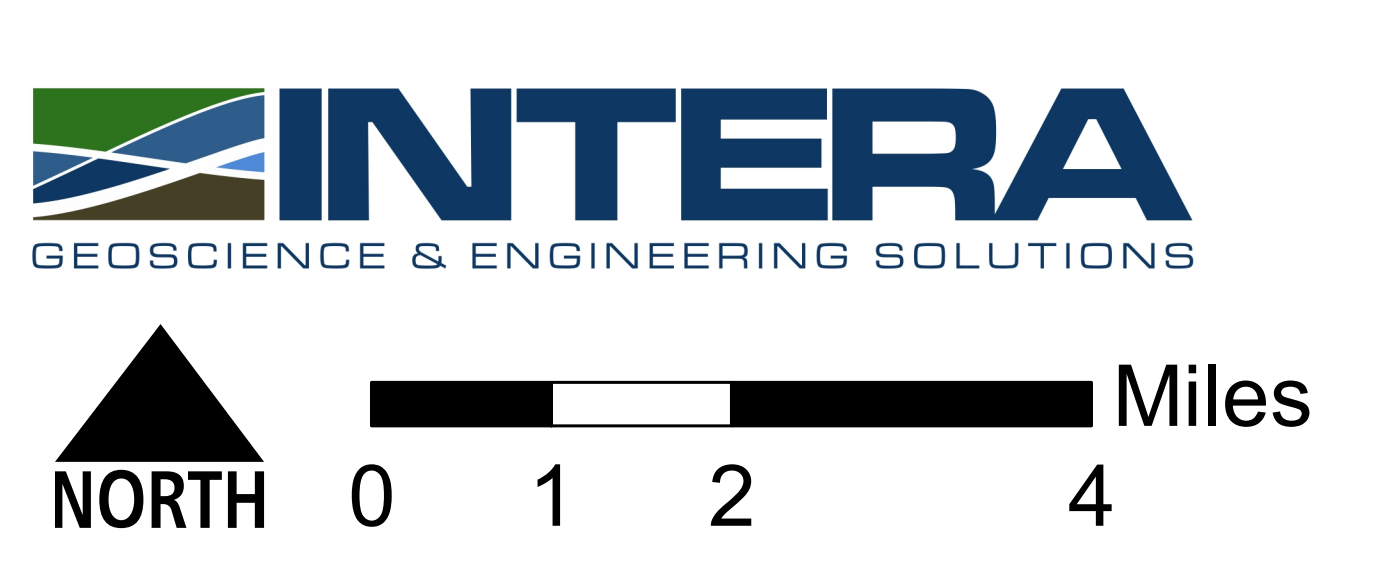
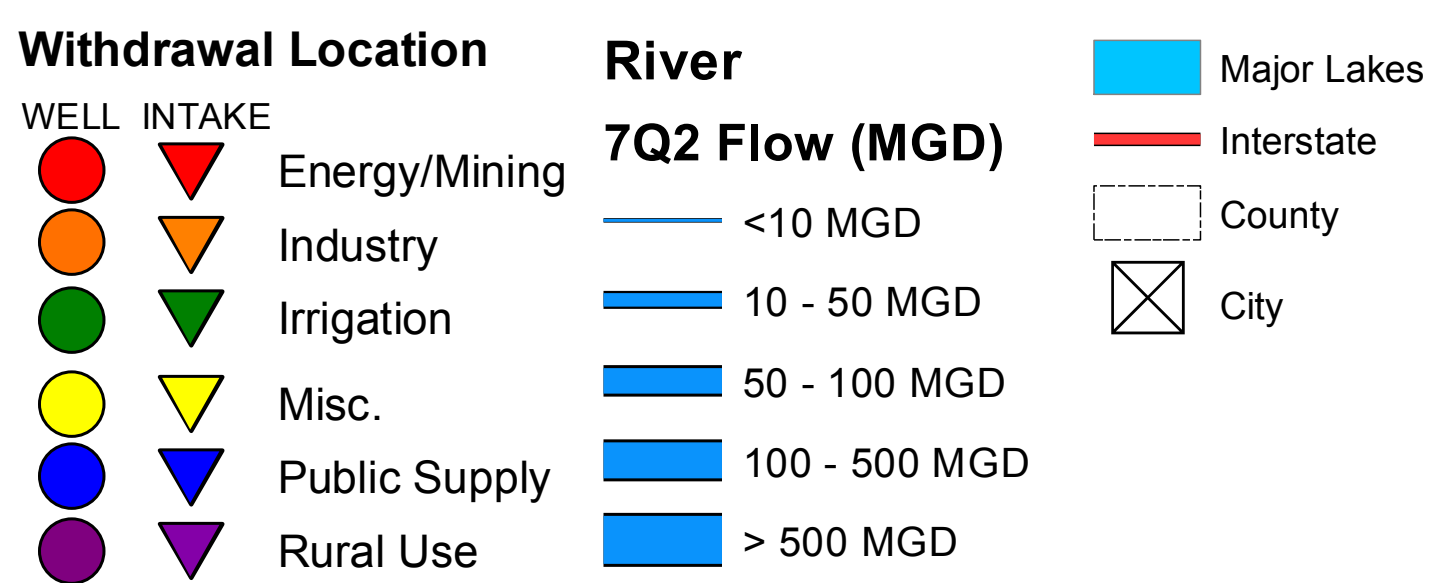
