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DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

AVAILABILITY OF GROUND WATER IN THE SCHOOLIE FLAT AREA, WASCO COUNTY, OREGON

By

R. C. Newcomb and G. M. Hogenson

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Prepared in cooperation with the Division of Indian Health, United States Public Health Service, Department of Health, Education, and Welfare

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INTRODUCTION

Purpose of the Investigation

The United States Public Health Service, Division of Indian Health, which is charged with the responsibility of raising the health standards of residents of the Indian reservations, has determined that one of the major health needs of the reservations is an adequate water supply. By letter from Dr. Ruth E. Dunham, area medical officer, dated March 19, 1956, the Geological Survey was requested to assist in locating an adequate water supply for a small part of the Warm Springs Indian Reservation, Oregon, specifically in the area known as "Schoolie Flat." This district is populated by about 20 Indian families and is an area in which ground water is difficult to obtain. The Health Service indicated that a supply of 10 gpm would be adequate, though a greater supply was desirable.

The Geological Survey tested the yield of the Frank Suppah well, located on Schoolie Flat, in December 1955, to determine whether it could be used as a source for the necessary supply (Brown, 1955). This well failed to yield the required amount of water.

In April 1956, the authors made a geologic reconnaissance of the area to supplement pre-existing general geologic information. This report comprises the result of that reconnaissance.

Location and Extent of the Area

The area studied includes those parts of Townships 7 and 8 South, lying in Ranges 11 and 12 East, Willamette meridian, and it lies in the southwestern part of Wasco County, Oreg. It includes all of Schoolie Flat and parts of the surrounding area (see pl. 1).

Previous Investigations

The area covered by this investigation is part of a larger area that has been studied and mapped geologically by the State College and the University. The results of that work were compiled and published by Hodge (1940, 1942). Hodge's maps show the general relations of the rock units but in many places do not closely locate the contacts between the units. A small area to the north and a larger one to the south of the Schoolie Flat were studied and described by Allen (1946) and Stearns (1931) respectively.

Land Forms and Drainage

There are two main topographic units within the area mapped. These are the maturely eroded Mutton Mountains in the northeastern part of the area and the youthfully dissected lava plain forming most of the remainder of the area. The deep, steep-walled canyons of the Warm Springs River and its principal tributaries have cut the former lava plain into flat-topped plateaus. These flat plateaus are named Schoolie Flat, Mill Creek Flat, "Island" Flat, and Miller Flat. The altitude of the flats ranges from about 3,000 down to 2,300 feet. Rising above the western part of the lava plain are two volcanic cones, Hoho Butte and Sidwalter Butte.

The Warm Springs River and its principal tributary, Beaver Creek, are perennial streams trending southeasterly across, and incised deeply into, the lava plain. Both streams are fed by smaller, intermittent tributaries. A USGS gaging station at Hehe Mill on the Warm Springs River was maintained from 1949 to 1952. The maximum streamflow recorded was 662 cubic feet per second on February 11, 1951, and the minimum was 98 cfs on January 17, 1950. The mean discharge measured at the station for the water year October 1, 1951 to September 30, 1952, was 166 cfs.

Climate

The Schoolie Flat has a cool, semiarid, subalpine climate, and, like most of the reservation, it lies in the rain-shadow of the Cascade Mountains. In 1955, the Weather Bureau station at Madras, at an altitude of 2,256 feet, recorded a frost-free period of 58 days. The highest temperature recorded was 102° F on July 15 and the lowest, -15° F on November 15. The average annual temperature for the 34 years of record was 47.4 degrees, and the average annual precipitation for the 35 years of record is 8.8 inches. It is to be expected that the climate of Schoolie Flat would be slightly cooler and wetter than that at Madras, owing to its greater altitude and its position nearer the crest of the Cascade Mountains.

THE ROCK UNITS AND THEIR WATER-BEARING CHARACTERISTICS

General Relationship of the Rock Units

Near mid-Tertiary time the Schoolie Flat area was characterized by a mature erosional terrain on the Eocene Clarno formation. Low places in this terrain were partly filled by middle late Oligocene and early Miocene tuffs of the John Day formation which, in turn, were covered by the fluviatile and lacustrine sediments making up the Pliocene Madras formation of Hodge (1928). This formation, in turn, was buried by Pleistocene lavas flowing eastward from the crest of the Cascade Range. The extent of the major rock units is shown on the accompanying map (pl. 1).

Clarno Formation

The Clarno formation is a thick series of volcanic ash, welded tuff, and lava beds of acidic to basic composition. The tuffs are partly weathered into clay and the lavas are dense and compact, offering little porosity for storing ground water and few open fractures, permeable zones, or other conduits for its transmission. Wells commonly obtain only meager yields from the Clarno formation, and water-bearing zones are difficult or impossible to locate without extensive test drilling.

