

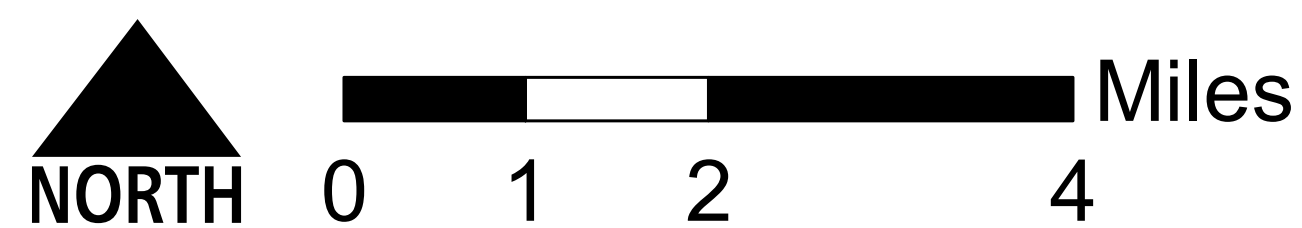
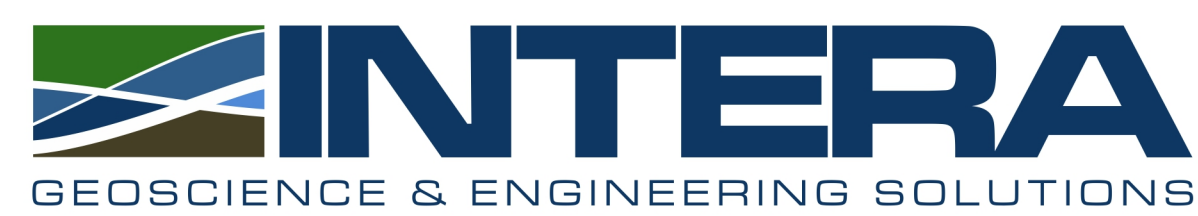
Water Resources and Use in Wayne County

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

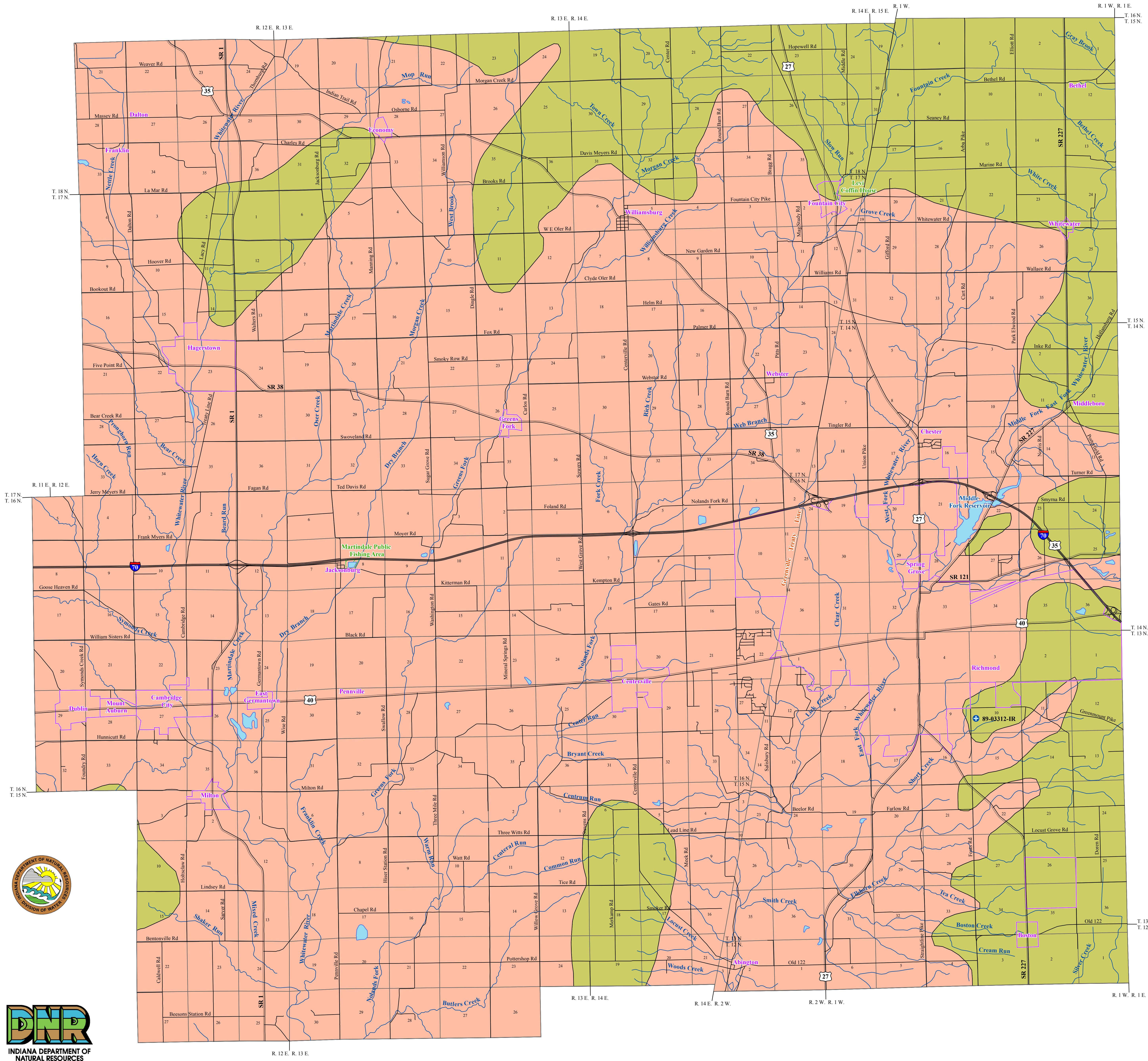
- Withdrawal Location**
- | WELL INTAKE | Symbol | Category |
|---------------|---------------|---------------|
| Red Circle | Red Circle | Energy/Mining |
| Orange Circle | Orange Circle | Industry |
| Green Circle | Green Circle | Irrigation |
| Yellow Circle | Yellow Circle | Misc. |
| Blue Circle | Blue Circle | Public Supply |
| Purple Circle | Purple Circle | Rural Use |

