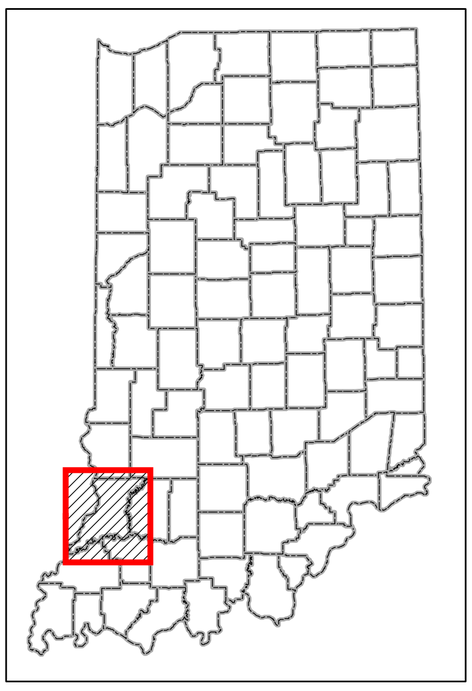
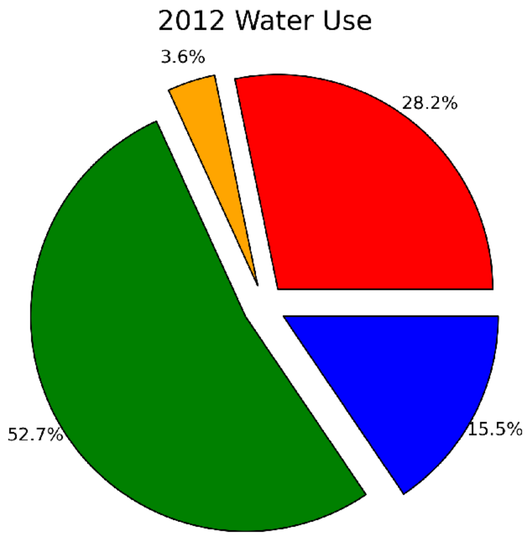
