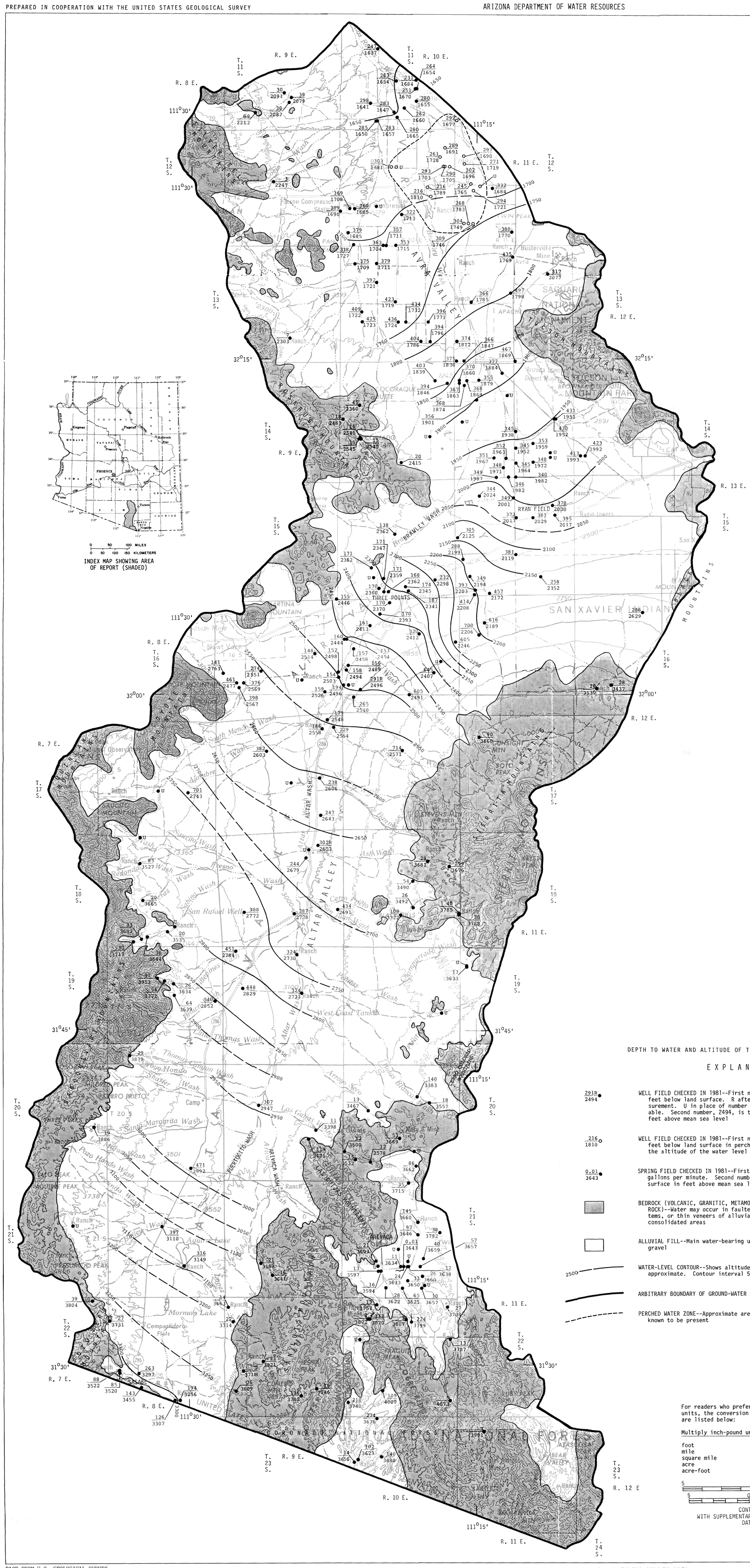

Introduction

The Avra/Altar Valley area includes about 1,490 square miles in Pima and Santa Cruz Counties in southeast Arizona. The area is bounded on the west by the Pozo Verde, Baboquivari, Quinlan, Coyote, Roskruge and Silver Bell Mountains. On the east the area is bounded by the San Luis, Las Guijas, Cerro Colorado, Sierrita, Black and the Tucson Mountains. The mountains are drained by many small washes that flow into the central part of the area. Altar and Brawley Washes are the main drainages and are subject to large-scale flooding at times. Altar Wash starts at the confluence of Puertocito and Arivaca Washes, flows northward, and becomes Brawley Wash at an indefinite point about 6 miles south of Tucson-Ajo Highway.

