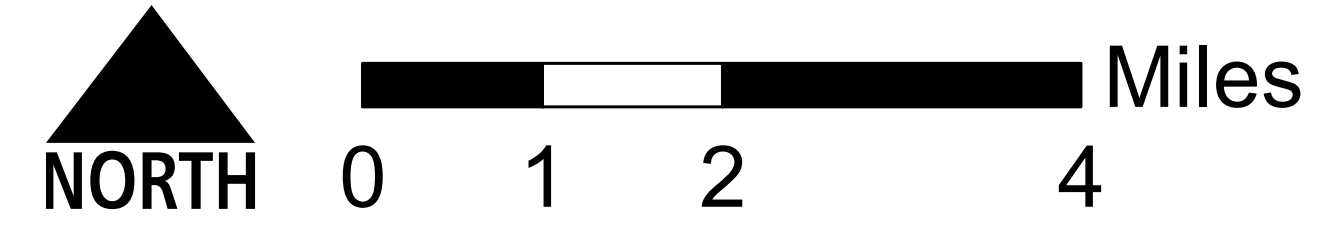


Water Resources and Use in Vigo County

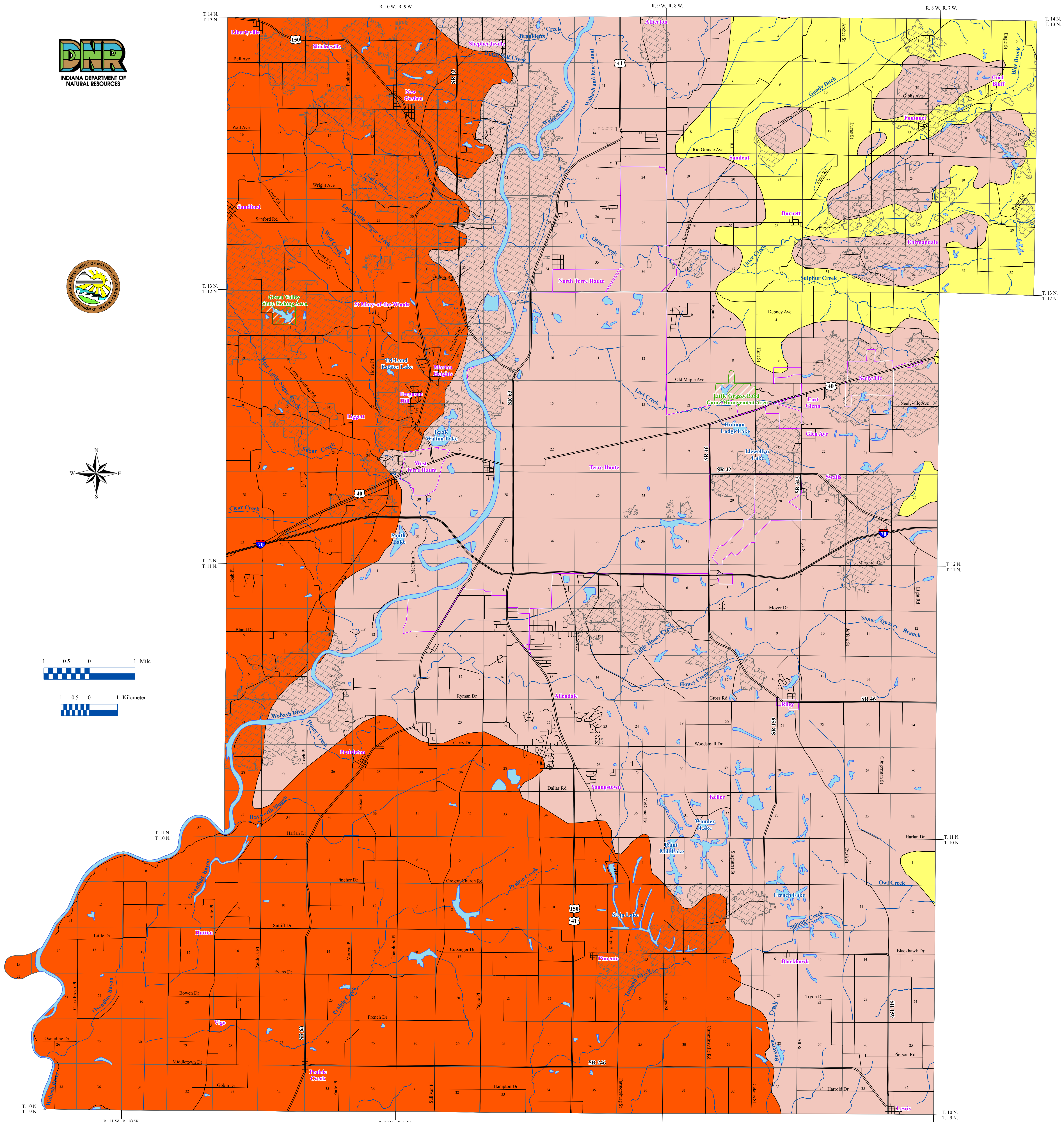
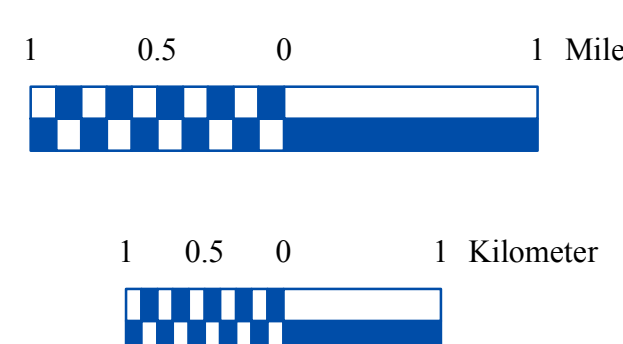
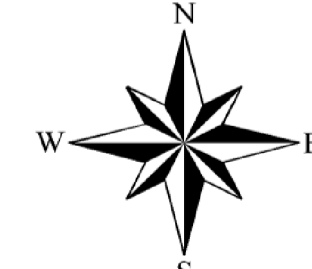
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|----------------------------|-----------------------|
| Withdrawal Location | River |
| WELL INTAKE | 7Q2 Flow (MGD) |
| ● Energy/Mining | — <10 MGD |
| ● Industry | — 10 - 50 MGD |
| ● Irrigation | — 50 - 100 MGD |
| ● Misc. | — 100 - 500 MGD |
|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

