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

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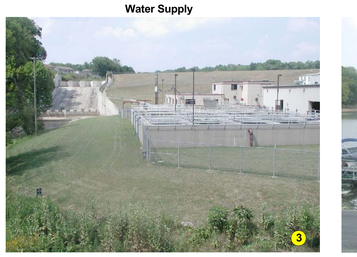
Water Supply



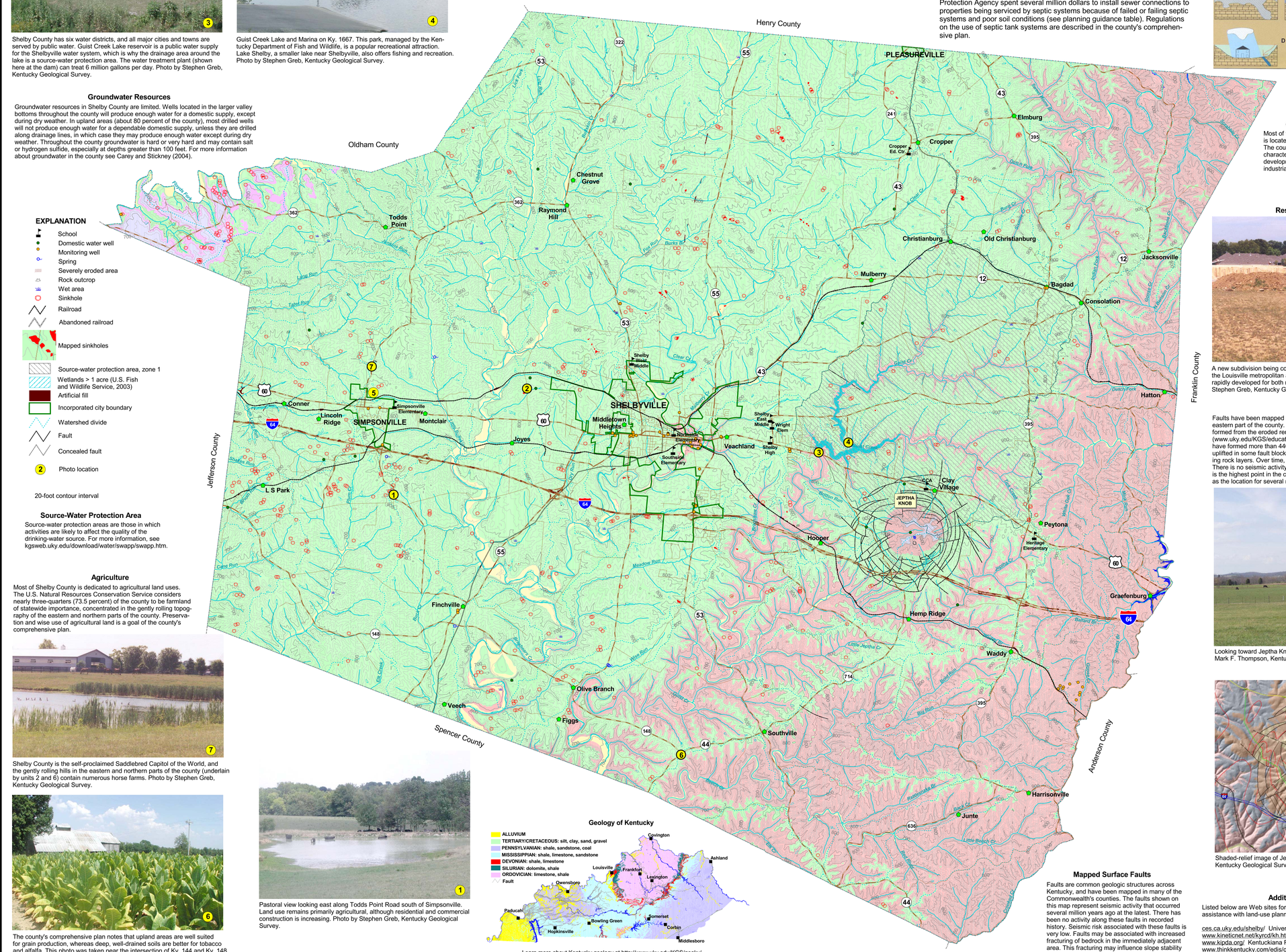
Shelby County has six water districts, and all major cities and towns are served by public water. Guist Creek Lake reservoir is a public water supply for the Shelbyville water system, which is why the drainage area around the lake is a source-water protection area. The water treatment plant (shown here at the dam) can treat 6 million gallons per day. Photo by Stephen Greb, Kentucky Geological Survey.

