Ground-water occurrence of the El Paso area and its related geology

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GROUNDWATER OCCURRENCE OF THE EL PASO AREA AND ITS RELATED GEOLOGY

by
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ABSTRACT

The groundwater supplies for the El Paso area are derived from formations of Recent and Santa Fe age in the Hueco Bolson and Mesilla Bolson. Both water table and artesian conditions exist in each area and groundwater qualities differ in some respects, but differences in lithology are more pronounced.

RESUMEN

El agua del subsuelo en el area de El Paso se deriva de formaciones de edad Reciente y Santa Fe en los bolsones del Hueco y Mesilla. Existen condiciones artesianas y de nivel fréatico en cada una de las areas, y las cualidades del agua subterránea difieren en algunos aspectos; pero las diferencias en la litologia son más pronunciadas.

INTRODUCTION

Groundwater resources of the El Paso area occur in two basins separated by the Franklin Mountains. These basins are the Hueco Bolson, lying to the east and the Lower Mesilla Valley in the Mesilla Bolson on the west. The geology of the two basins are similar and related but differ somewhat in lithology and groundwater occurrence.

HUECO BOLSON

The Hueco bolson is a elastic-filled graben that includes about 70 percent of El Paso County, Texas (Fig. 1) and extends several miles south into Mexico and a short distance north into New Mexico.

According to Mattick (1967, p. 85-91), the maximum thickness of the bolson fill, which occurs within a deep structural through paralleling the base of the Franklin Mountains (Fig. 2), is about 9,000 feet. The fill can be divided into two primary types, fluvial and lacustrine, but other deposits such as alluvial-fan material and aeolian sediments can be recognized throughout the area.

Lake deposits are most prominently exposed along the east and west flanks of the Franklin Mountains and in the Gold Hill area, north of downtown El Paso. Southeast of El Paso, several exposures can be observed along the valley escarpment of the Rio Grande with numerous outcrops of fluvial sand and gravel occurring as channel-filling deposits and covering terrace plains.

In the southeastern end of the Hueco bolson near McNary, Texas about 600 feet of unconsolidated clay, sand and gravel are exposed. According to Strain (1966), the bulk of these deposits range in age from early to mid-Pleistocene. The lower strata are mainly clay and silt with small amounts of sand while the upper strata, lying unconformably on the lower, consist of sand, gravel and clay. To these formations, Strain has assigned the names Fort Hancock to the lower

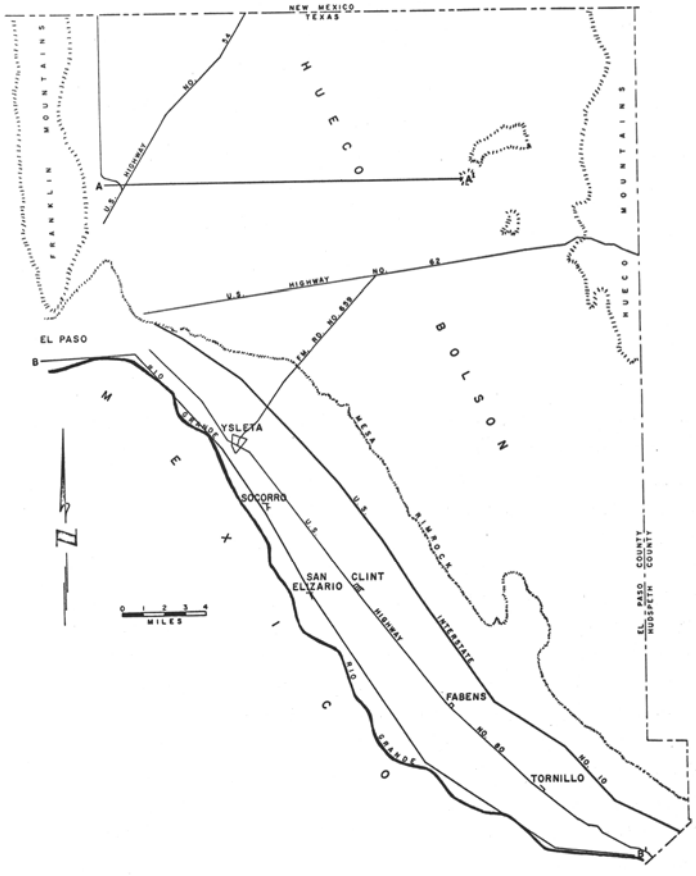

FIGURE 1.
Location map of the Hueco bolson, El Paso County, Texas.

and Camp Rice to the upper; probably these deposits are of Santa Fe age (Hawley, et al, 1969).