- Major Lakes
- Interstate
- County
- ⊠ City



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

BEDROCK AQUIFER SYSTEMS OF VIGO 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.

Bedrock aquifer systems in the county are overlain by unconsolidated deposits ranging from less than one foot up to 150 feet thick. The unconsolidated sand and gravel outwash aquifers near the Wabash River have far greater groundwater potential than any of the bedrock aquifers. However, bedrock aquifers are widely used in Vigo County where unconsolidated sediments are relatively thin and unproductive. There are no registered significant groundwater withdrawal facilities utilizing bedrock aquifers in this county. Most of the bedrock aquifers 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 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.

Three bedrock aquifer systems are identified for Vigo County. They are, from west to east and younger to older: the McLeansboro Group of Pennsylvanian age, the Carbondale Group of Pennsylvanian age and the Racoon Creek Group of Pennsylvanian age.

Pennsylvanian -- McLeansboro Group Aquifer System

The McLeansboro Group subarea is located in the western and southwestern portions of the county. This aquifer system consists in ascending order of the Shelburn, Patoka, Bond, and Mattoon Formations. However, in Vigo County the Mattoon Formation is absent. Total thickness of the group ranges up to 200 feet.

The Patoka Formation consists primarily of shale and sandstone with clay, limestone, and coal. The underlying Shelburn Formation consists of shale, siltstone, sandstone, coal, and limestone. Two important members of the Shelburn Formation include the West Franklin Limestone at the top of the formation and the Busserson Sandstone at the base. These are the primary aquifer units within the McLeansboro Group Aquifer System.

