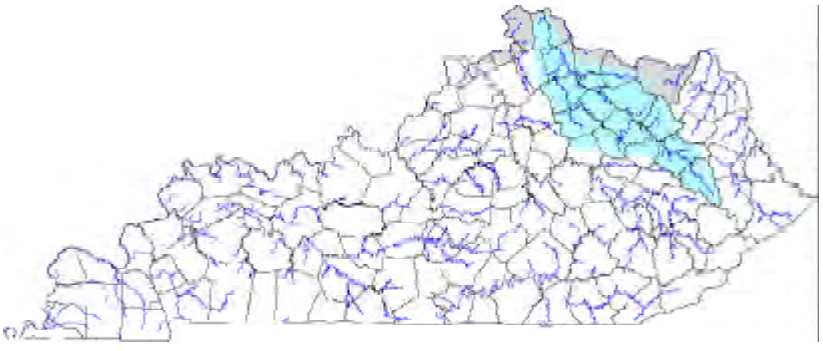
The Licking River Region in Kentucky:

Status and Trends

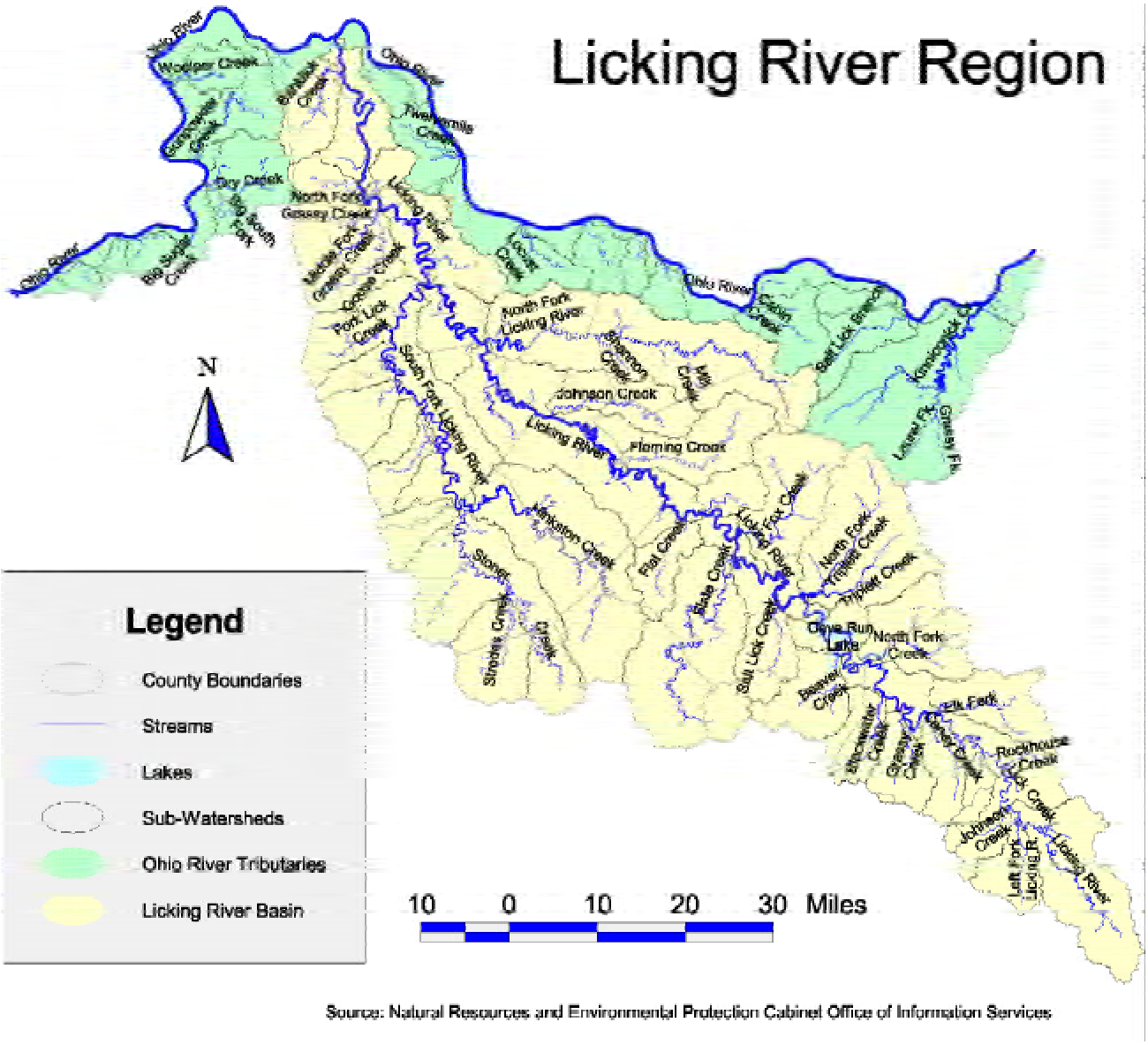


November 1998

We thank the Team members, the volunteers who have collected data and worked on watershed health issues, and Pamla Wood (coordinator), Barry Tonning (principal author), Maleva Chamberlain (layout), Rick Hill (cover), Lew Kornman (photos) and Kimberly Prough (maps).

"I have really enjoyed working with a basin team composed of such knowledgeable, practical and generous people. Their commitment and desire to involve many, many more people in the watershed effort has been an inspiration to me and others working on watershed issues in the Commonwealth."

Pamla Wood
Licking River Watershed
Team Coordinator



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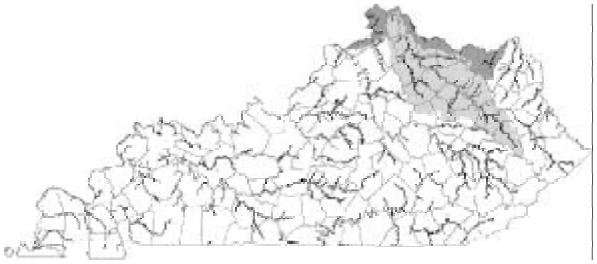


This report covers the entire drainage area – or *basin* – of the Licking River and other streams north and east of the basin along the Ohio River. In this report, the entire area is referred to as the Licking River region.

Are the streams in the Licking River region healthy?

