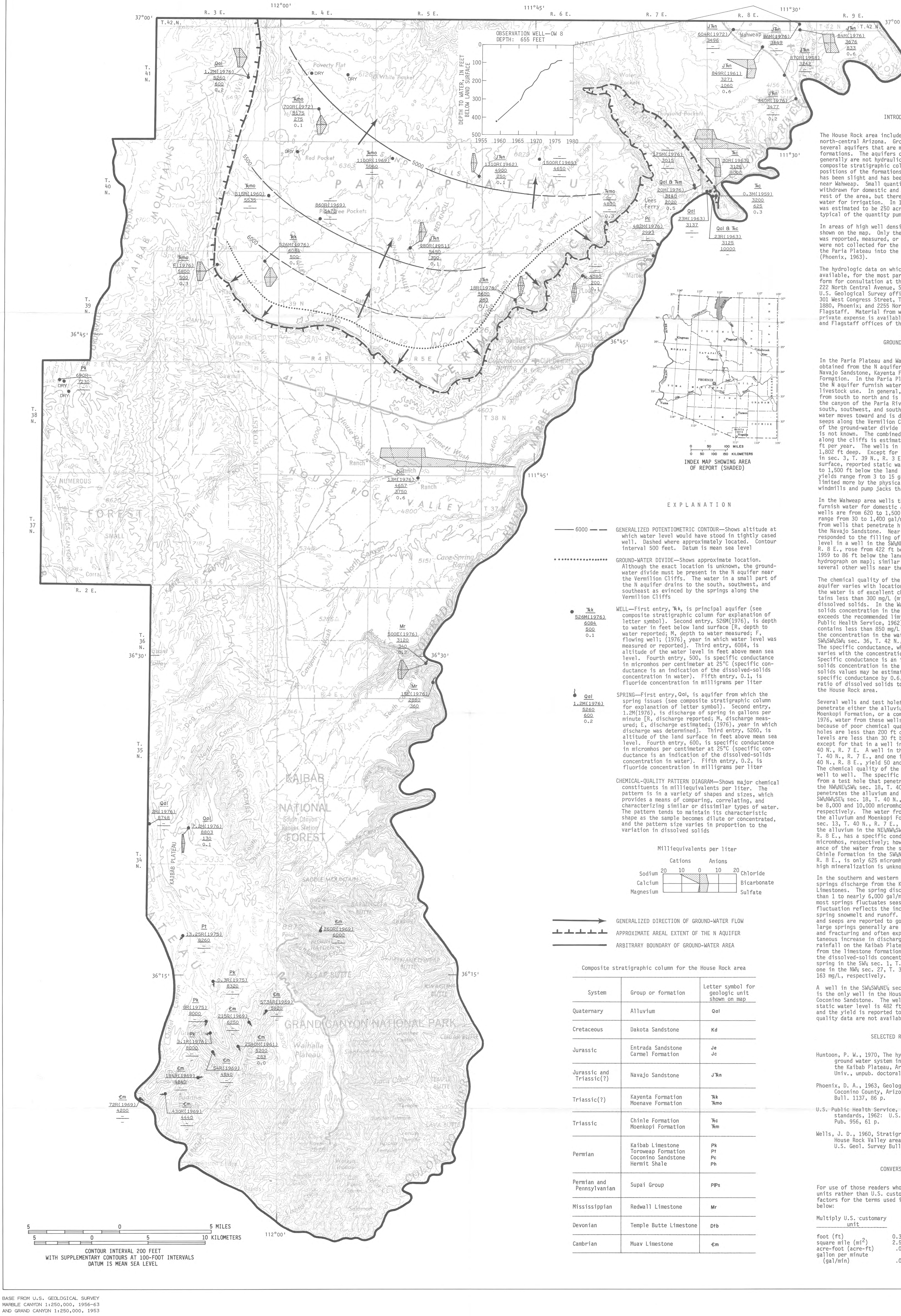
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
ARIZONA WATER COMMISSION

WATER-RESOURCES INVESTIGATIONS 78-15
OPEN-FILE REPORT (SHEET 1 OF 1)
GROUND-WATER CONDITIONS—HOUSE ROCK AREA



INDEX MAP SHOWING AREA
OF REPORT (SHADED)

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
MARBLE CANYON 1:250,000, 1956-63
AND GRAND CANYON 1:250,000, 1953

EXPLANATION

6000 — GENERALIZED POTENTIOMETRIC CONTOUR—Shows altitude at which water level would have stood in tightly cased well. Dashed where approximately located. Contour interval 500 feet. Datum is mean sea level

GROUND-WATER DIVIDE—Shows approximate location. Although the exact location is unknown, the ground-water divide must be present in the N aquifer near the Vermilion Cliffs. The water in a small part of the N aquifer drains to the south, southwest, and southeast as evinced by the springs along the Vermilion Cliffs