The depth to the bedrock surface ranges from less than one foot to over 125 feet in places, near St. Mary-of-the-Woods. Total well depths typically range from 50 to 170 feet. The amount of rock penetrated generally ranges from 10 to 110 feet. Most domestic wells produce less than 5 gallons per minute (gpm) with a few dry (pumped) holes reported. Static water levels range from 10 to 40 feet below the surface.

Most of the McLeansboro Group Aquifer System contains fine-grained materials that limit the movement of groundwater. However, in some areas alluvial materials directly overlie the bedrock surface. Therefore, the aquifer system is considered at moderate risk to contamination.

Pennsylvanian -- Carbondale Group Aquifer System

The Carbondale Group Aquifer System subsurfs throughout much of Vigo 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. Thickness of the Carbondale Group in Vigo County ranges up to 350 feet.

Depth to the bedrock surface is typically from 25 to 75 feet and well depths generally range from 70 to 200 feet. The amount of rock penetrated ranges from 10 to 160 feet. The Carbondale Group is considered a minor groundwater source with domestic wells typically pumping less than 10 gpm. Static water levels in the wells are commonly between 20 and 65 feet below the surface.

Most wells produce from the thicker sandstone and coal units in the upper formations of the Carbondale Group. Localized yields are greater in areas where outwash and alluvial sands and gravels directly overlie bedrock. A few dry (pumped) holes have been reported. Water quality from the deeper bedrock units is highly mineralized.

In areas where overlying clay materials are present, the Carbondale Group Aquifer System is at low risk to contamination. However, in some areas outwash and alluvial materials directly overlie the bedrock surface. These areas are at moderate to high risk from surface contamination.

Pennsylvanian -- Racoon Creek Group Aquifer System

The Racoon Creek Group Aquifer System subsurfs in portions of northeastern Vigo County. This bedrock aquifer system consists of mostly sandstone and shale with minor amounts of mudstone, coal, and limestone. The basal formation of the Racoon Creek Group, the Mansfield Formation, rests unconformably on Mississippian rocks. The Pennsylvanian-Mississippian erosional contact surface is quite irregular in elevation, resulting in variable thickness of Mansfield rocks. The lowermost part of the Mansfield commonly contains a large percentage of sandstone.

