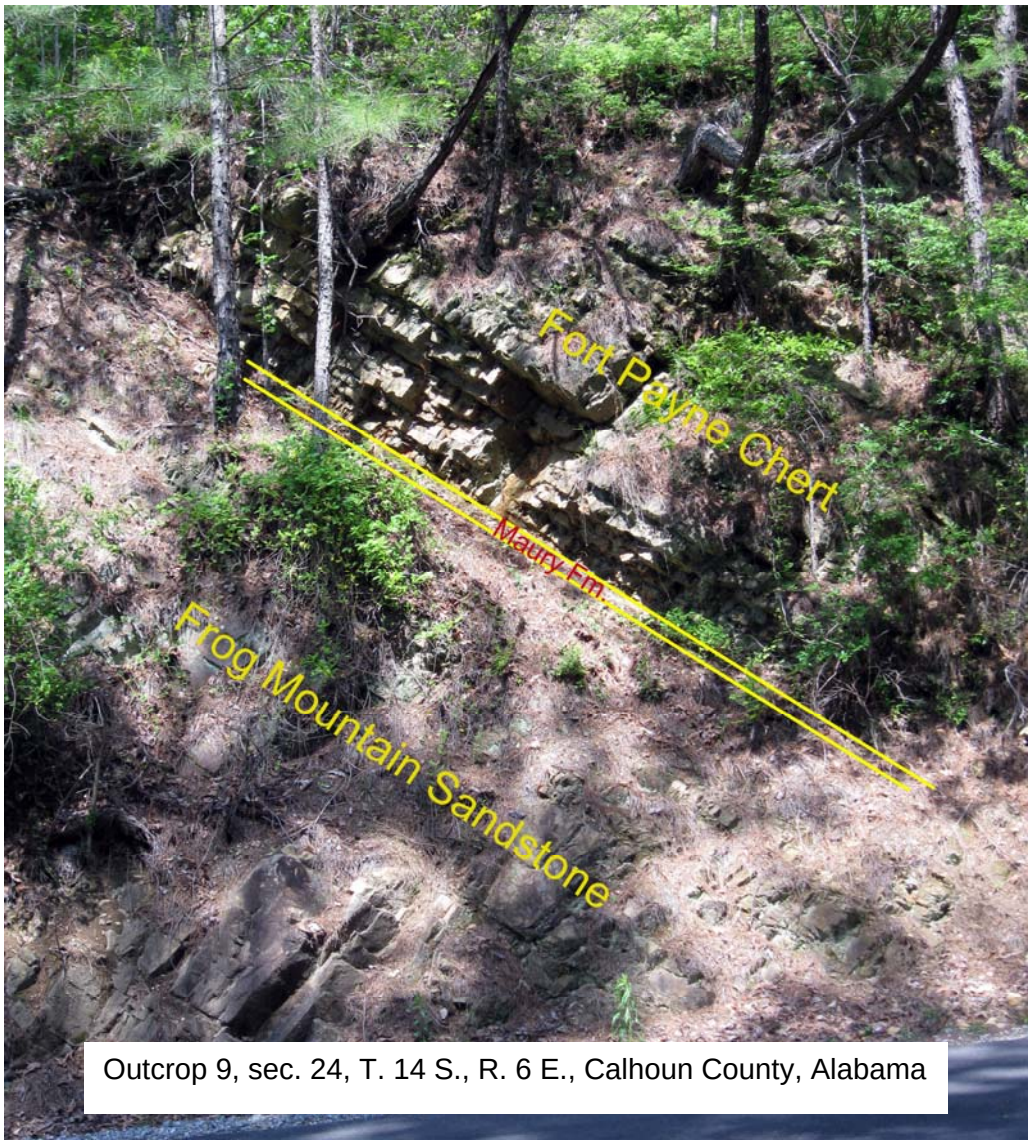
GROUNDWATER ASSESSMENT AND HYDROGEOLOGY OF THE OHATCHEE AND ANNISTON BEACH AREAS, CALHOUN COUNTY, ALABAMA



Outcrop 9, sec. 24, T. 14 S., R. 6 E., Calhoun County, Alabama

GEOLOGICAL SURVEY OF ALABAMA

Berry H. Tew, Jr.
State Geologist

GROUNDWATER ASSESSMENT AND HYDROGEOLOGY OF THE OHATCHEE AND ANNISTON BEACH AREAS, CALHOUN COUNTY, ALABAMA

A REPORT TO THE

CALHOUN COUNTY WATER AND FIRE PROTECTION AUTHORITY

OPEN FILE REPORT 1211

By
Stephen P. Jennings

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INTRODUCTION

Springs and wells currently serve as water-supply sources for the Calhoun County Water and Fire Protection Authority (CCWFPA), whose service area includes a large portion of northern Calhoun County, Alabama. In December 2010, CCWFPA requested that the Geological Survey of Alabama (GSA) evaluate the potential for development of additional public water supplies for portions of the CCWFPA service area. In April 2011, GSA entered into a contractual agreement with CCWFPA to conduct hydrogeologic assessments in the Ohatchee and Anniston Beach areas of Calhoun County. This report summarizes data collected and analyzed and presents interpretations of hydrogeological characteristics of the assessed areas along with recommendations for possible test well drilling sites.