Recreation

Guist Creek Lake and Marina on Ky. 1667. This park, managed by the Kentucky Department of Fish and Wildlife, is a popular recreational attraction. Lake Shelby, a smaller lake near Shelbyville, also offers fishing and recreation. Photo by Stephen Greb, Kentucky Geological Survey.

Groundwater Resources

Groundwater resources in Shelby County are limited. Wells located in the larger valley bottoms throughout the county will produce enough water for a domestic supply, except during dry weather. In upland areas (about 80 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 about groundwater in the county see Carey and Stickney (2004).



EXPLANATION

- School
- Domestic water well
- Monitoring well
- Spring
- Severely eroded area
- Rock outcrop
- Wet area
- Sinkhole
- Railroad
- Abandoned railroad
- Mapped sinkholes
- Source-water protection area, zone 1
- Wetlands > 1 acre (U.S. Fish and Wildlife Service, 2003)
- Artificial fill
- Incorporated city boundary
- Watershed divide
- Fault
- Concealed fault
- Photo location

20-foot contour interval

Source-Water Protection Area

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.

Agriculture

Most of Shelby County is dedicated to agricultural land uses. The U.S. Natural Resources Conservation Service considers nearly three-quarters (73.5 percent) of the county to be farmland of statewide importance, concentrated in the gently rolling topography of the eastern and northern parts of the county. Preservation and wise use of agricultural land is a goal of the county's comprehensive plan.

Shelby County is the self-proclaimed Saddlebred Capitol of the World, and the gently rolling hills in the eastern and northern parts of the county (underlain by units 2 and 6) contain numerous horse farms. Photo by Stephen Greb, Kentucky Geological Survey.

The county's comprehensive plan notes that upland areas are well suited for grain production, whereas deep, well-drained soils are better for tobacco and alfalfa. This photo was taken near the intersection of Ky. 144 and Ky. 148. Photo by Stephen Greb, Kentucky Geological Survey.

Pastoral view looking east along Todds Point Road south of Simpsonville. Land use remains primarily agricultural, although residential and commercial construction is increasing. Photo by Stephen Greb, Kentucky Geological Survey.

Geology of Kentucky

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

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 supercede 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 local area, visit our Land-Use Planning Internet Mapping Web Site at kgsmap.uky.edu/website/kyluplan/viewer.htm.

Acknowledgments

Geology adapted from Davidson (2002), Hettinger (2002), Mullins (2002a-b), Nelson (2001, 2002a-b)), Sparks and Galvin (2002), Thompson (2001, 2002a-b), and Zhang (2002a-b). Mapped sinkholes from Paylor and others (2004).

Landslides and Slope Stability

Steep slopes are common in heavily dissected eastern and southern parts of the county where interbedded shale and limestone form the bedrock. Areas of steep slope are susceptible to landslides and slumping. The county's comprehensive plan provides guidelines and limitations for construction in areas of steep slopes.

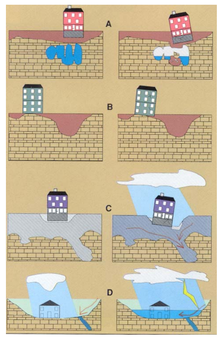
Floodplains

Damaging floods have occurred several times in the Shelbyville area, which is why a flood damage prevention ordinance was adopted by the county and a flood damage prevention plan was adopted for the city of Shelbyville in 1997. Development in known floodplains should be severely limited, although floodplains can often be used for parks and recreational land uses.

