What's all the fuss about *karst*? Part II: A Closer Look at Sinkholes

by L. Terek Ball

Nearly all of Lewisburg and roughly one-third of Greenbrier County are underlain by karst — a land area, generally underlain by limestone, in which the topography is chiefly formed by the dissolving of the bedrock. While it may be difficult to look underground to tell if you live on karst — unless, of course, you happen to be a caver — you can look at the surface for clues.

Sinkholes — a signature feature of karst — are plentiful in Greenbrier County and, in some areas, fill the landscape as far as the eye can see. In this area of West Virginia, sinkholes occur almost everywhere that limestone bedrock is exposed on the surface of the ground. From atop Muddy Creek Mountain, one can view an extensive sinkhole plain, which lies within the karst plateau of central Greenbrier County.

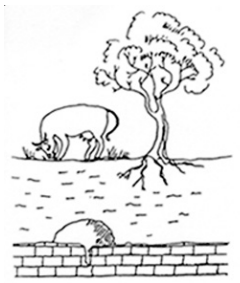
Other areas heavily laden with sinkholes can also be found along Rt. 60 from Lewisburg to Alta, Rt. 219 from Lewisburg to Pocahontas County, I-64 from Lewisburg to the Alta exit, Fairview Road, Davis Stuart Road, Old Powell Road behind the West Virginia State fairgrounds, and the Williamsburg Road, to mention a few.

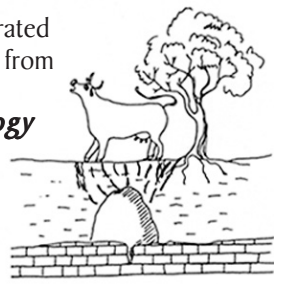
The sinkholes and karst topography of Greenbrier Valley were brought about by acidic rainwater dissolving the limestone bedrock over thousands and thousands of years. This type of eroding process has created a subsurface network of extensive caverns, giving rise in this unique region to one of the heaviest concentrations of sinkholes found anyplace in the world!

What are sinkholes and how do they form?

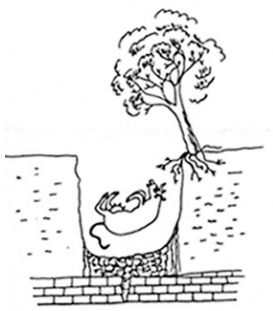
Sinkholes are loosely defined as natural depressions on the land surface caused by the removal and collapse of surface material into underlying voids. They can be closed depressions or they can have open bottoms, swallowing entire creeks, springs, or streams, which disappear underground. Both circumstances have one thing in common: caves and/or broken, weathered limestone bedrock near the soil surface.

Over thousands of years, flowing groundwater gradually dissolved channels through the limestone. This process creates a natural underground system of interconnected "pipes" and cavities or voids of various sizes, which cannot always support the weight of the overlying soil and rock. A sinkhole is then created when the surface materials collapse or are dissolved into the underground void, cavern, or cave stream. Although cover collapse sinkholes do occur throughout the Greenbrier County area, the vast majority of sinkholes are caused by the slow, gradual process of dissolving limestone bedrock and the downward movement of soil into the bedrock voids.





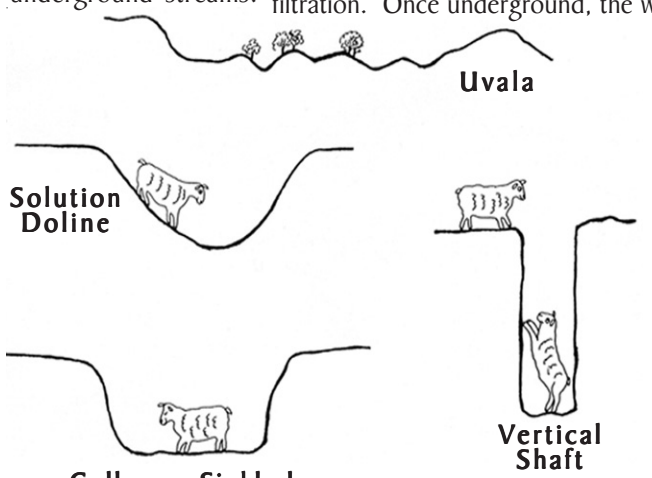
All illustrated sketches from ***Karst Hydrology Atlas of WV*** (1997) William K. Jones



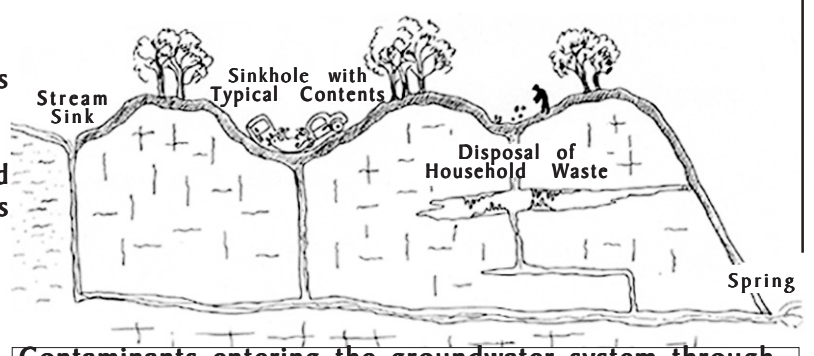
Sketch above depicts development of a cover collapse sinkhole by piping of soil particles and the formation of a soil arch which fails totally.

