

**INTRODUCTION**

Groundwater is a vital, renewable natural resource that is widely used throughout Kentucky. Wells and springs provide approximately one third of public and private domestic water supplies in the state. Surface streams, the major source of Kentucky's water supply, are primarily recharged by groundwater from adjacent aquifers. Once contaminated, groundwater can be difficult or impossible to remediate. A variety of activities at the land surface, once contaminated, can contribute to groundwater contamination. One important aspect of such efforts is recognition that these activities can help prevent contamination. This map, therefore, is a step toward that goal. It presents a generalized assessment of the relative hydrogeologic sensitivity of groundwater to the land surface. The hydrogeologic sensitivity of an area is defined as the ease and speed with which a contaminant can move into and within a groundwater system. The major factor that controls this sensitivity is the hydrogeologic characteristics of the system. The hydrogeologic characteristics of an area are defined as the ease and speed with which a contaminant can move into and within a groundwater system. These three essential components are illustrated in a rating graph (Figure 1) that is used to assess groundwater sensitivity and to assign a hydrogeologic sensitivity rating. Groundwater flow velocities, as determined by tracer studies, can be used to establish a sensitivity rating for various hydrogeologic settings. Also, overriding factors which can overrule associated hydrogeologic conditions must be considered. A detailed discussion of this assessment method is found in Ray and O'Neil (1993) & S.

This sensitivity assessment addresses only the naturally occurring hydrogeologic characteristics of an area. Possible impacts of human activity upon groundwater, such as mining, logging, industry, and the use of pesticides, injection wells, and landfills, have not been considered in the production of this map. Because of its small scale and generalized nature, this map is not intended for site-specific use, such as facility-site selection or detailed local land-use planning for city, county, or state agencies. However, the map should prove useful as a broad-scale educational, informational, and planning tool.

The primary data sources used in compiling this generalized map were the Kentucky Quaternary Maps (1:24,000 scale) published by the United States Geological Survey (USGS) in cooperation with the Kentucky Geological Survey (KGS). These detailed geologic maps have been compiled for the entire state. Hydrogeologic Investigation Atlas Maps (1:24,000 scale), developed in cooperation with the USGS, describing groundwater characteristics of the Gulf Coastal Plain and the Ohio River alluvium were also utilized.

Based upon differences in geologic, topographic, and hydrologic regimes, Kentucky is divided into five physiographic regions, as shown on Figure 2. Each region has different groundwater characteristics, which are reflected in this sensitivity map. These regions are: 1) Eastern Coal Field, 2) Bluegrass, 3) Mississippi Plateau, 4) Western Coal Field, and 5) Gulf Coastal Plain. Although not generally considered a physiographic region, the Ohio River alluvium is a distinct hydrogeologic setting and is included within these brief descriptions.

**EASTERN COAL FIELD**  
The Eastern Coal Field (also known as the Cumberland Plateau) consists predominantly of deeply dissected, Pennsylvanian-age sedimentary rocks, primarily sandstone, siltstone, and shale, interbedded with coal and some limestone. Shallow groundwater flow available for use is largely through fractures rather than primary porosity and permeability. Circumferential yield to wells and springs is generally low, but usually enough to sustain domestic use. High-yield municipal or industrial supply wells are uncommon. The Eastern Coal Field generally rates as moderate sensitivity (#3) on the rating scale. The sensitivity factor of groundwater velocity may locally exceed the moderate category especially along coal seams and enlarged stress-relief fractures.

**BLUEGRASS**  
The Bluegrass Region is underlain primarily by Cretaceous-age, interbedded limestone and shale. Although some typical red beds, such as sandstone, siltstone, and shale, are included within coal and some limestone. Shallow groundwater flow available for use is largely through fractures rather than primary porosity and permeability. Circumferential yield to wells and springs is generally low, but usually enough to sustain domestic use. High-yield municipal or industrial supply wells are uncommon. The Eastern Coal Field generally rates as moderate sensitivity (#3) on the rating scale. The sensitivity factor of groundwater velocity may locally exceed the moderate category especially along coal seams and enlarged stress-relief fractures.