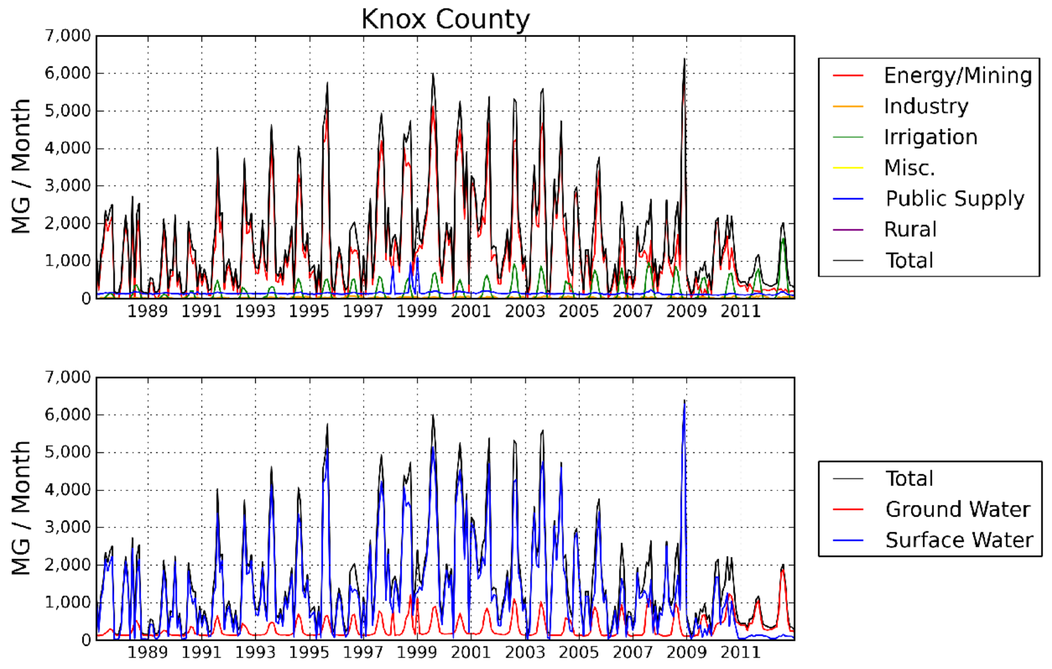
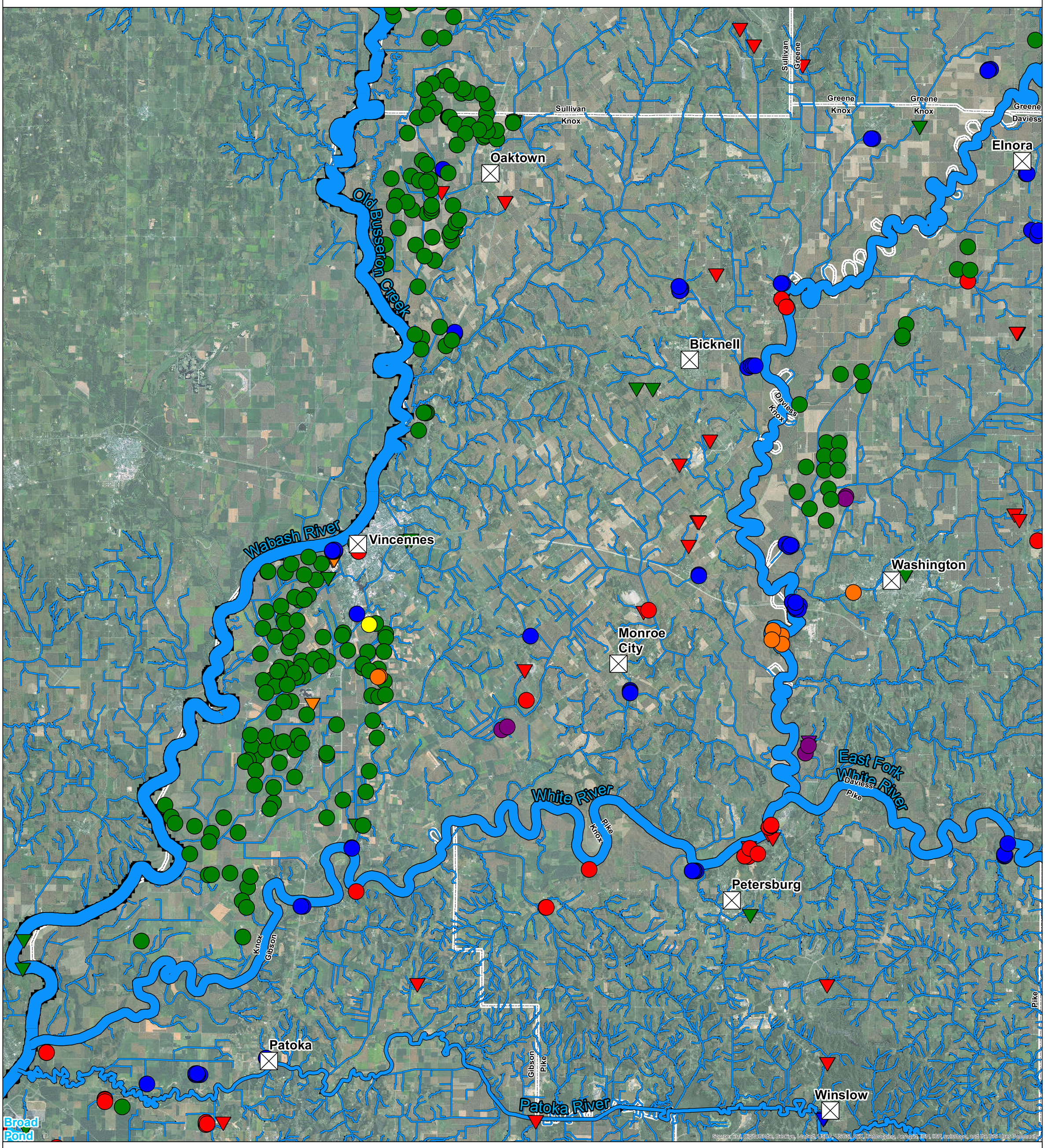




