STATE OF NEBRASKA

DEPARTMENT OF NATURAL RESOURCES
Roger K. Patterson
Director

October 7, 2003

IN REPLY REFER TO:

Mike Johanns
Governor

John Thorburn
Manager
Tri-Basin Natural Resources District
1308 2nd Street
Holdrege, NE 68949

Dear John,

This letter is being written to indicate our agency's support of the Nebraska Environmental Trust Fund application for the project entitled *"Republican Basin Water and Habitat Conservation Project"*. It is our intent to partner with the Nebraska Republican River Management Districts Association on the project and provide in-kind and potentially limited funding support for the project. Our staff time contributions will be primarily for land use assessment/survey and some time spent on outreach/public information.

This project should result in water conservation and water use reduction in a basin working to meet the water use requirements of the recent settlement of an interstate lawsuit. We believe funding this initiative can both help attain water use goals and conserve, enhance and create habitat. It can also help better utilize existing funding and promote a locally led conservation effort. We strongly encourage Trust funding for this effort.

Sincerely,

Roger K. Patterson
Director

pjb

clrshare\patterson

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REFERENCES

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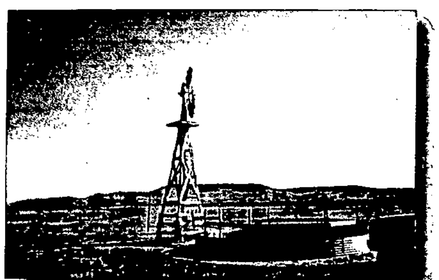
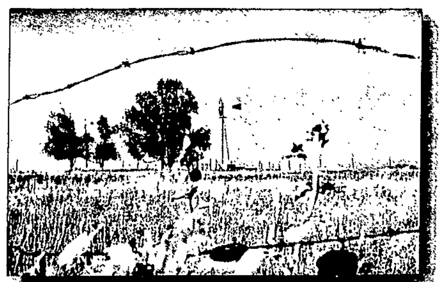


Windmill-powered well and livestock-watering tank, Platte County, Wyoming (Photograph courtesy of J.P. Mason, U.S. Geological Survey.)



Rangeland in Kit Carson County, Colorado (Photograph courtesy of R.R. Luckey, U.S. Geological Survey.)

For additional information contact:

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U.S. Department of the Interior
U.S. Geological Survey

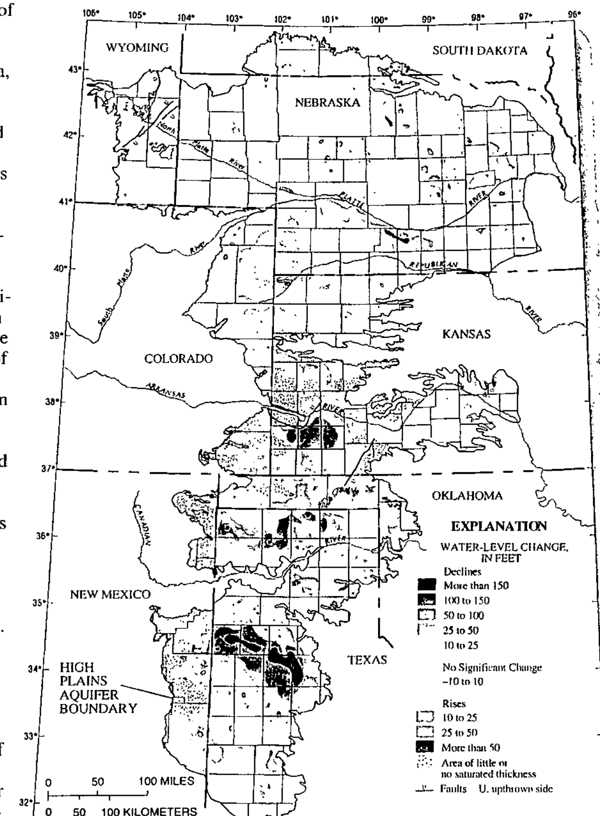
Fact Sheet FS–078–03
September 2003

USGS
science for a changing world

Water-Level Changes in the High Plains Aquifer, Predevelopment to 2001, 1999 to 2000, and 2000 to 2001