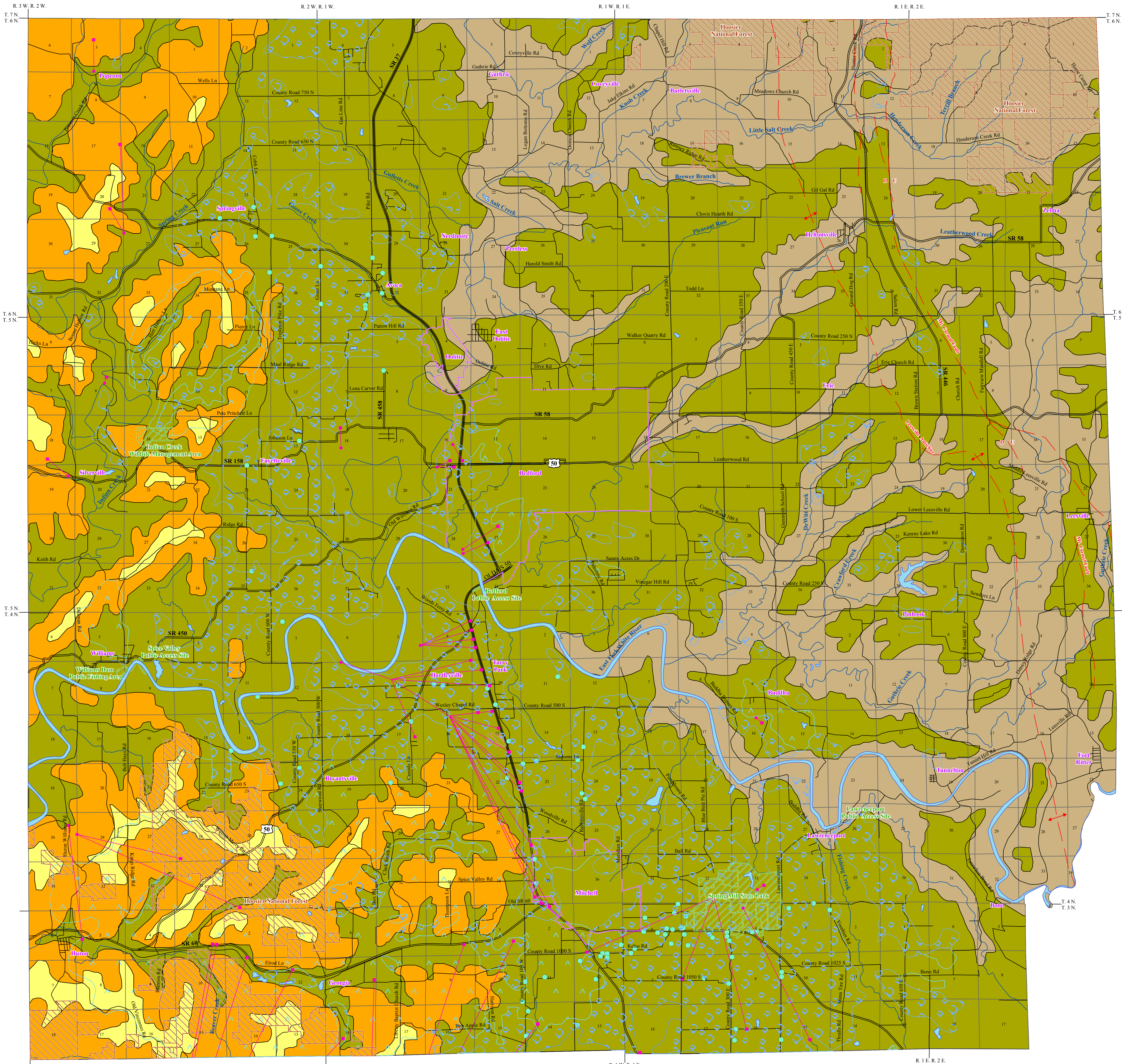


