

# **WATER LEVEL CHANGES IN THE UNCONFINED AQUIFER OF THE SAN LUIS VALLEY, 1980-1995**

By

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## **INTRODUCTION**

Water levels in the shallow valley-fill aquifer of the San Luis Basin respond to variations in natural recharge and discharge, as well as to well pumping and surface water irrigation practices. Natural recharge to the aquifer is generated along the margins of the basin, where streams draining the surrounding mountain ranges enter the unconsolidated sediments. Some ground water discharges to the Rio Grande River and exits the valley via surface water flow. Ground water in the closed basin portion of the valley north of the Rio Grande discharges principally via evapotranspiration. Cultural practices of shallow ground water pumping and irrigation-induced recharge, superimposed on the natural recharge and discharge processes, have resulted in distinct patterns of water level fluctuations in the unconfined aquifer.

Crouch (1985) described the changes in water levels observed over the decade from December, 1969 through January, 1980 (Crouch, 1985). That report, based on water level data collected by the U.S. Geological Survey and other entities, concluded that water stored in the unconfined aquifer across the valley decreased by about 880,000 acre-feet over the decade. The decline was attributed to a combination of factors, including increased ground water withdrawals for irrigation and decreased ground water recharge from surface water diversions. The author noted that the downward water level trend observed from December 1969 to January 1980 would not necessarily continue, as changing climate or irrigation practices could result in trends different from those measured during the study period.

## **1980-95 WATER LEVEL CHANGES**

Water level data were collected from the USGS electronic database (WATSTORE) for all wells with total

depth 100 feet or less, with recorded water level data over the period of interest (winter 1979-80 through winter 1994-95). Data from about 100 wells were used to contour changes in water levels over the 15-year period (figure 1).

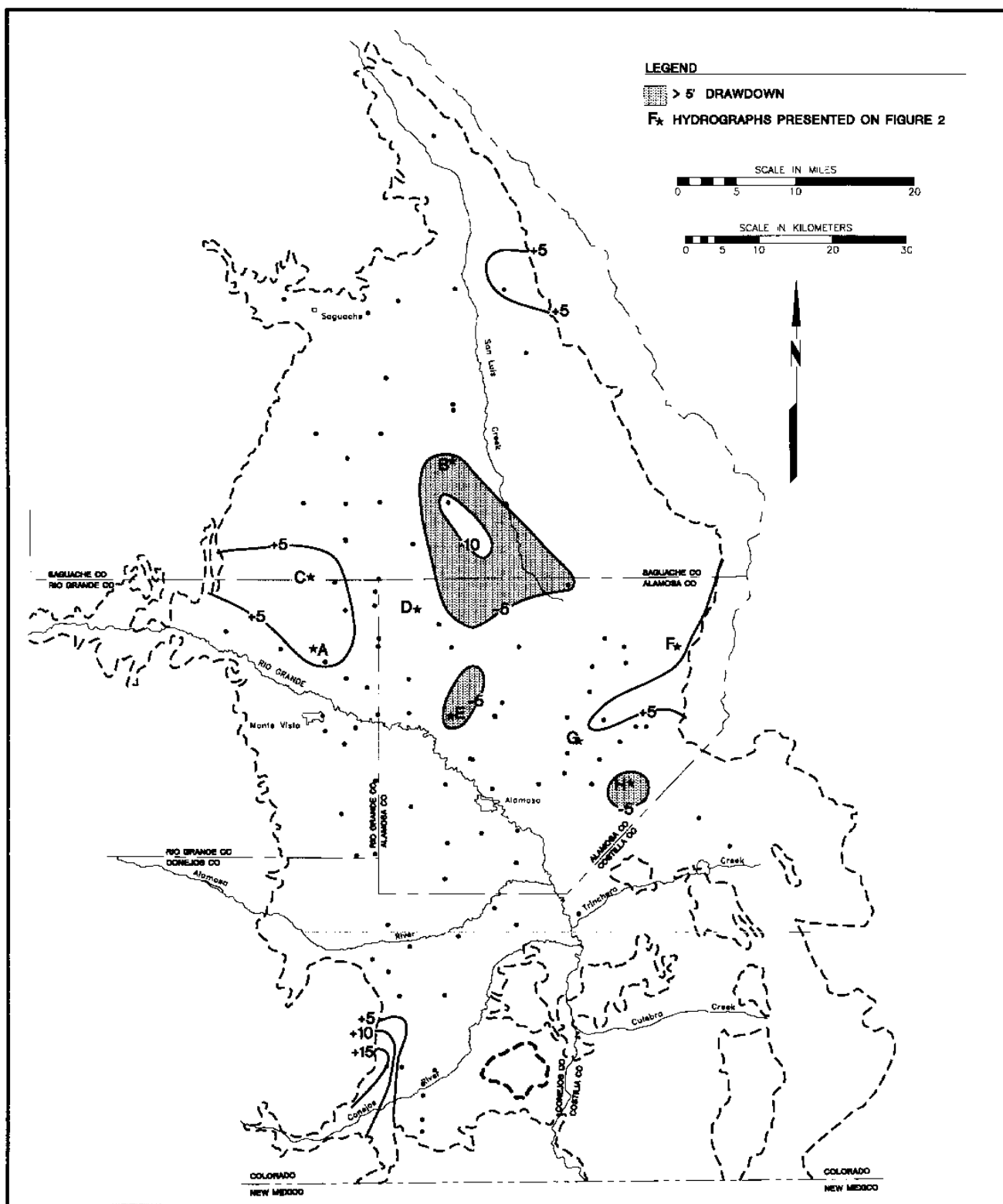
Analysis of water level changes over the study period showed some areas where water levels increased, primarily along the margins of the valley, and several areas of water level decline toward the center of the basin.

