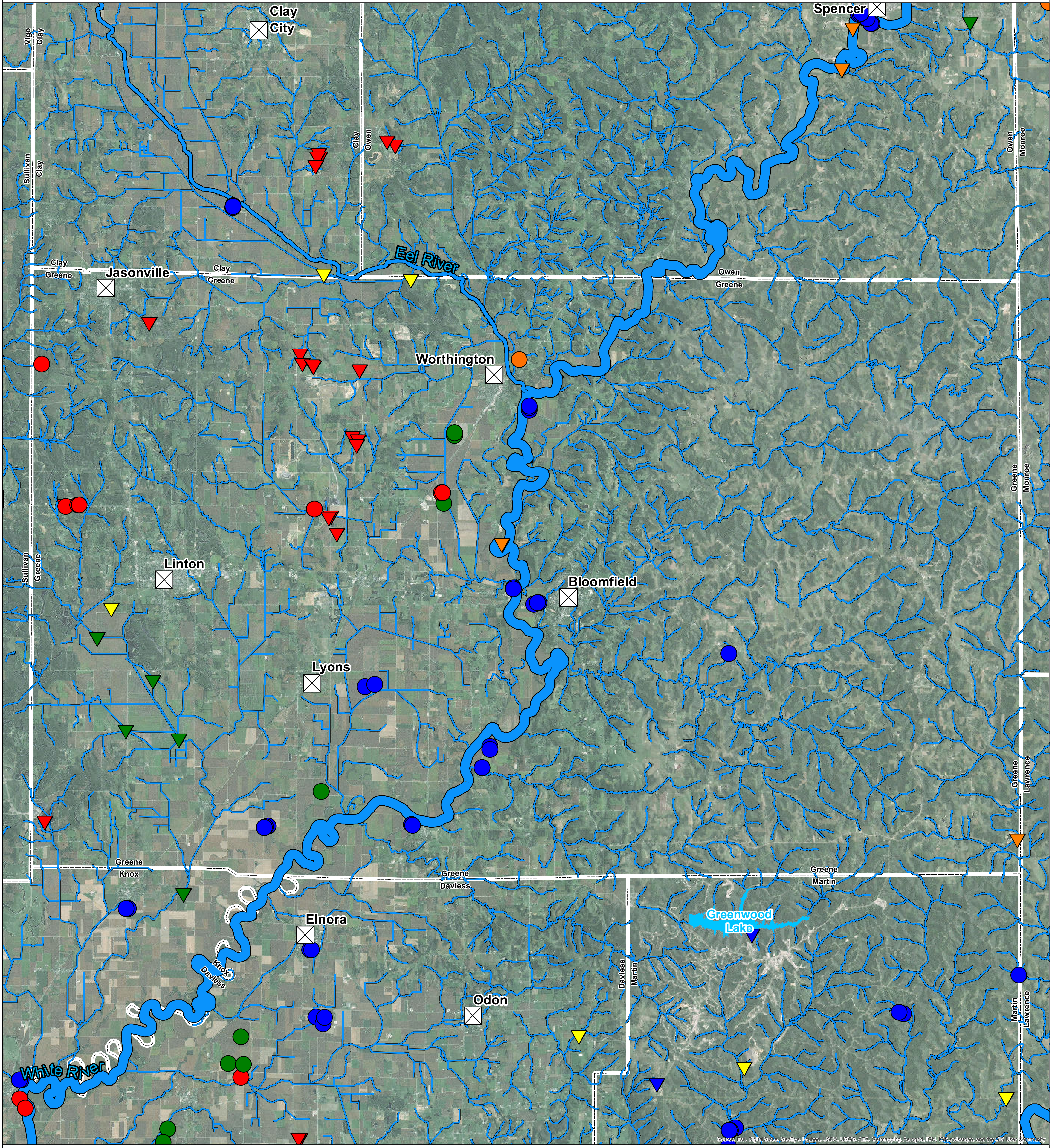
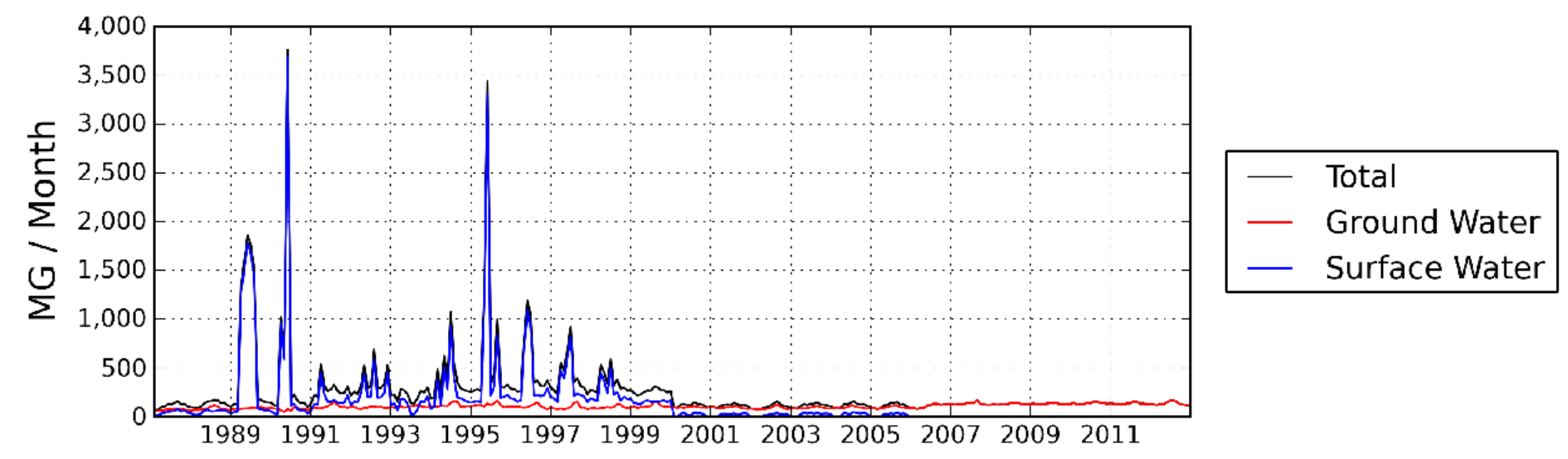
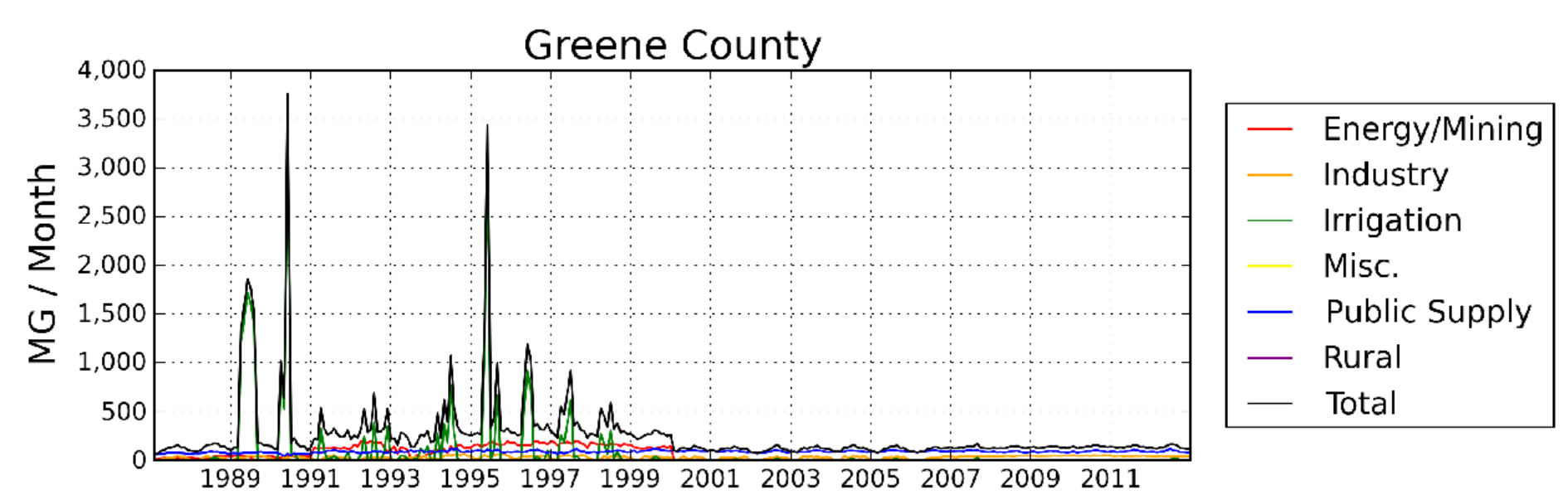


