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

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What Are the Factors That Cause Landslides?

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

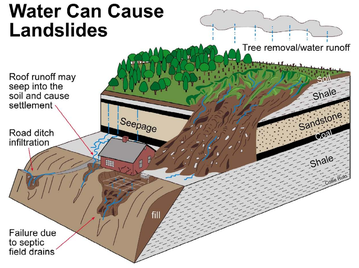
1. Steep slopes: Avoid when choosing a building site.
2. Water: Slope stability decreases as water moves into the soil. Springs, seeps, roof runoff, gutter downspouts, septic systems, and site grading that cause ponding or runoff are sources of water that often contribute to landslides.
3. Changing the 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)

Water Can Cause Landslides



EXPLANATION

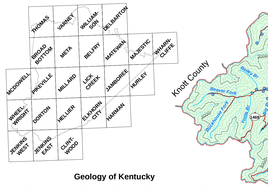
- School
- Water wells
- Commercial or industrial
- Domestic
- Monitoring
- Public
- Spring
- Wet area
- Railroad
- County line
- Watershed boundary
- Geologic fault
- Big Sandy Gas Field boundary
- Quarry
- Designated flood zone* (FEMA, 2005)
- Source-water protection area, zone 1
- Wetlands > 1 acre (U.S. Fish and Wildlife Service, 2003)
- Wildlife management area
- Incorporated city boundaries
- Artificial fill
- Landslide
- Dump
- 200-foot contour interval
- 4 Photo location

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

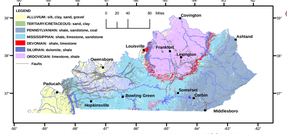
Source-Water Protection Areas

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.

7.5-Minute Quadrangle Index

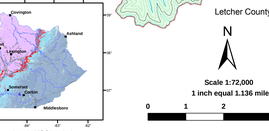


Geology of Kentucky



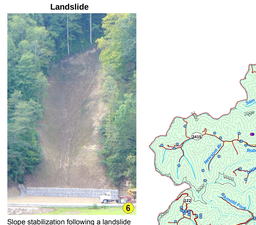
Learn more about Kentucky geology at www.uky.edu/KGS/geoky/

