**Kentucky Geological Survey**
James C. Cobb, State Geologist and Director
UNIVERSITY OF KENTUCKY, LEXINGTON

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

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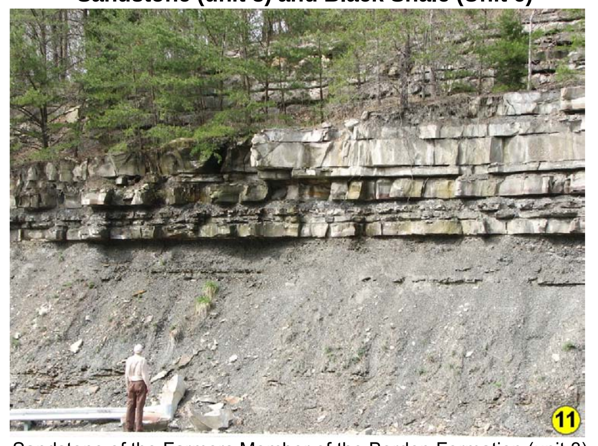
MAP AND CHART 154
Series XII, 2007

### Rowan County Courthouse at Morehead

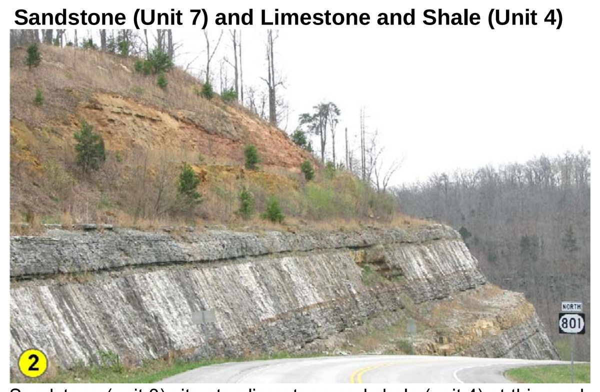

Rowan County, an area of 281 square miles in the Eastern Kentucky Coal Field, was formed in 1856. Most of the county is hilly to mountainous. The highest elevation, 1,435 feet, is Limestone Knob, about 3 miles southwest of Morehead. The lowest elevation, 625 feet, is where the Licking River leaves the county. The 2006 population was 22,221. Photo by Dan Carey, Kentucky Geological Survey.

### Sandstone (unit 3) and Black Shale (Unit 6)




Sandstone of the Farmers Member of the Borden Formation (unit 3) lies atop the Sunbury Shale (unit 6) at this roadcut on I-64. This sandstone has been extensively quarried in the county for building purposes. Photo by Dan Carey, Kentucky Geological Survey.

### Sandstone (Unit 7) and Limestone and Shale (Unit 4)

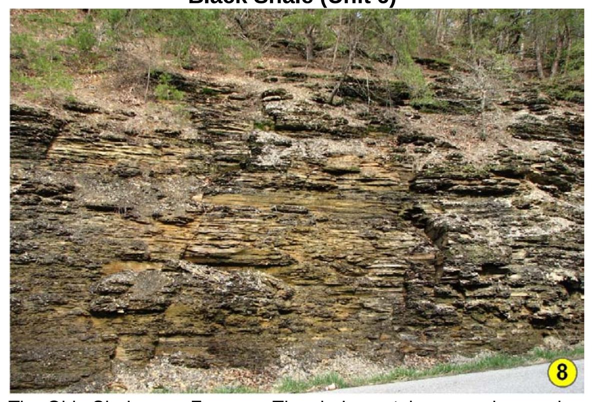



Sandstone (unit 8) sits atop limestone and shale (unit 4) at this roadcut on Ky. 801. Photo by Dan Carey, Kentucky Geological Survey.

### Alluvium (Unit 1)


Alluvial valleys (unit 1) provide flat land for agriculture, housing, and commerce, but may be subject to drainage and flooding problems. Photo by Dan Carey, Kentucky Geological Survey.

