#14

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

MAPS SHOWING GROUND-WATER CONDITIONS IN THE LOWER SANTA CRUZ AREA, PINAL, PIMA, AND MARICOPA COUNTIES, ARIZONA—1977

BY A. D. KONIECZKI AND C. S. ENGLISH

U.S. GEOLOGICAL SURVEY
WATER-RESOURCES INVESTIGATIONS 79-56
OPEN-FILE REPORT

TUCSON, ARIZONA
MARCH 1979

PREPARED IN COOPERATION WITH THE
ARIZONA WATER COMMISSION

KONIECZKI AND ENGLISH—GROUND-WATER CONDITIONS IN THE LOWER SANTA CRUZ AREA, ARIZONA

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Water Resources Division
Federal Building
301 West Congress
Tucson, Arizona 85701

May 31, 1979

TO THE USERS OF GEOLOGICAL SURVEY HYDROLOGIC DATA:

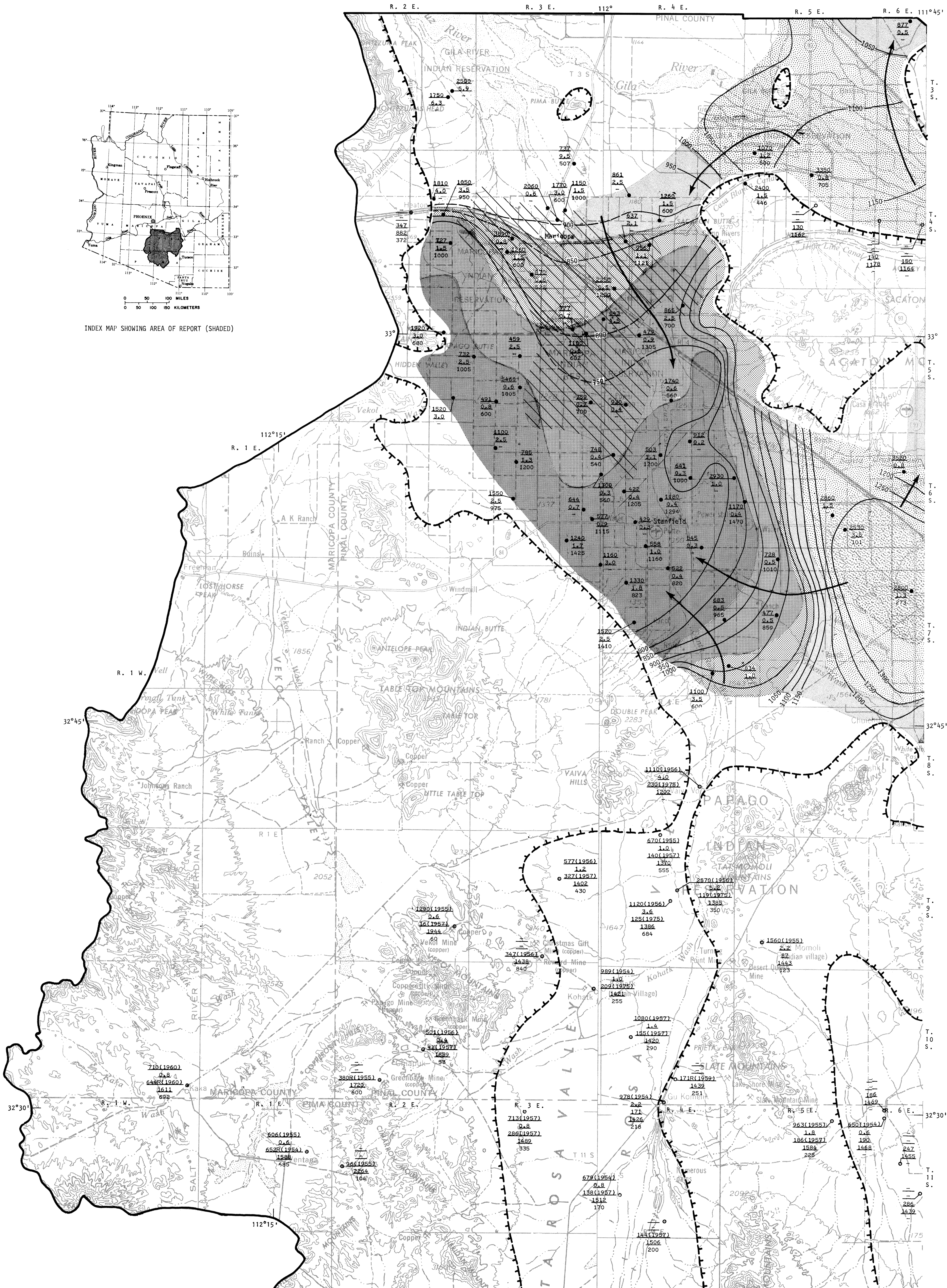
Enclosed is a copy of the report entitled "Maps showing ground-water conditions in the lower Santa Cruz area, Pinal, Pima, and Maricopa Counties, Arizona—1977," by A. D. Konieczki and C. S. English. The report was prepared by the U.S. Geological Survey in cooperation with the Arizona Water Commission and has been published as U.S. Geological Survey Water-Resources Investigations 79-56. Computer printouts of the hydrologic data on which the maps are based are available for consultation at the Arizona Water Commission, 222 North Central Avenue, Suite 800, Phoenix, and the U.S. Geological Survey offices in: Federal Building, 301 West Congress Street, Tucson, and Valley Center, Suite 1880, Phoenix. Material from which copies can be made at private expense is available at the Tucson and Phoenix offices of the U.S. Geological Survey.

