

GLOSSARY

Following are definitions for many karst-related technical terms, not all of which are used in this website. They are included as background information for readers who need access to technical language used in karst research.

Aquifer: A formation, a group of formations, or part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs.

Base flow: Persistent rate of outflow of groundwater from a spring that is not influenced by rapid recharge from precipitation or snowmelt. Base flow is a steady or slowly decreasing discharge rate and has uniform physical water-quality characteristics (for example, low turbidity). Summer base flow in Kentucky typically occurs from mid-June through mid-October, whereas winter base flow is slightly greater and persists from mid-December through mid-March.

Base level: Lowest level (elevation) in a study area of erosion by a stream or karst conduit. Mean sea level is normally the ultimate base level.

Bedding plane: A primary depositional lamination found in sedimentary rocks separating two strata of differing characteristics.

Bedrock aquifer: A rock formation, group of formations, or part of a formation that contains enough saturated, permeable material to yield significant quantities of water to wells and springs. Flow may be through pores, bedding planes, joints, fractures, or small conduits.

Bedrock-collapse sinkhole: Formed by the collapse of a bedrock roof into an underlying cave. Bedrock collapse in karst is rare, but is the origin of some sinkholes, principally karst windows.

Bugs: Packets of material placed in springs to adsorb groundwater tracing dyes (see Passive tracer receptor). The term is analogous with an electronic listening device.

Captured flow: See Pirated flow.

Cave: A natural opening created by dissolution or erosion of bedrock and large enough for an adult person to enter (Monroe, 1970). A diameter of 50 centimeters and a length (depth) of 2 meters are approximate minimum dimensions. Most cavers, however, would not count anything less than 10 meters long or deep as a cave. Orientation of the dimensions of the opening relative to the bedrock outcrop is significant. An open-air vertical pit many meters deep and one meter wide with minimal overhanging ledges is a cave, whereas an overhang in a cliff many meters wide and with one meter of overhang is not a cave. In Kentucky, caves can exceed 30 meters in width and hundreds of kilometers in aggregated length. The flow of water in a cave may be perennial, seasonal, or high-flow (flood) only, or the cave may be permanently dry. An excavated underground mine or tunnel is not a cave.

Cave (location) radio: A paired radio transmitter and receiver that use very long wavelength, low-frequency radio signals to send a radio signal from a cave to the surface. The transmitted electromagnetic field is in the shape of a torus (donut-shaped electromagnetic field) and can be detected at the surface through over 300 meters of rock. The point on the surface directly over the transmitter is found by locating the center of the torus-shaped signal, which has a null signal or weak signal strength. Depth can also be calculated. Transmission depth is limited by the logistics of transporting batteries, delicate electronics, and a circular antenna that may be a meter in diameter through wet, low, or narrow and sinuous cave passages. Typically, cave radio is deployed at an important location (critical survey station in the cave, proposed excavated entrance, etc.) for which the precise location of the cave relative to the surface is required. Some designs include telegraph keys for underground-to-surface communication or are capable of surface-to-underground voice transmission.

Class V underground injection well (stormwater drainage wells): A disposal site in which surface-water runoff (rainwater or snowmelt) is diverted below the ground surface. They are typically shallow disposal systems designed to infiltrate stormwater runoff below the ground surface. Stormwater drainage wells may have a variety of designs and may be referred to by other names, including dry wells, bored wells, and infiltration galleries. The names may be misleading, so it is important to note that a Class V well by definition is any bored, drilled, or driven shaft, or dug hole that is deeper than its widest surface dimension, or an improved sinkhole or a subsurface fluid distribution system (with piping to enhance infiltration capabilities). For further details see www.epa.gov/safewater/uic/class5/types_stormwater.html

Conduit: A tubular opening created by dissolution of the bedrock, which carries, can carry, or has carried water. Conduits have a minimum diameter of 1 centimeter up to a maximum diameter of 50 centimeters. Flow in a conduit may be year-round, seasonal, high-flow only, or the conduit may now be permanently dry. The minimum diameter is 1 centimeter, the approximate critical hydraulic diameter where water flow begins to transition to turbulent from smooth or laminar. Fundamental changes in the mechanisms of carbonate dissolution and groundwater flow occur as a result of a conduit reaching the 1-centimeter diameter.

