Chapter 5 Groundwater

5.1. Overview of State Groundwater Protection Programs

Many of the elements of Alabama's groundwater programs listed in Table 5-1 are managed by subdivisions within the Alabama Department of Environmental Management (ADEM), including the Land, Field Operations, and Water Divisions. The Groundwater Branch in the Water Division provides the hydrogeological support for these programs. Other programs related to groundwater management and protections are managed by other state and federal agencies. The on-site sewage program is managed by the Alabama Department of Public Health and the Class II Underground Injection Control Program is managed by the State of Alabama Oil and Gas Board. Groundwater quantity issues are addressed by the Alabama Department of Economic and Community Affairs Office of Water Resources. Other groundwater monitoring and regulatory programs are managed by the Geological Survey of Alabama and the Alabama Surface Mining Commission. The U.S. Environmental Protection Agency (EPA) provides oversight on all federally funded and delegated groundwater programs.

5.2 Coordination of State Groundwater Programs

The State of Alabama recognizes that there is a need to coordinate management of groundwater programs and as a result set up the Groundwater Programs Advisory Committee (GWPAC) in 1994 to aid in completing the requirements of EPA's Core Comprehensive State Groundwater Protection Program (CSGWPP). The ADEM Groundwater Branch and the GWPAC continue to work toward a fully integrated CSGWPP. This work includes coordinating groundwater regulatory programs and addressing program refinements identified during the CSGWPP core review process.

Meetings of the GWPAC have not been held since 2004; however one will be scheduled for 2008. This committee includes representatives of other state and federal agencies, consultants, water system representatives, and others who work in groundwater related fields. The meetings are used to provide groundwater program information, receive feedback and coordinate groundwater projects. A subcommittee of agencies involved in area wide groundwater monitoring programs was formed in late 1997. This subcommittee is working to maximize resources to provide the best monitoring coverage of the state.

5.3 Significant State Groundwater Program Developments

Table 5-1 shows a Summary of State Groundwater Protection Programs. The following items summarize some of the recent groundwater developments that are underway in Alabama:

Table 5-1 Summary of State Ground Water Protection Programs

Programs or Activities	Check	Implementation Status	Responsible State Agency (1)
Active Sara Title III Program	X	Fully established	EPA/ADEM/FOD/EMA
Ambient ground water level monitoring program	X	Fully established	GSA
Aquifer vulnerability assessment	X	Fully established Being updated	ADEM/GWB
Aquifer mapping	X	Fully established	GSA
Aquifer characterization	X	Fully established	GSA
Brownfield Redevelopment & Voluntary Cleanup Program Regulations	X	Fully established	ADEM/HWB
Dry Cleaner Trust Fund Program	X	Fully Established	ADEM/HWB
EPA-Endorsed Core Comprehensive State Groundwater Protection Program	X	Fully established	ADEM/GWB
Ground water discharge permits	X	Established in UIC Regulations	ADEM/UIC
Ground water Best Management Practices			
Ground water Legislation			
Ground water classification	X	Established in UIC Reg Definition	ADEM/UIC
Ground water quality standards			
Ground Water Use	X	Fully established	ADECA/WRD
Interagency coordination for ground water protection initiatives	X	Continuing efforts	ADEM/GWB
Non-point source controls	X	Ongoing education	ADEM/FOD
NPDES Permits for Land Application Sites	X	Fully established	ADEM/MUN/IND
Pesticide State Management Plan	X	Under Review	ADAI
Pollution Prevention Program	X	Fully established	ADEM/OEO
Resource Conservation and Recovery Act (RCRA) Primacy	X	Fully established	ADEM/HWB
Source Water Assessment Program	X	Fully established	ADEM/WSB
State Ground Water Program	X	Statute Based program	ADEM/GWB
State Superfund	X	Fully established	ADEM/LD
State RCRA Program incorporating more stringent requirements than RCRA Primacy	X	Fully established	ADEM/HWB
State Septic System Regulations	X	Fully established	ADPH
Subtitle D Solid Waste Program	X	Fully established	ADEM/SWB
Underground Storage Tank Installation Requirements	X	Fully established	ADEM/GWB
Underground Storage Tank Remediation Fund	X	Fully established	ADEM/GWB
Underground Storage Tank Registration Program	X	Fully established	ADEM/GWB
Underground Injection Control Program	X	Fully established	ADEM/GWB/OGB
Vulnerability Assessment for Drinking Water/Wellhead Protection	X	Fully established	ADEM/GWB
Well Abandonment Regulations	X	WSB Regs & Guidelines	ADEM/WSB/GWB
Wellhead Protection Program (EPA-approved)	X	Fully established	ADEM/WSB
Well Installation Regulations	X	Fully established	ADEM/WSB

(1) ADEM = Alabama Department of Environmental Management, FOD = Field Operations Division, GWB = Ground Water Branch, WSB = Water Supply Branch, LD = Land Division, HWB = Hazardous Waste Branch, OEO = Office of Education and Outreach, SWB = Solid Waste Branch, MUN = Municipal Section, IND = Industrial Section, GSA = Geological Survey of Alabama, ADPH = Alabama Department of Economic and Community Affairs, Office of Water Resources, EPA = Environmental Protection Agency, EMA = Emergency Management Agency