Average Daily Use: 25.7 MGD





Water Resources and Use in Knox County

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

Withdrawal Location

WELL	INTAKE	
●	▼	Energy/Mining
●	▼	Industry
●	▼	Irrigation
●	▼	Misc.
●	▼	Public Supply
●	▼	Rural Use

River

7Q2 Flow (MGD)

- <10 MGD
- 10 - 50 MGD
- 50 - 100 MGD
- 100 - 500 MGD
- > 500 MGD

- Major Lakes
- Interstate
- County
- City

INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS

NORTH

0 1 2 4 6 Miles

Mitchell E. Daniels, Jr., Governor
Department of Natural Resources
Robert E. Carter, Jr., Director

BEDROCK AQUIFER SYSTEMS OF KNOX 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 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 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.

Three bedrock aquifer systems are identified for Knox 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 Raccoon Creek Group of Pennsylvanian age. Bedrock aquifer systems in Knox County are overlain by unconsolidated deposits ranging in thickness from less than one foot to 210 feet.

The unconsolidated sand and gravel outwash aquifers near the Wabash and White rivers have far greater groundwater potential than the bedrock aquifers in the county. However, bedrock aquifers are widely used in Knox County where unconsolidated sediments are relatively thin and unproductive. Approximately 65 percent of all wells in this county are completed in bedrock.

Pennsylvanian -- McLeansboro Group Aquifer System

The McLeansboro Group subcrop area is located throughout nearly all of Knox County excluding the area along the eastern portion of the county. This aquifer system consists in descending order of the Mattoon, Bond, Patoka, and Shelburn Formations; however, the Mattoon Formation is not present in Knox County.

The Bond and Patoka Formations are composed of sandstone, shale, mudstone, siltstone, and limestone. The underlying Shelburn Formation consists of sandstone, shale, siltstone, mudstone, limestone, and coal. Two important members of the Shelburn Formation include the West Franklin Limestone at the top of the formation and the Busseron Sandstone at the base. These are the primary aquifer units within the McLeansboro Group Aquifer System in Knox County.

The depth to the bedrock surface ranges from less than one foot to 180 feet; however, the typical depth to bedrock ranges from 18 to 62 feet throughout the county. Total well depths commonly range from 75 to 160 feet. The amount of rock penetrated generally ranges from 35 to 115 feet. Domestic well yields range from 2 to 15 gallons per minute (gpm) with static water levels ranging from 14 to 45 feet below the surface. High yields are typically associated with significant drawdowns. A few dry (pumped) holes have been reported. There are no registered significant groundwater withdrawal facilities using the McLeansboro Group Aquifer System in Knox County.

In the majority of Knox County, the McLeansboro Group Aquifer System has a low susceptibility to surface contamination where thick clay deposits overlie the system. However where overlying clays are thin or absent, these areas are at moderate to high risk to contamination.

Pennsylvanian -- Carbondale Group Aquifer System

The Carbondale Group Aquifer System subcrops in portions of eastern Knox 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.

Depth to the bedrock surface ranges from 5 to 210 feet, however the depth to bedrock is typically from 28 to 140 feet throughout the county. Well depths generally range from 85 to 235 feet. The amount of rock penetrated ranges from 22 to 120 feet. The Carbondale Group is considered a minor groundwater source with most wells producing from the thicker sandstone and coal units found in the upper formations of the group. Reported domestic well yields range from 2 to 10 gpm with static water levels ranging from 15 to 75 feet below the surface. High 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. There are no registered significant groundwater withdrawal facilities using the Carbondale Group Aquifer System in Knox County.

Where the overlying sediment consists of thick fine-grained clay materials, the Carbondale Group Aquifer System in Knox 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.