Cover collapse: The collapse of unconsolidated cover (soil, regolith, residuum, or outwash) into the underlying cavernous bedrock.

Cover-collapse sinkhole: Formed by the collapse of the unconsolidated cover (soil, residuum, loess, or till) that formed the roof of a soil void or conduit at the soil-bedrock interface, or spanned a grike (cutter) or other karst void in the bedrock.

Distributary: Branching of a stream into multiple channels as flow approaches its local base level. Karst conduits frequently divide to discharge at multiple springs, at nearly the same elevation, located along the receiving stream.

Dissolution sinkhole (synonym: doline): Sinkhole resulting exclusively from gradual dissolution of the bedrock and removal of the dissolved rock and insoluble residuum via the sinkhole throat and karst aquifer conduits. Dissolution sinkholes may be totally buried and filled, or the bedrock may be totally exposed. Most dissolution sinkholes have the classic bowl-shaped contour, with a variable thickness of soil or other unconsolidated residuum covering the bedrock. (Also see Epikarst)

Dry well: A well drilled into a karst sinkhole into which stormwater runoff is directed to minimize flooding of a sinkhole area. Such wells are conditionally included in the Class V injection well category by the U.S. Environmental Protection Agency. Also see EPA.

Epikarst (synonym: subcutaneous zone): The interval below the organic soil and above the mass of largely unweathered soluble bedrock, consisting of highly corroded bedrock, residuum, subsoil, loose rock in soil (float), and unconsolidated material of other origins. Thickness of the epikarst in Kentucky varies from absent to a reported 30 meters. The epikarst is important for the storage and transport of soil water and groundwater in the karst system and is relevant to foundation stability.

Epikarstic dye introduction point: (1) A hole drilled through the soil and of very shallow depth into bedrock for the purpose of introducing groundwater tracers. A coarse gravel pack and casing are installed in the hole to direct inflow. The EDIP is tested for satisfactory inflow rate prior to introducing tracers. Tracer is commonly pre-mixed with water then pumped or poured into the hole. Additional water is added until the movement of the tracer into the epikarst is assured (George, S., Aley, T., and Lange, A., 1999, Karst system characterization utilizing surface geo-physical, borehole, geophysical and dye tracing techniques, *in* Hydrogeology and Engineering Geology of Sinkholes and Karst—1999, Proceedings of the Seventh Multidisciplinary Conference on Sinkholes and the Engineering and Environmental Impacts of Karst: Rotter-dam, A.A. Balkema, p. 225–242.). (2) Trenches excavated to the top of bedrock and used to introduce tracers are not strictly EDIPs, but have a similar function.

Fluorescent Dye (synonym: tracer): One of several organic dyes that fluoresce under short wavelength light, particularly when dissolved in water or other solvent. Detection of the dye is confirmed by analysis of the mixture used to extract the dye from charcoal (elutant) or water samples with a filter fluorometer or a scanning spectrofluorometer.

Graded filter: A method for filling sinkholes in which the sinkhole's throat in the bedrock is bridged with large pieces of stone. The layer of large stones is covered with a second layer of stones that are large enough to bridge the openings between the underlying stones. Layers of stone are laid down in courses until a final layer of fine gravel can be covered with soil and the surface can be graded.

Grike: A fissure in limestone bedrock developed by dissolution along a joint or other vertical or near-vertical fracture or uplifted bedding plane.

Groundwater basin: In a water-table aquifer, an area outlined on the surface through which groundwater flows toward a discharge zone or point. In karst, a groundwater basin can be larger than the associated surface-water drainage basin, if conduits extend outside of the topographical divide.

Gumdrop: Anchor fashioned from concrete and heavy-gauge wire that suspends a passive dye receptor above the bottom of a channel. A lanyard is tied from the gumdrop to a higher elevation to hold the anchor in place during high flow so that the dye receptor can be retrieved easily.