- Implementation of the Source Water Assessment Program within the ADEM Water Supply Branch regulations.
- Implementation of guidance for Risk Based Corrective Action (RBCA) with respect to releases from structures and/or facility's other than Underground Storage Tanks. This guidance was also revised in 2007.
- Implementation of revised guidance for Risk Based Corrective Action (RBCA) with respect to releases of petroleum fuels from Underground Storage Tanks.
- Initiation of transferring all documentation from the files to a FileNet Program allowing these files to be accessible to the public.
- The deadline for UST upgrades with spill, overfill and corrosion protection was December 22, 1998. Tanks should have been upgraded, replaced with a new system or permanently closed by this date. The compliance rate with these regulations is increasing with continuing enforcement of these requirements.
- A contract was signed with the Geological Survey of Alabama, in September 1997, to revise a series of 13 Aquifer Vulnerability Reports. These reports are being revised by updating geologic names and terms to match the most recent state mapping, revising vulnerability maps from 1:250,000 scale to 1:100,000 scale, revising the vulnerability rating methods, update information on public supply wells and to include text, maps and figures in an electronic CDROM format and GIS Interactive maps. Area 13 (Baldwin and Mobile Counties), Area 10 (Washington, Choctaw and Clarke Counties), Area 5 (Coosa, Cleburne, Clay, Randolph, Tallapoosa, Chambers and Lee Counties), Area 11 (Covington, Escambia, Monroe, Clarke, Butler and Crenshaw Counties), and Area 4 (Jefferson, St. Clair, Calhoun, Talladega and Shelby Counties) were completed prior to 2006. In 2006, Area 2 (Blount, Cherokee, DeKalb, Etowah, Jackson and Marshall Counties) and Area 7 (Bibb, Dallas, Hale, Perry and Wilcox Counties) has completed the review process and should be available in the near future.
- Regulations have been developed by ADEM and implemented to deal with Concentrated Animal Feeding Operations (CAFOS). Hydrogeologic site evaluations and groundwater monitoring requirements have been included in the regulations as part of siting and operation requirements for CAFO lagoons and land application sites.
- The U.S. Geological Survey has completed the National Water Quality Assessment that includes significant parts of Alabama's Mobile River and Lower Tennessee River Basins.
- The Alabama Department of Public Health has completed its on-site sewage regulations that went into effect on March 9, 2006.

5.4 Summary of Groundwater Contamination Sources

5.4.1 Reporting Area

Previous 305B reports have documented the Physiographic Provinces of the Highland Rim, Cumberland Plateau, Coastal Plan, and Alabama Valley and Ridge. The Alabama Department of Environmental Management has selected the Piedmont Upland physiographic section in Alabama for evaluation during the 2008 reporting period. This completes the total physiographic and geographic coverage of Alabama. The only aquifer in the reporting area is limited to the water-bearing igneous and metamorphic rocks. None of the igneous and metamorphic rocks in the study area are considered a major aquifer because of small yields.

Counties included in the reporting area in whole or part are Calhoun, Chambers, Chilton, Clay, Cleburne, Coosa, Elmore, Lee, Randolph, Talladega and Tallapoosa. Data contained in Table 5-2 and 5-3 were queried and retrieved by county. Some overlap of data from physiographic provinces highlighted in previous 305B report is shown for the above mentioned counties that do not lie wholly within the report's selected physiographic section.

5.4.2 Data Review and Compilation

Hydrogeologists from the ADEM Groundwater Branch are assigned to the major groundwater regulatory programs as part of the Comprehensive State Groundwater Protection Program. The information contained in Table 5-2, Groundwater Contamination Summary, was researched from ADEM's electronic databases and prepared by the hydrogeologists assigned to each of the programs listed under the Source type column.

5.4.3 Superfund CERCLIS and DOD Sites

ADEM's Land Division works with EPA and the Department of Defense to manage these types of sites. There are no Department of Defense facilities located within the reporting area. There is one facility identified within the reporting area listed on the National Priority List (NPL). Compounds such as dissolved solids, metals and nitroaromatics are associated with the NPL site are present and make remediation problematic. The CERCLIS sites are sites where State and Federal Funds have been used to conduct preliminary and secondary assessments by ADEM and EPA. There are no CERCLIS sites within the reporting area

5.4.4 Underground Storage Tank Program

The largest category of sites listed in Table 5-2 is Underground Storage Tanks (UST). These sites are managed by the ADEM Groundwater Branch. Assessment and clean up of eligible sites are funded through the State UST Trust Fund. Many of the cleanups listed include free product, source and soil removals. Active groundwater remediation systems are also included. Most of these cleanups involve gasoline releases, but also includes releases of diesel and fuel oils. These petroleum fuels include soluble compounds such as Benzene, Ethyl Benzene, Toluene, and Xylene (BTEX), Polynuclear Aromatic Hydrocarbons (PAH's), Methyl Tertiary Butyl Ether (MTBE), and lead that affects groundwater quality. Monitoring for MTBE at UST sites has been required since 1996. A monitoring effort from all public water supplies for MTBE was conducted in 2000 and continues to be under the Water Quality Regulations.