**MISSISSIPPIAN PLATEAU**  
The Mississippian Plateau (also known as the Pennsylvanian Plateau) is a moderately dissected region composed of low-relief plateaus and coxinas and is predominantly underlain by relatively pure Mississippian-age limestone. Karst topography and hydrogeology are well developed in much of the area. Circumferential yield to springs can be very large (up to 0.7 m<sup>3</sup>/sec [25 ft<sup>3</sup>/sec] during summer base runoff), with several springs and wells in the area serving as municipal and industrial supplies. Domestic wells are common, although in some areas contamination can be a problem because of polluted surface runoff into sinkholes and sinking streams. Yield to wells can vary greatly, depending on whether or not the well intersects fissures and conduits related to the slow dissolution of limestone. Recharge, flow and dispersal potential are usually characterized by high rates. Therefore, most of the Mississippian Plateau is rated as extremely sensitive (#5).

**WESTERN COAL FIELD**  
The Western Coal Field is similar to the Eastern Coal Field in that the bedrock consists mostly of Pennsylvanian-age sedimentary rocks, primarily sandstone, siltstone, and shale, with coal and some limestone. This region is generally composed of moderately dissected low plateaus and broad alluvial broadlands. With the exception of localized sandstone bodies, most groundwater flow within hydrologic flow units that transmits flow. Alluvial aquifers, especially along the Green River and its tributaries, are also utilized. Well yield is generally adequate for domestic needs, but municipal and industrial supply wells are uncommon. The Western Coal Field generally rates as moderate sensitivity (#3). The relatively thick alluvial aquifers in this region proved difficult to rate because of the occurrence of interbedded, clayey limestone deposits. Although these alluviums are generally fine-grained enough to rank as #2 sensitivity, sand and gravel layers are generally interbedded with the finer sediments, thus justifying an upgrade in sensitivity to #3. This problem was resolved by mapping these areas as a combination of both #2 and #3, and is shown with a diagonal grid pattern.

**GULF COASTAL PLAIN**  
The Gulf Coastal Plain, in far-western Kentucky, is also known as the Mississippi Embayment or the Jackson Purchase. This region is generally underlain by semi-consolidated Cenozoic-age and younger sand, silt, gravel, and clay deposits. The coarse sediments are prolific aquifers for industrial, municipal, and domestic water supply wells, although they are sensitive to contamination, especially at shallow depths. In general, the relatively low flow velocity within deeper sediment zones provides significant protection from contamination. Consequently, the sensitivity of this region usually ranges from moderate to high (#3 to #5), with some areas, where the depth to water is greater than 30 m (100 ft), rated as the lowest sensitivity in the state (#1). Mapped areas with depth to water table exceeding 100 m was obtained from Hydrogeologic Investigation Atlas Maps (1:24,000 scale).

**OHIO RIVER ALLUVIUM**  
The Ohio River alluvium, predominantly Pleistocene glacial-outwash sediments, consists of unconsolidated sand, gravel, silt, and clay deposits along the Ohio River. The coarse sand and gravel beds supply large volumes of water to industrial, municipal, and domestic wells. Groundwater can migrate quickly through these coarse sediments and consequently is rated as highly sensitive, a #4. Other aquifers in river alluvium, which are located throughout Kentucky, are not delineated on this map, but should be considered less sensitive than the coarse-grained Ohio River alluvium.