- River**
- | 7Q2 Flow (MGD) | Symbol |
|----------------|------------------------------------|
| <10 MGD | Thin Blue Line |
| 10 - 50 MGD | Medium Blue Line |
| 50 - 100 MGD | Thick Blue Line |
| 100 - 500 MGD | Very Thick Blue Line |
| > 500 MGD | Thick Blue Line with Dashed Border |

- | | |
|---------------------|-------------|
| Blue Square | Major Lakes |
| Red Line | Interstate |
| Dashed White Line | County |
| White Square with X | City |



BEDROCK AQUIFER SYSTEMS OF WAYNE 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, 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.

In Wayne County thickness of unconsolidated deposits overlying bedrock ranges from less than 5 feet in the east-central part of the county along Middle Fork East Fork Whitewater River near the town of Middleboro, to as much as 355 feet in the west-central part of the county southwest of Greens Fork where a buried bedrock valley is present.

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.

Two bedrock aquifer systems are identified for Wayne County. They are the Silurian and Devonian Carbonates and the Ordovician Maquoketa Group. Approximately 19 percent of all located wells in Wayne County are completed in bedrock.

Silurian and Devonian Carbonates Aquifer System

The Silurian and Devonian Carbonates Aquifer System subsurfaces along portions of northern, eastern, and southern Wayne County. In this county only the older Silurian age carbonates are present. Bedrock generally consists of limestone and dolomite with some shale.

Due to the availability of overlying unconsolidated deposits and the limited extent of the bedrock aquifer system, less than 5 percent of located wells are reported in this system in Wayne County. However, this system is capable of meeting the needs of some domestic and high-capacity users. Depth to the bedrock surface ranges from less than 5 feet to 240 feet. Total well depths are commonly from 30 to 130 feet. Well yields generally are from 1 to 12 gallons per minute (gpm) with static water levels from 15 to 45 feet below surface. In places, dry holes have been reported. There is one registered significant groundwater withdrawal facility (3 wells) with reported yields of 123 to 150 gpm.