Water Resources and Use in Lawrence County

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



BEDROCK AQUIFER SYSTEMS OF LAWRENCE COUNTY, INDIANA



The occurrence of bedrock aquifers depends on the original composition of the rocks and subsequent changes which influence the hydraulic properties. Post-depositional processes, such as jointing, fracturing, and solution activity, generally increase the hydraulic conductivity (permeability) of the upper portion of bedrock aquifer systems. Because permeability is generally greater near the bedrock surface, bedrock units within the upper 100 feet are commonly the most productive aquifers. In Lawrence County, rock types exposed at the bedrock surface range from relatively unproductive shales to moderately productive limestones.

Bedrock aquifer systems in the county are overlain by unconsolidated deposits of varying thickness. Most of the bedrock aquifers in the county are under confined conditions. In other words, the potentiometric surface (water level) in most wells completed in bedrock rises above the top of the water-bearing zone.

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

The quality of ground water in existing wells is generally satisfactory for domestic purposes, although some users may prefer some treatment for iron or hardness. The potential for encountering mineralized or saline ground water increases with greater well depths. This is especially true for any wells that may be drilled into bedrock strata below the Borden Group (for example, New Albany Shale and Limestone of Devonian age). Therefore, the discussion and evaluation of the ground-water potential of the bedrock aquifers is essentially limited to those geologic units lying above the expected limits of nonpotable water.

Four bedrock aquifer systems are identified for Lawrence County. They are, from west to east, youngest to oldest: Raccoon Creek Group of Pennsylvanian age; Buffalo Wallow, Stephensport, and West Baden Groups of Mississippian age; Blue River and Sanders Groups of Mississippian age; and Borden Group of Mississippian age.

The susceptibility of bedrock aquifer systems to surface contamination is largely dependent on the type and thickness of the overlying sediments. Just as recharge for bedrock aquifers cannot exceed that of overlying unconsolidated deposits, susceptibility to surface contamination will not exceed that of overlying deposits. However, 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.

Pennsylvanian -- Raccoon Creek Group Aquifer System

The Raccoon Creek Group outcrops on high ridge tops in the western and southwestern portions of Lawrence County. Most of the Pennsylvanian strata in Lawrence County has been eroded and only a thin remnant of the lowermost Mansfield Formation remains along ridges and hillsides. Thickness of the group in this county is less than 150 feet. The Mansfield Formation is composed primarily of cross-bedded sandstone with quartz-pebbles and chert conglomerate as well as carbonaceous shale.

Few wells are completed in the Raccoon Creek Group. Well depths in the general area range from 60 to 350 feet with the deeper wells penetrating into the underlying Mississippian strata in order to obtain an adequate ground-water supply. Depth to bedrock ranges from 0 to 30 feet. The Raccoon Creek Group is a limited ground-water resource with no potential for high-capacity wells in the county. Several of the existing domestic wells report capacities of less than 1 gallon per minute (gpm). Static water levels typically range from 10 to 100 feet.

The Raccoon Creek Group has a low susceptibility to contamination introduced at and near land surface. Relatively low permeability shale and sandstone units capped by dominantly clay materials occur above the water-bearing zones.

Mississippian -- Buffalo Wallow, Stephensport, and West Baden Groups Aquifer System

This Upper Mississippian bedrock aquifer system occurs in western and southwestern Lawrence County. This aquifer system 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 combined thickness of the West Baden and Stephensport in the county ranges from 0 where the older Blue River Group rocks are exposed to a maximum of about 210 feet in the western part of the county where the younger Pennsylvanian rocks occur. In the county, the Mississippian age bedrock was truncated by thousands of years of erosion. Subsequent burial of the erosion surface by sedimentation during Pennsylvanian time created one of the most widespread regional unconformities in the world, the Mississippian-Pennsylvanian unconformity. Younger Pennsylvanian age rocks overlap onto progressively older Mississippian age rocks at increasing distances north of the Ohio River. In the outcrop area of the Buffalo Wallow, Stephensport, and West Baden Groups Aquifer System nearly all of the surface bedrock materials are from the West Baden Group. The West Baden has a maximum thickness of 100 feet or less in the county. A limited amount of the overlying Stephensport strata is present in the extreme southwestern and northwestern parts of the county with a maximum thickness of about 110 feet.

The West Baden and Stephensport Groups are composed primarily of shale, limestone, and sandstone. The West Baden Group has 25 percent limestone, 40 percent shale, and 35 percent sandstone. The Stephensport Group has more limestone (approximately 40 percent) than the West Baden Group, less shale (25 percent), and chert-forming sandstone (35 percent).