That is the main question this report explores. In order to determine if the region's streams are contaminated, we have reviewed water sampling data, assessments of stream and river bank conditions, discharge permits for sewage treatment plants, and activities like farming, development, logging, and mining. We have found that what happens in the river basin – or *watershed* – directly impacts water quality and habitat conditions. Some tributaries in the Licking River region are contaminated with bacteria from sewage or livestock; silt from erosion, construction or logging; algae blooms fed by nutrients from fertilizers or manure; and some pollution from mining and industrial or urban sewage plants. Most of the streams in the region, however, seem to be free of excessive pollution. Maintaining good water quality in the unpolluted parts of the river and cleaning up contamination in other sections will require a closer look at what is happening in the watershed, how it impacts watershed health and what can be done to improve conditions. That is what this report is all about.

Basin or Watershed?
The *basin* of a river or stream is all the land that is drained by a lake, river or stream. Another word for basin is *watershed*, which comes from the observation that water is shed from an area of land and flows downhill into a body of water.

Where did this report come from?

This report was produced by the Licking River Region Team, a group of people representing various agencies and organizations in the watershed. The analysis and recommendations in the following pages are an important part of the Kentucky Watershed Initiative, a statewide effort to assess and improve watershed health in the Commonwealth. The report examines existing conditions in the Licking River watershed and other streams that drain directly into the Ohio River in northeastern Kentucky.

The information and maps that follow were collected from a variety of sources. Federal, state and local agencies provided much of the data, with supplemental information coming from *water monitoring* volunteers organized by the Licking River Watershed Watch, public universities and other organizations. This report will give readers a good, general background on the river basin. Hopefully, it will also spark some interest in exploring conditions within the smaller watersheds that feed into the Licking and Ohio rivers. Addressing issues in these tributary watersheds will require constructive, cooperative local action.

Water monitoring
Water monitoring to determine watershed health can involve many different activities. We can find out if our waters are fishable, swimmable, and drinkable by testing for various pollutants, checking oxygen levels, measuring water clarity and temperature, observing aquatic and terrestial life, and assessing habitat conditions both in the stream and along the banks.

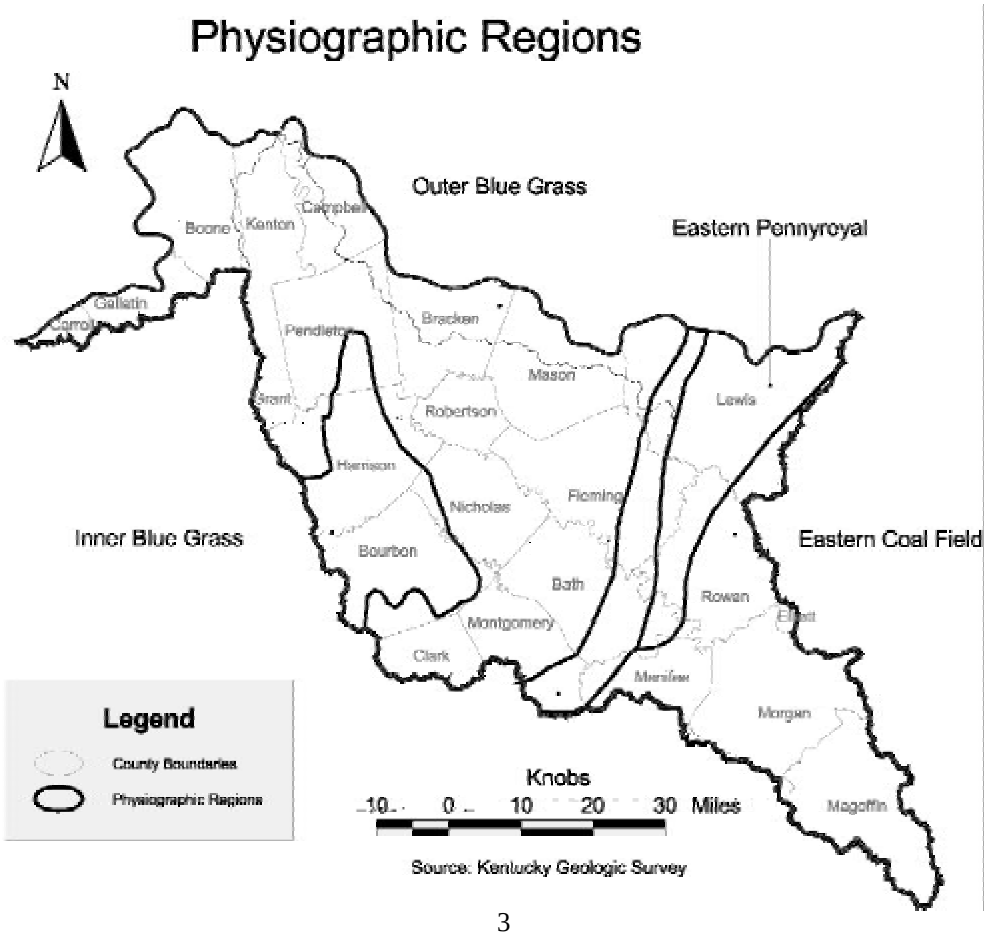
Low-water dams
Low-water dams are installed across a stream channel to create a year-round pool of water, usually to supply a drinking water treatment plant. Water flows over the top of the dams during heavy rains. During drier conditions in the summer, the dams hold back water that would normally flow downstream. While helpful for water supply, dams restrict movement of fish and other organisms.

Riffles
Riffles are short runs of rapidly flowing water, usually over rocks, downed trees and other objects in the stream channel. The churning waters of riffles create high-quality habitat for mussels, fish, and insects that live in the stream because of the higher levels of dissolved oxygen mixed into the water.

Land in the Licking River region

The Licking River and the smaller streams in the region drain a diverse watershed, with forested hills in the upper reaches, rolling farmland along the middle regions and urban/industrial development near the confluence with the Ohio River in Northern Kentucky. The Licking River – named for the mineral springs and salt licks that attracted buffalo and other animals – begins in the highlands of the Allegheny Plateau in Magoffin County. The river flows northwest through the Eastern Bluegrass for about 300 miles before emptying into the Ohio River between Newport and Covington. The two principal tributaries are the North Fork, which joins the main stem of the river near Milford, and the South Fork, which joins at Falmouth. The river drains an area of roughly 3,600 square miles, or about ten percent of the entire state. A dam near the town of Farmers on the Rowan-Bath county line – 173 miles upstream from the Ohio River – forms Cave Run Lake, an 8,300-acre reservoir that impounds 38 miles of the main stem and the lower reaches of several tributaries. Smaller, *low-water dams* are found on Slate Creek, Stoner Creek, the South Fork, and other locations.

