Prepared in cooperation with the
MISSISSIPPI DEPARTMENT OF ENVIRONMENTAL QUALITY
OFFICE OF POLLUTION CONTROL
MISSISSIPPI DEPARTMENT OF AGRICULTURE AND COMMERCE

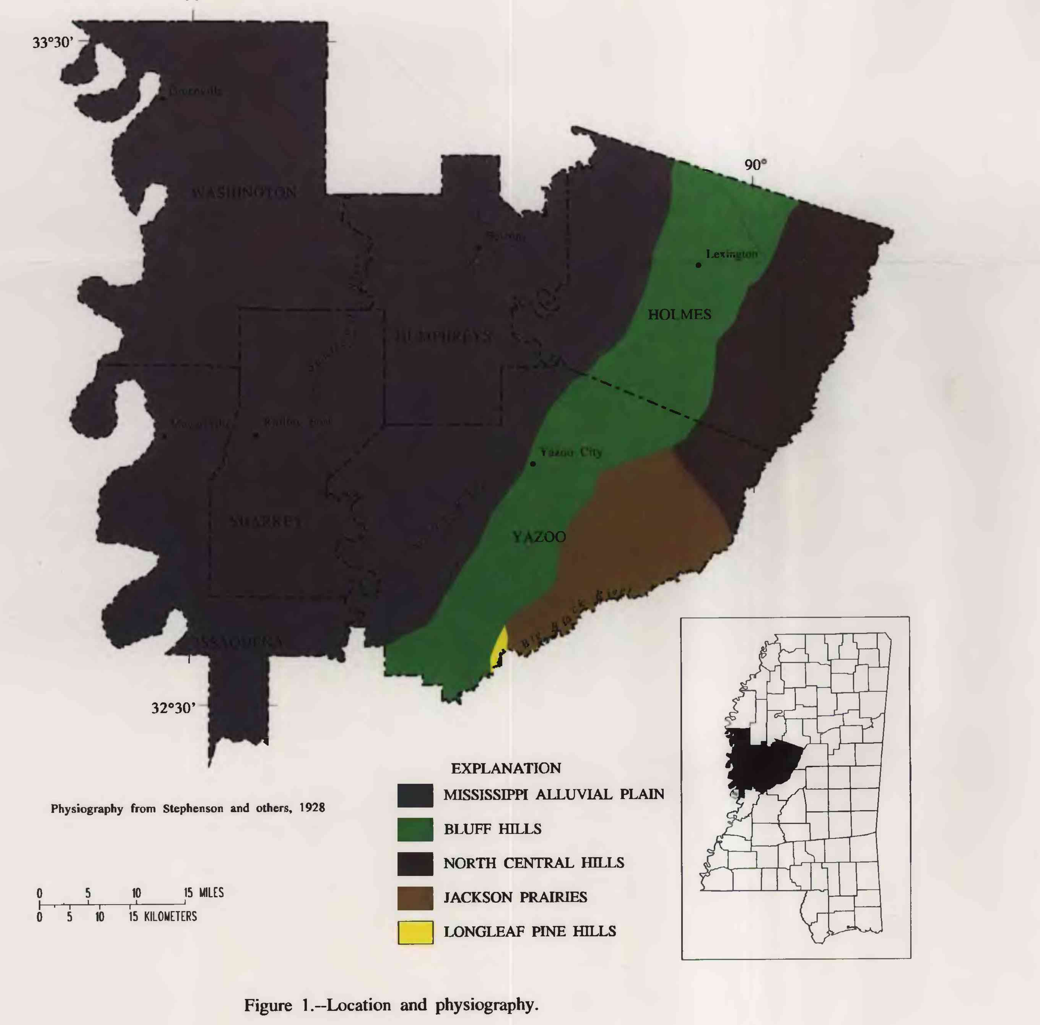

Figure 1.--Location and physiography.

Base from U. S. Geological Survey digital data, 1:100,000, 1982, 1984
Lambert Conformal Conic Projection
Standard parallels 33° and 45°, central meridian 90°00'