Groundwater occurs in both fluvial and lacustrine deposits throughout the Hueco bolson but the primary source

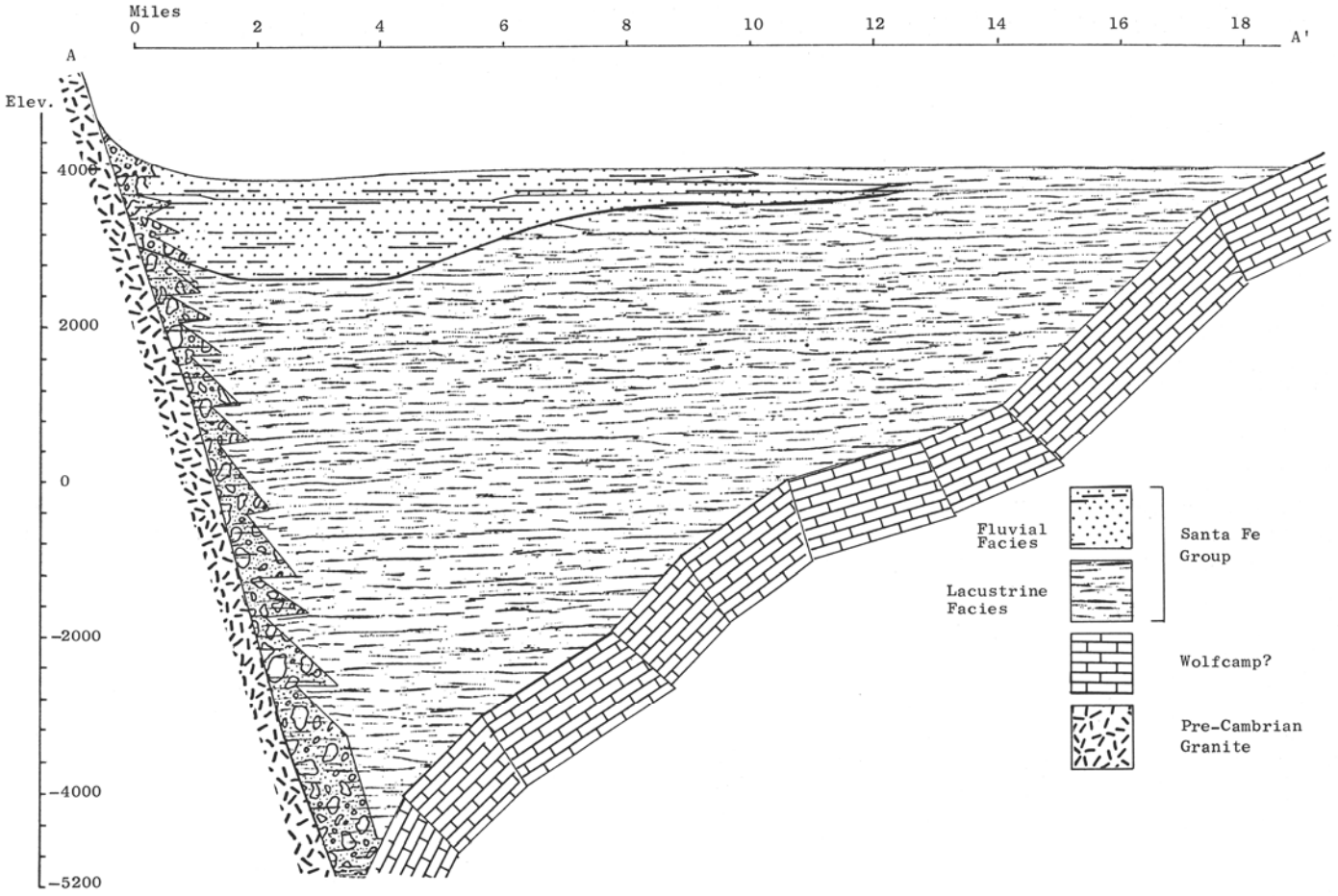

FIGURE 2.
Geology of the Hueco bolson.

of supply for the City of El Paso and irrigators are the fluvial aquifers. The deposits consist of unconsolidated sand lenses intercalated with gravel, silt, and clay in highly varied sequences which are poorly sorted and irregularly stratified.