John Day formation

In late Eocene or early Oligocene time, the Clarno formation was locally deformed and was eroded to a mature stage. In middle and late Oligocene and early Miocene time, several hundred feet of windborne volcanic ash was deposited over the area and was washed by streams into depressions in the maturely eroded land surface. A period of erosion followed, during which the John Day formation in the lowlands was leveled by wandering streams into a flat plain lying at the foot of the high hills composed of the Clarno formation.

The tuffs of the John Day formation are porous but are fine grained. Consequently, they absorb water readily but do not yield it to wells. So far as is known, all attempts to develop wells in the John Day formation have failed to obtain usable amounts of water.

Madras Formation of Hodge (1928)

Uplift and volcanism, which were to create much of the Cascade Mountains, started in Pliocene time. Layers of volcanic ash, sand, and silt and scattered small lenses of gravel were deposited upon the John Day formation in the lowland areas. In thickness these deposits range up to about 200 feet in the area mapped and to about 500 feet a few miles farther south. The deposits were named the Madras formation by Hodge (1928).

The materials making up this formation are mostly fine grained, although some beds of subrounded grit, gravel, and sand are present. Lenses of sand or gravel may yield water in the small amounts desired if such strata are present below the regional water table. However, most of the Madras formation of Hodge (1928) immediately underlies the rims of the tablelands. It is cut through and drained by the canyons, and, in most places, is high above the water table—which probably lies at about the level of the nearby streams. The beds of the Madras formation appear to dip below the level of Beaver Creek where that creek's canyon borders the northerly half of the west side of Schoolie Flat. In that situation the Madras is charged with ground water, and, if sufficiently permeable strata exist, it should yield water in the quantity desired.

The presence of such permeable strata below the level of the water table at this place can be definitely established only by test drilling.

Cascan Formation of Hodge (1938)

During Pleistocene time, the Cascadian volcanism was progressing. Andesitic and basaltic lavas, pouring eastward into the valley areas from the Cascades, covered the Madras formation of Hodge (1928), the John Day formation, and earlier rocks to depths of 100 or 200 feet. The lavas filled and covered pre-existing drainage lines and resulted in a broad, flat lava plain which originally sloped generally eastward. Small volcanoes associated with this outpouring of lava rose above the plain and now form Hoho Butte and the Sidwalter Buttes (part of which are shown at the west edge of pl. 1).

The lavas (the Cascan formation of Hodge, 1938) have sufficient porosity to store moderate to small amounts of ground water and sufficient permeability to yield water to wells. However, the lavas now occur mainly as the rimrock cappings of the plateaus and terraces and, like the Madras formation of Hodge (1928), lie high above the regional water table. Their position above the nearby streams largely prevents any possibility of their being recharged by the streams and facilitates the drainage of ground water from them. The lavas lie in an area of low annual precipitation and, therefore, receive only small amounts of recharge. Small quantities of water are present in some places, perched within the lava above the less permeable layers of the Madras formation.

Glaciofluviatile and Associated Deposits

Prior to the establishment of the present drainage pattern upon the lava plain, shallow deposits of glacial outwash and other poorly sorted fluviatile gravels and silts were deposited upon the lava along the western edge of the area mapped. They have since been eroded from much of the area. The silty matrix of the material, the location of the deposits in a semiarid region, and the position of the deposits upon the more permeable lavas render them unimportant as sources of even small amounts of ground water for the supply of the plateau areas. The small areas of these deposits are not shown on plate 1.

Recent Alluvium

During and since late Pleistocene time, the stream pattern has been reestablished upon the lava plain. The streams first cut narrow gullies through the lava and then, encountering the softer Madras formation of Hodge (1928) and John Day formation, cut rapidly downward into the soft sediments. The cutting resulted in narrow, steep-walled canyons having a rimrock of lava.

A thin, narrow ribbon of Recent alluvium borders each of the streams in some places. In most places this alluvium is made up of gravel and boulders of the Clarno formation and the lava of the Cascadian vulcanism resting in a matrix of silt and clay derived largely from the John Day and Madras formations. The high proportion of fine-grained material would prevent this alluvium from yielding water readily to wells in most places. In the canyon of Coyote Creek immediately above its confluence with Beaver Creek, the alluvium appears to contain sufficient coarse-grained material that shallow wells or infiltration galleries might obtain water in the quantity desired. The stripe of alluvium are not shown on plate 1.

OCCURRENCE OF GROUND WATER

Existing Wells

Five drilled wells are known within the area mapped. These are the Simnasho well, located in sec. 7, T. 7 S., R. 12 E., the Suppah well in sec. 34 of the same township, the "Island" well in sec. 36, T. 7 S., R. 11 E., the Sidwalter well in sec. 6, T. 8 S., R. 11 E., and the Miller well in sec. 34 of the same township. The wells are numbered 1 through 5 on the map (pl. 1) in the order listed above.