Average Daily Use: 4.4 MGD



# Water Resources and Use in Greene County

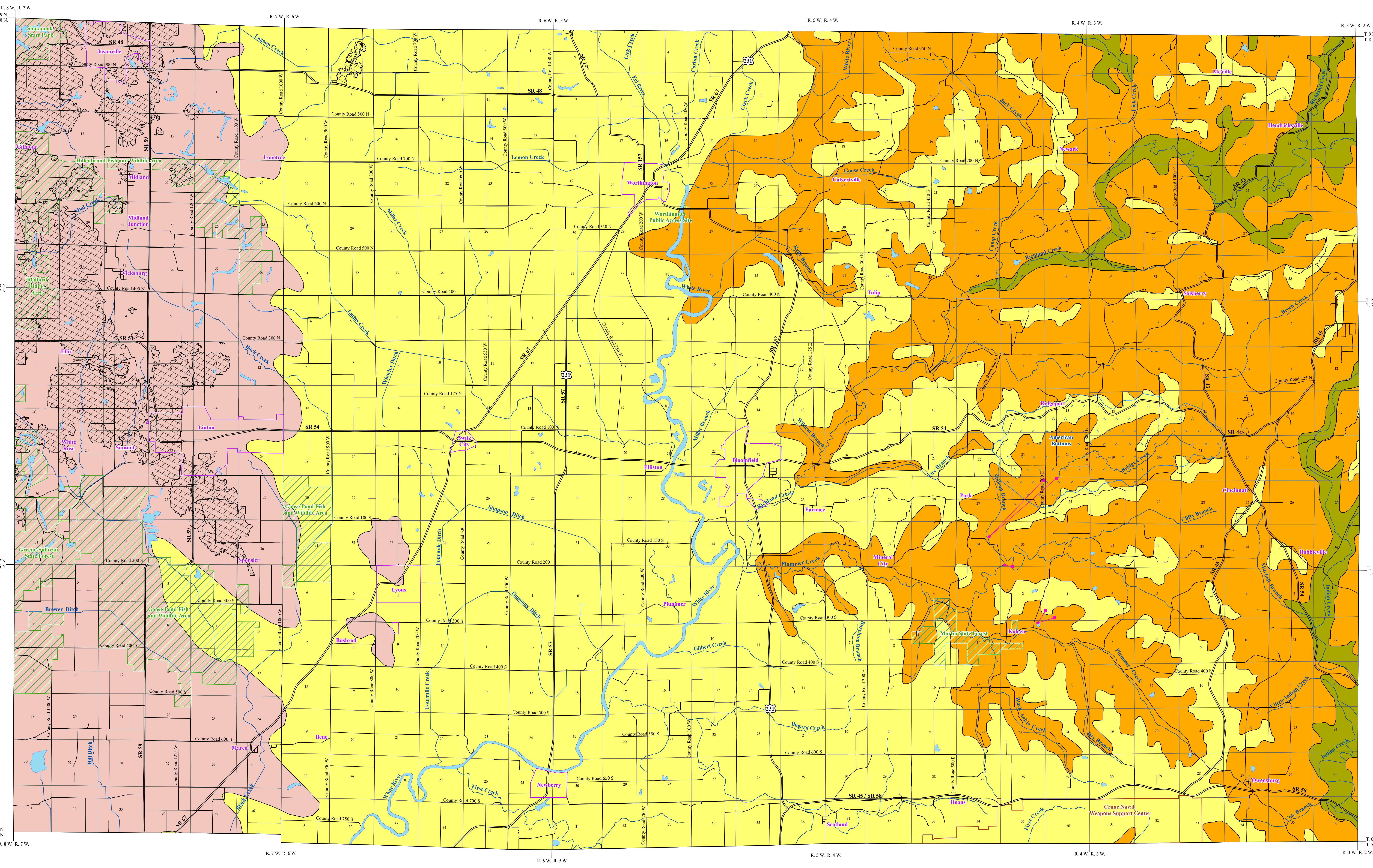
Data Sources: U.S. Geological Survey and Indiana Department of Natural Resources

