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Ground-water Overdraft

increasing demands creating long-run overdraft on ground-water resources of the Antelope Valley

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

Comparison of gross and net draft on ground-water resources in the Antelope Valley shows that farmers tend to over-irrigate—applying more water than may be necessary for best crop production.

Water requirements of alfalfa supplied by irrigation are estimated at 3.02 acre-feet per acre per year in the Valley. An additional 1.30 acre-feet annually provide for normal on-farm storage and distribution losses and the deep percolation necessary to prevent salt accumulation. The total of 4.32 acre-feet of irrigation is necessary to supply consumptive use. A group of Valley alfalfa farmers—studied in 1950—applied an average of eight acre-feet. Such over-irrigation may have been stimulated by certain economic factors.

Gross draft is the total volume of pumpage for an area, although a certain volume will percolate through the soil layers and return to ground-water. Overdraft is the volume of ground-water removed in excess of recharge from aquifers—water-bearing strata of earth—within a particular geographic area and for a specified period of time. Measurement of net draft is necessary to measure overdraft.

Net draft—the volume of ground-water permanently removed from storage—has been estimated to have increased in the Valley from 27,000 acre-feet per year in 1924 to 168,000 in 1951.

Developmental Overdraft

It does not necessarily follow that declining water levels are symptomatic of a serious overdraft condition. Water levels may fall when ground-water is unable to move rapidly enough through the aquifers to supply wells in the discharge area. This is possible even though—for the area as a whole—recharge equals or exceeds discharge and draft. Differentiation of overdraft—whether false or real—constitutes a tool of analysis for ground-water problems.

During initial development of a ground-water stock resource, developmental—short-run—overdraft often takes place if the annual recharge is to be stored in the ground-water reservoir.

Draft on the stock component which

lowers the water table enough to prevent natural discharge from the stock—and uses the entire potential recharge volume as actual recharge—constitutes developmental overdraft.

Prior to 1927 estimated draft in the Valley was not sufficient to cause developmental overdraft. Yet many artesian wells had ceased to flow and drops in water levels had caused local concern. Natural ground-water discharge was negligible. Use of water for agricultural purposes combined with waste of flowing artesian water modified the stock resource sufficiently to cause developmental overdraft.

Seasonal Overdraft

Annual draft on ground-water equal to safe-yield volumes will not maintain static ground-water levels at specified depths. Within each pumping season water levels decline when pumping starts and rise when pumping stops, because the pumping season in California does not usually coincide with the recharge season. Seasonal or annual overdraft is evidenced by this type of variation in water levels observed in the Valley as in most irrigated areas in the West.

Water levels usually will not be observed at the same position at the beginning of each pumping season. From one year to the next, or for several years, water levels fall or rise depending upon whether actual annual recharge in a particular year is less or greater than average annual recharge. This assumes a safe-yield draft volume. Although lacking definite regularity in amplitude or frequency, this imbalance between recharge and draft is called cyclical or periodic overdraft, and consists of wet and dry phases.

Long-run Overdraft

Long-run or secular overdraft exists when ground-water draft—year in and year out—exceeds recharge. It results from mining the ground-water stock resource. Seasonal and cyclical overdraft are observed as variations on an over-all trend.

Since 1940, expansions in irrigated acreage in the Valley have practically

eliminated the future possibility of recharge exceeding draft. Rejecting, at least tentatively, the possibility of drastic reductions in future water consumption or large-scale importation of additional water, long-run overdraft has been, since 1940—and will continue to be—the most important feature of the Valley's ground-water economy.

The estimated initial stock resource for the Valley was 10 million acre-feet of water, extending to a depth of 500 feet below the ground surface. The 500-foot depth was the probable economic limit of pumping for most crops. Allowing for growth and expansion, it is estimated that these limits could be reached in 35 to 65 years—depending upon the rate of expansion of water use.

Critical Overdraft

Sustained draft in an area may lead to compaction of clay aquifers which destroys ground-water storage capacity. If restoration of storage capacity becomes economically or technologically impossible, the causative draft of this situation is termed critical overdraft.

Critical overdraft can result from false overdraft, seasonal, cyclical, or long-run overdraft. No measurements of ground subsidence—to indicate the presence of critical overdraft—have been made in the Valley. If preservation of ground-water storage capacity is important, careful and accurate examination is necessary at all levels of ground-water use. If the amount of storage capacity destroyed by critical overdraft is small or unimportant relative to the total available storage, then critical overdraft may be ignored and attention focused on problems arising from long-run overdraft.

To be concluded next month.

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The differentiation of types of overdraft as an analytical technique in ground-water problems was initiated at the suggestion of S. V. Wantrup, Professor of Agricultural Economics, University of California, Berkeley.

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