Kentucky Geological Survey
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MAP AND CHART 134
Series XII, 2006

Generalized Geologic Map for Land-Use Planning: Mason County, Kentucky

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Acknowledgments

Geology adapted from Petersen (2005, 2006a, b), Plauché (2006a, b), Smith (2006), Toth and Petersen (2006), Toth (2006a, b), Toth and Petersen (2006), and Zhang (2005a, b). Sinkhole data from Paylor and others (2004). Karst illustration from Currens (2001).

Slope Failure

Mass movements or landslides of surficial materials are by far the most frequent and most costly geologic hazards in the northern Kentucky area. Northern Kentucky has the greatest monetary loss per capita caused by landslides in the country. The failure of the slope may be rapid, but more commonly is a slow, almost imperceptible movement, called creep, of a few inches per year. Whether rapid or slow, the end results and damage are similar and costly: broken plumbing, cracked walls and foundations, cracked streets and sidewalks, and commonly total loss of the structures.

Virtually all of the mass movements in western and northern Mason County occur in colluvium—the weathered soil and rock materials that crumble from the bedrock as it weathers. The lower slopes of unit 2 are commonly thickly mantled with colluvium.

Shales of unit 2 and adjacent unit 3 will break down and weather rapidly when exposed to air and water. These shaly units tend to swell considerably when exposed to water. For this reason, plumbing trenches under walls and foundations should be prevented from accumulating water. Units 2 and 3 may share a translational landslide.

Landslides and slumps are common in shales and mudstones of unit 5.

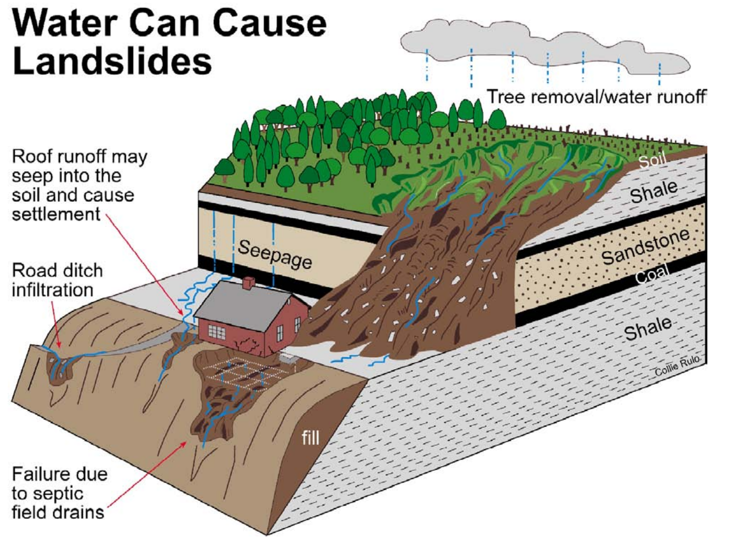
Gravity is the main driving force, but water nearly always plays a critical role by adding weight and lubricating the particles in the colluvium. Cutting into or overloading a slope with structures and fill can also be major contributing factors.

Precautions include taking care of all surface-water runoff by making certain that all runoff from roof, gutters, patios, sidewalks, and driveways is carried well away from and not toward the house; diverting drainage from areas sloping toward the house; cutting into natural slopes as little as possible and avoiding the use of fill; and trying to place the foundation of the structure on undisturbed bedrock.

When in doubt, consult an engineering geologist or a geotechnical engineer. Relict landslides can also be easily reactivated. Look for unusual bulges or cracks in the slope, tilted or curved trees, springs coming out onto the hillside, and tilted and cracked sidewalks, streets, and retaining walls.

For more information, see Potter (1996).

Water Can Cause Landslides



What Are the Factors That Cause Landslides?

Many factors contribute to landslides. The most common in eastern Kentucky are listed below:

1. Steep slopes: Avoid when choosing a building site.
2. Water: Slope stability decreases as water moves into the soil. Springs, seeps, roof runoff, gutter downspouts, septic systems, and site grading that cause ponding or runoff are sources of water that often contribute to landslides.
3. Changing the natural slope by creating a level area where none previously existed.
4. Poor site selection for roads and driveways.
5. Improper placement of fill material.
6. Removal of trees and other vegetation: Site construction often results in the elimination of trees and other vegetation. Plants, especially trees, help remove water and stabilize the soil with their extensive root systems.