An increase of between 5 and 10 feet is observed in the area of the Rio Grande fan where Crouch (1985) mapped water level declines of 20 feet or more. This area is one of heavy well development, but is also close to the recharge area along the western valley margin. Water levels in two wells in this area are presented on hydrographs A and C (figure 2).

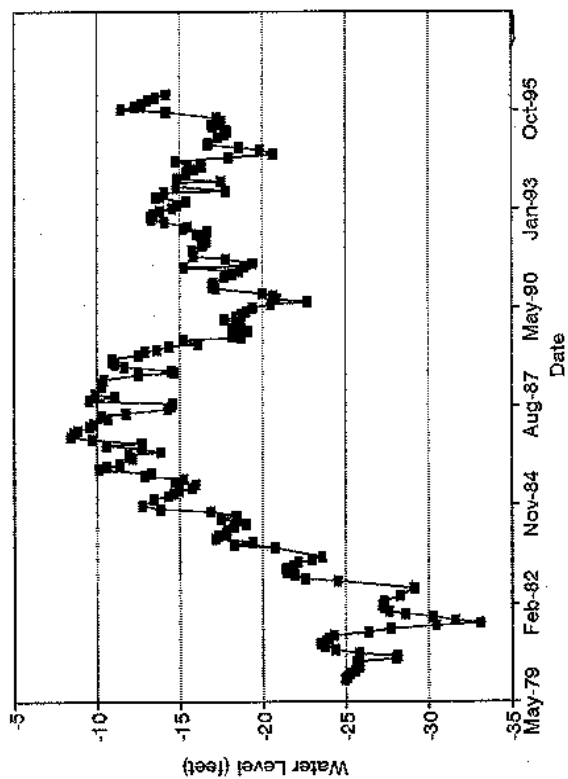
Toward the center of the valley, including areas near Hooper and Mosca, water levels declined over the 15-year period as much as 5 to 10 feet, with some smaller declines in the surrounding agricultural areas. Hydrographs B, D, and E show water level changes in two wells in this area. An additional area of water level decline greater than 5 feet is mapped just northwest of the Alamosa/Costilla county line, with water levels presented on hydrograph H (figure 2).

In the "sump area" of the closed basin, Crouch (1985) reported water level increases up to 5 feet over the decade of the 70s. In the subsequent 15 years, water levels have continued to rise in some wells, with additional increases over 5 feet in some places (hydrographs F and G, figure 2).