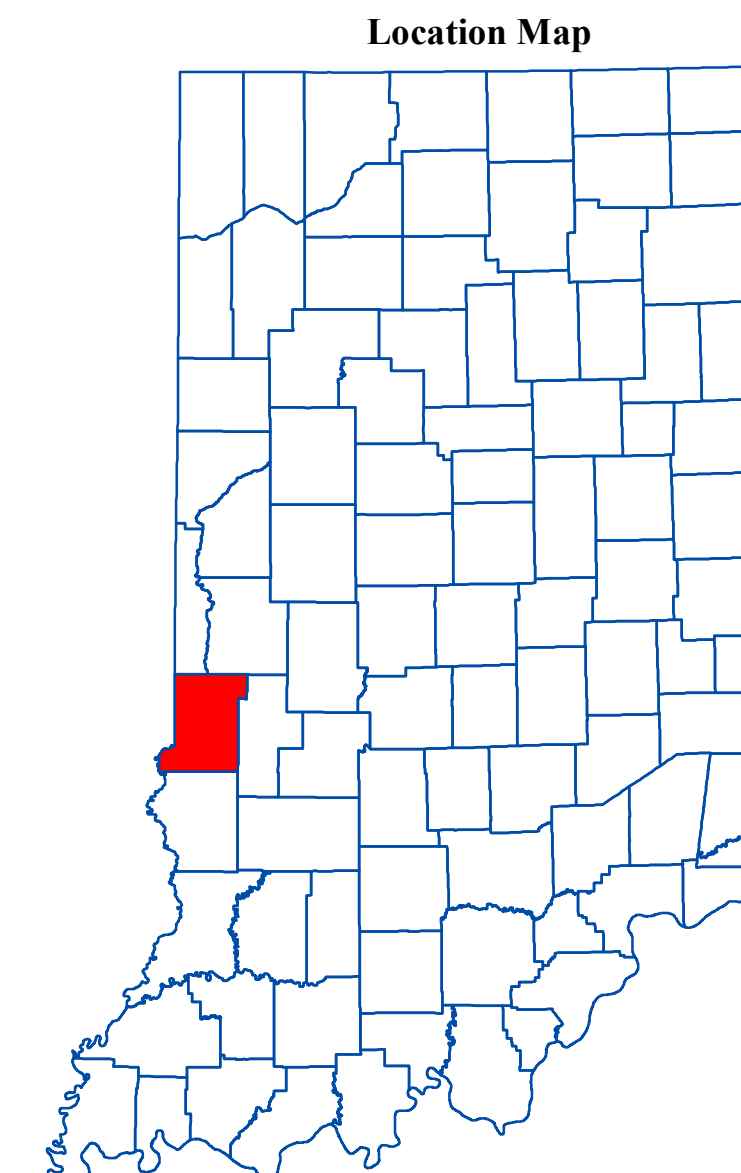
The depth to the bedrock surface is typically less than 100 feet. Wells in the Racoon Creek Group Aquifer System generally range from 70 to 250 feet deep. The amount of rock penetrated by wells varies from 10 to 150 feet. Domestic well production typically ranges from 2 to 15 gpm with a few dry (pumped) holes reported. Static water levels commonly range from 10 to 55 feet below the surface. This system is not very susceptible to contamination from the land surface because of thick, low-permeability strata above water-bearing zones. However, the system is moderately susceptible to contamination from the land surface where the unconsolidated deposits are thin.

Underground Mine Areas

In about 20 percent of the county various coal seams, primarily within the Carbondale Group, have been removed by underground mining methods. In underground mines approximately 50 percent of the coal seams was typically removed, leaving the potential for storage of substantial amounts of water in the larger mines. Although the Division has no records of wells drilled into these mines, yields of a few hundred gpm may be possible. A limitation on use of the water could be its more mineralized nature.

EXPLANATION

- Stream
- County Road
- State Road & US Highway
- Interstate
- Municipal Boundary
- State Managed Property
- Lake & River



