Texas Water Development Board

Open File Report

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Ground-Water Movement in the Cienega Creek Basin, Southern Jeff Davis County, Texas

by
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and
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Introduction

The Davis Mountains region of West Texas has for years enjoyed the relaxed serenity afforded by its remoteness from the more populated part of the State. However, the recent influx of new agricultural development has raised concerns by many local citizens fearing that there will not be enough water to supply both agricultural interests and drinking water needs. Concern has also been expressed that increased ground-water withdrawals might intercept ground-water flow destined for the cities of Marfa and Alpine.

In response to these concerns the Texas Water Development Board initiated a water well inventory and a water-level evaluation in an area south and east of the Davis Mountains (Figure 1). The study area, which encompasses approximately 147 square miles, is contained primarily within the drainage basin of Cienega Creek, but also includes portions of North Fork Alamito, Musquiz, and Limpia Creek drainage basins. The primary purpose of the study was to determine the direction of ground-water movement and to establish a water-level monitoring network that will identify changes in flow paths resulting from future pumpage. As part of this effort, 57 water wells were inventoried within the study area and depths to water were measured in 45.

Hydrology

Geology, Drainage, and Recharge

The study area is characterized as a predominantly eastward sloping alluvial plain on the southern flank of the Davis Mountains. Much of the area is covered by over 100 feet of alluvial sediments consisting mostly of gravel and clay. Underlying the gravel veneer is up to 2,000 feet of fractured volcanic bedrock. Ground water originating as precipitation on the surface infiltrates through the gravel zone and is contained in the fractures and joints in the volcanic rocks.

Most of the recharge to the ground-water system occurs along surface drainages that descend from higher elevations in the Davis Mountains where rainfall rates of 16 to 18 inches per year occur. Lesser amounts of recharge are derived from precipitation that falls directly on the study area. Steepness of the mountain slopes results in most of the water traversing through well-established drainages and descending onto the alluvial plain where the water rapidly infiltrates into the shallow gravel deposits. The headwaters of Cienega Creek and the North Fork of Alamito Creek drain an area west of Blue Mountain, while Musquiz Creek headwaters are in the Puertacitas Mountains east of highway 17. Public supply wells in Fort Davis are primarily recharged from water originating in the Chihuahua Creek basin, a tributary to Limpia Creek.

Ground-water Movement

Selected water-level measurements made in September and October of 1996 were used to construct a contoured water-level map (Figure 2). Water-level elevations ranged from 5,550 feet above mean sea level in the western portion of the study area to about 4,520 feet in the eastern portion. The configuration of the contours suggest a water table that closely resembles the slope of the overlying topography. The direction of ground-water movement is perpendicular to water-table contours and in the direction of diminishing elevation. Figure 3 is an interpretation of flow direction based on the contours in Figure 2. Although the flow paths are subject to interpretation, a general trend can be observed in that the ground-water movement appears to follow the same pathways as the surface drainage. In the south-western part of the study area ground water tends to move in a southerly direction similar to Alamito Creek. Ground water in the central part of the study area originates in the northwest, primarily west of Blue Mountain; a lesser amount is derived from east of Blue Mountain. Flow arrows indicate that ground water along the northern edge of the study area moves mostly toward tributaries of Limpia Creek.

This evaluation tends to support the theory expressed by Hart (1992)[1] of a ground-water divide located between Fort Davis and the intersection of highways 17 and 166. The ground-water divide serves to separate flow systems that traverse Fort Davis and the area south of highway 166. If movement interpretations made in this report are correct, then ground-water withdrawals in the central part of the study area should have little effect on water supply in the immediate Fort Davis area. Because ground water is generally moving from higher head elevations to lower, wells located north of highway 166 should intercept water flowing through the area before it reaches the central flat area to the south and thus not be affected by pumpage in the central study area.

The effect that increased ground-water withdrawals in the study area might have on water supplies in Marfa and Alpine can not be justifiably made based strictly on data presented in this report. However, based on the above assumed ground-water movement, it is most probable that current pumping locations within the study area will have little affect as far away as Marfa and Alpine.

