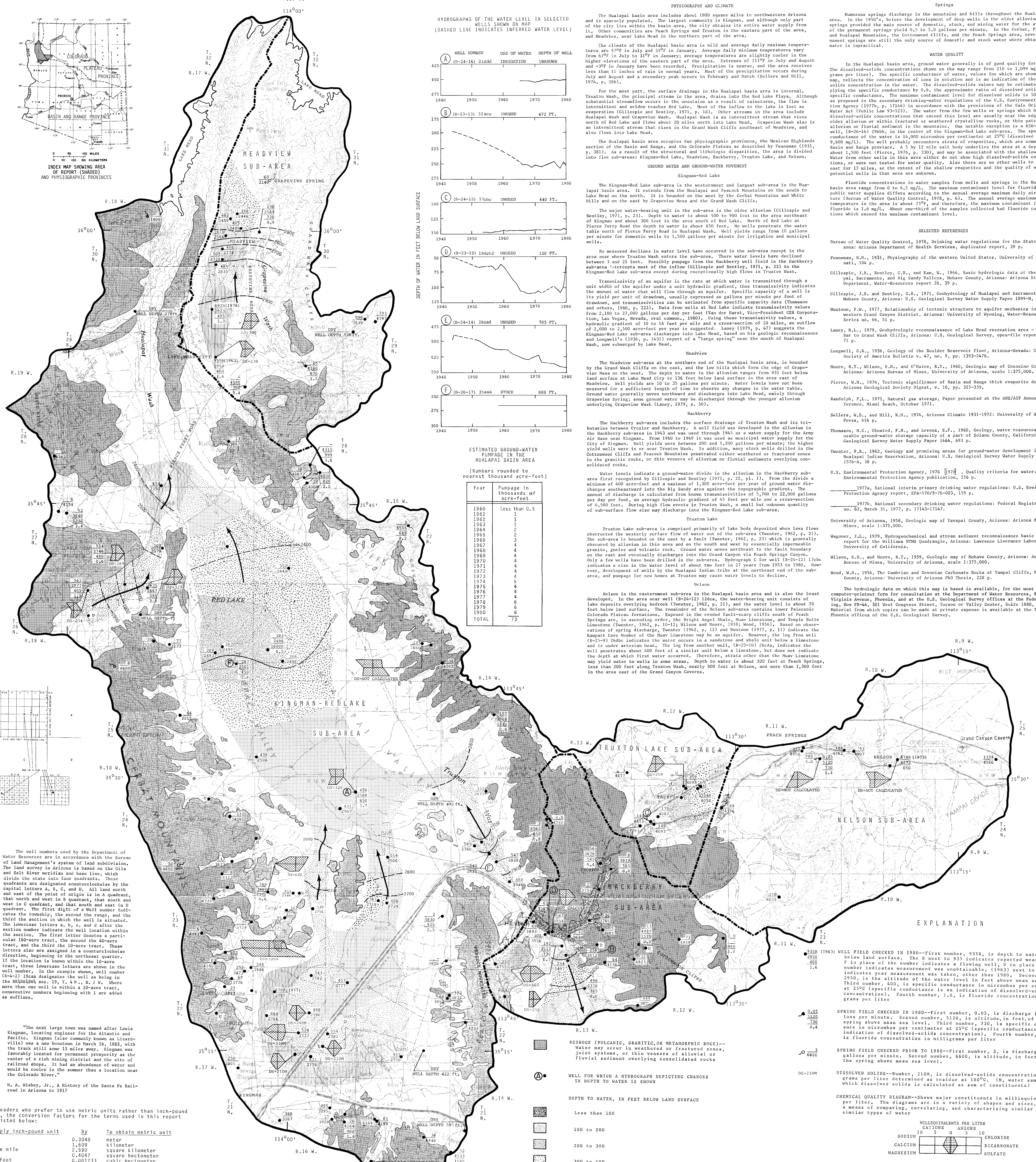

The well numbers used by the Department of Water Resources are in accordance with the Bureau of Land Management's system of land subdivision. The land survey in Arizona is based on the Gila and Salt River meridian and base line, which divide the state into four quadrants. These quadrants are designated counterclockwise by the capital letters A, B, C, and D. All land north and east of the point of origin is in A quadrant, that north and west in B quadrant, that south and west in C quadrant, and that south and east in D quadrant. The first digit of a well number indicates the township, the second the range, and the third the section in which the well is situated. The lowercase letters a, b, c, and d after the section number indicate the well location within the section. The first letter denotes a particular 160-acre tract, the second the 40-acre tract, and the third the 10-acre tract. These letters also are assigned in a counterclockwise direction, beginning in the northeast quarter. If the location is known within the 10-acre tract, three lowercase letters are shown in the well number. In the example shown, well number (B-4-2) 19caa designates the well as being in the NE¼NE¼SW¼ sec. 19, T. 4 N., R. 2 W. Where more than one well is within a 10-acre tract, consecutive numbers beginning with 1 are added as suffixes.

"The next large town was named after Lewis Kingman, locating engineer for the Altantic and Pacific. Kingman (also commonly known as Lizardville) was a new boomtown in March 16, 1883, with the track still some 15 miles away. Kingman was favorably located for permanent prosperity as the center of a rich mining district and the site of railroad shops. It had an abundance of water and would be cooler in the summer than a location near the Colorado River."

H. A. Wisbey, Jr., A History of the Santa Fe Railroad in Arizona to 1917

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
gallon per minute	0.06309	liter per second
gallons per day per foot	1.153	liters per day per meter

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

"Down from Flagstaff over the great plateaus and the road disappeared in the distance ahead. The water grew scarce, water was to be bought, five cents, ten cents, fifteen cents a gallon...Kingman and stone mountains again, where water must be hauled and sold."