Habitual troglomen: Animals that frequent the total-darkness areas of caves at certain times in their life cycle but live in other environments at other times and normally find their food above ground. The best known example is bats.

Intermittent lake: A seasonal or ephemeral lake that inundates a broad karst depression or valley after major precipitation events. Intermittent lakes function hydrologically in a manner similar to a type of karst valley (poljes) that develop along faults, but intermittent lakes lack several diagnostic geologic characteristics of poljes. (Also see Sinkhole flooding)

Joint: A break in the continuity of a body of rock occurring either singly, or more frequently in a set or system, but not attended by any invisible movement parallel to the surface of the discontinuity. (Also see Cover-collapse sinkhole and Bedrock-collapse sinkhole).

Karst (synonym: Karst terrain, Karst terrane): A landscape generally underlain by limestone or dolomite, in which the topography is chiefly formed by dissolving the rock and that may be characterized by sinkholes, sinking streams, closed depressions, subterranean drainage, and caves (Monroe, W.H., 1970, A glossary of karst terminology: U.S. Geological Survey, Water-Supply Paper 1899, 26 p.). The principal defining characteristic is the action of turbulent flow in conduits and caves, in the past or present. The term "terrain" implies that only the surface is considered, whereas "terrane" includes the subsurface (caves or aquifer) as a single system. Karst also forms on gypsum and salt bedrock, although not in Kentucky.

Karst conduit: A tubular opening created by dissolution of the bedrock, which carries, can carry, or has carried water flow. Conduits are defined as having a minimum diameter of 1 centimeter up to a maximum diameter of 0.5 meter. Flow in a

conduit may be year round, seasonal, high-flow only, or the conduit may be permanently dry.

Karst aquifer: A body of soluble rock that conducts water principally via a connected network of tributary conduits (tertiary porosity), formed by the dissolution of the rock, which drain a groundwater basin and discharge to at least one perennial spring. The conduits may be partly or completely water-filled. The karst aquifer may also have primary (intergranular) and secondary (fracture) porosity openings, which are saturated with water when below the potentiometric surface (water table).

Karst cave: See cave

Karst valley: A mid-size to valley-scale closed depression meeting the definition of a sinkhole but also enclosing and including more than one smaller sinkhole or a sinking stream.

Karst window: An unroofed section of a subterranean stream; a subterranean stream exposed to the surface within a sinkhole usually by collapse and dissolution and removal of a conduit's roof.

Land tide (informal usage): Overland flow in a normally dry surface channel caused by the runoff rate from a storm exceeding the intake rate of swallow holes and/or the discharge carrying capacity of the underlying caves and conduits. The morphology of the surface channel may be a well-defined stream course or a disrupted channel that links spill points between sinkholes and terminates at swallow holes.

Passive tracer receptor (synonyms: bug, dye detector, dye receptor, passive dye detector): Consists of two general types. (1) A activated carbon receptor is constructed of a few grams of coconut-shell charcoal enclosed in a mesh bag typically made of nylon screen. (2) A cotton receptor is a section of untreated surgical cotton or bleached broadcloth. Tracer receptors are fastened to a gumdrop or field expedient anchor.

Pirated (basin, watershed) flow: The process by which one stream or cave enlarges its drainage basin area by expanding into a neighboring drainage basin and rerouting (capturing) that drainage to the enlarging basin.

Ponor: See Sinkhole throat and Sinking stream.

Qualitative groundwater (dye) trace: Tracer experiment to establish the point-to-point connectivity, or flow vector, from the input point of the tracer to the resurgence. It only identifies the presence of tracer in the water (Worthington, S.R.H., and Smart, C.C., 2003, Empirical determination of tracer mass for sink to spring tests in karst, *in* Sinkholes and the engineering and environmental impacts of karst: American Society of Civil Engineers, Geotechnical Special Publication 122, p. 287–295). The method of sampling is commonly by passive tracer receptors.

Recharge: The infiltration or direct inflow of precipitation, water from impoundments, and runoff as it leaves impervious surfaces into earth materials (soil, sand and gravel, fractured insoluble bedrock, or karstic bedrock) that results in the replenishment of groundwater.

