

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

Daniel I. Carey

Limestone—Unit 4

Rockcastle County, 318 square miles in the Pennyroyal and Eastern Kentucky Coal Field Regions, was formed in 1810. The terrain is hilly in the north (unit 2), rolling karst (unit 4), and in the west-central part, and almost mountainous in the south (unit 6). The highest elevation, 1,638 feet, is on a ridge in the northeast near the Jackson County line. The lowest elevation, 810 feet, is Rockcastle River at the extreme southern tip of the county. The 2006 population, 16,857, was 1.7 percent greater than that of 2000. Photo by Dan Carey, Kentucky Geological Survey.

Renfro Valley
Internationally renowned Renfro Valley has been providing entertainment and family fun for over 68 years. Photo by Dan Carey, Kentucky Geological Survey.

Lake Linville
The 356-acre Lake Linville, with nearly 8 miles of shoreline, provides boating, fishing (bass, crappie, bluegill, and catfish), and lakeside homesites. Renfro Creek was dammed in 1968 by the 1-75 fill embankment to create the lake. The lake provides water to the Mount Vernon Water Works and is part of a source-water protection area. Photo by Dan Carey, Kentucky Geological Survey.

Water Resources
The Rockcastle River just below the Roundstone Creek confluence. Both streams contain endangered mussels and are listed under the U.S. Environmental Protection Agency's Endangered Species Protection Program limiting the use of pesticides. Groundwater flow maintained the streams during the extreme drought of 2007. The flow in Copper Creek was not sustained because the black shale (unit 5) in the drainage basin is a poor source of groundwater. Only a few small ponds remained in the dolomite karst (unit 4). Photos by Dan Carey, Kentucky Geological Survey.

Groundwater
About 2,900 people in Rockcastle County rely on private domestic water supplies: 1,100 use wells and 1,800 use other sources. In the eastern half of the county, most wells drilled in valley bottoms are adequate for a domestic supply. About half the wells drilled on hillsides are adequate for a domestic supply. Wells on ridges and hills yield less water. In the western half of the county, fewer than half the wells drilled in valley bottoms are adequate for a domestic supply, except where limestone is the predominant rock. In limestone-rich areas, three-quarters of the wells drilled in the valleys or uplands can produce enough water for domestic use. Through-out most of the county, wells on hillsides and ridges generally yield less water than wells drilled in valley bottoms. Salty water may be found in wells drilled less than 100 feet below the level of the principal valley bottoms. At greater depths no fresh water probably will be found. Springs in limestone may supply enough water for domestic use. For more information on groundwater in the county, see Carey and Slickney (2004).

Radon
Rockcastle County is considered to be in an area of moderate potential for elevated indoor radon levels. The U.S. Environmental Protection Agency estimates that 20,000 lung cancer deaths a year are radon-related. Radon is the second leading cause of lung cancer after smoking. The radon risk for smokers is 10 times that for nonsmokers. You can't see radon. And you can't smell it or taste it. It is produced by the decay of naturally occurring uranium in soil and water. The EPA recommends testing all homes and schools. Testing is inexpensive and easy. The average indoor radon level is 1.3 picocuries per liter. Homes with radon levels at 4 picocuries per liter or greater should be fixed. A commonly used method of radon reduction is a vent pipe system and a fan to pull radon from beneath the house and vent it to the outside. (U.S. Environmental Protection Agency, 2007.)

Kudzu
Kudzu, an invasive species from East Asia, creates a leafy sculpture as it blankets a hillside in Rockcastle County. It can grow 15 inches in a day, or 60 feet in a season. The nonwoody parts are edible. Studies have shown that kudzu can reduce hangovers and alcohol cravings. Photo by Dan Carey, Kentucky Geological Survey.

Shale and Siltstone
Erodible shales and erosion-resistant siltstones (right), exposed along U.S. 25, form the hills in northern Rockcastle County. Photo by Dan Carey, Kentucky Geological Survey.

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An uplifting experience that will not be appreciated: Left: All well in this newly built home until water from percolation, drains, lawn sprinklers, leaking sewers, or water mains soaks swelling soil beneath the foundation. Right: With time, expanding soils exert several tons per square foot of pressure on the foundation and shallow footings. Without remedial measures, the house will actually become deformed, and shatter masonry and windows. Remedies vary from mere maintenance that keeps drainage away from the house to expensive reconstruction of foundations. Prior site planning that takes geology into account is always preferable to dealing with problems after a structure is built. From AIGP (1993).