5.4.5 Hazardous Waste Management Program (RCRA)

There are eleven (11) hazardous waste sites managed under the Resource Conservation and Recovery Act (RCRA) identified in the study area. The ADEM Land Division's Hazardous Waste Branch manages this site. This site included extensive assessment, permitting and reporting requirements. Compounds such as chlorinated volatile organic compounds and BTEX associated with hazardous waste generated by the facility are present in many instances and have properties that make remediation problematic.

Table 5-2 Ground Water Contamination Summary

Source Type	Number of Sites	Number of sites that are listed and/or have confirmed releases	Number with confirmed ground water contamination	Contaminants	Number of Site Investigations (optional)	Number of sites that have been stabilized or have had the source removed	Number of sites with corrective action plans (optional)	Number of sites with active remediation (optional)	Number of sites with cleanup completed (optional)
NPL	1	1	1	Dissolved Solids, metals, Nitroaromatics	2				
CERCLIS (non-NPL)									
DOD/DOE									
Brownsfield & VCP Sites	6	6	6	VOCs, Metals	2	3	1		2
Drycleaning Trust Fund	2	2	2	Chorinated VOCs		2			
UST	245	245	245	BTEX, MTBE, PAHs					
RCRA Corrective Action	11	11	11	Chorinated VOCs, Petroleum Hydrocarbons (BTEX, MTBE, PAHs)	12	10	11	10	
Underground Injection	30	0	0						
State Sites	10	9	9	VOCs, Fluoride	9	7	2	1	1
Solid Waste	3	3	3	Metals					
Totals	308	277	277		25	22	14	11	3

Hydrogeologic Setting: Piedmont Upland Physiographic Section (Northern Piedmont Upland and Southern Piedmont Upland)Map Available: See Figure 5-1 Date Reporting Period: 2006-2007

Table 5-3 Basic Tables by Category, Totals, Overall by categories, by County - Alabama, 2005

	Water withdrawals (Mgal/d)															
	Public Supply		Commer-cial	Domestic	Industrial		Thermoelectric		Mining		Livestock	Aquaculture		Irrigation	Total	
County	Fresh	Saline	Fresh	Fresh	Fresh	Saline	Fresh	Saline	Fresh	Saline	Fresh	Fresh	Saline	Fresh	Fresh	Saline
Calhoun	19.76	0	0	0.83	1.1	0	0	0	0.19	0	0.12	0	0	0	22	0
Chambers	0	0	0	0.58	0	0	0	0	0	0	0.08	0	0	0.16	0.82	0
Chilton	2.55	0	0	0.58	0	0	0	0	0.32	0	0.09	0	0	0.56	4.1	0
Clay	0	0	0	0.39	0	0	0	0	0	0	0.14	0	0	0	0.53	0
Cleburne	0	0	0	0.72	0.71	0	0	0	0	0	0.17	0	0	0	1.6	0
Coosa	0	0	0	0.28	0	0	0	0	0.11	0	0.03	0	0	1.92	2.34	0
Elmore	2.17	0	0	0.38	0	0	0	0	0.21	0	0.1	0	0	0.29	3.15	0
Lee	0.77	0	0	0.7	0	0	0	0	0.26	0	0.04	0.05	0	0.69	2.51	0
Randolph	0	0	0	0.53	0	0	0	0	0	0	0.23	0	0	1.79	2.55	0
Talladega	6.36	0	0	1.26	1.26	0	0	0	0.75	0	0.13	0	0	0.17	9.93	0
Tallapoosa	0	0	0	0.28	0	0	0	0	0	0	0.05	0.03	0	0.05	0.41	0
Total:	31.61	0	0	6.53	3.07	0	0	0	1.84	0	1.18	0.08	0	5.63	49.94	0

Source: Tom Littlepage, Alabama Department of Economic & Community Affairs, 2008

5.4.6 Alabama Brownfield & Voluntary Cleanup Program

The ADEM's Land Division administers the Brownfield Redevelopment and Voluntary Cleanup Program pursuant to the Alabama Land Recycling and Redevelopment Act, Code of Alabama 1975, § 22-30E-4 (ADEM Admin. Code Rule 335-15-x-.xx). The program provides a mechanism for the implementation of a cleanup program that encourages applicants to voluntarily assess, remediate and reuse rural and urban areas with actual or perceived contamination. There are six sites managed under the Alabama Brownfield and Voluntary Cleanup Program within the study area. Compounds such as Volatile Organic Compounds (VOCs) and metals are associated with these sites.

5.4.7 Alabama Drycleaning Trust Fund Program

The ADEM's Land Division administers the Alabama Drycleaning Environmental Response Trust Fund (DERTF) Program pursuant to the Alabama Drycleaning Environmental response Trust Fund Act, Code of Alabama, 1975, § 22-30D-1 et. seq (ADEM Admin. Code Rule 335-16-x-.xx). The program established: (1) performance standards for facilities brought into use after May 24, 2003, (2) a schedule for the retrofit of facilities that were in existence prior to May 24, 2000, (3) criteria required for reporting a suspected release or site discovery, and (4) requirements for initial investigation, assessment, and remediation of contamination. There are two facilities managed under the Alabama Drycleaning Trust Fund in the study area. The compounds associated with these sites are volatile organic compounds associated with chlorinated solvents.