The maps for the lower Santa Cruz area are a part of a series that eventually will cover the entire state. The maps show depth to water, altitude of the water level, specific conductance, fluoride concentration, change in water level (1923-77), and land use. Hydrographs of the water level in selected wells and a table of historical pumpage also are included.

Sincerely yours,

Robert D. Mac Nish
District Chief

Enclosure



INDEX MAP SHOWING AREA OF REPORT (SHADED)

EXPLANATION

DEPTH TO WATER, IN FEET BELOW LAND SURFACE

- Less than 100
- 100-200
- 200-300
- 300-400
- 400-500
- More than 500
- Insufficient data

750 — WATER-LEVEL CONTOUR—Shows altitude of the water level, 1976-77. Dashed where approximately located. Contour interval 50 feet. Datum is mean sea level

● 737 / 9.5 / 507 — WELL FROM WHICH WATER SAMPLE WAS COLLECTED IN 1976-77—First entry, 737, is specific conductance in micromhos per centimeter at 25°C; specific conductance is an indication of the dissolved-solids concentration in water. Second entry, 9.5, is fluoride concentration in milligrams per liter. Third entry, 507, is depth of well in feet

○ 670(1955) / 1.0 / 140(1957) / 1370 / 555 — WELL FROM WHICH MISCELLANEOUS DATA HAVE BEEN COLLECTED—First entry, 670, is specific conductance in micromhos per centimeter at 25°C [(1955), year in which sample was collected if other than 1976-77]; specific conductance is an indication of the dissolved-solids concentration in water. Second entry, 1.0, is fluoride concentration in milligrams per liter. Third entry, 140, is depth to water in feet below land surface [R, depth to water reported; (1957), year in which depth to water was reported or measured if other than 1976-77]. Fourth entry, 1370, is altitude of the water level in feet above mean sea level. Fifth entry, 555, is depth of well in feet

AREA IN WHICH SOME WATER LEVELS ARE ANOMALOUSLY HIGH

GENERALIZED DIRECTION OF GROUND-WATER FLOW

APPROXIMATE BOUNDARY OF THE MAIN WATER-BEARING UNIT—The main water-bearing unit consists principally of unconsolidated alluvial deposits. The upper and the lower sand and gravel units are the main sources of ground water. Outside the boundary of the main water-bearing unit, small amounts of water may be obtained from alluvial deposits in narrow valleys or from faulted or fractured consolidated sedimentary rocks