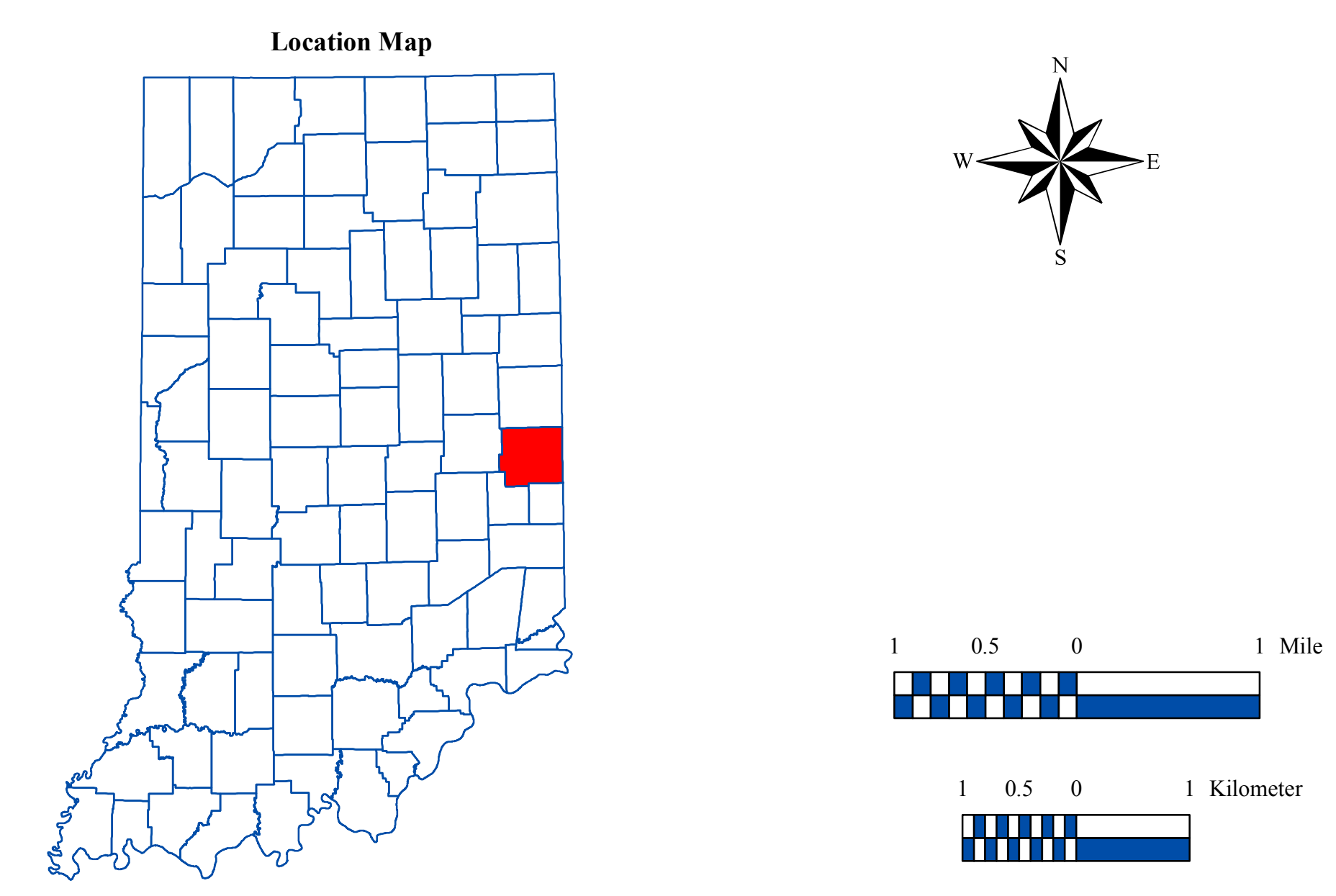
Most of the Silurian and Devonian Carbonates Aquifer System in Wayne County is overlain by thick clay deposits. These areas are considered at low risk to contamination. However, areas where bedrock is shallow and overlain by alluvial and outwash deposits are considered at moderate to high risk.