The depth to the bedrock surface is generally from 10 to 30 feet. Depths of wells that initially penetrate rocks in the Stephensport and West Baden Groups range from 75 to 350 feet, with most wells completed at depths of about 140 to 260 feet. Most wells deeper than 200 feet penetrate through the West Baden into the underlying Blue River Group.

The Buffalo Wallow, Stephensport, and West Baden Groups Aquifer System is not regarded as a major ground-water resource. However, most attempts to drill a domestic well into it are successful. Most of the water is found in the limestone and sandstone beds. Domestic wells completed in the system are commonly tested at 5 gpm or less. Reported static water levels range from 20 to 275 feet below land surface but are typically between 20 and 175 feet.

In the outcrop/subcrop area of the Stephensport and West Baden Groups Aquifer System the rock is predominantly shallow and contains numerous, irregular joints. In isolated areas some karst (see Karst Features and the Dissolution of Carbonate Rocks) 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.

Mississippian -- Blue River and Sanders Groups Aquifer System

The Blue River and Sanders Groups Aquifer System is present over most of Lawrence County. This Middle Mississippian age aquifer system encompasses two groups: the lowermost Sanders Group and the overlying Blue River Group. The Sanders Group includes the Haroldsburg and Salem limestone formations. These groups outcrop in a northwest to southeast band across the county. These are primarily limestones with some dolomitic limestone content. The overlying Blue River Group includes the St. Louis, Ste. Genevieve, and Paoli limestone formations. These are primarily limestones containing significant amounts of gypsum, anhydrite, shale, chert, and calcareous sandstone. Combined thickness for the Blue River and Sanders Groups ranges from 0 at their eroded eastern edge to about 775 feet in the southwest corner of the county where younger rocks overlie them.

Well depths in the Blue River and Sanders Groups Aquifer System in Lawrence County range from 25 to 325 feet, but most wells are completed at depths of about 95 to 175 feet. Depth to bedrock is generally between 10 and 40 feet below land surface.

The Blue River and Sanders Groups Aquifer System is not regarded as a major ground-water resource in Lawrence County. The potential for developing high-capacity wells is limited. Most domestic well capacities are less than 5 gpm. However, in some areas fractures and solution features may enhance production. Greater capacities have been reported but it is unlikely that these rates can be sustained for long durations. Reported static water levels range from 10 feet to 250 feet below land surface but are commonly between 20 and 80 feet.

Much of the Blue River and Sanders bedrock is within the Mitchell Plateau physiographic unit, an area typified by significant karst (see Karst Features and the Dissolution of Carbonate Rocks) development. Several well records describe cavities or solution channels with such terms as "mal and boulders, caves, or broken limestone". There are large areas of very shallow bedrock containing numerous joints, fractures, and solution features. These conditions warrant considering the aquifer system as a whole to be very susceptible to contaminants introduced at and near land surface.

Mississippian -- Borden Group Aquifer System

The outcrop/subcrop area of the Mississippian age Borden Group Aquifer System includes portions of the eastern half of Lawrence County, primarily in the valleys of the East Fork White River and some of its major tributaries. This bedrock aquifer system is composed mostly of siltstone and shale, but fine-grained sandstones are common. Carbonates are rare, but do occur as discontinuous interbedded limestone lenses, mostly in the upper portion of the group.