The climate of the Avra/Altar Valley area is arid, and is characterized by low precipitation and high summer temperatures, which, combined with low humidity, result in a high rate of evaporation. Thus, a large part of the precipitation evaporates before it can be used beneficially by crops or recharged to the ground-water reservoir (White and others, 1966, p. 14).

Data from several climatological stations in and near the valley indicate a wide range in precipitation from place to place and year to year. The wettest months are July, August and September; the remainder of the year is normally dry. The average yearly precipitation probably is less than 12 inches at the lower altitudes in the central parts of the valley area, but may be as much as 24 inches in the higher altitudes. The average daily maximum temperatures are 101°F in July and 65°F in January. Average daily minimum temperatures are 70°F in July and 32°F in January. Extremes of 116°F in July and 8°F in December have been recorded. (See Sellers and Hill, 1974, for detailed climatic data.)

Water use in the area includes agricultural irrigation, municipal and domestic supply and stock water. Development of ground water south of Township 16 South is minimal and is confined mostly to ranching, except for the area near Arivaca where the use is primarily domestic. North of Township 17 South the ground-water use is predominantly for irrigation. However, municipal pumpage is increasing as agricultural land is retired. The large-scale pumping of ground water for irrigation has been in excess of the rate of replenishment to the ground-water reservoir for some time and has caused declines in the water level. As a result, the area was declared a critical ground-water area on October 15, 1954. Since 1954, the amount of land under cultivation has decreased from approximately 28,200 acres to approximately 14,800 acres. On June 12, 1980 the Avra/Altar Valley area was included in the newly formed Tucson Active Management Area.

Occurrence and Movement of Ground Water

In the Avra/Altar Valley area the main water-bearing unit is the alluvial fill along the central axis of the valley. The alluvial fill may be as much as 2,000 feet thick and is composed of interfingering lenses of silt, sand and gravel (White and others, 1966, p. 18) that, when saturated, may yield more than 3,000 gallons per minute of water to properly constructed wells. Depths to water in the main water-bearing unit in the northern part of the area range from approximately 140 feet to 500 feet below land surface. Depths to water in the main water-bearing unit in the southern part of the area range from approximately 14 feet to 720 feet below land surface. Along the fringes of the valleys, pediments may exist where the alluvial fill is underlain by bedrock at shallower depths than in the central parts of the valley. The possibilities of high well yields are reduced by the small saturated thickness of alluvial fill. The bedrock (granitic, metamorphic, volcanic and crystalline sedimentary rocks) that comprises the mountains that border the valley to the east and west may yield small amounts of water to wells where sufficiently faulted or fractured. Thin alluvial deposits along narrow valleys in the mountains also may yield a few gallons per minute to stock and domestic wells. Several small alluvial areas overlie the crystalline rocks of the San Luis and Las Guijas Mountains. Of these, the alluvial area near Arivaca is the most developed. The area is drained by Arivaca Wash, a tributary of Altar Wash. The depth to water in the Arivaca area ranges from about 0 to 145 feet below land surface.

The direction and rate of movement of ground water in the Avra/Altar Valley area is a function of several factors. Prior to the development of ground water, the aquifer was in approximate hydrologic balance, that is, water moving into the area was approximately equal to the amount moving out of the area. The slope of the water surface was generally northeastward and then northward, conforming, in general, to the slope of the land surface. Ground water moved from the mountain areas toward the center of the valley and discharged into the Lower Santa Cruz basin area. Extensive development of the ground-water resources of Avra Valley began about 1950. Since that time many wells have been drilled, and as much as 159,000 acre-feet of ground water has been withdrawn each year. In 1965 a slight steepening in the gradient of the water surface in the area near Three Points was apparent (White, 1966, p. 27). Since 1965 water levels have declined as much as 76 feet in wells in the northern end of the area. (See Hydrographs A thru K, Plate 2.) In the southern part of the area the water level in one well in Township 18 South, Range 19 East, rose 19 feet. The rise probably is in response to intermittent flows in Altar Wash. In all other wells in the southern part of the area the water levels changed only a few feet or not at all. (See Hydrographs M thru P, Plate 2.) Many water-level measurements made in 1980, in Township 12 South, Ranges 10 and 11 East, indicate higher water-level altitudes than the water-level altitudes in the regional aquifer. These represent perched water zones that are formed when irrigation water percolates downward and is slowed or stopped by fine-grained beds.

