Prepared in cooperation with the U.S. ARMY CORPS OF ENGINEERS

OPEN-FILE REPORT 85-573

FIGURE 1. Data collection location map.

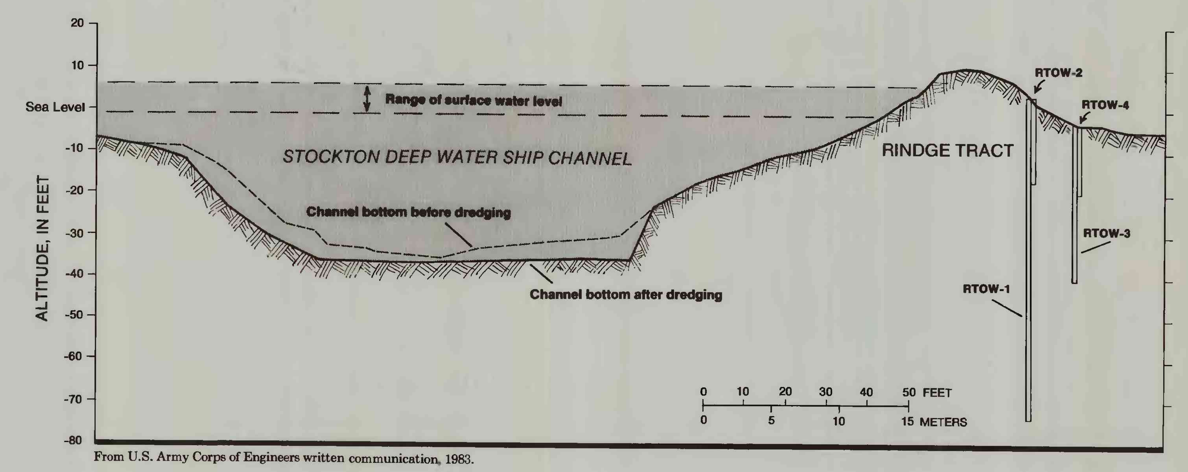

FIGURE 2. Generalized cross section of Rindge Tract Levee.

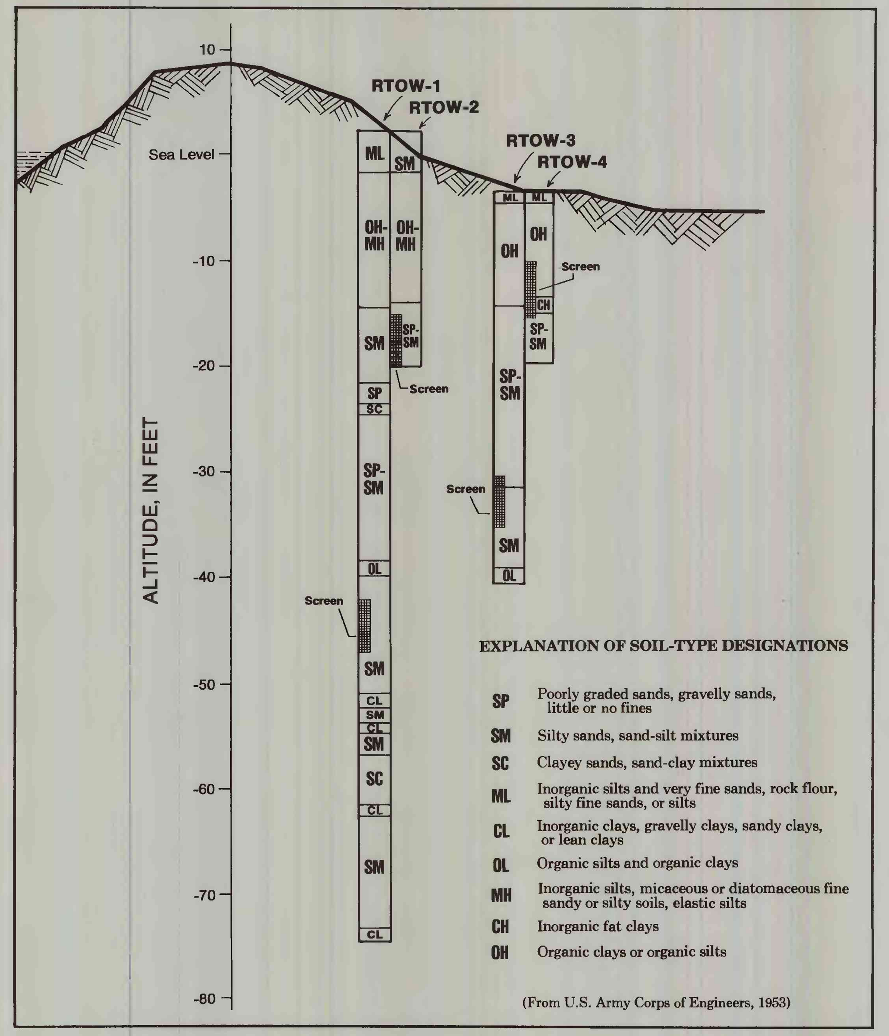

FIGURE 3. Lithology at Rindge Tract observation wells (modified from U.S. Army Corps of Engineers, written communication, 1983).