Pennsylvanian -- Raccoon Creek Group Aquifer System

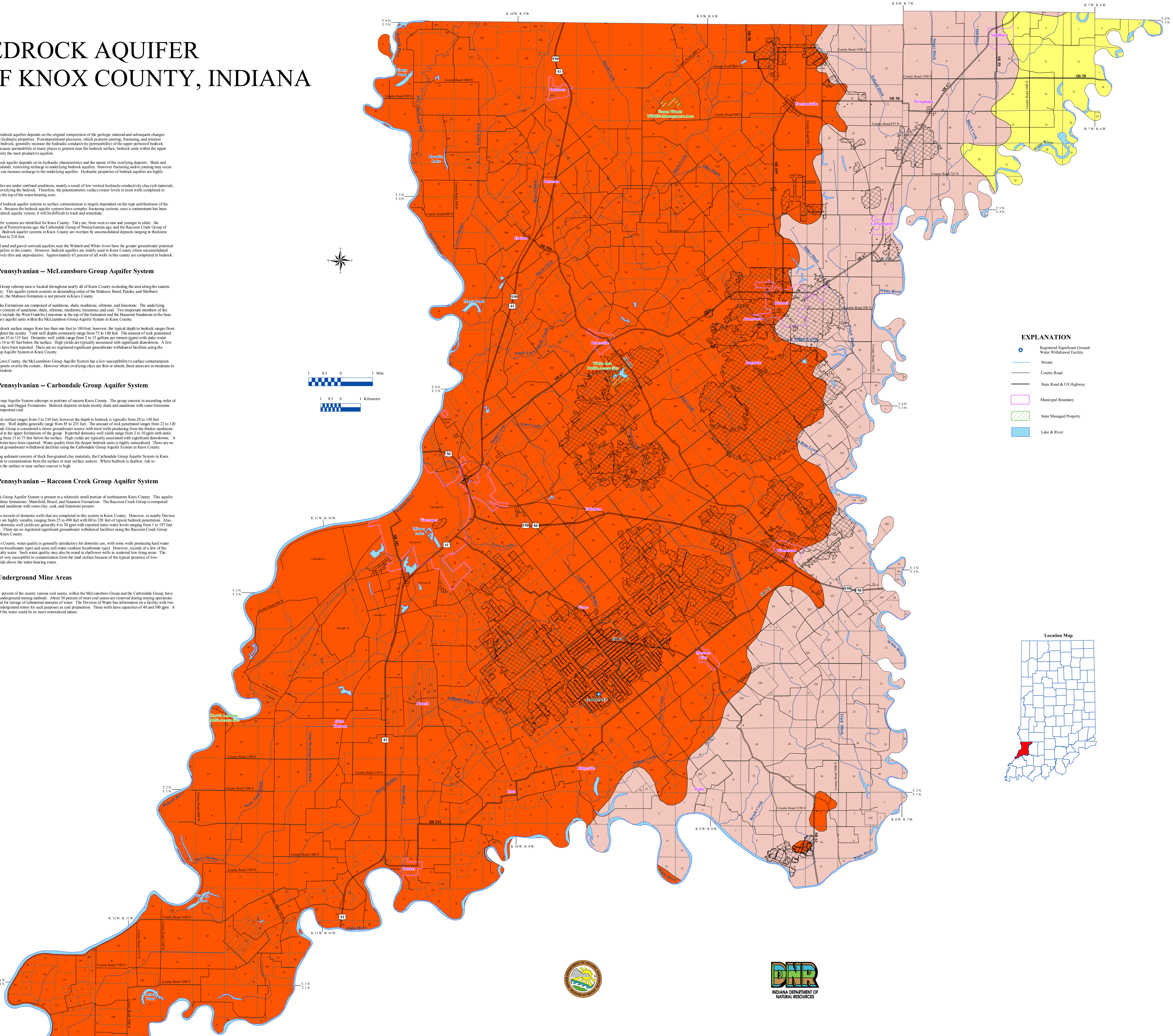
The Raccoon Creek Group Aquifer System is present in a relatively small portion of northeastern Knox County. This aquifer system consists of three formations: Mansfield, Brazil, and Staunton Formations. The Raccoon Creek Group is composed primarily of shale and sandstone with some clay, coal, and limestone present.

The Division has no records of domestic wells that are completed in this system in Knox County. However, in nearby Daviess County well depths are highly variable, ranging from 25 to 490 feet with 60 to 220 feet of typical bedrock penetration. Also, in Daviess County domestic well yields are generally 4 to 30 gpm with reported static water levels ranging from 1 to 197 feet below land surface. There are no registered significant groundwater withdrawal facilities using the Raccoon Creek Group Aquifer System in Knox County.

As noted in Daviess County, water quality is generally satisfactory for domestic use, with some wells producing hard water (calcium-magnesium-bicarbonate type) and some soft water (sodium bicarbonate type). However, records of a few of the deeper wells note salty water. Such water quality may also be noted in shallower wells in scattered low-lying areas. The aquifer system is not very susceptible to contamination from the land surface because of the typical presence of low-permeability materials above the water-bearing zones.

Underground Mine Areas

In approximately 5 percent of the county various coal seams, within the McLeansboro Group and 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. The Division of Water has information on a facility with two wells drilled into underground mines for such purposes as coal preparation. These wells have capacities of 40 and 500 gpm. A limitation on use of the water could be its more mineralized nature.



Map generated by Scott H. Dean
IDNR, Division of Water, Resource Assessment Section

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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. System1 and System2 were from the Indiana Department of Transportation (line shapefile, 2003) and based on a 1:24,000 scale. Managed Areas96 (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 Knox County, Indiana

by
Glenn E. Grove and Robert A. Scott
Division of Water, Resource Assessment Section

March 2011

UNCONSOLIDATED AQUIFER SYSTEMS OF KNOX COUNTY, INDIANA

The unconsolidated aquifer systems of Knox County are composed of sediments deposited by, or resulting from, a complex sequence of glaciers, glacial meltwaters, and post-glacial precipitation events. Nine unconsolidated aquifer systems have been mapped in Knox County: the Till Veneer, the Alluvial, Lacustrine and Backwater Deposits; the Wabash Lowland Till; the Wabash Lowland Till Subsystem; the Wabash River and Tributaries Outwash; the Wabash River and Tributaries Outwash Subsystem; the White River and Tributaries Outwash; the White 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. Approximately 35 percent of all wells in this county are completed in unconsolidated deposits.