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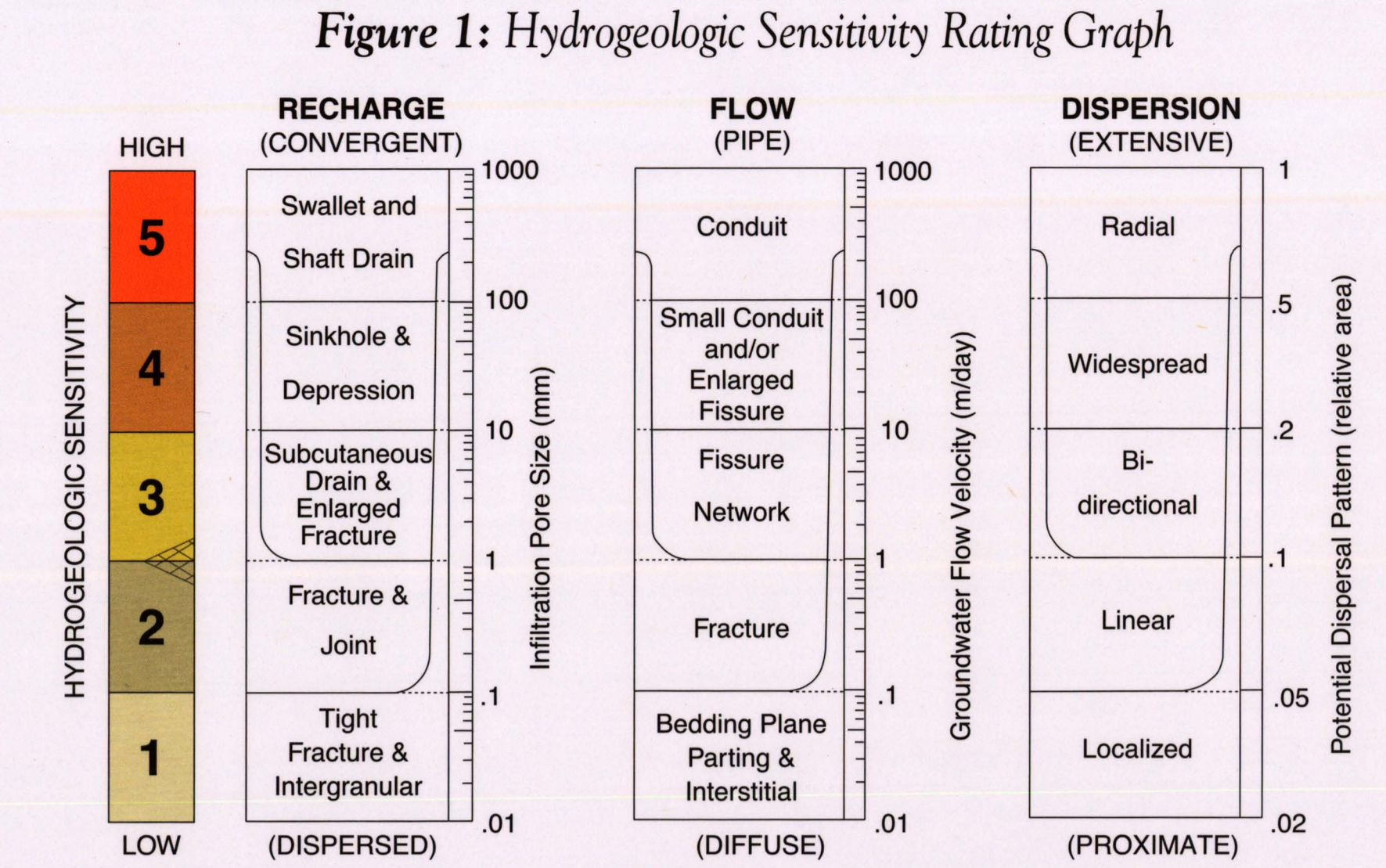
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# Groundwater Sensitivity Regions of Kentucky

by  
**Kentucky Department for Environmental Protection**  
 Division of Water Groundwater Branch  
 1994  
*Interpreted by*  
 Joseph A. Ray • James S. Webb • Phillip W. O'Neil  
 Scale  
 1:500,000

1" = approximately 8 miles  
 Universal Transverse Mercator Projection, Zone 16, Polyconic grid.

Figure 1: Hydrogeologic sensitivity rating graph, employing three primary hydrologic components: Recharge, Flow, and Dispersion. Recharge ranges from dispersed to convergent and is calibrated with an infiltration pore-size in mm. The lower two blocks of the recharge column are elevated to moderate sensitivity (#3) because the presence of soil macropores, ranging from 1-10 mm, increases groundwater recharge significantly. Flow ranges from diffuse to pipe and is calibrated with a flow-velocity scale expressed in meters per day. Dispersion ranges from proximate to extensive and is calibrated with dimensionless units that express relative rates of the potential dispersion patterns. Hydrogeologic sensitivity ratings range from (low #1) to (high #5). The diagonal grid pattern represents lacustrine deposits which are rated #2 and #3. For the lower two sensitivity zones of all three hydrologic components, overriding factors (such as coarse, granular media or enlarged stress-relief fractures) were recognized which elevate the sensitivity ratings. In order to illustrate these overriding factors, spikes were extended from the lower sensitivity zones to show the potential for elevation to higher sensitivity ratings. Many of the qualitative descriptions used in this map have been adapted from Quinlan and others (1992).