John Steinbeck, Grapes of Wrath, 1939

HYDROGRAPHS OF THE WATER LEVEL IN SELECTED WELLS SHOWN ON MAP
(DASHED LINE INDICATES INFERRED WATER LEVEL)

ESTIMATED GROUND-WATER PUMPAGE IN THE HUALAPAI BASIN AREA

(Numbers rounded to nearest thousand acre-feet)

Year	Pumpage in thousands of acre-feet
1960	Less than 0.5
1961	1
1962	1
1963	1
1964	2
1965	2
1966	3
1967	4
1968	4
1969	4
1970	4
1971	4
1972	4
1973	4
1974	5
1975	4
1976	4
1977	4
1978	6
1979	6
1980	6
TOTAL	73

PHYSIOGRAPHY AND CLIMATE

The Hualapai basin area includes about 1800 square miles in northwestern Arizona and is sparsely populated. The largest community is Kingman, and although only part of the city lies within the basin area, the city obtains its entire water supply from it. Other communities are Peach Springs and Truxton in the eastern part of the area, and Meadview, near Lake Mead in the northern part of the area.

The climate of the Hualapai basin area is mild and average daily maximum temperatures are 97°F in July and 55°F in January. Average daily minimum temperatures vary from 67°F in July to 31°F in January; average temperatures are slightly cooler in the higher elevations of the eastern part of the area. Extremes of 111°F in July and August and -3°F in January have been recorded. Precipitation is sparse, and the area receives less than 11 inches of rain in normal years. Most of the precipitation occurs during July and August and a secondary peak occurs in February and March (Sellers and Hill, 1974, p. 286).

For the most part, the surface drainage in the Hualapai basin area is internal. Truxton Wash, the principal stream in the area, drains into the Red Lake Playa. Although substantial streamflow occurs in the mountains as a result of rainstorms, the flow is intermittent and seldom reaches Red Lake. Most of the inflow to the lake is lost as evaporation (Gillespie and Bentley, 1971, p. 18). Other streams in the area include Hualapai Wash and Grapevine Wash. Hualapai Wash is an intermittent stream that rises north of Red Lake and flows about 20 miles north into Lake Mead. Grapevine Wash also is an intermittent stream that rises in the Grand Wash Cliffs southeast of Meadview, and also flows into Lake Mead.