The creeks, streams and rivers of the region are mostly upland types, with moderate to steep grades, well-developed *riffles* and shoals, rocky creek bottoms, and relatively narrow floodplains. Much of the lower half of the Licking River main stem below Cave Run Lake and the North and South forks are subject to excessive siltation linked to poor agricultural practices and land clearing activities and sewage pollution from a variety of sources. Coal-bearing regions in the upper reaches of the river have been affected by siltation from surface mining and brine from oil wells and now have less diverse communities of organisms than in the past.



Soils in the watershed range from thin silty clays in the hilly uplands to deeper loamy and sandier clays in the lower regions. Rock formations underlying the upland Eastsern Coalfield region include sandstone, siltstone and shale, with some interbedded coal deposits. The river flows though the Knobs Region near Cave Run Lake and enters the rolling, limestone hills of the Bluegrass Region. Especially in Bourbon County and much of Menifee County, limestone layers contain *sinkholes*, caves and underground flow channels. These formations make streams in these areas particularly sensitive to contamination from chemicals or other pollutants on the landscape, since groundwater moves much faster through the passages. The streams along the Ohio River drain mostly steep, hilly areas of pasture, small farm plots and some mixed forest lands.

The headwaters region is characterized by forest vegetation typical of the Eastern Mesophytic Forest, one of the most biologically diverse resources in North America. Current timber stands are second or third generation trees, with mixes of oak-poplar-hickory and pine species throughout the upper third of the watershed. While there is still a good diversity of tree species and some excellent stands scattered throughout the region, the quality of forest resources overall is mixed due to a general lack of resource planning, poor management practices and impacts from poor harvest techniques and skid roads. Pressure on forest resources is increasing as demand for timber rises and smaller trees become useable as chip or laminated beam stock.

Farms along the middle reaches of the river produce tobacco, corn, hay, and cattle, with much of the agricultural land in pasture year-round. Urban development is more extensive near the mouth of the Licking, particularly in northern Kenton and northwestern Campbell counties. Vegetation along the lower reaches is mostly turf, pasture and managed landscape, with a few remaining patches of unconnected forest. Impervious surfaces which shed water quickly – roofs, parking lots and roads – are more common and concentrated in the Northern Kentucky area, which lies across the Ohio River from Cincinnati.

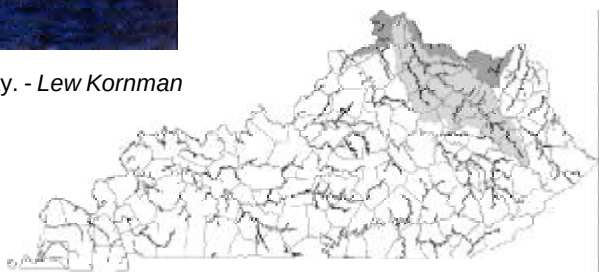
Cardinal flowers and mist flowers on the Licking River in Bath County. - *Lew Kornman*

Sinkholes

Sinkholes are openings that lead to underground passageways that can be very tiny or very large – even caves. The sinkholes and passages are created when rain dissolves limestone and flows beneath the surface along with other groundwater. Contaminants that flow into sinkholes easily pollute groundwater and the drinking water wells and streams they connect to.

Geography and Stream Health

How does geography affect the health of streams? The lay of the land, soil types, and vegetation in an area can directly affect water quality – especially when the land is cleared or tilled. For example, basins with loose soils, steep hills, or little vegetation are often severely eroded by rain storms, leaving streams and rivers muddy and subject to flooding from rapid runoff. Vegetation can reduce flooding by slowing down runoff from rain storms and can even filter out silt and other contaminants before they reach streams. Trees, bushes, and tall grass along stream banks also reduce erosion along the channel and create valuable habitat for birds, mammals, and other creatures.



Permitted discharges

Discharge permits, provided for under federal and state laws, allow the disposal of treated *effluent* in the water. This effluent can be relatively clean wastewater from properly functioning municipal and industrial sewage treatment plants, discharges from sedimentation or treatment ponds near mines or oil/gas wells, or storm water from culverts that drain city streets.

Septic systems

Septic systems, help clean up sewage from homes and businesses in areas not served by sewage treatment plants. On most systems, the first stage of treatment is the septic tank, where sewage is digested in an oxygen-free or *anaerobic* environment. After the anaerobic process, the partially treated waste is directed to a drain field, lagoon or wetland for further treatment in a more oxygenated or *aerobic* environment. If the process is working correctly, the relatively clean wastewater then soaks into the ground. Septic tanks require periodic maintenance pumping. Illegal straight lines pipe semi-treated water directly to streams.

