

Bedrock Aquifer Systems of Pike County, Indiana

by

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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, 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 is generally greatest near the bedrock surface, bedrock units within the upper 100 feet are usually the most productive aquifers. In Pike County, rock types exposed at the bedrock surface range from relatively unproductive shales to moderately productive sandstones. Thin limestone and coal seams are sometimes noted as water-bearing.

Bedrock aquifer systems in the county are overlain by unconsolidated deposits of varying thickness. Refer to the map for unconsolidated aquifer systems for more information. 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 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 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.

Three bedrock aquifer systems are identified for Pike County based on bedrock surface lithology. They are, from east to west and oldest to youngest: Raccoon Creek Group of Pennsylvanian age; Carbondale Group of Pennsylvanian age; and McLeansboro Group of Pennsylvanian age. The bedrock aquifer systems extend across Pike County generally as a series of bands trending north-northwest to south-southeast.

Bedrock aquifers are used extensively throughout the county except in the north and northeast where adequate ground water is generally available from shallower unconsolidated material in the buried bedrock valley or within the floodplains of the White and East Fork White Rivers. Elsewhere in the county, unconsolidated materials are very thin, primarily consisting of weathered bedrock residuum.

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.

In general, the potential for encountering mineralized or saline ground water in Pike County increases rapidly for bedrock wells deeper than 300 feet.

Pennsylvanian--McLeansboro Group Aquifer System

The outcrop/subcrop area of the McLeansboro Group is mostly confined to the northwestern portion of Pike County, where it ranges in thickness from 0 feet at its contact with the underlying Carbondale Group to about 150 feet at the western county line. This aquifer system consists in ascending order of the Shelburn, Patoka, Bond, and Mattoon Formations, however, only the Shelburn Formation is present in Pike County. The Shelburn Formation contains the Busseron Sandstone member at or near its base. The sandstone is typically gray to tan in color, fine to medium-grained, and massive. It is interbedded in places with gray shale. It is fairly extensive and is used in places as an aquifer, even though its low permeability typically limits well yields.

The depth to the bedrock surface in the McLeansboro Group is generally less than 50 feet. Wells range in depth from 45 to 307 feet, but are typically 75 to 175 feet deep. The amount of rock penetrated typically ranges from 40 to 155 feet, with a maximum of 298 feet. Static water levels in wells developed in the McLeansboro Group range from 12 to 55 feet below land surface, but are typically between 15 and 40 feet below the surface.

In general the McLeansboro Group in Pike County is considered a minor ground-water source with most wells producing from the Busseron sandstone member or from a combination of McLeansboro and Carbondale Group formations. Most domestic wells produce between 3 and 10 gpm with localized yields of up to 30 gpm.

Water quality is generally good and the aquifer system is not very susceptible to contamination from the land surface. However, in limited areas some improperly constructed or abandoned oil wells may have caused some contamination in the immediate vicinity of the wells. Expected contaminants would be dissolved solids, especially sodium and chloride, and crude oil. Natural water quality gets progressively worse (more salty) in wells deeper than about 200 or 300 feet.

Pennsylvanian--Carbondale Group Aquifer System

The outcrop/subcrop of the Carbondale Group occurs as a broad north-northwest to south-southeast trending band covering nearly 75% of Pike County. This Middle Pennsylvanian bedrock aquifer system consists in ascending order of the Linton, Petersburg, and Dugger Formations. It overlies the Raccoon Creek Group and underlies the McLeansboro Group. The Carbondale Group consists mostly of shales and sandstones with some coal and limestone. This group includes some laterally persistent limestones and four of Indiana's commercially important coals. Persistent shales and underclays are associated with several of these coals. Coal beds 5 to 8 feet thick are widespread. Clay beds as much as 10 feet thick underlie coals. Two limestone beds are 5 to 15 feet thick.

The entire section (although not its maximum thickness) of the Carbondale Group is present in Pike County. The thickness of the group ranges from 0 along its eastern edge to about 400 feet where it dips beneath younger rocks to the west. The Carbondale Group is considered a minor

ground-water source with most wells producing from the thicker sandstone and coal units. Most wells for homes, irrigation and stock produce between 1 and 13 gpm with localized yields of up to 25 gpm. A few (pumped) dry holes have been reported.

The depth to the bedrock surface is typically less than 40 feet. Well depths in the Carbondale Group range from 23 to 345 feet with most constructed at depths between 65 and 210 feet. The amount of rock penetrated by these wells typically ranges from 40 to 170 feet with a maximum of 323 feet. Static water levels in the wells vary from 0 (flowing) to 100 feet below the land surface, but are typically between 10 and 60 feet below the surface.