<b>Withdrawal Location</b>	<b>River</b>
WELL INTAKE	<b>7Q2 Flow (MGD)</b>
● Energy/Mining	— <10 MGD
● Industry	— 10 - 50 MGD
● Irrigation	— 50 - 100 MGD
● Misc.	— 100 - 500 MGD
● Public Supply	— > 500 MGD
● Rural Use	

■ Major Lakes	■ Interstate	
□ County	□ City	

NORTH 0 1 2 4 Miles

# BEDROCK AQUIFER SYSTEMS OF GREENE COUNTY, INDIANA



The occurrence of bedrock aquifers depends on the original composition of the geologic material and subsequent changes which influence the hydraulic properties. Post-depositional processes which promote jointing, fracturing, and solution activity of exposed bedrock, generally increase the hydraulic conductivity (permeability) of the upper portion of bedrock aquifer systems. Because permeability in many places is greatest near the bedrock surface, bedrock units within the upper 100 feet are commonly the most productive aquifers.

The yield of a bedrock aquifer depends on its hydraulic characteristics and the nature of the overlying deposits. Shale and glacial till act as aquicludes, restricting recharge to underlying bedrock aquifers. However, fracturing and/or jointing may occur in aquicludes, which can increase recharge to the underlying aquifers. Hydraulic properties of bedrock aquifers are highly variable.

Most bedrock aquifers are under confined conditions, mainly a result of low vertical hydraulic conductivity clay-rich materials, such as glacial till, overlying the bedrock. Therefore, the potentiometric surface (water level) in most wells completed in bedrock rises above the top of the water-bearing zone.

The susceptibility of bedrock aquifer systems to surface contamination is largely dependent on the type and thickness of the overlying sediments. Because the bedrock aquifer systems have complex fracturing systems, once a contaminant has been introduced into a bedrock aquifer system, it will be difficult to track and remediate.

Four bedrock aquifer systems are identified for Greene County. They are, from west to east and younger to older: the Carbondale Group of Pennsylvanian age; the Racoon Creek Group of Pennsylvanian age; the Buffalo Wallow, Stephensport, and West Baden Groups of Mississippian age; and the Blue River and Sanders Groups of Mississippian age. Bedrock aquifer systems in Greene County are overlain by unconsolidated deposits ranging in thickness from less than one foot in the southeastern corner of the county to over 195 feet southwest of an area known as the American Bottoms (Malott, 1919) located in central Greene County.

The unconsolidated sand and gravel outwash aquifer near the White River has far greater groundwater potential than the bedrock aquifers in the county. However, bedrock aquifers are widely used in Greene County where unconsolidated sediments are relatively thin and unproductive. Approximately 95 percent of all wells in this county are completed in bedrock. There are no registered significant groundwater withdrawal facilities utilizing the bedrock aquifer systems in Greene County.

### ■ Pennsylvania - Carbondale Group Aquifer System

The Carbondale Group Aquifer System subcrop in western Greene County. The group consists in ascending order of the Linton, Petersburg, and Dugger Formations. Bedrock deposits include mostly shale and sandstone with some limestone and commercially important coal.

The Carbondale Group is considered a minor groundwater source with most wells producing from the thicker sandstone and coal units present in the upper formations of the group. Depth to the Carbondale Group bedrock surface ranges from 5 to 75 feet but is typically from 15 to 40 feet. Well depths generally range from 80 to 230 feet with the amount of rock penetrated typically from 65 to 205 feet. Reported domestic well yields range from 2 to 8 gallons per minute (gpm) with static water levels ranging from 15 to 50 feet below the surface. Higher yields are typically associated with significant drawdowns. A few dry (pumped) holes have been reported. Water quality from the deeper bedrock units is highly mineralized.

Where the overlying sediment consists of thick fine-grained clay materials, the Carbondale Group Aquifer System in Greene County is at low risk to contamination from the surface or near surface sources. Where bedrock is shallow, risk to contamination from the surface or near surface sources is high.

### ■ Pennsylvania - Racoon Creek Group Aquifer System

The Racoon Creek Group Aquifer System subcrop areas throughout central Greene County. Bedrock consists of mostly sandstone and shale with minor amounts of siltstone, mudstone, coal, and limestone. The basal formation of the Racoon Creek Group, the Mansfield Formation, rests unconformably on Mississippian rocks.