Sanitary Sewer Overflows

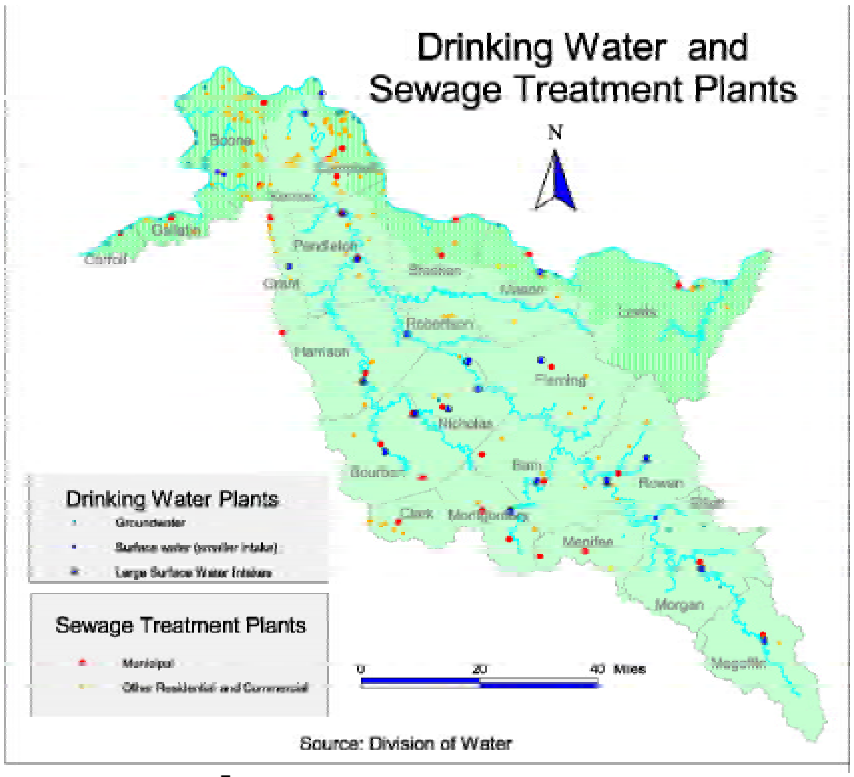
Newer sewers, called *sanitary sewer systems*, are not designed to handle rainwater. However, rainwater and groundwater seep or flow directly into the sewer lines through manhole covers and cracks in joints or lines. Surfacing of sewage or bypasses can occur when the sewage volume exceeds the pipe capacity. The sewage may actually surge from the tops of manholes or cracks in the manholes, or may flow from discharge pipes. These occurrences, referred to as *sanitary sewer overflows* (SSO's), occur throughout the state.

People and the river

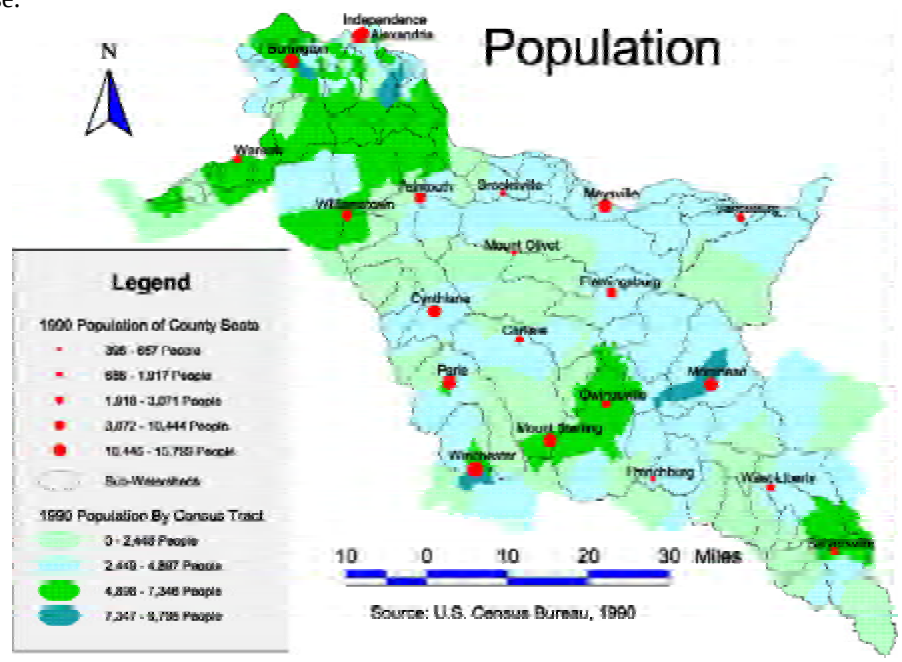
The Licking River and its tributaries provide a source of drinking water for about 80 percent of the 340,000 residents of the basin. There are 20 drinking water plants that draw from the river or its tributaries, more than 30 systems using public wells. Some of the households in the Licking River region are connected to one of the Some of the households in the Licking River region are connected to one of the more than 30 sewage treatment plants that discharge treated *effluent* into the river and its tributaries (see map). Thousands of homes use on-site systems, usually *septic systems* with tanks with drainage fields. Some households illegally pipe wastewater directly from houses (straight pipes) or from septic tanks (straight-line septic) into streams. Other discharges affecting water quality include flows from *sanitary sewer overflows* or *combined sewer overflows* during times of heavy rains, briny effluents from old, abandoned oil and gas wells and some contaminated coal mine drainage in the headwaters region..

The effectiveness of waste treatment by individual residential septic systems varies greatly. Health departments are responsible for permitting, inspecting and responding to complaints regarding septic or *onsite wastewater treatment systems*, and they have stepped up oversight activities in recent years. However, straight-line and failing systems are still found in some areas, where they discharge bacteria, viruses, protozoa, and algae-feeding nutrients into streams. County health environmental staff are exploring the use of less expensive lagoon systems, wetland treatment and other alternatives to address issues related to system costs and limiting factors like high water tables, poor soils, rocks, and small lots. A pilot health department program to cost-share septic system installation for low income individuals proved very popular in Rowan County, and interest exists throughout the basin and state for an expansion of this approach.

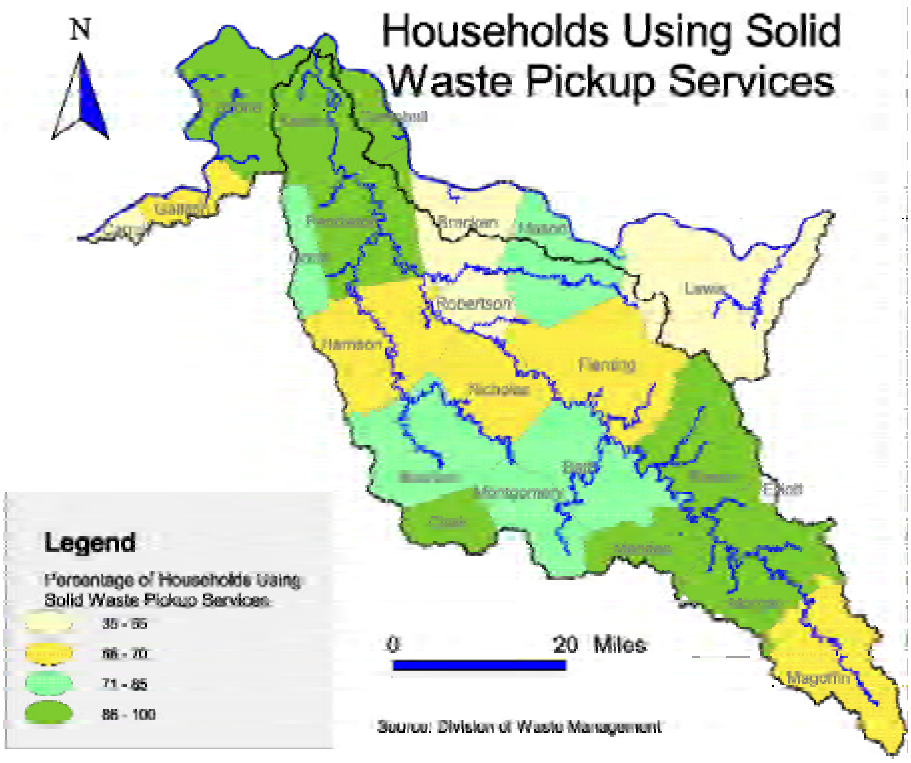
Sewage treatment plants also pose contamination problems. These may be undersized or poorly managed or maintained. This often happens with small "pack-