Ordovician - Maquoketa Group Aquifer System

The outcrop/subcrop area of the Maquoketa Group includes most of Wayne County. The Maquoketa Group consists of the Kope, the Dillsboro, and the Whitewater Formations. However, in Wayne County, only the Dillsboro and Whitewater Formations are present. This bedrock aquifer system includes mostly shale with some interbedded limestone units.

In Wayne County, the Maquoketa Group is considered a limited groundwater resource. Large diameter bucket wells are often used where overlying unconsolidated sands and gravels are limited and bedrock is shallow. Depth to the bedrock surface ranges from 4 to 290 feet but is typically 25 to 140 feet. Total well depths are commonly 50 to 165 feet. The amount of penetration into the Maquoketa Group is generally from 8 to 70 feet. Well yields are commonly 2 to 9 gpm with static water levels from 20 to 55 feet below surface. Also, significant drawdowns and dry holes are reported in this system.

Most of the Maquoketa Group Aquifer System in Wayne County is overlain by thick clay deposits. These areas are considered at low risk to contamination. However, in some places clay deposits are thin and/or sands and gravels directly overlie the bedrock surface. These areas are considered at high risk to contamination.



EXPLANATION	
	Registered Significant Ground-Water Withdrawal Facility
	Stream
	County Road
	State Road & US Highway
	Interstate
	Municipal Boundary
	State Managed Property
	Lake & River



Map Use and Disclaimer Statement

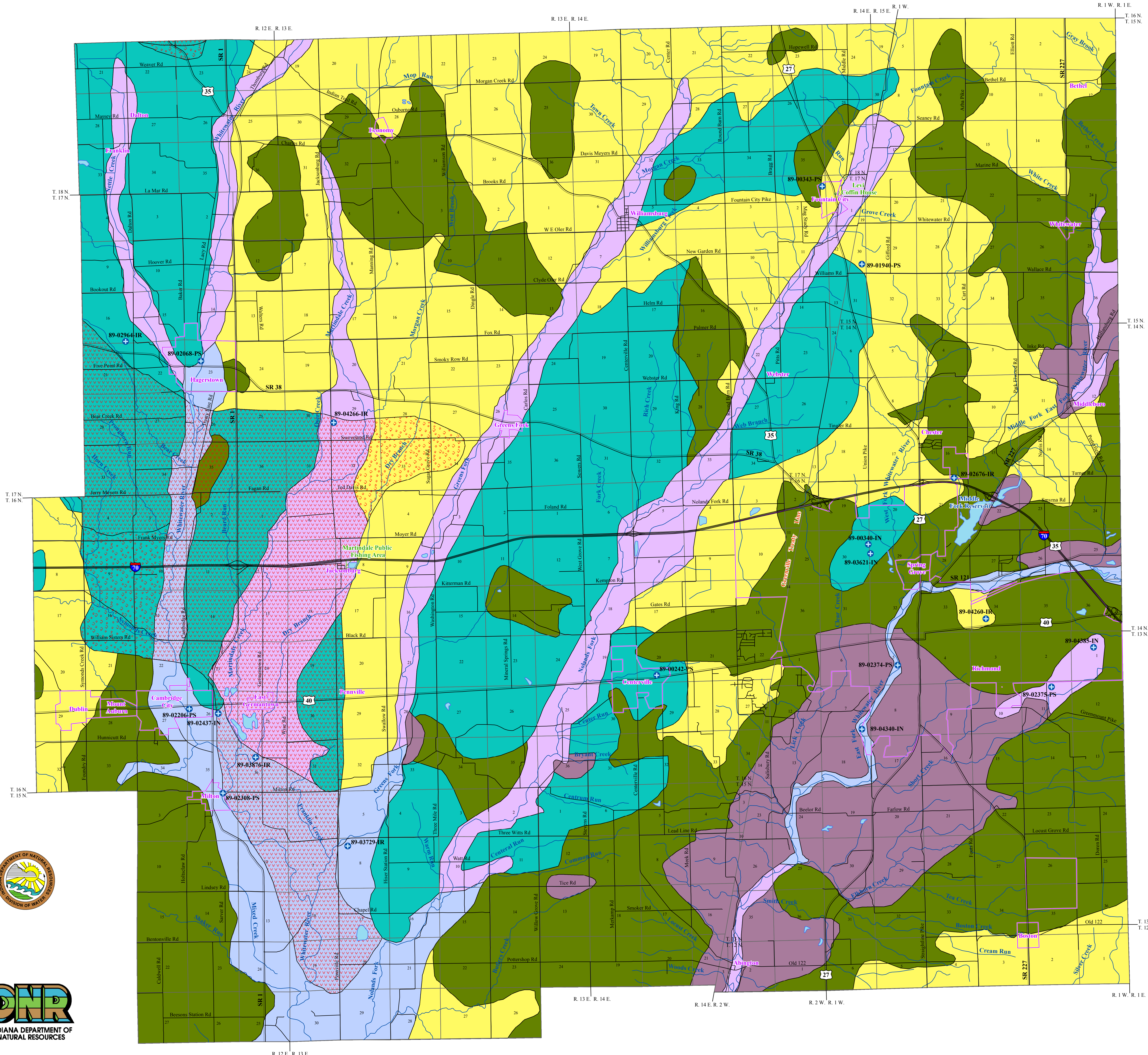
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This map was created from several existing shapefiles. Township and Range Lines of Indiana (line shapefile, 20020621), Land Survey Lines of Indiana (polygon shapefile, 20020621), and County Boundaries of Indiana (polygon shapefile, 20050621) were all from the Indiana Geological Survey and based on a 1:24,000 scale, except the Bedrock Geology of Southwestern Indiana (polygon shapefile, 20001124), which was at a 1:500,000 scale. System and System2 were from the Indiana Department of Transportation (line shapefile, 2003) and based on a 1:24,000 scale. Managed Areas (polygon shapefile, various dates) was from IDNR. City Areas in Southwestern Indiana (polygon shapefile, 1999) was from ESRI 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 Wayne County, Indiana