ARBITRARY BOUNDARY OF GROUND-WATER AREA

SPECIFIC CONDUCTANCE, IN MICROMHOS PER CENTIMETER AT 25°C	DISSOLVED SOLIDS (CALCULATED), IN MILLIGRAMS PER LITER
5000	3000
4000	2500
3000	2000
	1500
2000	
	1000
1000	
	500
300	200

APPROXIMATE RELATION OF SPECIFIC CONDUCTANCE TO DISSOLVED SOLIDS

The lower Santa Cruz area includes about 5,400 mi^2 in south-central Arizona and is the second largest agricultural area in the State. The area depends mainly on ground water for irrigation use, and in 1976 about 966,000 acre-ft of ground water was pumped from the area. The main water-bearing unit consists principally of unconsolidated alluvial deposits. In the extensively developed part of the area the alluvial deposits have been divided into four units—the upper sand and gravel unit, the silt and clay unit, the lower sand and gravel unit, and the local gravel unit, which is present only in the Maricopa-Stanfield area (Hardt and Cattany, 1965, p. 21). The upper and the lower sand and gravel units are the main sources of ground water. The upper sand and gravel unit is at the land surface in most of the area and is from less than 50 to about 600 ft thick. The silt and clay unit is from 100 to about 600 ft below the land surface and is from 0 to about 2,000 ft thick. The lower sand and gravel unit is a mixture of sand, gravel, and clay, which is usually more cemented than that in the upper unit. The unit is from 300 to 1,100 ft below the land surface in the western part of the area and from 300 to nearly 2,000 ft below the land surface in the eastern part and is from 0 to about 500 ft thick. Ground water may occur under confined conditions in the lower unit where overlain by the silt and clay unit. Where the silt and clay unit is not present, it is difficult to differentiate between the upper and the lower sand and gravel units. The local gravel unit is from 0 to nearly 1,000 ft thick. (See Hardt and Cattany, 1965, p. 21-25.) Outside the boundary of the main water-bearing unit, small amounts of water may be obtained from alluvial deposits in narrow valleys or from faulted or fractured consolidated sedimentary rocks.

Prior to major agricultural development, ground-water flow in the southeastern part of the area was from the southeast toward the northwest. In the northeastern part ground water flowed westward, and in the western part ground water flowed northwestward. As a result of the large-scale long-term withdrawal of ground water, the direction of ground-water flow has changed. In the southeastern and south-central parts of the area ground-water flow now is toward a large cone of depression near Eloy (sheet 2), and in the western part ground-water flow is toward a large cone of depression in the Maricopa-Stanfield area (sheet 1).

The long-term withdrawal of ground water has resulted in a general decline in water levels in the lower Santa Cruz area. Since 1923, declines of nearly 500 ft have occurred near Stanfield (sheet 3). The water level in a well in sec. 1, T. 6 S., R. 2 E., has declined 459 ft since 1950. Between 1923 and 1977, declines of less than 50 ft occurred near Casa Grande and in the northeastern part of the area along the Gila River (sheet 4). The rate of decline in water levels in wells west of Casa Grande and north of Eloy generally has decreased in the last few years, and small rises in water level occurred in some wells (see hydrograph D, sheet 3, and hydrograph B, sheet 4). The water level in a well in sec. 34, T. 6 S., R. 5 E., has risen 14 ft since 1940. In this area several large tracts of land are no longer farmed, and some tracts are subdivided for housing developments but remain sparsely populated. The local decrease in agricultural land use greatly reduced pumping in the area, which probably accounts for the decrease in the rate of decline and local rises in the water levels. In the northwestern part of the area the water level in a few wells in the main water-bearing unit is anomalously higher than the water level in most wells. The wells may be open to a shallow water-bearing zone that in other places is either drained of water or is absent.

In the lower Santa Cruz area the dissolved-solids concentrations in ground water range from less than 300 to more than 3,000 mg/L (milligrams per liter). The proposed secondary maximum contaminant level for dissolved solids in public water supplies is 500 mg/L (U.S. Environmental Protection Agency, 1977, p. 17146). The following recommended guidelines for dissolved solids in irrigation water are from the National Academy of Sciences and National Academy of Engineering (1973, p. 335).