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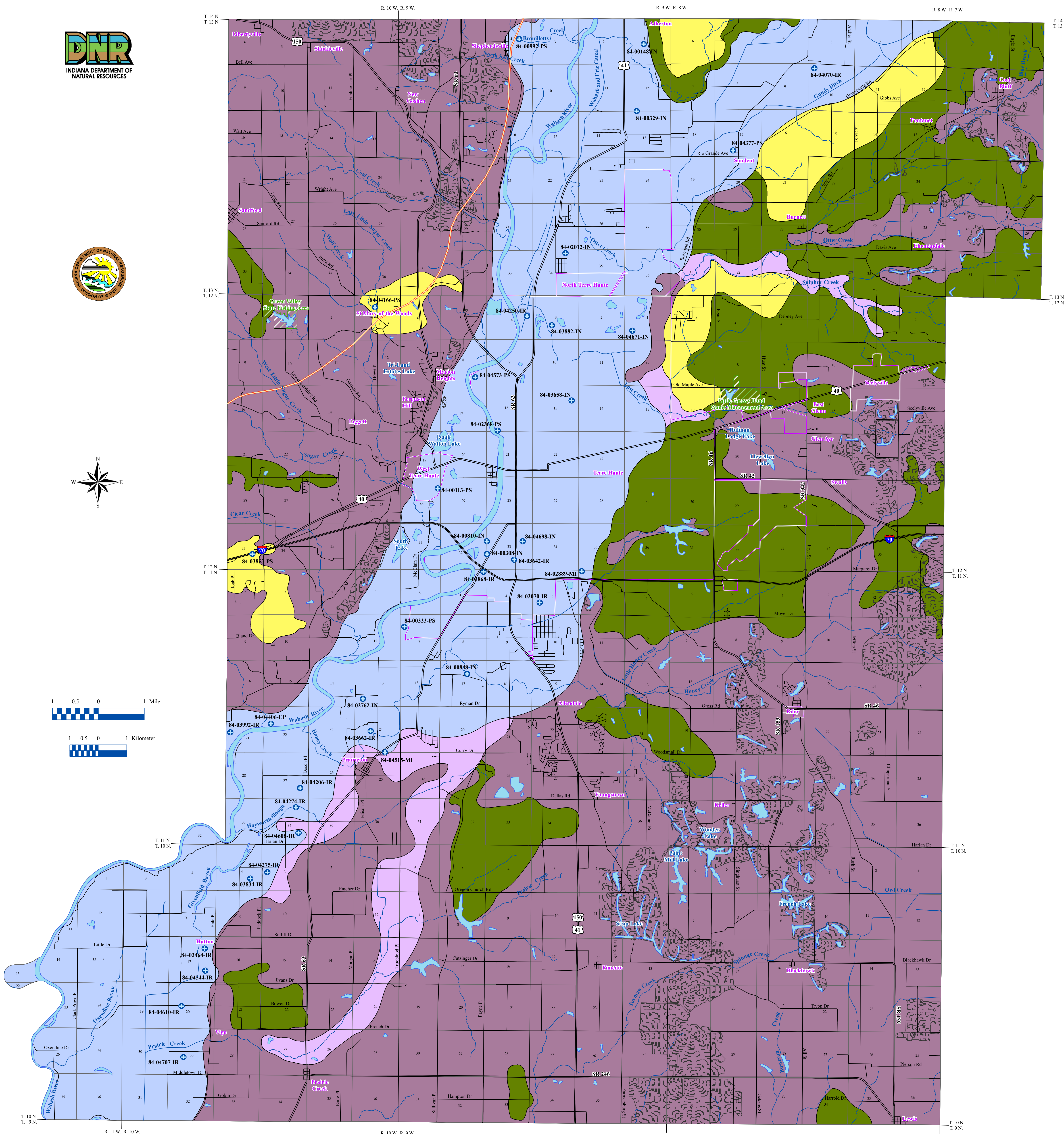
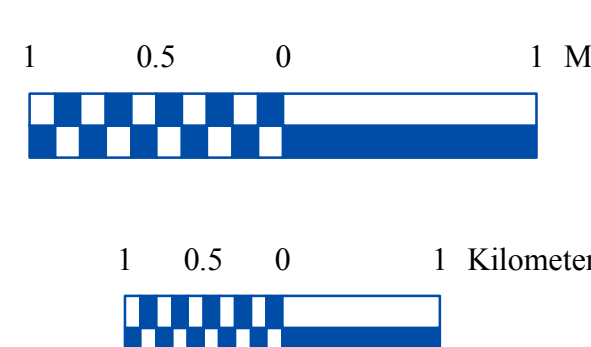
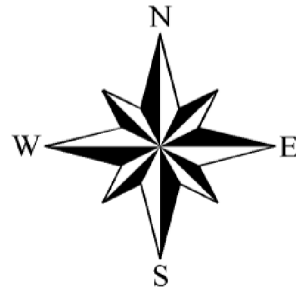
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This map was created from several existing shapefiles. Township and Range Lines of Indiana (line shapefile, 20020621), Land Survey Lines of Indiana (polygon shapefile, 20020621), County Boundaries of Indiana (polygon shapefile, 20020621) and Underground Coal Mines (polygon shapefile, 20081231), 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. Dead 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. 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.