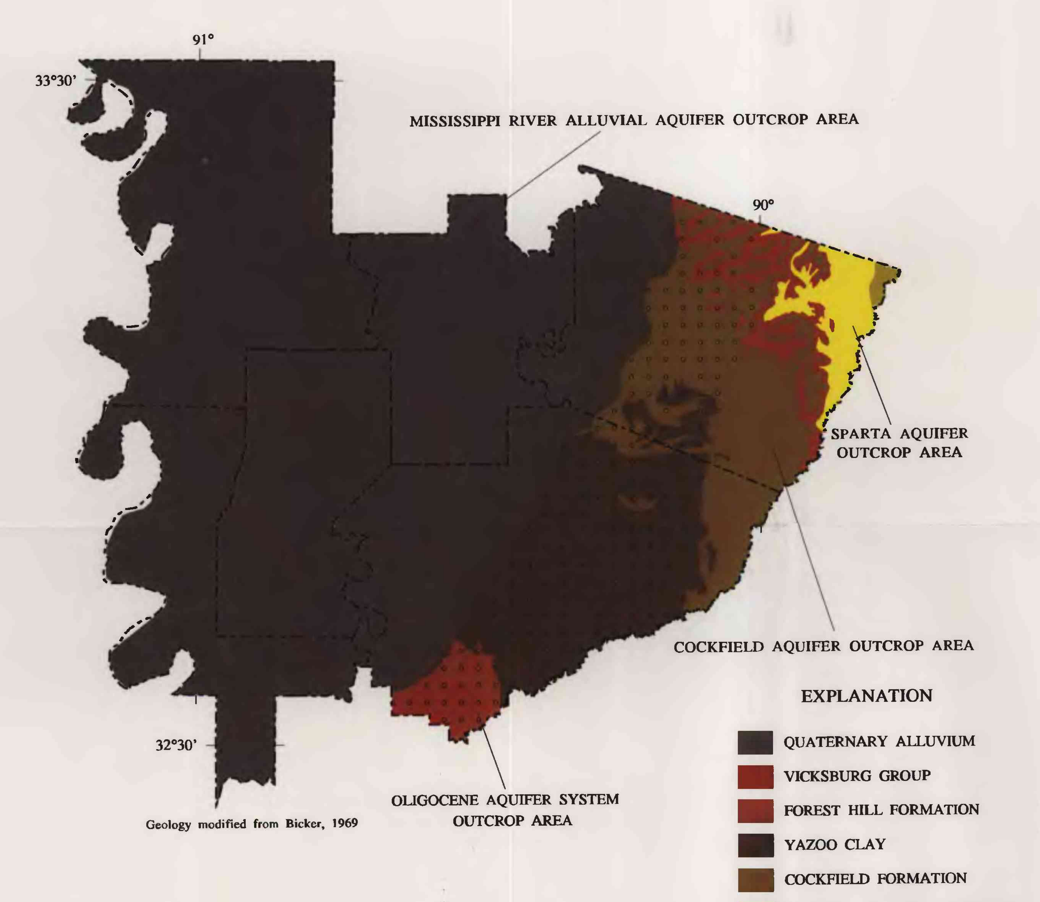

Figure 2.--Geology and aquifer outcrop areas.

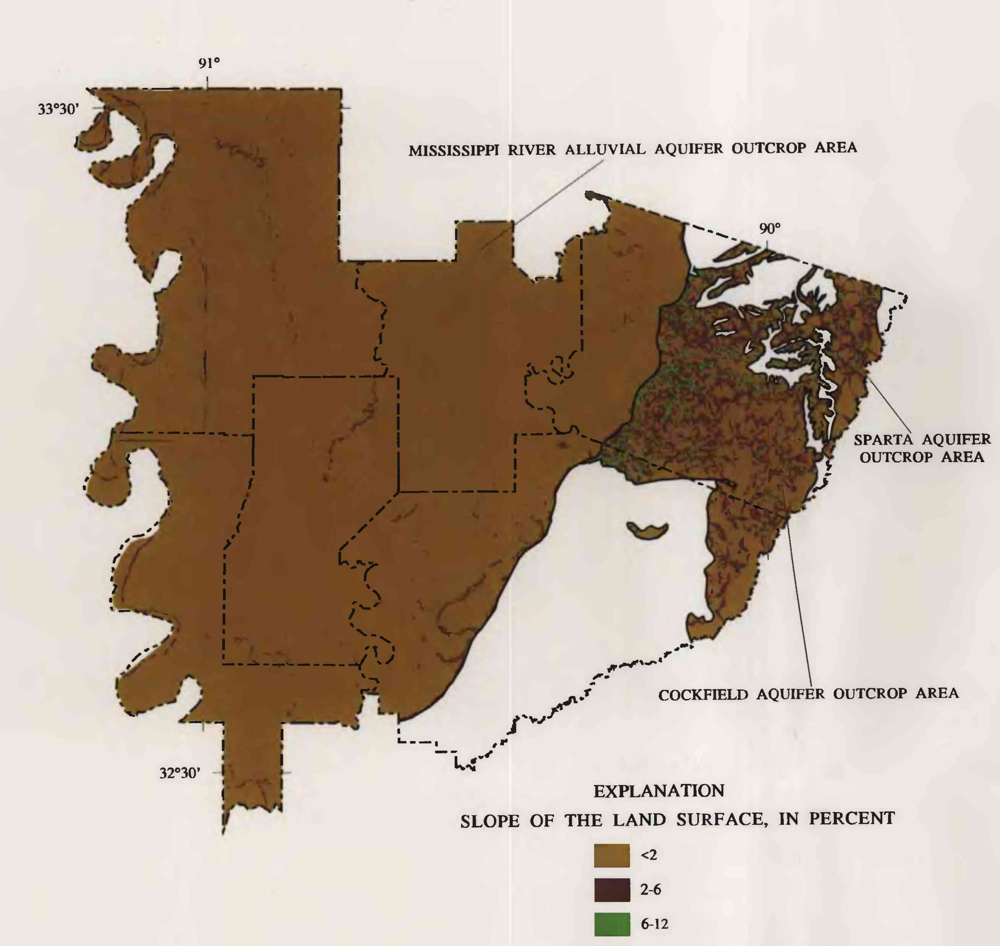

Figure 4.--Slope of the land for outcrop areas of major aquifers.