by
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Division of Water, Resource Assessment Section
July, 2011

UNCONSOLIDATED AQUIFER SYSTEMS OF WAYNE COUNTY, INDIANA



Six unconsolidated aquifer systems have been mapped in Wayne County: the Till Veneer, the New Castle Till, the New Castle Till Subsystem, the New Castle Complex, the Whitewater River Valley Outwash, and the Whitewater River Valley Outwash Subsystem.

Thickness of unconsolidated sediments that overlie bedrock are quite variable in Wayne County. Total thickness ranges from less than 4 feet along portions of the east edge of the East Fork Whitewater River Valley, to as much as 355 feet in the west-central part of the county where a buried bedrock valley is present.

Regional estimates of aquifer susceptibility to contamination from the surface can differ considerably due to variations 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.

Till Veneer Aquifer System

In Wayne County, the Till Veneer Aquifer System is mapped mostly in the southeastern portion of the county and along a small area of Nolands Fork River and Greens Fork River. This system generally consists of thin till, less than 50 feet thick, that directly overlies an uneven bedrock surface. In places, intermittent and discontinuous subsurface or surface sands and gravels are present. It is the most limited groundwater resource of the unconsolidated aquifer systems in the county.

Approximately 77 percent of wells started in the Till Veneer Aquifer System in Wayne County are completed in the underlying bedrock aquifer system. However, several large diameter bucket wells utilize thin, low yield sand and gravel seams and/or reportedly "wet" clay deposits. Also, drillers often complete wells at varying depths below the water bearing deposits. This allows for greater potential yield from storage for short duration pumping needs.

Reported well yields are generally less than 7 gallons per minute (gpm) with dry holes noted. Greater well yields have been reported, however, these wells are generally associated with significant to complete drawdown and it is likely that such production cannot be sustained for lengthy periods of time.

This aquifer system is generally not very susceptible to surface contamination because intratill sand and gravel units are overlain by thick till deposits.

New Castle Till Aquifer System

The New Castle Till Aquifer System is mapped throughout much of Wayne County. Typical deposits include a thick glacial till with intermittent sand and gravel deposits of variable thickness. Approximately 96 percent of wells completed in the area are finished in unconsolidated deposits of this system.

