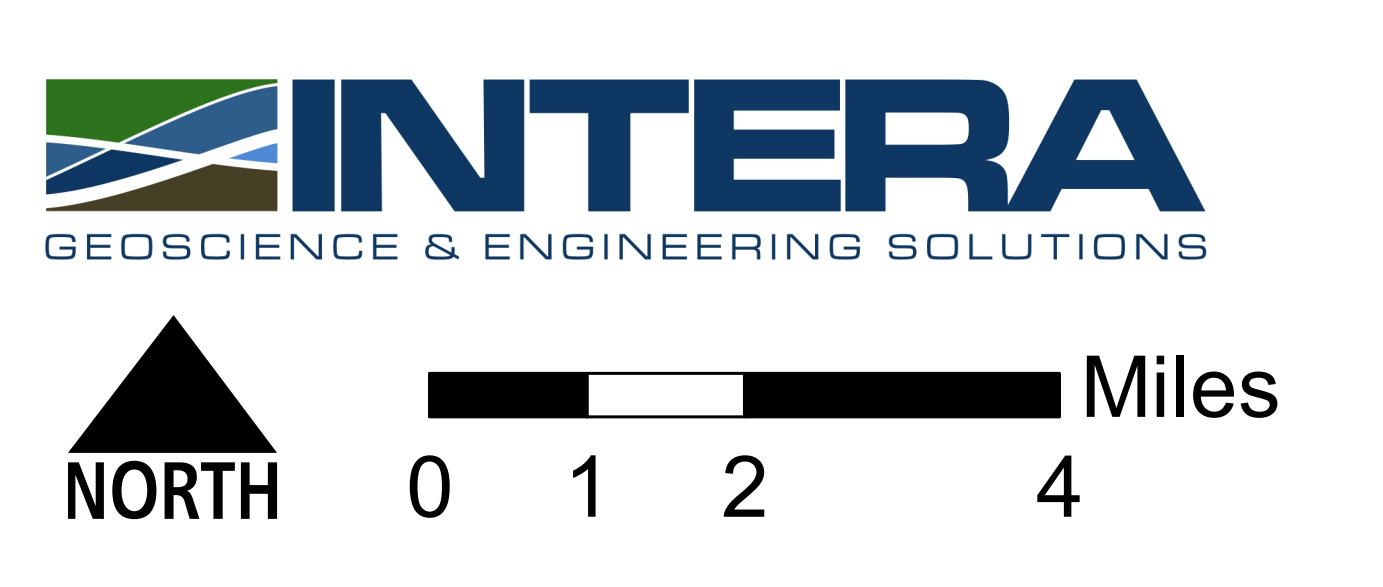
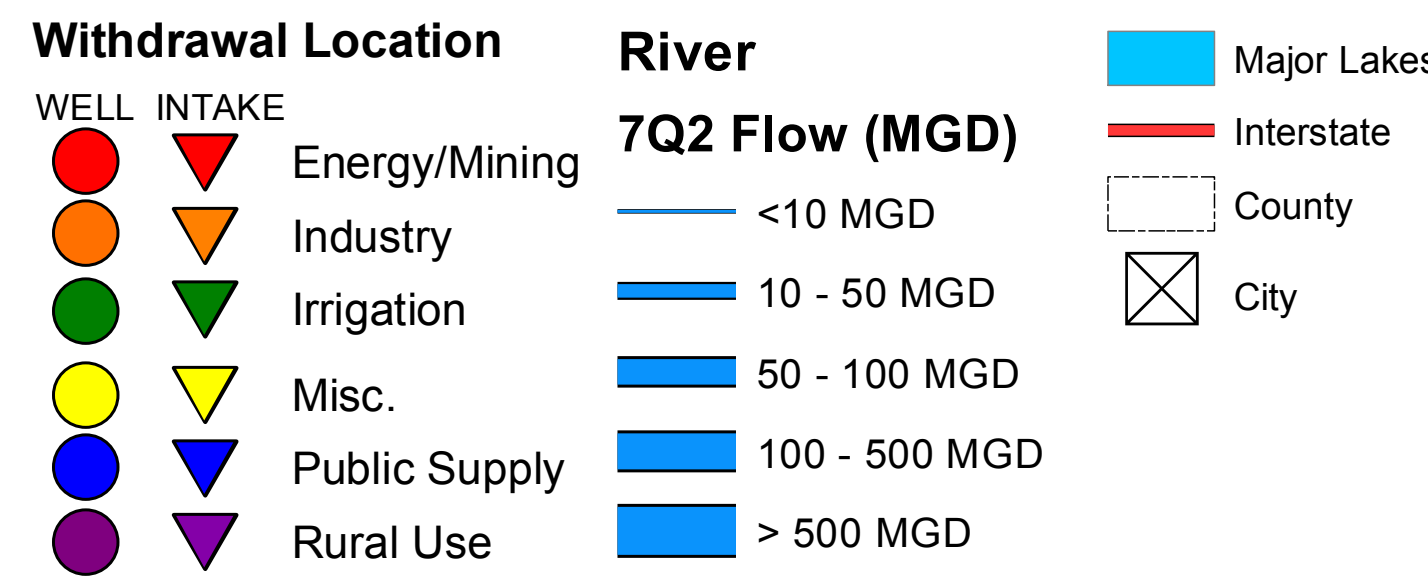