What Are Some Ways to Prevent Landslides?

1. Seek professional assistance prior to construction.
2. Proper site selection: Some sloping areas are naturally prone to landslides. Inspect the site for springs, seeps, and other wet areas that might indicate water problems. Take note of unusual cracks or bulges at the soil surface. These are typical signs of soil movement that may lead to slope failure. Also be aware of geologically sensitive areas where landslides are more likely to occur.
3. Alter the natural slope of the building site as little as possible during construction. Never remove soil from the toe or bottom of the slope or add soil to the top of the slope. Landslides are less likely to occur on sites where disturbance has been minimized. Seek professional assistance before earth moving begins.
4. Remove as few trees and other vegetation as possible. Trees develop extensive root systems that are very useful in slope stabilization. Trees also remove large amounts of groundwater. Trees and other permanent vegetative covers should be established as rapidly as possible and maintained to reduce soil erosion and landslide potential.
5. Household water disposal system: Seek professional assistance in selecting the appropriate type and location of your septic system. Septic systems located in fill material can saturate soil and contribute to landslides.
6. Proper water disposal: Allowing surface waters to saturate the sloping soil is the most common cause of landslides in eastern Kentucky. Properly located diversion channels are helpful in redirecting runoff away from areas disturbed during construction. Runoff should be channeled and water from roofs and downspouts piped to stable areas at the bottom of the slope.

   (From U.S. Department of Agriculture, Natural Resources Conservation Service, no date)

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Additional Resources

Listed below are Web sites for several agencies and organizations that may be of assistance with land-use planning issues in Mason County:

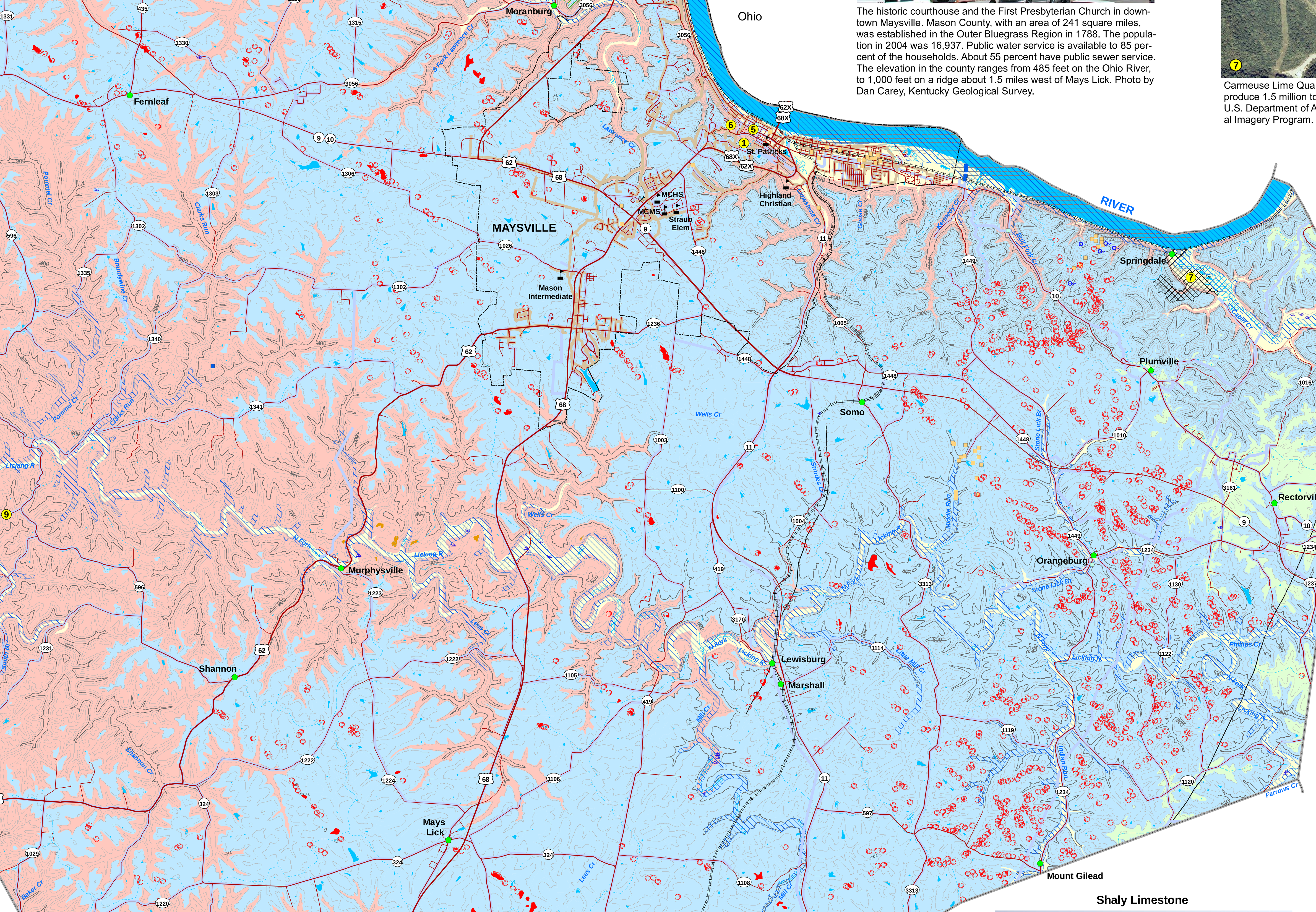
ces.ca.uky.edu/Mason/ University of Kentucky Cooperative Extension Service
www.btadd.com/ Buffalo Trace Area Development District
www.thinkkentucky.com/edis/cmnty/cw043/ Kentucky Economic Development Information System
www.uky.edu/KentuckyAtlas/21161.html Kentucky Atlas and Gazetteer, Mason County
quickfacts.census.gov/qfd/states/21/21161.html U.S. census data
kgsweb.uky.edu/download/kgsplanning.htm Planning information from the Kentucky Geological Survey