Bedrock Aquifer Systems of Vigo County, Indiana

by
Glenn E. Grove
Division of Water, Resource Assessment Section
December 2009

UNCONSOLIDATED AQUIFER SYSTEMS OF VIGO COUNTY, INDIANA



The unconsolidated aquifer systems of Vigo County are composed of sediments deposited by, or resulting from, a complicated sequence of glacial, glacial meltwaters, and post-glacial precipitation events. Six unconsolidated aquifer systems have been mapped in Vigo County: the Dissected Till and Residuum/Till Veneer; the Central Wabash Valley/Wabash Lowland Till; the Central Wabash Valley/Wabash Lowland Till Subsystem; the Wabash River and Tributaries Outwash; the Wabash River and Tributaries Outwash Subsystem; and the Coal Mine Spoil. Because of the complicated glacial geology, boundaries of the aquifer systems in this county are commonly gradational and individual aquifers may extend across aquifer system boundaries.

The thickness of unconsolidated deposits in Vigo County is quite variable, due to the deposition of glacial material over an uneven bedrock surface. Unconsolidated deposits typically range from 25 to 75 feet thick in the county and are up to 150 feet thick in some areas along the Wabash River.

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, unplugged or improperly abandoned wells, and open excavations can provide contaminant pathways that bypass the naturally protective clays.

Dissected Till and Residuum/Till Veneer Aquifer System

In Vigo County, the Dissected Till and Residuum Aquifer System and the Till Veneer Aquifer System are mapped as one system because they are similar in composition and aquifer characteristics. As in counties to the south, the Dissected Till and Residuum Aquifer System includes areas where pre-Wisconsin and/or Wisconsin till is thin and dissected due to deep down-cutting by streams or where soils have formed directly from bedrock due to weathering. The Till Veneer Aquifer System encompasses areas where the unconsolidated material is predominantly thin till overlying bedrock. This system is chiefly the product of the deposition of glacial till over an uneven, eroded bedrock surface rather than erosion of till by younger streams. Also included in this aquifer system are relatively thin deposits of alluvium, colluvium and gravel outwash overlying shallow bedrock in many stream valleys.

Much of northern Vigo County is mapped as Dissected Till and Residuum, especially along the Wabash River where the streams are deeply incised. In most of the southern half and in the upland regions in the northern half of the county thin till over bedrock is mapped as the Till Veneer Aquifer System. Total thickness of this system generally ranges from about 20 to 50 feet.

The Dissected Till and Residuum/Till Veneer Aquifer System has the most limited groundwater resources of the unconsolidated aquifer systems. There is little potential for groundwater production in this system in Vigo County, and most wells are completed in the underlying bedrock. About 85 percent of the reported wells within this system include thin isolated sand and/or gravel layers, and surficial sand and gravel outwash or alluvium. Depth of the wells completed in the Dissected Till and Residuum/Till Veneer Aquifer System typically ranges from 30 to 50 feet deep with static water levels ranging between 5 and 20 feet below the surface. Most of the wells have reported capacities of less than 10 gallons per minute (gpm). There are no registered significant groundwater withdrawal facilities utilizing this system.

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.

Central Wabash Valley/Wabash Lowland Till Aquifer System

The Central Wabash Valley/Wabash Lowland Till Aquifer System is mapped primarily in the northern half of Vigo County. This aquifer system predominantly consists of pre-Wisconsin glacial materials that typically exceed 70 feet in thickness.

This aquifer system is generally capable of meeting the needs of most domestic users and some high-capacity users. Potential aquifer materials within the glacial till include discontinuous intertill sand and gravel layers. Individual sand and gravel units are commonly 7 to 15 feet thick. Well depths range from 60 to 115 feet in this system. Domestic well yields range from 5 to 15 gpm and static water levels are 10 to 65 feet below the land surface. There are two registered significant groundwater withdrawal facilities (5 wells) using the Central Wabash Valley/Wabash Lowland Till Aquifer System. These facilities are used for public supply and have reported pumping rates ranging from 40 to 90 gpm.

The Central Wabash Valley/Wabash Lowland Till Aquifer System typically has a low susceptibility to surface contamination because intertill sand and gravel units are commonly overlain by thick glacial till. Shallow wells completed in this system are moderately susceptible to contamination.

