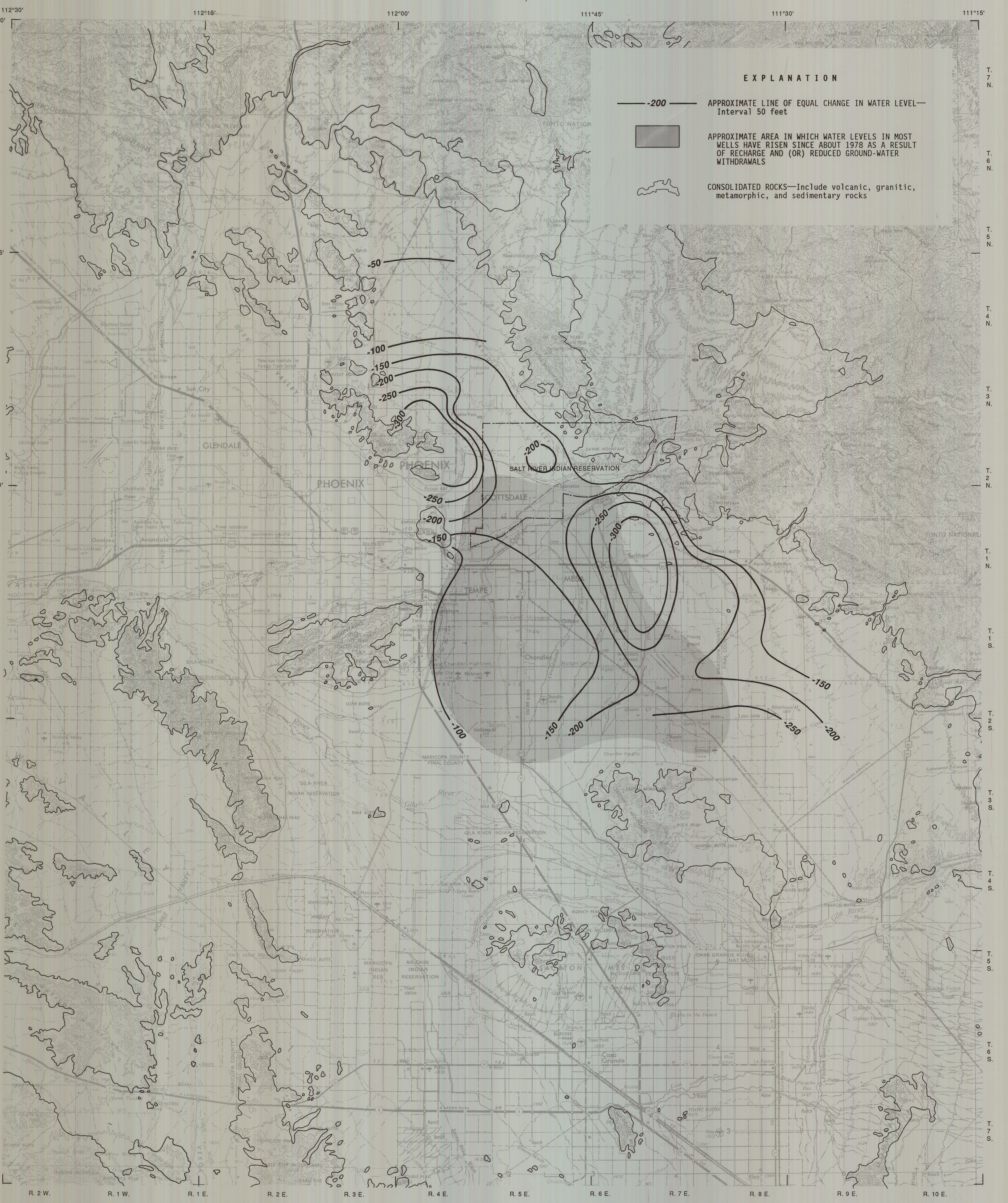
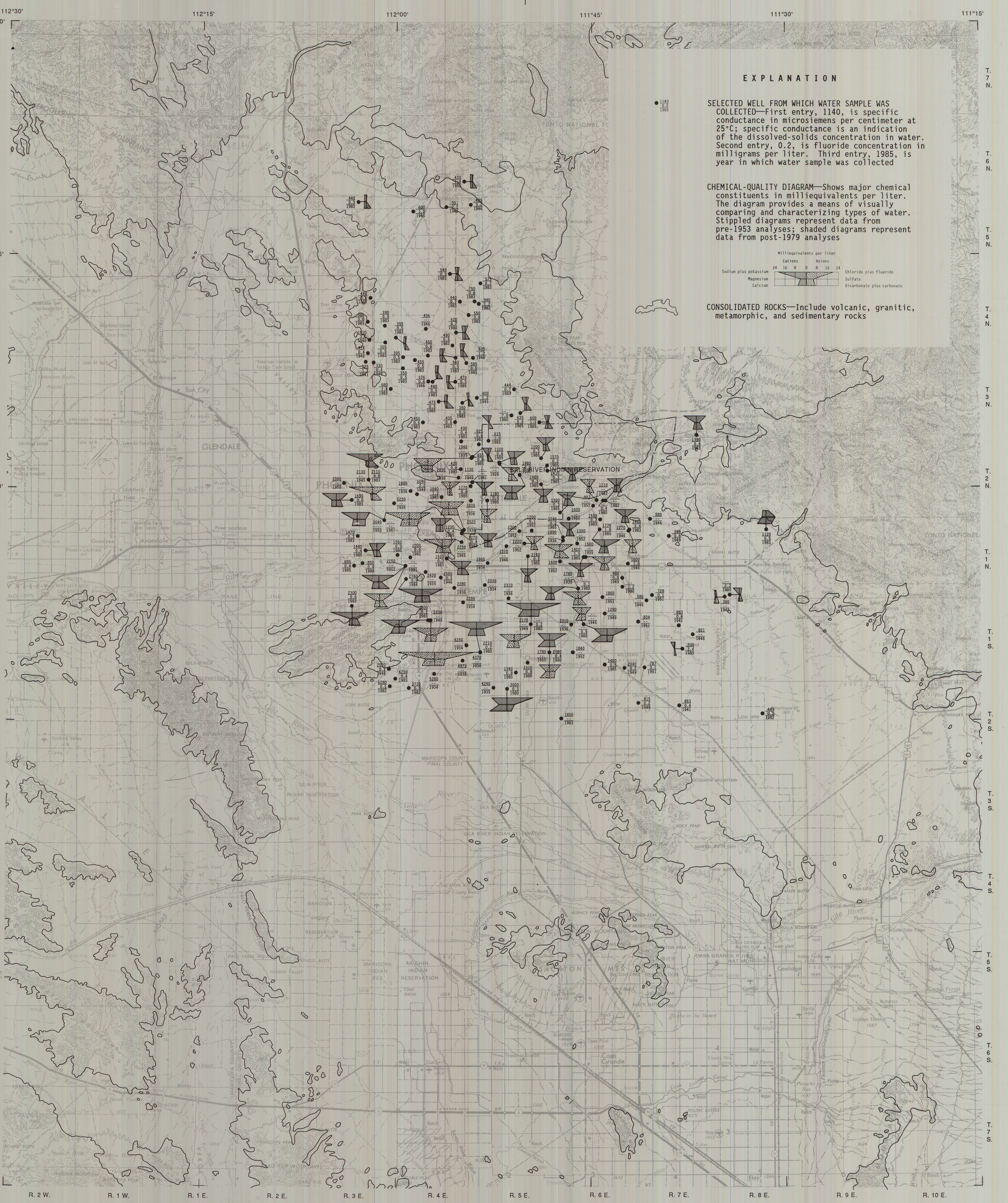