William Harsha Bridge

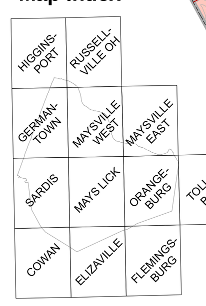
The new U.S. 62/68 bridge west of Maysville is the first cable-stayed bridge in Kentucky. Photo by Dan Carey, Kentucky Geological Survey.

Alluvium

The alluvial valley of the Ohio River at Dover. Photo by Dan Carey, Kentucky Geological Survey.



7.5-Minute Quadrangle Map Index



Electric Power

Eastern Kentucky Power produces 1,118 megawatts at the Spurlock coal-fired power station. A second 268-megawatt clean-coal-technology unit will go online in 2008. These units significantly reduce nitrogen oxide emissions, and can burn alternative fuels. Aerial photo (2004) by the U.S. Department of Agriculture, Farm Services Agency, National Agricultural Imagery Program.

Historic Mason County Courthouse

The historic courthouse and the First Presbyterian Church in downtown Maysville. Mason County, with an area of 241 square miles, was established in the Outer Bluegrass Region in 1788. The population in 2004 was 16,937. Public water service is available to 85 percent of the households. About 55 percent have public sewer service. The elevation in the county ranges from 485 feet on the Ohio River, to 1,000 feet on a ridge about 1.5 miles west of Mays Lick. Photo by Dan Carey, Kentucky Geological Survey.

For Planning Use Only

This map is not intended to be used for selecting individual sites. Its purpose is to inform land-use planners, government officials, and the public in a general way about geologic bedrock conditions that affect the selection of sites for various purposes. The properties of thick soils may supersede those of the underlying bedrock and should be considered on a site-to-site basis. At any site, it is important to understand the characteristics of both the soils and the underlying rock. For further assistance, contact the Kentucky Geological Survey, 859.257.5500. For more information, and to make custom maps of your area, visit the KGS Land-Use Planning Internet Mapping Web Site at kgsmap.uky.edu/website/kyluplan/viewer.htm.