Total well depths in the New Castle Till Aquifer System range from 70 to 130 feet deep. Potential aquifer materials include sand and gravel deposits that are typically 3 to 12 feet thick. The aquifer deposits are capped by thick clay with intermittent sand and gravel that generally range from 60 to 120 feet. Domestic well yields range from 10 to 20 gpm with static water levels from flowing to 130 feet below surface. There are four significant groundwater withdrawal facilities (7 wells) registered in this system. Reported yields range from 70 to 500 gpm.

In west-central Wayne County a portion of this system overlies part of a major buried bedrock valley. Few deep wells are available in this area. However, one domestic well reports a total depth of completion in gravel at 255 feet with a yield of 65 gpm.

The New Castle Till Aquifer System is generally not very susceptible to surface contamination because sand and gravel units are overlain by thick till deposits. However, some areas have windblown sand and silt and/or thin till overlying the aquifer deposits. These areas are considered at moderate to high risk to contamination.

New Castle Till Aquifer Subsystem

The New Castle Till Aquifer Subsystem is mapped throughout much of Wayne County. The subsystem is mapped similar to that of the New Castle Till Aquifer System. However, potential aquifer materials are thinner and potential yield is less in the subsystem than in the system. Description of aquifer units vary widely ranging from "wet" clay with no noted sands and gravels, to thick low yield sand and gravel deposits. Approximately 24 percent of wells in the area are completed in the underlying bedrock aquifer system. However, the subsystem has the potential of meeting the needs of some domestic users. Many wells completed in the subsystem are large diameter bucket wells, or drillers often complete wells at varying depths below the water bearing deposits. This allows for greater potential yield from storage for short duration pumping needs.

Well depths in the New Castle Till Aquifer Subsystem are typically 45 to 115 feet deep. Where present, sand and gravel deposits are generally 2 to 10 feet thick and are capped by 35 to 100 feet of clay with discontinuous sand and gravel. Isolated thicker sand and gravel deposits have been reported, however, a portion of the thickness is often noted as "dry". Also, in places drillers often continue the borehole depth 4 to 15 feet beneath the aquifer deposits.

A small portion of this system in west-central Wayne County overlies part of a major buried bedrock valley. Few deep wells are available in this area. However, one domestic well reports a total depth of completion at 164 feet with a yield of 6 gpm from a 9 foot sand and gravel aquifer unit.

Reported well capacities are generally 5 to 15 gpm. However, many wells with reported capacities greater than 10 gpm are associated with deeper static water levels and significant to complete drawdowns. Static water levels are commonly 15 to 55 feet below surface.

This aquifer subsystem is generally not very susceptible to surface contamination because sand and gravel units are overlain by thick till deposits. However, some areas have windblown surface sands and gravels or thin to no clay deposits. These areas are considered at moderate to high risk to contamination.

New Castle Complex Aquifer System

The New Castle Complex Aquifer System is mapped primarily in the central and northwest portions of Wayne County. Complex multiple glacial advances resulted in a sequence of multiple, stacked, till and outwash units that are quite variable in position and thickness. The sand and gravel deposits vary in thickness from thin to massive and are typically discontinuous and overlain by a thick till.

Completed well depths commonly range from 80 to 130 feet. Thickness of clay deposits that overlie the aquifer resource generally range from 40 to 115 feet with, in places, multiple sand and gravel deposits above the primary aquifer resource. Although some are noted as "dry", other layers may be a potential source of groundwater. Individually, the multiple discontinuous sands and gravels range from 4 to 19 feet thick.

A portion of this system in west-central and northwestern Wayne County overlies part of a major buried bedrock valley. Depth to bedrock is reportedly up to 355 feet. However, there is little evidence for groundwater potential at depth. Total depths of wells in this area are reportedly up to 130 feet.

A portion of this system overlies part of a major buried bedrock valley and is mapped to the northwest and west-central edge of Wayne County. Depth to bedrock is reportedly up to 258 feet in the northwest, and up to 306 feet to the west. Few wells are available, however, wells producing from deep gravel materials are reported at total depths of 200 feet in the northwest and 214 feet along the western edge of the county.