Base from U.S. Geological Survey 1:250,000
Mesa, 1954-69 and Poenix, 1954-69

CHANGE IN WATER LEVEL, ABOUT 1900 TO 1986



Geology from M.E. Cooley, 1973

TOPOGRAPHIC CONTOUR INTERVAL 200 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

CHEMICAL QUALITY OF THE GROUND WATER

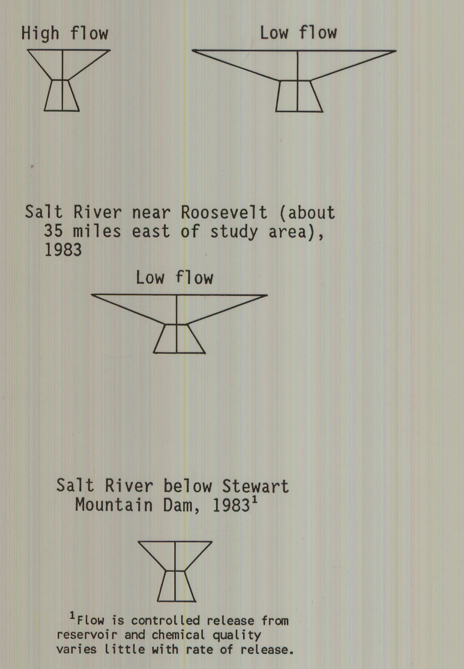


Figure 2.--Chemical quality of the surface water.