Wastewater Treatment

Shelbyville and Simpsonville (and their surrounding area) are served by a public wastewater treatment system. The Shelbyville Sewer Commission serves the Shelbyville area with treatment by the Shelbyville Municipal Waste Water Treatment Plant. Septic systems are used by the remainder of the county outside of the urban service area. In the 1980's, the county and the U.S. Environmental Protection Agency spent several million dollars to install sewer connections to properties being serviced by septic systems because of failed or failing septic systems and poor soil conditions (see planning guidance table). Regulations on the use of septic tank systems are described in the county's comprehensive plan.

Residential Construction



Limestone terrain can be subject to subsidence hazards, which usually can be overcome by prior planning and site evaluation. "A" shows construction above an open cavern, which later collapses. This is one of the most difficult situations to detect, and the possibility of this situation beneath a structure warrants insurance protection for homes built on karst terrain. In "B," a heavy structure presumed to lie above solid bedrock actually is partially supported on soft, residual clay soils that subside gradually, resulting in damage to the structure. This occurs where inadequate site evaluation can be traced to lack of geophysical studies and inadequate core sampling. "C" and "D" show the close relationship between hydrology and subsidence hazards in limestone terrain. In "C," the house is situated on porous fill (light shading) at a site where surface and groundwater drainage move supporting soil (darker shading) into voids in limestone (blocks) below. The natural process is then accelerated by infiltration through fill around the home. "D" shows a karst site where normal rainfall is absorbed by subsurface conduits, but water from infrequent heavy storms cannot be carried away quickly enough to prevent flooding of low-lying areas. Adapted from AIPG (1993).

Commercial and Industrial Development

Most of the commercial and industrial development in the county is located along the Interstate 64 and parallel U.S. 60 corridor. The county's comprehensive plan seeks to preserve the rural character of the county by zoning commercial and industrial development to contiguous existing or planned commercial or industrial areas.

Residential Development

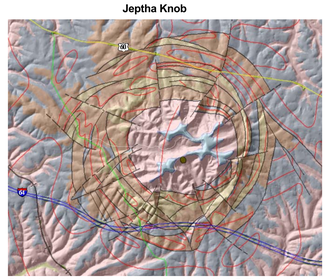
A new subdivision being constructed near Simpsonville. The county is within the Louisville metropolitan area, and the areas closest to Louisville are being rapidly developed for both residential and industrial land use. Photo by Stephen Greb, Kentucky Geological Survey.

Jeptha Knob

Faults have been mapped at the surface around Jeptha Knob in the southeastern part of the county. The ring of faults at Jeptha Knob were most likely formed from the eroded remnants of an ancient meteor or comet impact (www.uky.edu/KGS/education/meteorites.htm). The impact is interpreted to have formed more than 440 million years ago. It resulted in bedrock being uplifted in some fault blocks that were more resistant to erosion than surrounding rock layers. Over time, Jeptha Knob was formed in the resistant layers. There is no seismic activity associated with these faults. Because Jeptha Knob is the highest point in the county (1,163 feet above sea level), it has been used as the location for several radio and cell towers.

Looking toward Jeptha Knob from 3 miles east on U.S. 60. Photo courtesy of Mark F. Thompson, Kentucky Geological Survey.

Jeptha Knob



Shaded-relief image of Jeptha Knob. Courtesy of Mark F. Thompson, Kentucky Geological Survey.

Mapped Surface Faults

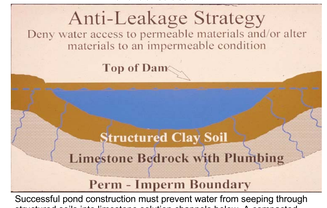
Faults are common geologic structures across Kentucky, and have been mapped in many of the Commonwealth's counties. The faults shown on this map represent seismic activity that occurred several million years ago at the latest. There has been no activity along these faults in recorded history. Seismic 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.