[1]Hart, M.A., 1992, The hydrology of the Davis Mountains, Trans-Pecos Texas: The University of Texas at Austin, unpublished M.A. thesis.

Water-level Observation Well Network

Comparison of historical measurements indicate that water levels in the study area has fluctuated only moderately with seasonal changes in available precipitation. Of 20 wells analyzed, seven show slight water-level declines while 13 show rises. Thus far, no single source of pumpage has significantly affected the regional water table. In order to document possible future changes in water levels, a network of 15 water-level observation wells were established in the study area in February of 1997 (Figure 4). These wells, in combination with other pre-existing observation wells throughout Jeff Davis County, will assist in future water-resource evaluations.

Figure 1

LOCATION OF STUDY AREA

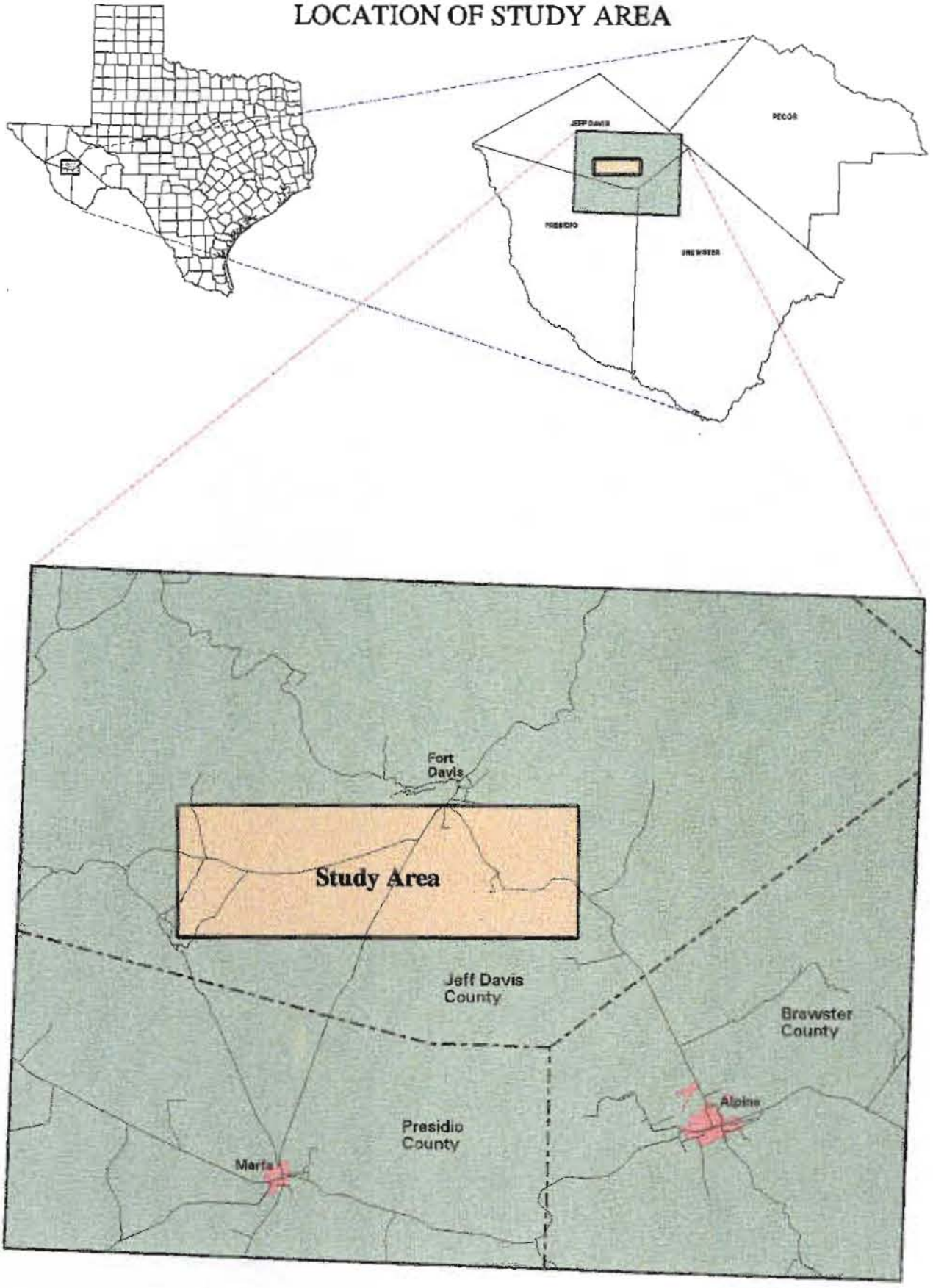
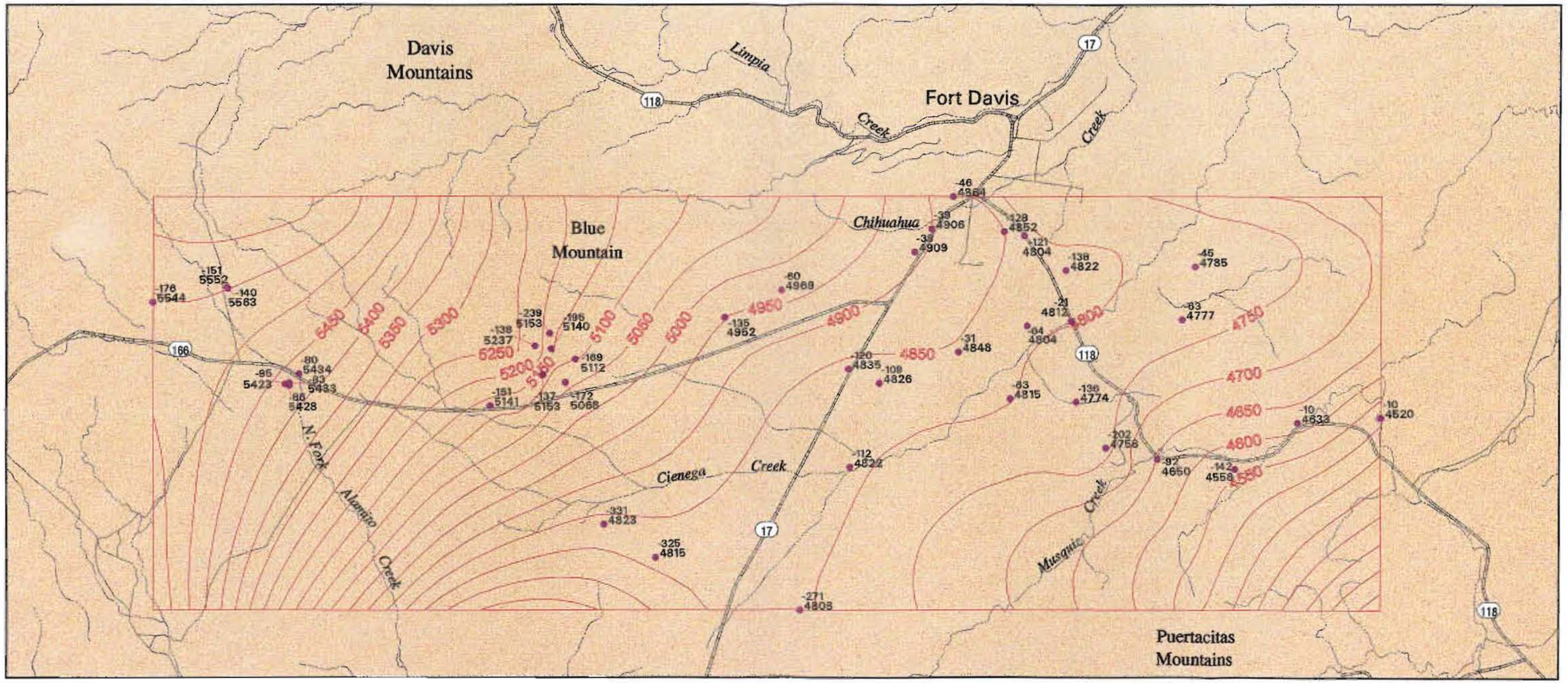