5.4.8 Underground Injection Control Program

The Underground Injection Control (UIC) program is managed by the ADEM Groundwater Branch. Each Class V UIC facility in the State is required to operate under an individual performance based discharge permit issued by the UIC Program. The UIC program reviews permit applications; issues individual performance based discharge permits for all Class V facilities; and inspects and tracks Class V facilities for compliance. In this reporting area, permits are issued to Class V facilities for the subsurface injection of treated wastewater from various industrial and commercial activities, and for the injection of materials intended to aid remediation at existing contamination sites. Some types of activities that are permitted and regulated by the UIC Program include discharges from clustered on-site sewage WWTPs, coal washing operations at coal mines, poultry processors, Laundromats, truck and car washes, and other industrial or commercial activities. State Underground Injection Control regulations prohibit the discharge from a class V injection well from causing an exceedance of MCLs in receiving groundwater. Class I and Class IV UIC wells are prohibited in the State of Alabama and Class II injection wells are managed by the State of Alabama Oil and Gas Board. One Class III operation is located in the State, outside of this reporting area.

5.4.9 State Groundwater Program

State Groundwater Program sites are those that are not regulated by established programs such as RCRA, UST, UIC, CERCLA, Drycleaner Trust Fund Program or the Brownfield &

Voluntary Cleanup Program. Sites such as releases from bulk petroleum storage facilities, pipelines, and otherwise unregulated chemical spills are assessed and remediated using the authority of the Alabama Water Pollution Control Act (AWPCA). Releases from these sites are in many cases reported by the responsible party through company initiated environmental audits or are discovered as a result of real-estate assessments during property transactions. Other groundwater incidents are discovered and reported to the Department by citizens or discovered through inspections. Assessment and cleanup of these sites is required to be conducted by the responsible party. Many types of contaminant releases have been addressed by this program. There are 10 facilities managed under the State Groundwater Program.

5.4.10 Solid Waste Program

There are three (3) solid waste facilities managed under the Solid Waste Program within the study area. The ADEM Land Division's Solid Waste Branch manages these sites, and includes extensive assessment, permitting and reporting requirements. Analytical data associated with these sites documents that metals are the constituents of concern at these sites

5.4.11 Ambient Monitoring Network

Aquifer monitoring data listed in Table 5-3 was evaluated for counties in the study area. The monitoring data were obtained from the Geological Survey of Alabama (GSA) and from ADEM's computer databases. The GSA maintains an ambient groundwater level monitoring network throughout the state. Four hundred ninety (400) sites are monitored in the fall for water levels. Fifty of these water level sites are springs. Twenty five (25) sites are located within the Piedmont Physiographic Section of Alabama. Twenty four (24) of these sites are wells, one (1) is a spring where discharge measurements are made.

