WELL

1977 WATER-LEVEL FLUCTUATIONS SMALL

The difference between the highest and lowest water levels in this well amounted to about 2 ft (0.61 m) in 1977, whereas differences in earlier years ranged from about 3.5 to 6.9 ft (1.07 to 2.10 m). During the previous three years, the water level has not recovered seasonally as much as in past years. This year a greater seasonal recovery was recorded.

The most important causes of water-level fluctuations in this well are infiltrating precipitation, pumping from nearby municipal-supply wells, and changes in stage of the nearby Platte River. The average annual water level in this well has remained nearly the same since 1968; no downward trend is evident despite the large groundwater withdrawals in the immediate vicinity. Because the soil is highly permeable, precipitation is an effective agent of recharge at this well's location. Seepage from the Platte River also recharges the aquifer whenever the water table is lower than river level.

WELL DATA

Location: In Metropolitan Utilities District well field; 0.5 mi (0.80 km) north of the U.S. Highway 75 bridge over the Platte River, then 2.75 mi (4.40 km) west
Depth: Not recorded
Diameter: Not recorded
Aquifer: Sand and gravel (undifferentiated Pleistocene deposits)
Water occurrence: Unconfined
Estimated predevelopment water level: 13 ft (4.00 m)
Net water-level change in 1977: +0.95 ft (+0.290 m)
Average annual net water-level change: Variable; no long-term rising or declining trend
Development near well: Omaha public-supply wells (Metropolitan Utilties District)

ASHLAND RECORDER WELL

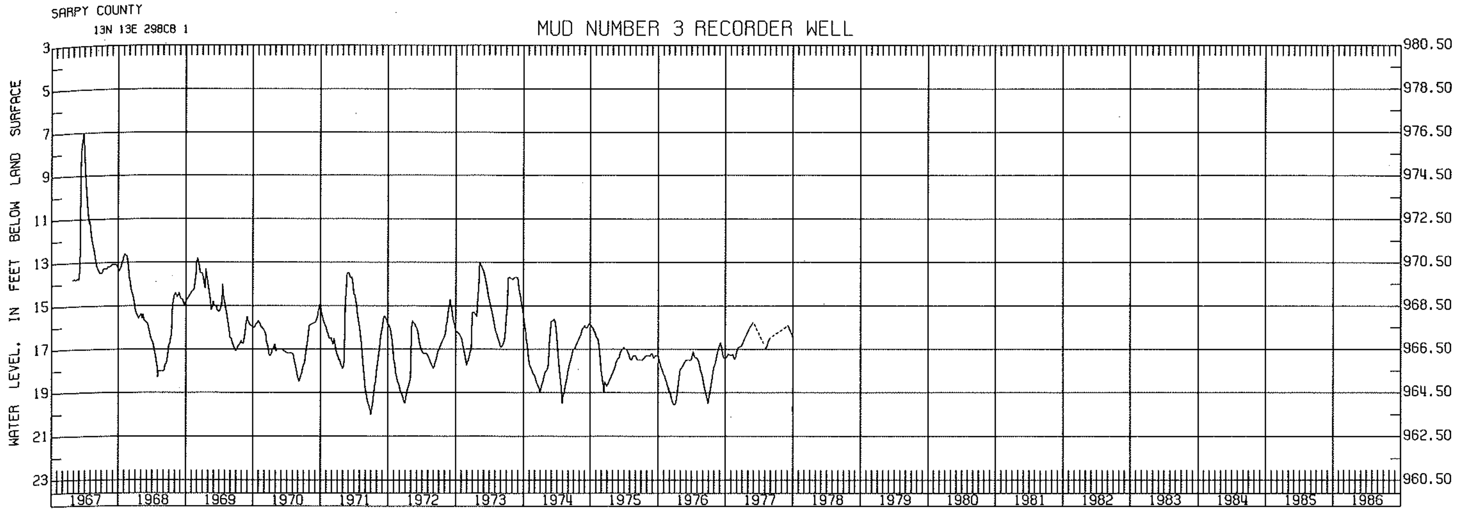
WATER-LEVEL FLUCTUATIONS SMALL IN 1977

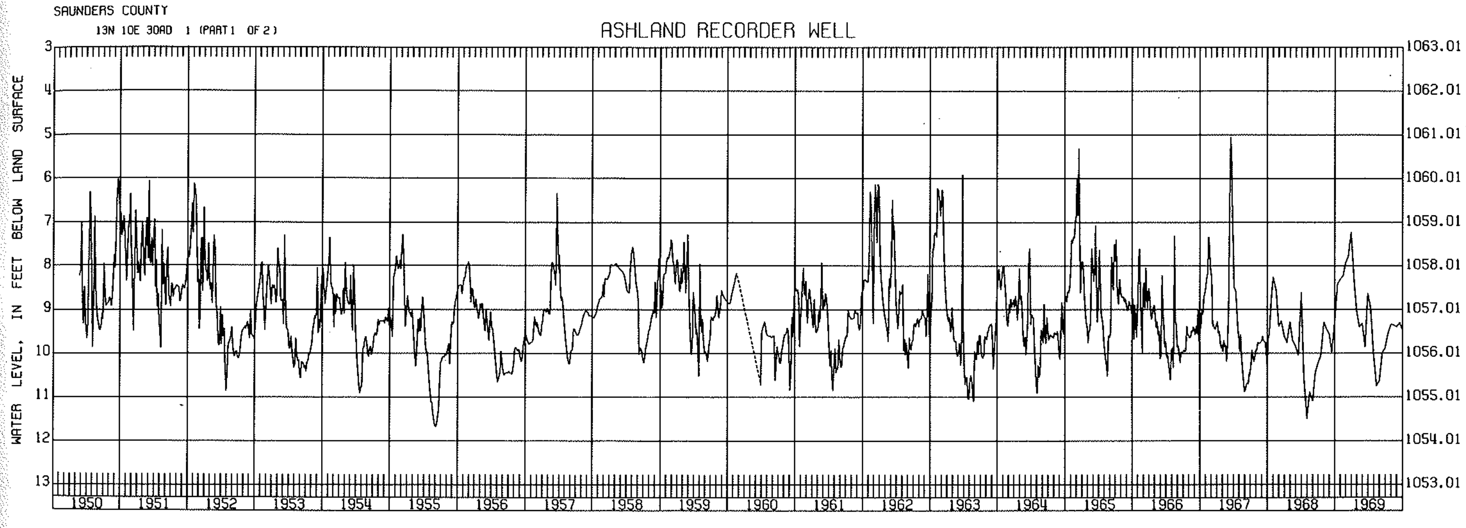
The difference between the highest and lowest water levels in this well amounted to about 2.1 ft (0.64 m), whereas differences prior to 1976 ranged from slightly less than 3 ft (0.91 m) to 6.1 ft (1.86 m). Compared to the water-level decline that occurred in August 1974, the decline in August 1977 was somewhat less and nearly the same as August 1976. A reduction in water use by Lincoln customers probably accounts for the smaller decline.

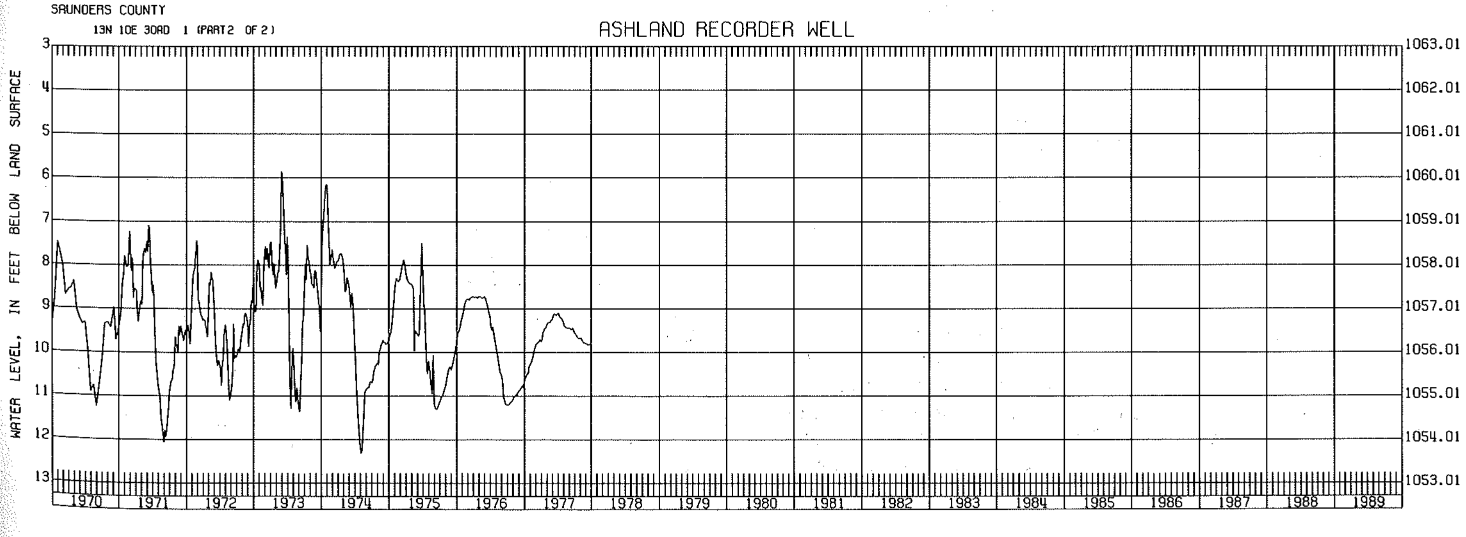
The most important causes of water-level fluctuations in this well are recharge from precipitation, pumping from nearby municipal-supply wells, and changes in stage of the nearby Platte River. The average annual water level since 1950 has remained nearly the same, no downward trend becoming established despite the large withdrawals in the immediate vicinity. Because the soil is highly permeable, precipitation is an effective agent of recharge at this well's location. Seepage from the Platte River also recharges the aquifer whenever the water table is lower than river level.