age" plants which serve clusters of houses, schools or other facilities. Also, sewage plants may not be large enough to accommodate increases in population, resulting in release of raw sewage during high use.



Illegal dumping of solid waste in the watershed has been declining over the past five years due to new planning and management laws, increased enforcement, public outreach and education, and greater awareness of the environmental and economic development impacts. By law, solid waste removal and land disposal services are available in every county. However, not all households subscribe to these services (see map below). Some instances of dumping are still being reported, however, and littering is still very much a problem throughout the basin. Littering and dumping cost taxpayers in the region a considerable amount of money. For example, a single county can spend $6,000 to $20,000 annually to pick up litter, and during 1993-98 2,760 illegal dumps in the region were cleaned up at public expense. Schools, public agencies and non-governmental organizations are promoting personal responsibility and stewardship in their efforts to reduce dumping, septic discharges and environmental degradation.



Combined Sewer Overflows
In older sewer systems known as *combined sewers*, the system is designed to collect stormwater from city streets, catch basins, yard drains, etc. If the volume of sewage and stormwater exceeds the capacity of the sewer pipes or the treatment plant, a portion of the sewage-stormwater mixture is allowed to bypass the treatment process and is sent either directly to streams or rivers or is partially treated before release. Bypass pipes from combined sewer systems are known as *combined sewer overflows* (CSO's). In the Licking River region, these only exist in Campbell and Kenton Counties.

Organisms as indicators
Healthy streams have low levels of contaminants and contain a diversity of plants and animals. Certain mussels and insect larvae (caddisfly, stonefly, mayfly) are often used as indicators of good water quality, similar to the coal mine canaries used to detect poisonous gases. Since these mussels and larva can live only in relatively clean water, their presence usually indicates that problems are few in that section of the stream. Students and adult volunteers are monitoring watershed health in Kentucky by observing these indicators through the Kentucky Water Watch program.

Mayfly
Lew Kornman

Riparian area
Stream banks and the land along them are called a riparian area. With appropriate vegetation, riparian areas provide natural protection from pollutants that drain off the land. Good riparian management can prevent erosion and flooding. It also provides important habitat for wildlife because it offers food, water, shelter and a travel corridor.

How do we determine watershed health?

Healthy watersheds produce clean water – water that is fishable, swimmable and suitable as a drinking water source. Watersheds that meet these criteria support a wide variety of aquatic life and are a valuable resource. State agencies mostly follow the guidelines in the federal Clean Water Act to determine whether or not the quality of river and stream water is acceptable. Under the Clean Water Act, states set standards for the water based on how it is being used. These uses can consider the high-quality values of a wild and scenic river, a stream's importance as a drinking water source, wildlife habitat, or other uses. The standards include benchmarks for various *parameters* like dissolved oxygen, temperature, acidity, and other measurable qualities.

If a lake, river or stream meets the standards for fishing swimming, and drinking water sources, it *fully supports* its designated use (see map, centerfold). If it falls short on a few measures, it may only *partially support* its use. Failure on additional counts can mean that it is *not supporting* its designated use. Bodies of water that do not support their use must have cleanup plans that identify and quantify the problem pollutants and specify how they will be reduced. Sometimes the pollutants come from sewage treatment plants, other times they are carried into the water by runoff from towns, farms, new developments, or other areas.

Watershed health means more than good water chemistry. In addition to chemical analyses, watershed health can be measured by observing plant and animal life. For example, certain species are *indicators*. Also, habitat is important to watershed and stream health. Vegetation in the riparian area - especially shrubs and trees - provides food and cover for terrestrial and aquatic life.

While state officials have information from samples collected on the Licking River and a few of its tributaries, most of the water in the basin has not been tested. An interagency workgroup is coordinating to increase the amount of monitoring conducted in the region. By working together, tax dollars can be stretched and better information provided on the condition of the watershed. Also, citizens active in the Licking River Watershed Watch have collected data to supplement public agency information and raise public awareness. Efforts are underway to secure greater involvement from high schools, public universities and civic groups for long-term citizen monitoring in the region. Further testing may reveal other problem areas that need attention. Reducing concentrations of pollutants that exceed state standards will involve a considerable amount of cooperative action and analysis.

Kentucky Water Quality Standards

The following *parameters*, or measurable criteria, are only a few of those being used to define Kentucky's water quality standards. The standards and units for each parameter are listed below. For example, if a water sample shows more than 400 fecal coliform CFUs in a 100 milliliter sample, the water would be considered contaminated.

