DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
CALIFORNIA DEPARTMENT OF WATER RESOURCES

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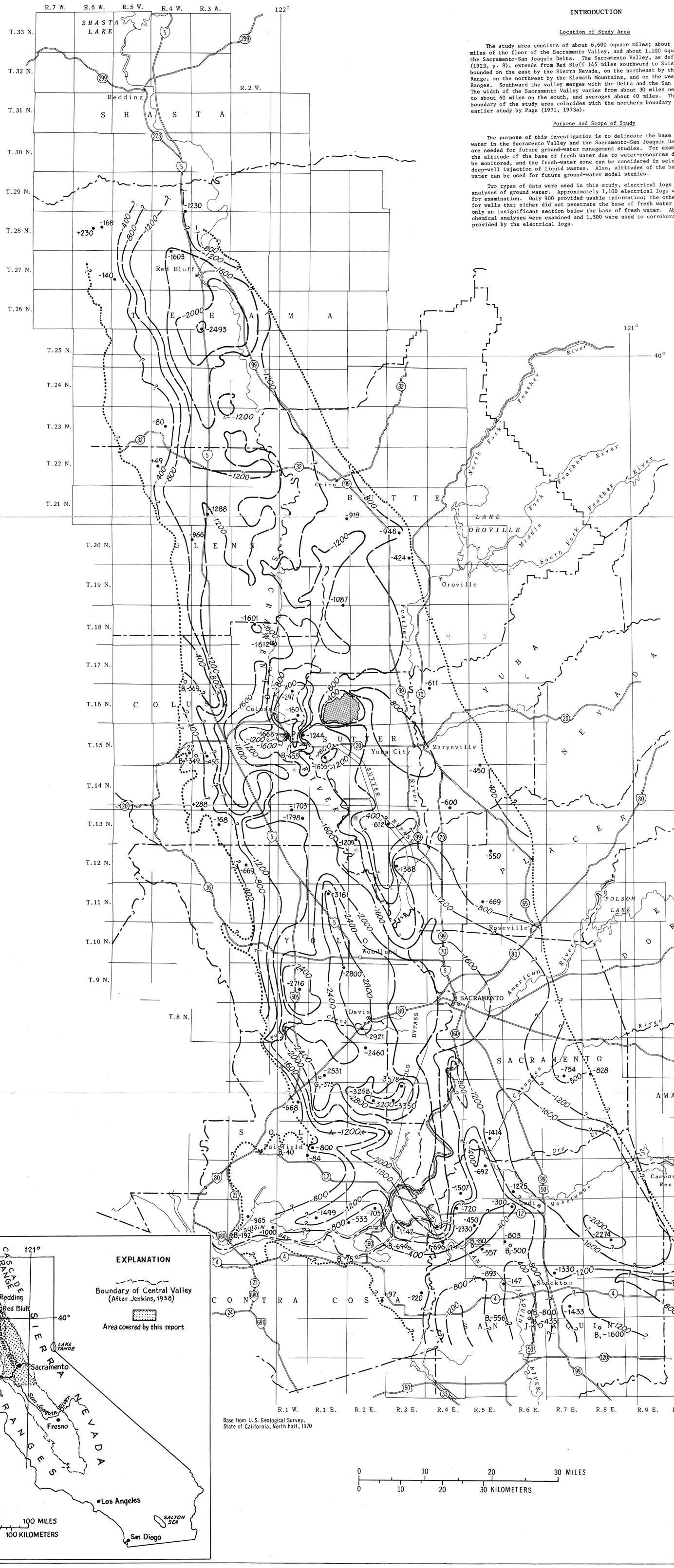
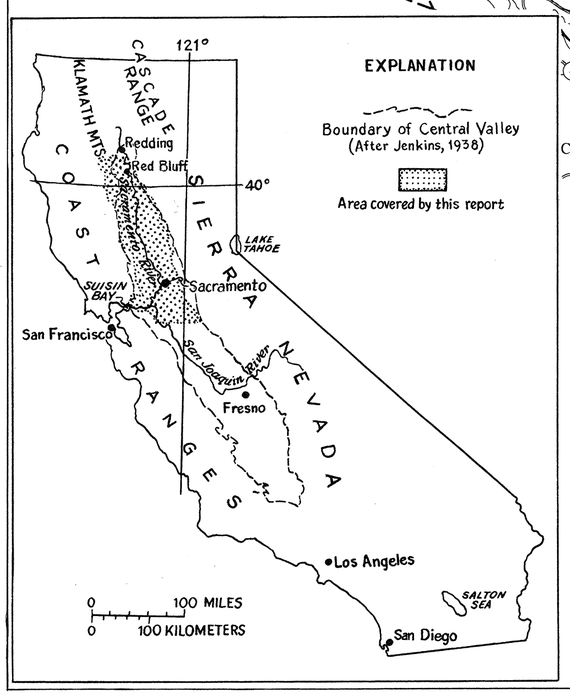
OPEN FILE REPORT