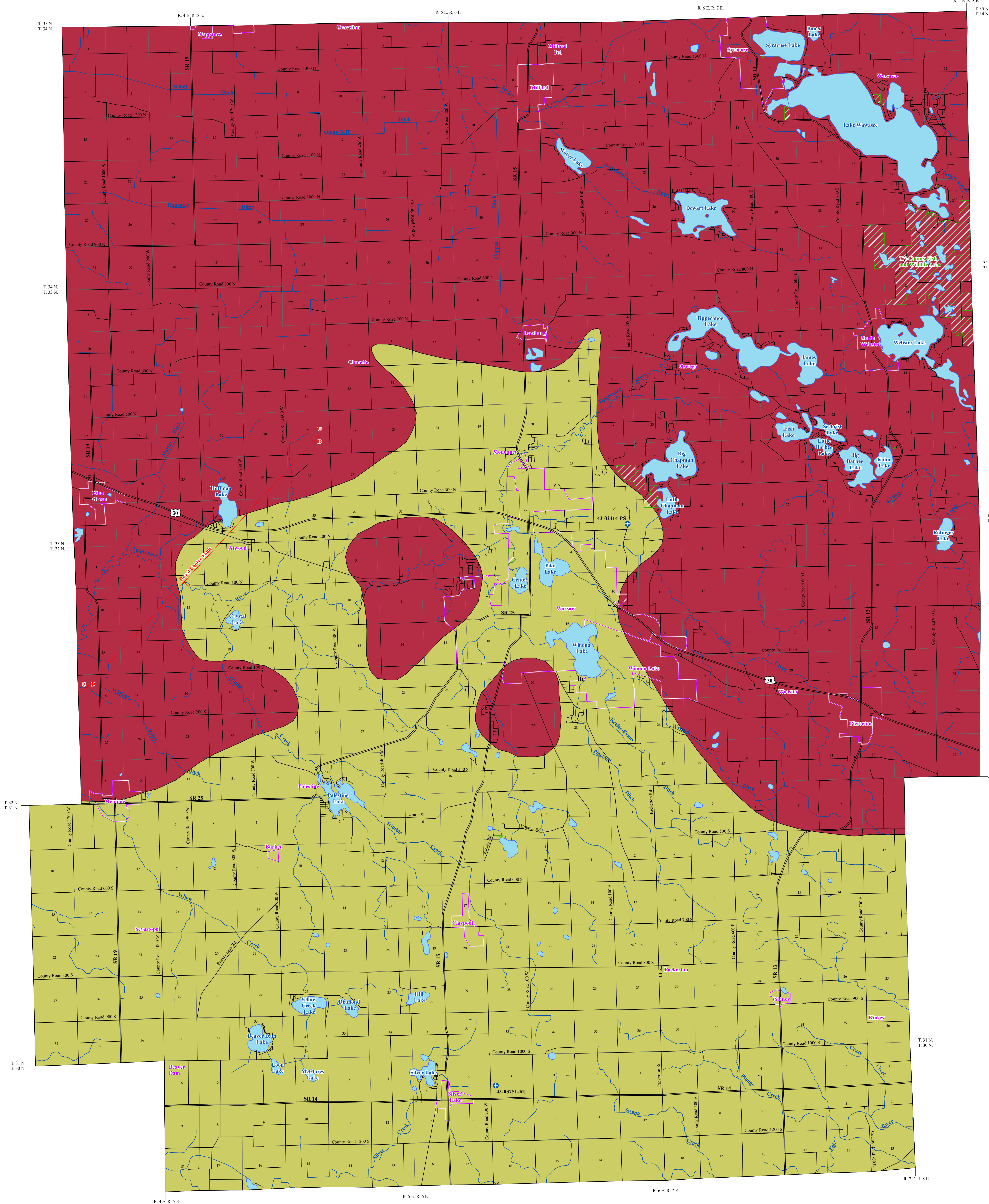