INTRODUCTION

Ground water is one of Mississippi's most important natural resources. The Mississippi Department of Environmental Quality, Office of Pollution Control, and the Mississippi Department of Agriculture and Commerce are developing a program to protect the aquifers in Mississippi from contamination from surface sources. The U.S. Geological Survey, in cooperation with these two agencies, is conducting a series of studies to delineate the outcrop areas of the major aquifers in Mississippi and those parts of the outcrop areas that are susceptible to contamination from surface sources.

Purpose and Scope

This report summarizes selected surface-contamination-susceptibility factors for major aquifers in Holmes, Humphreys, Issaquena, Sharkey, Washington, and Yazoo Counties (fig. 1). Susceptibility evaluations were performed by integrating data sets describing geologic, hydrologic, physiographic, and cultural data using a vector based geographic information system (GIS).

Two primary guidelines were established during the initial stages of the study. The first guideline is that the study is to address the relative ease by which surface contaminants might enter the saturated zone. Predicting the transport and disposition of contaminants after reaching the saturated zone was beyond the scope of the study.

The second guideline is to assume that only the parts of the aquifer that are unconfined are susceptible to surface contamination. These areas generally coincide with the outcrop areas of the geologic units which make up each aquifer. The confined parts of aquifers have a layer of relatively impermeable material between the aquifer and the surface and were not evaluated.

Location and Physical Features of the Study Area

The study area, located in west-central Mississippi, covers about 3,800 square miles and had a total population of about 136,000 people in 1990 (U.S. Bureau of the Census, 1991). Major cities in the study area include Belzoni, Greenville, Lexington, Mayersville, Rolling Fork, and Yazoo City (fig. 1). Parts of five physiographic districts are included in the study area. The Mississippi Alluvial Plain district is a broad, flat, gently sloping plain formed by the Mississippi River and its tributaries (Stephenson and others, 1928). The Bluff Hills district is characterized by pronounced hills with steep slopes, narrow ridges, and narrow intervening valleys, formed on loess deposits along the eastern edge of the Mississippi Alluvial Plain. The North Central Hills district is a hilly to moderately irregular upland shaped by stream erosion. The Jackson Prairies district is a relatively narrow strip of gently rolling land with many small prairie-like tracts. The Longleaf Pine Hills district is an area of rolling to moderately rugged hills.

Surface drainage in the North Central Hills and Jackson Prairies districts is southward to the Big Black River. In the Bluff Hills and Mississippi Alluvial Plain districts, surface drainage is south and west to the Yazoo and Sunflower Rivers.

Description of Major Aquifers

The major aquifers that were evaluated for their potential to contamination from surface sources are the Mississippi River alluvial, Cockfield, and Sparta aquifers (fig. 2). These aquifers consist of sediments of Tertiary to Quaternary age in the East Gulf Coastal Plain (table 1). A small part of the Oligocene aquifer system is present in the southern part of the study area. The Oligocene aquifer system is composed of the Byram, Glendon, Marianna, Mint Spring, and Forest Hill Formations, which consist of beds of clay, marl, limestone, and sand that range in thickness from 100 to 200 feet. Because of the limited areal extent of the Oligocene aquifer system, and because only small supplies of water are withdrawn from it, the Oligocene aquifer system was not considered to be a major aquifer in the study area and was not evaluated. The Meridian-upper Wilcox aquifer is a source of drinking water in the study area but does not crop out in the study area and was not evaluated.

Table 1.--Geologic units and major aquifers in the study area
[Modified from Slack and Darden, 1991]

System	Series	Group	Geologic unit	Principal aquifer or aquifer system
Quaternary	Holocene and Pleistocene		Mississippi River alluvium	Mississippi River alluvial aquifer
	Pleistocene		Loess Terrace deposits	
Tertiary	Oligocene	Vicksburg Group	Byram Formation Glendon Formation Marianna Formation Mint Spring Formation	Oligocene aquifer system
			Forest Hill Formation	
	Eocene	Jackson Group	Yazoo Clay Moodys Branch Formation	
		Claiborne Group	Cockfield Formation	Cockfield aquifer
			Cook Mountain Formation	
			Sparta Sand	Sparta aquifer
			Zilpha Clay Winona Sand	Winona-Tallahatta aquifer
			Tallahatta Formation	

Mississippi River Alluvial Aquifer

The Mississippi River alluvial aquifer (fig. 2) consists of the Mississippi River alluvium--primarily clay, silt, sand, and gravel of Quaternary age. The alluvium grades upward from gravel and coarse sand to medium or fine sand to clay. The upper part of the alluvium generally consists of clay of variable thickness. The coarse lower sediments (sands and gravels that comprise the alluvial aquifer) tend to be thicker in the center of the alluvial plain and thinner toward the periphery of the alluvial plain.