CHANGE IN WATER LEVEL FROM ABOUT 1900 TO 1986

The change in water level as shown on the map represents differences between water-level altitudes in about 1900 and 1986 (sheet 1). Water levels in wells declined more than 300 ft east of Mesa and west of the reservation, 100 to 250 ft on the reservation, 100 to 150 ft in the Tempe-Chandler area, and less than 50 ft near the north end of Paradise Valley. Changes in the ground-water system are the result of decrease of natural recharge and withdrawal of ground water. Recharge to the ground-water reservoir decreased because flow in the river was virtually eliminated as a result of the retention of water in the reservoirs on the Salt and Verde Rivers. Water infiltrating from canals and irrigated fields provides some recharge, but the quantity has diminished with time because many canals have been lined and irrigation practices have been changed to conserve water. Since ground-water pumping began, more than 80 million acre-ft has been pumped from the Salt River Valley (U.S. Geological Survey, 1986). The part of the Salt River Valley included in this report contains about half the irrigated land in the valley, but distribution of ground-water pumping has not been determined. Most of the ground water pumped in the study area has been used for irrigation. Although surface water is used for irrigation in much of the area, ground water has been withdrawn in nearly all areas to supplement or replace surface-water supplies in dry years. Surface water is not available in the Queen Creek area or in Paradise Valley north of the Arizona Canal. Long-term ground-water withdrawal together with the depletion of natural recharge has resulted in a general decline in water levels in wells throughout the area. The largest declines are in areas of large ground-water withdrawals or low aquifer yield. Most of the decline has occurred since the 1940's when intense development of ground-water resources began.

The release of large quantities of floodwater into the normally dry channel of the Salt River between February 1978 and June 1980 resulted in recharge to the ground-water system. Water levels in wells rose more than 50 ft along the Salt River and as much as 20 ft in most of the area between the Arizona Canal on the north and Chandler on the south (Mann and Rohne, 1983). Between the Arizona Canal and Chandler, water levels were lowest in 1978 and continued to rise slightly either as a result of additional recharge of floodwater or decreases in ground-water pumping. The area affected by rising water levels was determined by comparing altitudes of ground-water levels in 1986 with altitudes of ground-water levels in 1976 (Laney and others, 1978).

CHEMICAL QUALITY

Chemical quality of ground water in and near the Salt River Indian Reservation varies areally but is generally of good chemical quality for public supply (U.S. Environmental Protection Agency, 1976). In the area north of the Arizona Canal, specific conductance of the ground water ranged from about 300 to 600 μS/cm (microsiemens per centimeter at 25 °C). Specific conductance is a measure of the ability of the ions in solution to conduct electrical current and is an indication of the amount of dissolved solids in water. The dissolved-solids content, in milligrams per liter, is about 0.6 of the specific conductance. From the Arizona Canal to the south boundary of the study area, specific conductance of the ground water ranged from about 1,200 to 2,000 μS/cm. Near the southwestern part of the area, specific conductance of the ground water in some wells was greater than 6,000 μS/cm. Ground water in the southwestern part of the area generally is not used for public supply because of large dissolved-solids concentrations but is acceptable for irrigation and industrial uses.

Chemical data on ground water and surface water were collected from 1896 to 1903 (Lee, 1905). Because the location of the ground-water sampling sites and the methods used to collect and analyze the samples are uncertain, comparison of these data with more recent water-quality data is questionable, but some general observations are possible. For example, the dissolved-solids concentration (residue on evaporation at 110 °C) for a ground-water sample collected in Paradise Valley in 1902 was 256 mg/L (milligrams per liter), which is comparable to 1985 data in that area. Dissolved-solids concentrations for ground water in the Scottsdale-Tempe-Mesa area ranged from 520 to 3,810 mg/L for samples collected from 1896 to 1903 and from 500 to about 3,000 mg/L for samples collected from 1926 to 1986. The large concentrations of dissolved solids recorded by Lee (1905) may reflect the natural quality of the shallow ground water at that time or may have been the result of the leaching of salts from the soil and percolation of irrigation water to the shallow ground-water reservoir. Much of the area had been irrigated for many years before samples of the ground water were analyzed.