The Racoon Creek Group is generally a limited groundwater resource. However, the Mansfield Formation is a moderately dependable source of groundwater. Depth to bedrock ranges from 10 to 45 feet. Wells completed in the Racoon Creek Group are typically 120 to 260 feet deep with 85 to 240 feet of penetration into the bedrock. Domestic well capacities range from 2 to 12 gpm with static water levels of 25 to 100 feet below surface. Higher yields are commonly associated with significant drawdowns.

Clay materials that overlie bedrock are generally thick. These areas are considered at low risk to contamination. However, in some areas outwash, alluvial, and lacustrine sands and gravels directly overlie the bedrock surface. These areas are at high risk from surface contamination.

### ■ Mississippi - Buffalo Wallow, Stephensport, and West Baden Groups Aquifer System

This Upper Mississippian bedrock aquifer system is present in the eastern portion of Greene County and consists of three groups, from oldest to youngest: West Baden, Stephensport, and Buffalo Wallow. However, no Buffalo Wallow strata are present in the county. The West Baden and Stephensport Groups are composed primarily of limestone, and sandstone with minor amounts of shale.

The depth to the bedrock surface is commonly from 10 to 45 feet. Depths of wells range from 100 to 250 feet with 55 to 235 feet of typical penetration into bedrock. The Buffalo Wallow, Stephensport, and West Baden Groups Aquifer System is not regarded as a major groundwater resource. However, most attempts to drill a domestic well are successful. Domestic well yields are generally 4 to 15 gpm and reported static water levels range from 25 to 100 feet below land surface.

In some areas of the Buffalo Wallow, Stephensport and West Baden Groups Aquifer System, bedrock is shallow and some karst has developed in the limestone beds. These conditions warrant considering the aquifer system as a whole to be somewhat susceptible to contaminants introduced at and near land surface.

### ■ Mississippi - Blue River and Sanders Groups Aquifer System

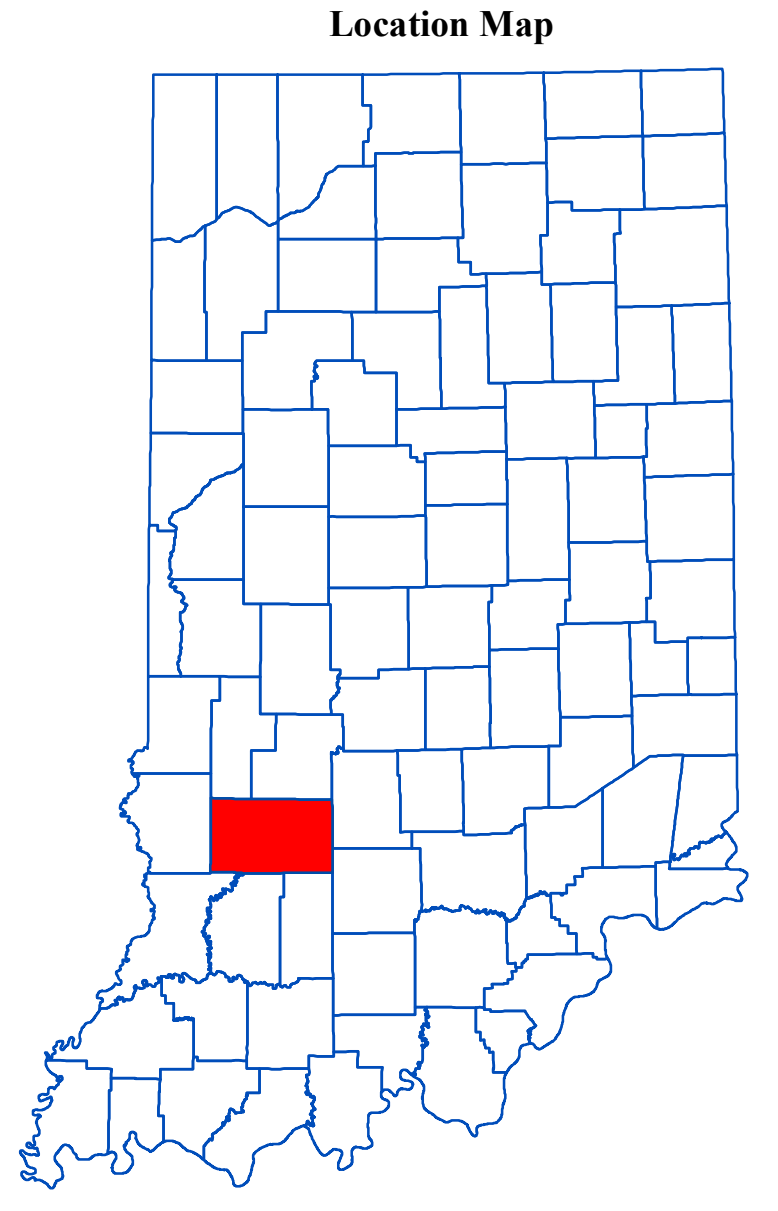
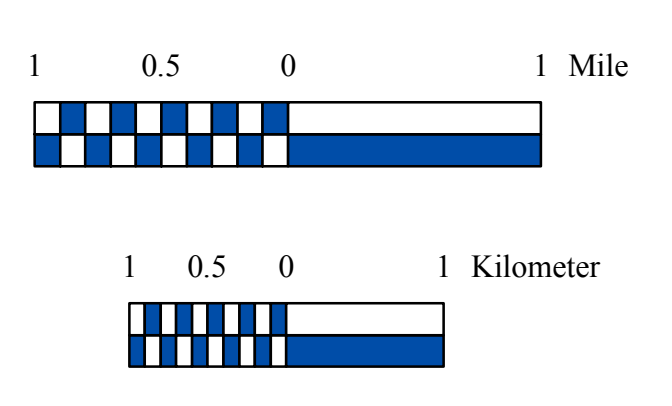
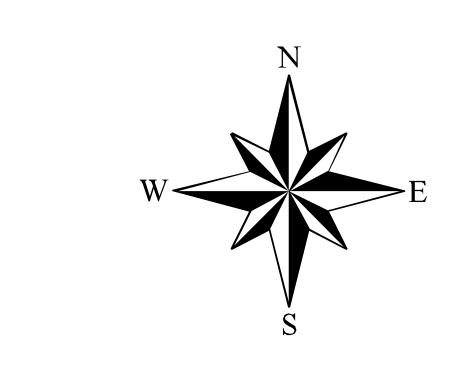
The Blue River and Sanders Groups Aquifer System is present in valleys of Lick Creek, Richland Creek, and Indian Creek in the eastern portion of Greene County. The Sanders Group includes primarily limestone with some dolomite limestone content. The overlying Blue River Group includes mostly limestones containing significant amounts of gypsum, anhydrite, shale, chert, and calcareous sandstone.