The Mississippi River alluvial aquifer ranges in thickness from 50 feet to more than 150 feet. The aquifer unconformably overlies the Sparta and Cockfield aquifers (fig. 3). A discontinuous clay layer partially impedes downward movement of water between the Mississippi River alluvial aquifer and the underlying aquifers. Where the clay layer is absent, the Mississippi River alluvial aquifer and the underlying aquifers are hydraulically connected.

According to Boswell and others (1968), recharge to the Mississippi River alluvial aquifer is primarily through direct infiltration of precipitation from the surface with lesser amounts coming from streams, runoff from adjacent highlands, and inflow from underlying aquifers. However, results of aquifer simulation studies by Sumner and Wasson (1990) indicate that direct infiltration of precipitation from the surface is a less important source of recharge to this aquifer than recharge from streams and lakes and runoff from adjacent highlands. Although not completely understood, recharge to the Mississippi River alluvial aquifer probably involves all of these sources. Regional movement of water in the Mississippi River alluvial aquifer is considered to have two components: a north-to-south component along the center of the aquifer, and a component from the edges of the aquifer toward the center (Sumner and Wasson, 1990).

Cockfield Aquifer

The Cockfield aquifer consists of sediments in the Cockfield Formation of Eocene age. The Cockfield Formation generally consists of beds of fine to medium sand, sandy carbonaceous clay, and thin beds of lignite (Spiers, 1977). The Cockfield Formation dips to the southwest at about 20 to 30 feet per mile.

The Cockfield aquifer ranges in thickness from 50 to 400 feet. Its recharge area generally coincides with the outcrop area of the Cockfield Formation and extends across the eastern part of the study area (fig. 2). The Yazoo Clay, where it is present, forms an upper confining unit, and the Cook Mountain Formation forms a lower confining unit to the Cockfield Formation (fig. 3). In the western part of the study area, the Cockfield aquifer is overlain by the Mississippi River alluvial aquifer. In the study area, almost all recharge to the Cockfield aquifer is from precipitation on the outcrop of the Cockfield Formation and from leakage from the Mississippi River alluvial aquifer where it overlies the Cockfield (Hosman and others, 1968). Regional ground-water movement generally is westward (Spiers, 1977).

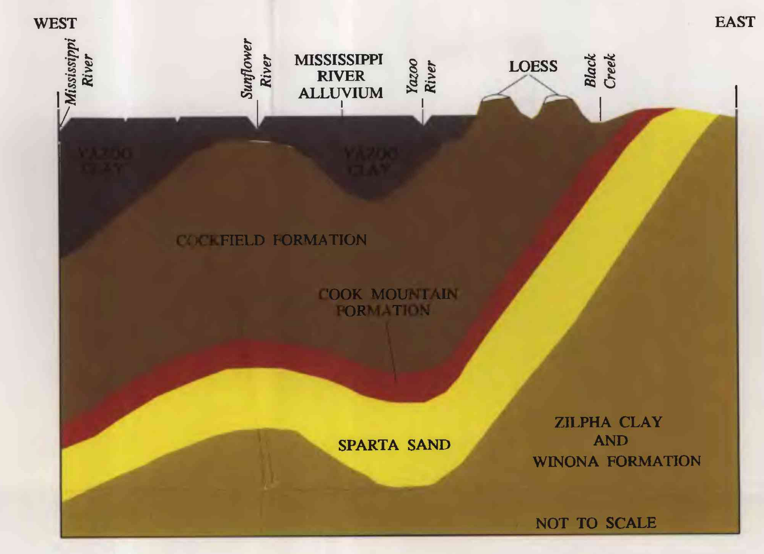

Figure 3.--Diagrammatic section showing geologic units in the study area.

Sparta Aquifer

The Sparta aquifer consists of sediments in the Sparta Sand of Eocene age. The Sparta Sand consists of two or three thick beds of rounded, well-sorted, quartz sand separated by beds of clay (Gandl, 1982). The Sparta Sand dips to the west at about 20 feet per mile.

The Sparta aquifer ranges in thickness from 100 to 400 feet. Its recharge area generally coincides with the outcrop area of the Sparta Sand and extends across the northeastern part of the study area (fig. 2). The Cook Mountain Formation forms an upper confining unit, and the Zilpha Clay forms a lower confining unit (fig. 3). In the western part of the study area, the Sparta aquifer is overlain by, but not in contact with, the Mississippi River alluvial aquifer.

Direct infiltration of precipitation on the outcrop is one of the primary sources of recharge to the Sparta aquifer (Hosman and others, 1968). Lesser amounts of recharge are from leakage from the Mississippi River alluvial aquifer where it overlies the Sparta and from streams during high stages. Regional ground-water movement generally is to the west (Newcome, 1976).

FACTORS AFFECTING SUSCEPTIBILITY TO CONTAMINATION

The relative susceptibility of major aquifers to surface contamination was evaluated on the basis of six factors: unsaturated zone media, aquifer media, slope of the land surface, depth to water table, soil permeability, and land use/land cover. These factors are summarized in table 2 and table 3. This method of factor analysis to determine the susceptibility of aquifers to surface contamination follows the basic principles introduced by Aller and others (1985). A GIS was used to integrate digital spatial data sets describing these factors.