Roadway Stability

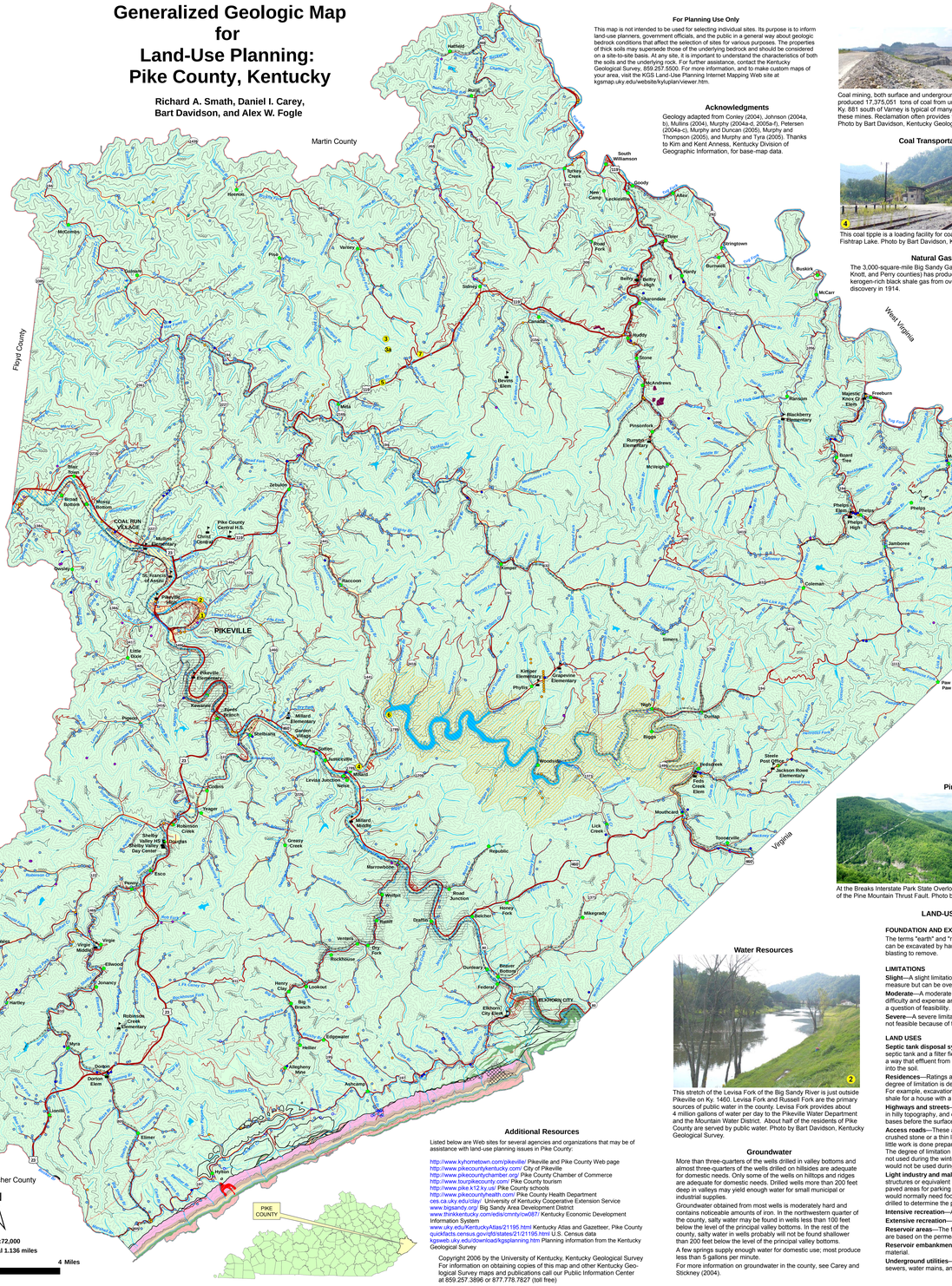


The mountainous topography of Pike County can make road construction difficult. Rights-of-way are often entirely steep or subject to landslides, as in this case in northern Pike County on Ky. 881. Photo by Bart Davidson, Kentucky Geological Survey.

Landslide



Slope stabilization following a landslide near Fishtrap Lake Dam. Photo by Bart Davidson, 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.

Acknowledgments

Geology adapted from Conley (2004), Johnson (2004a, b), Mullins (2004), Murphy (2004a-d, 2005a-f), Petersen (2004a-c), Murphy and Duncan (2005), Murphy and Thompson (2005), and Murphy and Tyra (2005). Thanks to Kim and Kent Arness, Kentucky Division of Geographic Information, for base-map data.

Additional Resources

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

http://www.kyhometown.com/pikeville/ Pikeville and Pike County Web page
http://www.pikecountykentucky.com/ City of Pikeville
http://www.pikecountychamber.org/ Pike County Chamber of Commerce
http://www.tourpikecounty.com/ Pike County tourism
http://www.pike.k12.ky.us/ Pike County schools
http://www.pikecountyhealth.com/ Pike County Health Department
ces.ca.uky.edu/clay/ University of Kentucky Cooperative Extension Service
www.bigsandy.org/ Big Sandy Area Development District
www.thinkkentucky.com/edis/cmntyrsw087/ Kentucky Economic Development Information System
www.uky.edu/KentuckyAtlas/21185.html Kentucky Atlas and Gazetteer, Pike County
quickfacts.census.gov/qfd/states/21/21195.html U.S. Census data
kgsweb.uky.edu/download/kgsplanning.htm Planning information from the Kentucky Geological Survey

Water Resources

This stretch of the Levisa Fork of the Big Sandy River is just outside Pikeville on Ky. 1460. Levisa Fork and Russell Fork are the primary sources of public water in the county. Levisa Fork provides about 4 million gallons of water per day to the Pikeville Water Department and the Mountain Water District. About half of the residents of Pike County are served by public water. Photo by Bart Davidson, Kentucky Geological Survey.

Groundwater

More than three-quarters of the wells drilled in valley bottoms and almost three-quarters of the wells drilled on hillsides are adequate for domestic needs. Only some of the wells on hilltops and ridges are adequate for domestic needs. Drilled wells more than 200 feet deep in valleys may yield enough water for small municipal or industrial supplies.

Groundwater obtained from most wells is moderately hard and contains noticeable amounts of iron. In the northwestern quarter of the county, salty water may be found in wells less than 100 feet below the level of the principal valley bottoms. In the rest of the county, salty water in wells probably will not be found shallower than 200 feet below the level of the principal valley bottoms.

A few springs supply enough water for domestic use; most produce less than 5 gallons per minute.

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

Coal

Coal mining, both surface and underground, is abundant in Pike County. In 2004, the latest year for which statistics are available, the county produced 17,375,051 tons of coal from underground mining and 11,491,708 tons from surface mining. This mountaintop-removal mine on Ky. 881 south of Varney is typical of many such mines in the county. Strict regulations are in force regarding reclaiming the land disturbed by these mines. Reclamation often provides for new land-use alternatives, such as subdivisions, shopping malls, and industrial complexes. Photo by Bart Davidson, Kentucky Geological Survey.

Coal Transportation

This coal tipple is a loading facility for coal trucks and trains near Fishtrap Lake. Photo by Bart Davidson, Kentucky Geological Survey.