WELL DATA

Location: In the Lincoln well field, 0.9 mi (1.45 km) north of the intersection of Route 6 and Route 906, which is 2.5 mi (4.00 km) northeast of Ashland
Depth: 20 ft (6.1 m)
Diameter: 8 in (203 mm)
Aquifer: Sand and gravel (undifferentiated Pleistocene deposits)
Water occurrence: Unconfined
Estimated predevelopment water level: 9 ft (2.75 m)
Net water-level change in 1977: +0.85 ft (+0.26 m)
Average annual net water-level change: Variable; no long-term rising or declining trend
Development near well: Lincoln public-supply wells


SARPY COUNTY
13N 13E 29BCB 1
MUD NUMBER 3 RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
3 5 7 9 11 13 15 17 19 21 23
980.50 978.50 976.50 974.50 972.50 970.50 968.50 966.50 964.50 962.50 960.50
1967 1968 1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986


SAUNDERS COUNTY
13N 10E 30AD 1 (PART 1 OF 2)
ASHLAND RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
3 4 5 6 7 8 9 10 11 12 13
1063.01 1062.01 1061.01 1060.01 1059.01 1058.01 1057.01 1056.01 1055.01 1054.01 1053.01
1950 1951 1952 1953 1954 1955 1956 1957 1958 1959 1960 1961 1962 1963 1964 1965 1966 1967 1968 1969


SAUNDERS COUNTY
13N 10E 30AD 1 (PART 2 OF 2)
ASHLAND RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
3 4 5 6 7 8 9 10 11 12 13
1063.01 1062.01 1061.01 1060.01 1059.01 1058.01 1057.01 1056.01 1055.01 1054.01 1053.01
1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989

MEAD RECORDER WELL

NET WATER-LEVEL DECLINE IN 1977

The water level in this well again declined, reaching a new low near the end of 1977. The decline began abruptly during the first part of March, continuing at a slower rate to mid-October. A slight recovery of the water level occurred at the end of the year, indicating that the effect of above-normal precipitation during August, September, October, and November began to recharge the aquifer. For 1977 there was a net water-level decline of 1.20 ft (0.365 m).

The trend since 1975 has been downward. Depth to water has ranged from about 40.23 ft (12.3 m) in 1966 to about 45.45 ft (13.9 m) in 1977 since the beginning of the water-level record for this well and the well it replaced.

WELL DATA

Location: 4 mi (6.4 km) south of the intersection of Route 92 and Route 692 near Mead, then 0.65 mi (1.05 km) east and 0.4 mi (0.64 km) south of the south end of load line 2 of the Mead Field Station
Depth: 80 ft (24.4 m)
Diameter: 6 in (152 mm)
Aquifer: Sand and gravel (undifferentiated Pleistocene deposits) and underlying sandstone (Dakota Group)
Water occurrence: Unconfined
Estimated predevelopment water level: 40 ft (12.2 m)
Net water-level change in 1977: −1.20 ft (−0.365 m)
Average annual net water-level change since 1964: −0.20 ft (−0.061 m)
Development near well: Irrigation wells; most drilled in late 1960s and early 1970s for The University of Nebraska's Mead Field Laboratory; average density of irrigation wells, 1/mi^2 (0.385/km^2)

SCOTTSBLUFF RECORDER WELL

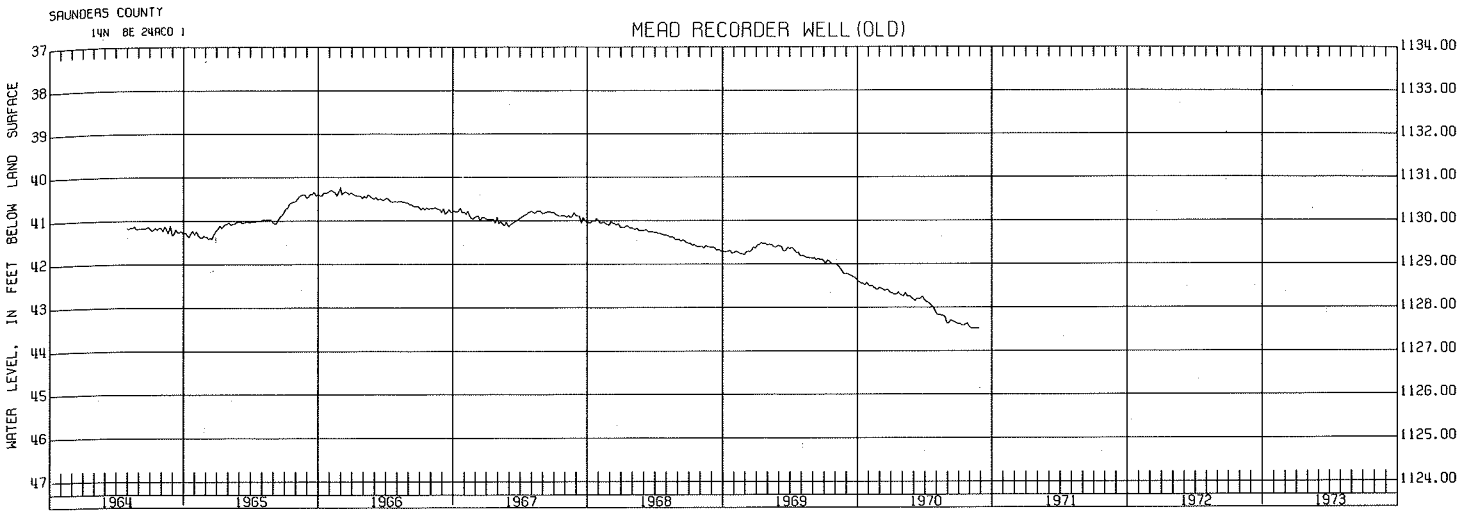
NORMAL SUMMER RISE DISRUPTED

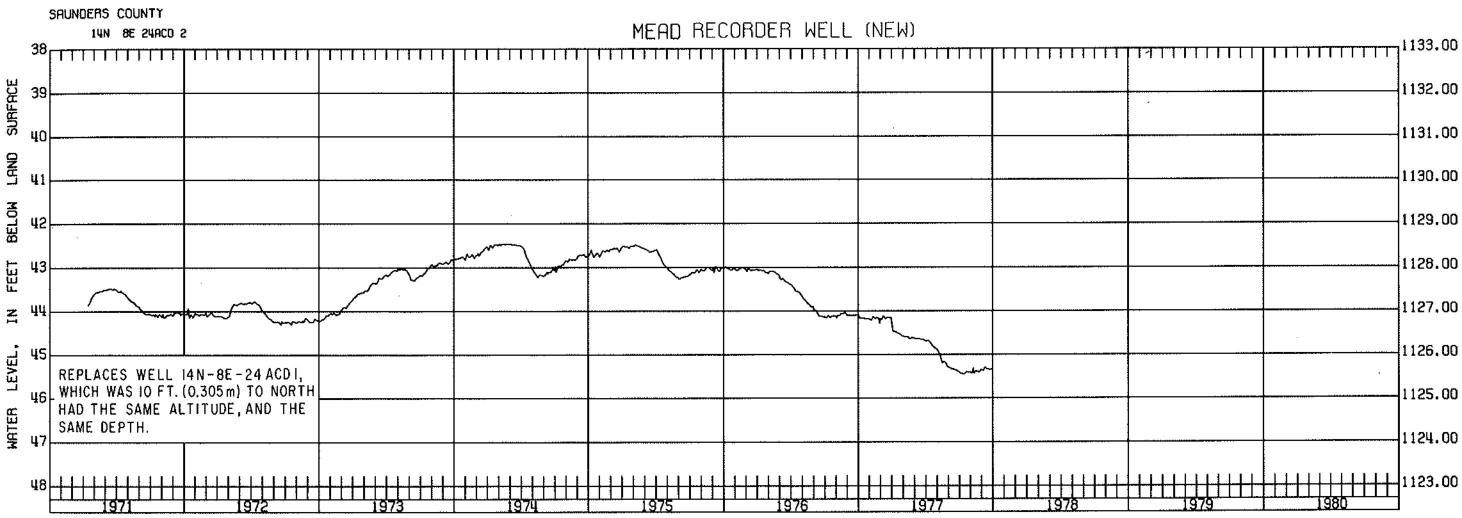
Recharge from applied irrigation water usually causes a summertime rise of the water level in this well. A rise did begin in June following a steady water-level decline that started in late September 1976. Pumping from nearby wells including some new wells significantly interrupted the usually steady rise experienced in past years. As a result, summer water levels did not reach the highs of previous summers.

During the period of record, the pre-irrigation low water level has ranged between depths of about 25.9 to 26.5 ft (7.9 to 8.1 m). The range of late-summer high water levels has been considerably greater — from depths of about 23.0 to 25.6 ft (7.9 to 8.1 m). Only the 1970 and 1975 year-end water levels were less than 25.0 ft (7.6 m). In all other years of record, the year-end water level has been between 25.0 and 25.8 ft (7.6 and 7.9 m).

WELL DATA

Location: 0.5 mi (0.80 km) north of the west intersection of Route 71 and Route 26 in Scottsbluff, then 0.8 mi (1.29 km) east
Depth: 32 ft (9.8 m)
Diameter: 6 in (153 mm)
Aquifer: Sand and gravel (undifferentiated Pleistocene deposits)
Water occurrence: Unconfined
Estimated predevelopment water level: 26 ft (7.9 m)
Net water-level change in 1977: −0.53 ft (−0.162 m)
Average annual net water-level change since 1962: Variable; no long-term rise or decline
Development near well: Irrigation wells; earliest in 1937, rapid development 1975 and 1977; average density of irrigation wells, 2.0/mi^2 (0.77/km^2); city of Scottsbluff municipal-supply wells to south; Enterprise Canal within 0.2 mi (0.320 km) to south


SAUNDERS COUNTY
14N 8E 24ACO 1
MEAD RECORDER WELL (OLD)
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
37
38
39
40
41
42
43
44
45
46
47
1134.00
1133.00
1132.00
1131.00
1130.00
1129.00
1128.00
1127.00
1126.00
1125.00
1124.00
1964
1965
1966
1967
1968
1969
1970
1971
1972
1973