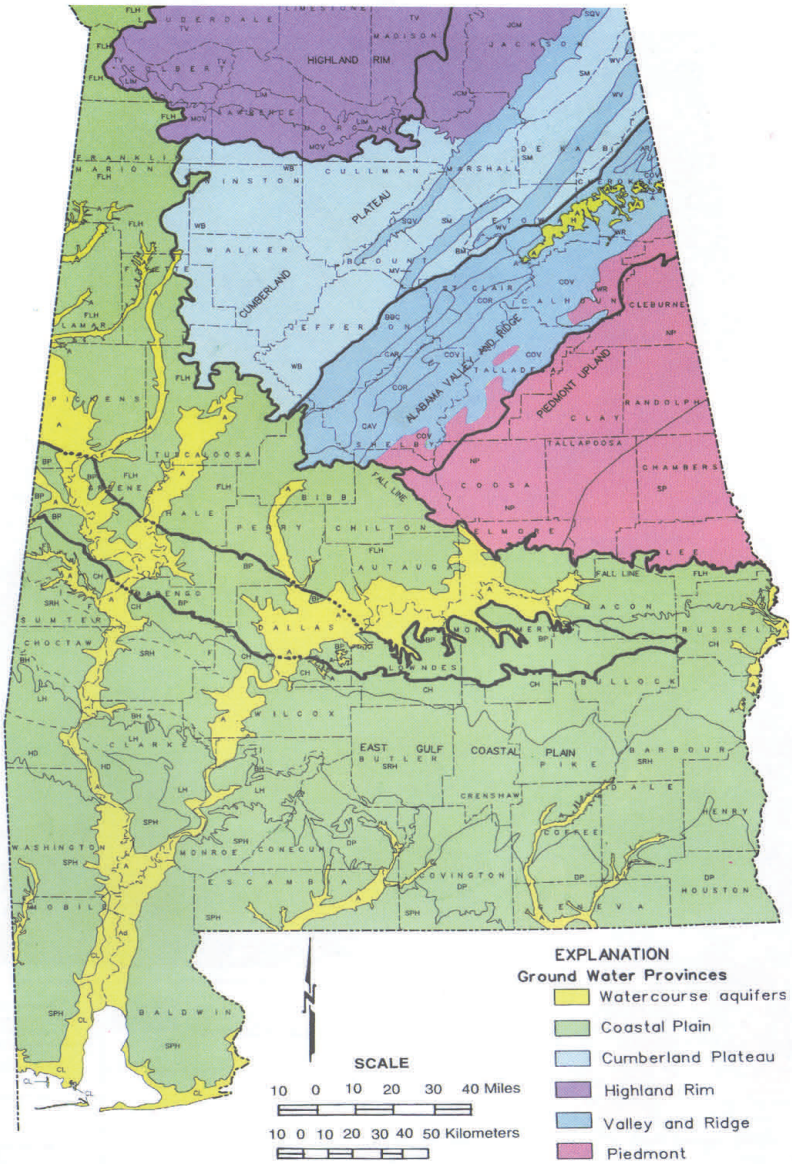
5.5 Summary of Groundwater Quality

5.5.1 Physiography

The physiographic section in this 305(b) Report is the Piedmont Upland. The Piedmont Upland Section is divided into two districts (the Northern Piedmont Upland district and the Southern Piedmont Upland district). Eleven counties in Alabama contain one or both of these districts. The counties are Calhoun, Chambers, Chilton, Clay, Cleburne, Coosa, Elmore, Lee, Randolph, Talladega ad Tallapoosa (see Figure 5-1).

Northern Piedmont Upland District
The Northern Piedmont Upland district is characterized by well-dissected upland developed on metamorphosed sedimentary and igneous rocks. The land surface ranges from about 1,100 feet above sea level in north Cleburne County to about 500 feet above sea level in the south near Mitchell Lake. Talladega Mountain forms a prominent northeastward-trending ridge that includes Cheaha Mountain (2,407 feet above sea level), the highest point in Alabama. All of Clay County, most of Cleburne, Randolph, and Coosa Counties, most of Tallapoosa County west of the Tallapoosa River, and the northwestern corner of Chambers County are in the Northern Piedmont Upland district. Surface drainage in the district generally is south to the Tallapoosa River and southwest to the Coosa River.

Figure 5-1 Alabama Ground Water Provinces



Ground water provinces are regions characterized by certain kinds of aquifers.