The quality of the groundwater in the fluvial deposits ranges from 300 ppm (parts per million) to over 1,500 ppm of total dissolved solids in the area lying above the valley escarpment (Fig. 3). In the underlying lake sediments, the total dissolved solids range as high as 50,000 ppm.

Below the escarpment of the valley, groundwater occurs in Recent fluvial deposits, mostly as brackish and saline water. Underlying this, fresh water occurs in deposits which represent an extension of the fresh water aquifers encountered outside the valley area to the north. This fresh water body is under artesian pressure which causes static levels in the various wells completed into the aquifer to rise within 40 feet of the ground surface in areas adjacent to the Rio Grande. The occurrence of the "sandwiched" fresh water is found at an average depth of about 250 feet from El Paso to Ysleta (Fig. 4) .

Near Fabens, Texas, another artesian aquifer is found with enough head to cause a continuous flow of 500 GPM at the surface from a well that was completed by the El Paso Water Utilities in 1957. The aquifer is encountered at an average depth of about 1,250 feet in a very small and limited area. Subsequent test drilling has not revealed its occurrence in other areas north of the Rio Grande, but several wells have been drilled into the aquifer in the river valley southeast of Ciudad Juarez.

LOWER MESILLA VALLEY OF THE MESILLA BOLSON

The geology of the Mesilla bolson is similar to that of the Hueco bolson and the basin fills are contemporaneous. By early Pleistocene (Kansan time) basin filling in the El Paso and Lower Mesilla Valley areas reached its climax (Kottlowski, 1958; Hawley, et al, 1969; King, et al, 1969) . The ancestral Rio Grande entered the Hueco bolson through Fillmore Gap between the Organ and Franklin Mountains and was diverted to its present course in late mid-Pleistocene time (Strain, 1966).

Groundwater produced for irrigation and muicipal purposes in the Lower Mesilla Valley occurs principally in deposits of the Santa Fe Group with many shallow wells completed in Recent river alluvium.