The thickness of unconsolidated deposits in Knox County is quite variable due to the deposition of glacial material over an uneven bedrock surface. Unconsolidated deposits range from less than one foot thick northwest of Bicknell to over 210 feet thick north of Willis in Knox County.

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.

Till Veneer Aquifer System

The Till Veneer Aquifer System occurs in 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, and is generally less than 50 feet thick. This system has the most limited groundwater resources of all the unconsolidated aquifer systems in Knox County. Much of Knox County is mapped as Till Veneer Aquifer System.

Potential aquifers within the Till Veneer Aquifer System in Knox County include thin isolated sand and/or gravel layers, and surficial sand and gravel outwash or alluvium. However, there is little potential for groundwater production in this system with 90 percent of the wells started in this system completed in the underlying bedrock. Wells producing from the Till Veneer Aquifer System have reported capacities of 2 to 7 gallons per minute (gpm) with static water levels ranging between 6 to 22 feet below the surface. The wells with reported capacities in the upper limits of this system have noted significant drawdowns. Some wells have been reported as "dry". 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.

Alluvial, Lacustrine, and Backwater Deposits Aquifer System

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

About 55 percent of wells started in this system in Knox County are completed in the underlying bedrock aquifer system. However, the Alluvial, Lacustrine, and Backwater Deposits Aquifer System is capable of meeting the needs of some domestic users in Knox County. Individual sand and gravel units range from 5 to 25 feet thick with well depths ranging from 38 to 62 feet. Domestic well yields range from 5 to 12 gpm with static water levels ranging from 6 to 24 feet below the surface. The wells with reported capacities in the upper limits of this system have noted significant drawdowns. There are no registered significant groundwater withdrawal facilities using the Alluvial, Lacustrine, and Backwater Deposits Aquifer System in Knox County.

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 Till Aquifer System

The Wabash Lowland Till Aquifer System is mapped in the southeastern portion of Knox County. This aquifer system is up to 210 feet in thickness, and consists primarily of glacial till with intertill sand and gravel layers. However, the sand and gravel aquifers in this system tend to be relatively discontinuous.

This aquifer system is capable of meeting the needs of domestic and some high-capacity users in Knox County. Individual sand and gravel units range from 8 to 30 feet thick with well depths ranging from about 44 to 100 feet. Domestic well yields range from 8 to 18 gpm with static water levels ranging from 20 to 48 feet below the surface. The higher yields are typically associated with significant drawdowns. There is one registered significant groundwater withdrawal facility (3 wells) using the Wabash Lowland Till Aquifer System. The reported combined capacity of the facility is 97 gpm.

The 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.

Wabash Lowland Till Aquifer Subsystem

The Wabash Lowland Till Aquifer Subsystem is found in portions of northwest, south-central and southeastern Knox County. The subsystem is mapped similar to the Wabash Lowland Till Aquifer System. However, potential aquifer materials are generally thinner and potential yields are less in the subsystem.

About 70 percent of wells started in this subsystem in Knox County are completed in the underlying bedrock aquifer system. However, the Wabash Lowland Till Aquifer Subsystem is capable of meeting the needs of some domestic users in the county. Potential aquifer materials include relatively thin, discontinuous intertill sand and gravel deposits. These intertill sand and gravel aquifer materials are generally 5 to 10 feet thick. The wells producing from this subsystem are typically completed at depths ranging from 40 to 63 feet. Domestic well yields range from 3 to 10 gpm with static water levels ranging from 6 to 35 feet below the surface. The higher yields are typically 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 intertill sand and gravel units are overlain by thick till deposits. Wells producing from shallow aquifers are moderately to highly susceptible to contamination.

Wabash River and Tributaries Outwash Aquifer System / White River and Tributaries Outwash Aquifer System

The Wabash River and Tributaries Outwash Aquifer System occupies the valleys of the Wabash River and its major tributaries. Although the White River is a major tributary of the Wabash River, within the drainage basin of the White River this system is called the White River and Tributaries Outwash Aquifer System. These systems include thick glacial outwash sands and gravels, that are (in some areas) capped by a layer of clay and/or silt deposits.

The Wabash / White River and Tributaries Outwash aquifer systems are capable of meeting the needs of both domestic and high-capacity users in Knox County. The wells utilizing these aquifer systems are completed at depths ranging from 30 to 76 feet with sand and gravel aquifer materials commonly 18 to 62 feet thick. Domestic well yields are typically 10 to 50 gpm with static water levels ranging from 6 to 15 feet below the surface.

In the Wabash / White River and Tributaries Outwash aquifer systems there are 89 registered significant groundwater withdrawal facilities (148 wells) with yields that range up to 2,100 gpm. Also, there is one significant groundwater withdrawal facility with 2 radial collector well systems. The reported capacity for each of these collector wells is 10,000 gpm.

