

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

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July 2003

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 in many places is greatest near the bedrock surface, bedrock units within the upper 100 feet are commonly the most productive aquifers. In Monroe 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.

Ground water quality is a concern in bedrock wells. The potential for encountering mineralized or saline ground water increases with greater well depths. This includes any wells that may be drilled into bedrock strata below the Borden Group (for example, the 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 Monroe County. They are, from west to east and 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 the Borden Group of Mississippian age.

## **Pennsylvanian -- Raccoon Creek Group Aquifer System**

The Raccoon Creek Group occurs in a very limited portion of southwestern Monroe County. Most of the Pennsylvanian strata in Monroe County have been eroded and only a thin remnant of the lowermost Mansfield Formation remains along ridges and hillsides.

The Mansfield Formation is composed primarily of cross-bedded sandstone with quartz-pebble and chert conglomerate as well as carbonaceous shale in some areas.

No known wells are completed in the Pennsylvanian strata in Monroe County. Described sandstone materials that are indicative of the Mansfield are shown to be from 20 to 92 feet thick. Wells in the general area where Pennsylvanian strata occur range in depth from 140 to 290 feet. It is likely that any wells in the Raccoon Creek area in Monroe County penetrate into the underlying Mississippian strata in order to obtain an adequate ground-water supply.

The Pennsylvanian strata are not generally very susceptible to contamination introduced at and near land surface. The bedrock surface is capped by clay materials ranging from 8 to 25 feet thick, and relatively low permeability shale and sandstone units typically occur above the water-bearing zones.

### **Mississippian -- Buffalo Wallow, Stephensport, and West Baden Groups Aquifer System**

This Upper Mississippian bedrock aquifer system is limited to a small area along the western edge of Monroe County. Nearly all of the surface bedrock materials are from the West Baden Group with total thickness of 80 feet or less in the county. A very limited amount of Stephensport strata may be present in the extreme southwestern part of the county. No Buffalo Wallow strata are present in the county.

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 8 to 30 feet below land surface. Well depths in the Stephensport and West Baden Groups range from 65 to 250 feet, with most wells completed at depths of about 80 to 140 feet. Deeper wells that exist may penetrate through the West Baden into a portion of the underlying Blue River and Sanders Groups.

The Buffalo Wallow, Stephensport, and West Baden Groups Aquifer System is not regarded as a major ground-water resource in the county. However, most attempts to drill a domestic well into it are successful. Most of the water will be found in the limestone and sandstone beds. Domestic wells completed in the system are commonly tested at 5 gallons per minute (gpm) or less. A few wells have been tested as high as 15 to 20 gpm. However, very few wells can sustain a pumping rate over 10 gpm. Static water levels range from 0 feet to 150 feet below land surface but are generally between 20 and 85 feet.

In the area of the Stephensport and West Baden groups the rock is predominantly shallow and contains numerous, irregular joints. In limited areas some karst 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 occur as the uppermost bedrock aquifer system over most of the west-central portion of Monroe 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 are primarily limestone with some dolomitic limestone content. The 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 to 325 feet.

Well depths in the Blue River and Sanders Group Aquifer System in Monroe County range from 0 to 300 feet, but most wells are completed at depths of about 90 to 160 feet. Some of the deeper wells penetrate into the underlying Borden Group Aquifer System. Depth to bedrock is generally between 10 and 30 feet.

The Blue River and Sanders Groups Aquifer System is not regarded as a major ground-water resource in the county. Most domestic well capacities range from 0 to 3 gpm. However, in some areas fractures and solution features may enhance production. Well drillers report that a few domestic wells yield up to 15 gpm. Static water levels range from 0 feet to 197 feet below land surface but are generally between 15 and 75 feet below surface.

The potential for developing high-capacity wells is extremely limited. However, several wells previously used by the town of Ellettsville reported initial capacities ranging from 55 to 192 gpm. The Ellettsville well depths ranged from 100 to 250 feet and were all located near McCormick's Creek northwest of the town limits.

Much of the Blue River and Sanders bedrock is within the Mitchell Plateau physiographic unit, an area typified by significant karst development. Areas of shallow bedrock, especially where joints, fractures, and solution features are present, may allow contamination. These conditions warrant considering the aquifer system as a whole to be susceptible to contaminants introduced at and near land surface.

### **Mississippian -- Borden Group Aquifer System**

The Mississippian Borden Group Aquifer System outcrops over most of the eastern half of Monroe County. This bedrock aquifer system is composed primarily 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.

Thickness of the Borden Group in Monroe County is up to 660 feet and in general thins as it dips to the southwest beneath younger rock formations. Well depths in the Borden Group Aquifer System may exceed 400 feet. However, most wells are completed at depths of 90 to 200 feet. Static water levels in the wells completed in the Borden aquifer range from 0 to 200 feet below land surface, but are commonly between 5 and 60 feet.

Because the Borden Group is generally not very productive, it is typically used only where overlying glacial drift or outwash deposits (if present) do not contain aquifer deposits. The Borden Group is often described as an aquitard and yields of wells completed in it are typically 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 from 1 to 7 gpm. A limited number of wells have been tested at greater capacities but it is doubtful that many could sustain such a rate for very long. Overall, there is little chance for development of high-capacity wells in the Borden Group Aquifer System.

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