Drainage Adjacent to a River

investigation on use of pumped well for field drainage of river seepage conducted on farm in Sacramento delta area

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Pumping ground water for relief of drainage problems in agricultural lands is an established practice. However, there are many situations in California where pumping has not been used and where it might—or might not—be the solution to severe drainage problems costing farmers thousands of dollars annually in crops and soil damage.

Because there are many areas along the major rivers in California where seepage is causing damage to adjacent agricultural land a study was made of the possibility of using drainage wells.

The farm selected for the study is located adjacent to the Sacramento River and has long suffered from high water table conditions during periods of high water in the river. The soil conditions are typical of the delta with peat and mineral soils intermixed.

Water can seep from a river in one or more of several ways. In some cases it seeps directly through the levee to the ground surface on the landward side.

In other cases the water moves down through the river bottom soil until it reaches a more permeable stratum—an aquifer—through which it can move laterally out under the land adjacent to the river, and rises to the surface where the soil conditions are favorable. Usually there is artesian pressure—greater water pressure in the permeable aquifers—that forces the seepage to the soil surface. A solution for such a drainage problem requires a detailed investigation to determine the direction of water flow and the location of the underground strata carrying the water out from the river. If a drainage well is to be effective it must be located in such a way that it taps the water in the artesian aquifer.

Conventional surface and subsurface drainage methods—such as open ditches and tile lines—are frequently ineffective in areas of artesian pressure. Many times subsurface water in such areas will rise to the soil surface a few feet away from an open ditch running only partly filled by water.

Two Types of Wells

There are two types of wells which may be used to solve drainage problems. One type is the water table well or gravity well which would be used to remove water from a saturated material lying above confining substrata. The other type of well is the artesian or pressure relief well which has perforations in the confined artesian aquifer. The second type of well operates by lowering the artesian pressure in the aquifer and thereby alleviating the drainage problem.

From preliminary studies it was determined that water on the test farm was flowing from the Sacramento River into an aquifer lying approximately 50′ below the ground surface. The water then moved out from the river through the aquifer and was forced by the pressure to the soil surface at distances of 500′–1,000′ from the river.

Piezometers—installed at many points in the field—enabled the determination of the subsurface water flow and the location of the various strata below the ground surface. The Sacramento River—in the vicinity of the test farm—is subject to tidal fluctuations and the piezometers terminating in the artesian aquifer 50′ below the ground surface indicated that the pressure in the aquifer responded to tidal changes in river level.

A preliminary test was made on the effect of pumping from this aquifer by using two small well points, 1½″ in diameter which were jetted to a depth of 55′–58′ below the ground surface. These wells were equipped with a special well point followed by 5′ of perforated pipe wrapped with screen. It was possible to pump only 20–30 gallons per minute from these two wells for a limited period of time. However, even this small amount of pumping produced some pressure relief in nearby piezometers and indicated the possible success of a larger diameter and larger capacity well.

Accordingly an 8″ diameter well was drilled by a cable tool rig to a depth of 85′. The well was plugged at 77′ and was perforated from that level up to 55′ with vertical perforations. The well log of material was quite similar to those obtained by jetting the piezometers.

Open end piezometers of ½″ pipe were located around the well; five piezometers on each side in the north-south direction and two each in the east-west direction. Each was jetted down into the underlying sand or gravel aquifer. The depths varied between 52′ and 62′. Water level recorders were installed on three of the piezometers to give a continuous record of water pressure fluctuations. To measure the changes in the shallow surface water table, six observation wells were located in the field adjacent to the pumped well. Each observation well was equipped with a continuous water level recorder. Water levels in the river were also measured by a recorder.

After the well had been installed and properly developed a pump was placed on the well and pumped for a period of

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Water level recorder for water table observation.

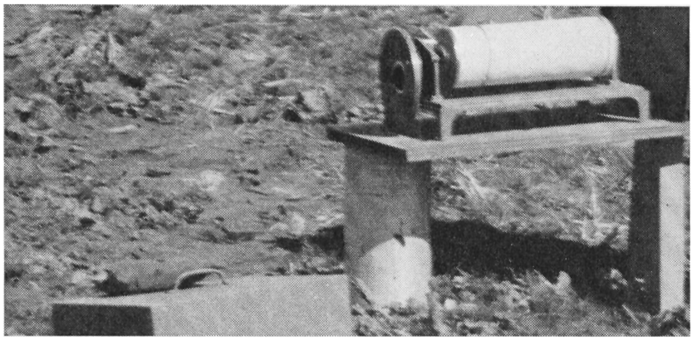

Illustration of the reduction of pressure in an artesian aquifer.