Contamination potential ratings for each factor were determined by multiplying the variable rating by the fixed weight for that factor (tables 2 and 3). Weights and ratings for the factors are based on their effect on a contaminant's ability to reach the saturated zone. Higher values for weights or ratings indicate a greater contamination potential.

Contamination potential ratings for aquifer media, unsaturated zone media, and soil permeability were based on the material's ability to conduct water (hydraulic conductance) to the aquifer. Because water entering an aquifer from the surface must first pass through the soil zone, unsaturated zone media, and finally the aquifer material, these three factors were combined into one series conductance factor. Because series hydraulic conductance is combined as a harmonic mean sum, the following formula was used to determine the combined contamination potential (McDonald and Harbaugh, 1984):

$$1/RT = 1/RS + 1/RU + 1/RA \quad (1)$$

where

RT = combined contamination potential rating for soil permeability, unsaturated zone media, and aquifer media,
RS = contamination potential rating for soil permeability factor,
RU = contamination potential rating for unsaturated zone media factor, and
RA = contamination potential rating for aquifer media factor.

The resultant combined contamination potential (RT) was normalized to 130 to give the appropriate weight to the combined rating for the three factors. The final contamination potential rating is the sum of the land use/land cover, slope of the land surface, depth to water, and the normalized combined contamination potential rating for soil permeability, unsaturated zone media, and aquifer media factors from equation 1.

Finally, categories of relative susceptibility were established and mapped for each aquifer (fig. 8). These categories are based on a percentage of the possible total sum of contamination potential ratings for each factor. These categories, in increasing rank of relative susceptibility, are as follows:

Percent of possible total rating	Relative susceptibility category
Less than 10	1
10-33	2
33-66	3
66-90	4
More than 90	5

The numerical values derived from the application of the rating system have no quantitative implication. The relative susceptibility categories are intended only to provide a comparison of contamination risks for different aquifers or parts of the same aquifer.

Geology

Geologic data (Bicker, 1969) were used to determine the aquifer and unsaturated zone media and the boundaries of the aquifer's recharge areas. Aquifer media were derived from the lithology of the geologic units that make up each aquifer. The unsaturated zone media generally were the same as the aquifer media, except in areas where different geologic units overlie those making up the aquifer. The boundaries of the recharge areas were based on the outcrop areas of the geologic units that form each aquifer (fig. 2).

Aquifer and unsaturated zone media ratings (table 2) are based on the permeability of the materials which make up the aquifer and unsaturated zone. Coarse-grained materials have a high contamination potential rating because they are more transmissive to water, and attenuation (chemical change) of contaminants is less effective in coarse- than in fine-grained materials. The aquifer media rating assigned to the Mississippi River alluvial aquifer was 21 because of the predominantly gravel and sand lithology. With the exception of parts of the aquifer overlain by the alluvial apron, a highly permeable alluvial fan deposit forming on the eastern edge of the aquifer along the bluff hills, the unsaturated zone media rating assigned to the Mississippi River alluvial aquifer was 25. Although the predominant lithology of the unsaturated zone is clay and silty clay, which would have a maximum unsaturated zone media rating of 15, the unsaturated zone media rating was increased to 25 to account for the discontinuous nature of this clay layer. The unsaturated zone media rating assigned for parts of the aquifer overlain by the alluvial apron was 45 because of the highly permeable nature of these deposits and the absence of the upper silty clay layer.

Table 2.--Contamination susceptibility factors
[>, greater than; <, less than; modified from Aller and others, 1985]

Factor	Weight	Divisions	Contamination potential rating (CPR)
Unsaturated zone media	5	Gravel	8-10
		Sand and gravel	7-9
		Sand	6-9
		Interbedded sand and clay	5-8
		Massive sandstone and limestone	3-7
		Clay	1-3
Aquifer media	3	Gravel	8-10
		Sand and gravel	7-9
		Sand	6-9
		Interbedded sand and clay	5-8
		Limestone	4-6
		Massive sandstone and limestone	3-7
Slope (percent)	3	0-2	10
		2-6	9
		6-12	5
		12-18	3
		>18	1
Depth to water table (feet)	5	0-5	10
		5-15	9
		15-30	7
		30-50	5
		50-75	3
		>75	1
Soil permeability (inches per hour)	5	<0.20	1-4
		0.2-0.6	4-7
		>0.60	8-10

The aquifer media rating assigned to the Cockfield aquifer was 21 because the predominant lithology is fine- to medium-grained sand. Unsaturated zone media ratings for the Cockfield aquifer varied depending on overlying units. Where only the Cockfield Formation was present, the unsaturated zone rating was 35 because of the predominantly sandy lithology. Parts of the aquifer that were overlain by the loess, a highly permeable deposit, were assigned an unsaturated zone rating of 50. Parts of the aquifer which were overlain by outliers of the Yazoo Clay, a relatively impermeable unit, were assigned an unsaturated zone media rating of 10.