Production in the Canutillo Well Field, which supplies

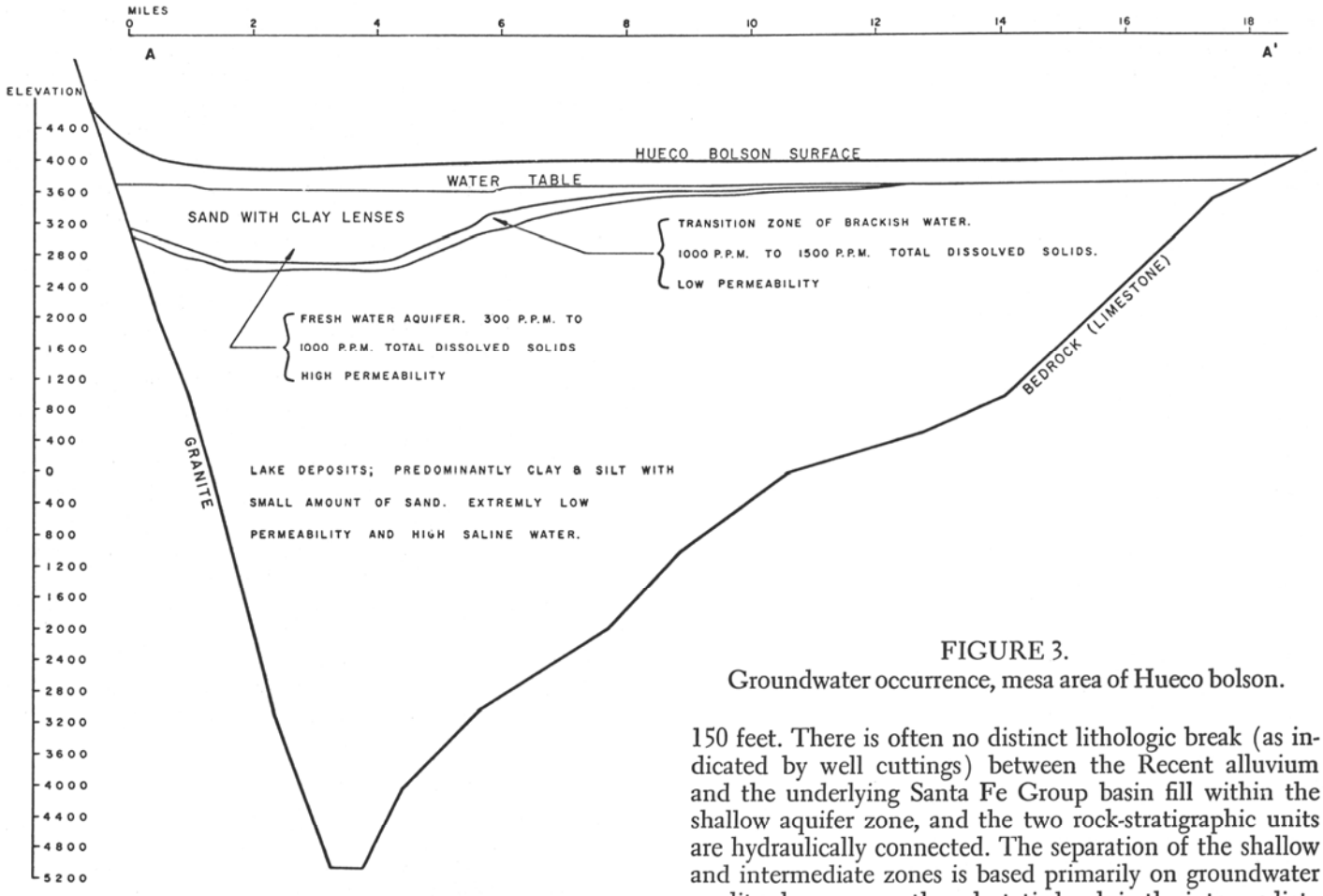

FIGURE 3.
Groundwater occurrence, mesa area of Hueco bolson.

the City of El Paso with a large portion of its water, is derived from three zones known as the shallow, intermediate, and deep which probably constitute only a two aquifer system. Most of the shallow zone is made up of coarse sand, gravel, silt and clay and probably does not exceed 90 feet in thickness when referring to Recent alluvium, but the production zone itself extends to an average depth of about 150 feet. There is often no distinct lithologic break (as indicated by well cuttings) between the Recent alluvium and the underlying Santa Fe Group basin fill within the shallow aquifer zone, and the two rock-stratigraphic units are hydraulically connected. The separation of the shallow and intermediate zones is based primarily on groundwater quality changes even though static levels in the intermediate average about 40 feet from the ground surface and only 10 feet in the shallow. There are no known continuous barriers between the two, but overlapping clay lenses possibly create a partial barrier to vertical components of groundwater movements.

The differing qualities of groundwater in the various zones may be noted in Figures 6 and 7 and are characteristic of the Canutillo Well Field. However, the quality of the