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Sandstone (Unit 3)
The pinkish Corbin Sandstone that caps the hills in southeastern Rockcastle County is exposed at this excavated pond near Sand Hill. Photo by Dan Carey, Kentucky Geological Survey.

Shale, Siltstone, Sandstone, Limestone, Coal, and Underclay (Unit 6)
Rocks of unit 6 are exposed along U.S. 25 north of Livingston. Percolating water seeps through cracks and crevices in the siltstone, sandstone, and coal until it meets impermeable shale. The shale breaks down quickly when exposed to air and water, leaving no support for the overlying rocks, which soon fall. Repeating the process for millions of years creates the rugged terrain of steep-sided hills seen below from the Sand Gap Baptist Church. Photos by Dan Carey, Kentucky Geological Survey.

Landslides
Hillslope construction can cause earth movement if not properly planned. Photo by Paul Howell, U.S. Department of Agriculture, Natural Resources Conservation Service.

Slope Failure
Mass movements of landslides of surficial materials are frequent and costly geologic hazards. 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.

What Are the Factors That Cause Landslides?
Many factors contribute to landslides. The most common are:
1. Steep slopes: Avoid when choosing a building site.
2. Water: Soil 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.

Water Can Cause Landslides
Tree removal/water runoff
Road ditch
Falls due to septic drains

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Mapped Surface Faults
Faults are common geologic structures across Kentucky, and have been mapped in many of the commonwealth's counties. The faults shown on this map represent seismic activity that occurred several million years ago at the latest. There has been no activity along these faults in recorded history. Seismic risk associated with these faults is very low. Faults may be associated with increased fracturing of bedrock in the immediately adjacent area. This fracturing may influence slope stability and groundwater flow in these limited areas.

Swelling Shale and Foundation Damage
Concrete floor slab
Swelling shale and soil
Soil
Shale
Gravel
Grass

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Shale and Alluvium
Thick beds of 340-million-year-old Newman Limestone are exposed along U.S. 25 near I-75. Percolating water enlarges cracks and crevices in a process that can produce underground conduits and caves. Sinkholes are formed when the ceiling of an underground cavity collapses. The limestone is mined for construction aggregate by Hanson Aggregates Midwest Inc. at their Mount Vernon Quarry (below). Photos by Dan Carey, Kentucky Geological Survey.

Karst Geology
Karst areas are indicated 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.

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A problem of some concern in this area is the swelling of some of the clays and shales. Expanding shale can cause backfill to swell and concrete to crack and crumble. It can heave the foundation, the slab, and interior partitions resting on it, and damage upper floors and interior partitions. This phenomenon has been responsible for extensive damage to schools, homes, and businesses in Kentucky. During times of drought, these same shales may shrink, causing foundations to drop. Any planned construction on these shales should seek professional advice from a geologist or engineer familiar with the problem.

What Are the Factors That Cause Landslides?
Many factors contribute to landslides. The most common are:
1. Steep slopes: Avoid when choosing a building site.
2. Water: Soil 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. After 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 installed in fill material can saturate soil and contribute to landslides.
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Shale and Siltstone
Erodible shales and erosion-resistant siltstones (right), exposed along U.S. 25, form the hills in northern Rockcastle County. Photo by Dan Carey, Kentucky Geological Survey.

Residential Drainage
An uplifting experience that will not be appreciated: Left: All well in this newly built home until water from percolation, drains, lawn sprinklers, leaking sewers, or water mains soaks swelling soil beneath the foundation. Right: With time, expanding soils exert several tons per square foot of pressure on the foundation and shallow footings. Without remedial measures, the house will actually become deformed, and shatter masonry and windows. Remedies vary from mere maintenance that keeps drainage away from the house to expensive reconstruction of foundations. Prior site planning that takes geology into account is always preferable to dealing with problems after a structure is built. From AIGP (1993).

Sandstone (Unit 3)
The pinkish Corbin Sandstone that caps the hills in southeastern Rockcastle County is exposed at this excavated pond near Sand Hill. Photo by Dan Carey, Kentucky Geological Survey.

Shale, Siltstone, Sandstone, Limestone, Coal, and Underclay (Unit 6)
Rocks of unit 6 are exposed along U.S. 25 north of Livingston. Percolating water seeps through cracks and crevices in the siltstone, sandstone, and coal until it meets impermeable shale. The shale breaks down quickly when exposed to air and water, leaving no support for the overlying rocks, which soon fall. Repeating the process for millions of years creates the rugged terrain of steep-sided hills seen below from the Sand Gap Baptist Church. Photos by Dan Carey, Kentucky Geological Survey.

Landslides
Hillslope construction can cause earth movement if not properly planned