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George A. Dinwiddie and James B. Cooper
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WATER-BEARING CHARACTERISTICS OF THE ROCKS OF EASTERN COLFAX AND WESTERN UNION COUNTIES, NEW MEXICO¹

By

GEORGE A. DINWIDDIE AND JAMES B. COOPER

U.S. Geological Survey

INTRODUCTION

The eastern part of Colfax County and the western part of Union County is predominantly a plains area studded with lava-capped mesas and volcanic cones. It contains some of the most interesting topographic and geologic features in New Mexico—one of which, Capulin Mountain, a near-perfect cinder cone, was designated a National Monument in 1916.

The principal structural feature of the area is the north-east-trending Sierra Grande arch that underlies the north-west part of Union County and continues southwestward through eastern Colfax County. In southeastern Colfax County, the Precambrian surface is about 4,900 feet above sea level; east of the axis of the arch the beds slope gradually to the southeast and near the New Mexico-Oklahoma State line the Precambrian surface is near sea level. West of the arch the beds slope gently to the northwest towards the axis of the Raton structural basin, about 20 miles west of Raton in Colfax County (Foster and Stipp, 1961).

The rocks that crop out in eastern Colfax and western Union Counties range in age from Triassic to Quaternary; most of them will yield water to wells. Rocks older than Triassic are not exposed in the area. Several oil test wells in eastern Union County have penetrated these rocks, which include all of the Paleozoic systems except the Silurian and Devonian, and have reached the Precambrian surface. No water wells in eastern Colfax or western Union Counties are known to tap water in rocks older than Triassic and nothing is known of the quantity or quality of the water that may be present in them. The principal aquifer is the Dakota Sandstone of Cretaceous age.

The following discussion is of general lithology, the known water-bearing characteristics, and the present and potential utilization of ground water from the stratigraphic units that crop out in the plains. The formations are described in order from oldest to youngest.

DOCKUM GROUP

The oldest rocks that crop out in the plains are strata in the Dockum Group of Late Triassic age. In Union County nearly all exposures are restricted to the drainage area of the Cimarron River. Here the Baldy Hill Formation, the Travesser Formation, the Sloan Canyon Forma-

tion, and the Sheep Pen Sandstone have been identified by Baldwin and Muehlberger (1959, p. 37-42) and are part of their Dockum Group. The total thickness of these formations is about 900 feet. They consist of thin-bedded light-brown sandstones and light-green, red, red-brown, and purple mudstone. Along the Cimarron River valley in Union County they yield small quantities of water to stock and domestic wells. The chemical quality is generally undesirable for domestic use but is satisfactory for stock use. In Colfax County a correlative of the Dockum, the Chinle Formation, crops out in a limited area in Temple Butte near the eastern side of the county in T. 26 N., R. 26 E. The Chinle consists mainly of brown or purplish-red sandstone and silty shale. Little is known of water in the Chinle because the formation is deeply buried a short distance from its one small outcrop.

ENTRADA SANDSTONE

The Entrada Sandstone of Late Jurassic age unconformably overlies beds of the Dockum Group throughout most of the area. It crops out sporadically in T. 26 N., R. 26 E., and T. 27 N., R. 25 E., Colfax County, and is well exposed along the Cimarron River valley in the northern part of Union County. The Entrada is a massive white to pink and light-buff, poorly cemented sandstone, in places as much as 80 feet thick. It is permeable and yields water of good chemical quality to stock and domestic wells near its outcrop. Generally a short distance from its outcrop the aquifer is too deeply buried to be exploited.

MORRISON FORMATION

The Morrison Formation of Late Jurassic age overlies the Entrada Sandstone with apparent conformity and crops out in T. 26 N., R. 26 E., and T. 27 N., R. 25 E. of Colfax County and in a few creeks near the eastern and southern sides of the county. It is well exposed along the Cimarron River valley in Union County. The Morrison consists of greenish-gray, green, and red-brown sandy clay, and local beds of white to brown sandstone, siltstone, and minor limestone; nodules of red-orange chalcedony ("agate") commonly occur near the base of the formation. In the plains area the Morrison ranges in thickness up to 550 feet. The formation generally does not yield sufficient water for stock and domestic use; however, locally, sandstone near the top of the formation does yield water to wells. The chemical quality of the water is gen-

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erally unsuitable for domestic use, but is satisfactory for stock use.

DAKOTA SANDSTONE

The Dakota Sandstone and the underlying Purgatoire Formation, both of Early Cretaceous age, are widespread in the plains area of eastern Colfax and western Union Counties. Because of their lithologic similarity it is most difficult to differentiate two formations everywhere. In this report the name Dakota Sandstone applies to all the sandstone, and minor amounts of shale, between the Morrison Formation and the overlying Graneros Shale. The Dakota crops out along the Canadian River in the southern part of Colfax County, in the Cimarron River valley of Union County, and in large areas of the plains of both counties. The upper part of the Dakota is a lenticular to parallel-bedded gray shale, shaly sandstone, and sandstone. The lower part is dark-gray shale with light-colored to white sandstone at the base. In the plains area the Dakota ranges in thickness up to 300 feet.