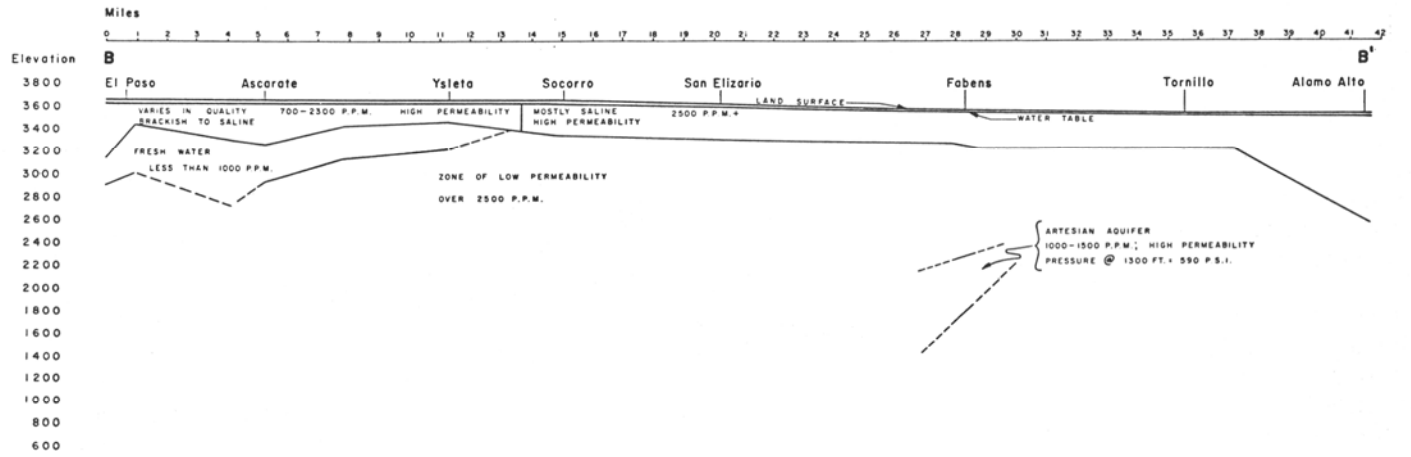

FIGURE 4.
Groundwater occurrence, El Paso Valley.

groundwater in the shallow zone becomes much better to the north and west of the field.

The deep aquifer is a fine grained homogenous body of unconsolidated sand with superior quality groundwater and an artesian head of about 440 feet (190 psi). The aquifer is encountered at an average depth of about 500 feet which places the existing piezometric surface at 60 feet below the surface of the ground. Its average thickness is about 500 feet and its only known occurrence is in the Canutillo Well Field. An equally extraordinary anomaly, besides its excellent quality, is the temperature of the water of 98° F.

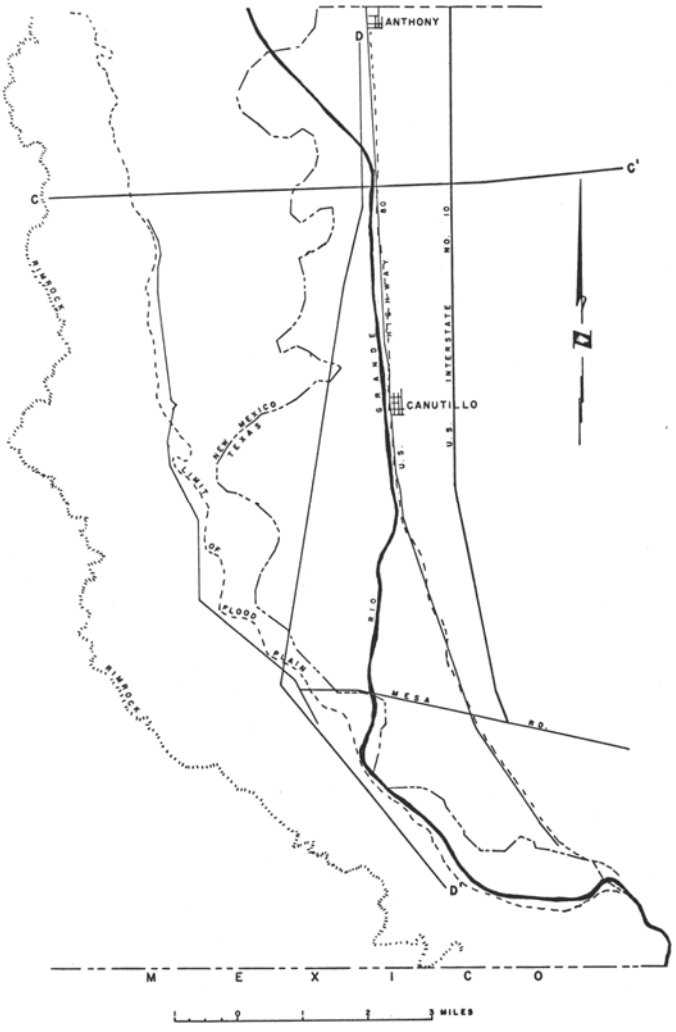

FIGURE 5.
Location map of the lower Mesilla Valley.

The aquifer may represent a fluvial environment of an isolated nature where the ancestral Rio Grande acquired stream velocity magnitudes great enough to carry silts and clays to other points of deposition, leaving the fine grained sand in its present locale.

King and others (1969) have speculated that the aquifer may represent deposition in a deltaic environment. It is also possible that the unit is basically an aeolian deposit analogous to the Medanos de Samalayuca dune complex in north-central Chihuahua (John Hawley, personal communication, July, 1969). In any case, the aquifer has rapid communication with a recharge zone of a highly permeable nature which is indicated by its water quality, and the recharge is directed through a zone with a high geothermal gradient.

