

FLUID LOGGING EXPERIMENTS TO DETERMINE DEPTH DISTRIBUTION OF SALTS BENEATH SEASONALLY FLOODED WETLANDS

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RESEARCH OBJECTIVES

Groundwater conjunctive use in California is being promoted by the State and Federal water resource agencies as a means of alleviating over-allocated water supply, especially in the western San Joaquin Valley. The U.S. Bureau of Reclamation, having recently undertaken a study of water banking in the aquifers that underlie seasonally flooded wetlands, has partnered with

The FEC logging technique had previously been performed only in vertical wells with diameters typically ranging between 5 to 15 cm. The wells at our study site had very limited access through a 3.8 cm diameter pipe that intersected the wellbore at a 45° angle (Figure 1). We modified the FEC logging technique such that this method could be used in these wells.

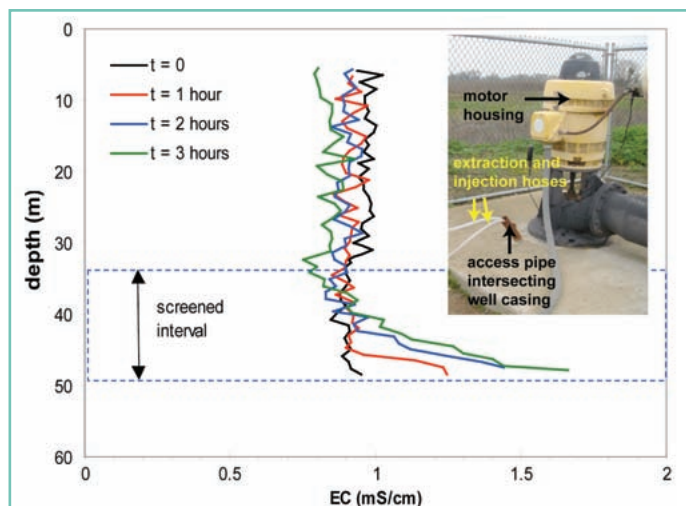


Figure 1. Electrical conductivity profiles measured over time in a well in the San Joaquin Valley as water is extracted at a constant rate of 0.7 m³/hr. Photograph of a well with limited access is shown in the upper right-hand corner.

Berkeley Lab to assess the potential impact of long-term pumping strategies on the quality of the water produced by these wells. Tsang and Doughty (2003) have shown how the flowing-fluid-electric-conductivity (FEC) logging method can be used to yield a profile of water quality along the length of the screened interval in the well. This current research extends this analysis in a very practical way, allowing the technique to be deployed in some nonideal situations, in particular at sites where the motor and well pump could not be removed to access the well casing.

APPROACH

FEC logging has been conducted in wells around the wetlands in the San Joaquin Valley. This technique involves replacing the wellbore water with deionized or low-salinity water while the wellbore water is simultaneously extracted. After the wellbore water is replaced by low-salinity water, the change in the electrical conductivity (EC) profile in the well is recorded over time as the water is extracted at a constant rate (Figure 1).

ACCOMPLISHMENTS

The typical EC probe used to log vertical wells has a diameter of 3.8 cm and a length of 1.8 m; such a probe could not fit into the access pipe intersecting our study wells. Instead, we successfully deployed a small EC probe manufactured by Campbell Scientific up to depths of 90 m. The probe has a cross-sectional dimension of 2.5 × 1.9 cm and is 8.9 cm long. To inject and extract the water simultaneously through the access pipe, we used small-diameter (1.9 cm) hoses. Because we were limited to using such a small hose, we developed and tested a new technique of injecting water uniformly over the well length by inserting pressure-compensating emitters along the length of the hose. This new technique replaces the more time-consuming, traditional approach of injecting low-salinity water only at the well bottom.

SIGNIFICANCE OF FINDINGS

We successfully conducted FEC logging in wells with limited access and obtained transient measurements of the electrical conductivity with depth (Figure 1). Over time the EC increases faster towards the bottom of the well than at the top of the screened interval, indicating that the formation at the bottom of the screened interval is more permeable or the EC of the water at the bottom of the well is higher. Obtaining data on the depth distribution of salts and identifying high salinity zones in the aquifers in the San Joaquin Valley is critical for evaluating the potential of groundwater for conjunctive water use.

RELATED PUBLICATION

Tsang, C.-F. and C. Doughty, Multi-rate flowing fluid electric conductivity method. *Water Resour. Res.*, 39(12), 1354, doi:10.1029/2003WR002308, 2003. Berkeley Lab Report LBNL-52518.

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