Figure 5-2 Generalized Geology of the Piedmont in Alabama

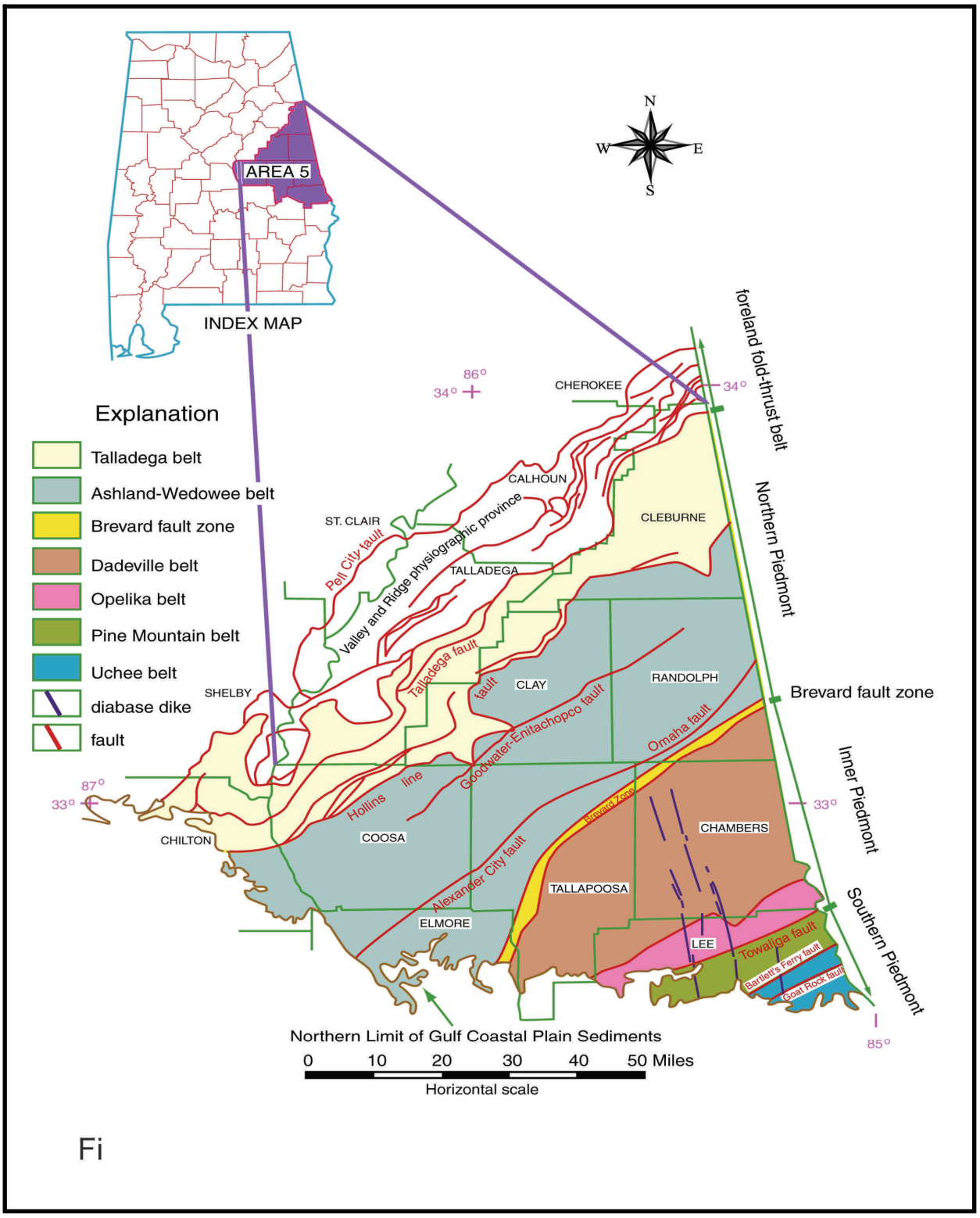


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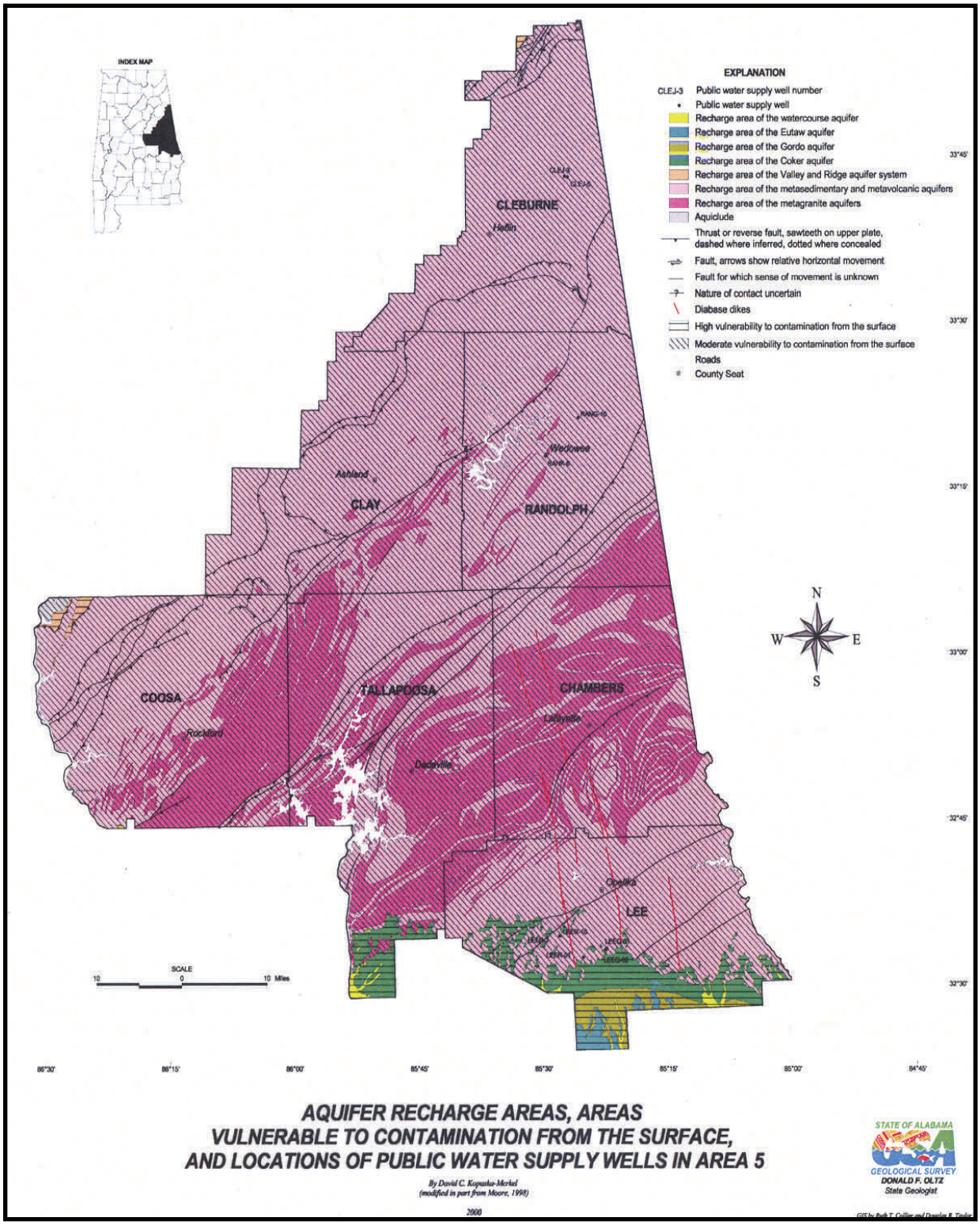
Figure 5-3 Aquifers in Area 5



Southern Piedmont Upland District
The Southern Piedmont Upland district is characterized by a rolling topography indicative of a dissected peneplain of advanced erosional maturity. The land surface of the district ranges in altitude from about 500 to 900 feet above sea level and averages about 800 feet above sea level. Most of Chambers and Lee Counties, the southeastern part of Randolph County, and most of Tallapoosa County east of the Tallapoosa River are in this district. Surface drainage in the district generally is southwestward to the Tallapoosa River and southeastward to the Chattahoochee River.