The aquifer media rating assigned to the Sparta aquifer was 21 because of the predominant fine sand lithology. In most areas, the unsaturated zone media rating assigned to the Sparta aquifer was 21; however, where the aquifer is overlain by the Cook Mountain Formation (a unit with relatively low permeability), a rating of 15 was assigned.

Slope of the Land Surface

Data sets describing the percent slope of the land surface were created from 1-degree digital elevation models (DEM's) (U.S. Geological Survey, 1970a, 1970b, 1973, 1979). DEM's are regular arrays of land-surface elevations. Each array is a block, 1 degree of latitude by 1 degree of longitude, with an elevation every 3 arc-seconds (about 250 feet). Elevations are reported to the nearest meter (U.S. Geological Survey, 1987). The GIS was used to create an approximation of the land surface from this array of elevations. This approximation of land surface, called a triangular irregular network (TIN), is a series of irregularly shaped triangles where elevation data are stored at the corner of each triangle. The GIS then used the three elevations to calculate the slope of each triangle. Using a TIN to approximate a three-dimensional surface results in the angular shapes of the slope polygons in figure 4.

Contamination potential ratings for the slope category are based on the assumption that runoff decreases and infiltration increases in areas of low slopes. Areas with steeper slopes have a lower contamination potential rating because of increased runoff and decreased infiltration of water into the aquifer.

Depth to Water Table

Maps of the depth to the water table in the outcrop area of each aquifer were created from 1-degree DEM's and digitized potentiometric maps for each aquifer. Potentiometric-surface elevation data for the Mississippi River alluvial aquifer were obtained from Goldsmith (1993); the Sparta aquifer from Darden (1987); and the Cockfield aquifer from Darden (1986). Data were processed by digitally sampling the land-surface elevation and the potentiometric-surface elevation every 1,500 feet, and calculating the difference between the two surfaces (the land-surface elevation minus the potentiometric-surface elevation) at each sampled point. The difference between each surface at each sampling point represents the depth to water at that point. Depth to water is mapped for each aquifer outcrop area in figure 5.

Contamination potential ratings for depth to water are based on the distance a contaminant would have to travel before reaching the saturated zone. Areas with shallow depths to the water table have a high contamination potential rating because there is less time for attenuation of contaminants by soil materials.

Soil Permeability

Data sets describing soil permeability were provided by the U.S. Soil Conservation Service (SCS). The soil layer generally is the uppermost part of the unsaturated zone characterized by significant biological activity. Each soil type was assigned permeability values obtained from the SCS county report series (Morris, 1961; Powell and others, 1959; Scott and Carter, 1962; Scott and others, 1975; Wynn and others, 1961). Soil permeability is mapped for each aquifer in figure 6.

Contamination potential ratings for soil permeability are based on the capacity of the soil to transmit water. The contamination potential rating increases as soil permeability increases because water moves more rapidly and allows less time for biodegradation, sorption, and volatilization.

Land Use/Land Cover

Land-use maps were created from Geographic Information Retrieval and Analysis System (GIRAS) data sets (U.S. Geological Survey, 1978a, 1978b, 1980a, 1980b). These data sets generally are compiled at a scale of 1:250,000 (U.S. Geological Survey, 1986) and are based on the land use and land cover classification system developed by Anderson and others (1976). This is a multilevel classification system wherein each successive level is a more detailed characterization of land use and land cover description (table 3). Level II categories were used for the susceptibility evaluations, but because of the detailed nature of level II categories, only level I categories are shown for each aquifer's outcrop area (fig. 7).

Contamination potential ratings for each land-use area are based on the relative contamination risk of anthropogenic and natural activities occurring in that area as well as hydrologic properties particular to each area. Because land-use activities influence ground-water contamination risk, this factor was assigned a weight of 5. Whenever possible, documented cases of the relation between ground-water contamination potential and land-use practice were used to support the rating assigned to each category.

Urban or Built-Up Land

The urban or built-up land category consists of any land that is intensively used and much of which is covered by structures. Included in this category are the residential; commercial and services; industrial; transportation, communications, and utilities; mixed urban or built-up land; and other urban or built-up land level II categories (table 3).

The residential category was assigned a contamination potential rating of 6. Sources of contamination in the residential category include septic tanks, sanitary sewers, and lawn fertilizers and chemicals. Septic tanks are a major source of contamination in this category (J.L. Crawford, Mississippi Department of Pollution Control, oral commun., 1992). Improved drainage in residential areas can increase runoff and decrease direct infiltration from the surface, thereby decreasing contamination risk (Becker, 1990).

The commercial and services category was assigned a contamination potential rating of 7. Although improved drainage and increased percentage of impervious surface area decrease direct infiltration of precipitation, some commercial operations use hazardous materials that could pose a threat to ground-water quality. A major source of contamination in this category is underground tanks used for storing petroleum products at gasoline stations.

The industrial category was assigned a contamination potential rating of 10. Many activities in industrial areas may lead to ground-water contamination. A study conducted in southern Mississippi and Louisiana determined that concentrations of most contaminants were higher in industrial land-use areas than in forested and in mixed agricultural and forested areas (Strickland and others, 1987).

