Ground-water Overdraft

Antelope Valley with limited water resources subject to condition of overdraft on ground-water

J. Herbert Snyder

The following article is the first in a series of reports on a study of ground-water resources of the Antelope Valley.

Antelope Valley—where more than 87% of the 12-million-dollar crop production in 1952 was from irrigated land—has become subject to a condition of long-run overdraft on its ground-water resources.

Seven different ground-water basins have been identified in the Valley but six of them are tributary to the central—Lancaster—basin which underlies some 353,000 acres of land and serves as the main ground-water reservoir. It has been estimated that—at the time of initial agricultural development in the Valley—the ground-water stock resource, to a depth of 500 feet, was approximately 10 million acre-feet. That estimate is complicated by the presence of pressure or artesian areas in the Valley. Artesian water has been tapped at depths from 80 to 1,800 feet below the ground surface.

The ground-water stock resource consists of water stored in aquifers—water-bearing strata of earth—to a depth of 500 feet, plus that made available by artesian pressures from aquifers at greater depths.

The annual ground-water recharge—the volume of inflow entering ground-water storage each year—is subject to variation, but some quantity is available each year. Thus, recharge to ground-water is the ground-water flow resource.

The main contribution to ground-water recharge comes from stream runoff. There are no indications that either rainfall on the valley floor or percolation from outside areas contribute.

Contributions of return recharge—resulting from applying volumes of water in excess of plant requirements—do not replenish the ground-water stock. They serve to transfer a portion of the stock from one part of the storage reservoir to another. A variable amount of over-irrigation is necessary to prevent salt accumulation in the surface soil.

Estimates of average annual recharge from stream runoff in the Valley have varied from 33,280 acre-feet to 81,400 acre-feet per year, based primarily on consideration of stream runoff-rainfall relations. Average annual runoff for the Valley is now estimated to be 51,100 acre-feet per year. A ground-water economy dependent upon variable runoff must absorb and store runoff during a surplus or wet phase for subsequent use during a dry or deficit phase.

The ground-water recharge is less than stream runoff because of losses by stream bed wetting, use by vegetation near the stream channels, by evaporation, and by surface diversions by irrigation districts. These losses—in the Valley—are estimated to be about 11,100 acre-feet per year, so the average annual recharge to ground water is placed at 40,000 acre-feet per year.

The Antelope Valley was selected for this area study because of its virtual isolation from outside water and its status as a self-contained ground-water unit. Water can be imported from areas outside the Valley but—because of the relatively high cost of imported water to agricultural users—the Valley will not receive relief by water importation until it can be provided at a price within the paying ability of the individual farmer. Institutional factors generally tend to favor a solution through transfer of water from surplus to deficit areas.

Removal of water from the ground-water stock resource of the Valley upset the balance normally existing between recharge and discharge.

When a reservoir is not full, natural discharge tends to be less than recharge—because of the available storage capacity. Although a balance may be maintained between recharge and discharge, no static water-table ordinarily exists.

The natural processes of ground-water discharge in the Valley have been blocked effectively by the removal of large volumes of water from storage for irrigation and nonagricultural uses.

Draft on ground water for nonagricultural use in 1950 and 1951 is estimated to have averaged 1,500–3,000 acre-feet per year, or 2% and 2.5% of the annual net draft for all uses.

Gross water consumption within urbanized Lancaster averaged less than 0.5 acre-foot per acre per year during the period 1946–1952. As population density increases, the gross consumption may increase to as much as 1.5 acre-feet per acre per year. Typical water applications to crops in the Valley range from two acre-feet for irrigated grains to as much as 6–10 acre-feet per acre per year for alfalfa and irrigated pasture. Future growth of either agricultural or nonagricultural land use in the Valley depends upon the availability of an adequate water supply and the competition for it.

As in other portions of southern California, agricultural land and water use in the Valley may contract and eventually disappear as urbanization increases. Nonagricultural users can afford to pay more than agricultural users for water.

Flowing artesian ground-water was used to irrigate small acreages in the Valley during the period 1890–1920 but many of the wells in the central portion had to be abandoned because of alkali soil conditions.

Abandoned wells were seldom capped and perhaps 100,000 acre-feet or 1% of the total ground-water stock resource may have wasted from these wells and evaporated. The loss of this water coupled with the loss in artesian pressure was enough to change the ground-water stock resource from one which yielded flowing water to one which required pumping. Even if artesian water had not been wasted, an equal volume would sooner or later have been used by farmers.

To be continued next month.

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