### Black Shale (Unit 6)




The Ohio Shale near Farmers. The shale contains enough organic matter to burn. It is unstable on slopes and may swell when wet and shrink when dry. Photo by Dan Carey, Kentucky Geological Survey.

### Cave Run Lake


Cave Run Lake provides a variety of aquatic activities. Rowan County is blessed with an abundance of water. Photo by Dan Carey, Kentucky Geological Survey.

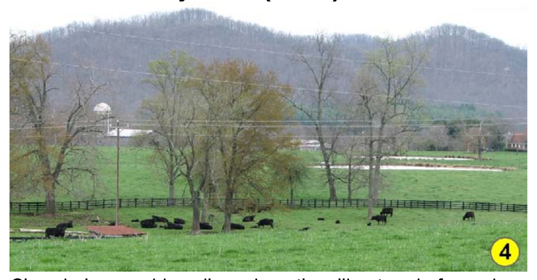
### Terrace Deposits (Unit 2)


Ancient river deposits of silt, sand, and gravel provide the foundation and terrain for this airfield near Farmers. Photo by Dan Carey, Kentucky Geological Survey.

### Siltstone, Sandstone, and Shale (Unit 3)


Reshaping the land to accomodate a new Wal-Mart Supercenter requires extensive excavation in unit 3. Photo by Dan Carey, Kentucky Geological Survey.

### Clay Shale (Unit 8)




Clay shales provide soils and gently rolling terrain for agriculture. Impermeable shales are favorable for ponds, but generally poor for other construction activities. Sandstone-capped hills (unit 7) are in the background. Photo by Dan Carey, Kentucky Geological Survey.

### Natural Resources


The timber industry contributes to the local economy. Photo by Dan Carey, Kentucky Geological Survey.

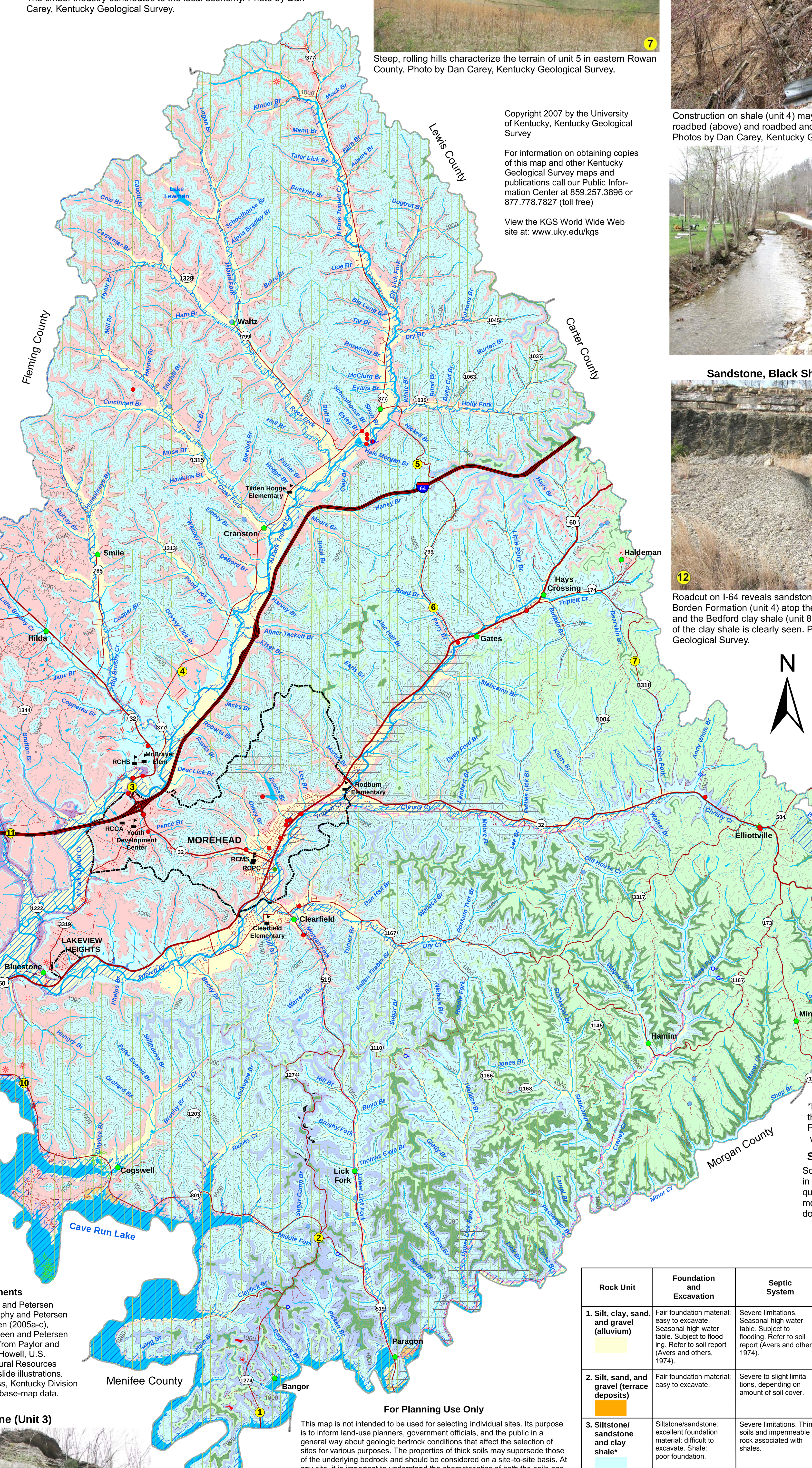
### Terrain of Shale, Siltstone, Sandstone, and Coal (Unit 5)