Water Quality

In the Avra/Altar Valley area ground water is of good quality for most uses. The dissolved-solids concentrations shown on the map range from 195 to 851 mg/L (milligrams per liter). The specific conductance values from additional samples, however, indicate that dissolved-solids concentrations in water from some wells and springs are less than 100 mg/L and more than 1,200 mg/L. For water from wells and springs without a complete analysis, the dissolved-solids values may be estimated by multiplying the specific conductance by 0.6, the approximate ratio of dissolved solids to specific conductance. The recommended maximum concentration for dissolved solids in public water supplies is 500 mg/L, as proposed in the secondary drinking-water regulations of the U.S. Environmental Protection Agency (1977b, p. 17146) in accordance with the provisions of the Safe Drinking-Water Act (Public Law 93-523). Of the 120 water samples collected the dissolved-solids concentration in only 21 exceeded the 500 mg/L limit, and the highest concentration was about 1,200 mg/L. The U.S. Environmental Protection Agency (1977a, b) has established national regulations and guidelines for the quality of water provided by public water systems. The standards established in these regulations are either primary or secondary. Primary drinking-water standards limit contaminants in drinking water that have been shown to affect human health. Primary drinking-water standards are enforceable either by the Environmental Protection Agency or by the States; in contrast, the secondary standards are not Federally enforceable. The standards express limits as "maximum contaminant levels" where contaminant means any physical, chemical, biological or radiological substance or matter in water.

Fluoride concentrations in water samples from wells and springs in the Avra/Altar Valley area ranged from 0.2 to 8.7 mg/L. The recommended maximum concentration for fluoride in public water supplies differs according to the annual average maximum daily air temperature (Bureau of Water Quality Control, 1978, p. 6). The annual average maximum daily air temperature in the area is about 78°F (Sellers and Hill, 1974, p. 70); therefore, the maximum concentration for fluoride is 1.6 mg/L. The fluoride concentration in only 5 of 120 samples collected exceed this limit and these are mainly from wells along the mountain drainages.

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U.S. Environmental Protection Agency, 1976, [1978], Quality criteria for water: U.S. Environmental Protection Agency publication, 256 p.

_____1977a, National interim primary drinking water regulations: U.S. Environmental Protection Agency Report, EPA-570/9-76-003, 159 p.

_____1977b, National secondary drinking water regulations: Federal Register, v. 42, no. 62, March 31, 1977: U.S. Geological Survey open-file report 80-330, maps.

U.S. Geological Survey, 1981, Annual summary of ground-water conditions in Arizona, Spring 1979 to Spring 1980: U.S. Geological Survey open-file report 81-906, maps.

White, N.D., Matlock, W.G., and Schwalen, H.C., 1966, The ground water of Avra and Altar Valleys, Pima County, Arizona: Arizona State Land Department, Water Resources report no. 25, 66 p.

DEPTH TO WATER AND ALTITUDE OF THE WATER LEVEL, SPRING 1981

EXPLANATION

291R/2494 — WELL FIELD CHECKED IN 1981--First number, 291R, is depth to water in feet below land surface. R after number indicates reported measurement. U in place of number indicates measurement was unobtainable. Second number, 2494, is the altitude of the water level in feet above mean sea level

216/1810 — WELL FIELD CHECKED IN 1981--First number, 216, is depth to water in feet below land surface in perched zone. Second number, 1810, is the altitude of the water level in feet above mean sea level

0.01/3643 — SPRING FIELD CHECKED IN 1981--First number, 0.01, is discharge in gallons per minute. Second number, 3643, is altitude of the land surface in feet above mean sea level