—By V.L. McGuire

The High Plains aquifer underlies one of the major agricultural regions in the world, including parts of eight states—Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming. In the area overlying the High Plains aquifer, the total number of acres irrigated with ground water increased rapidly after 1940 and was 2.1 million acres in 1949, 13.7 million acres in 1980, and 13.9 million acres in 1997—(Heimes and Luckey, 1982; Thelin and Heimes, 1987; U.S. Department of Agriculture, 1999). Water-level declines started to occur in the High Plains aquifer soon after the beginning of extensive ground-water irrigation. The water-level declines in the High Plains aquifer occur because of an imbalance between discharge, the largest component of which is ground-water withdrawals for irrigation, and recharge, which is primarily from precipitation. By 1980, water levels in the High Plains aquifer in parts of Texas, Oklahoma, and southwestern Kansas had declined more than 100 feet (Luckey and others, 1981). Water-level declines may result in additional cost for ground-water withdrawals because of increased pumping lift and decreased well yields. Water-level declines also can affect ground-water availability, streamflow, and health of riparian areas. In response to the water-level declines, the U.S. Geological Survey, in cooperation with numerous Federal, State, and local water-resource agencies, began a monitoring program in 1988 to assess annual water-level change in the aquifer using measurements from more than 7,000 wells. The purpose of this report is to present water-level changes in the High Plains aquifer from the time prior to significant ground-water irrigation development (termed predevelopment in this report) to 2001, 1999 to 2000, and 2000 to 2001. The water-level measurements used in this report were collected in winter or early spring when irrigation wells generally were not pumping.



Base from U.S. Geological Survey digital data, 1:2,000,000
Albers Equal-Area projection
Standard parallels 29°30′ N and 45°30′ N, central meridian 101°N

Figure 1. Water-level changes in the High Plains aquifer, predevelopment to 2001 (Modified from Luckey and others, 1981; McGuire and Fischer, 1999).

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The water-level change maps in this report were prepared using two methods. The map of water-level changes, predevelopment to 2001 (fig. 1) was contoured manually using the predevelopment to 2001 water-level-change values for each well. The water-level change maps, 1999 to 2000 and 2000 to 2001 (fig. 2*A* and fig. 2*B*) were generated using Thiessen-polygons (Thiessen, 1911). A Thiessen polygon was created for each well; the size of each polygon depends on the proximity of neighboring wells.

WATER-LEVEL CHANGES, PREDEVELOPMENT TO 2001

The map of water-level changes in the High Plains aquifer from predevelopment to 2001 (fig. 1) is based on water levels from 4,071 wells (table 1). The area-weighted average water-level change was a decline of 11.1 feet, and the water removed from the aquifer through 2001 is estimated to be about 200 million acre-feet. The greatest water-level changes occurred in southwestern Kansas and in the southwestern part of the Texas Panhandle (fig. 1). In most of the southwestern part of the Texas Panhandle, more than 50 percent of the predevelopment saturated thickness has been dewatered (McGuire and Fischer, 1999).

WATER-LEVEL CHANGES, 1999 TO 2000 AND 2000 TO 2001

Ninety-nine percent of all water-level changes from 1999 to 2000 were from a rise of 7.4 feet to a decline of 8.3 feet. The average area-weighted water-level change in the High Plains aquifer was a decline of 0.23 foot from 1999 to 2000 based on measurements from 7,403 wells (table 1). The largest areas of water-level decline are in northeast Nebraska, northeast Colorado, southwest Kansas, the Oklahoma Panhandle, and most of the aquifer area in Texas (fig. 2*A*).

Ninety-nine percent of all water-level changes from 2000 to 2001 were from a rise of 7.4 feet to a decline of 8.7 feet. The average area-weighted water-level change in the High Plains aquifer was a decline of 0.62 foot from 2000 to 2001 based on measurements from 7,650 wells (table 1). Water-level declines occurred over most of the aquifer area except in part of Texas, primarily north of the Canadian River where water-level rises occurred (fig. 2*B*).

The cumulative loss of water in storage in the aquifer from 1987 to 2002 is about 56 million acre-feet (fig. 3), which represents about 29 percent of the cumulative loss since predevelopment.