Steep, rolling hills characterize the terrain of unit 5 in eastern Rowan County. 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)

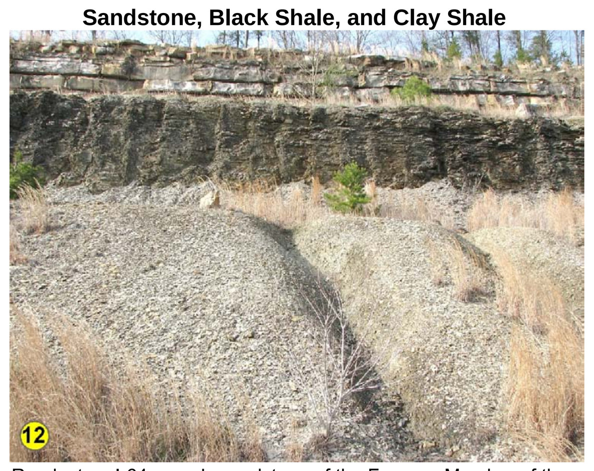
View the KGS World Wide Web site at: www.uky.edu/kgs




### Construction on Shale

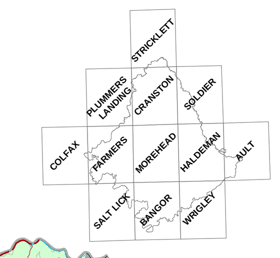

Construction on shale (unit 4) may require additional support for roadbed (above) and roadbed and streambank stability (below). Photos by Dan Carey, Kentucky Geological Survey.


### Sandstone, Black Shale, and Clay Shale




Roadcut on I-64 reveals sandstone of the Farmers Member of the Borden Formation (unit 4) atop the Sunbury black shale (unit 6), and the Bedford clay shale (unit 8) at bottom. The higher erodibility of the clay shale is clearly seen. Photo by Dan Carey, Kentucky Geological Survey.