Natural Gas

The 3,000-square-mile Big Sandy Gas Field (Martin, Pike, Floyd, Knott, and Perry counties) has produced 2.5 trillion cubic feet of kerogen-rich black shale gas from over 10,000 wells since its discovery in 1914.

Mine Reclamation

The University of Kentucky College of Agriculture has studied the growth of trees on coal mine spoil piles for several years. These spoil piles have been shown to sustain phenomenal tree growth over a very short time span. Here, aprons have been applied at the base of spoil piles made of different rock types to monitor sediment loss as rainwater filters through the piles. Photo by Bart Davidson, Kentucky Geological Survey.

Land-Use Hazards

Flooding along major streams and flash flooding along smaller streams is a significant hazard in Pike County. FEMA-designated floodplains indicate the level of flooding on major streams, but do not assess flash flooding on smaller streams.

Landslides resulting from construction on steep slopes are also a major cause of damages. Technical assistance from engineers or geologists familiar with the area should be obtained to determine site-specific conditions.

Surface and underground mining has occurred extensively throughout the county. Before undertaking construction in any area, evaluate the site for possible impacts from nearby or underground mined areas.

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.

Pine Mountain

At the Breaks Interstate Park State Overlook looking into Kentucky. The dashed line is the trace of the Pine Mountain Thrust Fault. Photo by Richard Smath, 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.

Old County Courthouse at Pikeville

Pike County, Kentucky's largest county with an area of 788 square miles, was formed in 1822 in the Eastern Kentucky Coal Field. It was named after General Zebulon Pike (who discovered Pikes Peak). The highest point in the county, 3,149 feet, is on a peak 2 1/4 miles southwest of Ashcamp. The lowest elevation, 610 feet, is where Tug Fork leaves the county. The county population in 2005 was 66,804, 2.8 percent smaller than in 2000. Photo by Bart Davidson, Kentucky Geological Survey.

Highway Construction

These views of the Ky. 119 road relocation project between Pikeville and Williamson by the Kentucky Transportation Cabinet show both completed and unfinished bridges. The project is about three-quarters complete and will cost $33 million. U.S. 23 has been upgraded to a four-lane highway and is a major north-south connector. Expanding U.S. 460 from two to four lanes will create a safer highway and also enhance economic activity. Photo by Bart Davidson, Kentucky Geological Survey.

Eastern Kentucky Exposition Center

The Eastern Kentucky Exposition Center in Pikeville provides a variety of entertainment—music, industrial shows, athletic events, and more. Photo by Bart Davidson, Kentucky Geological Survey.

Pikeville Cut-Through: Before and After

The Pikeville Cut-Through, which began in 1973, was a 14-year engineering achievement second only to the Panama Canal. The channel is 1,300 feet wide, 3,700 feet long, and 523 feet deep. It reroutes the flow of the Levisa Fork away from the oxbow that encircles Pikeville and controls flooding. The 390 acres of flat land that were created have seen extensive development. The 1974 photo above shows conditions before the cut-through. Photo below (2004) shows the completed cutoff. Photos from U.S. Department of Agriculture.

Fishtrap Lake

Fishtrap Lake, with a surface area of 1,130 acres, provides for fishing and boating. The surrounding recreational area affords biking, hiking, and camping. Fishtrap Lake Dam, completed in1968, protects the valley of the Levisa Fork of the Big Sandy River from flooding. It is situated about 6 miles east of Pikeville near the small community of Millard, and is the highest dam in eastern Kentucky. Built of native rock on a clay waterproof core, the dam is 195 feet high and 1,000 feet long. The job required moving 5 million cubic yards of rock and earth. The U.S. Army Corps of Engineers manages the dam and lake, in conjunction with the Commonwealth of Kentucky. Photo courtesy of the Huntington District, U.S. Army Corps of Engineers, www.lrh.usace.army.mil/projects/lakes/fri/.