Parameter	Value	Units
Dissolved Oxygen	>4.0	Milligrams per liter (parts per million)
pH (measures acidity)	6-9	Standard units (7.0 = neutral)
Fecal coliform	400	Colony-Forming Units per 100 milliliters of water
Temperature	89	Degrees Fahrenheit

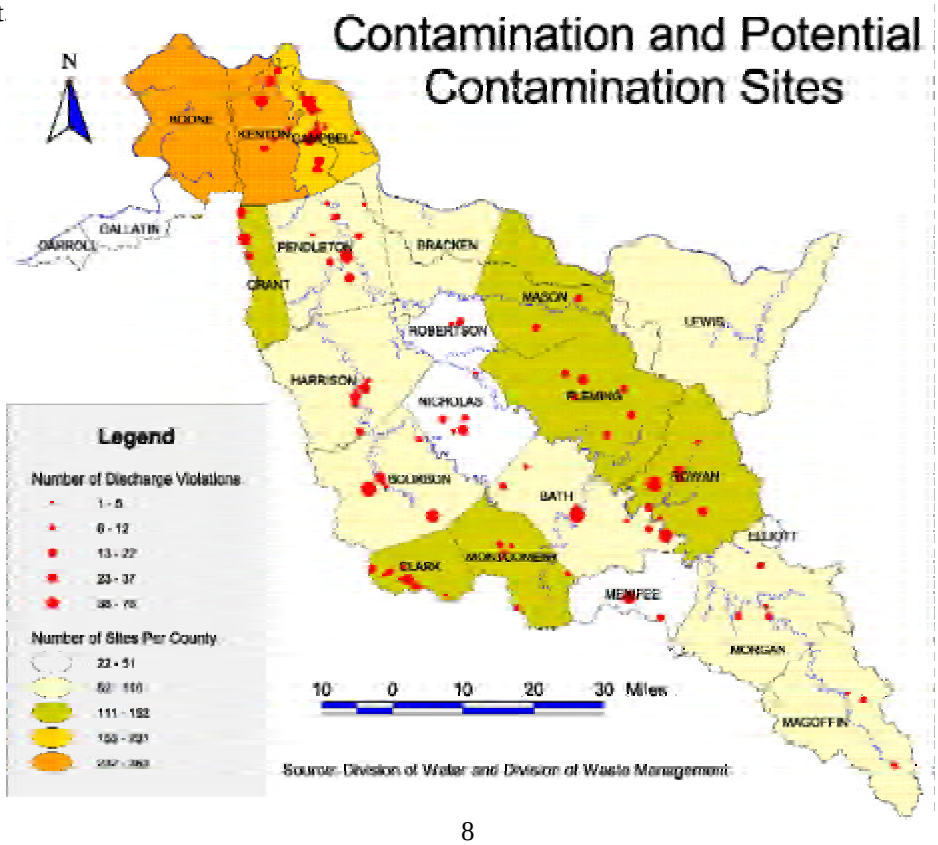
What are the water quality problems in the Licking River?

According to studies conducted over the past five years, the most common problems in the Licking River are nutrients, bacteria and sediments. Nutrients come from farm and residential fertilizers, livestock manure, faulty septic systems, and other sources. The phosphorus and nitrogen – nutrients – in fertilizers, manure and sewage cause algae to grow in the water. When the algae dies, it is decomposed by bacteria that use up the dissolved oxygen in the water. The loss of oxygen can cause fish to suffocate and die. Other bacteria – including some that may cause diseases in humans – can enter the water from inadequate septic systems, livestock manure or sewage plants and sewer lines that are bypassed or leak during heavy rains. These bacteria and the viruses and other germs that often accompany them pose a disease threat to swimmers, boaters and anglers. Sediment in the water causes muddy or cloudy conditions, interferes with fish reproduction and feeding, increases drinking water filtration costs, and generally degrades habitat. Sediment comes from poor farming, logging, development, and home building practices and stream bank erosion.

Other problems in the region come from clearing away vegetation on stream banks, straightening creek channels, undersized or poorly operated sewage treatment plants, and some industrial plants. Clearing trees and other vegetation from streams and straightening them is often done to reduce flooding, but usually only moves the floodwaters downstream and makes the situation worse elsewhere. In addition, removing trees that shade creeks and streams causes the water to become warmer, laden with algae and less suitable for fish and other organisms. It also causes streambank erosion, which can create further loss of land and add sediment to streams. Bacteria in the water means that sewage collection pipes and treatment plants in some areas need to be upgraded, along with some industrial wastewater treatment plants.

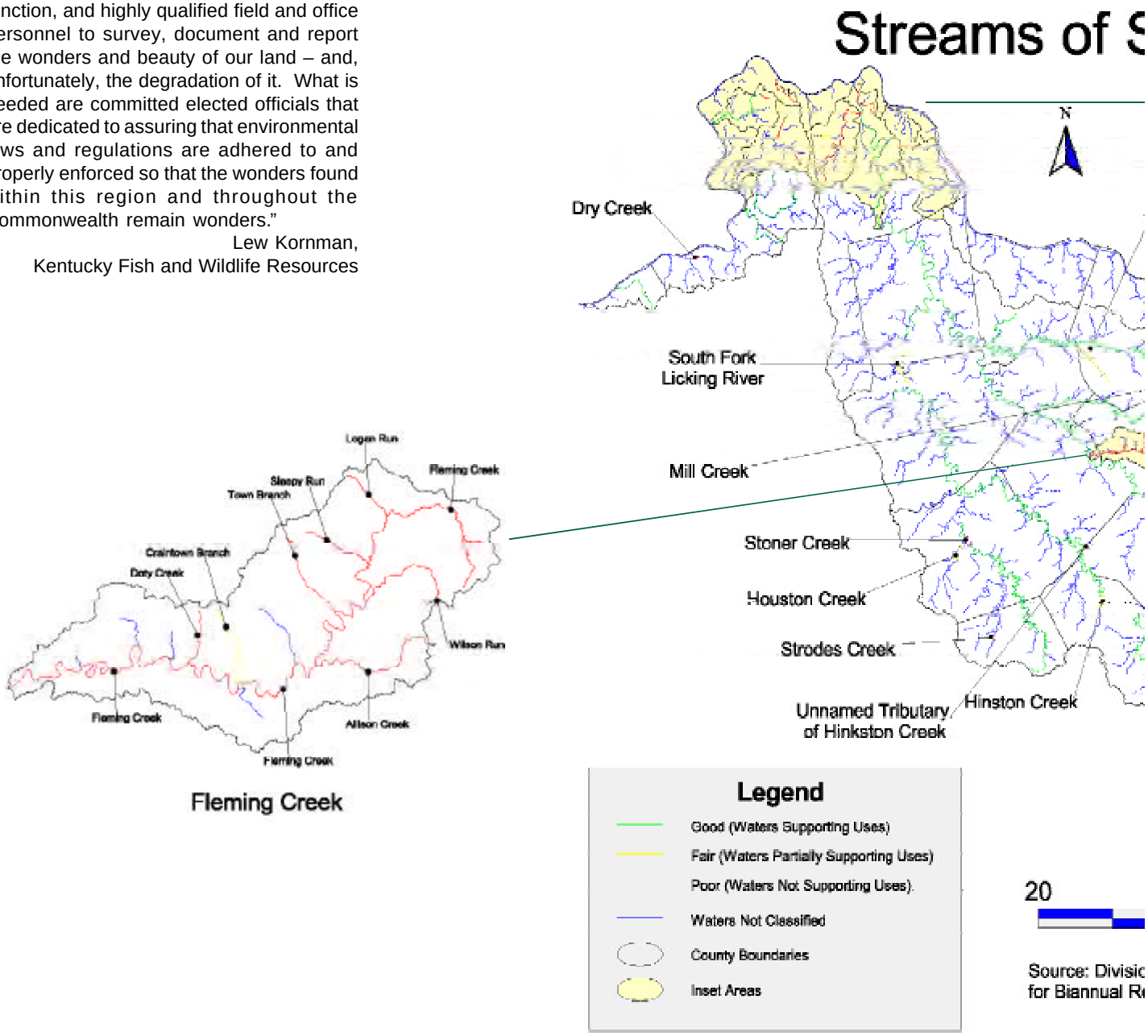
According to the Kentucky Division of Waste Management, there are many sites in the Licking River region that are contaminated or may be contaminated due to the presence of: underground storage tanks; hazardous waste facilities; landfills closed before July 1992; illegal dumps; and large tire piles, brine wells, or straight pipes.