Karst Geology

The term "karst" refers to a landscape characterized by sinkholes, springs, sinking streams (streams that disappear underground), and underground drainage through solution-enlarged conduits or caves. Karst landscapes form when slightly acidic water from rain and snowmelt seeps through soil cover into fractured and soluble bedrock (usually limestone, dolomite, or gypsum). Sinkholes are depressions on the land surface into which water drains underground. Usually circular and often funnel-shaped, they range in size from a few feet to hundreds of feet in diameter. Springs occur when water emerges from underground to become surface water. Caves are solution-enlarged fractures or conduits large enough for a person to enter.

Mineral Resources

Carmeuse Lime Quarry at the confluence of Cabin Creek and the Ohio River can produce 1.5 million tons per year of high-calcium lime. Aerial photo (2004) by the U.S. Department of Agriculture, Farm Services Administration, National Agricultural Imagery Program.

EXPLANATION

School
Water wells
- Domestic
- Monitoring
- Public
- Industrial

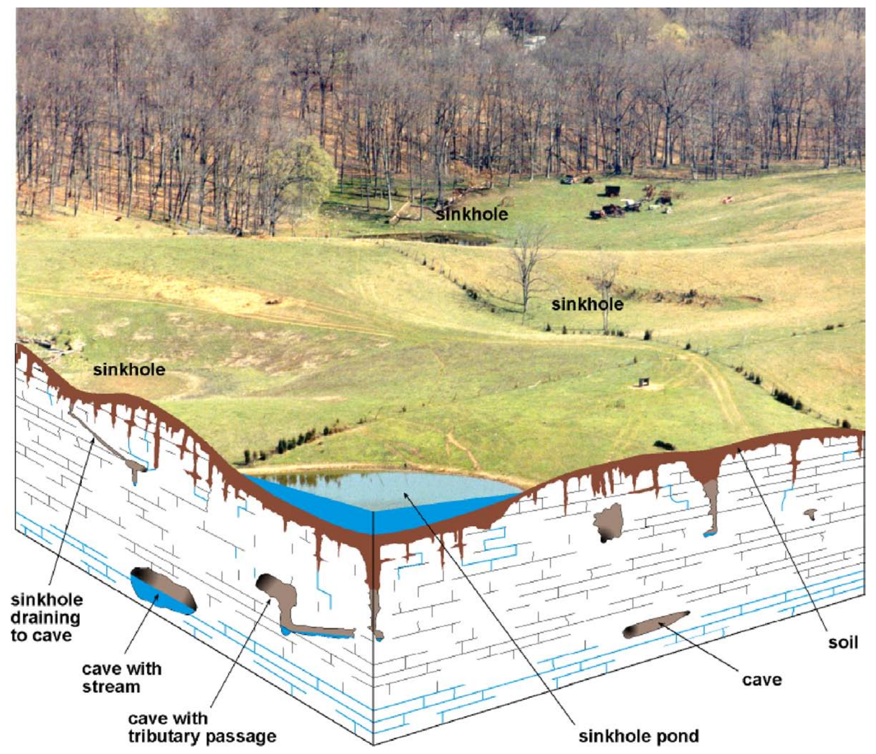
Spring
Sinkhole
Wet area
Rock outcrop
Mine or quarry
County line
Watershed boundary
Geologic fault
Concealed geologic fault
Mapped sinkhole
Wildlife management area
Quarry
Source-water protection area, zone 1
Wetlands > 1 acre (U.S. Fish and Wildlife Service, 2003)
Incorporated city boundaries
Designated flood zone* (FEMA, 2006)
40-foot contour interval
Photo location

*Flood information is available from the Kentucky Division of Water, Flood Plain Management Branch, www.water.ky.gov/floods/.

Source-Water Protection Areas

Source-water protection areas are those in which activities are likely to affect the quality of the drinking-water source. For more information, see kgsweb.uky.edu/download/water/swapp/swapp.htm.