Illustration by Mark E. Hayes

Figure 2

ELEVATION OF 1996 WATER LEVELS



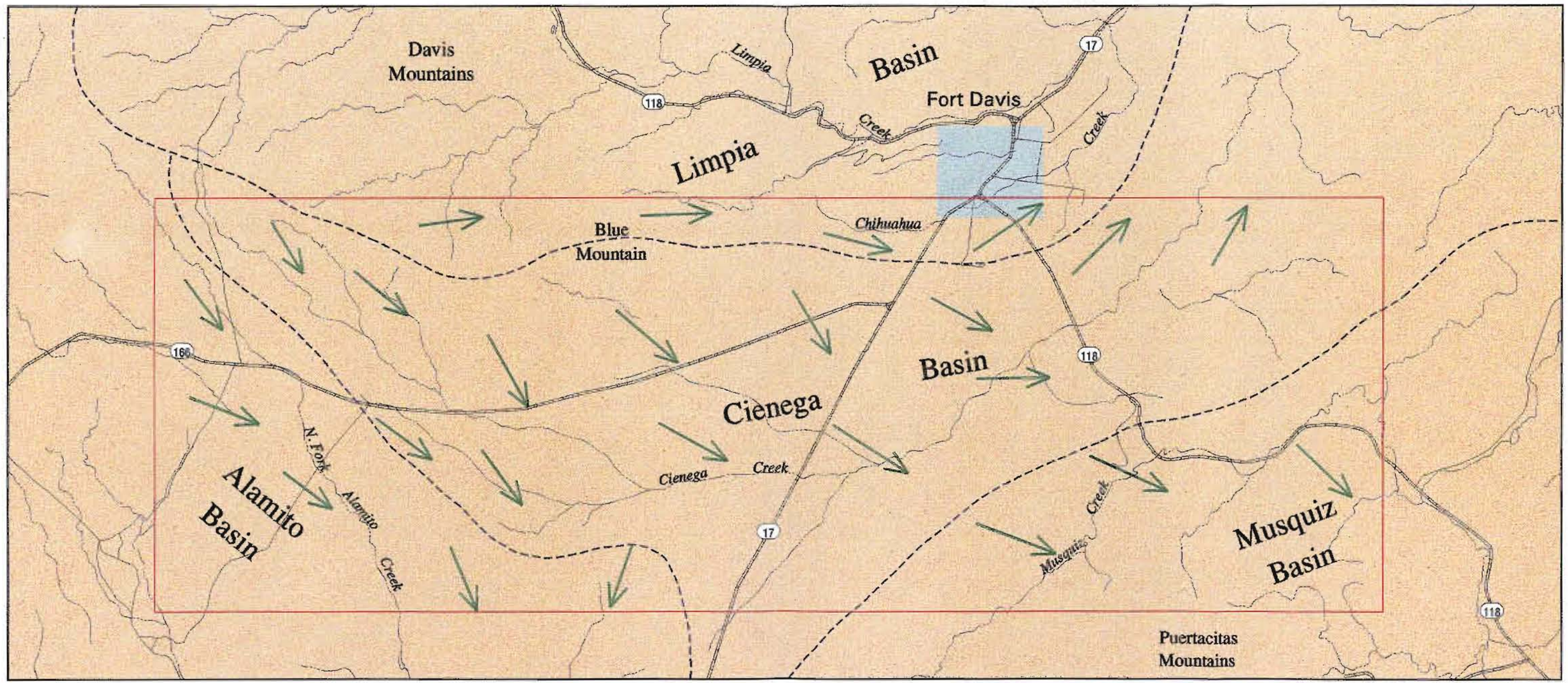
Miles
0 1 2 3 4 5

LEGEND
- Water well
- -29 Depth to water
- 4800 Elevation of water level above mean sea level
- Contour interval = 50 feet