The Blue River and Sanders Groups Aquifer System is not regarded as a major groundwater resource in the county. Well depths in Greene County range from 90 to 145 feet. Depth to bedrock is generally between 15 and 30 feet below land surface. Domestic well capacities range from 5 to 20 gpm with reported static water levels that range from 30 to 60 feet below surface. Yields are commonly associated with low static water levels and significant to complete drawdown. There are no registered significant groundwater withdrawal facilities utilizing this system.

In areas where overlying clay materials are present, the Blue River and Sanders Group Aquifer System is at low risk to contamination. However, in some areas karst has developed in the limestone beds and outwash, alluvial, and lacustrine sands directly overlie the bedrock surface. These areas are at moderate to high risk from surface contamination.

### ■ Underground Mine Areas

In approximately 10 percent of the county various coal seams, within the Carbondale Group, have been extracted by underground mining methods. About 50 percent of most coal seams are removed during mining operations leaving the potential for storage of substantial amounts of water. Although the Division has no records of wells drilled into these mines significant yield may be obtainable. A limitation on use of the water could be its more mineralized nature.



### EXPLANATION

- Input Karst Dye Test Point
- Output Karst Dye Test Point
- Karst Dye Trace
- Stream
- County Road
- State Road & US Highway
- Crane Naval Weapons Support Center
- Municipal Boundary
- Sinking-Stream Basin
- State Managed Property
- Lake & River

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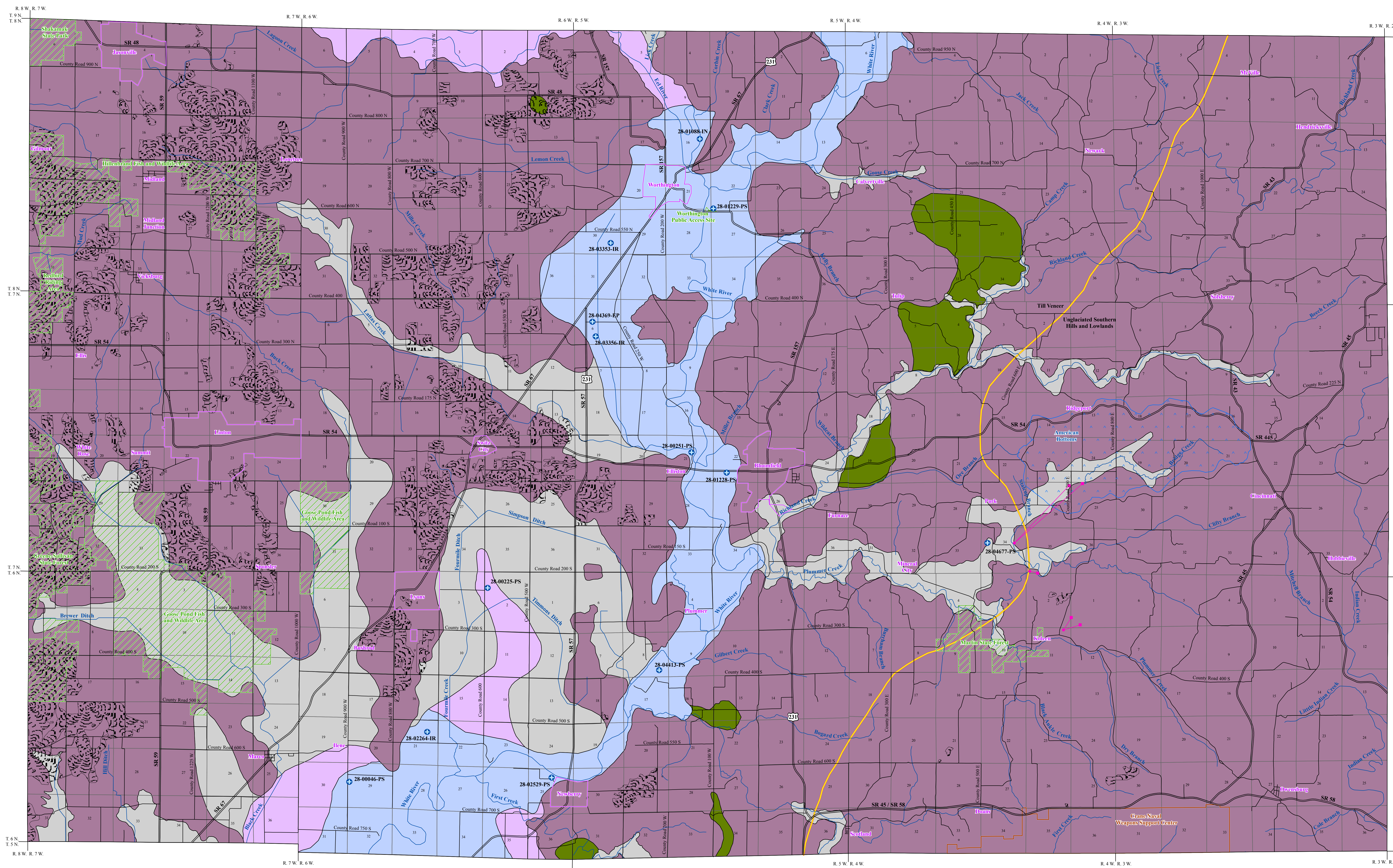
This map was created from several existing shapefiles. Township and Range Lines of Indiana (line shapefile, 20020621), Land Survey Lines of Indiana (polygon shapefile, 20020621) and County Boundaries of Indiana (polygon shapefile, 20020621), were all from the Indiana Geological Survey and based on a 1:24,000 scale, except the Bedrock Geology of Indiana (polygon shapefile, 20020318), which was at a 1:50,000 scale. Drain road shapefiles, System1 and System2 (line shapefiles, 2003), were from the Indiana Department of Transportation and based on a 1:24,000 scale. Managed Areas96 (polygon shapefile, various dates) was from DNR. Populated Areas in Indiana 2000 (polygon shapefile, 20021000) was from the U.S. Census Bureau and based on a 1:100,000 scale. Streams27 (line shapefile, 20000420) was from the Center for Advanced Applications in GIS at Purdue University.