Classification	Dissolved solids (milligrams per liter)
Water for which no detrimental effects are usually noticed...	500
Water that can have detrimental effects on sensitive crops...	500-1,000
Water that can have adverse effects on many crops; requires careful management practices......................	1,000-2,000
Water that can be used for tolerant plants on permeable soils with careful management practices..................	2,000-5,000

The maximum contaminant level for fluoride in public water supplies differs according to the annual average maximum daily air temperature (Bureau of Water Quality Control, 1978, p. 6). In the lower Santa Cruz area the annual average maximum daily air temperature is about 87°F, and the maximum contaminant level for fluoride is 1.4 mg/L. The fluoride concentration in much of the ground water exceeds 1.4 mg/L.

The hydrologic data on which these maps are based are available, for the most part, in computer-printout form for consultation at the Arizona Water Commission, 222 North Central Avenue, Suite 800, Phoenix, and at U.S. Geological Survey offices in: Federal Building, 301 West Congress Street, Tucson, and Valley Center, Suite 1880, Phoenix. Material from which copies can be made at private expense is available at the Tucson and Phoenix offices of the U.S. Geological Survey.

SELECTED REFERENCES

Anderson, T. W., 1968, Electrical-analog analysis of ground-water depletion in central Arizona: U.S. Geological Survey Water-Supply Paper 1860, 21 p.

Arizona Crop and Livestock Reporting Service, 1974, Cropland atlas of Arizona: Phoenix, Arizona Crop and Livestock Reporting Service duplicated report, 68 p.

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National Academy of Sciences and National Academy of Engineering, 1973 [1974], Water quality criteria, 1972: U.S. Environmental Protection Agency Report, EPA-R3-73-033, 594 p.

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__________1977, National secondary drinking water regulations: Federal Register, v. 42, no. 62, Thursday, March 31, 1977, p. 17143-17147.

CONVERSION FACTORS

For use of those readers who may 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 (ft)	0.3048	meter (m)
square mile (mi^2)	2.590	square kilometer (km^2)
acre-foot (acre-ft)	0.001233	cubic hectometer (hm^3)

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

BASE FROM U.S. GEOLOGICAL SURVEY
AJO 1:250,000, 1953,
MESA 1:250,000, 1954,
PHOENIX 1:250,000, 1954, AND
TUCSON 1:250,000, 1956

DEPTH TO WATER, ALTITUDE OF THE WATER LEVEL, SPECIFIC CONDUCTANCE, AND FLUORIDE CONCENTRATION IN THE WESTERN PART OF THE LOWER SANTA CRUZ AREA

MAPS SHOWING GROUND-WATER CONDITIONS IN THE LOWER SANTA CRUZ AREA, PINAL, PIMA, AND MARICOPA COUNTIES, ARIZONA—1977

By

A. D. Konieczki and C. S. English

EXPLANATION

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2240 / 0.5 / 890 — WELL FROM WHICH WATER SAMPLE WAS COLLECTED IN 1976-77—First entry, 2240, is specific conductance in micromhos per centimeter at 25°C; specific conductance is an indication of the dissolved-solids concentration in water. Second entry, 0.5, is fluoride concentration in milligrams per liter. Third entry, 890, is depth of well in feet

689(1954) / 1.0 / 420(1975) / 1625 / 585 — WELL FROM WHICH MISCELLANEOUS DATA HAVE BEEN COLLECTED—First entry, 689, is specific conductance in micromhos per centimeter at 25°C [(1954), year in which sample was collected if other than 1976-77]; specific conductance is an indication of the dissolved-solids concentration in water. Second entry, 1.0, is fluoride concentration in milligrams per liter. Third entry, 420, is depth to water in feet below land surface [(1975), year in which depth to water was measured if other than 1976-77]. Fourth entry, 1625, is altitude of the water level in feet above mean sea level. Fifth entry, 585, is depth of well in feet