Ꝑk
526M(1976)
6084
500
0.1

WELL—First entry, Ꝑk, is principal aquifer (see composite stratigraphic column for explanation of letter symbol). Second entry, 526M(1976), is depth to water in feet below land surface [R, depth to water reported; M, depth to water measured; F, flowing well; (1976), year in which water level was measured or reported]. Third entry, 6084, is altitude of the water level in feet above mean sea level. Fourth entry, 500, is specific conductance in micromhos per centimeter at 25°C (specific conductance is an indication of the dissolved-solids concentration in water). Fifth entry, 0.1, is fluoride concentration in milligrams per liter

Qal
1.2M(1976)
5260
600
0.2

SPRING—First entry, Qal, is aquifer from which the spring issues (see composite stratigraphic column for explanation of letter symbol). Second entry, 1.2M(1976), is discharge of spring in gallons per minute [R, discharge reported; M, discharge measured; E, discharge estimated; (1976), year in which discharge was determined]. Third entry, 5260, is altitude of the land surface in feet above mean sea level. Fourth entry, 600, is specific conductance in micromhos per centimeter at 25°C (specific conductance is an indication of the dissolved-solids concentration in water). Fifth entry, 0.2, is fluoride concentration in milligrams per liter

CHEMICAL-QUALITY PATTERN DIAGRAM—Shows major chemical constituents in milliequivalents per liter. The pattern is in a variety of shapes and sizes, which provides a means of comparing, correlating, and characterizing similar or dissimilar types of water. The pattern tends to maintain its characteristic shape as the sample becomes dilute or concentrated, and the pattern size varies in proportion to the variation in dissolved solids

Milliequivalents per liter
Cations
Anions
20 10 0 10 20
Sodium
Calcium
Magnesium
Chloride
Bicarbonate
Sulfate

GENERALIZED DIRECTION OF GROUND-WATER FLOW

APPROXIMATE AREAL EXTENT OF THE N AQUIFER

ARBITRARY BOUNDARY OF GROUND-WATER AREA

Composite stratigraphic column for the House Rock area

System	Group or formation	Letter symbol for geologic unit shown on map
Quaternary	Alluvium	Qal
Cretaceous	Dakota Sandstone	Kd
Jurassic	Entrada Sandstone Carmel Formation	Je Jc
Jurassic and Triassic(?)	Navajo Sandstone	JꝐn
Triassic(?)	Kayenta Formation Moenave Formation	Ꝑk Ꝑmo
Triassic	Chinle Formation Moenkopi Formation	Ꝑc Ꝑm
Permian	Kaibab Limestone Toroweap Formation Coconino Sandstone Hermit Shale	Pk Pt Pc Ph
Permian and Pennsylvanian	Supai Group	PIPs
Mississippian	Redwall Limestone	Mr
Devonian	Temple Butte Limestone	Dtb
Cambrian	Muav Limestone	Ꞓm

INTRODUCTION

The House Rock area includes about 1,500 mi^2 in north-central Arizona. Ground water is present in several aquifers that are made up of one or more formations. The aquifers overlie one another and generally are not hydraulically connected. The composite stratigraphic column indicates the relative positions of the formations. Ground-water development has been slight and has been mainly for public supply near Wahweap. Small quantities of ground water are withdrawn for domestic and livestock supplies in the rest of the area, but there is no known use of ground water for irrigation. In 1976 ground-water pumpage was estimated to be 250 acre-ft, which is probably typical of the quantity pumped in recent years.

In areas of high well density only selected wells are shown on the map. Only the springs for which discharge was reported, measured, or estimated are shown; data were not collected for the springs that discharge from the Paria Plateau into the canyon of the Paria River (Phoenix, 1963).

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; Valley Center, Suite 1880, Phoenix; and 2255 North Gemini Drive, Building 3, Flagstaff. Material from which copies can be made at private expense is available at the Tucson, Phoenix, and Flagstaff offices of the U.S. Geological Survey.

GROUND WATER

In the Paria Plateau and Wahweap areas ground water is obtained from the N aquifer, which includes the Navajo Sandstone, Kayenta Formation, and Moenave Formation. In the Paria Plateau, wells and springs in the N aquifer furnish water for domestic, public, and livestock use. In general, the ground water moves from south to north and is discharged to springs in the canyon of the Paria River; however, near the south, southwest, and southeast edges of the plateau, water moves toward and is discharged to springs and seeps along the Vermilion Cliffs. The exact location of the ground-water divide near the Vermilion Cliffs is not known. The combined discharge of the springs along the cliffs is estimated to be about 3,500 acre-ft per year. The wells in the plateau are from 610 to 1,802 ft deep. Except for the four horizontal wells in sec. 3, T. 39 N., R. 3 E., that flow at the land surface, reported static water levels range from 515 to 1,500 ft below the land surface, and reported well yields range from 3 to 15 gal/min. Well yields are limited more by the physical characteristics of the windmills and pump jacks than by aquifer characteristics.