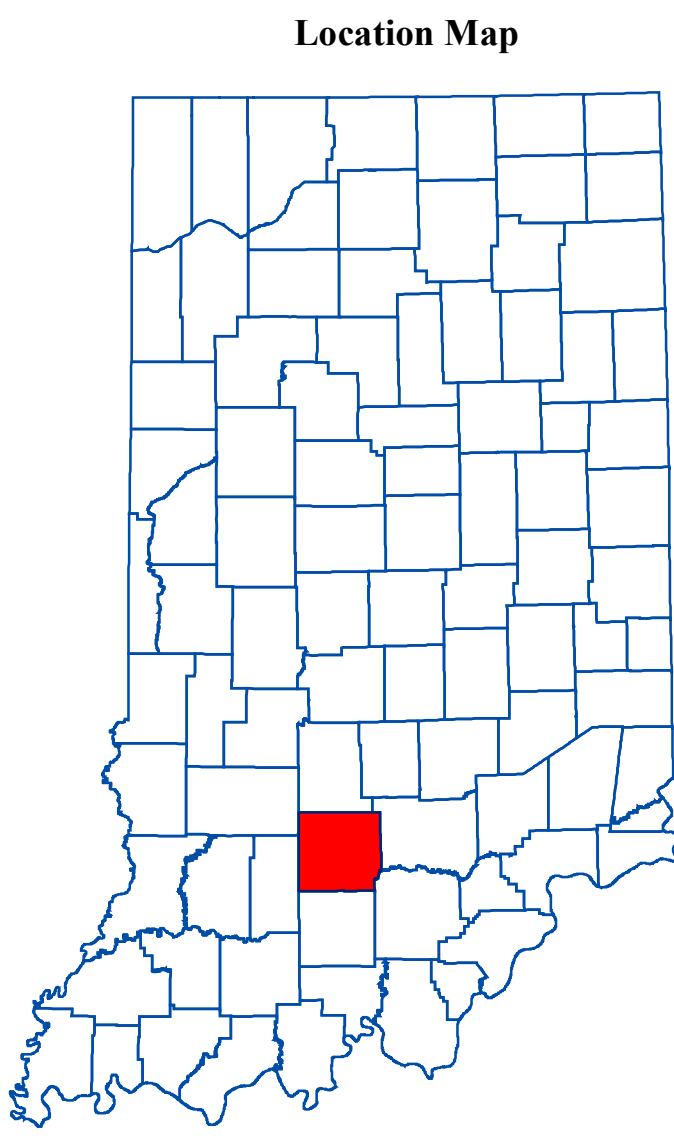
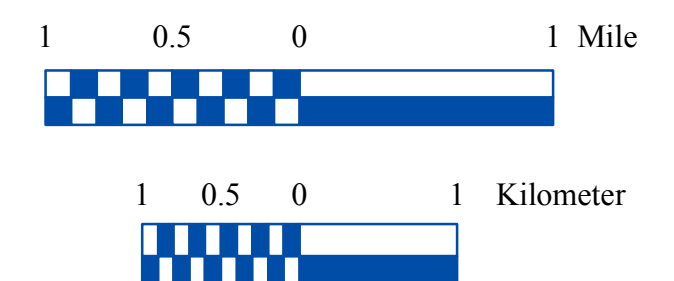
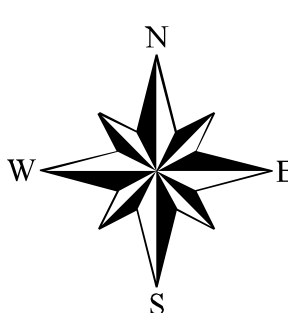
The Borden Group in Lawrence County is up to 550 feet thick and generally thins as it dips to the southwest beneath younger rock formations. Well depths in the Borden Group Aquifer System range from 40 to 340 feet. However, most wells are completed at depths of 60 to 140 feet. Reported static water levels in the wells completed in the Borden aquifer range from 10 to 110 feet below land surface, but are commonly between 10 and 60 feet.

Because the Borden Group is generally not very productive, it is typically used only where overlying deposits do not contain an aquifer. The Borden Group is often described as an aquitard and yields of wells completed in it are usually quite limited. Many wells, however, are able to produce sufficient water for domestic purposes by relying on extra well-bore storage created by drilling relatively large diameter and relatively deep wells. Most domestic wells completed in the group have reported testing rates of less than 5 gpm. A limited number of wells have been tested at greater rates, but it is doubtful that many could sustain such rates for very long. Overall, there is little chance for development of high-capacity wells in the Borden Group Aquifer System.

The Borden Group is composed primarily of fine-grained materials that limit the movement of ground water. This, along with up to 20 feet of overlying clay materials, puts the Borden Group Aquifer System at low risk to contamination from the surface or near surface.

EXPLANATION

- Sinking-Stream Basin
- Sinkhole Area
- Municipal Boundary
- State Managed Property
- Lake & River
- Cave or Crevice Described on Water Well Record
- Dye Test Input Point
- Dye Test Detection Point
- Karst Dye Trace
- Mt. Carmel Fault
- Levee/Anticline Crest
- County Road
- State Road & US Highway
- Stream