Water Resources and Use in Kosciusko County



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

BEDROCK AQUIFER SYSTEMS OF KOSCIUSKO 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.

The bedrock aquifer systems in Kosciusko County are overlain by unconsolidated deposits of varying thickness, ranging from 150 to more than 350 feet. Most of the bedrock aquifers, therefore, 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 formation.

The yield of a bedrock aquifer depends on its hydraulic characteristics and the nature of the overlying deposits. Shale and glacial till act as aquiclads, restricting recharge to underlying bedrock aquifers. However, fracturing and/or jointing may occur in aquiclads, 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 Kosciusko County. They are, from younger to older: the Devonian and Mississippian Coldwater, Ellsworth and Antrim Shales; and the Silurian and Devonian Carbonates.

Devonian and Mississippian – Coldwater, Ellsworth and Antrim Shales Aquifer System

In Kosciusko County only the Antrim Shale and Ellsworth Shale subcrop in the Coldwater, Ellsworth and Antrim Shales Aquifer System. The Antrim Shale in Indiana is typically described as brownish-black shale and the Ellsworth is described as greenish-grey shale. These shales are commonly considered an aquiclude; therefore, the system is an extremely limited ground-water resource. However, in some places the lower portion of the aquifer unit may contain some limestone.

The subcrop area for this system is present primarily in the northern half of Kosciusko County and is generally less than 125 feet thick. Depth to bedrock ranges from around 180 to more than 300 feet.

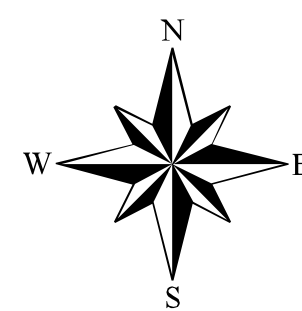
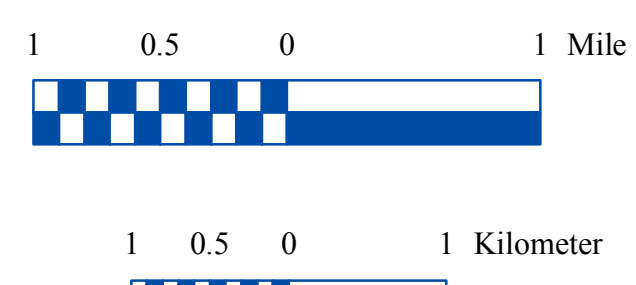
Due to the availability of ground water in the overlying unconsolidated aquifers very few wells have been completed in the Coldwater, Ellsworth and Antrim Shales Aquifer System in Kosciusko County. However, a few domestic wells have been reported. Total depths of domestic wells completed in this system range from 240 to 315 feet with penetration into bedrock generally less than 100 feet. Reported yields are less than 10 gallons per minute (gpm).

Because the permeability of shale materials is considered low and the overlying unconsolidated deposits are thick, susceptibility to contamination introduced at or near the surface is low.

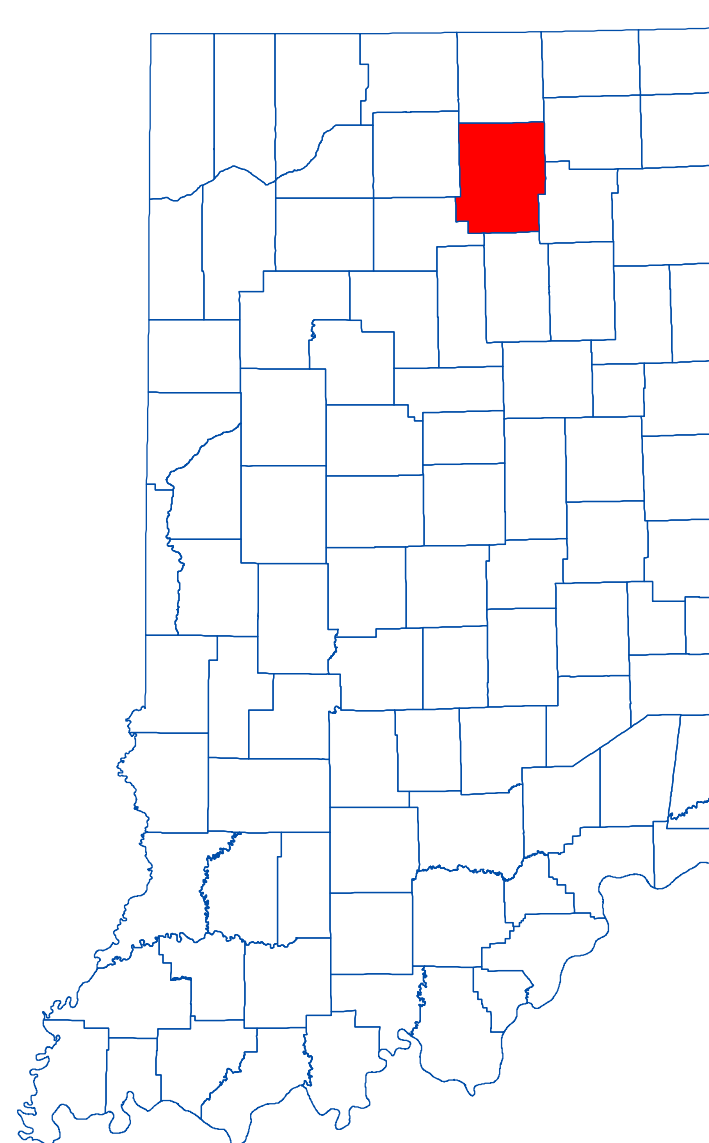
Silurian and Devonian Carbonates Aquifer System