SAUNDERS COUNTY
14N 8E 24ACO 2
MEAD RECORDER WELL (NEW)
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
REPLACES WELL 14N-8E-24 ACD1, WHICH WAS 10 FT. (0.305 m) TO NORTH HAD THE SAME ALTITUDE, AND THE SAME DEPTH.
38
39
40
41
42
43
44
45
46
47
48
1133.00
1132.00
1131.00
1130.00
1129.00
1128.00
1127.00
1126.00
1125.00
1124.00
1123.00
1971
1972
1973
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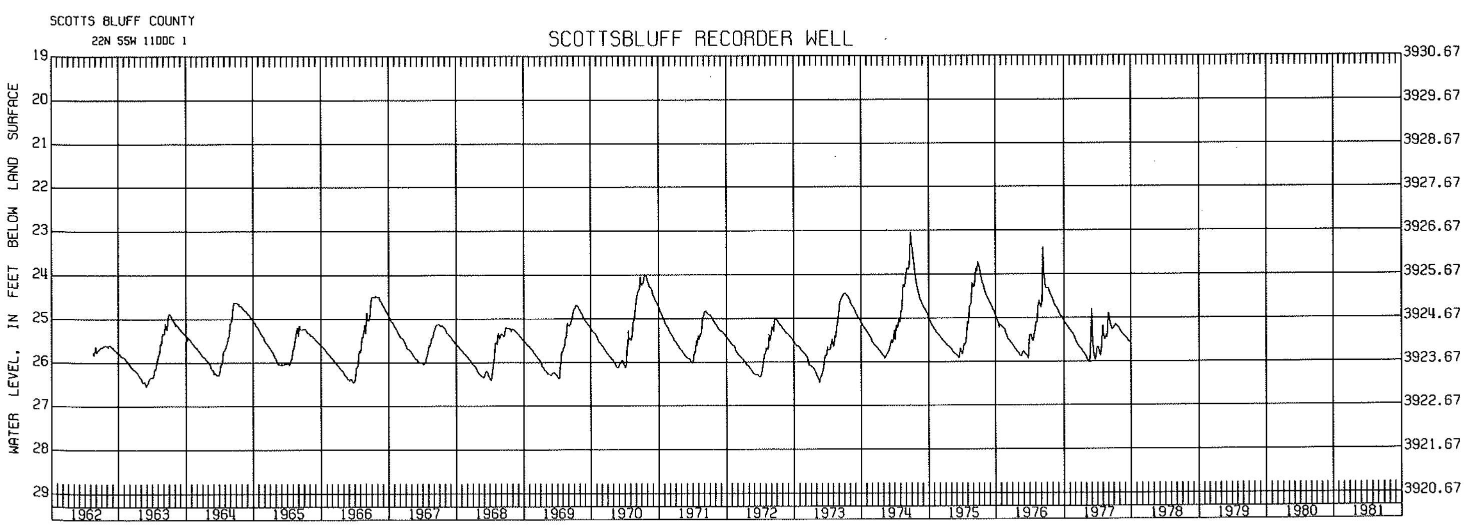
1975
1976
1977
1978
1979
1980


SCOTTS BLUFF COUNTY
22N 55W 11DDC 1
SCOTTSBLUFF RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
19
20
21
22
23
24
25
26
27
28
29
3930.67
3929.67
3928.67
3927.67
3926.67
3925.67
3924.67
3923.67
3922.67
3921.67
3920.67
1962
1963
1964
1965
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1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981

MIRAGE FLATS RECORDER WELL

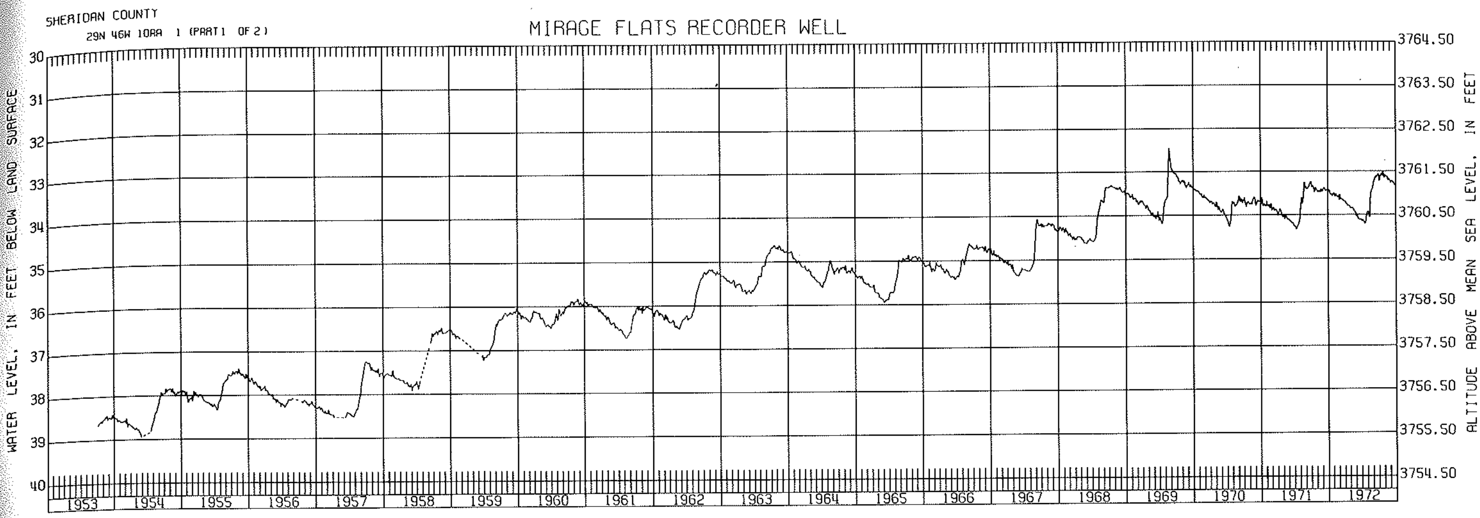
WATER LEVEL DECLINES FOR FOURTH YEAR

The water-level decline that began in this well during 1974 continued through 1977 but at a reduced rate. This continued decline reflects the increasing development in the area. Adequate precipitation during 1977 reduced the rate of decline experienced over the last few years.

Generally the annual pattern of water-level change during the period 1954-73 was downward during the first six months, sharply upward for the next two months, then downward again for the remainder of the year. The summertime rises were caused by recharge from canal seepage and surface water applied for irrigation, and the subsequent declines were due to lateral movement of the groundwater toward water-table depressions and toward the Niobrara River. Because the sum of the yearly rises exceeded the sum of the yearly declines, the long-term water-level trend was upward until 1973.

WELL DATA

Location: At Mirage Flats Project Headquarters, 11.5 mi (18.5 km) south of Hay Springs
Depth: 100 ft (30.5 m)
Diameter: 6 in (152 mm)
Aquifer: Sandstone (Ogallala Formation)
Water occurrence: Unconfined
Estimated predevelopment water level: 38.5 ft (11.7 m)
Net water-level change in 1977: −0.46 ft (−0.140 m)
Average annual net water-level change since 1953: +0.11 ft (+0.033 5 m)
Development near well: Irrigation wells; earliest in 1954, rapid development 1954, 1956, 1961, and 1976–77; average density of irrigation wells, 3.0/mi^2 (1.16/km^2); lateral of the Mirage Flats Irrigation District about 0.3 mi (0.483 km) to the northwest, another lateral about same distance to the southeast


SHERIDAN COUNTY
29N 46W 10AA 1 (PART1 OF 2)
MIRAGE FLATS RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
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37
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39
40
3764.50
3763.50
3762.50
3761.50
3760.50
3759.50
3758.50
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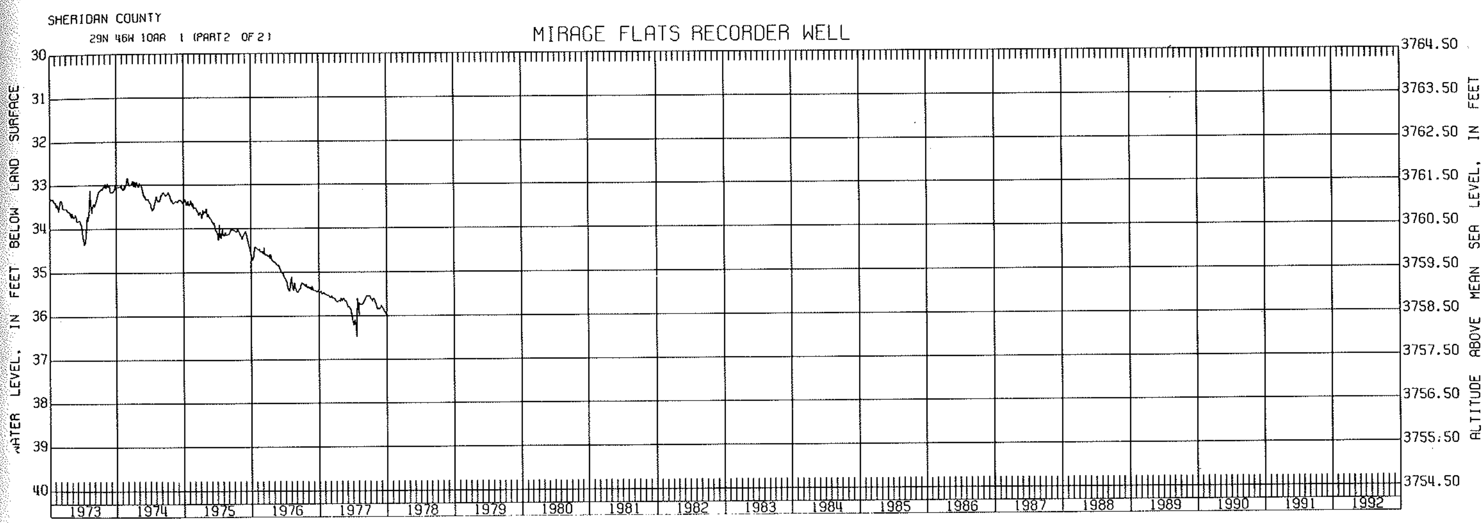
SHERIDAN COUNTY
29N 46W 10AA 1 (PART2 OF 2)
MIRAGE FLATS RECORDER WELL
WATER LEVEL, IN FEET BELOW LAND SURFACE
ALTITUDE ABOVE MEAN SEA LEVEL, IN FEET
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3764.50
3763.50
3762.50
3761.50
3760.50
3759.50
3758.50
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1992

3.0 WATER-LEVEL MEASUREMENT PROGRAM, 1977

More than 16,000 water-level measurements made in Nebraska during 1977 provide the basic data for this report.