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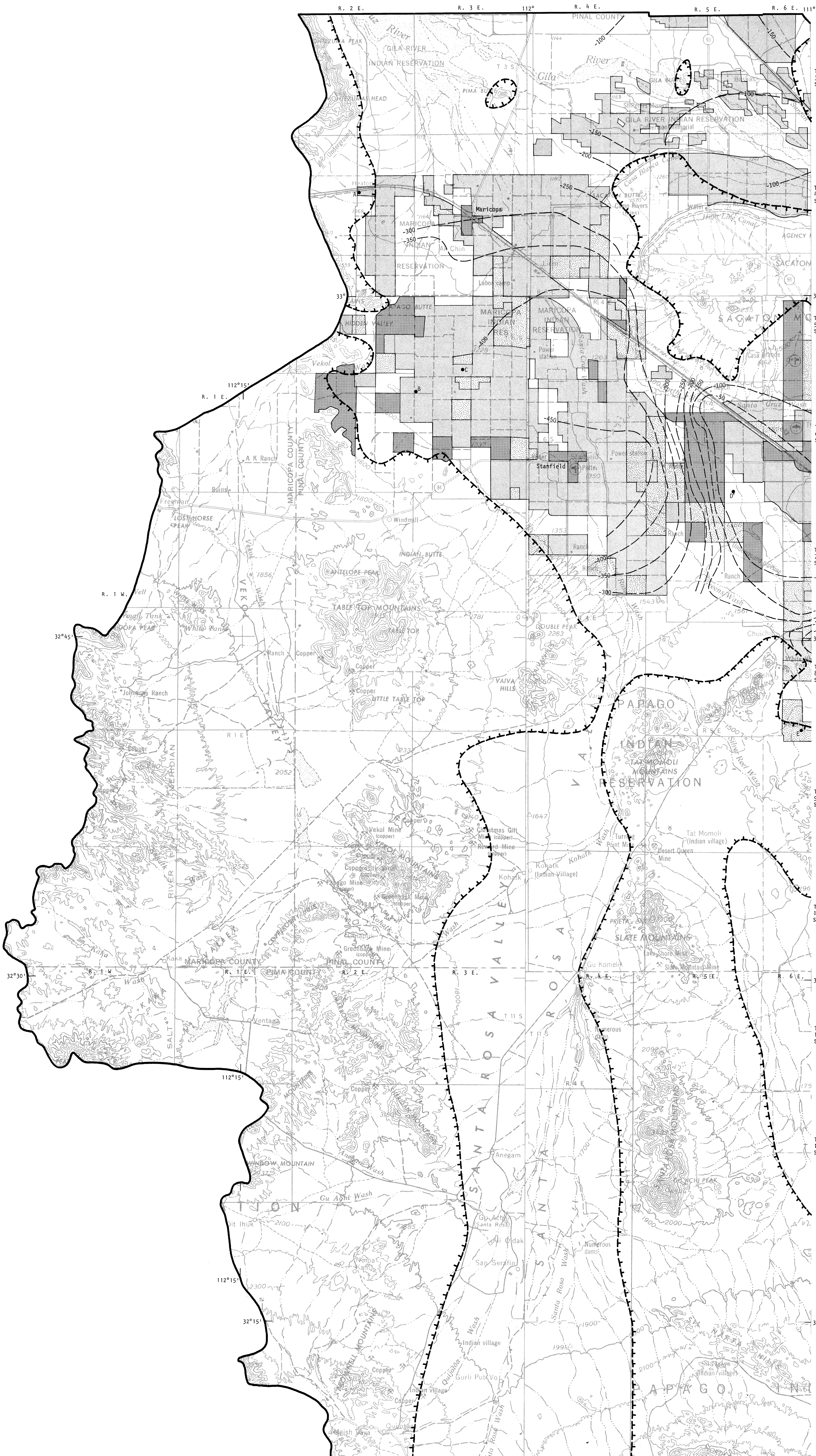