### Bedrock Aquifer Systems of Greene County, Indiana

by  
Robert A. Scott  
Division of Water, Resource Assessment Section  
May 2011



# UNCONSOLIDATED AQUIFER SYSTEMS OF GREENE COUNTY, INDIANA



The unconsolidated aquifer systems of Greene County are composed of sediments deposited by, or resulting from, a complex sequence of glaciers, glacial meltwaters, and post-glacial precipitation events. Six unconsolidated aquifer systems have been mapped in Greene County: the Till Vener / Unglacial Southern Hills and Lowlands; the Alluvial, Lacustrine and Backwater Deposits; the Wabash Lowland / Crawford Upland Till Subsystem; the White River and Tributaries Outwash; the White River and Tributaries Outwash Subsystem; and the Coal Mine Spoil. Because of the complex geological geology in most of the county, boundaries of the aquifer systems are commonly gradational and individual aquifers may extend across aquifer system boundaries.

The thickness of unconsolidated deposits in Greene County is quite variable due to the deposition of glacial material over an uneven bedrock surface. Unconsolidated deposits range from less than one foot in the southeastern corner of the county to over 195 feet thick southwest of an area known as the American Bottoms (Mallet, 1919) in central Greene County. Approximately 5 percent of all wells in this county are completed in unconsolidated deposits.

Regional estimates of aquifer susceptibility to contamination from the surface can differ considerably due to a wide range of variation within geologic environments. In addition, man-made structures such as poorly constructed water wells, unrigged or improperly abandoned wells, and open excavations can provide contaminant pathways that bypass the naturally protective clays.

## Till Vener / Unglacial Southern Hills and Lowlands Aquifer System

The Till Vener / Unglacial Southern Hills and Lowlands Aquifer System occurs in areas where the unconsolidated material is predominantly thin till overlying bedrock. This system has the most limited groundwater resources of all the unconsolidated aquifer systems in Greene County. The unconsolidated materials of this aquifer system consist primarily of pre-Wisconsin glacial till, some lacustrine deposits, and some eroded bedrock residuum. The total thickness of this system in Greene County is generally less than 50 feet thick. Most of Greene County is mapped as Till Vener / Unglacial Southern Hills and Lowlands Aquifer System.

There is little potential for groundwater production in this system in Greene County. All reported wells started in the Till Vener / Unglacial Southern Hills and Lowlands Aquifer System have been completed in the underlying bedrock. However, potential aquifer deposits may include thin, isolated sands and/or gravels with expected yields less than a few gallons per minute (gpm).

This system is generally not very susceptible to contamination from surface sources because of the low permeability of the near-surface materials. However, there are areas where protective clay layers are thin or absent. These areas are very susceptible to contamination.

## Alluvial, Lacustrine, and Backwater Deposits Aquifer System

The Alluvial, Lacustrine, and Backwater Deposits Aquifer System in Greene County is mapped within several wide floodplains along tributaries of the White River. This system consists of deposits resulting from glacial meltwater drainage. Fine-grained glaciolacustrine deposits formed in relatively stagnant water, or colluvium from the surrounding upland areas.

The Alluvial, Lacustrine, and Backwater Deposits Aquifer System is capable of meeting the needs of domestic users in Greene County. However, about 85 percent of wells started in this system in Greene County are completed in the underlying bedrock aquifer system. Individual sand and gravel units range from 5 to 15 feet thick with well depths ranging from 50 to 80 feet. Domestic well yields range from 5 to 10 gpm with static water levels ranging from 5 to 20 feet below the surface. The wells with reported capacities in the upper limits of this system have noted significant drawdowns. There is one registered significant groundwater withdrawal facility (one well) using the Alluvial, Lacustrine, and Backwater Deposits Aquifer System in Greene County with a reported capacity of 100 gpm.

Thick deposits of clay that have a low susceptibility to surface contamination commonly characterize this aquifer system. However, the susceptibility is greater in areas where surficial clay deposits are thin and directly overlie sand and gravel deposits.

