

# **Bedrock Aquifer Systems of Lawrence County, Indiana**

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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 greatest 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-pebble 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 cliff-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 359 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 limited 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 Harrodsburg and Salem limestone formations. These groups outcrop in a northwest to southeast band across the county. These are primarily limestone 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 “mud 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.

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