### 7.5-Minute Quadrangle Map Index

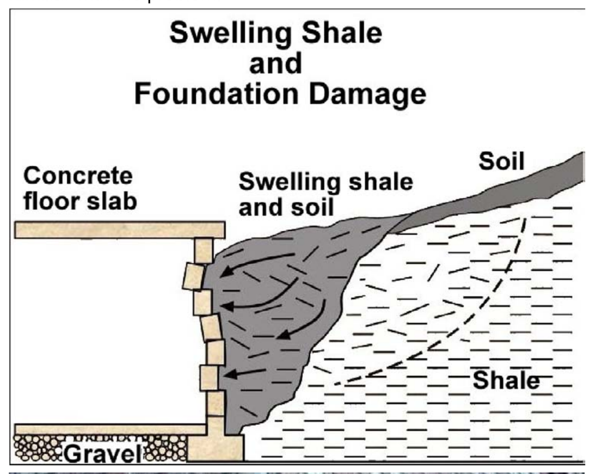


### Landslides

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

### Swelling and Shrinking Shales

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. Anyone planning construction on these shales should seek professional advice from a geologist or engineer familiar with the problem.



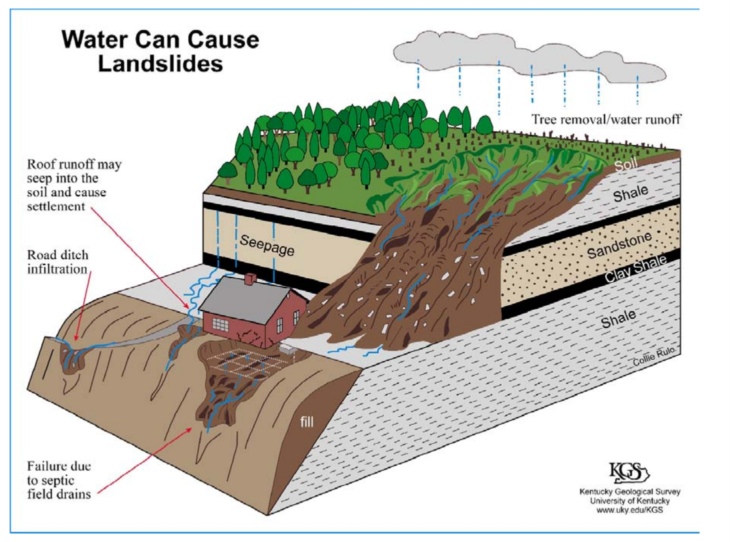

Some shales and the soils derived from them swell when exposed to water or air. These swelling shales and soils can have severe impacts on building foundations and other structures (e.g., bridges, dams, roads). Photo by John Kiefer, Kentucky Geological Survey.

Scale = 1:63,360
1 inch equals 1 mile
0 0.5 1 2 3 4 Miles

### 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)

### EXPLANATION

- School
- Oil well
- Gas well
- Water wells
  - Domestic
  - Monitoring
  - Agricultural
- Spring
- Abandoned railroad
- County line
- Watershed boundary
- Mine dump or mine spoil
- Landslide deposits
- Artificial fill
- Mapped sinkhole
- Source-water protection area, zone 1
- Incorporated city boundaries
- Wetlands > 1 acre (U.S. Fish and Wildlife Service, 2003)
- Designated flood zone* (FEMA, 2005)
- Public lands
- 100-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.

### 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.

### Additional Resources

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

www.moreheadrowan.org/rowancounty Rowan County
www.moreheadchamber.com Morehead Chamber of Commerce
www.kyhometown.com/morehead/ Morehead and Rowan County
www.rowanpva.com Rowan County Property Valuation Administrator
www.edc-eky.com Rowan County Economic Development Council
www.farmersky.com Farmers
ces.ca.uky.edu/rowan/ University of Kentucky Cooperative Extension Service
www.gwadd.org/ Gateway Area Development District
www.thinkkentucky.com/EDIS/cmnty/index.aspx?CW=034 Kentucky Economic Development Information System
www.uky.edu/KentuckyAtlas/21205.html Kentucky Atlas and Gazetteer, Rowan County
quickfacts.census.gov/qfd/states/21/21205.html U.S. census data

### Acknowledgments

Geology adapted from Duncan and Petersen (2005), Murphy (2005a-d), Murphy and Petersen (2005a, b), Nelson and Petersen (2005a-c), Palmgreen (2005), and Palmgreen and Petersen (2005). Mapped sinkhole data from Paylor and others (2004). Thanks to Paul Howell, U.S. Department of Agriculture, Natural Resources Conservation Service, for landslide illustrations. Thanks to Kim and Kent Anness, Kentucky Division of Geographic Information, for base-map data.