5.5.2 Geology

The Piedmont is underlain by igneous and metamorphic rocks, whose age, structure, and stratigraphic relations are not well understood. The Piedmont region is subdivided into three major tectonic belts: the Northern, Inner, and Southern Piedmonts. Each of these can be subdivided into two belts. The Northern Piedmont contains the Talladega and Ashland-Wedowee belts, the Inner Piedmont contains the Dadeville and Opelika belts, and the Southern Piedmont contains the Pine Mountain and Uchee belts (Figure 5-2). Each tectonic belt is distinct in terms of rock type associations and metamorphic grade and is separated from the others by regional synmetamorphic to postmetamorphic fault zones. The rocks in the Piedmont are predominantly clastic sediments that have been altered by several stages of regional metamorphism to slate, schist, phyllite, quartzite, gneiss, and marble. In some areas, these rocks have been intruded by mafic and felsic igneous rocks.
Several major faults and lines of metamorphic discontinuity cut the metamorphic units. The Talladega fault separates the Piedmont from the Valley and Ridge Province to the northwest. The Hollins line fault, Alexander City-Omaha fault system, and Goodwater-Enitachopco fault system, are major faults or metamorphic discontinuities in the northern part of the Piedmont. These structures are interpreted as major structural discontinuities resulting from the movement of metamorphic rock of one grade over that of another grade. The Brevard fault zone, Towaliga Fault zone, and Goat Rock fault zone are major structural features in the southern half of the study area. The Brevard and Goat Rock faults dip to the southeast and the Towaliga fault zone dips to the northwest.
Bedrock is exposed at the surface in some areas, but most of the Piedmont is covered by regolith. regolith, also known as saprolite, is is decomposed untransported material that has weathered from the Bedrock extends to depths of 50 to 100 Feet in many parts of the Piedmont.

Talladega Belt
The Talladega belt is underlain by low-rank metamorphosed sedimentary rocks that form a continuous northeast-southwest-oriented belt 8 to 22 miles wide. The Talladega belt consists predominantly of slate and phyllite with some marble, dolomite, and quartzite of the Hillabee Greenstone, Talladega Group, Heflin Phyllite, Sylacauga Marble Group, and Kahatchee Mountain Group. Foliations in the rocks generally dip southeastward at angles of 30 to 60 degrees.

Ashland-Wedowee Belt
The Ashland-Wedowee belt is underlain by high-grade metasedimentary rocks that include the Higgins Ferry, Poe Bridge Mountain, Hatchet Creek, Mad Indian, Wedowee, and Emuckfaw

Groups. Metavolcanic rocks include amphibolite and ultramafic rocks. Foliations of the metasedimentary rocks generally dip southeastward from 30 to 90 degrees.

Metagranite comprises about one-third of the Ashland-Wedowee belt. The Elkahatchee Quartz Diorite Gneiss, the largest granitic mass in Alabama, is 6 to 10 miles wide and 40 miles long. Associated granitic intrusions occur along strike into Clay and Randolph Counties. Granitic rocks consist of the minerals microcline, orthoclase, plagioclase, quartz, biotite and muscovite. A belt of metagranite (the Kowaliga Gneiss) crops out about 5 miles southeast of the Elkahatchee Quartz Diorite Gneiss.

Dadeville Belt
The Dadeville Belt consists primarily of micaceous gneiss and schist and some hornblende gneiss. The micaceous gneiss contains scattered feldspathic porphyroblasts and feldspathic bands. The Dadeville Belt contains scattered metagranite units, and a series of ultramafic rocks have intruded the micaceous and hornblende gneisses in some areas.

Opelika Belt
The Opelika belt is located immediately to the southeast of the Dadeville belt and is about 5 to 6 miles wide. The Opelika belt consists primarily of biotite gneiss and augen gneiss, and includes some granite gneiss and migmatites in southeastern Chambers County. Diabase dikes cut across the belt about 2.5 miles northeast of Auburn.

Pine Mountain Belt
The rocks of the Pine Mountain belt crop out southeast of the Opelika belt in Lee County. Foliation planes of the metamorphic rocks dip southeastward, and consist predominantly of garnetiferous-biotite schist and quartz-muscovite schist with some granite gneiss, biotite augen gneiss, quartzites, and dolomite marble.

Uchee Belt
The rocks of the Uchee belt crop out in Lee County southeast of the Pine Mountain belt. These rocks are predominantly biotite and hornblende gneiss and granite gneiss. Mylonitization is common in the granitic gneiss and may have been caused by movement on the Goat Rock fault.

5.5.3 Hydrogeology of Major Aquifers

The igneous and metamorphic rocks of the Piedmont in the study area typically yield small quantities of water. These aquifers are unconfined heterogeneous two-component systems consisting of fractured crystalline bedrock and overlying regolith. Primary porosity in the metamorphic rocks generally is less than 1 percent; secondary fracture porosity in bedrock locally greatly exceeds primary bedrock porosity. Regolith porosity values may approach 50 percent. The basal portions of regolith zones generally are the most productive aquifers. However, these productive aquifers generally are separated from one another by surface drainage divides, and adjacent basins tend not to be hydraulically connected. The Piedmont is divided into four aquifers and aquifer systems: the metagranite aquifers, the metasedimentary and metavolcanic aquifers, and the mafic igneous aquifers.