Needless to say, sinkhole shapes are variable and range from circular or oval bowl-shaped depressions that are wider than they are deep to funnel-shaped or steep-sided vertical depressions that may lead directly into underground streams. Their sizes can range from a few feet to greater than a thousand feet in width with depths up to several hundred feet. Some simple cone or bowl-shaped sinkholes can continue to enlarge and may coalesce with adjacent sinkholes to form wider or irregular shaped compound sinkholes. **The town of Lewisburg, for example, is situated in a large uvala sinkhole —** a compound sinkhole comprised of multiple coalescing depressions.

Regardless of sinkhole shapes or sizes, their presence is a clue to what lies below — bedrock that is broken and weathered and a likely place for special underground hydrological-geological processes.



Sketch above shows types of sinkholes.



Contaminants entering the groundwater system through sinkholes present a significant health concern because many wells tap water-filled cavities that are directly connected to the surface. In karst areas, groundwater typically resurfaces at springs and therefore carries the contamination into streams and rivers that may also be used as water supplies. - *Living on Karst* (1997) Cave Conservancy of the Virginias

Where does all the water go?

Remember the old adage: *what goes up comes down?* **In karst landscapes, the opposite holds true**: ***what goes down comes up!*** Most groundwater in karst regions returns to the surface of the land near streams and rivers through a cave or spring.

Rain and snowmelt percolating down through the soil are sources of groundwater. In non-karst regions, groundwater flows through the subsurface much as water is absorbed through a sponge, moving from upland areas to low land areas. The surface water becomes naturally purified as it passes slowly through the soil.

Groundwater flow in karst regions, however, acts very differently. Thin soils over fractured, cavernous limestone allow precipitation to enter the subsurface directly and rapidly, with a minimal amount of natural filtration. Once underground, the water can flow at very rapid speeds following difficult to predict paths that bear little relationship to the surface topography. In karst lands, the groundwater flow follows the fractures in the bedrock and, therefore, does not necessarily flow downhill.

What do sinkholes have to do with the quality of our drinking water?

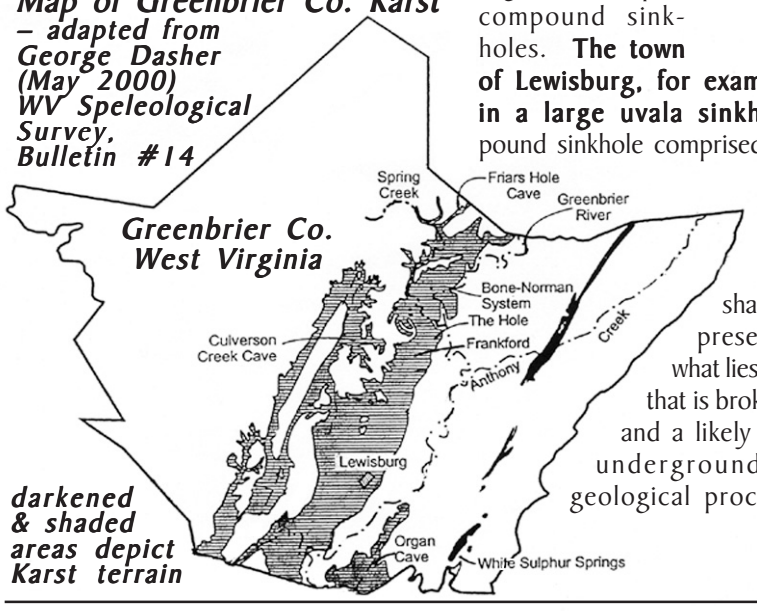
Sinkholes become natural drainage points on the land's surface and provide a direct link to our domestic source waters. For those of us living within the karst areas of Greenbrier County, our source of drinking water comes from either the Greenbrier River, an individual private well, or perhaps, a local karst spring.

Karst landscapes are, therefore, environmentally sensitive because contaminants can enter the groundwater quickly, with little or no filtration, through sinkholes, sinking or losing streams, and/or bedrock fractures enlarged by the dissolution process.

A fascinating characteristic of groundwater movement in karst landscapes compared to other types of terrain is the great speed with which the water is able to move from the surface of the land to our water supply. Years of dye tracing studies throughout the Greenbrier Valley have demonstrated that karst groundwater flow rates are often in the range of a mile per day! That means if pollutants enter the subsurface via a sinkhole near Lewisburg, those contaminants could easily end up at Davis Spring and enter into the Greenbrier River within 48 hours! This fast flowing movement of water also means that if one of your neighbors still uses their sinkholes as a trash dump — known in the past to be a very common practice — contaminants from those sinkholes can easily end up in your well water! In other types of terrains, it might take groundwater up to a year to travel only a few feet!

Sinkholes remain environmentally sensitive areas that need to be treated with care. Proper management of karst lands, therefore, also requires proper management of sinkholes because sinkholes and caves are components of integrated groundwater systems. With regard to water quality, the principle "garbage in- garbage out" applies to sinkholes. In other words, what you find in a sinkhole may very well affect what you get from your water faucet!

Map of Greenbrier Co. Karst – adapted from George Dasher (May 2000) WV Speleological Survey, Bulletin #14



darkened & shaded areas depict Karst terrain

Next issue

Part III: The Karst Watershed

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For more information on sinkholes and proper sinkhole management, check out the following sources: *Sinkhole Management* — WV Cave Conservancy [www.wvcc.net/education/Living on Karst]

Living with Sinkholes — VA Cave Board [www.state.va.us/dcr/dnh/vcbsinkholes.htm]

Sinkholes: The Movie [www.watersheds.org]

Sinkholes & Water Quality …We all live downstream— PA Dept. of Environmental Protection [www.pacd.org]

The Secret World of Greenbrier Valley … Agricultural Runoff & Water Quality" by R. Bowers (2001) [www.forester.net/sw_0111_secret.html]