Central Wabash Valley/Wabash Lowland Till Aquifer Subsystem

The Central Wabash Valley/Wabash Lowland Till Aquifer Subsystem is primarily mapped east of the Wabash River in Vigo County. The subsystem is mapped similar to that of the Central Wabash Valley/Wabash Lowland Till Aquifer System. However, potential aquifer materials are generally thinner and potential yields are less in the subsystem.

Unconsolidated deposits typically range from 50 to 100 feet thick in the subsystem. Potential aquifer materials include thin, discontinuous intertill sand and gravel deposits. Where present, these deposits are typically capped by till that is commonly 30 to 60 feet thick.

About half of the wells started in this subsystem in Vigo County are completed in the intertill sand and gravel units. However, the Central Wabash Valley/Wabash Lowland Till Aquifer Subsystem is capable of meeting the needs of some domestic users in the county. The wells producing from this subsystem are typically completed at depths ranging from 50 to 90 feet. Intertill sand and gravel aquifer materials are commonly less than 5 feet thick. Domestic well yields are generally 2 to 10 gpm and static water levels are typically 10 to 45 feet below the surface. There are no registered significant groundwater withdrawal facilities utilizing this subsystem.

This subsystem is generally not very susceptible to surface contamination because intertill sand and gravel units are overlain by thick glacial till. Shallow wells from shallow aquifers are moderately to highly susceptible to contamination.

Wabash River and Tributaries Outwash Aquifer System

The Wabash River and Tributaries Outwash Aquifer System is mapped along the Wabash River in the county. This system includes thick glacial outwash sands and gravels and is capped by a layer of clay, sandy clay, silt, or loess deposits in a few places. The total thickness of unconsolidated deposits in this system ranges from 40 feet up to 150 feet.

This aquifer system is capable of meeting the needs of domestic and high-capacity users in Vigo County. The wells utilizing the Wabash River and Tributaries Outwash Aquifer System are completed at depths ranging from 40 to 75 feet with saturated sand and gravel aquifer materials commonly 25 to 60 feet thick. Static water levels are typically 20 to 40 feet below the surface. In Vigo County, there are 36 registered significant groundwater withdrawal facilities (78 wells) in this system. Predominant uses for these facilities are public water supply, industry and irrigation. Reported production for high-capacity wells ranges up to 2700 gpm. Also, one large diameter radial collector well has a reported capacity of 8333 gpm.

This system is highly susceptible to surface contamination where sand and gravel deposits are near the surface and have little or no clay deposits. However, areas that have overlying thick clay deposits are moderately susceptible to contamination.

Wabash River and Tributaries Outwash Aquifer Subsystem

The Wabash River and Tributaries Outwash Aquifer Subsystem is mapped along portions of Otter Creek and Prairie Creek and a few areas adjacent to the Wabash River. The subsystem is mapped similar to the Wabash River and Tributaries Outwash Aquifer System. However, potential aquifer materials are generally thinner, with thicker overlying silt and/or clay materials, and potential yields are less in the subsystem. The total thickness of unconsolidated deposits in this subsystem ranges from about 30 feet to over 100 feet. The aquifer materials are generally overlain by 10 to 45 feet of silt and/or clay. However, in some places, this layer is missing and unconsolidated sand and gravel deposits lie above the productive aquifer.

The Wabash River and Tributaries Outwash Aquifer Subsystem has the potential to meet the needs of domestic and some high-capacity users. The wells in this subsystem are completed at depths commonly ranging from 45 to 75 feet. Saturated aquifer materials include sand and gravel deposits that are commonly 10 to 30 feet thick. Domestic well yields typically range from 5 to 20 gpm with static water levels generally ranging from 5 to 30 feet below the surface. There are no registered significant groundwater withdrawal facilities in this subsystem in Vigo County.

