DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
ARIZONA WATER COMMISSION

WATER-RESOURCES INVESTIGATIONS
OPEN-FILE REPORT 79-1488
SHEET 1 OF 1
BODAWAY MESA AREA

CONVERSION FACTORS

For 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)
mile (mi)	1.609	kilometer (km)
square mile (mi^2)	2.590	square kilometer (km^2)
acre-foot (acre-ft)	0.001233	cubic hectometer (hm^3)
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
gallon per minute (gal/min)	0.06309	liter per second (L/s)

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

EXPLANATION

3T-521 / ▲ 30R(1963) / 4383 / 1650 / 2.1 — WELL THAT PENETRATES THE CHINLE FORMATION—First entry, 3T-521, is well number or name. Second entry, 30R(1963), is depth to water in feet below land surface [R, depth to water reported; M, depth to water measured; (1963), year in which water level was determined]. Third entry, 4383, is altitude of the water level in feet above mean sea level. Fourth entry, 1650, is specific conductance in micromhos per centimeter at 25°C (specific conductance is an indication of the dissolved-solids concentration in water). Fifth entry, 2.1, is fluoride concentration in milligrams per liter

■ 3T-531A / 180 / DRY — WELL THAT PENETRATES THE MOENKOPI FORMATION—First entry, 3T-531A, is well number or name. Second entry, 180, is depth of well in feet

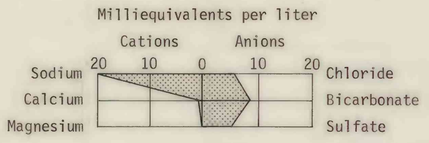
● 3T-502 / 428 / DRY — WELL THAT PENETRATES THE COCONINO SANDSTONE—First entry, 3T-502, is well number. Second entry, 428, is depth of well in feet

COLLINS-COBB OIL TEST / ◍ 2200R / 3630 — EXPLORATION HOLE THAT PENETRATES THE REDWALL LIMESTONE—First entry, Collins-Cobb Oil Test, is well name. Second entry, 2200R, is depth to water in feet below land surface [R, depth to water reported]. Third entry, 3630, is altitude of the water level in feet above mean sea level

3135 / 200E(1951) / 6840 / 0.2 — SPRING THAT ISSUES FROM THE REDWALL LIMESTONE—First entry, 3135, is altitude of land surface in feet above mean sea level. Second entry, 200E(1951), is discharge of spring in gallons per minute [E, discharge estimated; (1951), year in which discharge was estimated]. Third entry, 6840, is specific conductance in micromhos per centimeter at 25°C (specific conductance is an indication of the dissolved-solids concentration in water). Fourth entry, 0.2, is fluoride concentration in milligrams per liter

2950 — SPRING THAT ISSUES FROM THE MUAV LIMESTONE—Number, 2950, is altitude of land surface in feet above mean sea level

CHEMICAL-QUALITY DIAGRAM—Shows major chemical constituents in milliequivalents per liter. The diagrams are in a variety of shapes and sizes, which provides a means of comparing, correlating, and characterizing types of water



DS=1000 — DISSOLVED SOLIDS—Number, 1000, is dissolved solids in milligrams per liter

Triassic rocks — APPROXIMATE AREAL EXTENT OF THE TRIASSIC ROCKS

ARBITRARY BOUNDARY OF GROUND-WATER AREA

INTRODUCTION

The Bodaway Mesa area includes about 800 mi^2 in north-central Arizona, and most of the area is in the Navajo Indian Reservation. Ground-water development has been slight, and the water is used mainly for domestic and livestock supplies. Only nine wells are known to yield water, and seven are known to be dry. The Chinle Formation is the principal aquifer tapped by the wells; in places the Moenkopi Formation and the Redwall and Muav Limestones yield water to wells and springs. The composite stratigraphic column indicates the relative positions of the formations.

In 1977 estimated ground-water withdrawals were less than 5 acre-ft. Because ground-water withdrawals have been slight, the ground-water conditions in 1977 probably are not significantly different from those during 1951-67—the period for which data are shown on the map.

The hydrologic data on which the map is 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

Most of the ground-water development has taken place in the extreme eastern part of the area, where sedimentary rocks of Triassic age are exposed at the land surface and are underlain by a thick sequence of Permian to Cambrian sedimentary rocks. In the rest of the area the Triassic rocks have been eroded, and the older units are exposed at the land surface (Cooley and others, 1969, pl. 1). In the Bodaway Mesa area the Chinle Formation is the principal aquifer tapped by wells. The formation is composed of the Owl Rock, Petrified Forest, and Shinarump Members (Cooley and others, 1969, pl. 1). The Owl Rock Member is mostly siltstone and is not known to supply water to wells.

The Petrified Forest Member consists of interbedded siltstone, mudstone, and sandstone. Five wells tap the member and are 100 to 317 ft deep. The deepest well is dry, and reported water levels in two of the wells are 15 ft below the land surface; reported well yields are 3 and 5 gal/min. The dissolved-solids concentration in the water from one well completed in the Petrified Forest Member is 1,210 mg/L (milligrams per liter). The recommended maximum contaminant level 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 (1977, p. 17146) in accordance with provisions of the Safe Drinking Water Act (Public Law 93-523). Specific conductance in micromhos per centimeter at 25°C is an indication of the dissolved-solids concentration in water and varies with the concentration of ions in solution. Dissolved-solids values may be estimated by multiplying the specific conductance by 0.6, which is the approximate ratio of the dissolved solids to specific conductance. The most abundant ions in water from the Petrified Forest Member are sodium, bicarbonate, sulfate, and chloride. The fluoride concentrations in water from two wells are 5.9 and 7.0 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). In the Bodaway Mesa area the annual average maximum daily air temperature is about 66°F, and the maximum contaminant level for fluoride is 1.8 mg/L.