PURPOSE AND SCOPE

Within its overall service area, the CCWFPA delineated two areas with greatest needs to locate and develop groundwater supplies, the Ohatchee area in western Calhoun County and the Anniston Beach area in the eastern part of the county (fig. 1). The primary purposes of this investigation were to assess the availability of groundwater in the Ohatchee and Anniston Beach areas of Calhoun County through delineation of the hydrogeology of each area and to locate prospective areas for further evaluation by test well drilling. As used herein, each groundwater assessment area includes a primary area of interest outlined by CCWFPA and surrounding areas (plate 1). Analysis of data for each assessment area extends beyond the boundaries of the primary area of interest in order to adequately evaluate the service area within the context of the geologic, hydrologic, and geochemical setting and to provide a more comprehensive study. This

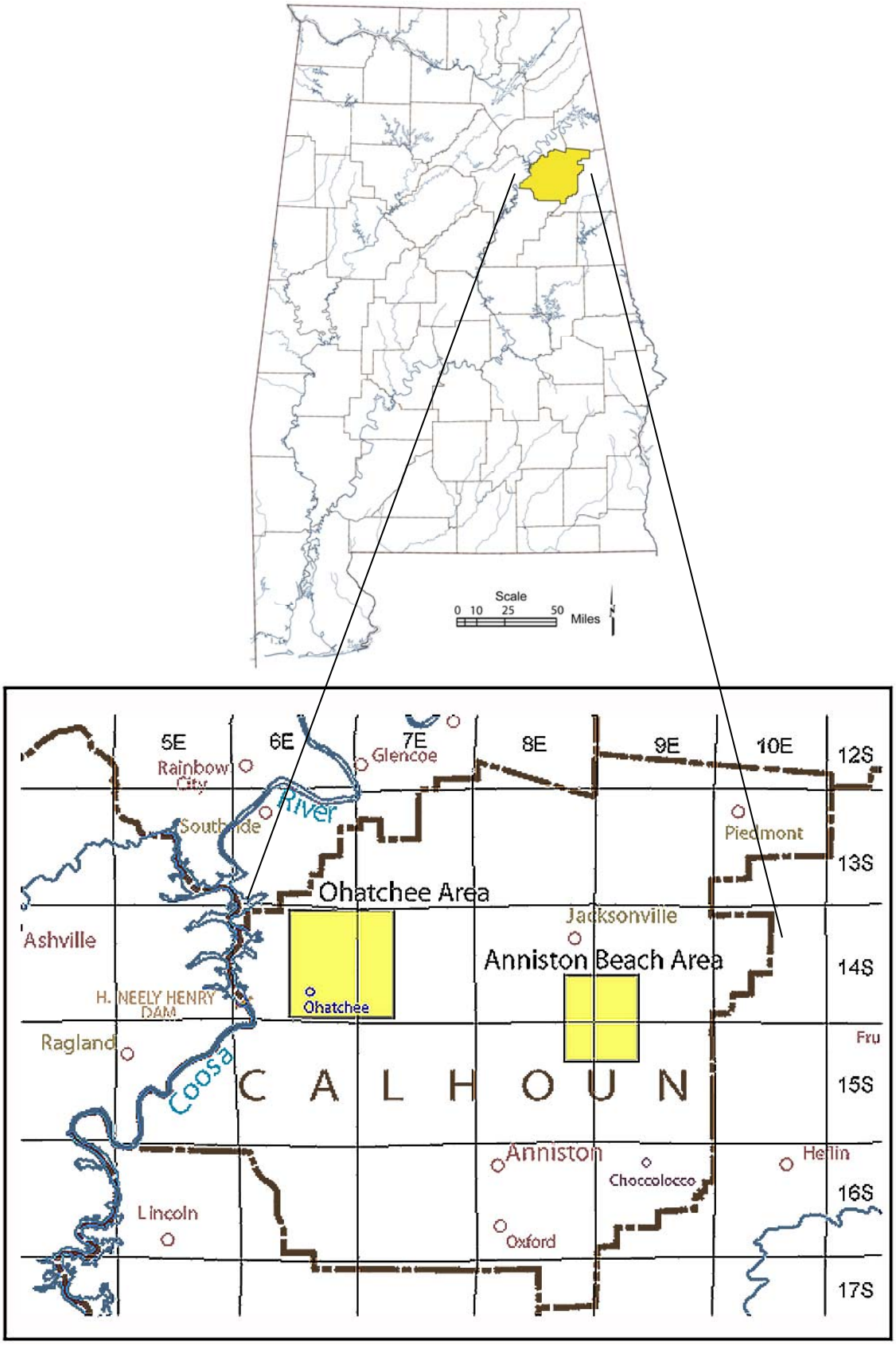

Figure 1.—Location of Ohatchee and Anniston Beach groundwater assessment areas, Calhoun County, Alabama.

investigation relies primarily on geological field data collected in 2011-2012, data on file at GSA from water wells and test holes drilled in the assessment areas, published and unpublished maps and data, and satellite imagery.

Although groundwater is stored in and flows through all of the geologic formations in the assessment areas, some rock units, or portions thereof, have greater potential as aquifers than others, especially with regard to groundwater flow rates and water quality necessary for public water supplies. Some rock types, such as shale, commonly have relatively poor aquifer transmissive properties, making them unlikely targets for development of large capacity wells, whereas other rock types, such as chert and carbonate rocks (limestone and dolomite), commonly are more permeable, especially in hydrogeologic settings in which fracturing and/or dissolution processes have occurred. Therefore, in this investigation, effort is concentrated on rock types and geologic units which are more likely to serve as aquifers.