Much more subsurface data are needed to make more accurate assumptions but undoubtedly future test drilling will prove a more extensive occurrence of the deep aquifer zone.

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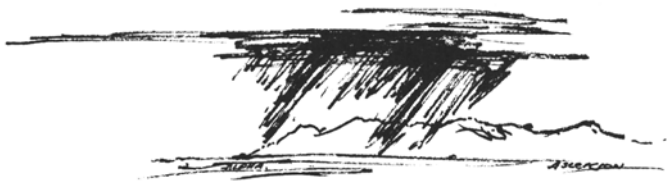
(Figures 6 and 7 on following pages)



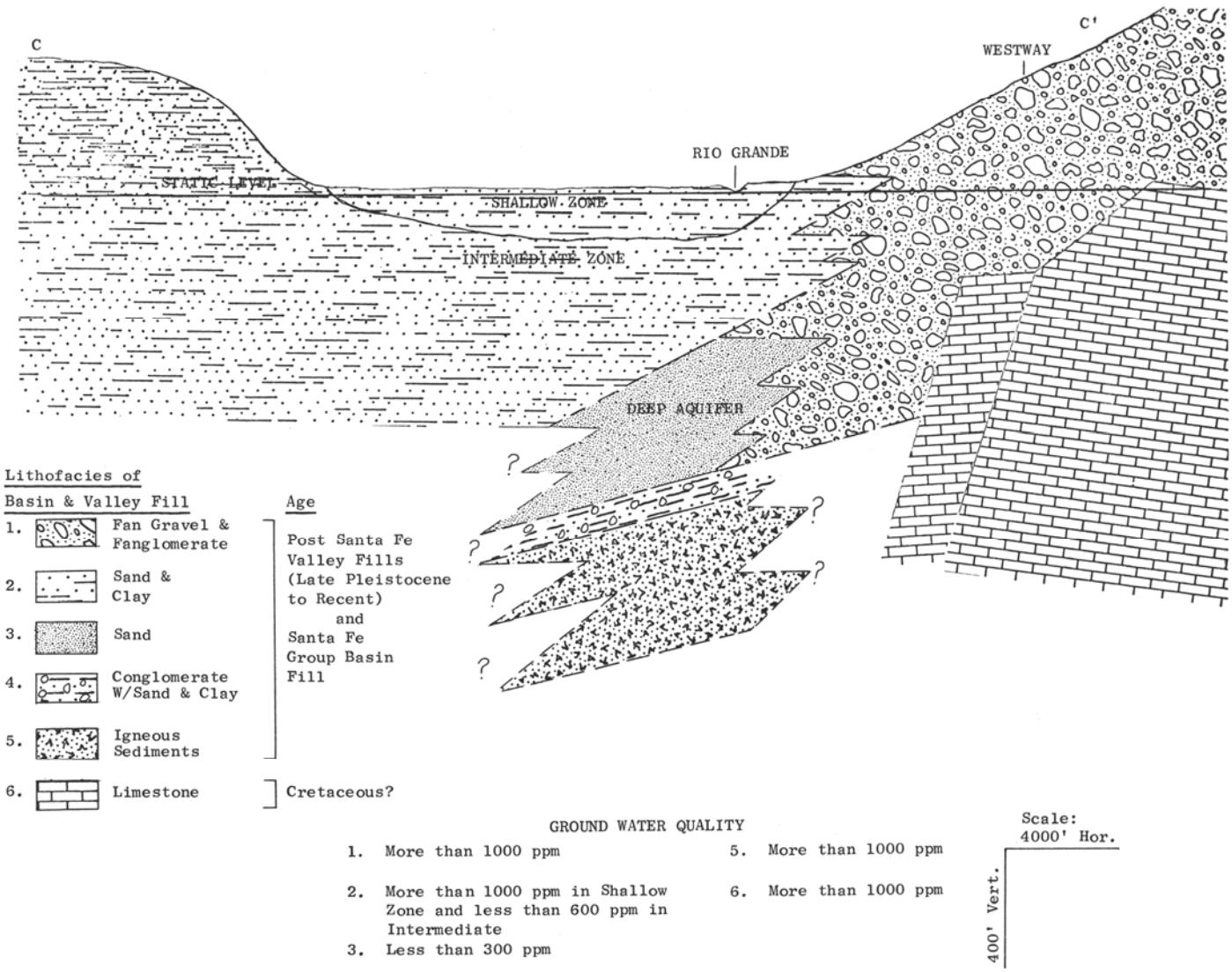


FIGURE 6.
Generalized geology and groundwater occurrence in Canutillo Well Field.