Base from U. S. Geological Survey,
State of California, North half, 1970

0 10 20 30 MILES
0 10 20 30 KILOMETERS



EXPLANATION

Boundary of Central Valley (After Jenkins, 1938)

Area covered by this report

INTRODUCTION

Location of Study Area

The study area consists of about 6,600 square miles; about 5,500 square miles of the floor of the Sacramento Valley, and about 1,100 square miles of the Sacramento-San Joaquin Delta. The Sacramento Valley, as defined by Bryan (1923, p. 8), extends from Red Bluff 145 miles southward to Suisun Bay. It is bounded on the east by the Sierra Nevada, on the northeast by the Cascade Range, on the northwest by the Klamath Mountains, and on the west by the Coast Ranges. Southward the valley merges with the Delta and the San Joaquin Valley. The width of the Sacramento Valley varies from about 30 miles near Red Bluff to about 60 miles on the south, and averages about 40 miles. The southern boundary of the study area coincides with the northern boundary used in an earlier study by Page (1971, 1973a).

Purpose and Scope of Study

The purpose of this investigation is to delineate the base of fresh ground water in the Sacramento Valley and the Sacramento-San Joaquin Delta. The data are needed for future ground-water management studies. For example, changes in the altitude of the base of fresh water due to water-resources development can be monitored, and the fresh-water zone can be considered in selecting sites for deep-well injection of liquid wastes. Also, altitudes of the base of fresh water can be used for future ground-water model studies.

Two types of data were used in this study, electrical logs and chemical analyses of ground water. Approximately 1,100 electrical logs were available for examination. Only 900 provided usable information; the other 200 logs were for wells that either did not penetrate the base of fresh water or penetrated only an insignificant section below the base of fresh water. About 4,000 chemical analyses were examined and 1,500 were used to corroborate information provided by the electrical logs.

Definitions

Fresh water, as used in this report, is water with a specific conductance of less than 3,000 µmhos/cm (micromhos per centimeter) at 25°C. This is about 2,000 mg/l (milligrams per liter) dissolved solids. A relationship between dissolved solids and specific conductance exists. The following equation adapted from Hem (1970, p. 99) can be used to approximate the relationship:

Specific conductance x 0.65 ≈ dissolved solids, in milligrams per liter.

The factor of 0.65 is reasonable for approximation of dissolved solids from specific conductance. In practice, the value of the factor for individual water samples ranges from about 0.50 to about 1.00, dependent on ionic species or combinations of species in solution.

Water with a specific conductance less than 3,000 µmhos is considered fresh in this study for several reasons. First, this limiting value was used in previous ground-water studies in California (Olmsted and Davis, 1961, p. 134-136, pl. 5; Page, 1971, 1973a). Second, this assumption is consistent with criteria established by the [U.S.] Federal Water Pollution Control Administration (1968, table IV-3) for irrigation water. Finally, 3,000 µmhos/cm can be picked with comparative ease on most available electrical logs because of the magnitude and character of the self-potential and resistivity curves in this range of specific conductance.

Salty or saline water, as used in this report, is water with a specific conductance greater than 3,000 µmhos/cm. In addition, salty water contains sufficient chloride as sodium chloride to taste salty to most people--more than 200 to 300 mg/l of chloride, according to Richter and MacLean (1939) and U.S. Public Health Service (1962, p. 32-34)--or contains at least this amount of sodium chloride by analysis. Saline water contains other dissolved mineral constituents and is based either on specific conductance or on chemical analysis.