Quality (geochemistry) of groundwater in low permeability rocks, such as shale, is commonly marginal to poor for drinking water, whereas other lithologies are more likely to contain groundwater with acceptable levels of dissolved ions. Only general observations of groundwater quality are presented in this report, primarily due to lack of wells completed in the principal prospective aquifers in the assessment areas.

Because of the importance of geologic structure in delineation of potential aquifers and groundwater flow, considerable effort was made to measure and/or estimate structural attitude (strike and dip) and spatial relationships of geologic units. Projections of measured geologic dip of outcropping strata into the subsurface, coupled with available data from water wells and test holes, were used to make estimations of depths of aquifers for test well planning purposes.

Sparse water level data, lack of data regarding aquifer characteristics such as porosity and permeability, and only rudimentary understanding of the hydrogeology in the assessment areas preclude quantitative estimations of groundwater storage and flow. Experience from other areas in similar hydrogeologic settings, however, coupled with available data and analyses mentioned above, allow reasonable estimations of aquifer potential of geologic units in the assessment areas and their suitability for public water supply use.

PHYSIOGRAPHIC, HYDROLOGIC, AND GEOLOGIC SETTING

Physiography is important in delineating hydrogeology and hence aquifer potential of geologic units. The Ohatchee and Anniston Beach groundwater assessment areas lie in the Valley and Ridge Province (fig. 2), a region characterized by significant local topographic relief with generally parallel ridges and valleys. Physiography of the Valley and Ridge Province results primarily from differential erosion of fold and thrust belt structural features wherein more resistant rocks form ridges and less resistant rocks comprise valleys. Geomorphic features are strongly influenced by stratigraphy and geologic structure, and geomorphology similarly affects surface water and groundwater hydrology. Highland areas commonly serve as aquifer recharge areas. Potential energy, which is imparted to groundwater through gravity and measured as elevation head and/or pressure head, provides the energy for production of work necessary for groundwater flow.

Topography in the Ohatchee assessment area is characterized generally by northeast trending ridges, locally broken by gaps, separated by valleys which range in width from about ¼ mile to greater than 2 miles (plate 1). Overall topographic relief in the area exceeds 350 feet with the highest point at approximately 824 feet above sea level in the northeastern part of the area and the lowest point below 500 feet elevation in the southwestern part of the area. Locally, relief from ridge crests to adjacent lowlands is about 200 feet. Overall drainage is to the southwest toward the Coosa River, with Ohatchee and Tallaseehatchee Creeks being the principal streams in the area.

Topography in the Anniston Beach area is dominated by Choccolocco Mountain to the east and valleys and small ridges to the west, especially west of Alabama Highway 21. Overall relief across the assessment area is about 1,000 feet, with a high point of approximately 1,620 feet on north-trending Choccolocco Mountain and another high point in the south-central part of the area, north of the community of Anniston Beach. In the primary area of interest, topographic relief is about 700 feet, with a high point of 1,380 feet above sea level. Little Tallaseehatchee Creek, with headwaters on the western slopes of Choccolocco Mountain, drains most of the assessment area. The topographic low point is in the northwestern part of the area, where Little Tallaseehatchee Creek drains toward Tallaseehatchee Creek and the Coosa River.