Water quality is generally good and the aquifer system is not very susceptible to contamination from the land surface. However, in areas of surface and underground coal mining, some localized contamination may have occurred. (Refer to the unconsolidated aquifer systems map for locations of any areas surface mined for coal.) Contaminants are typically dissolved solids, including calcium, magnesium, sulfate, bicarbonate, and iron. The natural quality of well water gets progressively more mineralized (commonly changing from a calcium-magnesium-bicarbonate type to a sodium bicarbonate or sodium chloride type) as wells are drilled deeper than about 200 to 300 feet and the rock strata dip beneath younger rocks to the southwest. The Carbondale Group is bounded on the west by the McLeansboro Group.

Pennsylvanian--Raccoon Creek Group Aquifer System

Aquifers contained within this Lower to Middle Pennsylvanian bedrock have generally low yielding capability. However, their value is most significant to the homes and farms using these sources. In general, well depths are greater in the Pennsylvanian rocks than in other aquifer systems in the state, and depths over 200 feet are common. Well casing diameters are usually six inches or greater, indicating the low yield capabilities of these aquifers. Because of the low permeability of the bedrock, the abundance of shale confining zones both above and below aquifer systems, and the limitation in available drawdown, it is seldom possible to divert large volumes of water into any particular pumping center.

The outcrop/subcrop area of the Raccoon Creek Group exists along the east side of Pike County and in a buried bedrock valley in the northeastern corner of the county. The group consists in ascending order of the Mansfield, Brazil, and Staunton Formations. The Mansfield Formation rests unconformably on rocks of late Mississippian age. This erosional contact surface is quite irregular in elevation, resulting in quite variable thickness of Mansfield rocks.

Total thickness of the group in the county ranges from about 350 feet near the eastern county line to about 800 feet in the northwestern part of the county. Shale and sandstone compose approximately 95 percent of the group. Clay, coal, and limestone make up nearly all the rest. Shale is more common than sandstone and it is usually light gray to dark-gray in color. The shale may be soft, non-silty to hard, silty, and sandy. The sandstone is mostly fine grained. Where the sandstone is present in the subsurface, massive cross-bedded sandstone seems to be common. Coal beds are typically quite thin, but could be as thick as 5 feet in some areas. Clay beds from 1 to 6 feet thick underlie coal seams. Two limestone beds are 1 to 5 feet thick. The lowermost part of the Mansfield commonly contains a large percentage of sandstone. Much of it is cross-bedded and may contain a quartz-pebble and chert conglomerate.

The depth to the bedrock surface is typically less than 30 feet, except in parts of a buried bedrock valley system, where the depth to bedrock may be over 150 feet. Well depths in the Raccoon Creek Group are highly variable, ranging from 35 to 300 feet. However, most are constructed at depths of 60 to 200 feet. The amount of rock penetrated by wells typically ranges from 20 to 140 feet, with a maximum of 185 feet. Static water levels in the wells vary from 4 to 75 feet below the land surface, but they are typically between 10 and 50 feet below the surface.

In general, the Raccoon Creek Group is considered a dependable ground-water source in Pike County with many wells producing from the basal sandstone of the Mansfield Formation. Yields for domestic wells typically range from 2 to 10 gpm with localized yields of up to 20 gpm. Potentially higher yielding wells may be obtained locally for light industrial, irrigation, farm operation, or small municipal usage of up to 50 gpm.

Water quality is generally good and the aquifer system is not very susceptible to contamination from the land surface. However, in areas of surface and underground coal mining, some localized contamination may have occurred. (Refer to the unconsolidated aquifer systems map for locations of surface coal mined areas.) Contaminants are typically dissolved solids, including calcium, magnesium, sulfate, bicarbonate, and iron. Natural water quality gets progressively worse (more salty) in wells deeper than about 300 to 400 feet as the strata dip beneath younger rocks to the southwest. The Raccoon Creek Group is bounded on the west by the Carbondale Group.

Underground Mine Areas

In these areas various coal seams within the Carbondale Group have been removed by underground mining methods. Approximately 50 percent of the coal has been removed, leaving the potential for storage of substantial amounts of water in the larger mines. Although the Division has no records of wells drilled into these mines, yields of a few hundred gpm are possible. A limitation on use of the water could be its more mineralized nature.

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