The Shinarump Member is composed of fine- to coarse-grained sandstone and conglomerate beds and is the basal member of the Chinle Formation. The Shinarump generally is less than 100 ft thick; however, the thickness varies greatly because of erosion and because the unit fills channels scoured in the underlying Moenkopi Formation. Ground water may occur under confined conditions in areas where the Shinarump is overlain by siltstone and mudstone of the Petrified Forest Member. At least three wells obtain their water from the Shinarump. Wells that tap the Shinarump are 100 to 412 ft deep, water levels are 15 to 200 ft below the land surface, and well yields range from 2 to 30 gal/min. In places the Shinarump does not yield water to wells. Well 3T-515, which is 412 ft deep, penetrates the Shinarump from 0 to 80 ft and the Moenkopi from 80 to 412 ft below the land surface and reportedly is dry. Water in the Shinarump generally contains large concentrations of dissolved solids—mainly sodium, bicarbonate, and sulfate. Water from two wells that tap the Shinarump contains 1,000 and 1,110 mg/L of dissolved-solids and 260 and 480 mg/L of sulfate. The recommended limit for sulfate in public water supplies is 250 mg/L (National Academy of Sciences and National Academy of Engineering, 1973, p. 89). Fluoride concentrations in the two water samples are 1.6 and 2.1 mg/L.

The Moenkopi Formation is composed of weakly cemented siltstone and sandstone interbedded with well-cemented, limy, fine- to coarse-grained sandstone. Three wells penetrate the Moenkopi Formation—two are reported to be dry and one is reported to yield water. Information is not available on the depth to water, yield, or quality of the water in the Moenkopi Formation.

Four wells in the Bodaway Mesa area are known to penetrate rocks of Permian to Mississippian age. Three wells penetrate the Coconino Sandstone. The wells are 428, 1,000, and 1,292 ft deep and penetrate 80, 450, and 582 ft, respectively, of the Coconino; the wells do not yield water. The fourth well—a 3,440-ft-deep exploration hole—penetrates the Redwall Limestone from 1,945 to 2,470 ft below the land surface. The water level reportedly is 2,200 ft below the land surface. Information is not available on the yield or quality of the water.

Perennial flow of the Little Colorado River is maintained by a series of springs that discharge from the Redwall and Muav Limestones along the east and west walls of the canyon of the river. The river forms the south and southwest boundaries of the area and is perennial in the 13-mi reach upstream from its confluence with the Colorado River. Springs along the east wall of the canyon, which is in the Bodaway Mesa area, yield about 25 percent of the perennial flow. Discharge from the individual springs along the east and west walls of the canyon ranges from seeps to 35 ft^3/s, and the combined discharge is about 220 ft^3/s; about 60 ft^3/s is discharged by the springs in the Bodaway Mesa area. The water contains large concentrations of dissolved solids—mainly chloride, bicarbonate, sodium, and calcium. Samples from two of the springs contain 2,430 and 3,970 mg/L of dissolved solids. The water is not used in the area and flows downstream to the Colorado River.

SELECTED REFERENCES

Bureau of Water Quality Control, 1978, Drinking water regulations for the State of Arizona: Arizona Department of Health Services duplicated report, 39 p.

Cooley, M. E., 1976, Spring flow from pre-Pennsylvanian rocks in the southwestern part of the Navajo Indian Reservation, Arizona: U.S. Geological Survey Professional Paper 521-F, 15 p.

Cooley, M. E., Harshbarger, J. W., Akers, J. P., and Hardt, W. F., 1969, Regional hydrogeology of the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah, with a section on Vegetation, by O. N. Hicks: U.S. Geological Survey Professional Paper 521-A, 61 p.

Irwin, J. H., Stevens, P. R., and Cooley, M. E., 1971, Geology of the Paleozoic rocks, Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah: U.S. Geological Survey Professional Paper 521-C, 32 p.

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.

Repenning, C. A., Cooley, M. E., and Akers, J. P., 1969, Stratigraphy of the Chinle and Moenkopi Formations, Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah: U.S. Geological Survey Professional Paper 521-B, 34 p.

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

_____1977, National secondary drinking water regulations: Federal Register, v. 42, no. 62, March 31, 1977, p. 17143-17147.

Composite stratigraphic column for the Bodaway Mesa area

System	Group, formation, or member
Triassic	Chinle Formation Owl Rock Member Petrified Forest Member Shinarump Member Moenkopi Formation
Permian	Kaibab Limestone Toroweap Formation Coconino Sandstone Hermit Shale
Permian and Pennsylvanian	Supai Group
Mississippian	Redwall Limestone
Devonian	Temple Butte Limestone
Cambrian	Muav Limestone

BASE FROM U.S. GEOLOGICAL SURVEY
MARBLE CANYON 1:250,000, 1956-63
AND FLAGSTAFF 1:250,000, 1954

MAP SHOWING GROUND-WATER CONDITIONS IN THE BODAWAY MESA AREA, COCONINO COUNTY, ARIZONA—1977

BY
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