Additional Planning Resources

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

ces.ca.uky.edu/shelby/ University of Kentucky Cooperative Extension Service
www.kineticnet.net/kyrcd/kh.html Kentucky Resource Conservation and Development
www.kipda.org/ Kentuckiana Regional Planning and Development Agency
www.thinkkentucky.com/edis/cmnty/cmntyindex.htm Detailed county statistics
www.uky.edu/KentuckyAtlas/21211.html Kentucky Atlas and Gazetteer
quickfacts.census.gov/qfd/states/21/21211.html U.S. census data
www.shelbycountykentucky.com/ Shelby County government site
www.shelbypz.com/compplan.htm Shelby County comprehensive plan

Pond Construction



Successful pond construction must prevent water from seeping through structured soils into limestone solution channels below. A compacted clay liner or artificial liner may prevent pond failure. Getting the basin filled with water as soon as possible after construction prevents drying and cracking, and possible leakage, of the clayey soil liner. Ponds constructed in dry weather are more apt to leak than ponds constructed in wet weather. A geotechnical engineer or geologist should be consulted regarding the requirements of a specific site. Other leakage prevention measures include synthetic liners, bentonite, and asphaltic emulsions. The U.S. Department of Agriculture--Natural Resources Conservation Service can provide guidance on the application of these liners to new construction, and for treatment of existing leaking ponds.

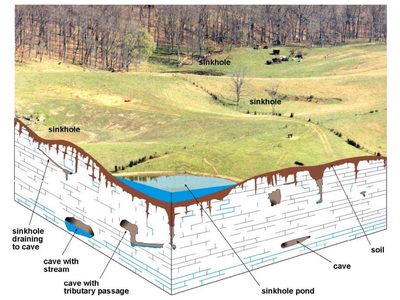
Dams should be constructed of compacted clayey soils at slopes flatter than 3 units horizontal to 1 unit vertical. Ponds with dam heights exceeding 25 feet, or pond volumes exceeding 50 acre-feet, require permits. Contact the Kentucky Division of Water, 14 Reilly Rd., Frankfort, KY 40601, telephone: 502.564.3410. Illustration by Paul Howell, U.S. Department of Agriculture--Natural Resources Conservation Service.

Karst Geology

Much of the county is underlain by limestone, which is susceptible to karst conditions (see planning guidance table below). 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 where 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 that are large enough for a person to enter.

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)

This sinkhole is typical of those in Shelby County. Photo by Stephen Greb, Kentucky Geological Survey.

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Planning Guidance by Rock Unit Type