In the Wahweap area wells that tap the N aquifer furnish water for domestic and public supplies. The wells are from 620 to 1,500 ft deep, and well yields range from 30 to 1,400 gal/min. The larger yields are from wells that penetrate highly fractured zones in the Navajo Sandstone. Near Wahweap, water levels have responded to the filling of Lake Powell. The water level in a well in the SW¼NW¼SW¼ sec. 36, T. 42 N., R. 8 E., rose from 422 ft below the land surface in 1959 to 86 ft below the land surface in 1976 (see hydrograph on map); similar rises were measured in several other wells near the lake.

The chemical quality of the ground water in the N aquifer varies with location. In the Paria Plateau the water is of excellent chemical quality and contains less than 300 mg/L (milligrams per liter) of dissolved solids. In the Wahweap area the dissolved-solids concentration in the water from wells generally exceeds the recommended limit of 500 mg/L (U.S. Public Health Service, 1962). The water generally contains less than 850 mg/L dissolved solids; however, the concentration in the water from a well in the SW¼SW¼SW¼ sec. 36, T. 42 N., R. 8 E., is 1,390 mg/L. The specific conductance, which is shown on the map, varies with the concentration of ions in solution. Specific conductance 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, which is the average ratio of dissolved solids to specific conductance in the House Rock area.

Several wells and test holes in the Lees Ferry area penetrate either the alluvium, Chinle Formation, Moenkopi Formation, or a combination of these. As of 1976, water from these wells was not being used because of poor chemical quality. The wells and test holes are less than 200 ft deep, and static water levels are less than 30 ft below the land surface except for that in a well in the NW¼SW¼NE¼ sec. 13, T. 40 N., R. 7 E. A well in the SW¼SW¼NE¼ sec. 13, T. 40 N., R. 7 E., and one in the SW¼NW¼SE¼ sec. 18, T. 40 N., R. 8 E., yield 50 and 33 gal/min, respectively. The chemical quality of the water varies greatly from well to well. The specific conductance of the water from a test hole that penetrates all three units in the NW¼NE¼SW¼ sec. 18, T. 40 N., R. 8 E., and one that penetrates the alluvium and Chinle Formation in the SW¼NW¼SE¼ sec. 18, T. 40 N., R. 8 E., is reported to be 8,000 and 10,000 micromhos per centimeter at 25°C respectively. The water from a well that penetrates the alluvium and Moenkopi Formation in the SW¼SW¼NE¼ sec. 13, T. 40 N., R. 7 E., and one that penetrates the alluvium in the NE¼NW¼SW¼ sec. 18, T. 40 N., R. 8 E., has a specific conductance of 2,020 and 2,700 micromhos, respectively; however, the specific conductance of the water from the spring that issues from the Chinle Formation in the SW¼NW¼SE¼ sec. 18, T. 40 N., R. 8 E., is only 625 micromhos. The source of the high mineralization is unknown.

In the southern and western parts of the area many springs discharge from the Kaibab, Redwall, and Muav Limestones. The spring discharge ranges from less than 1 to nearly 6,000 gal/min, and the discharge of most springs fluctuates seasonally. The seasonal fluctuation reflects the increase in infiltration from spring snowmelt and runoff. Many of the small springs and seeps are reported to go dry in the summer. The large springs generally are associated with faulting and fracturing and often experience an almost instantaneous increase in discharge in response to intense rainfall on the Kaibab Plateau. The quality of water from the limestone formations generally is excellent; the dissolved-solids concentration in the water from a spring in the SW¼ sec. 1, T. 32 N., R. 3 E., and from one in the NW¼ sec. 27, T. 36 N., R. 5 E., is 144 and 163 mg/L, respectively.

A well in the SW¼SW¼NE¼ sec. 34, T. 40 N., R. 7 E., is the only well in the House Rock area that taps the Coconino Sandstone. The well is 540 ft deep, the static water level is 482 ft below the land surface, and the yield is reported to be 20 gal/min. Water-quality data are not available for the well.

SELECTED REFERENCES

Huntoon, P. W., 1970, The hydro-mechanics of the ground water system in the southern portion of the Kaibab Plateau, Arizona: Tucson, Arizona Univ., unpub. doctoral thesis, 381 p.

Phoenix, D. A., 1963, Geology of the Lees Ferry area, Coconino County, Arizona: U.S. Geol. Survey Bull. 1137, 86 p.

U.S. Public Health Service, 1962, Drinking water standards, 1962: U.S. Public Health Service Pub. 956, 61 p.

Wells, J. D., 1960, Stratigraphy and structure of the House Rock Valley area, Coconino County, Arizona: U.S. Geol. Survey Bull. 1081-D, p. D117-D158.

CONVERSION FACTORS

For use of those readers who may prefer to use metric units rather than U.S. customary units, the conversion factors for the terms used in this report are listed below:

Multiply U.S. customary 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)	.001233	cubic hectometer (hm^3)
gallon per minute (gal/min)	.06309	liter per second (L/s)

MAP SHOWING GROUND-WATER CONDITIONS IN THE HOUSE ROCK AREA, COCONINO COUNTY, ARIZONA—1976

By

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