Chemical-quality data collected from 1980 to 1985 were compared with data collected from 1926 to 1952 before intense ground-water pumping began. In general, the data show little evidence of change in chemical quality of the ground water in most of the area. Eight wells in the study area were sampled before 1953 and after 1979, and chemical-quality diagrams for each pair of analyses are shown for comparison. Chemical-quality diagrams for the predevelopment and postdevelopment samples for three wells in sec. 19, T. 1 N, R. 4 E.; sec. 22, T. 2 N., R. 3 E.; and sec. 24, T. 2 N., R. 4 E., are similar. Chemical-quality diagrams show that concentrations of dissolved solids, especially sodium, calcium, and chloride, increased in three wells in sec. 10, T. 1 S, R. 5 E.; sec. 24, T. 1 S., R. 5 E.; and sec. 8, T. 1 S., R. 6 E., and decreased in two wells in sec. 2, T. 1 N., R. 3 E., and sec. 19, T. 1 S., R. 4 E. The apparent changes in the chemical quality of ground water probably resulted from the dewatering of sediments, deepening of wells, and changes in recharge patterns. One of the wells in sec. 24, T. 2 N, R. 4 E., for which two chemical analyses are available was deepened between sampling dates; however, the chemical-quality diagrams for the two samples are similar.

Ground water in Paradise Valley was a mixed sodium magnesium bicarbonate type, whereas ground water in most of the Salt River Indian Reservation and to the south was a sodium chloride type. Concentrations of fluoride ions in ground water generally were less than 1.4 mg/L, which is the maximum contaminant level set by the Bureau of Water Quality Control (1978) for fluoride levels in areas where the annual average maximum daily air temperature is greater than 79.3 °F. In one area south of the reservation, fluoride concentrations ranged from 1.5 to 2.6 mg/L. Water samples from a few wells near the consolidated-rock outcrops on the west side of Paradise Valley and near Carefree contained fluoride concentrations that ranged from 2.2 to 4.5 mg/L. North of the reservation, water from a 2,830-foot-deep well contained fluoride concentrations of 7.0 mg/L.

Nitrate concentrations exceeded the maximum contaminant level of 10 mg/L as nitrogen (U.S. Environmental Protection Agency, 1976) in water from a few wells scattered throughout the southern part of the study area. In the Salt River Indian Reservation, water samples from two wells in secs. 16 and 23, T. 2 N., R. 5 E., contained concentrations of nitrate as nitrogen of 22 and 11 mg/L, respectively.

Concentrations of hexavalent chromium exceeded the maximum contaminant level of 0.050 mg/L (U.S. Environmental Protection Agency, 1976) in water samples taken in 1983 from a well in sec. 23, T. 3 N., R. 4 E., and one in sec. 25, T. 4 N., R. 3 E. Concentrations of hexavalent chromium were 0.190 and 0.056, respectively, and correlate with data from a study on hexavalent chromium in Paradise Valley by Robertson (1975), which stated that the occurrence has a natural geologic origin.

Water in the Salt River near Mesa was sampled for chemical analysis during seven periods in 1899 and 1900 (Lee, 1905). Dissolved-solids concentrations ranged from 724 to 1,391 mg/L, which is approximately equivalent to specific conductance of about 1,200 to 2,300 μS/cm. The largest dissolved-solids concentrations occurred during low flows and the smallest during high flows. The chemical-quality diagram for the low-flow conditions of 1900 is similar to the diagram for a typical low-flow sample taken in 1983 from the Salt River near Roosevelt (fig. 2). The chemical-quality diagram for the high-flow conditions of 1899 is similar to the diagram for a sample of the water released from Stewart Mountain Dam in 1983. Since the reservoirs were completed, releases have consisted mainly of water released from storage. This water includes large volumes of surface runoff that typically contain small concentrations of dissolved solids. Most of the surface runoff occurs on a few days each year, and the water would pass quickly from the watershed if the reservoirs were not present. Water that was available for recharge most of the time under natural conditions, therefore, was base flow. Most of the surface runoff now is stored in the reservoirs where the base flow of the river is diluted. In 1983, the specific conductance of water from the Salt River near Roosevelt, which is upstream from the reservoir, averaged 1,965 μS/cm for base flow and 455 μS/cm for high flow. Specific conductance of water from the Verde River below Tangle Creek, above Horseshoe Dam, averaged 619 μS/cm for base flow and 270 μS/cm for high flow. In 1983, releases from the downstream reservoirs had an average specific conductance of 900 μS/cm on the Salt River and 362 μS/cm on the Verde River (White and Garrett, 1986).

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