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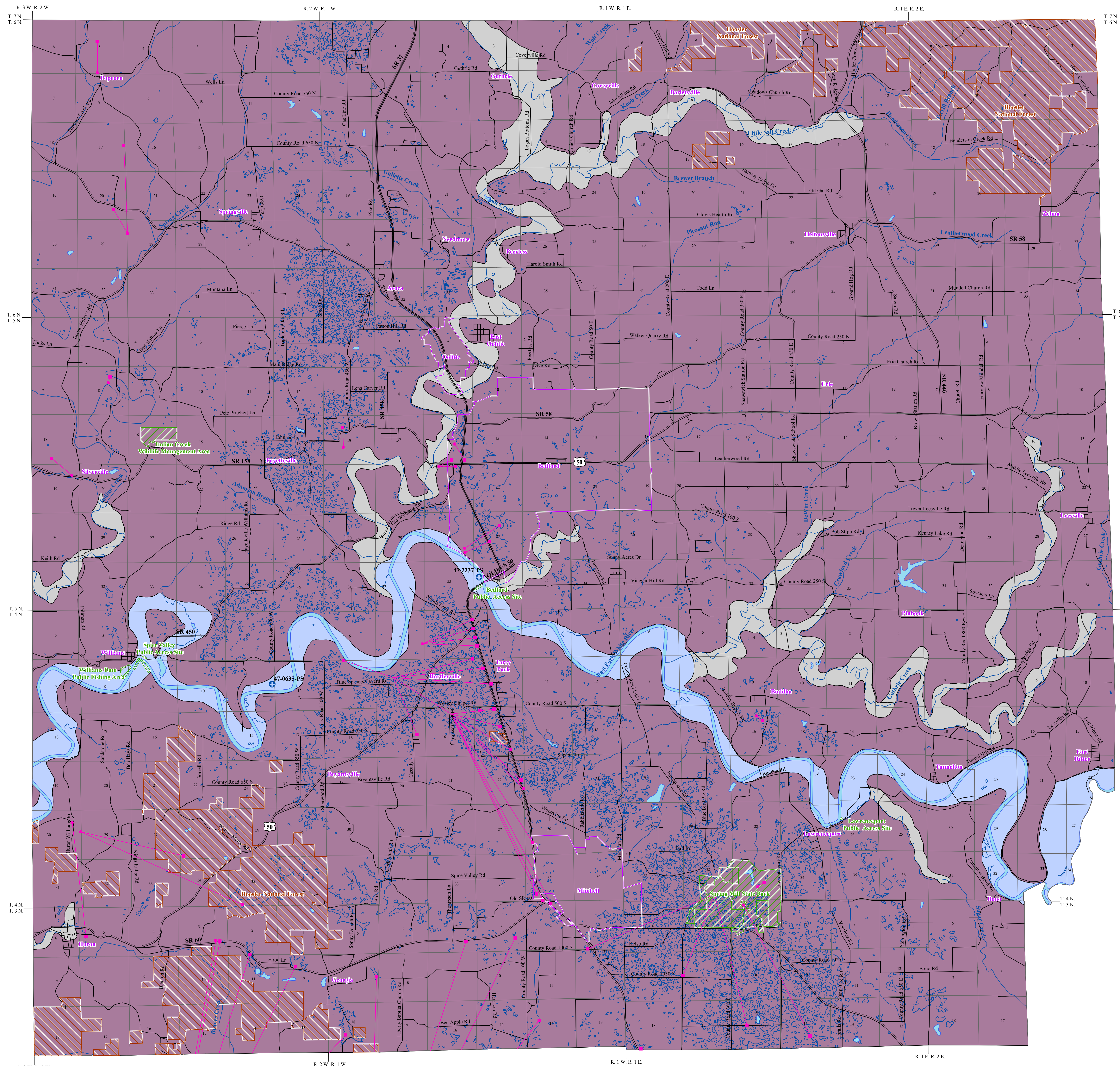
This map was created from several existing shapefiles: Township and Range Lines of Indiana (line shapefile, 20020621), Land Survey Lines of Indiana (polygon shapefile, 20020621), and County Boundaries of Indiana (polygon shapefile, 20050621) were all from the Indiana Geological Survey and based on a 1:24,000 scale, except the Bedrock Geology of Indiana (polygon shapefile, 20020318), which was at a 1:500,000 scale. Draft road shapefiles, System1 and System2 (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, 20021000) was from the U.S. Census Bureau and based on a 1:100,000 scale. Structural Features of Indiana (line shapefile, 20020718) was from the Indiana Geological Survey and based on various scales. Streams27 (line shapefile, 20000420) was from the Center for Advanced Applications in GIS at Purdue University. Managed Areas 96 (polygon shapefile, various dates) was from IDNR. Selected Subsurface Dye Traces in Parts of Southern Indiana (line shapefile, 2000025), and Input and Detection Points for Selected Subsurface Dye Traces in Parts of Southern Indiana (point shapefile, 20001124) were all from the Indiana Geological Survey and based on a 1:24,000 scale. Sinkhole Areas and Sinking-Stream Basins in Part of Southern Indiana (polygon shapefile, 20001124) were also from the Indiana Geological Survey, but based on a 1:126,720 scale.