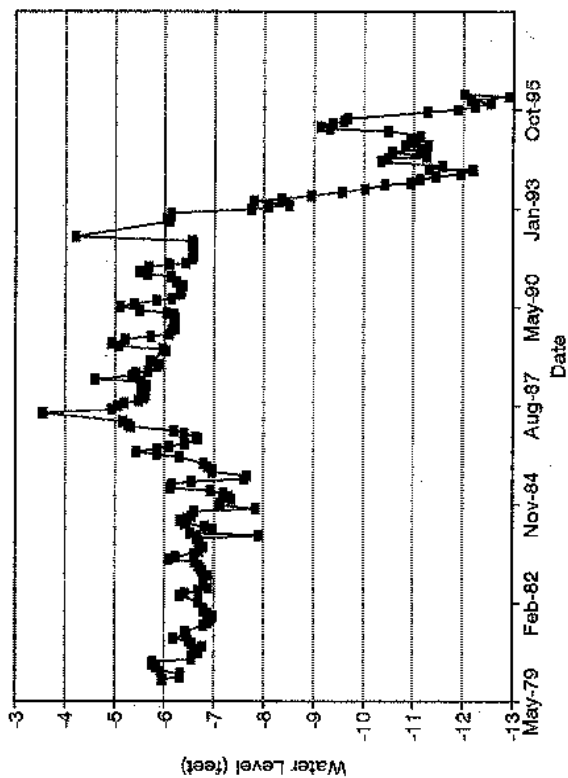
In the area south of Trinchera Creek, Crouch mapped water level declines greater than 20 feet. Unfortunately, water level data retrieved from the WATSTORE system did not include any wells in this area monitored 1980 to 1995;



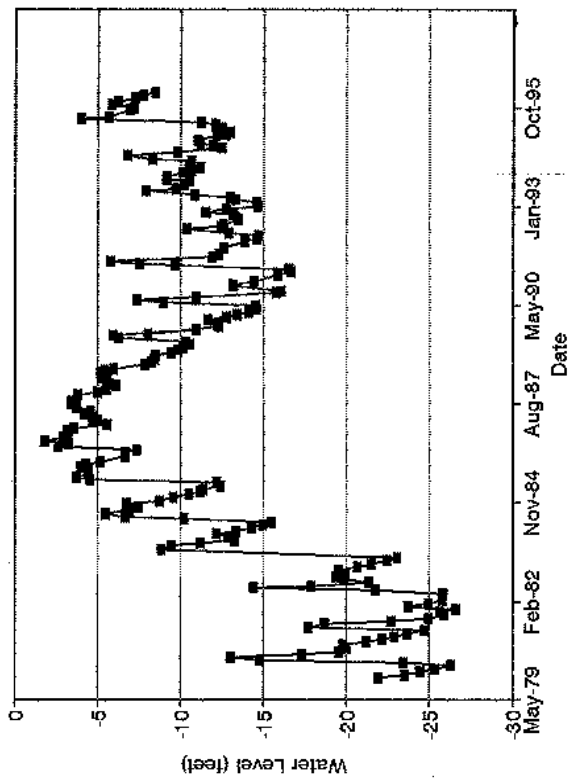
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B  
Well NA04201007CCC



C  
Well NA04100831CCC



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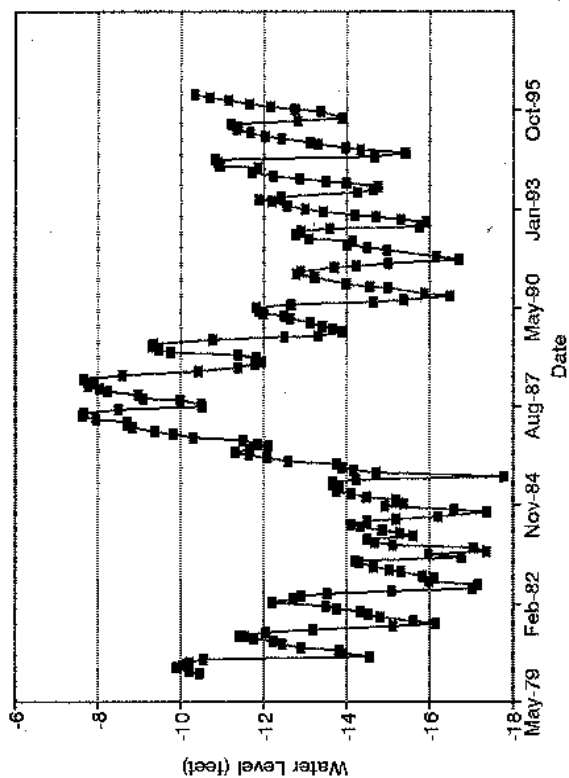