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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. Sand, silt, and gravel (unconsolidated)	Fair foundation material; easy to excavate. Seasonal high water table. Subject to flooding. Refer to soil report (Kelley and others, 1990).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Kelley and others, 1990).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Kelley and others, 1990).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Kelley and others, 1990).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Kelley and others, 1990).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Kelley and others, 1990).	Slight to severe limitations, depending on type of activity and topography. Subject to flooding. Refer to soil report (Kelley and others, 1990).	Slight to severe limitations, depending on type of activity and topography. Subject to flooding. Refer to soil report (Kelley and others, 1990).	Pervious material. Seasonal high water table. Subject to flooding. Refer to soil report (Kelley and others, 1990).	Fair stability. Fair compaction characteristics. Piping hazard. Refer to soil report (Kelley and others, 1990).	Slight limitations, in general, except for seasonal high water table. Subject to flooding. Refer to soil report (Kelley and others, 1990).
2. Sandstone, siltstone, shale, coal, clay, and limestone	Fair to good foundation material; difficult to excavate. Possible low strength associated with shales, sparse coals, and underclays. Possibility of underground coal-mine voids.	Severe limitations. Thin soils and impermeable rock associated with shales.	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.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations, depending on activity. Rock excavation may be required.	Slight to severe limitations, depending on type of activity and topography. Possible steep wooded slopes. Slight limitations for forest or nature preserve.	Severe limitations. Reservoir may leak where rocks include rock coal, are jointed or fractured.	Severe limitations. Reservoir may leak where rocks are fractured.	Severe to moderate limitations. Thin soils. Possible rock excavation.
3. Sandstone	Excellent foundation material; difficult to excavate.	Severe limitations. Thin soils.	Severe to moderate limitations. Rock excavation may be required. Steep slopes.	Severe to moderate limitations. Rock excavation may be required. Steep slopes.	Severe to moderate limitations. Rock excavation may be required. Possible steep slopes and narrow ridges.	Moderate to severe limitations. Rock excavation may be required. Steep slopes.	Moderate to severe limitations, depending on activity. Steep wooded slopes.	Slight to severe limitations, depending on activity and topography. Steep wooded slopes. Slight limitations for forest or nature preserve.	Severe limitations. Reservoir may leak where rocks are fractured.	Severe limitations. Reservoir may leak where rocks are fractured.	Severe limitations. Rock excavation. Thin soils.
4. Black shale	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 to moderate limitations. Low strength, slumping, and seepage problems.	Severe to moderate limitations. Low strength, slumping, and seepage problems.	Severe to moderate limitations. Low strength, slumping, and seepage problems.	Not recommended.	Moderate to severe limitations, depending on activity.	Slight to severe limitations, depending on activity. Slight limitations for forest or nature preserve.	Slight limitations for small ponds.	Severe limitations. Poor strength and stability.	Moderate limitations. Poor strength. Wetness.
5. Shale and sandstone	Fair to good foundation material; difficult to excavate. Possible low strength associated with shales.	Severe limitations. Thin soils and impermeable rock associated with shales.	Not recommended.	Severe limitations. Rock excavation. Steep slopes. Shales weak.	Severe limitations. Rock excavation. Steep slopes. Shales weak.	Not recommended.	Severe limitations. Rock excavation. Steep slopes. Weak shales.	Slight to severe limitations, depending on activity and topography. Possible steep wooded slopes. Slight limitations for forest or nature preserve.	Moderate to severe limitations. Reservoir may leak where rocks, including coal, are jointed or fractured.	Moderate to severe limitations. Reservoir may leak where rocks, including coal, are jointed or fractured.	Severe to moderate limitations. Thin soils. Possible rock excavation.
6. Limestone, shale, chert	Good to excellent foundation material; difficult to excavate.	Moderate to severe limitations. Thin soils and impermeable rock associated with shales.	Severe to moderate limitations. Rock excavation may be required. Steep slopes.	Severe limitations. Rock excavation. Steep slopes.	Severe limitations. Rock excavation. Steep slopes.	Severe limitations. Rock excavation. Steep slopes.	Severe limitations. Rock excavation. Steep slopes.	Slight to severe limitations, depending on activity and topography. Possible steep wooded slopes. Slight limitations for forest or nature preserve.	Severe limitations. Reservoir may leak where rocks are fractured.	Severe limitations. Reservoir may leak where rocks are fractured.	Severe limitations. Rock excavation. Thin soils.
7. Siltstone and sandstone	Excellent foundation material; difficult to excavate.	Severe limitations. Thin soils.	Severe to moderate limitations. Rock excavation may be required. Steep slopes.	Moderate to severe limitations. Rock excavation may be required. Steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes and narrow ridges.	Moderate to severe limitations. Rock excavation may be required. Steep slopes.	Moderate to severe limitations, depending on activity. Steep wooded slopes.	Slight to severe limitations, depending on activity and topography. Steep wooded slopes. Slight limitations for forest or nature preserve.	Severe limitations. Reservoir may leak where rocks are fractured.	Severe limitations. Reservoir may leak where rocks are fractured.	Severe limitations. Rock excavation. Thin soils.
8. Shale (red, green, gray), sandstone, limestone, and dolomite	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. Low strength, slumping, and seepage problems.	Severe limitations. Low strength, slumping, and seepage problems.	Severe limitations. Low strength, slumping, and seepage problems.	Moderate to severe limitations, depending on activity.	Slight to severe limitations, depending on activity and topography. Steep wooded slopes. Slight limitations for forest or nature preserve.	Severe limitations. Reservoir may leak where rocks are fractured. Shale has poor strength and wetness in shales.	Severe limitations. Thin soils. Possible rock excavation. Poor strength and wetness in shales.	Severe to moderate limitations. Thin soils. Possible rock excavation. Poor strength and wetness in shales.