The Hualapai basin area occupies two physiographic provinces, the Mexican Highlands section of the Basin and Range, and the Colorado Plateau as described by Fenneman (1931, p. 381). As a result of the structural and lithologic disparities, the area is divided into five sub-areas: Kingman-Red Lake, Meadview, Hackberry, Truxton Lake, and Nelson.

GROUND WATER AND GROUND-WATER MOVEMENT

Kingman-Red Lake

The Kingman-Red Lake sub-area is the westernmost and largest sub-area in the Hualapai basin area. It extends from the Hualapai and Peacock Mountains on the south to Lake Mead on the north. It is bounded on the west by the Cerbat Mountains and White Hills and on the east by Grapevine Mesa and the Grand Wash Cliffs.

The major water-bearing unit in the sub-area is the older alluvium (Gillespie and Bentley, 1971, p. 23). Depth to water is about 500 to 900 feet in the area northeast of Kingman and about 300 feet in the area south of Red Lake. North of Red Lake at Pierce Ferry Road the depth to water is about 650 feet. No wells penetrate the water table north of Pierce Ferry Road in Hualapai Wash. Well yields range from 10 gallons per minute for domestic wells to 1,500 gallons per minute for irrigation and municipal wells.

No measured declines in water level have occurred in the sub-area except in the area near where Truxton Wash enters the sub-area. There water levels have declined between 3 and 25 feet. Possibly pumpage from the Hackberry well field in the Hackberry sub-area intercepts most of the inflow (Gillespie and Bentley, 1971, p. 22) to the Kingman-Red Lake sub-area except during exceptionally high flows in Truxton Wash.

Transmissivity of an aquifer is the rate at which water is transmitted through a unit width of the aquifer under a unit hydraulic gradient, thus transmissivity indicates the amount of water that will flow through an aquifer. Specific capacity of a well is its yield per unit of drawdown, usually expressed as gallons per minute per foot of drawdown, and transmissivities can be estimated from specific capacity data (Thomasson and others, 1960, p. 222). Data from wells at Red Lake indicate transmissivity values from 2,100 to 27,000 gallons per day per foot (Van der Harst, Vice-President CER Corporation, Las Vegas, Nevada, oral commun., 1980). Using these transmissivity values, a hydraulic gradient of 10 to 14 feet per mile and a cross-section of 10 miles, an outflow of 2,000 to 2,500 acre-feet per year is suggested. Laney (1979, p. 47) suggests the Kingman-Red Lake sub-area discharges into Lake Mead, based on his geologic reconnaissance and Longwell's (1936, p. 1431) report of a "large spring" near the mouth of Hualapai Wash, now submerged by Lake Mead.

Meadview

The Meadview sub-area at the northern end of the Hualapai basin area, is bounded by the Grand Wash Cliffs on the east, and the low hills which form the edge of Grapevine Mesa on the west. The depth to water in the alluvium ranges from 935 feet below land surface at Lake Mead City to 136 feet below land surface in the area east of Meadview. Well yields are 10 to 35 gallons per minute. Water levels have not been measured for a sufficient length of time to observe any changes in the water table. Ground water generally moves northward and discharges into Lake Mead, mainly through Grapevine Spring; some ground water may be discharged through the younger alluvium underlying Grapevine Wash (Laney, 1979, p. 50).

Hackberry

The Hackberry sub-area includes the surface drainage of Truxton Wash and its tributaries between Crozier and Hackberry. A well field was developed in the alluvium in the Hackberry sub-area in 1943 and was used through 1945 as a water supply for the Army Air Base near Kingman. From 1960 to 1969 it was used as municipal water supply for the City of Kingman. Well yields were between 200 and 1,200 gallons per minute; the higher yield wells were in or near Truxton Wash. In addition, many stock wells drilled in the Cottonwood Cliffs and Peacock Mountains penetrated either weathered or fractured zones in the granitic rocks, or thin veneers of alluvium or fluvial sediments overlying consolidated rocks.