The Silurian and Devonian Carbonates Aquifer System subcrops throughout most of the southern half of Kosciusko County. The aquifer system in this county consists primarily of Silurian age carbonates of the Wabash Group and middle Devonian age carbonates of the Muscatatuck Group. Total thickness of this aquifer system exceeds 900 feet in places.

Due to the availability of the overlying unconsolidated resources very few wells have been completed in the Silurian and Devonian Carbonates Aquifer System. Reported domestic wells utilizing this system in Kosciusko County have depths ranging from 277 to 504 feet deep. The amount of rock penetrated in this system varies from 5 to 127 feet. Domestic well yields range from 12 to 60 gpm. Static water levels are between 22 to 80 feet below the land surface. There are 2 registered significant ground-water withdrawal facilities (4 wells). Reported yields from the individual wells are 50 to 70 gpm. Refer to the table for details on the wells and to the map for facility locations. In Kosciusko County the Silurian and Devonian Carbonates Aquifer System has a low susceptibility to surface contamination because thick clay deposits overlie the system.



Location Map



EXPLANATION

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

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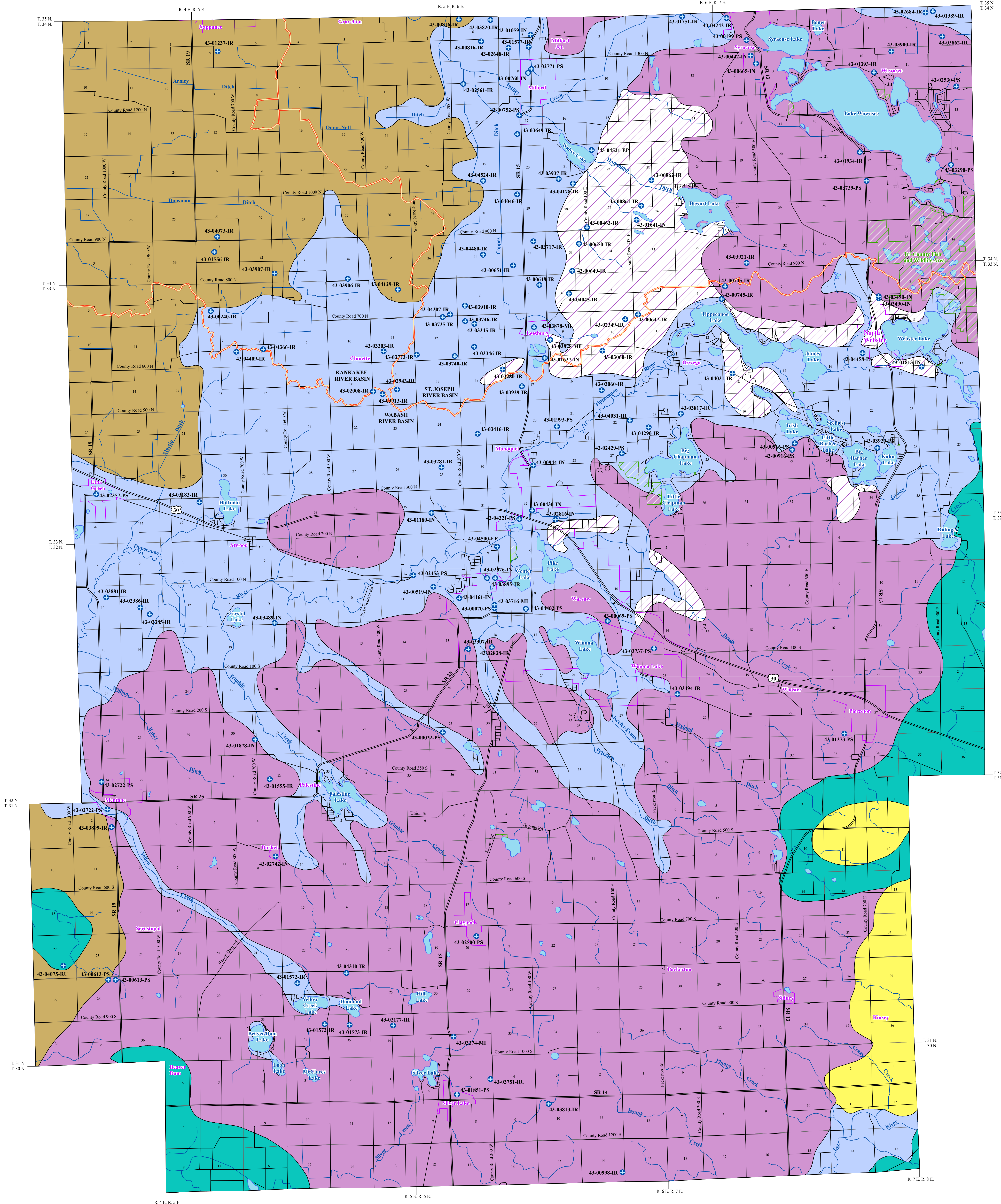