The transportation, communications, and utilities category was assigned a contamination potential rating of 7. Many activities common to this category, such as producing, processing, treating, and transporting oil, gas, and electricity, have the potential to contaminate ground-water supplies.

Because of its relatively limited areal extent and ambiguous description, the mixed urban or built-up land category was assigned the same contamination potential rating as the dominant surrounding land-use category. For example, if an area classified as mixed urban or built-up land was surrounded by land classified as residential, such an area would have a contamination potential rating of 6 (table 3).

The other urban or built-up land category was assigned a contamination potential rating of 4. Most activities taking place on such land pose little or no threat to ground-water quality.

Table 3.--Land use/land cover categories and ratings
[--, indicates areas were merged with adjacent areas; CPR, contamination potential rating; modified from Anderson and others, 1976]

Land use categories Level I	Level II	General description or example	CPR
Urban or built-up land	Residential	High and low density residential areas	6
	Commercial and services	Land used for the sale of goods and services	7
	Industrial	Land used for the manufacture of products	10
	Transportation, communications and utilities	Roads, railways, utility lines, airports, docks	7
	Mixed urban or built-up land	More than one-third intermixture of two or more urban/built-up level II categories	--
	Other urban or built-up land	Parks, cemeteries, zoos, levees	4
Agricultural land	Cropland and pasture	Land used to cultivate crops and livestock	10
	Orchards, groves, vineyards, nurseries, and ornamental horticultural areas	Land used to cultivate fruits, nuts, trees	--
	Confined feeding operations	Stock yards, feed lots, chicken houses	10
	Other agricultural land	Ponds, field roads, out buildings	--
Forest land	Deciduous forest land	Predominately deciduous trees present	4
	Evergreen forest land	Predominately evergreen trees present	4
	Mixed forest land	More or less equal numbers of deciduous and evergreen trees present	4
Water	Streams and canals	Streams, canals, unimpounded linear water bodies	8
	Lakes	Natural impoundments	8
	Reservoirs	Artificial impoundments	8
Wetlands	Forested wetland	Wetlands dominated by woody vegetation	8-10
	Nonforested wetland	Wetlands dominated by herbaceous vegetation or nonvegetated	8-10
Barren land	Sandy areas other than beaches	Sand bars usually in rivers and streams	--
	Strip mines, quarries, and gravel pits	Lands undergoing surface mineral extraction	8
	Transitional areas	Areas changing from one category to another	--
	Mixed barren land	Mixture of barren land categories; no category occupies more than two-thirds total area	--

Agricultural Land

The agricultural land-use category consists of any land used for the production of food or fiber. Included in this category are: cropland and pasture; confined feeding operations, orchards, groves, vineyards, nurseries, and ornamental horticulture operations; and other agricultural land level II categories.

The cropland and pasture category was assigned a contamination potential rating of 10 because of the large amount of agricultural chemicals used in the cultivation of crops. Insecticides, herbicides, fertilizers, and other chemicals, when accompanied by irrigation and/or precipitation, present a high potential for affecting ground-water quality.

The confined feeding operations category was assigned a contamination potential rating of 10. The high concentration of livestock produces a build-up of waste that has the potential to degrade ground-water quality (Anderson and others, 1976).

Because of their small areal extent, the other agricultural land and the orchards, groves, vineyards, nurseries and ornamental horticultural categories were assigned the same contamination potential rating as the dominant surrounding land-use category. For example, an other agricultural land area surrounded by cropland and pasture would have a contamination potential rating of 10.

Forest Land

The forest land category includes any land with a tree-crown areal density of 10 percent or more, which is stocked with trees capable of producing timber or other wood products, which influence the climate or water regime. Included in the forest land category are the deciduous forest land, evergreen forest land, and mixed forest land level II categories.

Because of the similar hydrologic and anthropogenic properties of the forest land level II categories, the same contamination potential rating (4) was assigned to each level II category. A study in southern Mississippi and Louisiana determined that ground-water samples from forested land-use areas had consistently lower concentrations of analyzed constituents than samples from mixed agricultural-forest land and industrial land use areas (Strickland and others, 1987).

Water

The water category includes any land that is continually covered by water. To be included, if these areas are linear they must be at least 1/8 mile wide and if extended they must cover at least 40 acres (Anderson and others, 1976). Many of the water bodies in Mississippi do not meet this requirement and were mapped with the dominant surrounding land-use category. Included in the water category are the streams and canals; lakes; reservoirs; and bays and estuaries level II categories.

All of the level II water categories were assigned a contamination potential rating of 8 because surface-water bodies generally are hydraulically connected with local ground-water systems and contamination of a surface-water body could lead to ground-water contamination.

Wetlands

The wetlands category includes any land where the water table is at, near, or above the land surface for a significant part of most years. Aquatic or hydrophytic vegetation usually is established, although some areas may not be vegetated. Included in the wetlands category are the forested and nonforested wetland level II categories.