3.1 Location of Observation Wells and Availability of Data

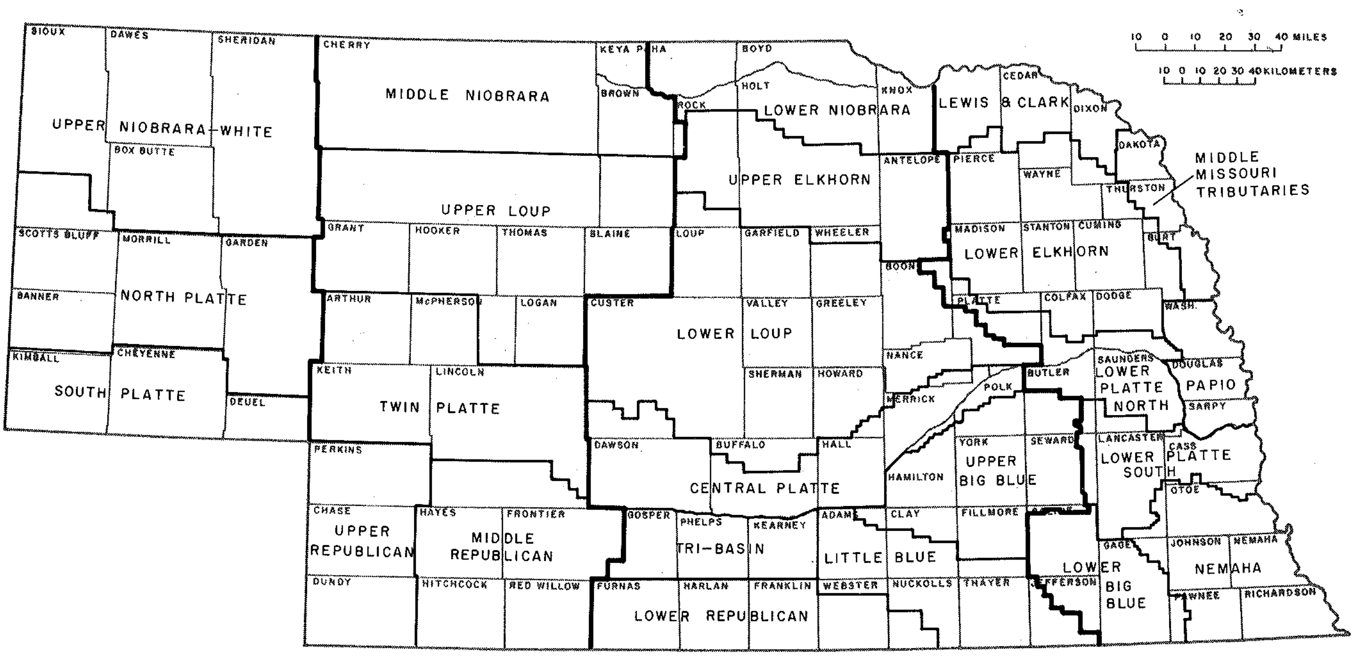
More than 16,000 water-level measurements made during 1977 in almost 4,500 observation wells were available for use in the preparation of this report. Observation-well networks are operated in Nebraska by 33 different agencies and associations for the purpose of obtaining water-level data for a variety of specific needs. The different needs and interests in water-level data are reflected by the nonuniform distribution of observation wells. The number of observation wells per county ranges from one or two in several counties to more than 100 in others.

Locations of all observation wells in which fall 1977 water-level measurements were made and for which data are available in the files of the U.S. Geological Survey and the Conservation and Survey Division are shown on the four segments of a state map included in this section of the report. Data from these wells provided the basis for most of the information presented herein. Records of the water-level measurements made in these observation wells may be obtained, upon request, from the Conservation and Survey Division, The University of Nebraska, 113 Nebraska Hall, Lincoln, Nebraska 68588.

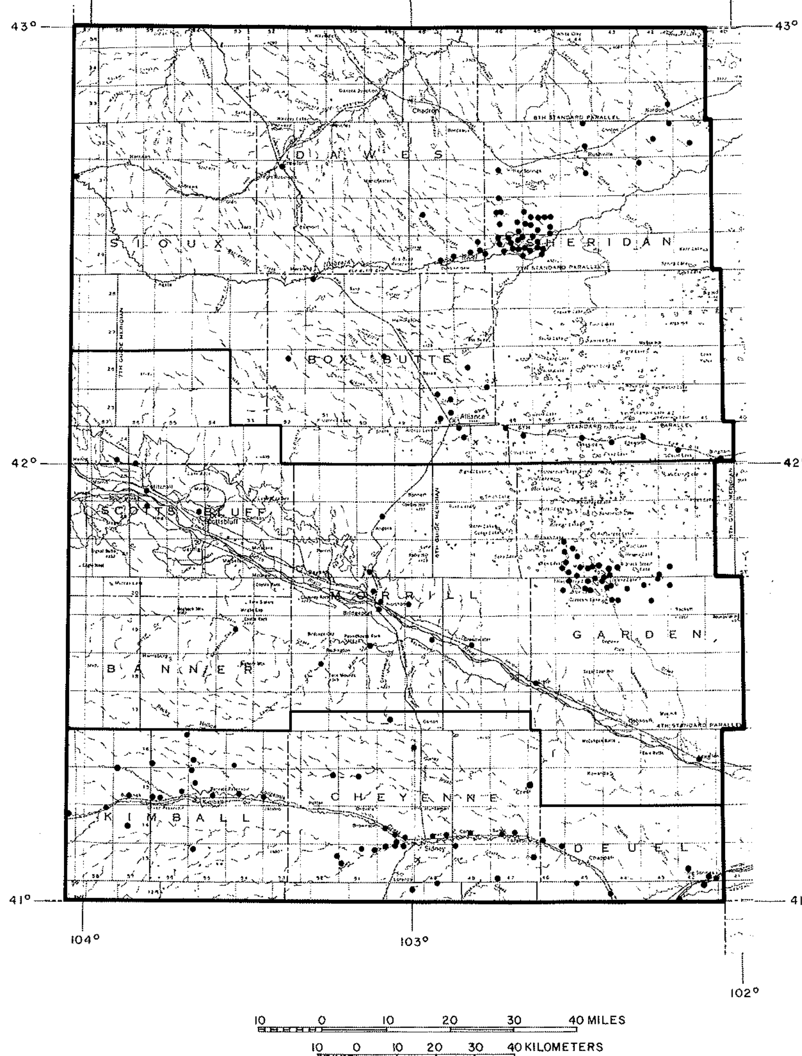
As part of the cooperative groundwater investigation program of the U.S. Geological Survey and the Conservation and Survey Division, a statewide water-level measurement program was inaugrated in 1930. Initially this program consisted of an observation-well network to provide long-term data on changes in the amount of groundwater in storage and to detect areas where changes in water levels indicated problems might occur. The original observation-well network was designed to provide data for a generalized appraisal of the state's groundwater resources, hence a need to obtain detailed water-level data for specific areas led to the establishment of a number of local observation-well networks.

The need for water-level data to use in planning and evaluating the development of Nebraska's groundwater resources has changed the original cooperative water-level measurement program considerably. Currently the program not only provides for operation of the statewide observation-well network but also provides for assistance and advice to other agencies and associations in the establishment and operation of local observation-well networks, the operation and maintenance of a computer storage-and-retrieval system for water-level data from all networks, and the evaluation and dissemination of water-level data.

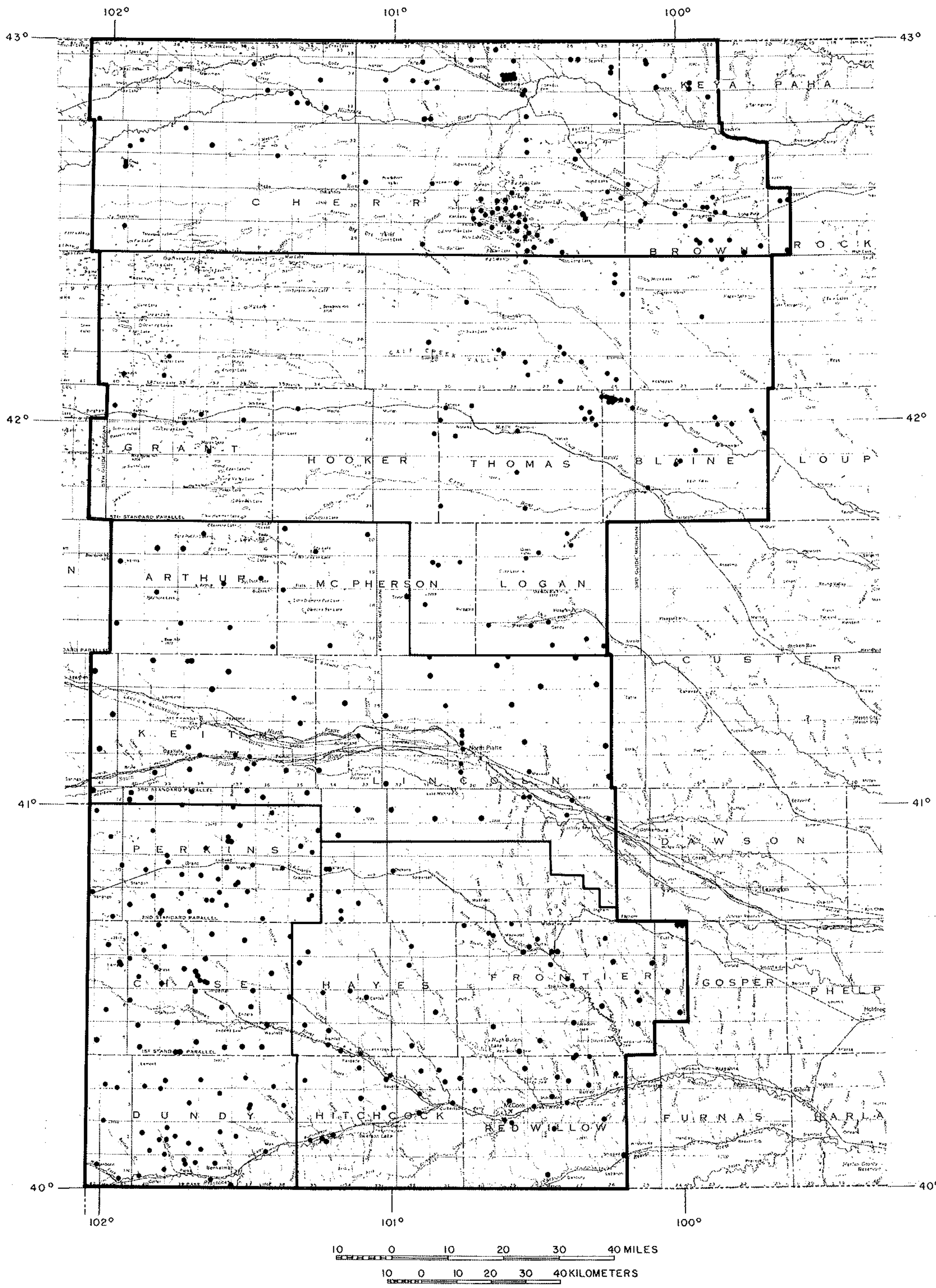
The cooperation and assistance of the following agencies and associations in collecting and providing water-level data during 1977 is gratefully acknowledged: U.S. Bureau of Reclamation; U.S. Fish and Wildlife Service; Nebraska Department of Water Resources; Big Blue River Compact Administration; Lower Republican, Middle Republican, Upper Republican, Upper Big Blue, Little Blue, Central Platte, Twin Platte, South Platte, Lower Niobrara, Middle Niobrara, Upper Niobrara-White, Lower Loup, Upper Loup, Lower Elkhorn, Upper Elkhorn, Middle Missouri Tributaries, Lewis and Clark, Nemaha, and Tri-Basin Natural Resources Districts; Central Nebraska Public Power and Irrigation District; South-Central Nebraska Pump Irrigators Association; Clay County, Fillmore County, Hamilton County, Seward County, and York County Ground Water Conservation Districts; Lincoln Water System; and Omaha Municipal Utilities District.