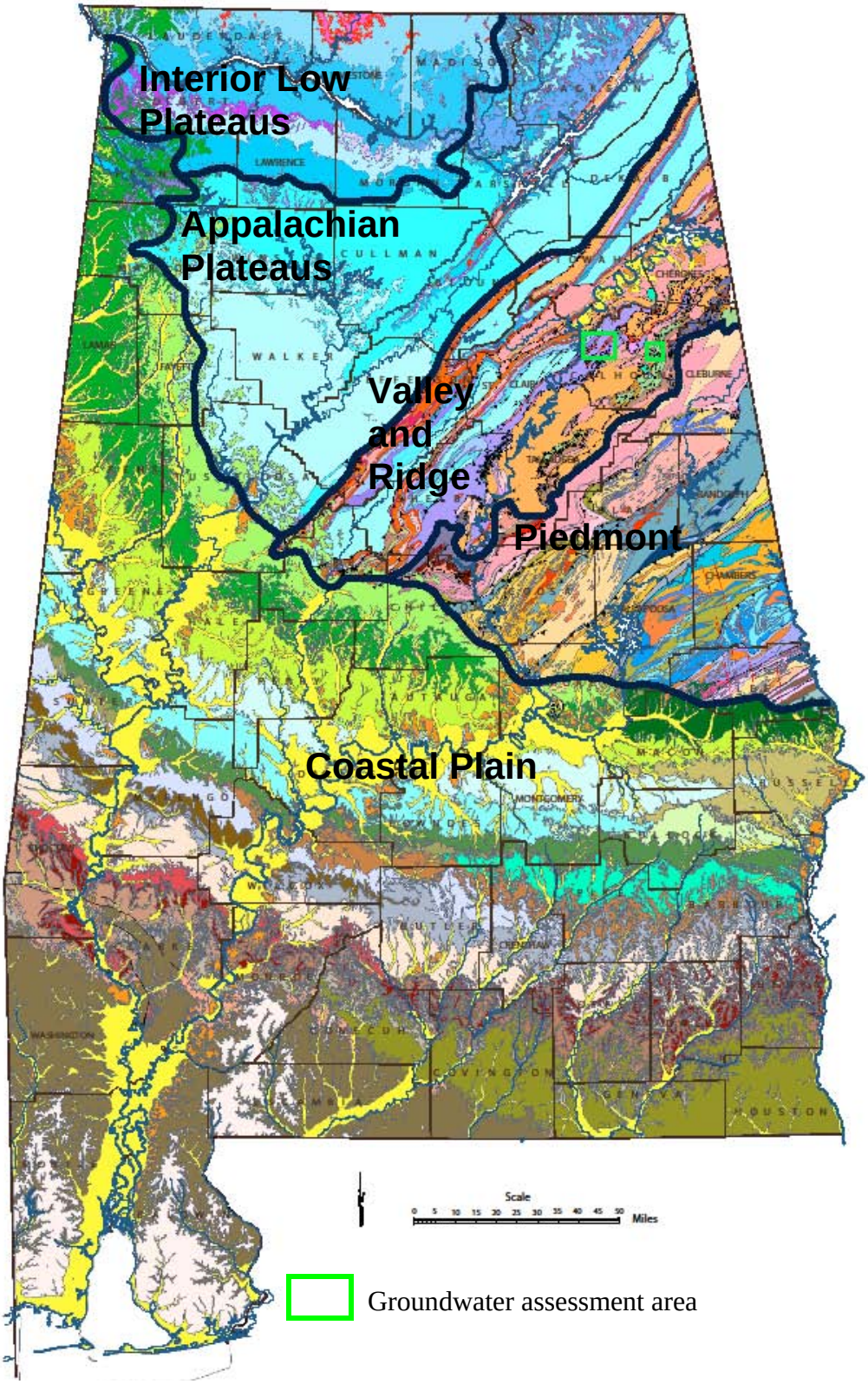

Figure 2.—Physiographic provinces, geology, and Calhoun County Water and Fire Protection Authority groundwater assessment areas. See Geological Survey of Alabama (2006) for explanation of geologic units statewide.

Paleozoic sedimentary rocks, ranging in age from Early Cambrian to Early Pennsylvanian, occur across Calhoun County, with older rocks predominating to the southeast and younger rocks more prevalent to the northwest (plate 2). Thrust faults cross the county in general northeast- to north-trending directions and include the regionally extensive Pell City and Jacksonville faults. Juxtaposition of rocks of widely varying ages and types is largely the result of southeast-dipping thrust faults that developed during the phase of major compressional tectonics which formed the Appalachian Mountains in the late Paleozoic Era (Alleghanian orogeny). Northwest translation (displacement) of the strata due to thrust faulting in Calhoun County is on the order of tens of miles (Thomas and Bayona, 2005).

The Ohatchee area lies in the Coosa deformed belt, a region of folding and imbricate thrust faults between the Helena thrust sheet to the northwest and the Pell City thrust sheet to the southeast. Geologic structure within the Ohatchee assessment area is comprised mainly of folds, bounded on their frontal (northwestern) sides by thrust faults (plates 2, 3). Commonly exposed along the hanging wall of the faults are Ordovician limestone formations: the Little Oak Limestone or the Newala Limestone. A relatively thin interval of dusky red to yellow shale and siltstone with minor limestone and sandstone of Ordovician Greensport Formation is present above the Little Oak Limestone in the northwestern part of the Ohatchee assessment area. Overlying the Ordovician rocks are sandstone and shale beds of the Devonian Frog Mountain Sandstone. Above the Frog Mountain Sandstone is a thin interval (< 3 feet) of green shale and siltstone, the Maury Formation, which is the lowermost Mississippian stratigraphic unit. Geologic formations above the Maury Formation are, in ascending order, the Mississippian Fort Payne Chert, Tuscumbia Limestone, Floyd Shale, and Mississippian-Pennsylvanian Parkwood Formation. Sandstone beds of the Frog Mountain and chert and limestone beds of the Fort Payne Chert and Tuscumbia Limestone are the principal erosion-resistant rocks that form topographic ridges on the southeastern flanks of imbricate fault slices in the Ohatchee assessment area. Between the ridges are areas of low relief and/or valleys composed of shale, siltstone, and thin sandstone and limestone beds of Parkwood Formation and Floyd Shale undifferentiated in most of the area.

The Anniston Beach area is located along the Jacksonville thrust fault in the eastern part of the Appalachian fold and thrust belt (plates 2, 4). In the assessment area, Lower Cambrian Shady Dolomite and terrigenous clastic rocks of the Chilhowee Group were thrust over and now lie juxtaposed to the younger and normally overlying Cambrian Rome and Conasauga Formations, which comprise major units of the Pell City thrust sheet. Within the Jacksonville thrust sheet, outcrop belts of Shady Dolomite and Chilhowee Group are broken up by imbricate thrust faults of more localized extent. South of Jacksonville near Whites Gap, erosion through the Jacksonville and Pell City thrust sheets has exposed Ordovician shale and limestone of the Athens Shale and Little Oak and Newala Limestones undifferentiated of the underlying Eden thrust sheet in a structural feature termed a fenster or window (Osborne and Szabo, 1984).