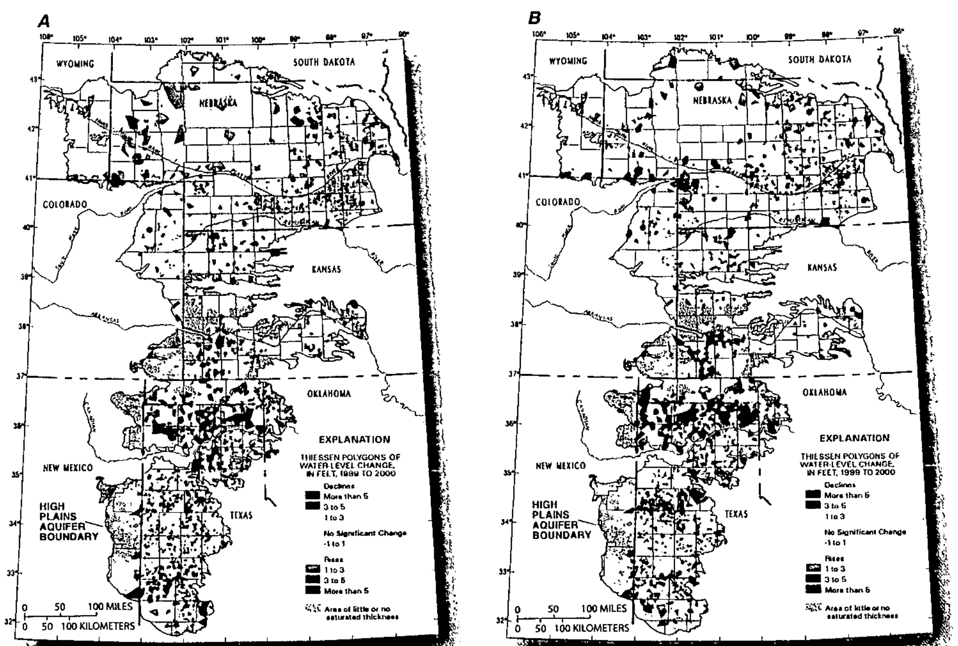


Figure 2. Generalized water-level changes in the High Plains aquifer, (*A*) 1999 to 2000 and (*B*) 2000 to 2001.

Table 1. Number of wells measured and used in this report for predevelopment, 1999, 2000, and 2001 and number of wells used for the water-level comparison periods—predevelopment to 2001, 1999 to 2000, and 2000 to 2001.

State	Wells measured and used in this report				Wells used in water-level comparison periods		
	Predevelopment	1999	2000	2001	Predevelopment to 2001	1999 to 2000	2000 to 2001
Colorado	614	570	548	557	404	531	527
Kansas	4,169	1,266	1,214	1,366	634	1,163	1,153
Nebraska	6,681	3,604	3,699	3,849	1,710	3,275	3,537
New Mexico	3,197	24	167	525[a]	319[a]	18	89
Oklahoma	1,270	242	214	242	163	175	167
South Dakota	72	112	160	113	72	93	94
Texas	4,823	2,515	2,541	2,525[b]	750[b]	2,098	2,028[b]
Wyoming	26	53	59	60	19	50	55
High Plains (Total)	20,852	8,386	8,602	9,237	4,071	7,403	7,650

[a]Includes well measured in New Mexico, 1997 to 2000, because many wells in New Mexico are measured on a rotating 5-year schedule.

[b]Includes wells in Howard and Martin County, Texas, with estimated 2001 water levels based on an average of 2000 and 2002 water levels, because few wells were measured in these counties in 2001.

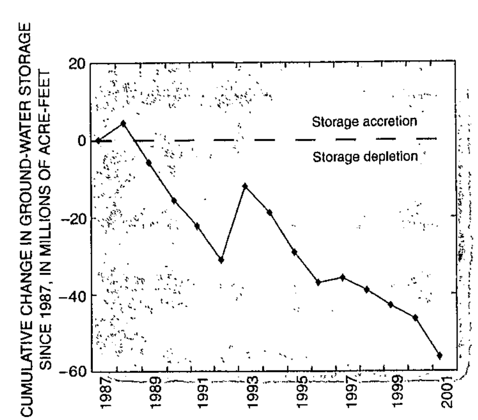
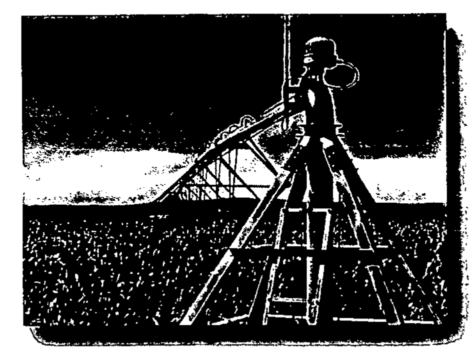


Figure 3. Cumulative changes in ground-water storage in the High Plains aquifer since 1987 (modified from U.S. Geological Survey, 2002).



A center-pivot irrigation system with drop tubes, in Dundy County, Nebraska (Photograph courtesy of M.K. Landon, U.S. Geological Survey.)