Water levels indicate a ground-water divide in the alluvium in the Hackberry sub-area first recognized by Gillespie and Bentley (1971, p. 22, pl. 1). From the divide a minimum of 400 acre-feet and a maximum of 1,300 acre-feet per year of ground water discharges southeastward into the Big Sandy area against the topographic gradient. The amount of discharge is calculated from known transmissivities of 5,700 to 22,000 gallons per day per foot, an average hydraulic gradient of 45 feet per mile and a cross-section of 6,500 feet. During high flow events in Truxton Wash, a small but unknown quantity of sub-surface flow also may discharge into the Kingman-Red Lake sub-area.

Truxton Lake

Truxton Lake sub-area is comprised primarily of lake beds deposited when lava flows obstructed the westerly surface flow of water out of the sub-area (Twenter, 1962, p. 21). The sub-area is bounded on the east by a fault (Twenter, 1962, p. 23) which is generally obscured by alluvium in this area and on the south and west by essentially impermeable granite, gneiss and volcanic rock. Ground water moves northeast to the fault boundary on the east and eventually discharges into the Grand Canyon via Peach Springs Canyon. Only a few wells have been drilled in the sub-area. Hydrograph C for well (B-24-12) 17cbc indicates a rise in the water level of about two feet in 27 years (from 1953 to 1980. However, development of wells by the Hualapai Indian tribe at the northeast end of the sub-area, and pumpage for new homes at Truxton may cause water levels to decline.

Nelson

Nelson is the easternmost sub-area in the Hualapai basin area and is also the least developed. In the area near well (B-24-12) 26dca, the water-bearing unit consists of lake deposits overlying bedrock (Twenter, 1962, p. 21), and the water level is about 70 feet below land surface. The remainder of the Nelson sub-area contains lower Paleozoic Colorado Plateau formations. Exposed in the eroded fault-scarp cliffs south of Peach Springs are, in ascending order, the Bright Angel Shale, Muav Limestone, and Temple Butte Limestone (Twenter, 1962, p. 10-12; Wilson and Moore, 1959; Wood, 1956). Based on observations of spring discharge, Twenter (1962, p. 12) and Huntoon (1977, p. 11) indicate the Rampart Cave Member of the Muav Limestone may be an aquifer. However, the log from well (B-25-9) 26dbc indicates the water occurs in a sandstone and shale unit below a limestone and is under artesian head. The log from another well, (B-25-10) 26cda, indicates the well penetrates about 400 feet of a similar unit below a limestone, but does not indicate the depth at which first water occurred. Therefore, strata other than the Muav Limestone may yield water to wells in some areas. Depth to water is about 320 feet at Peach Springs, less than 200 feet along Truxton Wash, nearly 900 feet at Nelson, and more than 1,300 feet in the area east of the Grand Canyon Caverns.

Springs

Numerous springs discharge in the mountains and hills throughout the Hualapai basin area. In the 1950's, before the development of deep wells in the older alluvium, these springs provided the main source of domestic, stock, and mining water for the area. Most of the permanent springs yield 0.5 to 5.0 gallons per minute. In the Cerbat, Peacock, and Hualapai Mountains, the Cottonwood Cliffs, and the Peach Springs area, several permanent springs are still the only source of domestic and stock water where obtaining well water is impractical.

WATER QUALITY

In the Hualapai basin area, ground water generally is of good quality for most uses. The dissolved-solids concentrations shown on the map range from 210 to 1,099 mg/L (milligrams per liter). The specific conductance of water, values for which are shown on the map, reflects the concentration of ions in solution and is an indication of the dissolved-solids concentration in the water. 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 maximum contaminant level for dissolved solids 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). The water from the few wells or springs which have dissolved-solids concentrations that exceed this level are usually near the edge of the older alluvium or within fractured or weathered crystalline rocks, or thin patches of alluvium or fluvial sediment in the mountains. One notable exception is a 650-foot deep well, (B-26-16) 29bbb, in the center of the Kingman-Red Lake sub-area. The specific conductance of the water is 16,000 micromhos per centimeter at 25°C (dissolved solids, 9,600 mg/L). The well probably encounters strata of evaporites, which are common in the Basin and Range province. A 5 by 12 mile salt body underlies the area at a depth of about 1,500 feet (Pierce, 1976, p. 330), and may be associated with the shallow evaporites. Water from other wells in this area either do not show high dissolved-solids concentrations, or were not tested for water quality. Also there are no other wells to the southeast for 13 miles, so the extent of the shallow evaporites and the quality of water from potential wells in that area are unknown.