Because of the similar hydrologic and anthropogenic properties of each wetland level II category the same contamination potential rating (8) was assigned to each level II category. Wetlands generally are hydraulically connected to local ground-water systems, and contamination of a wetland could lead to ground-water contamination.

Barren Land

The barren land category consists of any land with limited ability to support life and in which less than one-third of the area has vegetation or other cover. Level II categories included in the barren land category are sandy areas other than beaches; strip mines, quarries, and gravel pits; transitional areas; and mixed barren land.

Strip mines, quarries, and gravel pits were assigned a contamination potential rating of 8. Pits resulting from mineral extraction commonly intercept the water table and provide direct contact between ground water and near surface activities. Because of their limited areal extent, the sandy areas other than beaches, transitional areas, and mixed barren land categories were assigned the same contamination potential rating as the dominant surrounding land-use category.

SUSCEPTIBILITY OF MAJOR AQUIFERS TO SURFACE CONTAMINATION

Relative susceptibility (to contamination from surface sources) categories range from 1 to 5 for the aquifer outcrop areas. The Mississippi River alluvial aquifer outcrop has the smallest percent area rated within susceptibility category 4; the Cockfield aquifer outcrop has the largest percent area rated within susceptibility category 4 (table 4). For the three aquifers, the combined aquifer outcrop areas rated within susceptibility categories 1 and 5 are less than 1 percent of the total area. These areas are not mapped (fig. 8) because they are too small to be discerned at the map scale used.

Mississippi River Alluvial Aquifer

Less than 1 percent of the Mississippi River alluvial aquifer outcrop area rated within susceptibility category 5; 35 percent rated within susceptibility category 4; 62 percent rated within susceptibility category 3; 2 percent rated within susceptibility category 2; and less than 1 percent rated within susceptibility category 1 (table 4). Aquifer outcrop areas rated within susceptibility category 4 (fig. 8) generally are located along larger streams and rivers where depths to water are lower, where soil permeability is higher on the natural levees which have formed along the larger waterways, and where the predominant land use is agricultural. Factors most contributing to areas rated within susceptibility category 3 for the Mississippi River alluvial aquifer are the relatively impermeable unsaturated zone material and low soil permeabilities. Areas rated within susceptibility category 2 generally are located where the land use type is not agricultural.

Cockfield Aquifer

About 43 percent of the Cockfield aquifer outcrop area rated within susceptibility category 4; 57 percent rated within susceptibility category 3; and less than 1 percent rated within susceptibility categories 2 and 1 (table 4). Areas rated within susceptibility category 4 are located mostly in the eastern part of the outcrop (fig. 8). Factors most influencing areas rated within susceptibility category 4 in the eastern part of the outcrop include high soil permeability, shallow depths to water, low slopes, and agricultural land use. Areas in the western part of the outcrop rated within susceptibility category 3 due to steep slopes, great depths to water, and land use being primarily forested land.

Table 4.--Relative susceptibility category of major aquifers to surface contamination
[Values are percent surface area of the aquifer's outcrop area, values are rounded and may not total 100 percent]

Aquifer name	Category 1	2	3	4	5
Mississippi River alluvial aquifer	Less than 1	2	62	35	Less than 1
Cockfield aquifer	Less than 1	Less than 1	57	43	0
Sparta aquifer	Less than 1	1	58	41	0

Sparta Aquifer

About 41 percent of the Sparta aquifer outcrop area rated within susceptibility category 4; 58 percent rated within susceptibility category 3; 1 percent rated within susceptibility category 2; and less than 1 percent rated within susceptibility category 1 (table 4). Areas which are rated within susceptibility category 3 for the Sparta aquifer are located in the central and eastern parts of the outcrop (fig. 8). Factors most influencing areas rated within susceptibility category 3 for the Sparta aquifer include shallow depths to the water table and low slopes. These areas are located primarily along stream valleys. Areas rated within susceptibility category 2 generally are located where slopes are steep (away from stream valleys) and the water table is deep.

SUMMARY

The relative susceptibility of the Mississippi River alluvial, Cockfield, and Sparta aquifers in west-central Mississippi to contamination from surface sources was determined by analyzing six factors: unsaturated zone media, aquifer media, soil permeability, slope of the land surface, depth to water table, and land use/land cover. A geographic information system was used to integrate digital spatial data sets describing these factors to rate the susceptibility of unconfined parts of these aquifers to contamination from surface sources. Areas were rated within one of five categories in increasing rank of relative susceptibility to contamination from surface sources.

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CONVERSION FACTORS AND VERTICAL DATUM

Multiply	By	To obtain
inch	2.54	centimeter
inch per hour	2.54	centimeter per hour
foot	0.3048	meter
mile	1.609	kilometer
square mile	2.59	square kilometer
foot per mile	0.018939	meter per kilometer
foot per day	0.3048	meter per day

Sea Level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)--a datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

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Susceptibility of Major Aquifers to Surface Contamination--Holmes, Humphreys, Issaquena, Sharkey, Washington, and Yazoo Counties, Mississippi

By
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1993

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