ASSESSMENT OF GROUND-WATER AVAILABILITY IN COOKS SPRINGS WATER AUTHORITY SERVICE AREA

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GEOLOGICAL SURVEY OF ALABAMA

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By

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INTRODUCTION

The Geological Survey of Alabama (GSA) conducted an investigation to identify sites suitable for water well test drilling for the Cooks Springs Water Authority (Authority). The Authority's service area is located in southwestern St. Clair County. The Authority selected two areas, one in the northern end and one to the southern end of the Authority's service area, as priority locations for exploratory drilling. The GSA collected data on wells in the area, compiled water level data, reviewed the geology of each area and assessed its potential for water yields suitable for public supply. After a general appraisal of each area, high altitude photographs of the study area were analyzed for lineaments. Lineaments are visible linear features on aerial photographs that may indicate the presence of bedrock fractures that could improve nearby ground-water flow. Based on the general hydrogeologic characteristics and lineaments, no suitable sites were available for ground-water development for public supply within the service area. However, if access to property to the northwest of this service area can be acquired, test drilling in the Tuscumbia Limestone, Ft. Payne Chert, and Maury Formation undifferentiated or the base of the Floyd Shale may prove successful.

HYDROGEOLOGIC CHARACTERISTICS

The geologic formations exposed in the Cooks Springs area of St. Clair County Alabama, from oldest to youngest, are Ketona Dolomite of Cambrian age; the Chepultepec Dolomite and Copper Ridge Dolomite undifferentiated of Cambrian and Ordovician age; Longview Limestone, Newala Limestone, Odenville Limestone, and the Greensport Formation, Little Oak Limestone, and Lenoir Limestone undifferentiated of Ordovician age; Frog Mountain Sandstone of Devonian age; Tuscumbia Limestone, Fort Payne Chert, and Maury Formation undifferentiated, Pride Mountain Formation, Hartselle Sandstone, and Floyd Shale of Mississippian age; the Parkwood Formation of Mississippian and Pennsylvanian age; the Pottsville Formation, including the Shades and Pine Sandstone Members and the informally named Pottsville Formation undifferentiated, Hardwick Tunnel member, and the Pottsville Formation upper part, all of Pennsylvanian age; and alluvium of Quaternary age (plate 1). These formations and their descriptions are discussed in greater detail in three GSA Quadrangle Series Map reports: Geology of the Odenville 7.5-minute quadrangle, St. Clair County, Alabama, QS 23 (Osborne and Irvin, 2002); Geology of the Wattsville 7.5-minute quadrangle, St. Clair

County, Alabama, QS 28 (Bearce, Osborne and Howell, 2003); and Geology of the Cooks Springs 7.5-minute quadrangle, St. Clair and Shelby Counties, Alabama, QS 32(Ward and Osborne, 2004). These reports also contain detailed geologic maps and cross sections that were used extensively in this investigation and are reproduced in part in plates 1 and 2.

Within the Cooks Springs Water Authority service area (Plate 1) are outcrops of the Parkwood Formation and Floyd Shale undifferentiated of Mississipian and Pennsylvanian age, the Pottsville Formation of Pennsylvanian age, and alluvial deposits of Quaternary age. Cross section A-A' (Bearce and others, 2003) on plate 2 crosses the northern end of Cooks Springs service area and shows the depth and thickness of these formations in that area. Cross section B-B' (Osborne and Irvin, 2002) begins northwest of the Cooks Springs service area in Acmar and traverses southeastward across the southern end of the service area and terminates south of Wolf Pen Ridge. To the northwest of Brompton are outcrops of the Tuscumbia Limestone, Fort Payne Chert, and Maury Formation undifferentiated, which, in this area, consists mostly of Fort Payne Chert. Odenville has a public supply well (GSA number STCX-19) approximately 2 miles north of Brompton that produces over 500 gallons per minute (gpm) from this formation.

Alluvial deposits adjacent to and under Cane Creek and Kelly Creek typically contain water-bearing sands; however, these sands are rarely thick enough to provide a high yield of water and are susceptible to contamination from the surface. The Pottsville Formation is likewise a poor option for a public supply source. The formation consists of dark-gray silty shale, sandstone, and interbeds of coal and underclay and does not generally yield more than 5 to 10 gallons gpm to individual wells. Additionally, the water quality can be poor. Water moving through coal seams, when present, oxidizes pyrite, which occurs with the coal, and results in high levels of dissolved iron, frequently to an objectionable extent (table 1). Well STCS-3 is typical of Pottsville water while the water from other wells in table 1 may indicate infiltration of water from overlying alluvial deposits. The water can be treated to reduce iron but at a greater cost.

Finding a high yielding well completed in the Pottsville Formation is very unlikely. One way to improve the chances of a high yield well is by lineament analyses from high altitude photographs. A composite photograph was made from four USGS digital orthographic quarter quadrangles, and a lineament analysis was performed. While many lineaments were identified, the lineaments within the Cooks Springs service area

are not significant enough to suggest that a large yield well (greater than 200 gpm) will result from the possible fractures.

Table 1.—Chemical analyses of water from wells completed in the Pottsville Formation, St. Clair County, Alabama (modified from Causey, 1963).