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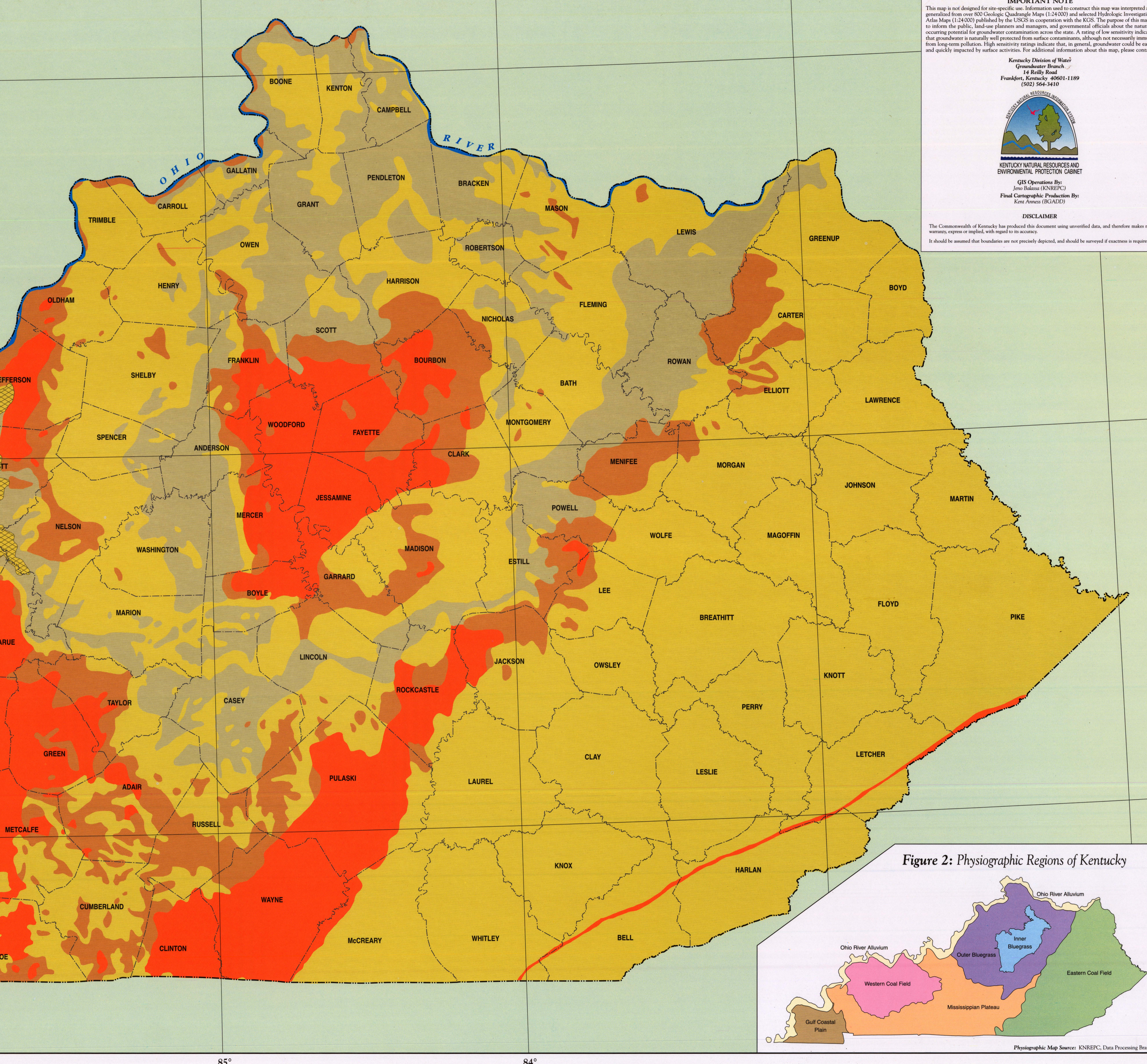
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**IMPORTANT NOTE**  
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**DISCLAIMER**  
 The Commonwealth of Kentucky has produced this document using unverified data, and therefore makes no warranty, express or implied, with regard to its accuracy. It should be assumed that boundaries are not precisely depicted, and should be surveyed if exactness is required.

Figure 2: Physiographic Regions of Kentucky

**PHYSIOGRAPHIC REGIONS OF KENTUCKY**

This map shows the five physiographic regions of Kentucky: Eastern Coal Field, Bluegrass, Mississippi Plateau, Western Coal Field, and Gulf Coastal Plain. The map is overlaid with county boundaries and names.

**PHYSIOGRAPHIC MAP SOURCE:** KNRPEC, DATA PROCESSING BRANCH