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

Wabash River and Tributaries Outwash Aquifer Subsystem / White River and Tributaries Outwash Aquifer Subsystem

These aquifer systems are generally located adjacent to the Wabash / White River and Tributaries Outwash aquifer systems. They typically occupy a higher topographic position and have considerably thinner (typically 6 to 28 feet thick) sand and gravel units than the main outwash aquifer systems. Commonly, the sand and gravel is covered by a layer of clay, till, lacustrine, or loess deposits with a typical thickness ranging from 5 to 20 feet.

The Wabash / White River and Tributaries Outwash aquifer subsystems are capable of meeting the needs of both domestic and high-capacity users in Knox County. The wells utilizing these aquifer systems are completed at depths ranging from 30 to 55 feet. Although not nearly as productive as their respective outwash systems, domestic wells completed in these subsystems typically yield 10 to 20 gpm. There are 9 significant groundwater withdrawal facilities (18 wells) using these systems in Knox County. High-capacity wells in these aquifer systems have reported rates ranging up to 650 gpm.

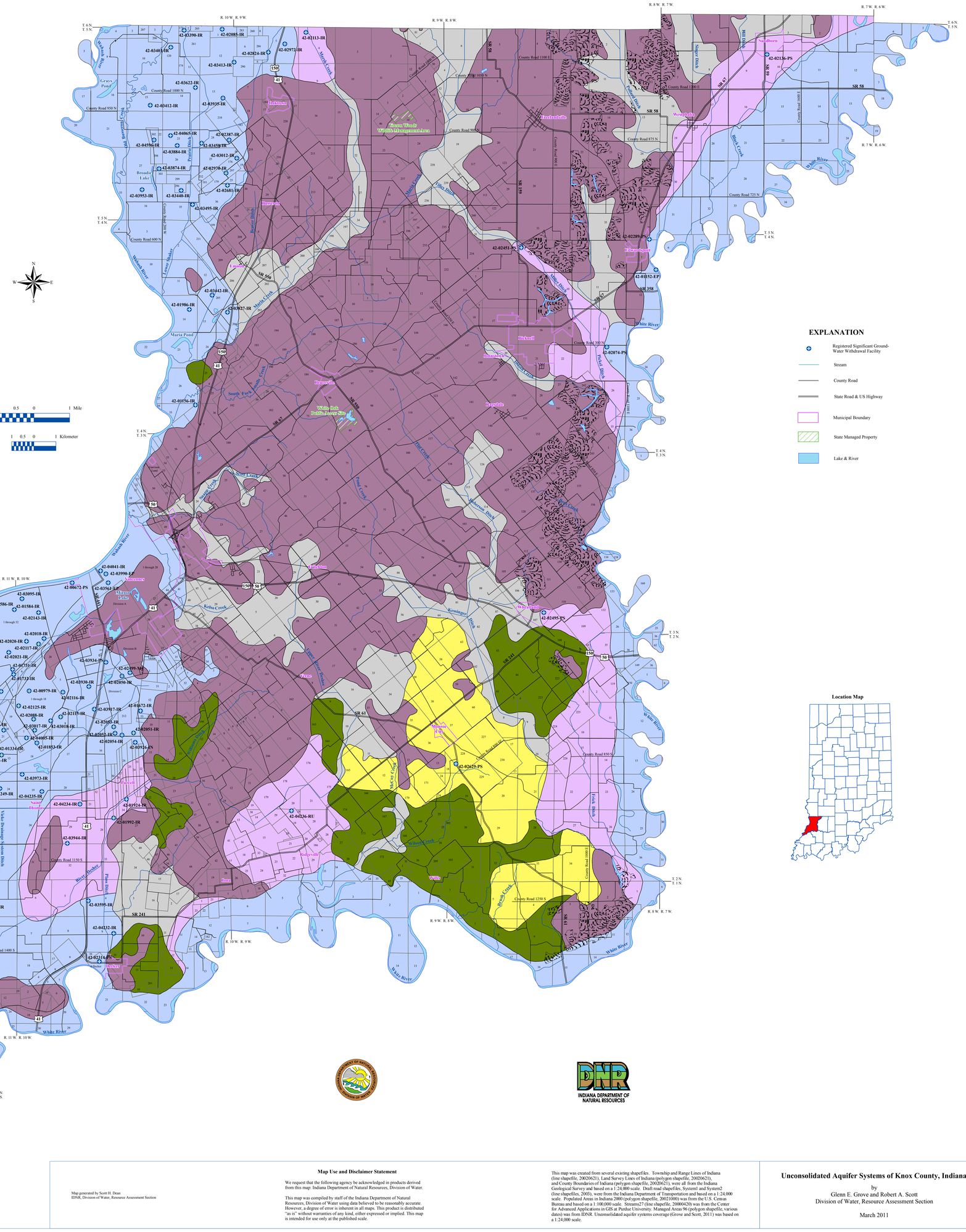
In general, these subsystems are moderately to highly susceptible to surface contamination. Although the overlying silt, clay, or till may provide some protection to the confined portions of these subsystems, in places such protection does not exist.