The New Castle Complex Aquifer System is capable of meeting the needs of domestic and high-capacity users. Domestic wells are commonly 10 to 35 gpm with static water levels from 20 to 70 feet below surface. There are 5 registered significant groundwater withdrawal facilities (9 wells) with reported yields up to 400 gpm.

This aquifer system is not very susceptible to contamination where thick clay deposits overlie aquifer materials. However, in places clay deposits are thin and wind-blown fine sand and silt are present. These areas are at moderate to high risk to surface contamination.

Whitewater River Valley Outwash Aquifer System

The Whitewater River Valley Outwash Aquifer System is mapped along sections of the Whitewater River on the west side of Wayne County near Hagerstown and continuing south to the county line, to the southwest along sections of Greens Fork and Nolands Fork rivers, and along the East Fork Whitewater River in Richmond and continuing east and southwest. The system includes thick glacial outwash sands and gravels with intermittent clay layers that, in some areas, are capped by a thin layer of clay and/or silt deposits.

Completed well depths generally range from about 25 to over 111 feet with saturated sand and gravel aquifer materials up to 52 feet thick. In places, clay or fine grained windblown sand and silt deposits overlie the outwash sand and gravels. These deposits range from 1 to 38 feet thick.

A portion of this system overlies part of a major buried bedrock valley. Seismic data suggests depth to bedrock is reportedly up to 272 feet. However, there is little evidence for groundwater potential at depths beyond 110 feet.

The Whitewater River Valley Outwash Aquifer System is capable of meeting the needs of both domestic and high-capacity users in Wayne County. Domestic well yields range from 10 to 50 gpm with static water levels ranging from 0 to 95 feet below the surface. There are 6 registered significant groundwater withdrawal facilities (11 wells) in the Whitewater River Valley Outwash Aquifer System. Reported production for these high-capacity wells range from 150 to 1,458 gpm. In the buried valley area there are 3 registered significant groundwater withdrawal facilities (4 wells). High-capacity production ranges from 110 to 440 gpm.