Bedrock Aquifer Systems of Lawrence County, Indiana

by
Randal D. Maier
Division of Water, Resource Assessment Section



UNCONSOLIDATED AQUIFER SYSTEMS OF LAWRENCE COUNTY, INDIANA



Three unconsolidated aquifer systems have been mapped in Lawrence County: the Unglaciated Southern Hills and Lowlands; the Alluvial, Lacustrine, and Backwater Deposits; and the White River and Tributaries Outwash. Boundaries between the systems are relatively well defined.

With the exception of the White River and Tributaries Outwash Aquifer System, unconsolidated aquifers in the county do not have much potential for development of successful water wells. The majority of the county has less than 30 feet of unconsolidated material overlying bedrock. Drillers prefer to bypass the unconsolidated deposits in favor of the underlying bedrock. However, that too has relatively limited potential, and many county residents prefer to tap into a public water supply serving much of the county.

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

Unglaciated Southern Hills and Lowlands Aquifer System

The Unglaciated Southern Hills and Lowlands Aquifer System covers most of Lawrence County. It is the most limited groundwater resource of the unconsolidated aquifer systems in the county. The unconsolidated deposits generally involve weathered bedrock residuum with some eolian sand deposits in some areas near the White River. No known glacial till deposits exist in the county.

Total thickness of the unconsolidated materials overlying bedrock are up to 50 feet but are generally from 10 to 35 feet. Thicker materials are present in areas near the East Fork White River where loess sand and loess deposits overlie clay materials, or where karst features are prevalent and sequences of "boulders and mud holes" or "broken limestone and mud" are reported by drillers.

Clay materials dominate this unconsolidated aquifer system. Thin sand or gravel materials may be present but are rare and commonly less than 3 feet thick. Some smaller stream valleys are also mapped in this system. These may include a few feet of colluvium, alluvium, and lacustrine silt and clay. In those valleys a thin sand layer may be encountered.

The Division has no record of drilled wells actually producing from this system. Where only bedrock residuum is present, the chances for completing a successful drilled well in these materials are practically zero. A few old dug wells may still exist in the county, but their yields would be very small.

Because of the low permeability of the surface materials, this system is not very susceptible to contamination from surface sources.

Alluvial, Lacustrine, and Backwater Deposits Aquifer System

The Alluvial, Lacustrine, and Backwater Deposits Aquifer System is made up of heterogeneous bodies of alluvial, colluvial, and lacustrine materials within valley bottoms and terraces of some larger streams tributary to the East Fork White River.

Unconsolidated deposits within the system include Wisconsin and Holocene (Recent) silt, sand, and gravel along streams and terraces as well as pre-Wisconsin age colluvial, alluvial, and lacustrine silt, clay, and sand. The lacustrine deposits are older lake materials formed in bodies of relatively stagnant water. These deposits are attributed to the White River valley becoming choked with outwash from receding glaciers. The outwash deposits effectively dammed the tributary streams, thus creating lakes in which several feet of fine-grained glaciolacustrine deposits accumulated.

Total thickness of unconsolidated materials overlying bedrock in this system is commonly less than 50 feet. However, around the Town of Huron a few wells report thicker sequences of unconsolidated deposits with one well reporting up to 99 feet of clay, sand, and gravel. Most sand and gravel lenses, where present, are commonly less than 5 feet thick and may be confined within the glaciolacustrine deposits or directly overlie bedrock.

This aquifer system is an extremely limited resource and the Division has no records of wells actually producing from these deposits. Drillers prefer to bypass the unconsolidated deposits in favor of the underlying bedrock. The potential does exist, however, for completion of adequate domestic wells in some places where the unconsolidated deposits are thicker than 25 feet. Large-diameter bucket-rig wells are commonly successfully employed where other means of extracting seepage from limited or fine-grained deposits are not available.

This aquifer system is generally marked by surface deposits of soft silt and clay that have low susceptibility to surface contamination.

White River and Tributaries Outwash Aquifer System

The White River and Tributaries Outwash Aquifer System is located in the southern half of Lawrence County along the course of the East Fork White River. The system is made up of large volumes of outwash materials that were deposited within the river valley by the retreating continental ice sheets. As the ice sheets melted, the sediment contained within them was delivered to the East Fork White River in quantities too large for the stream to transport. As a result, the increased sediment load was stored in the valley as vertical and lateral accretionary deposits. As long as the retreating ice continued to provide sediment in quantities too large for the stream to transport, the valley continued to be filled. This valley-filling process formed the most prolific aquifer system in the county.