Coal Mine Spoil Aquifer System

The Coal Mine Spoil Aquifer System is present in the eastern portions of Knox County and covers about 5 percent of the county. The coal seams occur within the Carbondale 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 Knox 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 that are 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.



Map generated by Scott H. Dean
IDNR, Division of Water, Resource Assessment Section

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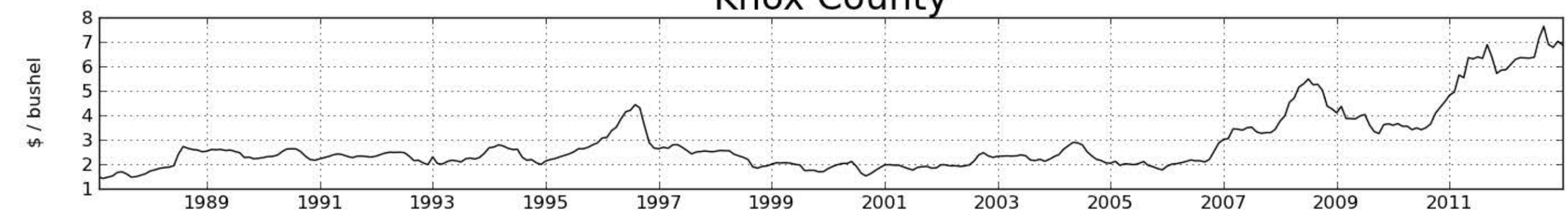
INDIANA DEPARTMENT OF NATURAL RESOURCES

Unconsolidated Aquifer Systems of Knox County, Indiana

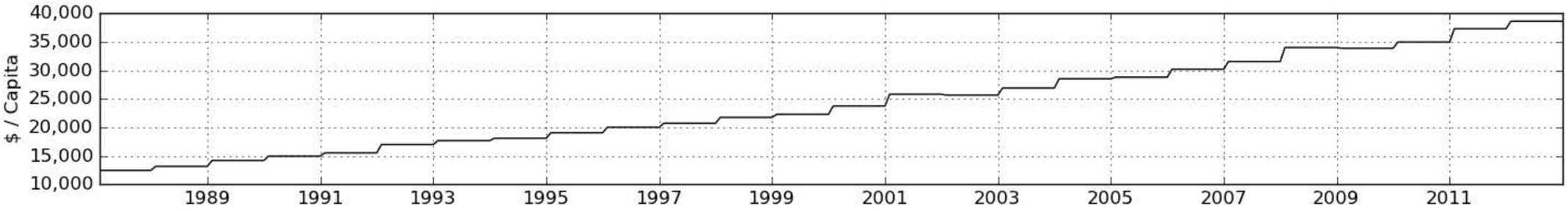
by
Glenn E. Grove and Robert A. Scott
Division of Water, Resource Assessment Section