BEDROCK (VOLCANIC, GRANITIC, METAMORPHIC OR CRYSTALLINE SEDIMENTARY ROCK)--Water may occur in faulted or fractured zones, joint systems, or thin veneers of alluvial or fluvial sediment overlying consolidated areas

ALLUVIAL FILL--Main water-bearing unit consisting of silt, sand, and gravel

2500 — WATER-LEVEL CONTOUR--Shows altitude of the water level. Dashed where approximate. Contour interval 50 feet. Datum is mean sea level

ARBITRARY BOUNDARY OF GROUND-WATER AREA

PERCHED WATER ZONE--Approximate area in which perched ground water is known to be present

GROUND-WATER PUMPAGE

Total pumpage in Altar Valley area is mostly from domestic and stock wells, and the amount is equal to or less than 500 acre-feet per year and is, therefore, not shown.

GROUND-WATER PUMPAGE IN THE AVRA VALLEY AREA

YEAR	PUMPAGE IN THOUSANDS OF ACRE-FEET	YEAR	PUMPAGE IN THOUSANDS OF ACRE-FEET
1935	1	1958	120
1936	1	1959	130
1937	4	1960	140
1938	8	1961	134
1939	9	1962	140
1940	12	1963	115
1941	10	1964	115
1942	6	1965	125
1943	20	1966	95
1944	19	1967	121
1945	23	1968	134
1946	23	1969	155
1947	34	1970	157
1948	38	1971	140
1949	48	1972	146
1950	41	1973	152
1951	75	1974	129
1952	80	1975	159
1953	85	1976	115
1954	90	1977	110
1955	95	1978	66
1956	100	1979	71
1957	110	1980	83
		TOTAL:	3712

For readers who prefer to use metric units rather than inch-pound units, the conversion factors for the terms used in this report are listed below:

Multiply inch-pound unit	By	To obtain metric unit
foot	0.3048	meter
mile	1.609	kilometer
square mile	2.590	square kilometer
acre	0.4047	square hectometer
acre-foot	0.001233	cubic hectometer

5 0 5 MILES
5 0 5 10 KILOMETERS

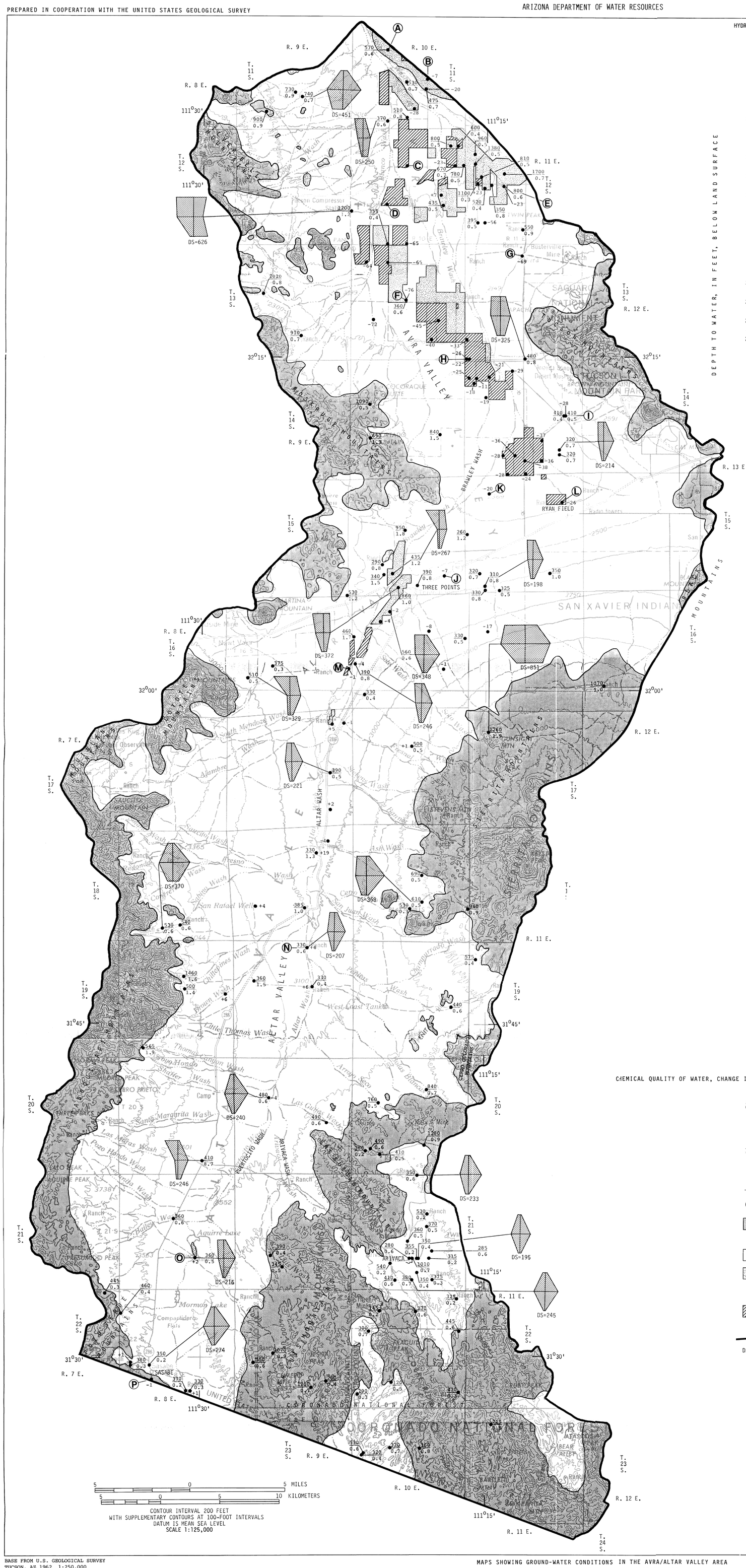
CONTOUR INTERVAL 200 FEET
WITH SUPPLEMENTARY CONTOURS AT 100-FOOT INTERVALS
DATUM IS MEAN SEA LEVEL
SCALE 1:125,000