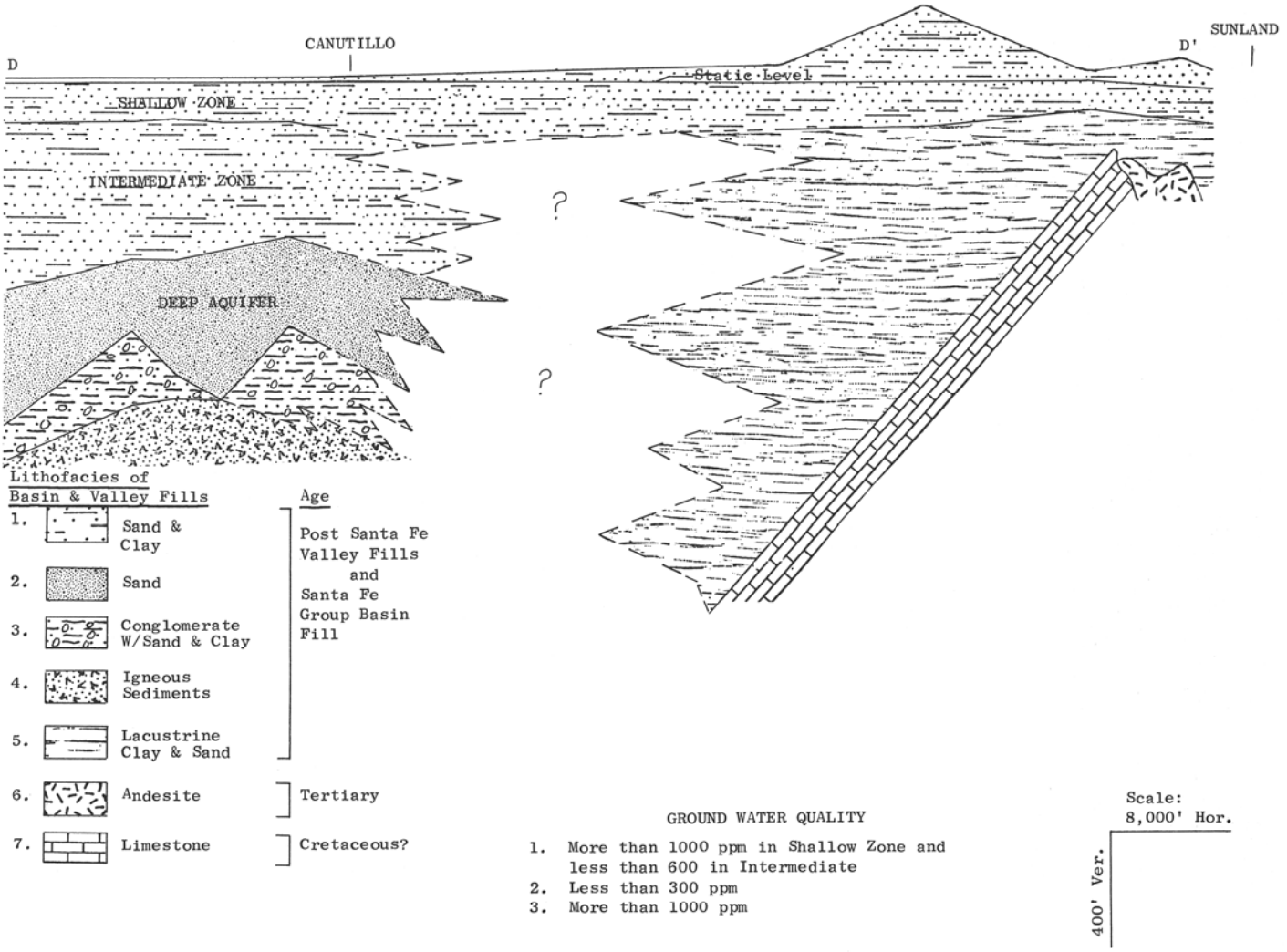


FIGURE 7.
Generalized geology and groundwater occurrence, lower Mesilla Valley to El Paso Canyon.