March 2011

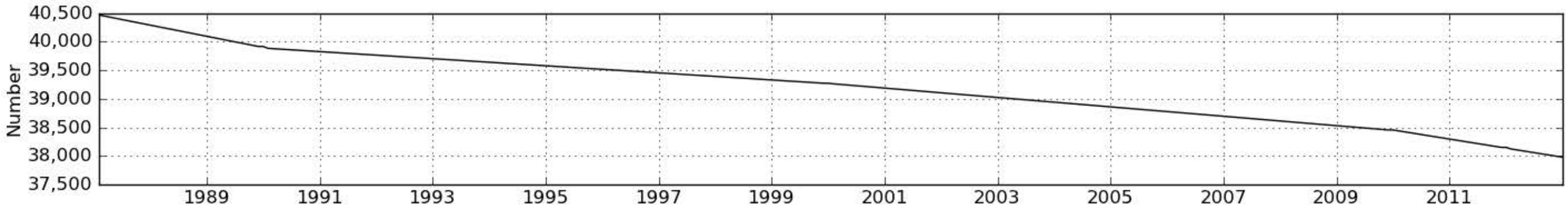
Knox County



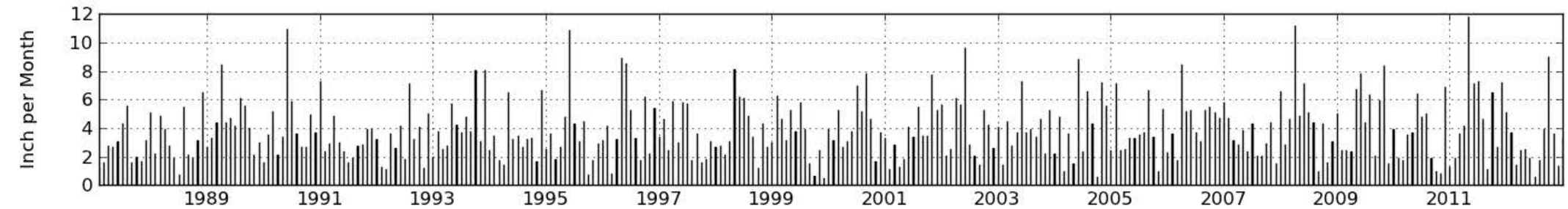
Corn Price



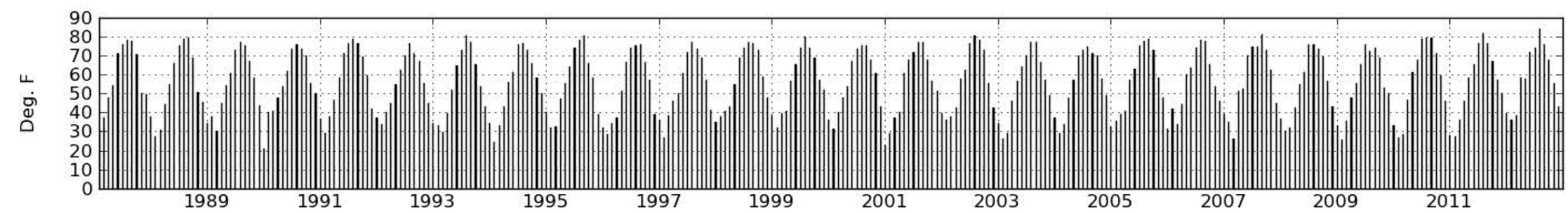
Income



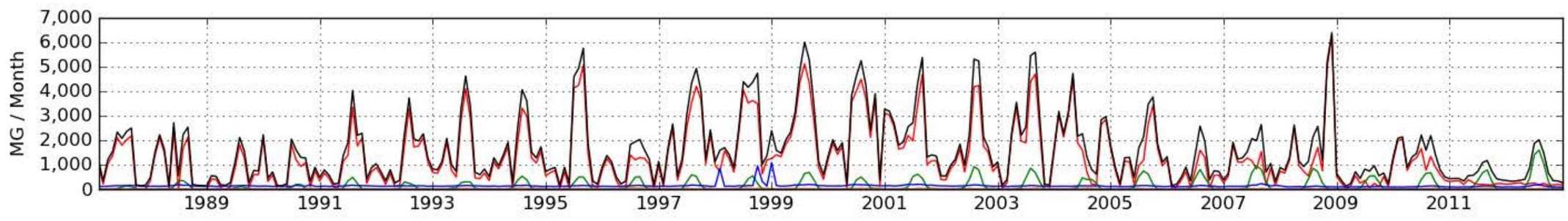
Population



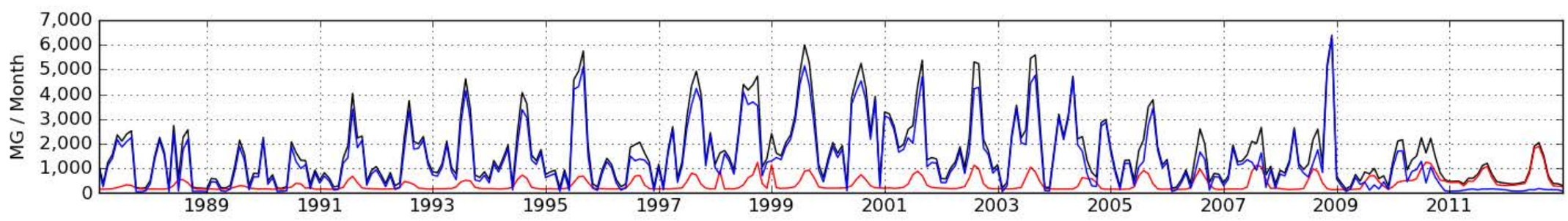
Precipitation



Temperature



Energy/Mining
Industry
Irrigation
Misc.
Public Supply
Rural
Total



Total
Ground Water
Surface Water