HYDROGEOLOGY OF THE GROUNDWATER ASSESSMENT AREAS

HYDROGEOLOGY OF THE OHATCHEE AREA

Chert and cherty limestone of the undifferentiated Mississippian Fort Payne Chert and Tuscumbia Limestone constitute the principal prospective aquifer, herein termed the Fort Payne-Tuscumbia aquifer and labeled Mtfp on plate 3, in the Ohatchee assessment area. No attempt was made in this investigation to distinguish the Fort Payne Chert from the overlying Tuscumbia Limestone, and the two formations are mapped together, following the precedent of the Geologic Map of Alabama (Osborne and others, 1988). This hydrogeologic unit has been found elsewhere in the state to be a prolific groundwater source. The stratigraphic unit as mapped also includes the thin Maury Formation, though the Maury is generally impermeable and not considered part of the overlying aquifer interval. Warman and Causey (1962) ascribed a thickness of about 350 feet to the Fort Payne in northern Calhoun County (they did not recognize the Tuscumbia Limestone), whereas Moser and DeJarnette (1992) indicate a maximum combined thickness of 175 feet for the Fort Payne Chert and Tuscumbia Limestone in the county. The apparent thickness of the Fort Payne-Tuscumbia interval varies from about 150 feet to greater than 300 feet. It is not determined whether the apparent variations in thickness are true or due to local folds and faults (fig. 3).

Tuscumbia/Fort Payne/Maury (Mtfp) outcrop mapped in the Ohatchee area occurs in several long, subparallel belts (plate 3), where it generally forms ridges broken locally

by gaps. Along its outcrop belts and in the subsurface east-southeast of the ridges, chert and limestone of the Fort Payne-Tuscumbia interval dip to the southeast (fig. 3 and cover page) and continue beneath the younger shale and thin sandstone and siltstone beds of the undifferentiated Parkwood Formation and Floyd Shale (fig. 4). Cross section A-A' (plate 5) illustrates the geology of the area along Grayton Road, northeast of the town of Ohatchee. Undifferentiated Parkwood Formation and Floyd Shale overlie the Fort Payne-Tuscumbia aquifer and act as a confining unit. Most wells drilled in the Ohatchee area are shallow, small-capacity Parkwood-Floyd wells (plate 3) used for domestic purposes. Fort Payne-Tuscumbia rocks also crop out in several shorter belts in the assessment area, each bounded to the west by a relatively small-scale thrust fault. Local changes in strike and dip occur along the Fort Payne-Tuscumbia outcrop areas and are significant in consideration of aquifer development and groundwater recharge due to the likelihood of enhancement of fracture development at or near the structural changes. Because bedding in the Fort Payne Chert commonly is undulatory, giving the rock a somewhat wavy or knobby appearance, and cross bedding is locally present in the Tuscumbia Limestone, the important task of determining representative strike and dip of the formations is often somewhat difficult, especially when exposure surfaces are small.

Beds or intervals of the Fort Payne-Tuscumbia outcrops exhibiting visible (macro) porosity are commonly composed of tan- to light-gray, fossil moldic chert with numerous fractures and dissolution features. Grain-rich fabrics (fossil fragmental) are common in the Tuscumbia Limestone, but chert is less prevalent than in the Fort Payne. Grain-rich beds, dominated by echinoderm fragments or their molds, in the Fort Payne Chert are generally more prevalent in the middle to upper part of the unit, and thin shale interbeds and shaly chert beds are more common in the lower part of the formation. Dissolution channels, fractures perpendicular to bedding, and bedding plane conduits probably connect the porous intervals in the Fort Payne-Tuscumbia aquifer. A public supply well drilled and constructed in 2009 to a depth of 212 feet by the CCWFPA in sec. 17, T. 13 S., R. 9 E., about 5 miles northeast of Jacksonville (plate 2), is a Fort Payne-Tuscumbia aquifer well located in a hydrogeologic setting similar to that in the Ohatchee area. The aquifer intervals in the CCWFPA well, which was tested at 710 gallons per minute (gpm) for 6 days with measured drawdown of 35 feet, are porous and permeable,

Figure 3.—Lower Mississippian Fort Payne Chert, outcrop 68, SE¼NW¼ sec. 24, T. 14 S., R. 6 E., Calhoun County, Alabama. Localized folds and small faults interrupt southeast dip of beds, resulting in apparent thickening of stratigraphic section. Brown field bag in foreground is approximately 1 foot in width.

tan to light-gray, fractured chert and cherty limestone beds which display abundant dissolution cavities. Porous beds are interbedded with medium- to dark-gray, dense, cherty limestone and nonporous, porcelanic chert. It is anticipated that a test well drilled at or near the location shown on cross section A-A' (plates 3, 5) would penetrate aquifer intervals within the Fort Payne-Tuscumbia similar in petrophysical characteristics to those encountered in the CCWFPA well described above.

Availability of water quality data for the Fort Payne-Tuscumbia aquifer is very limited in the Ohatchee groundwater assessment area due to lack of wells completed in the unit. Records from GSA files indicate that a spring, located in the SW¼ sec. 35, T. 14

Figure 4.—Mississippian Floyd Shale, outcrop 42, SE¼SW¼ sec. 15, T. 14 S., R. 6 E., Calhoun County, Alabama.