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This map was created from several existing shapefiles. Township and Range Lines of Indiana (line shapefile, 20020621), Land Survey Lines of Indiana (polygon shapefile, 20020621) and County Boundaries of Indiana (polygon shapefile, 20020621), were all from the Indiana Geological Survey and based on a 1:24,000 scale, except the Bedrock Geology of Indiana (polygon shapefile, 20020316), which was at a 1:500,000 scale. Draft road shapefiles, System1 and System2 (line shapefiles, 2005), 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. Streams77 (line shapefile, 20000420) was from the Center for Advanced Applications in GIS at Purdue University. Structural Features of Indiana (line shapefile, 20020719) was from the Indiana Geological Survey and based on various scales. Managed Areas 96 (polygon shapefile, various dates) was from IDNR.

Bedrock Aquifer Systems of Kosciusko County, Indiana

by
Glenn E. Grove
Division of Water, Resource Assessment Section
April 2008

UNCONSOLIDATED AQUIFER SYSTEMS OF KOSCIUSKO COUNTY, INDIANA



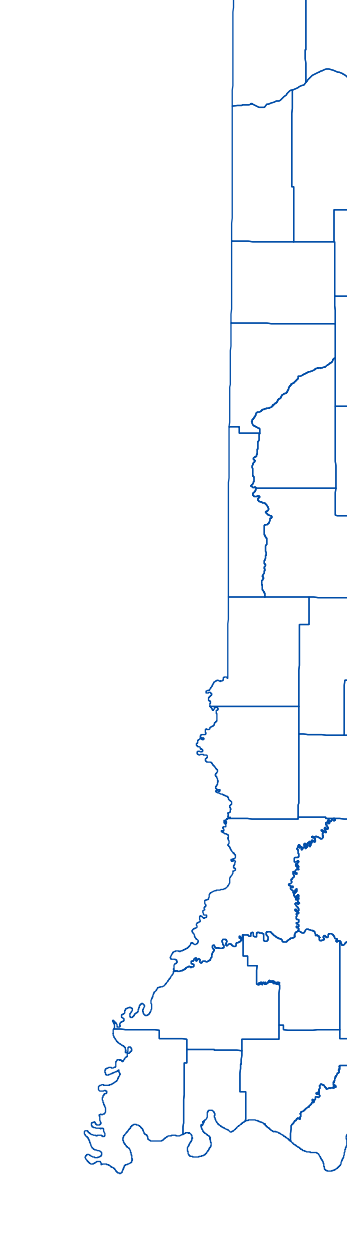
Six unconsolidated aquifer systems have been mapped in Kosciusko County: the Auburn/Bluffton/Warsaw Till; the Nappanee; the Auburn/Bluffton/Warsaw Complex; the Natural Lakes and Moraines; the Natural Lakes and Moraines Subsystem and the St. Joseph and Tributary Valleys/Wabash River and Tributaries Outwash. The northern portion of the county has been described and mapped in two previously published regional basin study reports (Water Resource Availability in the St. Joseph River Basin, Indiana, 1987 and Water Resource Availability in the Kankakee River Basin, Indiana, 1990).