Well No.	Date of collection	Silica (SiO_2)	Aluminum (Al)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate(CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Hardness (as $CaCO_3$)		Specific conductance (micromhos @ 24 ° C)	pH
															Calcium, magnesium	Non-carbonate		
		Milligrams per liter																
STCS-3	6/27/53	34.5		3.4	16.7	11.4	16.9		56.5	0	25.9	13.3			98.5			6.6
STCS-7	12-29-55	18.1	1.2	.6	2.9	1.1	103.6	.9	285.2	0	4.3	9.1		2	19.4	11.7		8.1
STCS-8	12/9/55	12.6	2.0	2.1	3.9	3.5	87.9	1.2	240.4	10.5	6.1	7.0		1.1	39.0	24.1		8.3

The City of Ragland, located several miles northeast of the area shown on plate 1, is underlain by similar geology to Cooks Springs. Ragland is located in the outcrop of the Pottsville Formation with the Mississippian age Tuscumbia Limestone, Fort Payne Chert, and Maury Formation undifferentiated cropping out about 2 miles to the south. Ragland drilled six wells into the Pottsville prior to 1960 (table 2). The depths of those wells varied from 300 to 406 feet. The highest water yield was from a 320-foot well, STCS-7, which reported 112 feet of drawdown when pumped at 110 gpm in 1955. Water-quality results for this well are reported in table 1. Ragland does not currently obtain water from any of the wells shown in table 1. Rather, their water comes from two

Table 2.— Wells drilled for the city of Ragland, Alabama

Well no.	Total depth (feet)	Aquifer	Date drilled	Yield (gpm)	Remarks
STCS-3	406	Ppv	1953		Cased to 50 ft.
STCS-4	300	Ppv	1943	60	Cased to 20 ft.
STCS-5	200	Ppv	<1928	10	Supply inadequate.
STCS-6	350	Ppv			Drilled through a layer of coal.
STCS-7	320	Ppv	1955	110	Cased to 25 ft. Drawdown 112 ft when pumped 24 h at 110 gpm in 1955.
STCS-8	305	Ppv	1955	90-100	Cased to 26.5 ft. Drawdown 80 ft when pumped 24 h at 90 to 100 gpm in 1955.
STCR-03	225	Mf	1972	5	TW-1, 5 gpm from 18-20 ft, none down hole
STCR-01	175 (385)	Mtfpm	1972	150	TW-2, “Liggins well”, plugged back to 175 ft. Cased to 44 ft. Test pumped at 150 gpm in 1972.
STCS-01	200		1972	300	TW-3, water would not clear, well abandoned.
STCS-04			1970	115	TW-4, Drawdown > 50 ft when pumped at 115 gpm in 1972.
STCS-08	80	Mtfpm	1972	10	TW-5, cased to 19 ft, water between 34 and 43 ft.
STCS-02	167	Mtfpm	1972	500	TW-6, Milton Wright farm, drawdown 29 ft when pumped at 500 gpm for 72 h in 1973.
Active wells STCS-03	175	Mtfpm	1974	400	TW-7, 16-in. casing to 38 ft, 12-in. casing from 0 to 55 ft, open hole below. Drawdown 30 when pumped 72 h at 400 gpm in 1974.
Active wells STCS-17	175	Mtfpm	1977	400	8-in. casing to 440 ft., 6-in. casing from 0 to 140 ft. Drawdown 7 ft when pumped 60 hrs at 400 gpm in 1977.
STCS-05	500	Mtfpm	1990	70	TW-1, 6-in. casing to 105 ft, open hole below casing.
STCS-06	452	Mtfpm	1990	175	TW-2, 6-in. casing to 63 ft. open hole below casing.
STCS-07	248	Mtfpm	1990	100	TW-3, Cased to 82 ft.

wells completed in the Mississippian Tuscumbia Limestone and the Fort Payne Chert located to the southeast of town (wells STCS-03 and STCS-17). Both wells have a test capacity of 400 gpm.

The best opportunity for large quantities of good quality ground water in the Cooks Springs area is from fracture openings in the Mississippian Fort Payne Chert and solution openings in overling limestones, when present. This formation consists of grayish-orange, thin to locally medium-bedded chert. The chert is highly fractured and allows rapid movement of ground water. Plate 1 shows the location of public supply wells owned by Odenville. These wells are all completed in the Tuscumbia Limestone, Fort Payne Chert, and Maury Formation undifferentiated. Unfortunately, occurrence of these formations is northwest of the Cooks Springs Water Authority's service area. While the formation occurs at depth, the chances of open fractures decrease with depth.

Another target formation that should be considered, if the Authority can secure property to the northwest of their service area, is the Floyd Shale. While this formation is not generally a good aquifer, a chert interval at the base of the formation in this area has proven successful for the city of Odenville. Odenville's wells are shown on plate 1. Odenville is reported to have test pumped one of these wells at 1,000 gpm. Unfortunately, water from many wells producing from this formation has a high level of dissolved iron, which could add to treatment costs.

The geologic formations northwest of the service area are folded and faulted (cross-section B-B′). The steep dip of the formations will require careful selection of a drilling site to assure the target formation will be encountered at a relatively shallow depth (<300 feet). At much greater depths, fractures could be sealed, preventing transport of water to a well. To assure finding the chert at the base of the Floyd Shale at a relatively shallow depth, the well should be located within the outcrop the Floyd Shale near its contact with the underlying Hartselle Sandstone.

Extensive water level data were collected and reviewed; however, there was insufficient data due to the limited use of this aquifer to make a reliable potentiometric map of the Pottsville Formation. The collected water level data is shown on plate 1.

SUMMARY

Cooks Springs Water Authority has a limited number of options for public water supply. The geologic formations within their current service area are known to yield a limited amount of water that is generally high in dissolved iron. If Cooks Springs Water

Authority is to drill a successful public supply well, it will need to move northwest, outside of its current service area, and closer to the outcrop area of the Tuscumbia Limestone, Fort Payne Chert, and Maury Formation undifferentiated or the Floyd Shale.

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