EXPLANATION

—— -50 —— APPROXIMATE LINE OF EQUAL CHANGE IN WATER LEVEL—Interval 50 feet

C● WELL FOR WHICH A HYDROGRAPH IS SHOWN

IRRIGATED AREA AS OF 1976—Modified from the Arizona Crop and Livestock Reporting Service (1974) by personnel of the U.S. Geological Survey. Land under cultivation or that prepared for cultivation was considered irrigated

SUBDIVIDED AREA AS OF 1976—Land subdivided for housing development

FALLOWED AREA AS OF 1976—Land no longer irrigated

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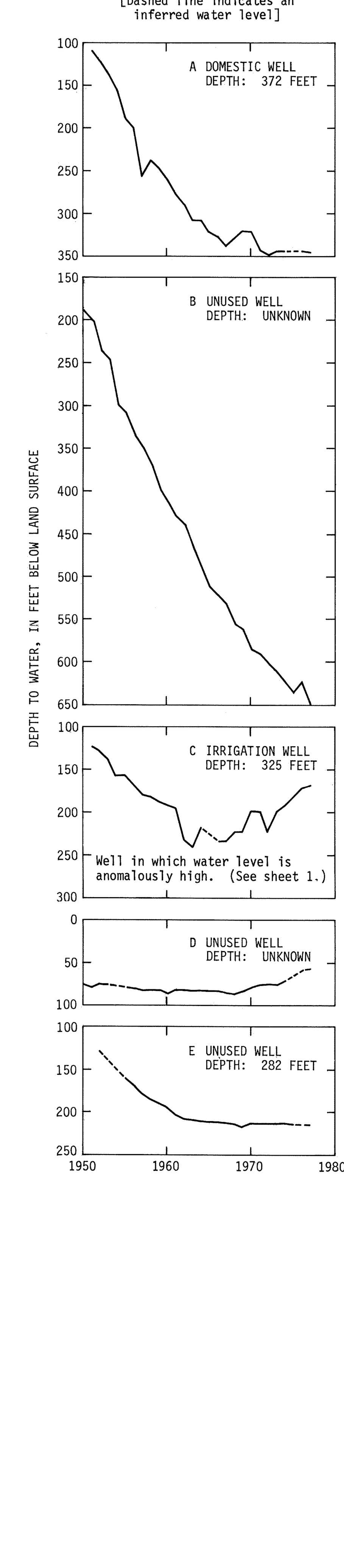
ARBITRARY BOUNDARY OF GROUND-WATER AREA

ESTIMATED GROUND-WATER PUMPAGE IN THE LOWER SANTA CRUZ AREA

[Numbers rounded to nearest thousand acre-feet]

Year	Pumpage, in thousands of acre-feet	Year	Pumpage, in thousands of acre-feet
1915	82	1947	700
1916	83	1948	950
1917	84	1949	1,100
1918	85	1950	1,000
1919	86	1951	1,030
1920	88	1952	950
1921	90	1953	1,400
1922	93	1954	1,200
1923	96	1955	1,200
1924	99	1956	1,100
1925	101	1957	1,100
1926	104	1958	1,200
1927	106	1959	1,200
1928	109	1960	1,100
1929	111	1961	1,150
1930	135	1962	1,050
1931	160	1963	1,000
1932	185	1964	1,150
1933	210	1965	910
1934	235	1966	915
1935	260	1967	1,120
1936	285	1968	910
1937	305	1969	1,043
1938	325	1970	890
1939	352	1971	819
1940	372	1972	798
1941	421	1973	990
1942	500	1974	1,130
1943	515	1975	973
1944	530	1976	966
1945	610		
1946	660	TOTAL	38,521

HYDROGRAPHS OF THE WATER LEVEL IN SELECTED WELLS SHOWN ON THE MAP
[Dashed line indicates an inferred water level]



BASE FROM U.S. GEOLOGICAL SURVEY
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CHANGE IN WATER LEVEL, 1923-77, LAND USE, AND HYDROGRAPHS OF THE WATER LEVEL IN SELECTED WELLS IN THE WESTERN PART OF THE LOWER SANTA CRUZ AREA

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