Environmental Protection



- Never use sinkholes as dumps. All waste, but especially pesticides, paints, household chemicals, automobile batteries, and used motor oil should be taken to an appropriate recycling center or landfill.
- Make sure runoff from parking lots, streets, and other urban areas is routed through a detention basin and sediment trap to filter it before it flows into a sinkhole.
- Make sure your home septic system is working properly and that it's not discharging sewage into a crevice or sinkhole.
- Keep cattle and other livestock out of sinkholes and sinking streams. There are other methods of providing water to livestock.
- See to it that sinkholes near or in crop fields are bordered with trees, shrubs, or grass buffer strips. This will filter runoff flowing into sinkholes and also keep tilled areas away from sinkholes.
- Construct waste-holding lagoons in karst areas carefully, to prevent the bottom of the lagoon from collapsing, which would result in a catastrophic emptying of waste into the groundwater.
- If required, develop a groundwater protection plan (410KAR5:037) or an agricultural water-quality plan (KRS224.71) for your land use.

(From Currens, 2001)

The Ohio River at Maysville

The bluffs of the Ohio at Maysville rise nearly 400 feet above the river and provide spectacular views of the valley. The 1932 Simon Kenton Bridge is in the foreground and the J.M. Stuart coal-fired power plant is upstream on the Ohio side. A floodwall and levee system protects low-lying areas from flooding. The river provides transportation, cooling water, and drinking water from its alluvial aquifers. Photo by Dan Carey, Kentucky Geological Survey.

LAND-USE PLANNING TABLE DEFINITIONS

FOUNDATION AND EXCAVATION

The terms "earth" and "rock" excavation are used in the engineering sense; earth can be excavated by hand tools, whereas rock requires heavy equipment or blasting to remove.

LIMITATIONS

Slight—A slight limitation is one that commonly requires some corrective measure but can be overcome without a great deal of difficulty or expense.

Moderate—A moderate limitation is one that can normally be overcome but the difficulty and expense are great enough that completing the project is commonly a question of feasibility.

Severe—A severe limitation is one that is difficult to overcome and commonly is not feasible because of the expense involved.

LAND USES

Septic tank disposal system—A septic tank disposal system consists of a septic tank and a filter field. The filter field is a subsurface tile system laid in such a way that effluent from the septic tank is distributed with reasonable uniformity into the soil.

Residences—Ratings are made for residences with basements because the degree of limitation is dependent upon ease and required depth of excavation. For example, excavation in limestone has greater limitation than excavation in shale for a house with a basement.

Highways and streets—Refers to paved roads in which cuts and fills are made in hilly topography, and considerable work is done preparing subgrades and bases before the surface is applied.

Access roads—These are low-cost roads, driveways, etc., usually surfaced with crushed stone or a thin layer of blacktop. A minimum of cuts and fills are made, little work is done preparing a subgrade, and generally only a thin base is used. The degree of limitation is based on year-around use and would be less severe if not used during the winter and early spring. Some types of recreation areas would not be used during these seasons.

Light industry and malls—Ratings are based on developments having structures or equivalent load limit requirements of three stories or less, and large paved areas for parking lots. Structures with greater load limit requirements would normally need footings in solid rock, and the rock would need to be core drilled to determine the presence of caverns, cracks, etc.

Intensive recreation—Athletic fields, stadiums, etc.

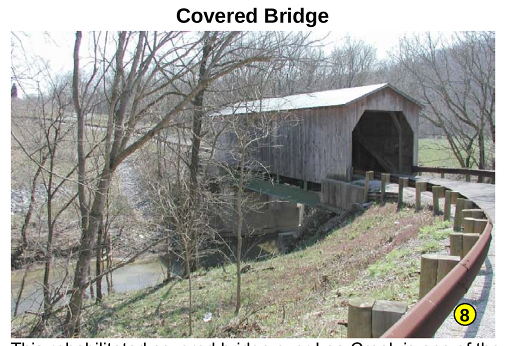
Extensive recreation—Camp sites, picnic areas, parks, etc.

Reservoir areas—The floor of the area where the water is impounded. Ratings are based on the permeability of the rock.

Reservoir embankments—The rocks are rated on limitations for embankment material.

Underground utilities—Included in this group are sanitary sewers, storm sewers, water mains, and other pipes that require fairly deep trenches.

Covered Bridge



This rehabilitated covered bridge over Lee Creek is one of the few remaining in the state. Photo by Dan Carey, Kentucky Geological Survey.