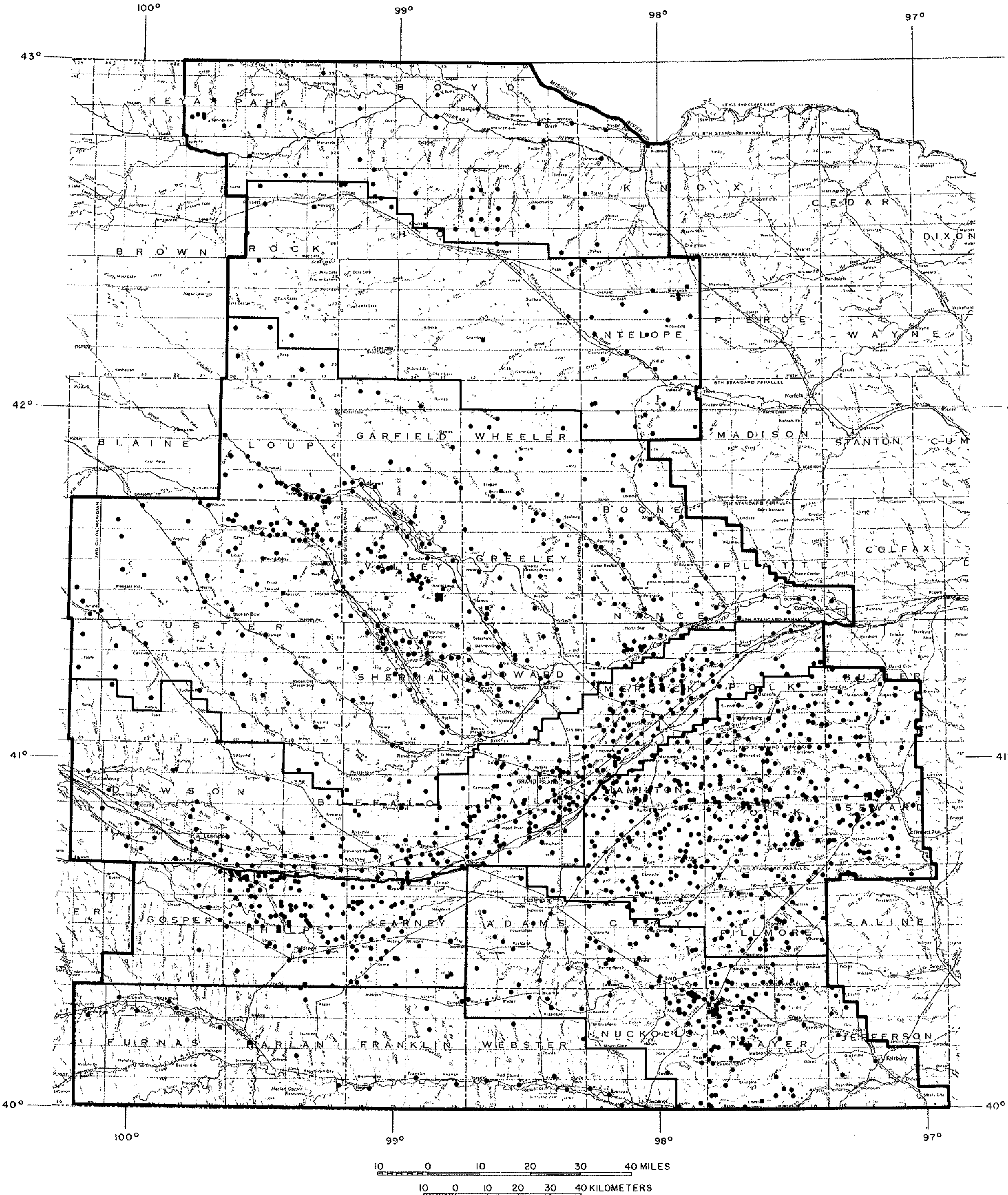
Nebraska Natural Resources Districts and boundaries (shown by heavy, dark lines) of following maps showing location of water-level observation wells



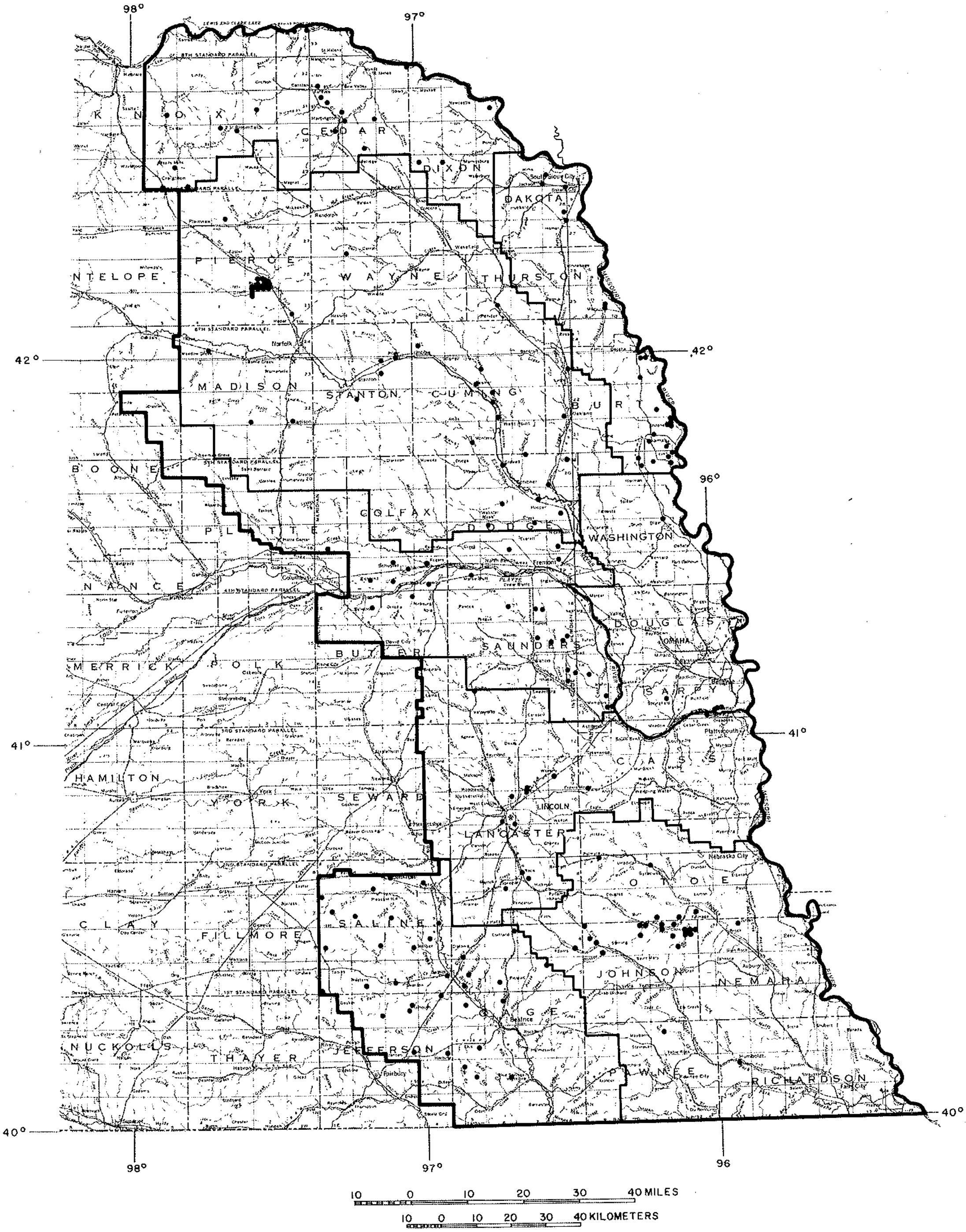
Location of water-level observation wells in Upper Niobrara-White, North Platte, and South Platte Natural Resources Districts



Location of water-level observation wells in Middle Niobrara, Upper Loup, Twin Platte, Upper Republican, and Middle Republican Natural Resources Districts



Location of water-level observation wells in Lower Niobrara, Upper Elkhorn, Lower Loup, Central Platte, Upper Big Blue, Little Blue, and Lower Republican Natural Resources Districts



Location of water-level observation wells in Lewis and Clark, Middle Missouri River Tributaries, Lower Elkhorn, Lower Platte North, Lower Platte South, Lower Big Blue, and Nemaha Natural Resources Districts

3.0 WATER-LEVEL MEASUREMENT PROGRAM (continued)

3.2 Changes in Program and Other Activities During 1977

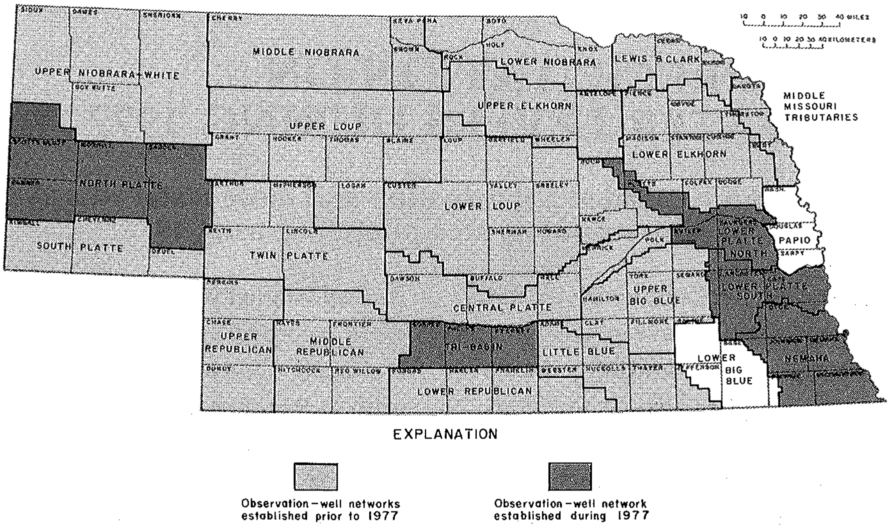
Establishment of local observation-well networks by the North Platte, Tri-Basin, Nemaha, Lower Platte North, and Lower Platte South Natural Resources Districts was the most significant change in the state's water-level measurement program. More than 200 observation wells in the networks established by these five natural resources districts were measured for the first time in 1977. In future years, data from these wells will provide a better basis for evaluating the significance of water-level changes in many parts of the state where groundwater development for irrigation is taking place.