Kosciusko County has a very complex glacial history as it was subjected to multiple glacial advances from the north, west and east. The county lies in an interlobate area that was affected by the Saginaw lobe and Huron-Erie lobes. The dynamic interaction of the lobes resulted in a complex overlap and cross-cutting of glacial terraces. The resulting glacial landscape includes moraines, ground moraines, outwash channels, tunnel valleys (subglacial drainage channels) and outwash plains. In northeastern Kosciusko County a well developed moraine exists around the town of Packerton. The Packerton Moraine reaches an elevation of over 900 feet mean sea level (msl) and rises over 175 feet above adjacent valleys of the Tippecanoe River and the El River. Outwash channels and/or tunnel valleys trend to the northwest off the flank of the Packerton Moraine where they intersect a broad outwash plain. This broad valley is currently occupied by the Tippecanoe River which trends west to southwest across the center of Kosciusko County. This outwash plain broadens to more than five miles wide, where it is intersected by a north-south trending outwash plain in the north-central part of the county (around Leesburg). Due to the area's complex glacial history, the boundaries between the systems are gradational and individual aquifers may extend across aquifer system boundaries.

The thickness of unconsolidated sediments in Kosciusko County is quite variable, ranging from around 150 feet in small areas along the north-central border, western border and southeastern border of the county, to in excess of 250 feet in the central part of the county. Elsewhere in Kosciusko County, unconsolidated deposits are commonly 200 to 300 feet thick. Almost all the domestic wells are completed in unconsolidated deposits in 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.

Location Map



Auburn/Bluffton/Warsaw Till Aquifer System
The Auburn/Bluffton/Warsaw Till Aquifer System is mapped in the southeastern corner of the county along the Whiting County line and primarily consists of thick clay with intertill sand and gravel layers. In Kosciusko County, this system ranges in thickness from about 150 feet to more than 250 feet. Saturated aquifer materials include sand and/or gravel layers that commonly range from 5 to 10 feet thick and are typically overlain by 80 to 120 feet of till.
This system is generally capable of meeting the needs of most domestic and some high-capacity users. Wells producing from the Auburn/Bluffton/Warsaw Till Aquifer System range from 68 to 225 feet deep. Domestic well capacities are commonly 15 to 60 gallons per minute (gpm) and static water levels range from flowing to 92 feet below the surface.
The Auburn/Bluffton/Warsaw Till Aquifer System has a low susceptibility to surface contamination because intertill sand and gravel units are commonly separated from the surface by thick till layers.

Nappanee Aquifer System
In Kosciusko County, the Nappanee Aquifer System is mapped along the northwestern and southwestern portions of the county. This system typically consists of thick clay with intertill sand and gravel deposits. In places the system can be 250 feet in total thickness. Aquifer sand and gravel layers are commonly less than 10 feet but isolated thicknesses up to 20 feet have been reported.
Well depths commonly range from 50 to 200 feet below the surface. Potential aquifer layers include sand and/or gravel that typically range from 5 to 15 feet thick. Aquifer materials are generally overlain by 40 to 80 feet of clay and can include intertill sand and gravel deposits ranging from 3 to 9 feet thick.
The Nappanee Aquifer System is capable of meeting the needs of domestic and some high-capacity users. Domestic well capacities commonly range from 12 to 30 gpm. Static water levels range from 10 to 30 feet below the surface. There are seven registered significant ground-water withdrawal facilities (9 wells) in the Nappanee Aquifer System in Kosciusko County. Reported yields for high-capacity wells in this aquifer system range from 200 to 1200 gpm. This aquifer system is generally not very susceptible to surface contamination because intertill sand and gravel units are overlain by thick till deposits.

Natural Lakes and Moraines Aquifer System
The Natural Lakes and Moraines Aquifer System in Kosciusko County is mapped over much of the county and is a complex aquifer system typically with multiple intertill sand and gravel seams. Unconsolidated deposits range in thickness from about 150 feet to over 325 feet. Thick surficial clays predominate and are generally 80 to 150 feet thick. A few localized surficial sand and gravel deposits are reported and range from 20 to 50 feet thick; however, the static water levels are commonly deep and these deposits are seldom used.
This system is capable of meeting the needs of domestic and most high-capacity users in Kosciusko County. Wells completed in this aquifer system range in depth from 35 to 300 feet deep. However, the wells are typically 70 to 150 feet deep. The primary aquifer is generally between 15 and 30 feet thick. In addition, many areas have several shallower aquifers that range in thickness from 5 to 15 feet. Domestic well yields are commonly 10 to 50 gpm and static water levels are typically 10 to 45 feet below the surface. There are 30 registered significant ground-water withdrawal facilities (67 wells) utilizing this system with reported yields up to 1450 gpm for individual wells.
The Natural Lakes and Moraines Aquifer System is generally not very susceptible to surface contamination because thick clay deposits overlie intertill sand and gravel seams. Wells producing from shallow aquifers are moderately to highly susceptible to contamination.