Rock Unit	Karst Potential	Foundation and Excavation	Septic System	Residence with Basement	Highways and Streets	Access Roads	Light Industry and Malls	Intensive Recreation	Extensive Recreation	Reservoir Area	Reservoir Embankments	Underground Utilities
1. Alluvium	None, but site investigation recommended where less than 25 feet to soluble rock.	Fair foundation material; easy to excavate.	Severe limitations. Failed septic systems can contaminate groundwater. Refer to soil report (Hall and others, 1980).	Water in alluvium may be in direct contact with basements. Refer to soil report (Hall and others, 1980).	Slight limitations. Refer to soil report (Hall and others, 1980).	Slight to moderate limitations. Refer to soil report (Hall and others, 1980).	Slight to moderate limitations. Avoid construction in floodplains. Refer to soil report (Hall and others, 1980).	Refer to soil report (Hall and others, 1980).	Refer to soil report (Hall and others, 1980).	Refer to soil report (Hall and others, 1980).	Not recommended. Refer to soil report (Hall and others, 1980).	Not recommended. Refer to soil report (Hall and others, 1980).
2. Limestone and shale	High.	Good to excellent foundation material; difficult excavation.	Severe to moderate limitations. Impermeable rock. Locally fast drainage through fractures and sinks to water table, with possible contamination.	Severe to moderate limitations. Rock excavation may be required. Poor drainage when shale present.	Moderate limitations. Rock excavation possible. Local drainage problems, if shale present. Sinks common.	Moderate limitations. Rock excavation likely. Local seeps.	Slight to severe limitations. Rock excavation. Local drainage problems. Groundwater contamination possible.	Slight to moderate limitations, depending on activity. Sinks common.	Slight to moderate limitations, depending on activity.	Moderate to severe 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. Possible rock excavation.
3. Dolomite and shale	Medium.	Good to excellent foundation material; difficult to excavate.	Severe limitations. Impermeable rock. Locally fast drainage through fractures and sinks. Danger of groundwater contamination.	Severe to moderate limitations. Rock excavation may be required.	Severe to moderate limitations. Rock excavation may be required.	Moderate limitations. Rock excavation possible. Local drainage problems. Sinks common.	Moderate limitations, depending on topography. Rock excavation. Local drainage problems. Sinks common.	Slight to moderate limitations, depending on activity. Sinks common.	Slight limitations. Sinks common.	Moderate limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Moderate limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Severe limitations. Rock excavation.
4. Shale and dolomite	Medium.	Fair to good foundation material; difficult to excavate.	Moderate to severe limitations. Impermeable rock. Locally fast drainage through fractures and sinks to water table, with possible contamination.	Severe to moderate limitations. Rock excavation may be required.	Moderate limitations. Rock excavation possible. Local drainage problems, especially on shale. Sinks common and caves possible.	Moderate limitations. Rock excavation possible. Local drainage problems. Sinks common.	Slight to severe limitations. Rock excavation. Local drainage problems. Groundwater contamination possible.	Slight to moderate limitations, depending on activity and topography. Possible steep wooded slopes.	Slight to moderate limitations, depending on activity and topography. Possible steep wooded slopes.	Moderate to severe 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. Possible rock excavation.
5. Limestone	High.	Excellent foundation material; difficult to excavate.	Severe limitations. Impermeable rock. Locally fast drainage through fractures. Danger of ground-water contamination.	Severe limitations. Rock excavation, locally, upper few feet may be rippable. Solution channels common. Local seepage problems.	Severe limitations. Rock excavation; locally, upper few feet may be rippable. Local seepage problems. Solution channels common.	Slight limitations. Local drainage problems.	Slight to moderate limitations. Rock excavation; locally, upper few feet may be rippable. Local seepage problems. Solution channels.	No limitations.	No limitations.	Severe to moderate limitations. Leaky reservoir rock. Locally, conditions may be favorable. Solution channels common.	Severe limitations. Reservoir may leak where rocks are fractured. Solution channels possible.	Severe limitations. Rock excavation.
6. Shale* and limestone	Medium.	Good to excellent foundation material; moderately difficult to difficult to excavate.	Severe limitations. Impermeable rock.	Slight to moderate limitations. Earth and rock excavation. Poor drainage.	Slight to moderate limitations. Earth and rock excavation. Local seeps; subgrade requires drainage.	Slight limitations. Local seeps.	Slight limitations. Generally rippable in shallow cuts. Local seeps.	No limitations.	No limitations.	Slight limitations. Most favorable sites on this unit. Locally impermeable rock, thin and underlain by fissured limestone.	Slight limitations.	Moderate limitations. Highly variable amount of rock and earth excavation.

*Subject to landslides on steep slopes.

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 and without 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 presence of caverns, cracks, etc.

Intensive recreation--Athletic fields, stadiums, etc.

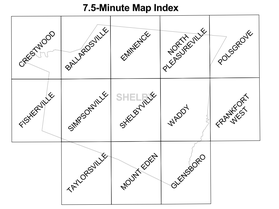
Extensive recreation--Camp sites, picnic areas, parks, etc.

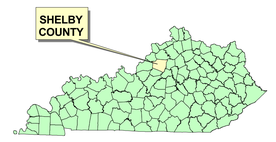
Reservoir areas--The floor of the area where the water is impounded. Ratings are based on the permeability of the rock.

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.

7.5-Minute Map Index





Scale 1:63,360
1 inch equals 1 mile

3 0 3 6 Miles