Sinkhole: Any closed depression in soil or bedrock formed by the erosion and transport of earth material from below the land surface. A sinkhole is circumscribed by a closed topographic contour and drains to the subsurface. Morphologies of sinkholes formed in soluble rock include dissolution sinkhole or doline (gently sloping depression that is wider than it is deep), karst window (sinkhole exposing an underground stream), vertical shaft (depressions in bedrock much deeper than it is wide and roughly circular in plan), grike (depression in bedrock much deeper than wide and crudely shaped like a lens [lenticular in plan]). (Also see Cover-collapse sinkhole and Bedrock-collapse sinkhole).

Sinkhole cluster area: A group of two or more sinkholes clustered so that the average spacing among them is closer than the average among other sinkholes in the immediate area as a whole. A sinkhole cluster is likely to have a common groundwater basin.

Sinkhole flooding: Water temporarily ponded in a sinkhole resulting from precipitation or flow reversal in a conduit. The origin of the water is either runoff from the surface of the sinkhole watershed, which exceeds the intake capacity of the swallow hole, or reversal of the direction of groundwater flow, resulting in resurgent discharge from the throat of the sinkhole.

Sinkhole topographic plain: A broad planar surface on which most of the local relief is the result of sinkholes and nearly all drainage is underground.

Sinkhole rim: The projected line of approximately constant elevation circling the interior slope of a sinkhole and demarcating a change in slope from convex at the higher elevation to concave at the lower elevation. This term is difficult to define with clarity and should be used with discretion, if at all.

Sinkhole throat (informal usage): Outlet or outlets for a sinkhole allowing runoff from the sinkhole watershed to flow into the ground. Not all sinkhole throats exhibit a unobstructed opening or an opening large enough for a person to enter, but some have large dimensions and all are a sink point for an intermittent, seasonal, or perennial stream varying in flow rate from rivulet to rivers.

Sinkhole watershed: An area bounded by a projected line demarcating a change in slope from the center of the sinkhole to the outer boundaries of the sinkhole, which represents a local topographic drainage divide. Precipitation falling on the surface sloping toward the sinkhole is likely to run into the sinkhole throat, or infiltrate the soil and move through subsoil conduits to the throat.

Sinking stream: A surface-flowing stream that disappears underground, typically into a swallow hole.

Specific electrical conductance: The ability of a substance to conduct an electrical current. In hydrogeology, it is used as an indicator of the strength of dissolved minerals in water. It is measured in milliSiemens or microSiemens, the reciprocal of the resistance in ohms across a 1 centimeter cube of liquid water solution.

Spring: Any natural discharge of water from rock or soil onto the surface of the land or into a body of surface water.

Springshed: An area on the land surface bounded by a line projected vertically from the boundary between two karst groundwater basins. Precipitation falling inside of the springshed discharges at one spring, or an interconnected distributary of springs, at the local base level discharge zone. A springshed is analogous to a watershed but is frequently discordant with topography and can be dynamic in that the boundary can temporarily shift in response to unevenly distributed precipitation resulting in the activation of overflow routes, both overland and underground, into adjacent basins.

Swallet: Informal usage generally synonymous with swallow hole. In formal use, a losing reach of alluvium-floored stream channel or other diffuse inflow of water into the underlying karstic bedrock.

Swallow hole: A place where water disappears or sinks underground. A swallow hole generally implies nearly instantaneous water loss into an opening at the bottom of a sinkhole or karst valley, whereas a swallet may refer to gradual water loss into the gravel along a streambed, with no depression apparent.

Topography: The physical features of a landscape: hills, valleys, rivers, etc. Maps of the topography commonly represent the shape of the surface with contour lines of constant elevation.

Topographic (watershed) divide: The boundary between two surface drainage systems, typically drawn along the crest of a hill. Water flows away from the divide.

Turbidity: A measure of sediment suspended in water by the scattering or adsorption of light.

Water table: The surface at the top of groundwater, below which water completely fills the pore spaces of the rock.