Areas within this aquifer subsystem that have overlying clay deposits are moderately susceptible to surface contamination, whereas, areas that lack overlying clay deposits are highly susceptible to contamination.

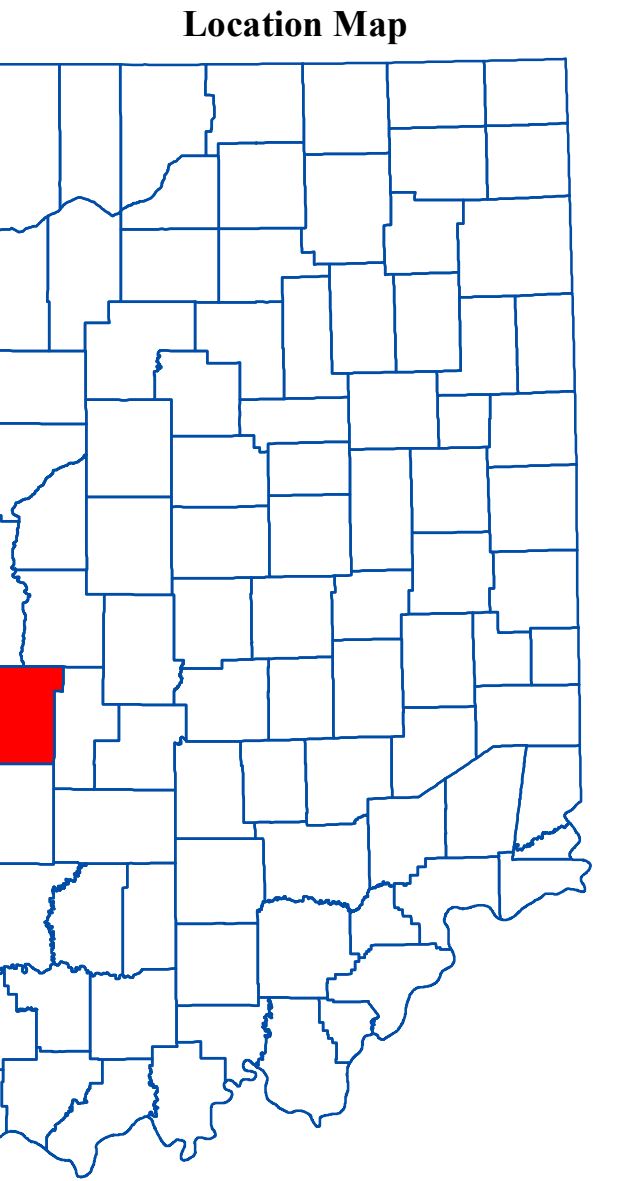
Coal Mine Spoil Aquifer System

The Coal Mine Spoil Aquifer System covers about 7 percent of Vigo County primarily because the coal seams are shallow enough to be economically surface mined. The coal seams occur within the Carboniferous Group of Pennsylvanian age and the upper Racoon Creek Group of Pennsylvanian age. The surface mined seams are in several large areas in eastern Vigo County and a few smaller areas west of the Wabash River. This aquifer system was formed during the process of mining coal by 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, silt, and sand up to gravel, slabs, and boulders. Where extensive, these spoil areas contain considerable amounts of groundwater.

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. Nearly all of the wells started in this system are completed in bedrock in Vigo County. However, one domestic well reports a yield of 10 gpm and a static water level of 25 feet below the surface. Also, a few observation wells for watershed reclamation projects utilize this system.

Generally, it is expected that aquifers in old coal mine spoil that was 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 moderately susceptible.

- EXPLANATION**
- Registered Significant Groundwater Withdrawal Facility
 - Stream
 - County Road
 - State Road & US Highway
 - Interstate
 - Southern Limit of Wisconsin Glacial Deposits
 - Municipal Boundary
 - State Managed Property
 - Lake & River



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Unconsolidated Aquifer Systems of Vigo County, Indiana
 by
 Glenn E. Grove
 Division of Water, Resource Assessment Section
 December 2009

Vigo County