Dealing with water quality issues will take education, time, conscious change in human habits, and financial support



"We have the laws, regulations, statutory function, and highly qualified field and office personnel to survey, document and report the wonders and beauty of our land – and, unfortunately, the degradation of it. What is needed are committed elected officials that are dedicated to assuring that environmental laws and regulations are adhered to and properly enforced so that the wonders found within this region and throughout the Commonwealth remain wonders."

Lew Kornman,
Kentucky Fish and Wildlife Resources



Poor Quality Streams in the Fleming Creek Watershed

Stream (Fleming County)	Source of pollutants	Pollutants
Allison Creek	pasture grazing, intensive animal feeding operations	nutrients, organic enrichment/low oxygen, noxious native aquatic plants, pathogens
Craintown Branch	agriculture, pasture grazing, intensive animal feeding operations	nutrients, noxious native aquatic plants, pathogens
Doty Creek	pasture grazing, intensive animal feeding operations	organic enrichment/low oxygen, pathogens
Fleming Creek	agriculture	organic enrichment/low oxygen, nutrients, pathogens
Logan Run	land disposal	organic enrichment/low oxygen
Sleepy Run	agriculture, pasture grazing, intensive animal feeding operations	pathogens
Town Branch	agriculture, pasture grazing, intensive animal feeding operations	pathogens
Wilson Run	pasture grazing, intensive animal feeding operations	pathogens

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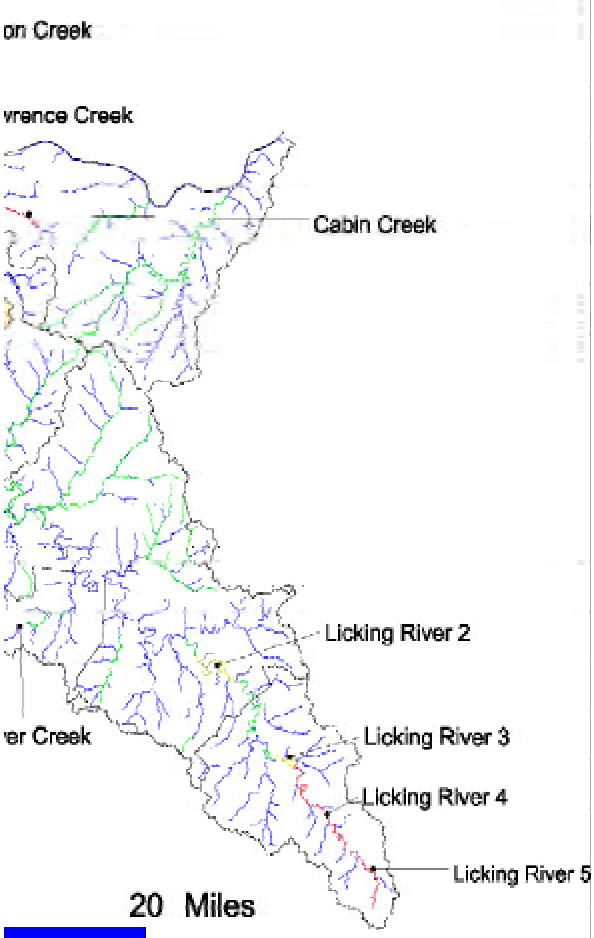

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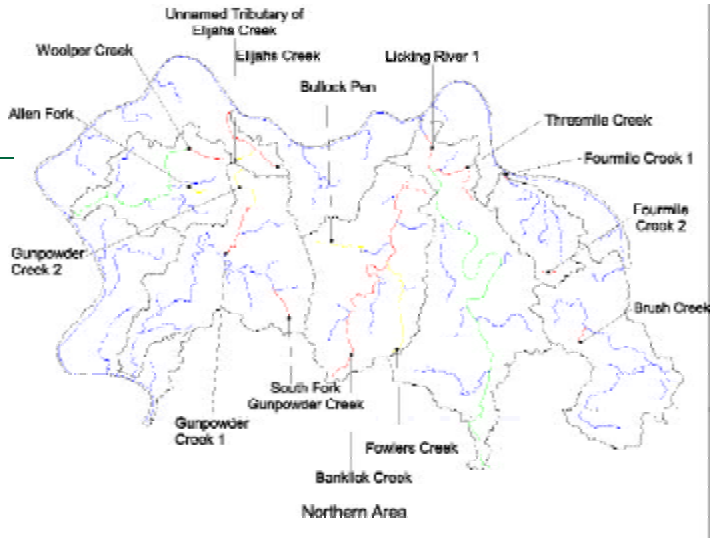