For information on obtaining copies of this map and other Kentucky Geological Survey maps and publications call our Public Information Center at 859.257.3896 or 877.778.7827 (toll free)

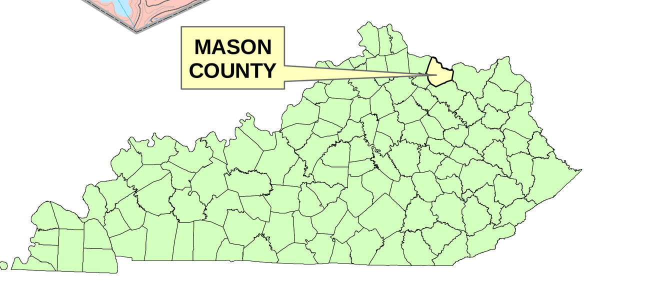
View the KGS World Wide Web site at: www.uky.edu/kgs

Shaly Limestone

Rolling topography characterizes areas underlain by shaly limestones (unit 2). Photo by Dan Carey, Kentucky Geological Survey.

Limestone Spring

Water travels underground through conduits in the limestone and emerges at springs. A line of sinkholes is an indicator of an underground flow path. Photo by Dan Carey, Kentucky Geological Survey.



Groundwater

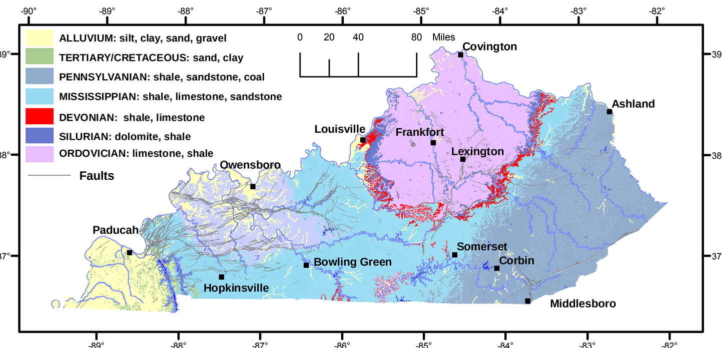
The Ohio River alluvium is the best source of groundwater in the county. Many properly constructed drilled wells will produce several hundred gallons per minute from the alluvium; most wells are able to produce enough for a domestic supply at depths of less than 100 feet. Water is hard or very hard, but otherwise of good quality.

In the lower sections of the larger creek valleys discharging into the Ohio River, most drilled wells will also produce enough water for a domestic supply at depths of less than 100 feet. Some wells located in the major creek valleys will produce enough water for a domestic supply, except during dry weather.

In upland areas (about 70 percent of the county), most drilled wells will not produce enough water for a dependable domestic supply, unless they are drilled along drainage lines, in which case they may produce enough water except during dry weather. Groundwater in these areas is hard or very hard and may contain salt or hydrogen sulfide, especially at depths greater than 100 feet.

For more information on groundwater in the county, see Carey and Stickney (2004)

Geology of Kentucky



Learn more about Kentucky geology at www.uky.edu/KGS/geoky/

Limestone and Shale

Nearly all of Mason County is underlain by rocks composed of layers of limestone and shale. In general, when shale is predominant the terrain is rugged. When limestone is dominant, the terrain is more gentle and suitable for agriculture and development. Limestone forms steep cliffs along streams cutting from the uplands to the river. Layered rocks are shown in this road cut along U.S. 62/68. Photo by Dan Carey, Kentucky Geological Survey.

Limestone

Limestone soils provide for a strong agricultural economy. Photo by Dan Carey, Kentucky Geological Survey.