The Dakota Sandstone is the principal aquifer in the plains area of eastern Colfax and western Union Counties. It yields adequate quantities of water to stock and domestic wells and where present, the lower sandstone unit may yield 500 gpm (gallons per minute) or more to wells. The chemical quality of the water is variable, but generally is suitable for stock and irrigation use; in places it is undesirable for domestic use.

GRANEROS SHALE

The Graneros Shale of Early and Late Cretaceous age conformably overlies the Dakota Sandstone and crops out principally in Tps. 23 and 24 N., Rs. 23, 24, and 25 E., Colfax County and in many localities in the uplands of western Union County. It consists mainly of fossiliferous dark-gray to black, fissile shale, but in places it contains thin (less than 1 foot) beds of limestone. The Graneros ranges in thickness up to 170 feet in the plains area. In the southern part of Colfax County the Graneros yields generally less than 5 gpm to a few stock wells; it is not known to yield water to wells in Union County. The quantity and quality of water from the Graneros generally are neither adequate nor acceptable for domestic use.

GREENHORN LIMESTONE

The Greenhorn Limestone of Late Cretaceous age conformably overlies the Graneros Shale and crops out in many places in the plains of Colfax and Union Counties. The Greenhorn consists of thin beds of gray to black limestone that weathers to a light tan, and dark-gray to black calcareous shale. The formation is seldom more than 30 feet in thickness. The Greenhorn probably will yield small quantities of water through fractures at places where it is saturated. A few wells in the plains area obtain small yields from the Greenhorn near the outcrop of the formation. The water from most of the wells in the Greenhorn is of fair quality, though it is hard.

CARLILE SHALE

The Carlile Shale of Late Cretaceous age conformably overlies the Greenhorn Limestone and crops out at many places in the northeast corner of Colfax County and the northwest corner of Union County. The Carlile mainly consists of dark-gray to black shale that contains some thin beds of limestone and a few thin beds of silty sandstone. The formation ranges in thickness up to 200 feet in the plains area. It is not considered as an aquifer, although it is possible that at places permeable beds in the upper part of the formation might yield some water to a well.

NIOBRARA FORMATION

The Niobrara Formation of Late Cretaceous age conformably overlies the Carlile Shale and crops out generally east of U.S. Highway 85 in Colfax County. In Union County it crops out only in scattered upland localities in the northwest corner of the county. The Niobrara consists of a 15- to 20-foot thick basal unit of interbedded light-gray limestone and an upper unit, as much as 1,000 feet thick, of gray, calcareous shale and sandy shale. Small quantities of hard but potable water possibly can be obtained from fractured limestone in the basal unit of the Niobrara at places where the formation is saturated near areas of recharge. At places away from recharge areas, the sulfate content of the water may be very high. The Niobrara is not considered an aquifer in the plains area.

PIERRE SHALE

The Pierre Shale of Late Cretaceous age conformably overlies the Niobrara Formation, and though poorly exposed, crops out in a zone about 12 miles wide that extends from southern Colfax County at about R. 19 E. to northern Colfax County at about R. 26 E.; it has not been identified in Union County. The Pierre is about 1,650 feet thick and consists of a black fissile shale that contains horizons of calcareous concretions. The shale is nearly impermeable and where it does contain water, the water is of very poor chemical quality. The Pierre Shale is not considered to be an aquifer in the plains area.

[In this article there is no mention of the Trinidad Sandstone, Vermejo Formation, and the Raton Formation as potential aquifers. It is believed that the reason for this is that this account is limited to the plains of eastern Colfax County and western Union County. In addition, there is a lack of well data in the high mesas.—Ed.]

OGALLALA FORMATION

The Ogallala Formation of Pliocene age occurs as irregularly shaped outliers, some of which cover as much as 10 to 15 square miles in parts of the plains area of Colfax and Union Counties. In much of the area it is covered by lava flows. The Ogallala is a heterogeneous deposit of sand, silt, and clay that contains some gravel and boulders near

the base. The thickness of the Ogallala in the plains area ranges up to nearly 300 feet; it is thickest where it fills ancient valleys cut in the underlying bedrock. Water of good chemical quality is yielded to wells from the Ogallala. The yield is variable and is dependent upon the thickness and type of saturated material, which in turn is dependent upon the topography of the surface upon which the Ogallala was deposited. A well at the Capulin Mountain National Monument penetrated the Ogallala Formation from 671 to 680 feet beneath basaltic cinders and yields more than 40 gpm.