Natural Lakes and Moraines Aquifer Subsystem
The Natural Lakes and Moraines Aquifer Subsystem in Kosciusko County is primarily mapped in the central and north-central part of the county where a relatively thin layer of outwash overlies moraine topography. This subsystem is typically transitional between the large outwash areas in the central portion of the county and the Natural Lakes and Moraines Aquifer System. The subsystem is a complex sequence of glacial deposits ranging in thickness from around 200 feet to over 300 feet. It generally consists of continuous surficial sand and gravel deposits that vary in thickness from 20 to over 60 feet thick but are commonly 30 to 50 feet thick. Below the surficial sand and gravel deposits, thick clay predominate. The clay layers are typically 50 to 110 feet thick. Most areas have two to more intertill sand and gravel aquifers. The deeper sand and gravel deposits tend to be thicker and more continuous and are commonly between 15 and 25 feet thick. Most wells are completed in the deeper aquifers. However, some wells use the surficial sand and gravel deposits.
This subsystem is capable of meeting the needs of domestic and most high-capacity users in Kosciusko County. Wells completed in this aquifer system range in depth from 27 to 260 feet deep. However, the wells are generally 60 to 150 feet deep. Domestic well yields are commonly 10 to 50 gpm and static water levels are typically 5 to 30 feet below the surface. There are 16 registered significant ground-water withdrawal facilities (21 wells) utilizing the Natural Lakes and Moraines Aquifer Subsystem with reported yields of 68 to 1250 gpm.
Wells that utilize the surficial sand and gravels in this subsystem are highly susceptible to contamination. However, wells that produce from the deeper aquifers in the Natural Lakes and Moraines Aquifer Subsystem are generally not very susceptible to surface contamination because thick clay deposits overlie intertill sand and gravel seams.

