

# **Bedrock Aquifer Systems of Johnson 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.

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 susceptibility of bedrock aquifer systems to surface contamination is largely dependent on the type and thickness of the overlying sediments. Because bedrock aquifer systems may 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 Johnson County. They are, from west to east and youngest to oldest: the Borden Group of Mississippian age; the New Albany Shale of Devonian and Mississippian age; and Silurian and Devonian Carbonates.

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

In Johnson County, the Mississippian age Borden Group Aquifer System is present in most of the western half of the county. This bedrock aquifer system is composed mostly of siltstone and shale, but fine-grained sandstones are also common. Although carbonates are rare, discontinuous interbedded limestone lenses are present, mostly in the upper portion of the group.

The Borden Group in Johnson County is up to 600 feet thick and generally thins as it dips to the southwest beneath younger rock formations. Depth to bedrock is typically 20 to 70

feet. Well depths in the Borden Group Aquifer System range from 10 to 375 feet. However, wells are typically completed at depths of 55 to 125 feet and typically penetrate 10 feet or less of bedrock.

The Borden Group is generally not very productive and it is typically used only where overlying deposits do not contain an aquifer. Many wells, however, are able to produce sufficient water for domestic purposes by relying on extra well-bore storage by drilling larger diameter and deeper wells. Typical yield of most domestic wells is less than 10 gpm with some dry holes reported. Yield may be greater in areas where thin outwash deposits overlie the bedrock. Static water levels are typically between 10 and 35 feet below surface.

The Borden Group is composed primarily of fine-grained materials that limit the movement of ground water. In areas where overlying clay materials are present, the Borden Group Aquifer System is at low risk to contamination from the surface or near surface. However, in some areas the bedrock is overlain by outwash materials that may be capped by thin deposits of silt, lacustrine silt, or colluvium. These areas are at moderate to high risk to contamination.

### **Devonian and Mississippian -- New Albany Shale Aquifer System**

The New Albany Shale Aquifer System in Johnson County is an extremely limited ground-water resource. The outcrop/subcrop area for the New Albany Shale in Johnson County is present along an approximate northwest to southeast trending band. This aquifer system consists mostly of brownish-black carbon-rich shale, greenish-gray shale, and minor amounts of dolomite and dolomitic quartz sandstone.

The New Albany Shale in Johnson County is up to 120 feet thick and generally increases in thickness as it dips to the southwest beneath younger rock formations. Depth to bedrock is typically 25 to 130 feet. Completed well depths are commonly 55 to 140 feet with wells typically penetrating less than 15 feet of bedrock.

This aquifer system is considered a poor ground-water resource and is generally described as an aquitard. However, a few domestic wells have been completed in this system. Typical yields are 10 gpm or less with some dry holes reported. In some cases well productivity is enhanced where outwash materials overlie the bedrock surface. Static water levels typically range from 10 to 40 feet below surface.

The permeability of shale materials is considered low. The New Albany Shale Aquifer System, therefore, has a low susceptibility to contamination introduced at or near the surface. However, in some areas the bedrock is overlain by outwash materials that may be capped by thin deposits of silt, lacustrine silt, or colluvium. These areas are at moderate to high risk to contamination.

## **Silurian and Devonian Carbonates Aquifer System**

In Johnson County, the outcrop/subcrop area of the Silurian and Devonian Carbonates Aquifer System is restricted to portions of the eastern third of the county. This system includes middle-Devonian age carbonates (limestone and dolomite) of the Muscatatuck Group and the underlying carbonates of Silurian age. Because carbonate units of Silurian and Devonian age are similar and cannot easily be distinguished on the basis of water well records, they are considered as a single water-bearing system.

The Muscatatuck Group in Johnson County is up to 125 feet thick and generally increases in thickness as it dips to the southwest beneath younger rock formations. The underlying Silurian carbonates are 125 to 175 feet thick and also thicken as they dip to the southwest. The combined thickness, therefore, is up to 300 feet with depth to bedrock ranging from 80 to 250 feet below surface.

Few water wells are completed in the Silurian and Devonian Carbonates Aquifer System in Johnson County. Prolific unconsolidated aquifer materials overlie the carbonate bedrock aquifer system and are used as the primary source of water. However, a few wells penetrate 10 to 35 feet of the carbonate bedrock with completed well depths that range from 225 to 265 feet.

The Silurian and Devonian Carbonates Aquifer System is capable of meeting the needs of domestic and some high-capacity users. Typical domestic yields are 10 gpm or greater with static water levels commonly reported from 60 to 90 feet below surface. One registered significant water withdrawal facility (one well) has a reported yield 80 gpm. However, this well is located outside the outcrop area at a depth of 500 feet. Also, this well penetrates through the Mississippian Borden Group and Devonian New Albany Shale Aquifer Systems. It is likely that there is some contribution from the overlying bedrock aquifer systems.

Most of the Silurian and Devonian Carbonates Aquifer System is overlain by thick clay deposits. Therefore, most of the aquifer system is considered at low risk to contamination. However, in some areas the aquifer system is overlain by unconsolidated deposits composed primarily of sand and gravel outwash materials. In such areas, the aquifer system is considered at moderate to high risk.

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