Other changes in the water-level measurement program related to observation-well activities during 1977 were mostly of a routine nature, such as changing the frequency of measurements in some wells and replacing destroyed or nonfunctioning observation wells. However, one recorder well and one replacement recorder well were installed in areas where pumping of groundwater for irrigation is significantly affecting water levels. Sufficient data were not available for inclusion in this report of the hydrograph for the new Cook recorder well in Johnson County. A hydrograph for the replacement recorder well in Shickley is included in section 2.1.

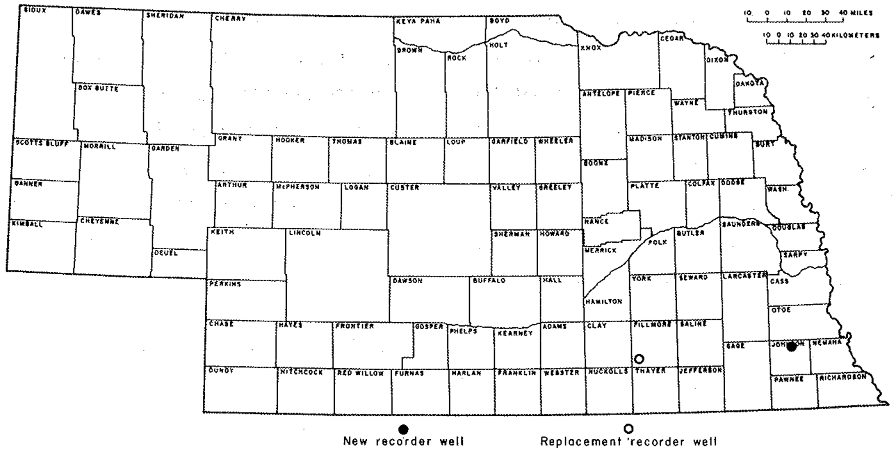
Other activities in the water-level measurement program during 1977 included making mass water-level measurements and entering historical water-level information into the computerized file system maintained by the U.S. Geological Survey and the Conservation and Survey Division.

Mass water-level measurement is the practice of measuring water levels in a large number of wells within the shortest possible time in order to obtain data representative of nearly uniform hydrologic conditions. During the spring of 1977 mass measurements were made in about 200 wells in Frontier, Hayes, and Lincoln counties to provide data for a hydrogeologic study of the area between the Platte and Republican rivers in Lincoln, Hayes, Frontier, Red Willow, and Hitchcock counties. A similar measurement was made in JohnsonCounty.

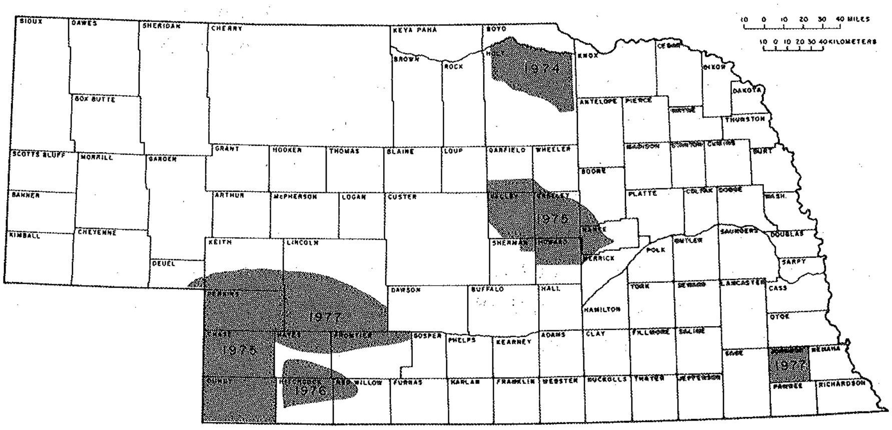
Historical water-level data were entered into the computerized file system for about 400 wells in the Republican River basin of southwest Nebraska and for approximately 70 other wells scattered throughout the state. Most of the data for wells in the Republican River basin are measured on a regular basis by local irrigation districts. Data in the computerized file system are readily available and can be used, with existing computer programs, to delineate areas where significant water-level changes have occurred.



Natural Resources Districts having a network of observation wells, fall 1977



Location of water-level recorder wells installed or replaced in 1977



Areas where mass water-level measurements have been made since 1974; number indicates year in which measurements were made

4.0 EFFECT OF PRECIPITATION ON GROUNDWATER LEVELS DURING 1977

Less groundwater was needed for irrigation and more water was available for recharge because of above normal precipitation during 1977.

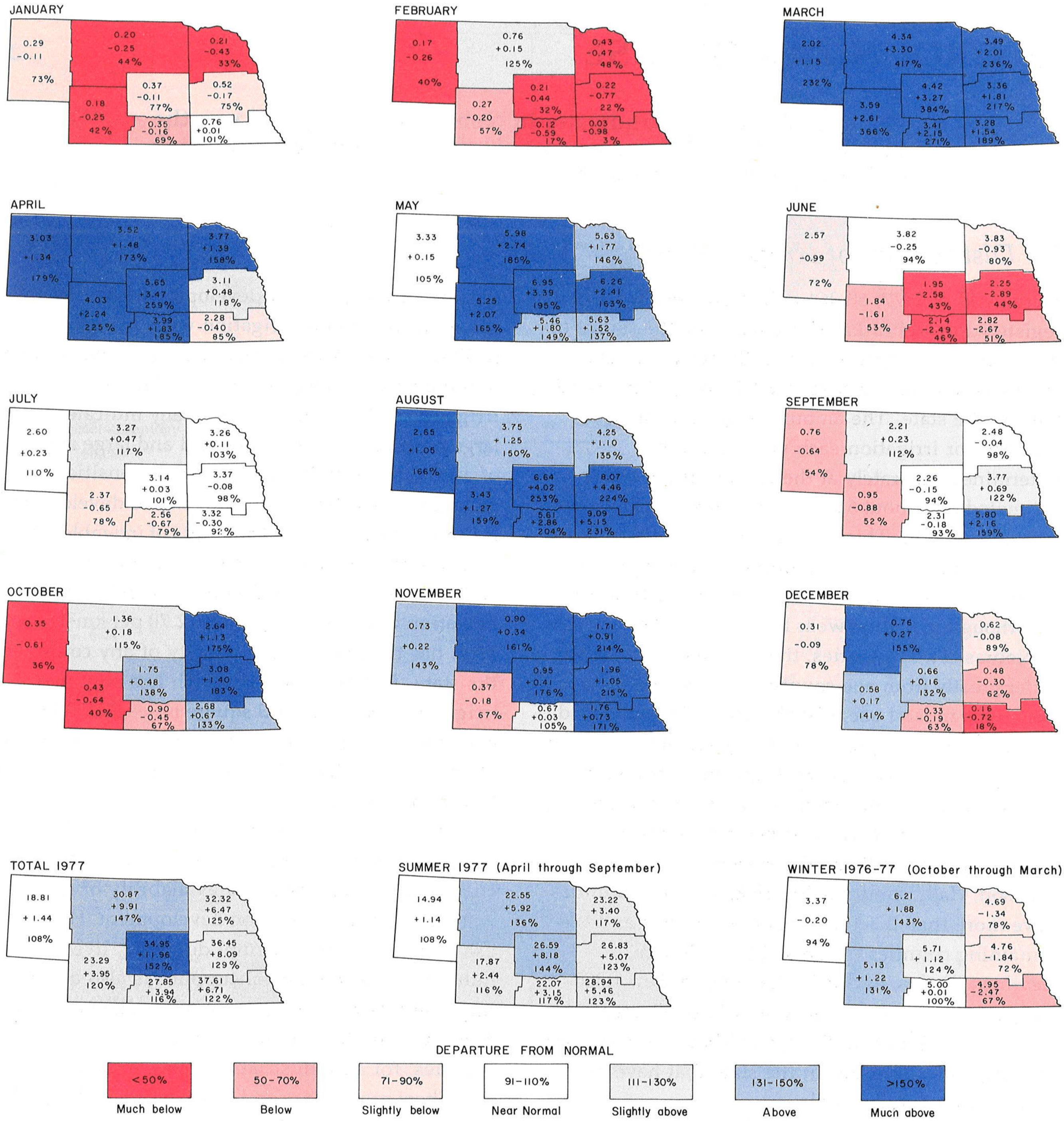
Although the year began dry, soil-moisture deficits were made up by the normal-to-above-normal precipitation during March, April, and May. Some recharge to groundwater supplies also occurred at this time. Pumping of groundwater for irrigation was required by early summer because of below-normal precipitation in all Nebraska's National Weather Service divisions during June. Most pumping stopped when precipitation was much above normal in all National Weather Service divisions during August. Unfortunately, this abundant rainfall was too late for dryland crops in extreme southeastern Nebraska where several years of continuous drought took its toll of crops. Heavy demands were made on the groundwater resources of this area where irrigation was possible. Near-normal to above-normal precipitation continued for the rest of the year except for the Panhandle and Southwest divisions. Precipitation during September and October is important annually in replenishing soil moisture and providing recharge to the groundwater reservoir.

Several major periods of precipitation affected groundwater levels during 1977. The first major storm started with heavy wet snow in the panhandle area of the state on March 10. By March 11 the storm had spread over the entire state with all weather stations reporting rain and/or snow. Snowfall was heaviest, 10 to 20 inches (255 to 510 mm), along a path from the Imperial-Sidney area to the Gordon-Valentine area. Precipitation amounts were above normal during the next two months with a maximum of 6.43 inches (163 mm) reported at the North Loup station in April and a maximum of 9.78 inches (248 mm) reported at the Ellsmere 9ENE station in May. The next major precipitation was during August when record amounts of precipitation were recorded at many stations. Among these were Nebraska City with 13.78 inches (350 mm), Auburn with 11.9 inches (300 mm), and David City with 11.04 inches (280 mm).