Illustration by Mark E. Hayes

Figure 3

DIRECTION OF GROUND-WATER MOVEMENT



N

Miles

0 1 2 3 4 5

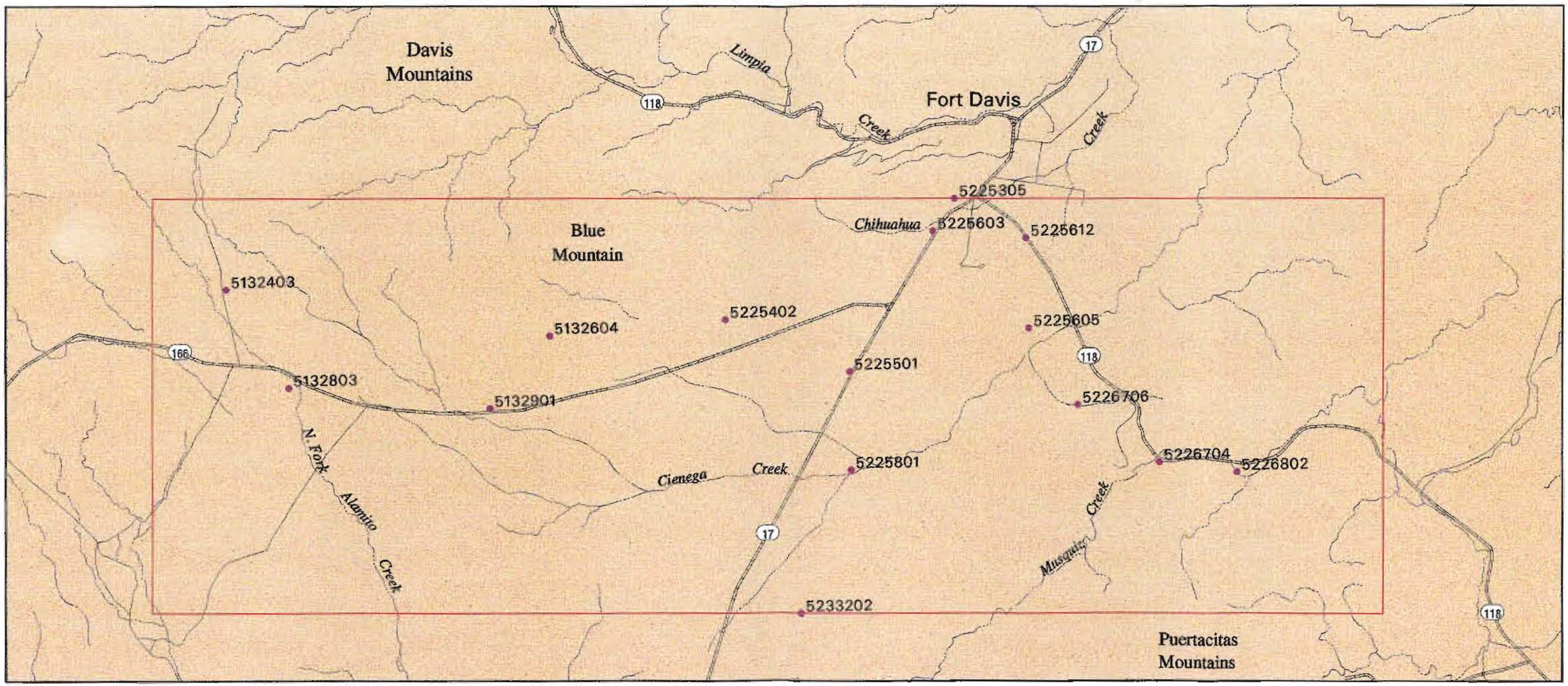
LEGEND

------- Basin line

Illustration by Mark E. Hayes

Figure 4

WATER LEVEL OBSERVATION WELL NETWORK



N

Miles

0 1 2 3 4 5

LEGEND

Water well

5132604 State well number

Illustration by Mark E. Hayes