## Wabash Lowland / Crawford Upland Till Aquifer Subsystem

The Wabash Lowland / Crawford Upland Till Aquifer Subsystem is found in portions of south-central and east-central Greene County. This aquifer system is up to 195 feet in thickness, and consists primarily of glacial till with intertilled sand and gravel layers. However, the sand and gravel aquifers in this system tend to be relatively discontinuous.

The Wabash Lowland / Crawford Upland Till Aquifer Subsystem is capable of meeting the needs of some domestic users in Greene County. However, nearly all wells started in this subsystem in Greene County are completed in the underlying bedrock aquifer system. Potential aquifer materials include relatively thin, discontinuous intertilled sand and gravel deposits. These intertilled sand and gravel aquifer materials are generally 5 to 10 feet thick with well depths ranging from 40 to 50 feet. Domestic well yields for this system are typically less than 10 gpm with static water levels ranging from 10 to 25 feet below the surface. The higher yields are commonly associated with significant drawdowns. There are no registered significant groundwater withdrawal facilities utilizing this subsystem.

This subsystem is generally not very susceptible to surface contamination because intertilled sand and gravel units are overlain by thick till deposits. Wells producing from shallow aquifers are moderately to highly susceptible to contamination.

## White River and Tributaries Outwash Aquifer System

The White River and Tributaries Outwash Aquifer System is located within the floodplains of the White River and its major tributaries. This system includes thick glacial outwash sands and gravels, that are (in some areas) capped by a thin layer of clay and/or silt deposits.

The White River and Tributaries Outwash Aquifer System is capable of meeting the needs of both domestic and high-capacity users in Greene County. The wells utilizing this system are completed at depths ranging from 50 to 100 feet with sand and gravel aquifer materials commonly 20 to 70 feet thick. Domestic well yields are typically 10 to 40 gpm with static water levels ranging from 8 to 15 feet below the surface. In the White River and Tributaries Outwash Aquifer System there are 11 registered significant groundwater withdrawal facilities (24 wells) with yields that range from 100 to 1,500 gpm.

This aquifer system is highly susceptible to surface contamination where sand and gravel deposits are near the surface and have little or no overlying clay deposits.

## White River and Tributaries Outwash Aquifer Subsystem

The White River and Tributaries Outwash Aquifer Subsystem is mapped primarily along the Ed River in the northern section of the county, and adjacent to the White River and Tributaries Outwash Aquifer System in the southern portion of the county. This system generally occupies a higher topographic position and has considerably thinner (typically 8 to 16 feet thick) sand and gravel units than the main outwash aquifer system. Also, outwash deposits are commonly covered by a thicker layer of clay, till, lacustrine, or loess deposits ranging from 10 to 35 feet in thickness.

The White River and Tributaries Outwash Aquifer Subsystem is capable of meeting the needs of both domestic and some high-capacity users in Greene County. The wells utilizing this aquifer system are completed at depths ranging from 45 to 80 feet. Although not nearly as productive as the outwash system, domestic wells completed in this subsystem typically yield 10 to 30 gpm with static water levels ranging from 5 to 20 feet below the surface. There is one significant groundwater withdrawal facility (2 wells) using this subsystem in Greene County. Each of the high-capacity wells in this aquifer subsystem have reported rates of 150 gpm.

In general, these subsystems are moderately to highly susceptible to surface contamination. Although the overlying clay or till may provide some protection to the confined portions of these subsystems, in places such protection does not exist.