The base of fresh water is defined as that depth below which only salty or saline water is present. In parts of the valley, bodies of salty or saline water overlie useful bodies of fresh water. A discussion of those conditions is presented later in this report.

Acknowledgments

Collection of data and completion of the study was made possible by the cooperation of public agencies, private companies, and individuals. Electrical well logs and other relevant data were furnished by the U.S. Bureau of Reclamation, the California Department of Water Resources, and the California Division of Oil and Gas (with permission of owners).

CONFIGURATION OF THE BASE OF FRESH GROUND WATER

Fresh ground water in the study area is contained almost exclusively in unconsolidated or poorly consolidated continental and volcanic deposits of Pliocene to Holocene age (Olmsted and Davis, 1961, p. 34-117). The deposits have a maximum thickness of about 3,600 feet, but generally are much thinner (Page, 1973b).

The surface of the base of fresh water is uneven and generally reflects the configuration of continental and volcanic deposits. Deeper geologic structures such as faults and gas reservoirs are rarely reflected in the shape of the base. Along the east margin of the valley, the basement complex of Mesozoic age delineates the lower limit of fresh water. Along the west margin, marine bedrock of Eocene age or older probably delineates the lower limit.

The minimum estimated altitude of the base of fresh water is 3,578 feet below mean sea level at a point between Walnut Grove and Davis about 15 miles southwest of Sacramento. In general, the base of fresh water is less than 2,000 feet below mean sea level.

In several parts of the valley, saline water zones are found near land surface. Some of these zones, described by Olmsted and Davis (1961, p. 135-136), can be divided into two groups based on knowledge of what lies beneath them. One group of shallow saline water zones overlies fresh water. Areas in this group include:

Tps. 3 and 4 N., Rs. 3, 4, and 5 E.
Tps. 6 and 7 N., R. 4 E.
Tps. 8 and 9 N., R. 4 E.
T. 14 N., R. 1 W.

For the second group of shallow saline water zones, inadequate information is available about what type of water underlies the shallow zone. Two of the more notable areas are located as follows:

Tps. 12 and 13 N., R. 2 E.
T. 12 N., R. 6 E.

Sutter Buttes, a volcanic plug, is also surrounded by saline water that occurs near land surface and slopes into the valley, reflecting the configuration of the underlying marine rocks.

The configuration shown on the map generally substantiates the work of Olmsted and Davis (1961, pl. 5). Variations between the two maps result mainly from the availability of more data in 1973 and the difference in intervals used to contour the data. Contours on the base of fresh water in the central part of the delta are based on poor control and are considered tentative.

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For additional information write to:—
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EXPLANATION

-220
Well
Well selected to show base of fresh water with specific conductance generally less than 3,000 micromhos per centimeter. Number is altitude of base of fresh water, in feet above (+) or below (-) mean sea level.

B,-80
Supplemental wells
Selected wells in which base of fresh water could not be delineated. The letter B indicates that electrical log for well begins at altitude where conductance of water is greater than 3,000 micromhos per centimeter; the letter C indicates that electrical log for well ends at altitude where conductance is less than 3,000 micromhos per centimeter. The number indicates altitude, in feet below (-) mean sea level.

?—1200
Contour
Contour on base of fresh water with specific conductance generally less than 3,000 micromhos per centimeter. Queried where data are inconclusive. Contour interval 400 feet. Datum is mean sea level.

Boundary
Approximate line where fresh water is in contact with bedrock or basement complex. Beyond the western boundary, water extends to marine rocks of Eocene or Cretaceous age (after California Division of Mines, 1960a, and California Division of Mines and Geology, 1963). Beyond the eastern boundary, water extends to basement complex (after Smith, 1964). Queried where data are inconclusive.

Sutter Buttes
Marine sediments surrounding igneous core.

MENLO PARK, CALIFORNIA

BASE OF FRESH GROUND WATER—APPROXIMATELY 3,000 MICROMHOS—IN THE SACRAMENTO VALLEY AND SACRAMENTO-SAN JOAQUIN DELTA, CALIFORNIA

By
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December, 1973