BASE FROM U.S. GEOLOGICAL SURVEY
TUCSON, AZ 1962 1:250,000
NOGALES, AZ 1956, REV. 1969 1:250,000

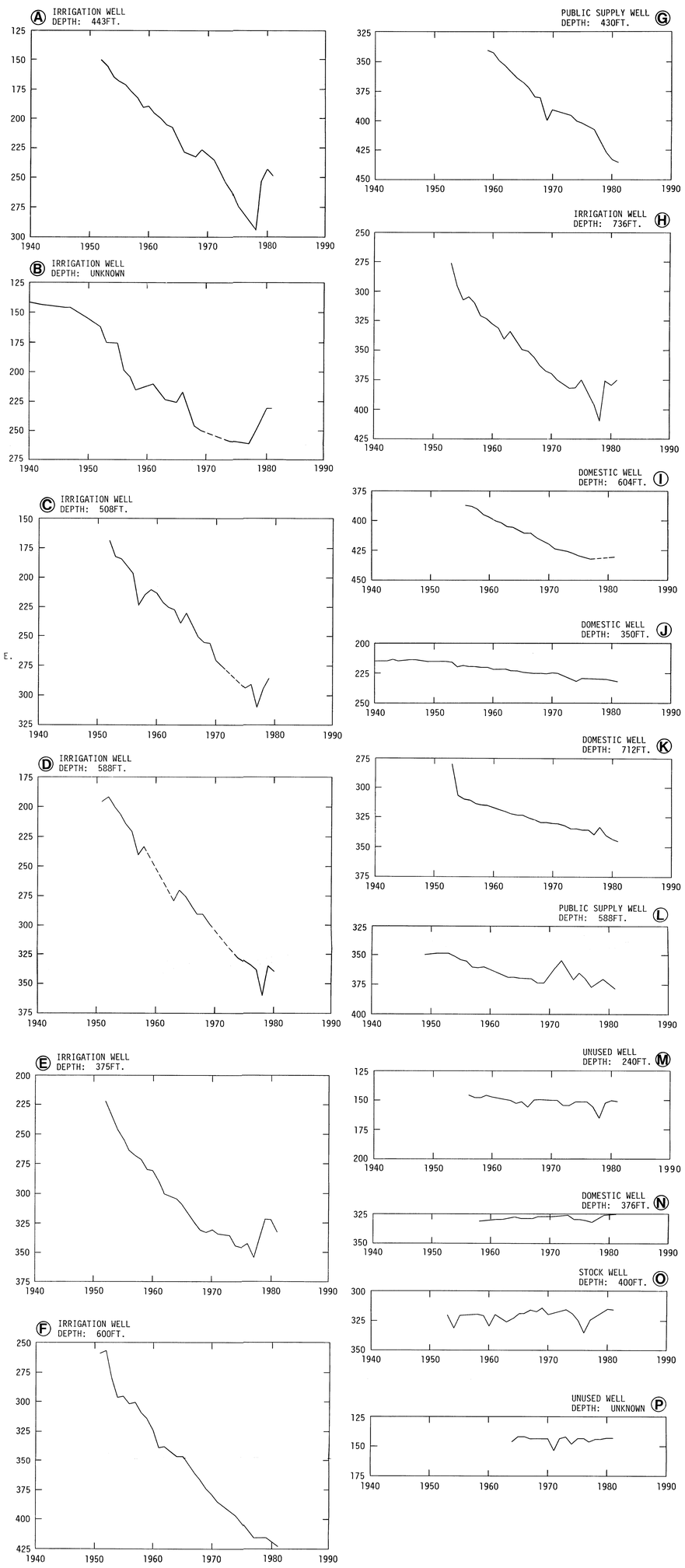
MAPS SHOWING GROUND-WATER CONDITIONS IN THE AVRA/ALTAR VALLEY AREA PIMA AND SANTA CRUZ COUNTIES, ARIZONA--1981