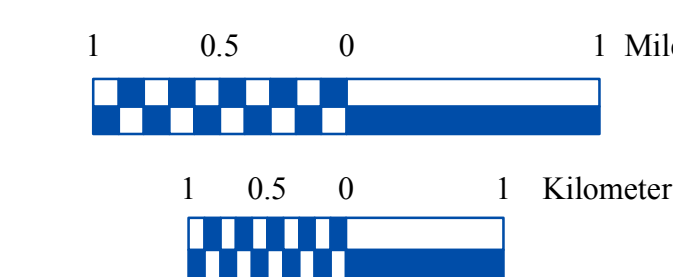
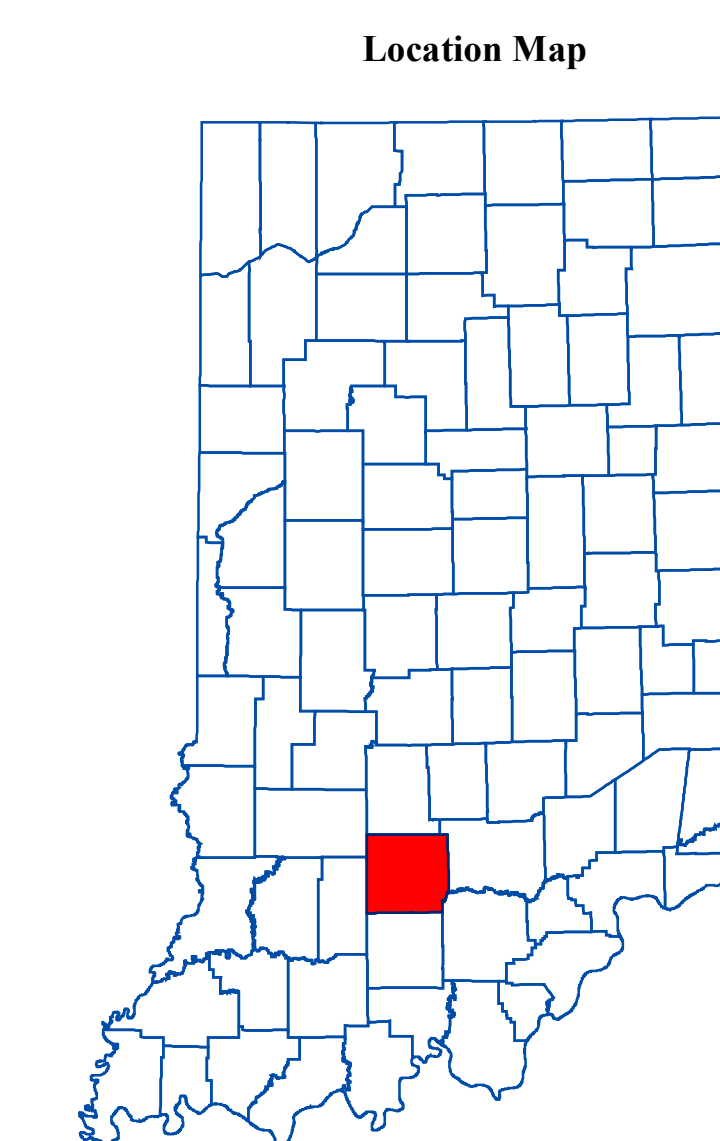
This unconsolidated aquifer system overlies bedrock and typically ranges from 20 to 100 feet in total thickness. The sand and gravel deposits in some areas may be overlain by a silty clay or a clay-sand mixture that ranges from 8 to 35 feet thick. Sand and gravel deposits are reported up to 90 feet thick. Insufficient data are available to give a typical range for aquifer thickness and water levels in the county.

The White River and Tributaries Outwash Aquifer System has the greatest potential of any aquifer system in Lawrence County and can meet the needs of high-capacity water users. Data from the few well records available show that well yields of 125 to 550 gallons per minute (gpm) have been obtained in this aquifer system. Static water levels in those wells range from 8 to 23 feet below surface.

This aquifer system is generally unconfined and, therefore, is highly susceptible to surface contamination in areas where no clay cover exists. It is moderately susceptible where a clay cover is present.

EXPLANATION

- Registered Significant Ground-water Withdrawal Well
- Dye Test Input Point
- Dye Test Detection Point
- Karst Dye Trace
- Stream
- County Road
- State Road & US Highway
- Lake & River
- Federal Managed Property
- State Managed Property
- USGS Closed Contours (Mostly Karst Depressions)
- Municipal Boundary



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Unconsolidated Aquifer Systems of Lawrence County, Indiana

by
Randal D. Maier
Division of Water, Resource Assessment Section
September 2003

Lawrence County