Metagranite Aquifers

The metagranite aquifers include a heterogeneous group of granitic and metagranitic rocks in the southern part of the Northern Piedmont (Ashland-Wedowee belt) and the Inner Piedmont (Dadeville belt). The metagranite aquifers occupy nearly a quarter of the area of the Piedmont, including high-yield zones in the vicinity of Rockford, near Dadeville, and in northern Elmore County. The "felsic intrusive" and "gneiss" components of the metagranite aquifers are characterized by relatively low well yields (median yields of 6 and 7 gpm, respectively). The "metamorphic mafic-ultramafic" hydrogeologic unit has a relatively high median yield of 15 gpm. Wells completed in metagranite of the Elkahatchee Quartz Diorite Gneiss and associated rocks of the Ashland-Wedowee belt range from less than 100 to more than 500 feet in depth. The Metagranite aquifers in the Ashland-Wedowee belt are tapped by many wells for industrial use and at recreation sites, schools, churches, and camps, but are not used as municipal water supplies owning to small yields.

The average thickness of regolith overlying metagranite aquifers of the Dadeville belt is about 50 feet. Wells developed in saturated regolith may yield as much as 50 gpm but generally yield less than 10 gpm. Well depths range from 35 to 500 feet. The Dadeville belt is tapped by many wells for industrial use and at recreation sites, schools, churches, and camps, but is not used as a municipal water supply owing to small yields.

Metasedimentary and Metavolcanic Aquifers

The metasedimentary and metavolcanic aquifers occupy about three-quarts of the Piedmont and are the most geologically diverse of the three Piedmont aquifer groups. Metasedimentary and Metavolcanic aquifers are found in all six Piedmont tectonic belts. The metasedimentary and metavolcanic aquifers classified by Guthrie and others (1994) as "phyllite+quartzite+slate," "schist," "metagraywache," "dolomite marble," and "mylonite" hydrogeologic units. High-yield zones are more common in the Southern Piedmont (southeast of the Brevard Zone) than in the Northern Piedmont, but do not correspond to particular rock types or hydrogeologic units. Instead, high-yield zones develop in regional fracture systems that crosscut hydrogeologic unit boundaries and even metamorphic belts.

Median well yields of different kinds of metasedimentary and metavolcanic aquifers range from 9 gpm for mylonite to 10 gpm for phyllite+quartzite+slate and dolomite marble. Phyllite+quartzite+slate yield significantly more water than do gneiss or felsic intrusive rocks of the metagranite aquifers. Public-supply wells completed in the Talladega belt range from 100 to 540 feet in depth and yield less than 30 gpm. Wells in the Hillabee Greenstone have been used as a public source of water in the past, but are no longer used for that purpose because of small yields (generally less than 10 gpm). The metasedimentary and Metavolcanic in the Ashland –Wedowee belt is tapped by many wells for industrial use and at recreation sites, schools, churches, and camps, but is not used for municipal water supply owing to small yields. Rocks in the Opelika belt do not yield sufficient quantities for water for public supplies, but do supply water to some domestic wells.

Wells in the Pine Mountain belt generally yield less than 25 gpm each, but one well yielded more than 2,000 gpm. This well may penetrate either solution cavities in dolomite or large fractures in quartzite. The towns of Auburn, Smiths, and Beauregard have wells completed in rocks of the Pine Mountain belt. Beauregard maintains three wells for water supply. A spring that discharges from carbonate rocks of the Pine Mountain belt was used at one time as an emergency water supply by Opelika. Auburn and Opelika now uses surface water as their

principal water supply. No public-supply wells tap rocks of the Uchee belt.

Mafic Igneous Aquifers

The mafic igneous aquifers consist of intrusive dikes composed of Diabase that trend north to north-northwest and crop out in Lee and Chambers Counties. Because the mafic igneous aquifers are extremely restricted in aerial extent, they are only locally important sources of groundwater. However, the bedrock of the mafic igneous aquifers weathers readily, hence relatively high-yield wells can be completed locally in these aquifers. No public-supply wells tap the mafic igneous aquifers

5.5.4 General Statement of Groundwater Quality and Vulnerability

The source of recharge to aquifers is precipitation, mostly rain supplemented by occasional snow. Average annual precipitation for the Piedmont area is about 52 inches per year, but a large part runs off during and directly after rainstorms. Chandler (1076) estimated recharge to aquifers in the study area to be about 6 inches per year. Because some aquifer recharge areas are narrow, precipitation falling on the recharge area of one aquifer may contribute indirectly to recharge of adjacent aquifers.

Aquifer vulnerability is a difficult concept to evaluate in the Piedmont area owing to the complexity and variability of the geology and aquifers involved. Piedmont aquifers are moderately vulnerable to contaminants from both surface and subsurface sources in their outcrop areas. Piedmont aquifers are unconfined, which means that they are readily accessible to contaminants introduced at or near the land surface, even where the aquifers are buried by soil or unsaturated regolith.

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