Fluoride concentrations in water samples from wells and springs in the Hualapai basin area range from 0 to 6.5 mg/L. 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). The annual average maximum daily temperature in the area is about 75°F, and therefore, the maximum contaminant level for fluoride is 1.6 mg/L. About one-third of the samples collected had fluoride concentrations which exceed the maximum contaminant level.

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The hydrologic data on which this map is based is available, for the most part, in computer-printed form for consultation at the Department of Water Resources, 99 East Virginia Avenue, Phoenix, and at the U.S. Geological Survey offices at the Federal Building, Box FB-44, 301 West Congress Street, Tucson or 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.

EXPLANATION

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

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

DEPTH TO WATER, IN FEET BELOW LAND SURFACE

- Less than 100
- 100 to 200
- 200 to 300
- 300 to 400
- 400 to 500
- 500 to 600
- Greater than 600
- Insufficient data

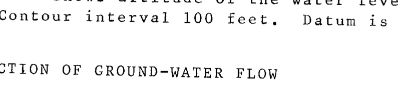
935R (1963) / 2950 / 400 / 1.6 WELL FIELD CHECKED IN 1980--First number, 935R, is depth to water in feet below land surface. The R next to 935 indicates reported measurement, F in place of the number indicates a flowing well, U in place of the number indicates measurement was unobtainable; (1963) next to 935R indicates year measurement was taken, other than 1980. Second number, 2950, is the altitude of the water level in feet above mean sea level. Third number, 400, is specific conductance in micromhos per centimeter at 25°C (specific conductance is an indication of dissolved-solids concentration). Fourth number, 1.6, is fluoride concentration in milligrams per liter

0.05 / 5120 / 730 / 0.4 SPRING FIELD CHECKED IN 1980--First number, 0.05, is discharge in gallons per minute. Second number, 5120, is altitude, in feet, of the spring above mean sea level. Third number, 730, is specific conductance in micromhos per centimeter at 25°C (specific conductance is an indication of dissolved-solids concentration). Fourth number, 0.4, is fluoride concentration in milligrams per liter

3 / 6600 SPRING FIELD CHECKED PRIOR TO 1980--First number, 3, is discharge in gallons per minute. Second number, 6600, is altitude, in feet, of the spring above mean sea level.

DS=210M DISSOLVED SOLIDS--Number, 210M, is dissolved-solids concentration in milligrams per liter determined as residue at 180°C. (M, water sample in which dissolved solids is calculated as sum of constituents)

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



2500 WATER-LEVEL CONTOUR--Shows altitude of the water level. Dashed where approximate. Contour interval 100 feet. Datum is mean sea level

GENERALIZED DIRECTION OF GROUND-WATER FLOW

ARBITRARY BOUNDARY OF GROUND-WATER AREA

ARBITRARY BOUNDARY OF GROUND-WATER SUB-AREA

BASE FROM U. S. GEOLOGICAL SURVEY
WILLIAMS, AZ, 1954, REV. 1970 1:250,000
KINGMAN, AZ. 1954, REV. 1969 1:250,000
LAS VEGAS, NV. AZ. CA. 1954, REV. 1969 1:250,000
GRAND CANYON, AZ, 1953, REV. 1970 1:250,000

DEPTH TO WATER, ALTITUDE OF THE WATER LEVEL, AND WATER QUALITY

MAP SHOWING GROUND-WATER CONDITIONS IN THE HUALAPAI BASIN AREA MOHAVE, COCONINO, AND YAVAPAI COUNTIES, ARIZONA--1980

by

W. H. Remick