Precipitation continued above normal in eastern Nebraska during September with a high of 7.77 inches (197 mm) recorded at Grand Island. The first major snow of the 1977-78 winter fell on November 8 and 9 with amounts ranging from 3 to 10 inches (76 to 254 mm) in the western, northern, and eastern parts of the state. Several snowfalls were recorded in December with 1 to 5 inches (25.5 to 127 mm) total along the southern border of the state and 2 to 13 inches (51 to 330 mm) elsewhere.

The above-normal precipitation for the year resulted in groundwater level declines that were less than that experienced over the last few years. Not only was there increased recharge but also less water was pumped for irrigation, municipal, and other uses.

Almost all recharge to aquifers in Nebraska comes from precipitation that infiltrates into the ground at or near the point where it falls. In some localities, however, seepage from streams, lakes, irrigation canals, and applied irrigation water may be a more important source. No precise quantitative relationship between precipitation amounts and resultant changes in groundwater levels in the state has been determined, but a rough correlation between water-level fluctuations and precipitation can often be noted in the records. Precipitation amounts can also affect water levels indirectly, since quantities of groundwater pumped for irrigation and municipal use generally are less during wet periods and greater during dry periods.



Summary of monthly, seasonal, and total precipitation in 1977 for eight National Weather Service divisions of Nebraska showing average precipitation amounts in inches, departure (+ or −) from normal precipitation in inches, and the percentage of normal precipitation

5.0 GROUNDWATER USE

The largest use of groundwater in Nebraska during 1977 was the approximately 6 million acre-feet (7 km^3) pumped from the state's 60,064 registered irrigation wells.

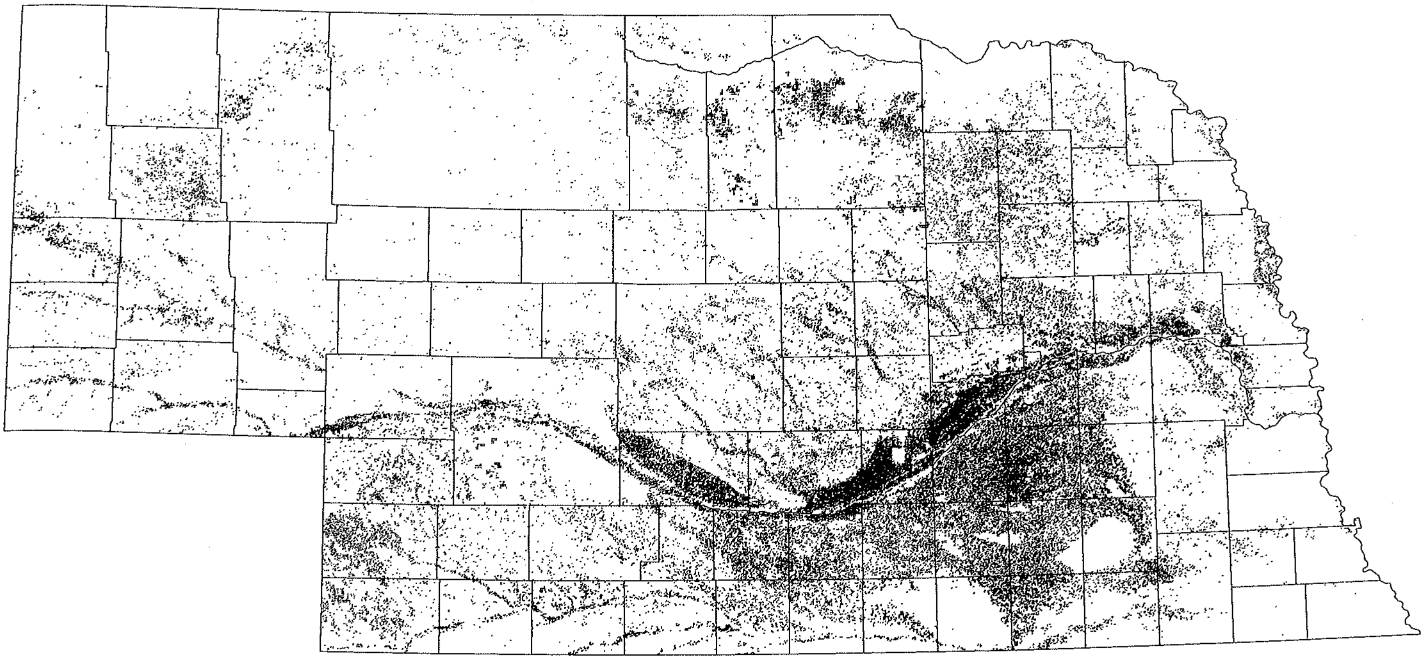
5.1 Distribution of Irrigation Wells

At the end of 1977, 60,064 irrigation wells had been registered in Nebraska. These wells are the source of water used in irrigating almost 83 percent of the estimated 6.4 million acres (26 000 km^2) of irrigated land in the state. The amount of groundwater pumped for irrigation each year cannot be determined accurately at the present time, but it is estimated that about 6 million acre-feet (7.4 km^3) was pumped in 1976. This amount is several times more than the total amount of groundwater pumped for domestic, livestock, municipal, and industrial use.

Although irrigation wells have been drilled in each of Nebraska's 93 counties, their number and density differ greatly from one county to another because of variations in land use, distribution of irrigable land, and availability of groundwater. About 43 percent of the registered irrigation wells are concentrated in a 12-county area comprising the upper part of the Big Blue River and Little Blue River basins and the central part of the Platte River valley. Buffalo, Dawson, Hall, Hamilton, Merrick, and York counties have more than 2,300 irrigation wells each and the remaining counties (Adams, Clay, Fillmore, Kearney, Phelps, and Polk) have more than 1,300 irrigation wells each. Antelope, Chase, Custer, Dodge, Holt, Lincoln, Platte, and Thayer counties are the only other counties in the state that have more than 1,000 irrigation wells.

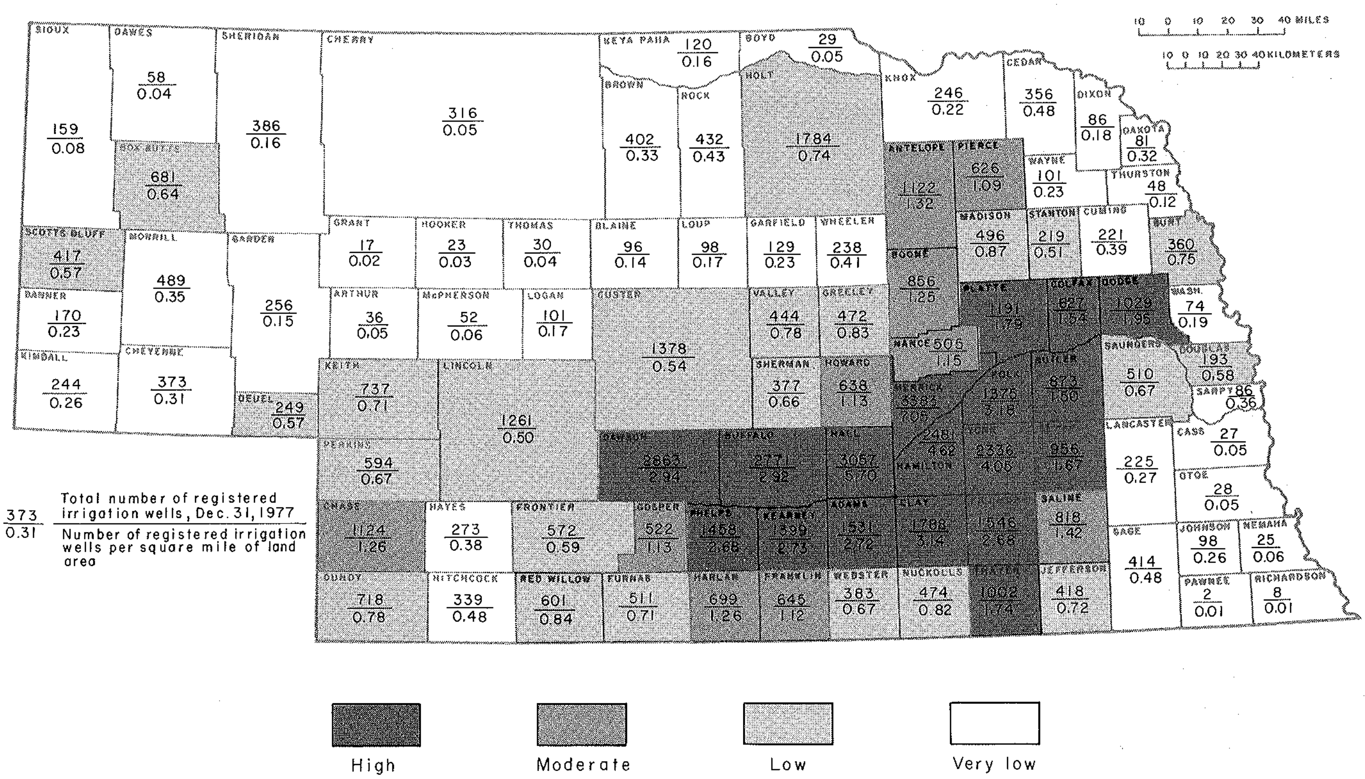
Although the total number of irrigation wells in a given county provides some indication of the amount of groundwater development that has taken place, the number of irrigation wells per square mile (2.59 km^2) of land area in that county is a better index of the degree of development. A high density of irrigation wells in a county generally indicates both a large percentage of irrigable land and large amounts of available groundwater. Very low densities generally characterize counties where development is limited either by small amounts of irrigable land or by aquifers that yield only small amounts of water to wells, or both. Merrick County, averaging 7.05 irrigation wells per square mile (2.70 per km^2) of land area, has the highest well density of any county in the state. Pawnee County, which has only two irrigation wells in its 433 square miles (1 120 km^2) of land area, has the lowest well density — an average of about one well per 217 square miles (one well per 560 square kilometers).

By far the largest use of groundwater in Nebraska is for irrigation, and most of the concern about changes in water levels and availability of groundwater is related to irrigation development. However, use of groundwater for rural domestic, livestock, industrial, and municipal supplies is also quite important. Groundwater is used for almost all rural domestic supplies in the state; for most livestock supplies; for all industrial supplies, except some sugar beet processing; and for all municipal supplies, except for Crawford, Beaver Lake, and part of Omaha's supply.