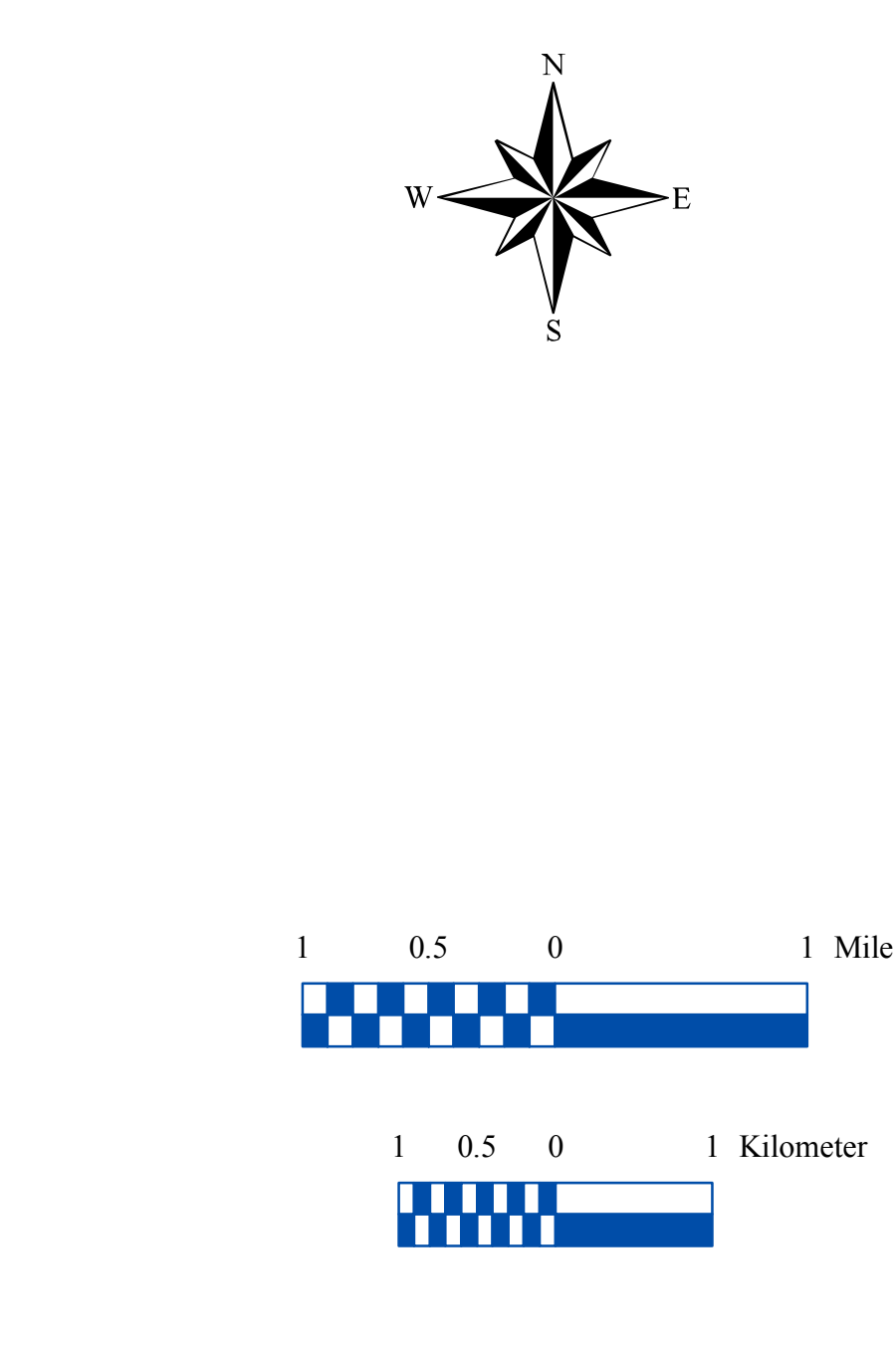
Auburn/Bluffton/Warsaw Complex Aquifer System
The Auburn/Bluffton/Warsaw Complex Aquifer System is mapped along the southeastern and southwestern portions of Kosciusko County. This aquifer system is characterized by deposits that are quite variable in materials and thickness. A thick till commonly overlies the sand and gravel aquifer deposits. This system generally has multiple layers of intertill sand and/or gravel of various thickness and lateral extent. The main aquifer deposits are typically deeper, thicker, and more continuous than the shallower sand and gravel layers in this system. In Kosciusko County, this system is more than 300 feet thick in places. Saturated aquifer materials in this system are commonly 10 to 25 feet thick and are overlain by a till cap that is generally 60 to 130 feet thick.
This system is capable of meeting the needs of domestic and some high-capacity users in Kosciusko County. Wells in this system are typically completed at depths of 70 to 170 feet. Domestic well yields are commonly 15 to 50 gpm and static water levels are generally 15 to 65 feet below the surface. There is only one registered significant ground-water withdrawal facility (2 wells) utilizing this system. The individual wells have a reported capacity of 70 gpm. The Auburn/Bluffton/Warsaw Complex Aquifer System is not very susceptible to contamination because thick clay deposits overlie the aquifer materials.

St. Joseph and Tributary Valleys/Wabash River and Tributaries Outwash Aquifer System
The St. Joseph and Tributary Valleys/Wabash River and Tributaries Outwash Aquifer System is mapped primarily along the Tippecanoe River and some tributaries of the St. Joseph River along the central, north-central and northeast portions of Kosciusko County. This system is also mapped along former outwash channels and/or tunnel valleys on the flanks of the Packerton Moraine that are occupied by present day streams. Large amounts of outwash sand and gravel from the melting glaciers were deposited in the stream valleys making this the most productive aquifer system in the county. The coarser sediments tend to be deeper while the finer sands were generally deposited higher in the sequence as the ice front receded. In some areas this system exceeds 150 feet in thickness with over 100 feet of continuous sand and gravel. However, the outwash is typically 35 to 75 feet thick with the thickness of saturated sands and/or gravels commonly ranging from 30 to 60 feet. In some areas 10 to 45 feet of sandy clay or silt lies at the surface or below the surficial sand and gravels.
These sand and gravel deposits have adequate potential for domestic and most high-capacity users. Well depths are typically 60 to 130 feet. Domestic well yields are commonly 15 to 60 gpm and static water levels are generally 3 to 30 feet below the surface. Seventy-nine registered significant ground-water withdrawal facilities (133 wells) are in the St. Joseph and Tributary Valleys/Wabash River and Tributaries Outwash Aquifer System in Kosciusko County. Reported yields for high-capacity wells in this aquifer system range from 75 to 2250 gpm.
This aquifer system is highly susceptible to contamination from surface sources in areas that lack overlying clay layers. The system is only moderately susceptible where it is overlain by relatively thick clay or silt deposits.

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



Kosciusko County