### Siltstone (Unit 3)

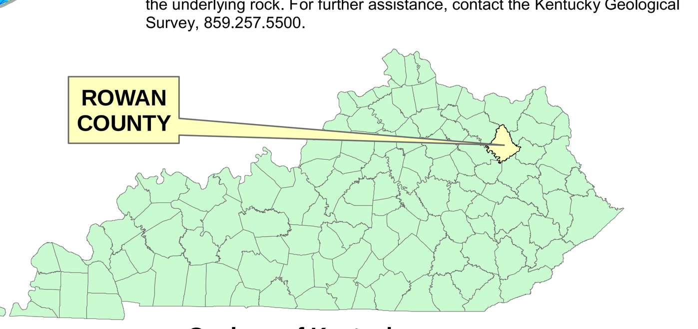

Siltstone in the Cowbell Formation (unit 3) is seen in this roadcut on Ky. 1274 and throughout the county. The thin shale bed within the siltstone retards water and feeds the clinging cedar tree. Photo by Dan Carey, Kentucky Geological Survey.

### Groundwater

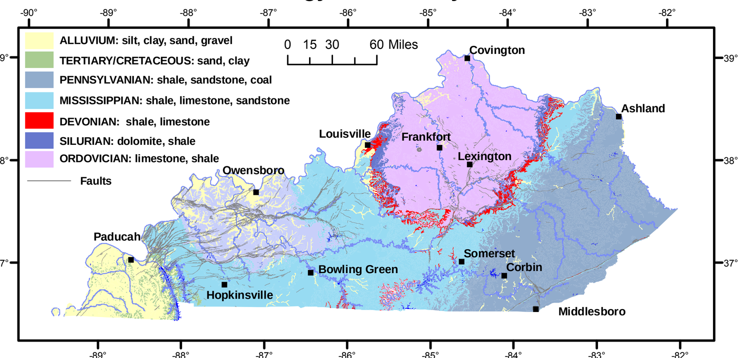
About 2,400 people in Rowan County rely on private domestic water supplies: 1,700 use wells and 700 use other sources. Some wells located in the Licking River and major creek valleys, and in far eastern Rowan County, will produce enough water for a domestic supply, except during dry weather. In upland areas of Rowan County (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. Throughout the county groundwater 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 (2005).