S., R. 6 E. (spring N76 on plate 3), likely flows from the Fort Payne-Tuscumbia aquifer. Measurements from a water sample collected from the spring in 1957 indicate hardness of 124 milligrams per liter (mg/L), pH 6.0, and water temperature 61º F. About 2 miles north of the Ohatchee assessment area, along the southeastern base of Greens Creek Mountain, however, chemical analyses of water samples from wells E-01 and E-02 in T. 13 S., R. 6 E. (plate 2), indicate the presence of generally good quality groundwater in the Fort Payne-Tuscumbia aquifer (Moser and DeJarnette, 1992). Well E-02, the test well for a public water supply well for the town of Southside, tested 325 gpm in a 26 hour pump

test with a drawdown of 29.4 feet. The aquifer intervals are described by the driller as "broken" limestone and chert and "soft …white chalky rock" at depths from approximately 111 feet to 170 feet. Located nearby, well E-01—a private supply well, 98 feet deep—is productive from the uppermost part of the aquifer. Water from well E-01 is of good quality but has higher levels of iron (0.310 mg/L) than well E-02 (0.02 mg/L), probably indicating influence from water in the overlying Floyd Shale. Wells completed in the Parkwood-Floyd interval, in addition to having low yields, commonly have undesirable hardness, unacceptable iron concentrations, and/or other objectionable water quality issues (Warman and others, 1960; Warman and Causey, 1962; and Moser and DeJarnette, 1992). Elsewhere in Calhoun County, the quality of water from the Fort Payne-Tuscumbia aquifer is generally good, with an average hardness of 129 mg/L (Warman and others, 1960).

HYDROGEOLOGY OF THE ANNISTON BEACH AREA

The Cambrian Shady Dolomite and Conasauga Formation contain the principal aquifer intervals in the Anniston Beach groundwater assessment area, though rocks of the Chilhowee Group, which crop out on Choccolocco Mountain (plate 4), also locally serve as an aquifer. The Cambrian Rome Formation, the outcrop area of which comprises a large portion of the western part of the primary area of interest, is not considered a significant aquifer, though some small-capacity wells and springs are sourced in sandstone and thin limestone beds of the formation in the assessment area. As discussed above, relatively impermeable beds of Ordovician Athens Shale crop out in the Whites Gap window in the north-central part of the assessment area (plate 4). Limestone and thin shale beds of Ordovician Little Oak and Newala Limestones crop out in relatively small areas of the window, but the few rock exposures do not appear to be porous and permeable, though some karst development may be possible.

The Lower Cambrian Shady Dolomite is a poorly exposed interval of predominantly bluish-gray to pale yellowish- to brownish-gray, cherty dolomite and limestone with subordinate amounts of shale and shaly limestone and dolomite. Primary sources of information about the lithologic characteristics and thickness of the Shady are descriptions of drill cuttings and cores from water wells and test holes in Calhoun County and a relatively small number of outcrops. Osborne and Szabo (1984) characterized the

Shady as light-gray, argillaceous to sandy, laminated dolomite, dolomitic limestone, quartzite, and chert from outcrops and drill cores from southern and eastern Calhoun County. They note some intervals of coarsely crystalline, porous chert with “boxwork” texture. Thickness of the Shady Dolomite ranges from 370 feet in Cherokee County to 1,000 feet in southern Calhoun County (Raymond and others, 1988) and is thought to be about 500 feet thick in eastern Calhoun County (Osborne and Szabo, 1984). Outcrops of Shady Dolomite are found at the northeast end of Choccolocco Mountain, south of Piedmont in the Choccolocco Valley, in the Anniston valley area, on ridges in and adjacent to Fort McClellan, and in the Whites Gap area (Warman and Causey, 1962; Osborne and Szabo, 1984).

In the Whites Gap area, tan to yellowish-brown, highly weathered chert is the predominant lithology of the Shady Dolomite. The chert is commonly iron-stained and porous, with "lacey and "boxwork" texture (fig. 5). Limonite nodules and particles are common in some exposures of the Shady. Because of a lack of fresh outcrops that exhibit unequivocal bedding planes, the structural attitude of the Shady beds in this area is difficult to determine. At two very weathered outcrops in the SW¼ sec. 30, T. 14 S., R. 9 E., strike appears to be northeast and dip is northwest at angles of about 50º to 57º. The Shady outcrop belt is probably fault bounded in this area (plates 4, 6). Contorted bedding and breccia containing blocks of Weisner sandstone and shale along with beds of dark red and tan laminated mudstone of the Wilson Ridge Formation (?) in the NE¼SW¼ sec. 30, T. 14 S., R. 9 E., are evidence of a fault bordering the eastern side of the Shady outcrop belt (fig. 6). This fault was likely penetrated in a core hole drilled to 119.6 feet in 1983 in the vicinity of the outcrop (Osborne and Szabo, 1984), labeled K-CH7 on plate 4. It is anticipated that a test well drilled near the eastern fault contact of the Shady Dolomite with rocks of the Chilhowee Group (plates 4, 6) would penetrate potential aquifer intervals in the Shady and might reach the Conasauga Formation below the Jacksonville fault.

Figure 5.—Shady Dolomite hand sample, outcrop 48, NW¼NW¼ sec. 31, T. 14 S., R. 9 E., Calhoun County, Alabama. Sample consists of weathered, iron-stained, porous chert with indistinct bedding.

Despite the relatively limited outcrop area of Shady Dolomite in Calhoun County, the unit is considered a significant aquifer. Moser and DeJarnette (1992) identified 67 wells and 23 springs in the Shady in the county, with average spring discharge of 324 gpm. In the Anniston Beach area, two springs (L01 and L66) on the western side of a ridge in sec. 36, T. 14 S, R. 8 E., are located in outcrop of the Shady Dolomite. Flow rates of approximately 500 gpm and 100 to 942 gpm have been measured from L01 and L66, respectively (Johnston, 1933; Moser and DeJarnette, 1992).

Figure 6.—Contorted bedding and jumbled blocks of sandstone, shale, and mudstone of Chilhowee Group interpreted as a thrust fault zone, outcrop 51, SW¼ sec. 30, T. 14 S., R. 9 E., Calhoun County, Alabama.

