

GROUND WATER IN THE RED LAKE AREA,
NAVAJO INDIAN RESERVATION
ARIZONA AND NEW MEXICO

By

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In March 1958, the Navajo Tribal Council requested the U. S. Geological Survey to conduct a study of the ground-water resources of the Red Lake area, Arizona and New Mexico, to determine if 1,000,000 gpd (gallons per day) of water was available for the operation of a proposed sawmill. The Red Lake area lies in a synclinal valley between the Defiance Plateau and the Chuska Mountains. A geologic map was made and special attention was given to the structural features as related to ground-water occurrence. Several sites were selected for test drilling in alluvium along Tohdildonih Wash, a perennial stream, and in volcanic material in Buell Park; one site was selected for a deep test in consolidated rock near the southwestern bank of Red Lake.

The consolidated rocks in the Red Lake area range from Permian to Cretaceous in age. They consist of a thick series of alternating shale and sandstone and minor amounts of conglomerate and limestone. Deposits of pleistocene and Recent alluvium overlie the older bedrock along the larger streams. Several small volcanic plugs, dikes, and lava flows have the general composition of minette or trachybasalt and are associated with agglomerate, breccia, and tuff. Two large volcanic vents within the area are Buell Park and the Green Knobs. These vents are filled with lapilli tuff which contains numerous fragments of igneous rock and angular and rounded pebbles of material derived from country rock at depth. All the volcanic rocks are believed to be of Pliocene age.

There are three main structural features in the area: (1) the Defiance monocline on the west; (2) the Todilto anticline on the east; and (3) the Fuzzy Mountain syncline between. Strata near the monocline dip eastward as much as 20° ; the strata forming the syncline have gentle dips--about 1° or 2° . The trend of these structures is generally north.

Water is recharged to the bedrock formations on the Defiance uplift, where large areas of Permian sandstone are exposed. The water moves eastward down the monocline into the Fuzzy Mountain syncline, and southward along the synclinal axis.

Test wells were drilled in three areas. The first area--in the alluvium along Tohdildonih Wash--proved favorable and 4 gravel-packed production wells, each 32 inches in diameter, were completed. Each of these wells produced 200 gpm (gallons per minute) with about 50 feet of drawdown (after 36 hours of pumping) from the static water levels, which were 15 feet below the land surface. The computed coefficient of transmissibility obtained from tests is about 22,000 gpd per foot, which indicates a moderately productive aquifer for this region. The computed storage coefficient is about 0.03, indicating water-table conditions.

The second area tested was near the western bank of Red Lake, where a deep test well showed the presence of water in the Sonsela sandstone bed of the Chinle formation, and in the Shinarump member of the Chinle formation and the De Chelly sandstone which act as a single aquifer in this area. The Sonsela sandstone bed at a depth of 220 to 250 feet yielded 75 gpm with a drawdown of 185 feet from a static water level of 95.4 feet. The water was brackish and was sealed off. The aquifer which consists of the Shinarump member of the Chinle and the De Chelly sandstone member of the Cutler formation at a depth of 720 to 1,180 feet yielded 4 gpm by artesian flow at the land surface. A 72-hour pumping test indicated that these formations in this well will yield 55 gpm with 540 feet of drawdown.

Five test wells and two production wells were drilled in the third area at Buell Park, a volcanic vent about 2-1/2 miles in diameter. The floor of the park is relatively flat and is partly covered with alluvium. Crudely bedded lapilli tuff interbedded with cinders fills the conduit and underlies the alluvium. Both the volcanic material and the alluvium contain water; as they are in contact with the De Chelly sandstone member, which also contains water, they and the De Chelly are interconnected hydraulically and form a common hydrologic system. This system, in effect, is similar to a gravel-packed well that has diameter of 2-1/2 miles.

The lapilli tuff penetrated in both production wells is saturated; however, most of the water comes from cinder zones within the tuff. The deepest well, drilled near the periphery of the park in the southeastern quadrant, penetrated cinders between 120 and 130 feet and between 220 and 230 feet. The well yielded 174 gpm with a drawdown of 50 feet (after 72 hours) from a static water level of 20.7 feet. The other well, drilled near the eastern periphery of the park, penetrated cinders between 50 and 70 feet. It yielded 625 gpm with 28.5 feet of a drawdown (after 72 hours) from a static water level of 31.5 feet.

The chemical quality of water from all production wells is good. The dissolved-solids content of water from the alluvium near Tohdildonih Wash is 328 ppm (parts per million); from the Shinarump and De Chelly, 266 ppm, and in Buell Park, 499 ppm.

In conclusion, the seven production wells completed in the Red Lake area are capable of supplying the required minimum of 1,000,000 gpd of good water for the operation of the proposed sawmill. The combined yield of these wells is 1,500,000 gpd, and, should the need arise, additional water can be developed in Buell Park.