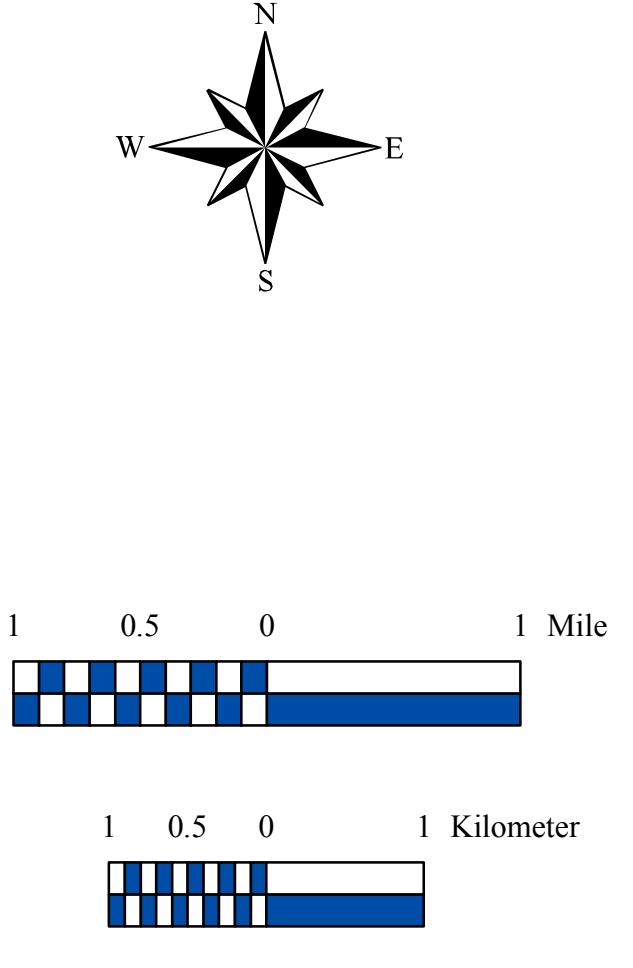
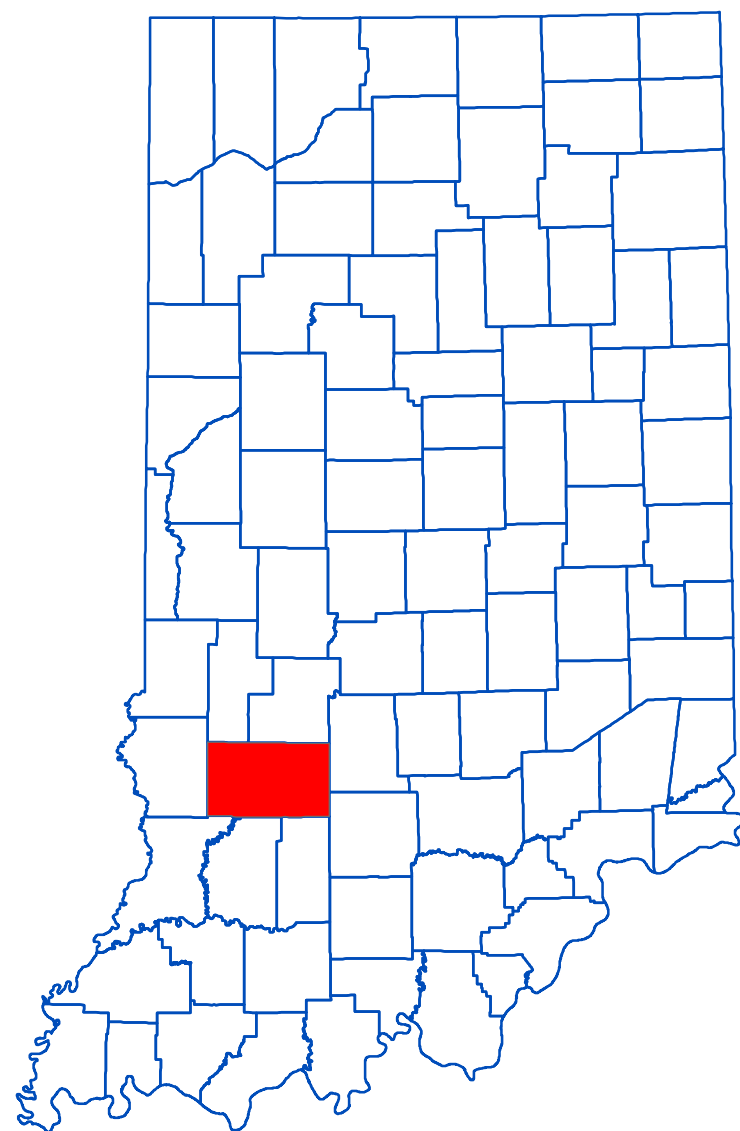
## Coal Mine Spoil Aquifer System

The Coal Mine Spoil Aquifer System is present in the western portion, and to a lesser degree southeastern Greene County, and covers about 10 percent of the county. The coal seams occur within the Carbonade Group and the Racoon Creek Group of Pennsylvanian age. This aquifer system was formed during the process of coal surface-mining methods. The overburden was typically broken up by blasting and moved aside to uncover the desired coal seam. The overburden, most of which was originally solid rock, became a heterogeneous mixture of particles ranging in size from clay to boulders. Where extensive, these spoil areas may contain considerable amounts of groundwater.

In Greene County, there are no reported wells producing from the Coal Mine Spoil Aquifer System. Wells started in this system are usually completed in bedrock. Information from surface coal mine areas in other counties indicate the quality of groundwater in this system is probably much poorer than in the overburden before mining took place. Typically, a significant increase in total dissolved solids, especially calcium, magnesium, bicarbonate, and sulfate occurs. High iron, and in places low pH, can severely limit potential uses of groundwater from this system.

Generally, it is expected that aquifers in coal mine spoil not graded and capped with compacted soil are highly susceptible to contaminants introduced at the surface. However, spoil aquifers in areas benefiting from modern reclamation methods are likely to be only moderately susceptible.

Location Map



### EXPLANATION

- Registered Significant Groundwater Withdrawal Facility
- Input Karst Dye Test Point
- Output Karst Dye Test Point
- Karst Dye Trace
- Stream
- County Road
- State Road & US Highway
- Approximate Southern Limit of Older Glacial Deposits
- Crane Naval Weapons Support Center
- Municipal Boundary
- Sinking-Stream Basin
- State Managed Property
- Lake & River

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This map was created from several existing shapefiles. Township and Range Lines of Indiana (line shapefile, 2002021), Land Survey Lines of Indiana (polygon shapefile, 2002021), County Boundaries of Indiana (polygon shapefile, 2009021), Selected Subsurface Dye Traces in Parts of Southern Indiana (line shapefile, 2000023), and Input and Detective Points for Selected Subsurface Dye Traces in Parts of Southern Indiana (point shapefile, 2001124), were all from the Indiana Geological Survey and based on a 1:24,000 scale except for the Pre-Wisconsin Glacial Limit (polygon shapefile, 2010010) which is at a 1:500,000 scale. Draft road shapefiles, System and System (line shapefiles, 2003), were from the Indiana Department of Transportation and based on a 1:24,000 scale. Populated Areas in Indiana 2000 (polygon shapefile, 2002100) was from the U.S. Census Bureau and based on a 1:100,000 scale. Stream2 (line shapefile, 2006020) was from the Center for Advanced Applications in GIS at Purdue University. Managed Areas 96 (polygon shapefile, various dates) was from DNR. Large-Scale D.G. Hypsography data (line shapefile, various dates) was from the US Geological Survey and based on a 1:24,000 scale. Surface Coal Mines in Southwestern Indiana (polygon shapefile, 2000107) was from the Indiana Geologic Survey and based on a 1:24,000 scale. Unconsolidated Aquifer System coverage (Scott, 2011) was based on a 1:24,000 scale.

### Unconsolidated Aquifer Systems of Greene County, Indiana

by  
Robert A. Scott  
Division of Water, Resource Assessment Section  
May 2011



# Greene County