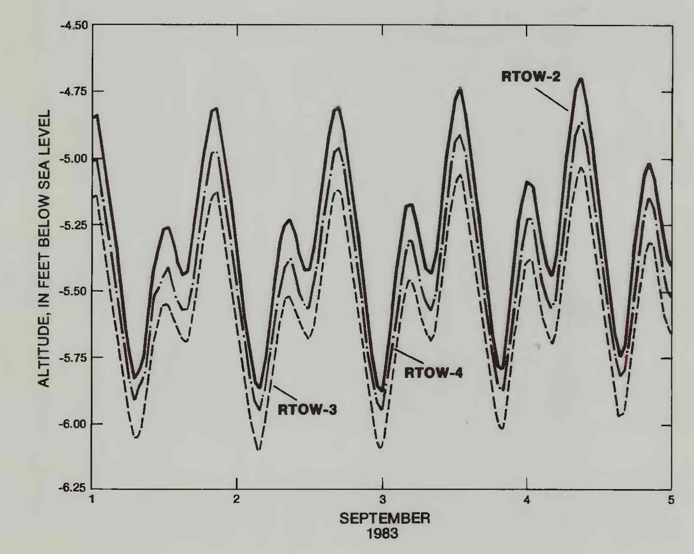

FIGURE 4. Hydrograph showing relation between water levels at RTOW-2, RTOW-3, and RTOW-4.

DISCUSSION

The Sacramento-San Joaquin Delta is formed at the confluence of the two major rivers that drain the Central Valley of California (fig. 1). Prior to development in the late 1800s, the delta was a vast tule marshland. The Sacramento and San Joaquin Rivers and many interconnecting sloughs meandered back and forth across the tidelands, frequently overflowing their banks. The growth of population in the area during and after the gold rush presented a need to develop the agricultural potential of the marshlands. The soils in the area are primarily organic (U.S. Army Corps of Engineers, 1980), providing an excellent base for the intensive agriculture that now dominates the economy of the region.

Approximately 1,100 miles of levees were constructed to form about 60 tracts or islands that protect these lands from periodic flooding. The levees were constructed of sand, silt, and peat dredged from the channel bottom and are subject to erosion and failure. Owing to compaction, oxidation of the peat, and other related conditions, the islands are subsiding at rates of up to 0.25 foot per year (Newmarch, 1981). The altitude of the land surface of the islands is often below sea level and below the surface-water level in the channel. This condition causes stresses that may contribute to high ground-water levels and levee failure (Limerinos and Smith, 1975).

In 1876, Congress authorized the San Joaquin River project for navigation. Construction of the Stockton Deep Water Ship Channel began in 1877 to facilitate freight travel from San Francisco to the Port of Stockton. In 1965, the U.S. Army Corps of Engineers was authorized to deepen and modify parts of the ship channel to allow deeper-draft vessels to travel to the port. Because of concern that removal of the fine silts and clays along the channel bottom might increase seepage of water into the interior of the islands, the U.S. Army Corps of Engineers drilled four observation wells to monitor ground-water levels at a site along the channel on the landside of the Rindge Tract levee approximately 7 miles downstream from the Port of Stockton (fig. 2).

The U.S. Army Corps of Engineers requested that the U.S. Geological Survey install and maintain continuous recorders to monitor water levels in each of the four wells. Monitoring began in July 1983 and was also to provide data to show the relation between surface-water levels in the channel and ground-water levels in the wells. Surface-water data from a tide gage on Rindge Tract, approximately 1 mile upstream from the well site, were furnished by the California Department of Water Resources.

The four observation wells were drilled and screened at different depths to show water-level changes in different parts of the aquifer (fig. 3). Rindge Tract Observation Wells (RTOW) -2, -3, and -4 were screened within the same lithologic unit (SP-SM) and exhibited similar diurnal fluctuations and responses to surface-water-level changes (fig. 4). For this reason, only the hydrograph of RTOW-2 is shown in figure 5. Where data were missing for RTOW-2, data for RTOW-4 was substituted.

RTOW-1 was screened below a semipervious layer of organic silt and has a different hydrograph record than the other three wells (David Wickets, U.S. Army Corps of Engineers, oral commun., May 1985). The range of diurnal fluctuation is only about 0.3 foot compared to about 1 foot for RTOW-2, -3, and -4. Although RTOW-1 does respond to variations in surface-water levels, the lag time is about 10 hours instead of 1-2 hours for RTOW-2.

About October 18, 1983, the water levels in RTOW-2, -3, and -4 rose more than 0.5 foot. No precipitation was recorded that week (U.S. National Oceanic and Atmospheric Administration, 1983) and no abnormal fluctuation of surface-water level was shown. All three of the piezometers showed the same rise. The data at RTOW-1 was lost during this period so no comparison with that data can be made.