Figure 2. Well Hydrographs

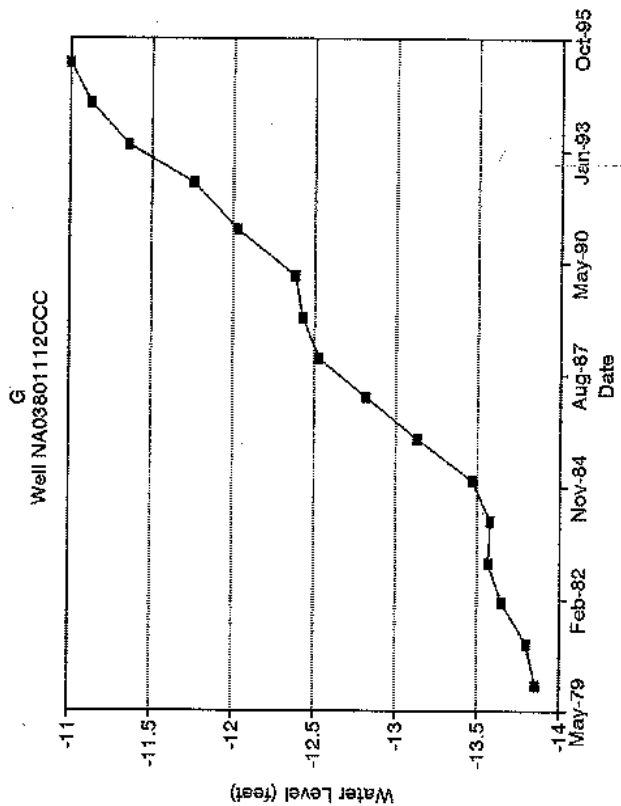
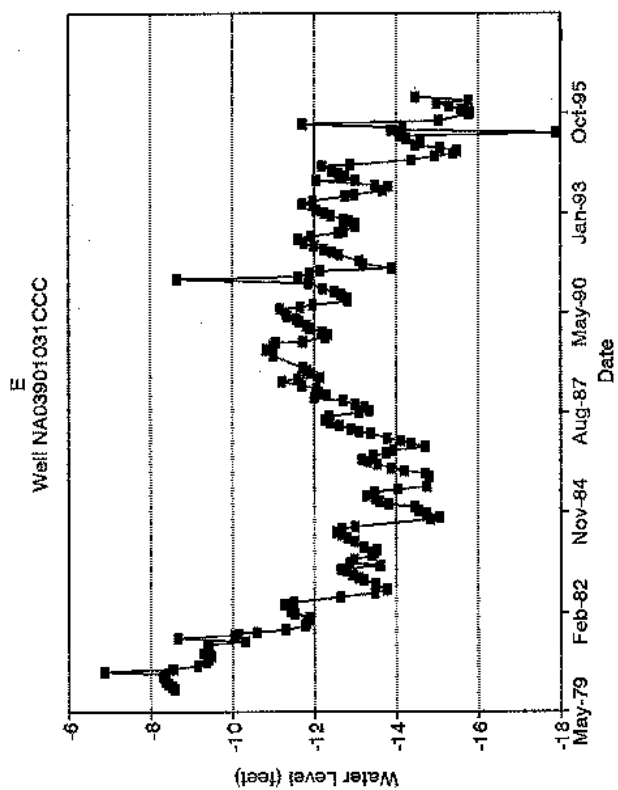
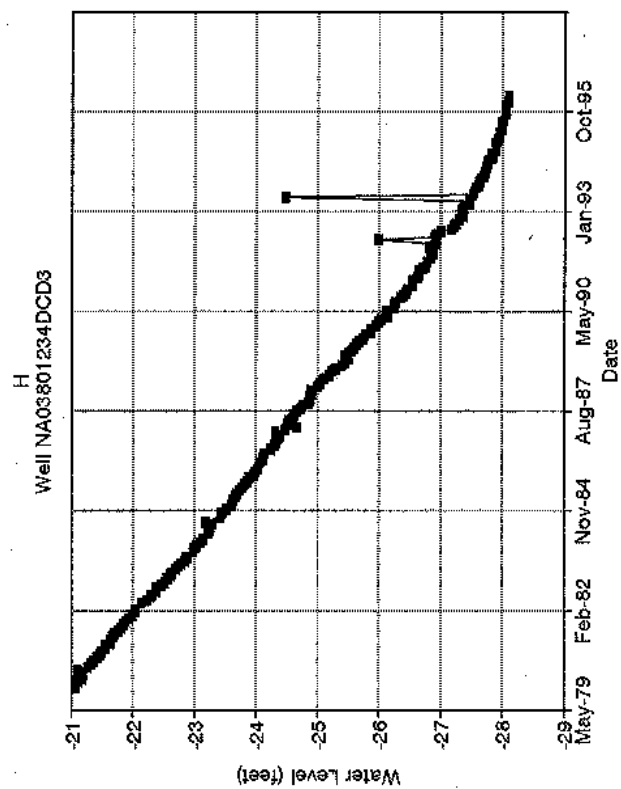
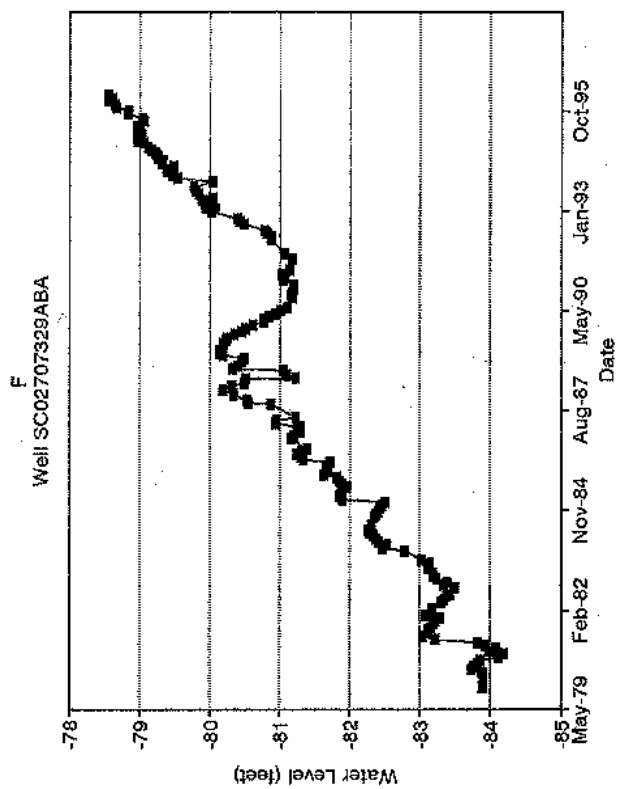