Planning Guidance by Rock Unit Type

Rock Unit	Karst Potential Rating	Foundation and Excavation	Septic System	Residence with Basement	Highways and Streets	Access Roads	Light Industry and Malls	Intensive Recreation	Extensive Recreation	Reservoir Areas	Reservoir Embankments	Underground Utilities
1. Alluvium—clay, silt, sand, and gravel	None, but on-site karst investigation recommended where less than 25 feet thick over soluble rock.	Fair foundation material; easy to excavate. Refer to soil report (Forsythe and Jacobs, 1986).	Severe limitations. Failed septic systems can contaminate groundwater. Refer to soil report (Forsythe and Jacobs, 1986).	Water in alluvium may be in direct contact with basements. Refer to soil report (Forsythe and Jacobs, 1986).	Slight limitations. Refer to soil report (Forsythe and Jacobs, 1986).	Slight to moderate limitations. Refer to soil report (Forsythe and Jacobs, 1986).	Slight to moderate limitations. Avoid construction in floodplain. Refer to soil report (Forsythe and Jacobs, 1986).	No limitations. Possible flooding. Refer to soil report (Forsythe and Jacobs, 1986).	No limitations. Possible flooding. Refer to soil report (Forsythe and Jacobs, 1986).	Refer to soil report (Forsythe and Jacobs, 1986).	Not recommended.	Not recommended.
2. Shale*, limestone	Medium to low.	Fair to good foundation material; difficult excavation. Slumps when wet. Avoid steep slopes.	Slight to severe limitations, depending on amount of soil cover and depth to impermeable rock.	Severe to moderate limitations. Rock excavation may be required. Slumps when wet. Avoid steep slopes. Possible shrinking and swelling shales.	Severe to moderate limitations. Rock excavation may be required. Slumps when wet. Avoid steep slopes.	Severe to moderate limitations. Rock excavation may be required. Slumps when wet. Avoid steep slopes.	Moderate to severe limitations, depending on topography. Rock excavation. Local drainage problems. Susceptible to landslides.	Slight to severe limitations, depending on activity and topography. Possible steep wooded slopes.	Slight to moderate limitations, depending on activity and topography. Possible steep wooded slopes. Slight limitations for forest or nature preserve.	Moderate to slight limitations. Reservoir may leak where rocks are fractured.	Slight to moderate limitations. Reservoir may leak where rocks are fractured.	Moderate to severe limitations. Rock excavation likely.
3. Limestone, shale*	High to medium.	Good to excellent foundation material; difficult to excavate.	Moderate to severe limitations. Impermeable rock. Locally fast drainage through fractures and sinks. Danger of groundwater contamination.	Severe to moderate limitations. Rock excavation may be required.	Moderate to severe limitations. Rock excavation possible. Local drainage problems, especially on shale. Sinks possible. Avoid steep slopes.	Slight to severe limitations, depending on topography. Rock excavation likely. Local drainage problems, especially on shale. Sinks possible.	Slight to severe limitations, depending on topography. Rock excavation. Sinks common. Local drainage problems. Groundwater contamination possible.	Slight to moderate limitations. Rock excavation may be required.	Slight limitations, depending on activity and topography. Possible steep wooded slopes. No limitations for nature or forest preserve.	Moderate to slight limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Moderate to severe limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Moderate to severe limitations. Rock excavation likely.
4. Clay, silt, sand, and gravel (high-level terrace deposits and glacial outwash)	None, but on-site karst investigation recommended where less than 25 feet thick over soluble rock.	Fair foundation material; easy to excavate.	Severe to slight limitations, depending on amount of soil cover.	Moderate to slight limitations, depending on slope.	Slight limitations.	Slight limitations, depending on degree of slope.	Slight limitations, depending on degree of slope.	Moderate to slight limitations, depending on activity and topography. Possible wooded slopes.	Slight limitations, depending on activity and topography. Possible wooded slopes. Slight limitations for nature preserve.	Not recommended. Pervious material.	Severe to slight limitations. Unstable steep slopes.	Slight limitations.
5. Clay shales, mudstone, and dolomite	Low.	Poor foundation material; easy to moderately difficult to excavate. Low strength and stability. May contain plastic clays.	Severe limitations. Thin soils and low permeability.	Severe limitations. Low strength, slumping, and seepage problems.	Severe limitations on slopes. Strength, slumping, and seepage problems.	Severe limitations on slopes. Strength, slumping, and seepage problems.	Severe limitations on slopes. Strength, slumping, and seepage problems.	Moderate to severe limitations, depending on activity.	Slight to severe limitations, depending on activity. Slight limitations for forest or nature preserve.	Slight limitations. Reservoir may leak where rocks are fractured. Most ponds on shale are successful.	Severe limitations. Poor strength and stability.	Moderate limitations. Poor strength. Wetness.

*Some of these shales can shrink during dry periods and swell during wet periods and cause cracking of foundations. On hillsides, especially where springs are present, they can also be susceptible to landslides.