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

Whitewater River Valley Outwash Aquifer Subsystem

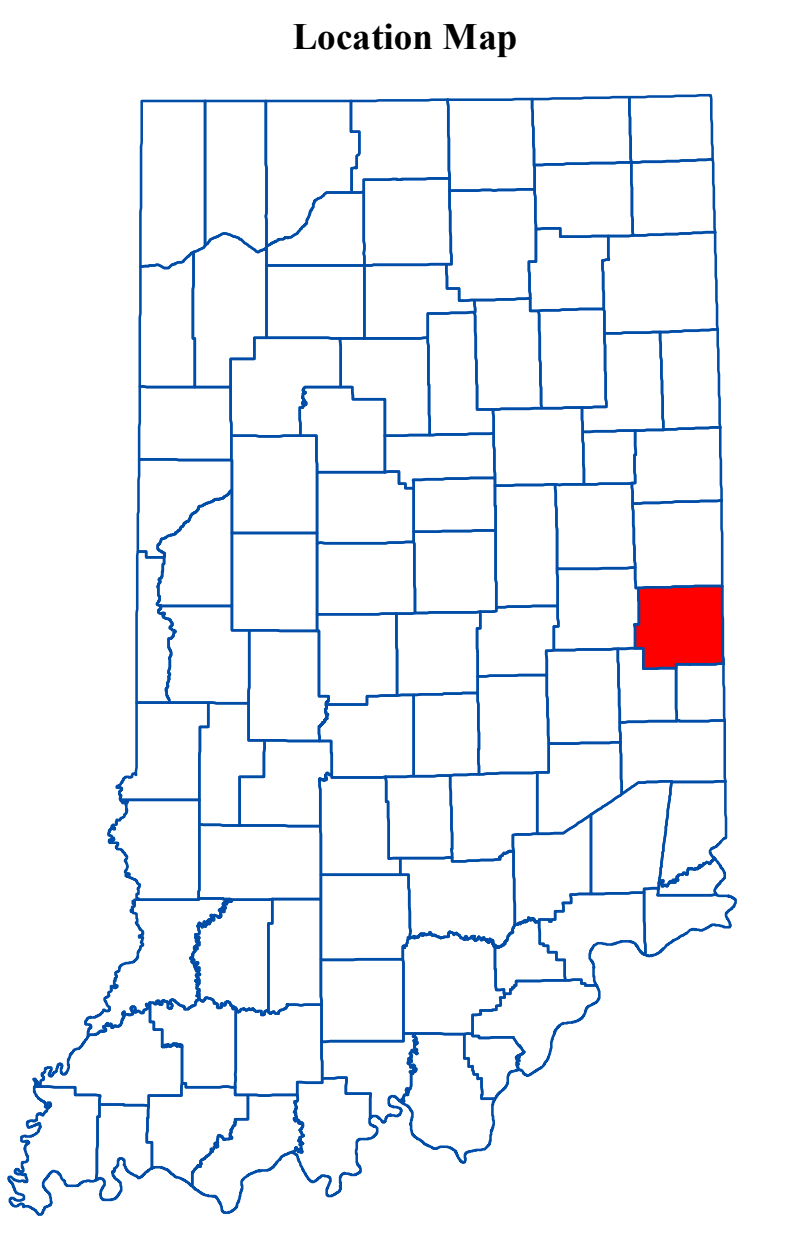
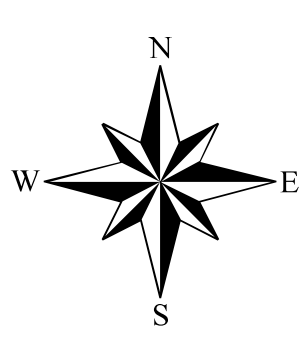
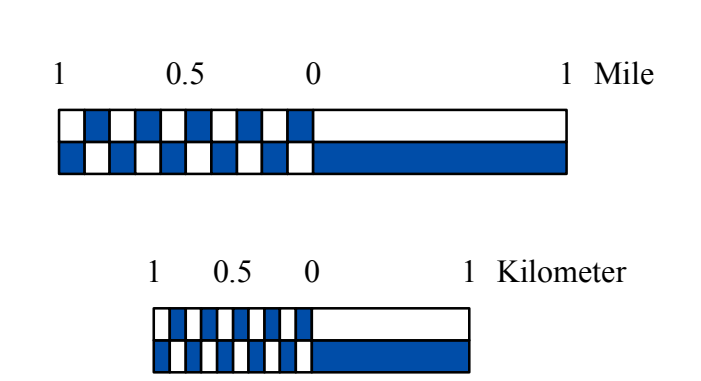
The Whitewater River Valley Outwash Aquifer Subsystem is mapped mostly along several tributaries of the Whitewater River; along a section of Short Creek southeast of Richmond, and along portions of the East Fork of the Whitewater River. It is mapped similar to the Whitewater River Valley Outwash Aquifer System, however, potential aquifer materials are thinner and overlying fine sands, silt or clay deposits are thicker. Also, in places discontinuous clay layers of variable thickness may be present.

Well depths in the White River and Tributaries Outwash Aquifer Subsystem generally range from 16 to 135 feet. In places, aquifer materials are up to 65 feet of continuous sand and gravel. In some areas the upper portions of the total aquifer sequence of sands and gravels are reported as "dry".

A portion of this system overlies part of a major buried bedrock valley. Seismic data suggests depth to bedrock is reportedly up to 272 feet. However, there is little evidence for groundwater potential at depths beyond 135 feet.

The White River and Tributaries Outwash Aquifer Subsystem is capable of meeting the needs of domestic and some high-capacity users. Domestic well capacities range from 10 to 65 gpm with static water levels of 1 to 50 feet below ground surface. There are 2 registered significant groundwater withdrawal facilities (4 wells) with capacities from 150 to 335 gpm. In the buried valley area there is one registered significant groundwater withdrawal facility (one well) with a reported production of 250 gpm.

Areas that lack overlying clay deposits are highly susceptible to contamination. However, where overlying clay deposits are present the system is moderately susceptible to surface contamination.



EXPLANATION table with symbols for Registered Significant Groundwater Withdrawal Facility, Stream, County Road, State Road & US Highway, Interstate, Municipal Boundary, State Managed Property, and Lake & River.

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Unconsolidated Aquifer Systems of Wayne County, Indiana

by
Randall D. Maier
Division of Water, Resource Assessment Section
July 2011

Wayne County