Figure 2. Well Hydrographs, Continued

therefore, we are unable to comment on the ongoing water level trends in this area.

## GROUND WATER RECHARGE

Two indicators of available ground water recharge were considered to aid in interpretation of ground water level trends observed over the study period. These indicators are:

- Rio Grande River streamflow at Del Norte, Colorado
- precipitation at Alamosa, Colorado.

Figures 3 and 4 show how these two indicators have varied through time.

Over the period studied by Crouch (1985), streamflow in the Rio Grande was about 4 percent below the long-term (1950 to present) average, and precipitation at Alamosa was about 2.5 percent below average. Over the 1980-95 study period, streamflow on the Rio Grande was about 12 percent above the long-term average, and precipitation at Alamosa was less than 1 percent below average. The 1980 through 1995 period included several years of very high runoff in the mid-1980s, most notably 1985, 1986, and 1987.

## WATER LEVEL TRENDS

Water levels near the basin margins are strongly affected by annual recharge events and by year-to-year changes in runoff from the surrounding mountains (hydrographs A through D, figure 2). Conversely, ground water levels in the valley center experience little seasonal change, and were not strongly affected by the high or low runoff periods.

In areas where extensive ground water pumping occurs, ground water levels are expected to decline during periods of average recharge, due to ground water withdrawal from storage. During periods when ground water recharge is below average, the decline in water levels is expected to be steeper; conversely, when ground

water recharge is above average, some recovery (or a lower rate of decline) in water levels is predicted. Therefore, in the areas of well development in the unconfined aquifer, declining levels would be predicted from 1969 through 1981 (an average-recharge period immediately preceded by a very wet year), rising levels (or smaller declines) 1984 through 1987 (an above- average recharge period), and falling levels from 1988 through 1995 (an average to below-average recharge period). These patterns are observed in many hydrographs (Crouch, 1985; figure 2). For example, where Crouch mapped water level declines greater than 20 feet over the decade of the 1970s, a net 5 to 10 foot recovery was mapped over the subsequent 15-year period. During that period, water levels recovered during the wet period of the late 80s, and declined again in the early 90s. Another observed trend is rising water levels in the sump area. Water levels in this area have risen steadily over the past 25 years, through both wet and dry periods. (hydrographs G and F, figure 2).

## SUMMARY

The unconfined aquifer is affected by natural recharge along the valley margins, but also reflects the influences of well pumping and recharge by surface water irrigation practices. Water level declines and recoveries are somewhat predictable based on indicators of available recharge, but cultural practices have clearly left their mark on aquifer conditions.

## REFERENCE

Crouch, Thomas M. 1985. Potentiometric Surface, 1980, and Water-Level Changes, 1969-80, in the Unconfined Valley-Fill Aquifers of the San Luis Basin, Colorado and New Mexico. U.S. Geological Survey Hydrologic Atlas HA-683.