### 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.




### Geology of Kentucky




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

## Planning Guidance by Rock Unit Type

| Rock Unit | 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. Silt, clay, sand, and gravel (alluvium) | Fair foundation material; easy to excavate. Seasonal high water table. Subject to flooding. Refer to soil report (Avers and others, 1974). | Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Avers and others, 1974). | Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Avers and others, 1974). | Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Avers and others, 1974). | Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Avers and others, 1974). | Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Avers and others, 1974). | Slight to severe limitations, depending on type of activity and topography. Subject to flooding. Refer to soil report (Avers and others, 1974). | Slight to severe limitations, depending on type of activity and topography. Subject to flooding. Refer to soil report (Avers and others, 1974). | Pervious material. Seasonal high water table. Subject to flooding. Refer to soil report (Avers and others, 1974). | Fair stability. Fair compaction characteristics. Piping hazard. Refer to soil report (Avers and others, 1974). | Slight limitations, in general, except for seasonal high water table. Subject to flooding. Refer to soil report (Avers and others, 1974). |
| 2. Silt, sand, and gravel (terrace deposits) | 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 slope. | Slight limitations, depending on slope. | Moderate to slight limitations, depending on activity and slope. | Slight limitations, depending on slope. | Pervious material. Not recommended. | Severe to slight limitations. Unstable steep slopes. | Slight limitations. |
| 3. Siltstone/ sandstone and clay shale* | Siltstone/sandstone: excellent foundation material; difficult to excavate. Shale: poor foundation. | Severe limitations. Thin soils and impermeable rock associated with shales. | Moderate to severe limitations. Rock excavation. Very steep slopes. Unstable shales. | Moderate to severe limitations. Rock excavation. Very steep slopes. Unstable shales. | Moderate to severe limitations. Rock excavation may be required. Very steep slopes. Unstable shales. | Moderate to severe limitations. Rock excavation may be required. Very steep slopes. Unstable shales. | Moderate to severe limitations. Rock excavation may be required. Very steep slopes. Unstable shales. | Slight to severe limitations, depending on activity and topography. Possible steep wooded slopes. Slight limitations for forest or nature preserve. | Slight to moderate limitations. Reservoir may leak where rocks are fractured. | Slight to moderate limitations. Reservoir may leak where rocks are fractured. Unstable shales. | Severe limitations. Thin soils. Rock excavation. Shales: poor strength; wetness. |
| 4. Limestone and shale | Excellent foundation material; difficult to excavate. | Severe limitations. Locally fast drainage through fractures. Danger of groundwater contamination. | Severe to moderate limitations. Rock excavation; locally, upper few feet may be rippable. Sinks possible. Drainage required. | Slight to moderate limitations. Rock excavation; locally, upper few feet may be rippable. Sinks possible. Drainage required. | Slight limitations. Local drainage problems from seeps or springs. Sinks possible. | Slight to moderate limitations, depending on topography. Rock excavation; locally, upper few feet may be rippable. Sinks possible. Local drainage problems. | Slight to severe limitations. Rock excavation may be required. | Slight to moderate limitations, depending on activity and topography. Slight limitations for forest or nature preserve. | Severe limitations. Leaky reservoir rock. Locally, conditions may be favorable. Sinks possible. | Severe limitations. Leaky rock. | Severe limitations. Rock excavation. |
| 5. Shale, siltstone, sandstone, and coal* | Fair to good foundation material; difficult to excavate. Possible low strength associated with shales, sparse coals, and underclays. | Severe limitations. Thin soils and impermeable rock associated with shales. | Severe to moderate limitations. Rock excavation may be required. | Moderate to severe limitations. Rock excavation may be required. Possible steep slopes. | Moderate to severe limitations. Rock excavation may be required. Possible steep slopes. | Moderate to severe limitations. Rock excavation may be required. Possible steep slopes. | Moderate to severe limitations. Rock excavation may be required. | Slight to severe limitations, depending on activity and topography. Possible steep wooded slopes. Slight limitations for forest or nature preserve. | Slight limitations. Reservoir may leak where rocks, including coal, are jointed or fractured. | Severe limitations. Reservoir may leak where rocks are fractured. | Severe to moderate limitations. Thin soils. Possible rock excavation. |
| 6. Black shale | Fair foundation material with drainage management; easy to moderately difficult to excavate. Low strength and stability if wet. | Severe limitations. Thin soils and low permeability. | Severe limitations unless kept dry through proper drainage management. | 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. |
| 7. Sandstone | Excellent foundation material; difficult to excavate. | Severe limitations. Thin soils. | Severe to moderate limitations. Rock excavation may be required. Possible steep slopes. | Severe to moderate limitations. Rock excavation may be required. Possible steep slopes. | Moderate to severe limitations. Rock excavation may be required. Possible steep slopes. | Moderate to severe limitations. Rock excavation may be required. Possible steep slopes. | Slight to severe limitations, depending on activity and topography. Possible steep wooded slopes. | Slight to severe limitations, depending on activity and topography. Possible steep wooded slopes. Slight limitations for forest or nature preserve. | Slight to moderate limitations. Reservoir may leak where rocks are fractured. | Slight to moderate limitations. Reservoir may leak where rocks are fractured. | Severe limitations. Rock excavation. Thin soils. |
| 8. Clay shale* and minor units | 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. |

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

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