Total wells registered January 1, 1978:
60,064

Location of registered irrigation wells in Nebraska as of December 31, 1977



Total number and density of registered irrigation wells in Nebraska, by counties, as of December 31, 1977

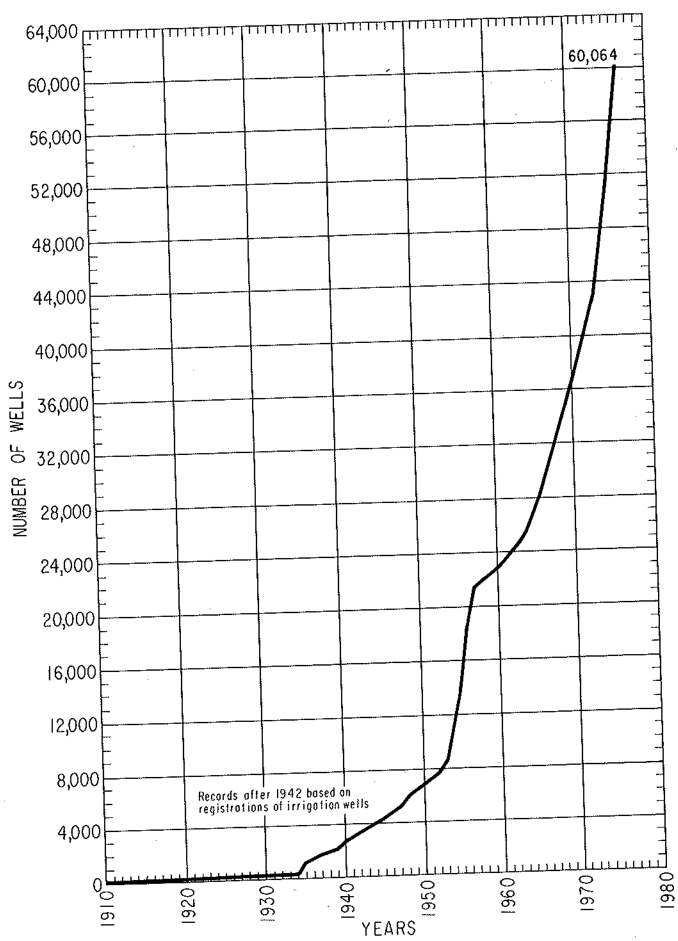
5.0 GROUNDWATER USE (continued)

5.2 Trends in Groundwater Use

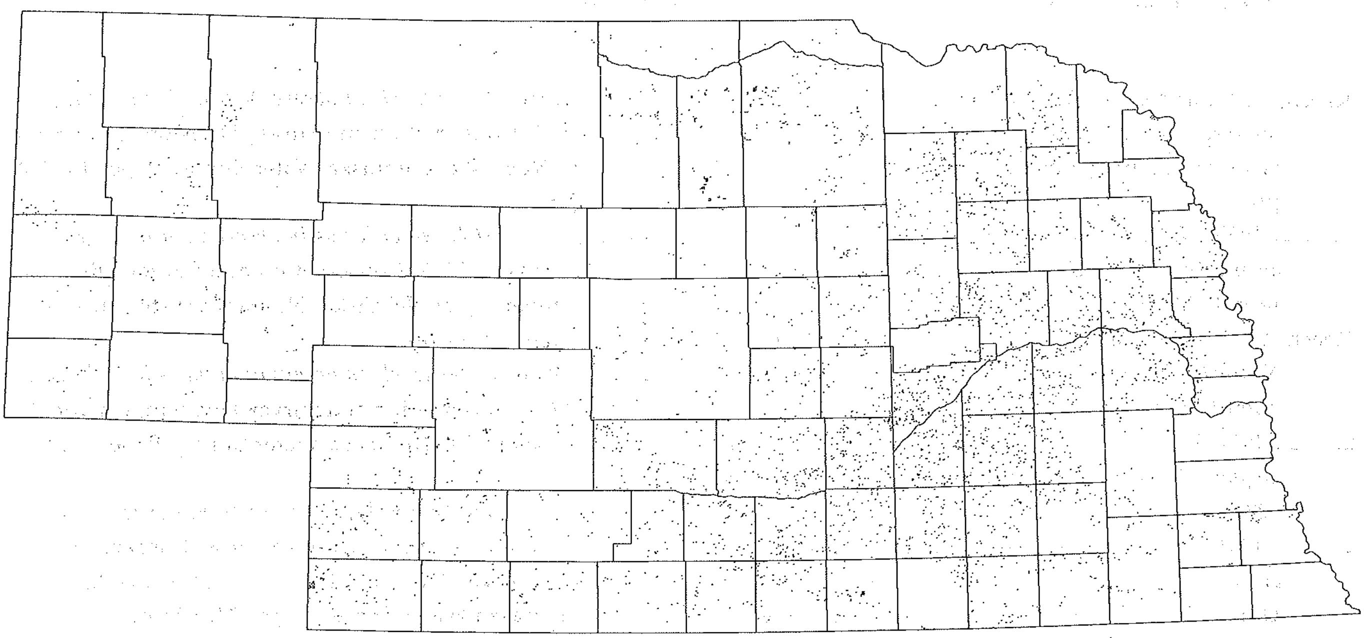
During 1977, installation of new irrigation wells continued at a moderate rate. As of December 31, 1977, a total of 3,321 irrigation wells drilled during the year had been registered with the Nebraska Department of Water Resources. An additional 1,754 irrigation wells drilled in earlier years also were registered during 1977. Probably several hundred wells drilled during the year will not be registered until 1978. The number of wells drilled in 1977 was exceeded only in 1956, 1957, 1974, 1975, and 1976. New wells were registered in all the state's 93 counties except Grant, Hooker, Pawnee, and Thomas. One hundred or more new wells were drilled in each of six counties (Merrick, 134; Holt, 121; Hall, 112; Hamilton, 112; Buffalo, 106; and York, 100).

The annual number of new irrigation wells is related to many factors, the most apparent being climatic conditions. During the years when precipitation was markedly below normal, especially during the growing season in the years 1952-56, 1966, and 1974-76, the number of irrigation-well installations increased. The increased drilling often continues for a year or more after the drought period.

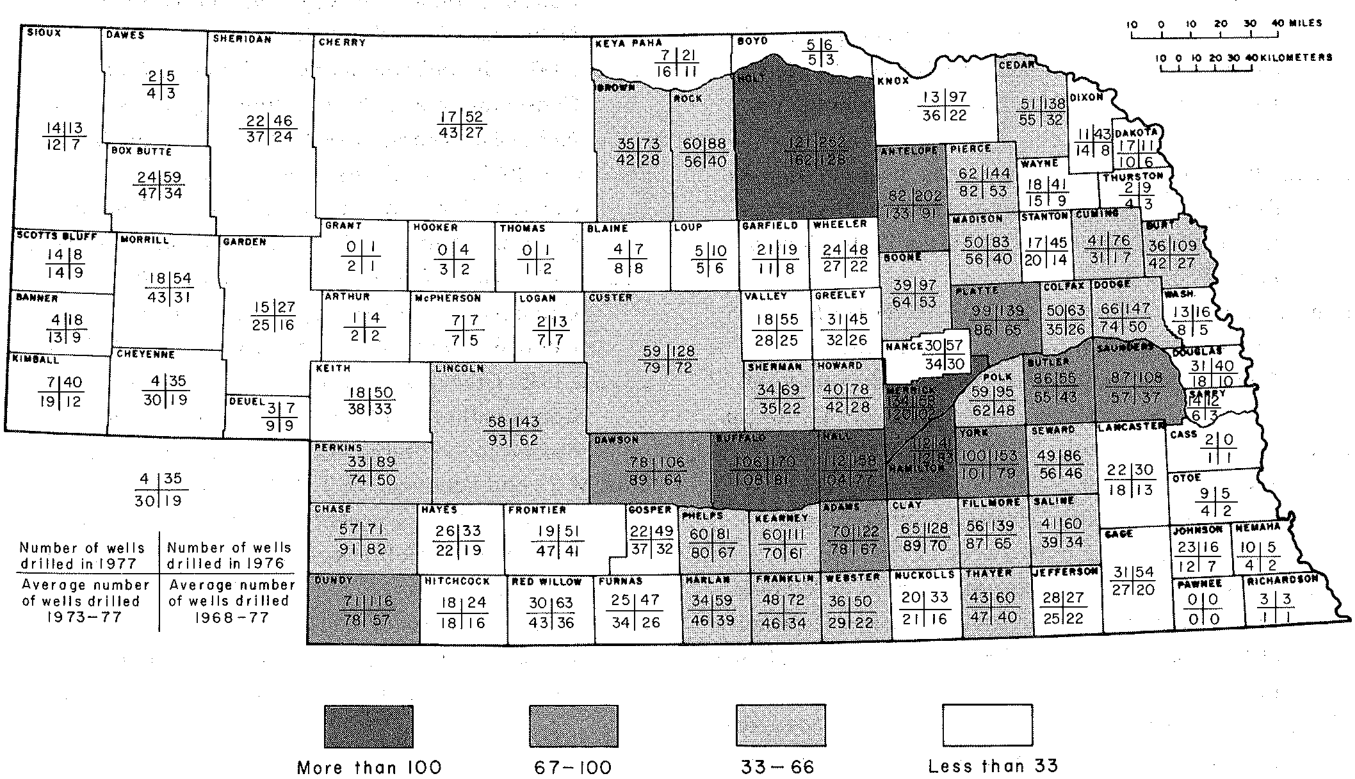
Soil type, economics, and/or topography have in the past made irrigation impractical in many parts of Nebraska that are underlain by an available supply of groundwater. However, changes in agricultural practices and economic conditions as well as advances in irrigation technology have made it feasible to use groundwater for irrigating land in these areas. As a result, there has been a great and continuing increase in the number of irrigation wells installed in some counties during the past 11 years. During that period, for example, 1,275 irrigation wells were drilled in Holt County, 912 in Antelope County, 823 in Chase County, and 719 in Custer County. Generally, the areas of new development are in the northeastern, central, and southwestern parts of the state, where center-pivot irrigation systems provide a means to overcome limitations imposed by soil type and/or topography. Also, center-pivot systems are becoming more common in the Platte River valley and Big Blue River and Little Blue River basins — areas where gravity irrigation systems have been traditional.



Cumulative total of registered irrigation wells in Nebraska, 1910-1977



Location of registered irrigation wells drilled in Nebraska in 1977



Number of Nebraska registered irrigation wells drilled in 1977, 1976, 1973-77, and 1968-77, by counties

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