by

R. W. REETER AND C. V. CADY



HYDROGRAPHS OF THE WATER LEVEL IN SELECTED WELLS SHOWN ON MAP
(Dashed line indicates inferred water levels)



CHEMICAL QUALITY OF WATER, CHANGE IN WATER LEVEL, 1940-1981, IRRIGATED AREA, AND HYDROGRAPHS OF THE WATER LEVEL IN SELECTED WELLS

EXPLANATION

690 / 0.5 ● WELL FOR WHICH A WATER SAMPLE WAS COLLECTED IN 1981--First number, 690, is specific conductance in micromhos per centimeter at 25°C (specific conductance is an indication of the dissolved-solids concentration in water). Second number, 0.5, is the fluoride concentration in milligrams per liter

145 / 0.2 ● SPRING FOR WHICH A WATER SAMPLE WAS COLLECTED IN 1981--First number, 145, is specific conductance in micromhos per centimeter at 25°C (specific conductance is an indication of the dissolved-solids concentration in water). Second number, 0.2, is the fluoride concentration in milligrams per liter

-23 ● CHANGE IN WATER LEVEL FROM 1965 TO 1981

Ⓐ● WELL FOR WHICH A HYDROGRAPH DEPICTING CHANGE IN DEPTH TO WATER IS SHOWN

BEDROCK (VOLCANIC, GRANITIC, OR METAMORPHIC ROCK)--Water may occur in faulted or fractured zones, joint systems, or thin veneers of alluvial or fluvial sediment overlying consolidated areas

ALLUVIAL FILL--Main water-bearing unit consisting of silt, sand, and gravel

IRRIGAT DEAREA AS OF 1981--Based on aerial photography taken in 1972. Field checked in 1980 and 1981. Land under cultivation or that prepared for cultivation was considered irrigated. Total area is approximately 14,800 acres

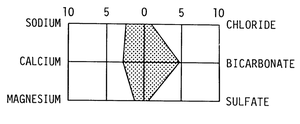
AREA IRRIGATED PRIOR TO 1981 BUT OUT OF PRODUCTION AS OF WINTER 1980--Based on aerial photographs taken in 1972. Field checked in 1980 and 1981. Total area is approximately 13,400 acres

ARBITRARY BOUNDARY OF GROUND-WATER AREA

DS=368 DISSOLVED SOLIDS--Number, 267, is dissolved-solids concentration in milligrams per liter determined as residue at 180°C

CHEMICAL QUALITY DIAGRAM--Shows major constituents in milliequivalents per liter. The diagrams are in a variety of shapes and sizes providing a means of comparing, correlating and characterizing similar or dissimilar types of water

MILLIEQUIVALENTS PER LITER



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