Dredging began in the area of the Rindge Tract site during the latter part of July 1983. During that time, RTOW-1 showed a rise in water level of more than 3 feet and the other three wells showed a rise of about 1 foot. The water level at RTOW-1, which was about 0.5 foot below the water level at RTOW-2 before this time, rose to a height almost 2 feet above the other water levels (fig. 6). Diurnal fluctuations at all wells appear unchanged.

Water levels in all four wells dropped 1.5 to 2 feet between September 1983 and September 1984 and continued to drop through December 1984. The relation of the water levels in RTOW-1 to those of the other wells does not appear to be changing or returning to the predredging altitude below the levels of the other wells.

Selected References

Akers, J.P., 1974, The effect of proposed deepening of the John F. Baldwin and Stockton ship channels on salt-water intrusion, Suisun Bay and Sacramento-San Joaquin Delta areas, California: U.S. Geological Survey Water-Resources Investigations Report 56-73, 10 p.
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-----1980, San Francisco Bay to Stockton, Calif. (John F. Baldwin and Stockton Ship Channels): Interim general design memorandum and appendices, 231 p.
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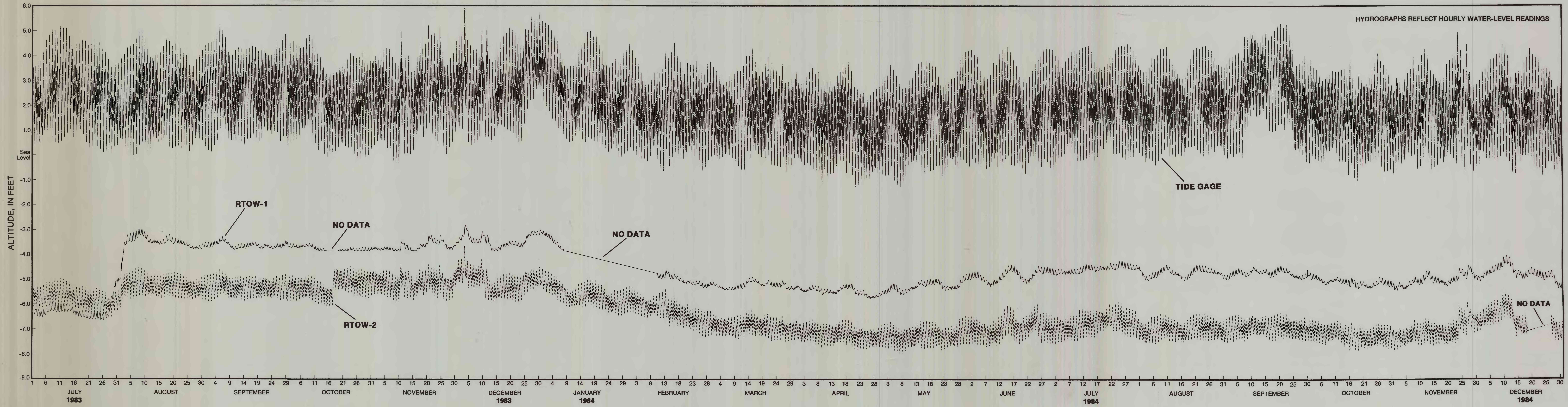

FIGURE 5. Hydrograph showing ground-water levels and channel surface-water levels at Rindge Tract on the Stockton Deep Water Ship Channel.

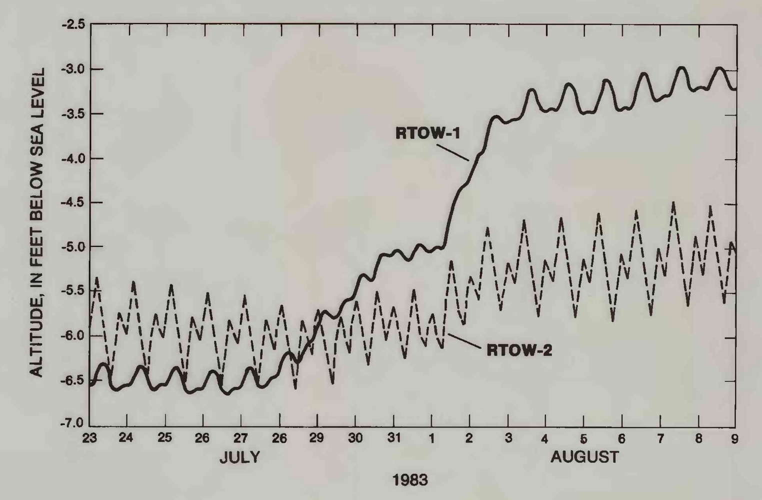

FIGURE 6. Hydrograph showing change in water levels at RTOW-1 and RTOW-2 during dredging period.

GROUND-WATER AND SURFACE-WATER-LEVEL DATA AT RINDGE TRACT ON THE STOCKTON DEEP WATER SHIP CHANNEL, SAN JOAQUIN COUNTY, CALIFORNIA, 1983-84

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1986

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