Water quality from wells and springs in the Shady Dolomite is generally good, though considerable variations in iron and hardness have been reported from Calhoun County (Moser and DeJarnette, 1992). Average hardness is about 100 mg/L (Warman and others, 1960; Moser and DeJarnette, 1992). As noted above, local concentrations of the iron mineral limonite in some beds of the Shady Dolomite are indications of a complex and, as yet, poorly understood geochemical history of the unit that accompanies the complex structural geologic framework of the area.

The Middle to Upper Cambrian Conasauga Formation occurs in a large area of generally low topographic relief with relatively few outcrops in the Pell City thrust sheet extending from southern Cherokee County, Alabama, to the Fort McClellan window and to the northwest a few miles west of Alexandria in the central part of Calhoun County (plate 2). Conasauga outcrop is also found in eastern and southern Calhoun County. Thick regolith and dark red soils cover much of the outcrop area of the formation. Osborne and Szabo (1984) stated that the Conasauga Formation is approximately 500 feet thick in the Piedmont area but thins to about 100 feet near Coldwater Spring south of Anniston. Later, on the basis of detailed mapping and the discovery of significant fossils, Osborne and others (2000) depicted the Conasauga as 1,600 feet thick in the Anniston area. Shale and mudstone comprise a greater proportion of the Conasauga Formation in northern Calhoun County, and carbonate rocks increase in the unit southward in the county. Limestone and dolomite beds of the Conasauga locally are subject to dissolution along fractures and bedding planes, and the formation is commonly cherty as a result of weathering and near-surface geochemical processes. Aquifer intervals in the Conasauga Formation commonly display porous, cherty, "boxwork" texture, resulting from dissolution of carbonate minerals and precipitation of quartz along fractures and bedding planes (fig. 7).

In the Anniston Beach area, the lower part of the Conasauga Formation is predominantly shale and mudstone with thin carbonate rock beds, whereas the upper part of the formation contains significant dolomite and limestone intervals. The Conasauga is poorly exposed in the primary area of interest of the Anniston Beach groundwater assessment area. Conasauga chert and carbonate rocks crop out along Whites Gap Road Southeast (outcrop 55, SE¼NE¼ sec.25, T. 14 S., R. 8 E.), where they strike northeast

Figure 7.—Porous and permeable interval in Conasauga Formation near Big Spring at Jacksonville, Alabama. Development of "boxwork" texture resulting from precipitation of chert lining conduits for groundwater flow is evident along bedding planes and fractures (outcrop Cal J 17, NE¼ sec. 14, T. 14 S., R. 8 E.).

and dip approximately 24º southeast (plate 4). A possible Conasauga aquifer test well is illustrated in cross section B-B' (plates 4, 6), where the Conasauga likely dips beneath the Shady Dolomite of the Jacksonville fault block. Thickness of the Conasauga in this area is unknown but is likely relatively thin (fault bounded) as evidenced by the Whites Gap window. A small spring discharges from the Conasauga a short distance west of the above-mentioned outcrop along the hanging wall of the fault contact with the Athens Shale (plate 4).

Many wells have been completed in Conasauga aquifer intervals in Calhoun County, and several large springs discharge from the formation (Moser and DeJarnette, 1992). A well recently (2010) drilled by the City of Piedmont Utilities Board is interpreted to be completed in fractured and porous, cherty dolomite and limestone of the Conasauga aquifer. Springs that are sourced in the Conasauga Formation are important public water supplies for the cities of Piedmont and Jacksonville. Water from Conasauga aquifers is generally considered good quality, though average hardness of 164 mg/L in the county (Warman and Causey, 1962) is higher than desired. Concentrations of iron that exceed the recommended standard of 0.3 mg/L are problems in a few Conasauga wells and springs in the county (Moser and DeJarnette, 1992).

The Chilhowee Group in Alabama is comprised of the Weisner, Wilson Ridge, Nichols, and Cochran Formations (Mack, 1980). On Choccolocco Mountain the formations have not been mapped separately (Chilhowee Group undifferentiated), but east of the Indian Mountain thrust fault in eastern Calhoun County, the Weisner and Wilson Ridge Formations have been mapped as a unit, whereas the Cochran and Nichols Formations have been mapped separately (plate 2). Although the Nichols and Cochran Formations are not considered aquifers due to the relative abundance of shale, mudstone, and siltstone, the undifferentiated Weisner and Wilson Ridge Formations are sources of groundwater to wells and springs in Calhoun County (Moser and DeJarnette, 1992). At Wilson Ridge, Cherokee County, Alabama, Mack (1980) measured a combined thickness of about 1,100 feet for the Weisner and Wilson Ridge Formations. The Chilhowee Group undifferentiated as mapped in the Anniston Beach area is thought to consist primarily of the Weisner and Wilson Ridge Formations (Osborne and Szabo, 1984). Whereas sandstone, conglomerate, and quartzite are the predominant lithologies of the Weisner in

the Anniston Beach area (fig. 8), the Wilson Ridge Formation is primarily composed of siltstone, fine-grained sandstone, shale, and mudstone.

Figure 8.—Sandstone and thin shale beds of Cambrian Weisner Formation, outcrop 35, SE¼NE¼ sec. 30, T. 14 S., R. 9 E., Calhoun County, Alabama. Dip of beds is 14º - 16º east with cross bedding common. Intergranular porosity is evident along with minor bedding plane conduits and fractures.