The Simnasho well is a 6-inch well 565 feet deep. It is drilled entirely in the Clarno formation. Its static water level was reported to be 430 feet below the land surface in October 1955, and it is reported to yield 10 gpm with 19 feet of drawdown. It is used at times to supply domestic and stock water in the settlement of Simnasho. The driller, R. J. Strasser, believes that this well would supply 10 gallons per minute. A bailer test of unreported length, at the time the well was completed showed a yield of 10 gpm at 10 feet of drawdown.

The Suppah well is 6 inches in diameter and 300 feet deep. It is near the contact between the lavas of the Cascan formation of Hodge and the Clarno formation, and reportedly penetrates 12 feet of soil and gravel, 108 feet of "soft lava rock" (probably lava of the Cascan formation), 58 feet of hard lava, and 122 feet of fractured rock. The last two units are probably part of the Clarno formation. The water level was 100.39 feet below the land surface on December 1, 1955. A capacity test of the well, made by the Geological Survey in December 1955, indicated that the well had a short-term yield of about 4 gpm and a sustained yield of about 2 gpm (Brown, 1955).

The "Island" well is 6 inches in diameter and 500 feet deep. Its log is not available, but it probably penetrates 150 feet or 200 feet of lava and about 300 feet of the Madras formation of Hodge, and possibly enters the John Day formation. It is used to supply stock water, and its yield, though small, is reported to be reliable for that purpose. The driller, an employee of the R. J. Strasser Drilling Co., recalls only that the water was obtained below the lava rock (presumably in the Madras formation), the static water level was low in the well, and the water level drew down greatly with a small amount of bailing.

The Sidwalter well is 6 inches in diameter and 407 feet deep. No information is available concerning its capacity or water level.

The Miller well is 6 inches in diameter and 320 feet deep. It is said to have penetrated 240 feet of "rock" (lava), and 72 feet of cemented gravel (Madras formation). Water was reportedly encountered at a depth of 320 feet and the water level as reported by the driller was 208 feet below the ground surface on December 26, 1934. The driller reported a yield of "lots of water" after several hours "hard bailing," with a 10-foot drawdown. The well is used to supply stock water. The Miller well might be worthy of testing for the Schoolie Flat supply if other closer supplies cannot be located.

Ground Water Available for Wells on Schoolie Flat

The rock formations that may, in certain places, yield the required minimum of 10 gallons of water per minute are practically restricted to the Clarno formation, the Madras and Cascan formations of Hodge, and the Recent alluvium.

The Clarno formation includes a variety of volcanic rocks which are mostly tight and essentially devoid of water, but it does have some closely jointed zones which afford small yields to wells. The location and depth of these water-yielding zones are not predictable. The streams that eroded the Clarno formation should have deposited fans of mixed detritus on the flatter lands that now underlie Schoolie Flat. Such a fan may lie buried beneath the lava of Hodge's Cascan formation west of the small creek valley that flows west onto Schoolie Flat in sec. 3, T. 8 S., R. 12 E.

The Madras formation of Hodge has grit and gravel beds capable of yielding small or moderate supplies of water to wells. Where these beds lie far enough from the canyons, even where they are above the main water table, they may contain enough perched ground water to supply the needed water to wells. Also, where these beds extend down below the water table (as they may near Beaver Creek, see p. 5) they may yield water in the required quantities.

The lavas of Hodge's Cascan formation have permeable layers, and, in places where they are underlain by clayey layers of the Madras formation, they may contain small amounts of perched water.

In only a few places is the alluvium low enough, sufficiently extensive, and permeable enough to supply water to wells. One of these places is the gravelly bar at the confluence of Coyote and Beaver Creeks in sec. 14, T. 7 S., R. 11 E.

QUALITY OF THE GROUND WATER

No detrimental chemical condition is known to be present in the ground waters of the Schoolie Flat area. Two comprehensive analyses of the water of the Suppah well showed the water to be soft, to be slightly on the alkaline side of the pH scale, and to contain a relatively small amount of dissolved chemical material (Brown, 1955). Although the other well waters were not analyzed, their taste, odor, and general appearance all suggest water of good quality.

CONCLUSIONS

The geologic and water-well data suggest that the most promising sources of ground water for a minimum supply of 10 gallons per minute in the Schoolie Flat area are:

1. Shallow wells which would test the water-bearing characteristics of the alluvium at the confluence of Beaver and Coyote Creeks in sec. 14, T. 7 S., R. 11 E.
2. Test wells which would explore for perched water supplies within 300 or 400 feet of the surface in the Cascan and Madras formations of Hodge and in buried post-John Day alluvial fans in about the following locations:
    a. In the NE cor. sec. 4, T. 8 S., R. 12 E., primarily to test for water in the Madras formation and pre-lava alluvial fans of that depositional epoch.
    b. In a linear area extending through the northwest and southeast corners of sec. 30, T. 7 S., R. 12 E.

3. Controlled pumping tests which would evaluate the Simnasho well and (possibly) the Miller well as to their suitability as primary or supplemental sources of water for a distribution system.
4. A deep well which would test the Madras formation below the regional water level near the NW cor. sec. 30, T. 7 S., R. 12 E.

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