This is the first of three articles focused on groundwater and discusses some groundwater fundamentals to help us better understand how groundwater systems work. The second article, to be published next week, focuses on potential sources of contamination. A final article, published two weeks from now, will focus on injection wells.

A Few Groundwater Basics

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Water is essential to life. Whether your drinking water comes from a public water supply or a private well or spring, your very existence depends upon having safe, consumable water. The average American uses approximately 100 to 175 gallons of water per day and many homes and businesses use groundwater as their sole drinking water source. However, not all groundwater is suitable for drinking water.

Groundwater is essential to our public water supply systems, economic growth, national agricultural production, and the overall quality of life that we all share whether or not we are personally dependent on it for drinking water.

But what is groundwater?

Groundwater is stored beneath the land surface of our local communities in formations of saturated rock, sand, gravel, and soil. Unlike surface water, groundwater does not flow in a series of lakes and rivers. Instead, the rainfall and snow melt that seeps into our soil continues its downward journey and eventually fills the pores of these subsurface formations. The amount of water that infiltrates the subsurface varies widely, depending on land use, the type of soil present, and the amount of precipitation that falls.

Groundwater can also be replaced or recharged when rock formations come into contact with surface water bodies such as lakes and rivers. When these points of connection discharge groundwater to the surface, they are called springs. Formations that contain large enough amounts of water to feed springs or wells are called aquifers.

The two factors which determine the amount of water that aquifers can provide are called porosity and permeability. Porosity is a measure of the amount of pore space, or holes and cracks, present in a rock formation. The more pores present, the greater the rock's ability to hold water. A rock with many pores has high porosity. Permeability refers to the degree to which the pores are connected, providing the groundwater a way to move within the rock formation.

Some rock formations, including many clays and shales, have very low permeability and do not readily allow water to pass through. Other rock types such as sandstone, sand and gravel can be highly permeable in multiple directions, allowing water to move through its pores regardless of flow direction. In most aquifers, it can take years or even thousands of years for groundwater to travel only one or two miles.

Most aquifers are confined by low permeable geological formations. If you think of a sponge between two layers of children's clay you get a sense of an aquifer system that has a very porous layer bounded top and bottom by denser, less permeable layers. These confining layers inhibit the vertical movement of groundwater between these formations.

Groundwater is found in rock, sand, gravel, and soil at a wide variety of depths. Fresh groundwater—that is, water with lower salinities and mineral content—is usually located nearer the earth's surface.

Based on geologic environments and aquifer characteristics, four shallow aquifer systems have been identified in the Newton County area. They include the Kankakee, the Iroquois Moraine, the Iroquois Basin, and the Iroquois Buried Valley. These shallow aquifers consist of unconsolidated glacial deposits composed of sand and gravel within thick sequences of clay. The thickness of these individual and irregular or discontinuous aquifers ranges from three to 37 feet, but most are less than 10 feet.

Because of their irregular nature and thick sequences of impermeable clay, there can be limitations to the amount of water produced in these shallow aquifers. The total thickness of these unconsolidated sediments ranges from about 100 feet in most of the northern and central portions of Newton County to 50 feet in the southern portion of the county.

These sand and gravel deposits also overlie bedrock where four deeper bedrock aquifer systems are identified. These deeper aquifers are known as the Mississippian Borden Group, the Devonian and Mississippian New Albany Shale, the Silurian and Devonian Carbonates, and the Kentland Anomaly. These deeper formations can yield greater quantities of water but the water quality can vary significantly.

Deeper rock formations can contain water of limited quality or usability, usually because of higher dissolved mineral content. Water with salinities less than 10,000 parts per million of Total Dissolved Solids (TDS) is considered an Underground Source of Drinking Water (USDW) while generally anything above that number is not considered a source of drinking water. The base of most USDW's in Newton County varies but is generally around 800 feet below ground surface.

Estimates place the volume of nationally-usable groundwater at 100 quadrillion gallons. However, a problem exists: the potential for groundwater contamination. Groundwater can be extremely susceptible to contamination from a variety of common sources, including improperly functioning septic tanks, excessive use of fertilizers and pesticides, improperly managed industrial processes, as well as oil and gas operations.

As precipitation falls and moves downward to recharge the groundwater, it can carry the contaminants with it.   What happens on the surface doesn't always stay there and can have significant impacts on groundwater and shallow drinking water sources.

Once groundwater has been contaminated, cleaning it up to make it usable again can be extremely difficult, costly, and is sometimes not feasible at all. That is why it is important that these and other potential sources of contamination be managed in ways that protect groundwater.

Some wastes are generated by industrial processes that are difficult or impossible to treat to levels that are safe for discharge at the surface, typically into streams, rivers, and lakes. Some of these wastes, in liquid form, can be injected into deep geologic formations thousands of feet below the earth's surface and permanently isolated from usable water resources. Safely managing this process is the purpose of the State and Federal Underground Injection Control Program which will be discussed in a later article.