VOLCANIC ROCKS

Lava fields and flows of Tertiary and Quaternary age cover many hundreds of square miles in the plains area of eastern Colfax and western Union Counties. They are prominent as caps on mesas and as flows in the valleys. The volcanic rocks mainly consist of basalt but there are also some rhyolitic to latitic tuffs and flows. They lie above the water table in many localities; however, many springs issue from the bases of the basalt flows as water percolates downward through joints and fractures. The village of Branson, Colorado, about one mile north of the New Mexico State line north of Folsom, is supplied by water from several springs located in T. 32 N., R. 28 E., Union County. These springs yield about 50 gpm from basaltic lava flows which cap a large mesa in this area. Near Capulin yields of 1,000 gpm or more are obtained from shallow wells that tap water in cinders. This area is presently being investigated as a possible source of municipal supply for the city of Raton. Water in the lava and associated alluvium generally is of good chemical quality.

ALLUVIUM

Alluvium of Quaternary age occurs in the plains area as stream-channel deposits, as wind-blown silt and clay deposits, and as an areal deposit in the Capulin basin in Tps. 28 and 29 N., Rs. 26 to 28 E., south and west of Capulin. The alluvium consists of clay, silt, sand, and gravel that generally are not consolidated. It yields adequate quantities of water to domestic and stock wells in many stream valleys. In the Capulin basin the alluvium is as much as 100 feet thick and may yield 100 to 300 gpm to wells. The chemical quality is generally satisfactory for stock, domestic, and irrigation uses.

PEDIMENT GRAVELS

Pediment gravels of Quaternary age occur as veneers on remnants of pediments. They are present at many places in Colfax County and are particularly noticeable near Springer and Maxwell. The gravels consist of sand and gravel, clay and silt. Water-saturated zones in the gravel generally are not thick enough to yield more than a few gallons per minute. The pediment gravels are not considered to be an aquifer in eastern Colfax and western Union Counties.

GENERAL OCCURRENCE OF WATER

Water wells in eastern Colfax and western Union Counties range in depth from less than 10 feet to about 700 feet. Water levels range from above land surface to more than 600 feet below land surface. Yields of wells range from a few gpm to 1,000 gpm or more.

Water in the Ogallala Formation, the volcanic rocks, and the alluvium, at most places, occurs under water-table conditions. The older formations contain water that is under artesian pressure, except near the areas of outcrop. Near Springer a few wells tapping the Dakota Sandstone flow at the surface.

UTILIZATION OF WATER

The principal utilization of ground water in eastern Colfax and western Union Counties is for domestic and stock supplies on the ranches of the area. The village of Des Moines has four wells that tap the Dakota Sandstone and supply an average of about 20,000 gallons per day to the municipal supply. The villages of Folsom and Capulin are supplied by private wells that tap volcanic cinders or alluvium. The village of Branson, Colorado, is supplied by springs in Union County that yield about 50 gpm from basaltic lava flows. The National Park Service owns one well that is used for public supply at the Capulin National Monument.

Large supplies of ground water are not generally available in eastern Colfax or western Union Counties. The largest yields are obtained from volcanic cinders and alluvium in the Capulin basin, south and west of Capulin. Here, yields of more than 1,000 gpm have been obtained from wells; some irrigation is done near Capulin. It is possible that the aquifers in this area could be developed to yield many times the amount of water presently being utilized, although at present it is not known if recharge to the aquifers is sufficient to sustain large yields over the years. The city of Raton, which is supplied with surface water, is investigating this area, and if conditions appear favorable plans to replace, or supplement its municipal supply with ground water.

SUMMARY

The rocks that crop out in the plains of eastern Colfax and western Union Counties range in age from Triassic to Quaternary. Most of them are of sedimentary origin, but some are volcanic. Some of the rocks yield water readily to wells; others may yield small quantities, or in places none at all. Nothing is known of the water-bearing potential of rocks older than Triassic.

The Dakota Sandstone is the principal aquifer in the area and yields adequate water for stock and domestic supplies to hundreds of wells. Other stratigraphic units that are considered to be aquifers include sandstones of the Dockum Group; Entrada Sandstone; Morrison Formation; Ogallala Formation; volcanic cinders; and alluvium. The chemical quality of the water yielded by these aquifers is suitable for most ordinary uses, although the

Dakota Sandstone, Morrison Formation, and sandstones of the Dockum Group locally yield water that is undesirable for domestic use.

Adequate quantities of ground water are available for stock and domestic use throughout eastern Colfax and western Union Counties. Water wells range in depth from less than 10 feet to about 700 feet. A few wells near Springer flow; elsewhere water levels range from a few feet to more than 600 feet below the land surface. Most of the water is used on ranches; only minor amounts are utilized for public supply. Large yields are not common and are known to be obtained only from volcanic cinders and alluvium near Capulin.

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