Beds of the Chilhowee Group dip predominantly to the east and are largely untested as an aquifer in the Anniston Beach area (plate 4). The Weisner Formation is considered a prospective aquifer unit due to its general coarse-grained texture, considerable thickness, and presence of fractures and faults. Moreover, because the formation is generally a ridge-forming unit, groundwater that flows from high to low

elevations through the Weisner Formation can acquire considerable pressure head. Whether such groundwater remains confined in the Weisner Formation, making the unit or portions thereof an aquifer, or the water is forced into other formations, evaluation of the hydrogeology of the Anniston Beach assessment area should consider the Weisner Formation as an important component of the overall groundwater flow system. The finer grained rocks of the Wilson Ridge Formation likely act as confining beds and barriers to groundwater flow.

Fracture zones in the Chilhowee Group and karst features in the Shady Dolomite, Conasauga Formation, Knox Group, and Newala and Little Oak Limestones comprise the aquifer of Coldwater Spring near Anniston, the primary water supply for the city and surrounding communities (Kidd, 2001). Coldwater Spring is one of the largest springs in the state, with measured discharge ranging from about 15 million gallons per day (Mgal/d) to about 32 Mgal/d (Moser and DeJarnette, 1992) and has an average discharge of 31.2 Mgal/d (Kidd, 2001). Elsewhere in the Chilhowee Group in Calhoun County, there are few large springs and few wells.

In the Anniston Beach groundwater assessment area, a few Weisner aquifer springs and wells are located on the western slopes of Choccolocco Mountain. Measured flow rates from 25 gpm to 364 gpm have been reported from a Weisner spring in the NW¼NE¼ sec. 20, T. 14 S., R. 9 E., known as Whites Gap Spring (K50) (plate 4). Another small, unnamed spring that discharges from the Chilhowee Group is located in the SE¼ sec. 18, T. 14 S., R. 9 E., and two relatively shallow, private use wells, K21 (depth 80 feet) and K-Murray (depth 152 feet), are also on Choccolocco Mountain (plate 4).

A comparatively low average hardness of 39 mg/L measured in water samples from 16 wells and 16 springs in the Weisner and Wilson Ridge undifferentiated aquifer in Calhoun County (Moser and DeJarnette, 1992) is not altogether unexpected, owing to the lack of carbonate rocks in the formations. High concentrations of iron are known from a few wells constructed in the Chilhowee Group aquifers, though in most wells and springs in Calhoun County, iron concentrations are below 0.3 mg/L. A water sample collected in 1988 from well K21, mentioned above, contained 1.6 mg/L of iron (Moser and

DeJarnette, 1992), but water from Whites Gap Spring (K50) contained only 0.02 mg/L of total iron (Warman and Causey, 1962).

CONCLUSIONS

Evaluation of the complex geology of the Ohatchee and Anniston Beach groundwater assessment areas indicates several prospective areas and geologic units that warrant further evaluation for test well drilling. Interpretation of the hydrogeology of the areas and location of potential drill sites rely primarily on observations and measurements of surface geological outcrops and limited subsurface data from water wells and test holes.

In the Ohatchee area, prospective areas for test well drilling lie on the southeastern limbs of folds which are bounded on the northwest by thrust faults. Potentially porous and permeable chert and limestone beds of the Fort Payne-Tuscumbia interval dip to the southeast and are projected to lie beneath relatively impermeable strata of the Parkwood Formation and Floyd Shale undifferentiated. Favorable geologic structures, coupled with likely recharge of the potential aquifers along ridges formed in part from outcrop of Fort Payne Chert and Tuscumbia Limestone, indicate significant potential for aquifer development in the area. This concept has proven successful in locating significant groundwater supplies in the Fort Payne-Tuscumbia aquifer elsewhere in Alabama, including north of Jacksonville and north of the Ohatchee groundwater assessment area in northwestern Calhoun County. In addition, groundwater withdrawn from the Fort Payne-Tuscumbia aquifer is commonly good quality water and requires little treatment. With the available hydrogeologic data, however, predicting groundwater quantity and quality at any given location entails a significant degree of uncertainty.

Chert and dolomite of the Shady Dolomite and cherty limestone and dolomite of the Conasauga Formation are the primary potential aquifers in the Anniston Beach area. Shady Dolomite crops out in structurally complex areas within the Jacksonville thrust sheet such as in the Whites Gap area. Porous and permeable chert and carbonate rocks of poorly exposed beds of the Shady Dolomite, along with limited evidence of the unit's water-bearing characteristics from wells and springs, indicate significant potential for aquifer development. Jointed, and in some localities, silicified intervals of dolomite and limestone in the Conasauga Formation are proven aquifers in Calhoun County, and are

likely present in the Anniston Beach area west of the Jacksonville fault and in the footwall beneath the Shady Dolomite. Coarse-grained sandstone and fractured quartzite beds of the Weisner Formation of the Chilhowee Group constitute additional potential aquifers in the eastern part of the area where they have been folded and faulted and now form Choccolocco Mountain. There is a significant risk per test well of finding suitable groundwater supplies in the Anniston Beach area due to limited data to delineate the complex geology in the area and sparse data regarding the hydrogeology of potential aquifer units, the consequences of very limited well data and generally poor exposures of the geological formations. The potential for the availability of large quantities of groundwater in the area is high, however, when consideration is given to the presence of extensively folded, fractured, and weathered sedimentary rocks, large recharge areas, and the likelihood of groundwater flow resulting from high potential energy from considerable topographic relief.

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