Poor Quality Streams in the Northern Area

Stream	Sources	Pollutants
ALLEN FORK (BOONE COUNTY)	urban runoff/storm sewers, habitat modification	siltation, habitat alteration, nutrients
BANKLICK CREEK (KENTON COUNTY)	municipal point sources, combined sewer overflow, urban runoff/storm sewers, flow modification	nutrients, organic , enrichment/low oxygen, habitat alteration, pathogens
BRUSH CREEK (CAMPBELL COUNTY)	municipal point sources	organic enrichment/ low oxygen
ELIJAHS CREEK (BOONE COUNTY)	industrial point sources	organics
FOUR MILE CREEK (CAMPBELL COUNTY) – 1	municipal point sources, small sewer plants, collection system failure	pathogens
FOUR MILE CREEK (CAMPBELL COUNTY) – 2	small sewer plants, municipal point sources, septic tanks	organic enrichment/ low oxygen
GUNPOWDER CREEK (BOONE COUNTY) – 1	urban runoff/storm sewers, industrial permitted discharges	unknown
GUNPOWDER CREEK (BOONE COUNTY) – 2	urban runoff/storm sewers, industrial permitted discharges	organics
THREE MILE CREEK (CAMPBELL COUNTY)	collection system failure	pathogens, organic enrichment/low oxygen, nutrients
WOOLPER CREEK (BOONE COUNTY)	municipal point sources, construction, flow modification, urban runoff/storm sewers	nutrients, habitat alteration, suspended solids,organic enrichment/low oxygen

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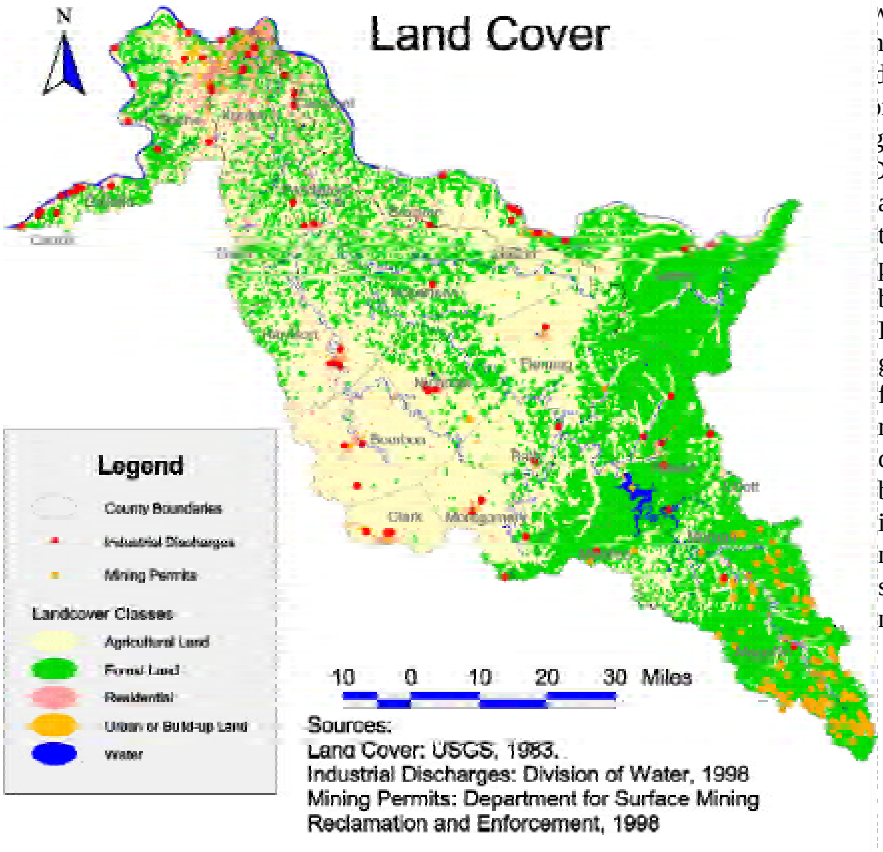
Other Poor Quality Streams

Stream	Source of pollutants	Pollutants
CABIN CREEK (MASON CO., LEWIS CO.)	agriculture, habitat modification	siltation, habitat alteration
HINKSTON CREEK (MONTGOMERY CO.)	municipal point sources	nutrients, unknown toxicity
LICKING RIVER – 1 (CAMPBELL COUNTY)	municipal point sources, combined sewer overflow	pathogens
LICKING RIVER – 2 (MORGAN COUNTY)	municipal point sources	pathogens
LICKING RIVER – 3 (MAGOFFIN COUNTY)	municipal point sources	organic enrichment/low oxygen
LICKING RIVER – 4 (MAGOFFIN COUNTY	collection system failure	siltation
LICKING RIVER - 5 (MAGOFFIN COUNTY	collection sytem failure	siltation

How does land use affect watershed health?

Environmental studies in the Licking River region demonstrate the close link between land activities and water quality. Headwaters of the basin contain old oil and gas wells, abandoned coal mines, and logged areas, which can contribute brine, acidity and silt, respectively, to the river. The middle section of the basin flows through agricultural lands that produce row crops, livestock and their periodic by-products – water-borne sediment and manure. This manure can come from the horse farms in the South Fork watershed, dairies along the middle reaches of the river, beef cattle on farms in the Gateway Area, hogs, chickens and even household pets throughout the watershed.

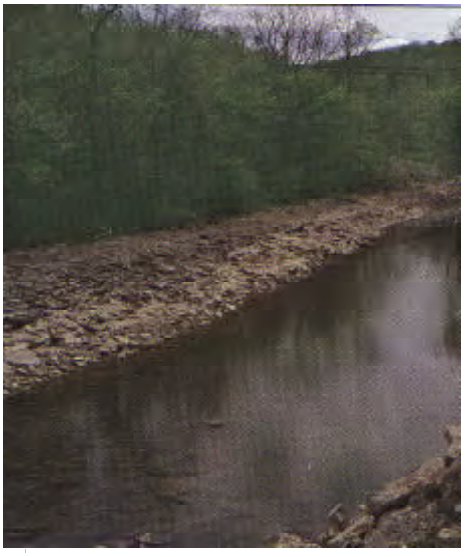


water runoff from the cities along the nd Licking rivers contains automotive diment from land clearing activities, om cars and other sources, nutrients that gae blooms, and other urban contami- Development and loss of greenspace also causes surges in stream levels due to rapid runoff - from roofs, roads and parking lots -which erodes stream banks and can cause localized flooding. Finally, the loss of trees, shrubs and grasses along stream banks causes further instability and erosion, with resulting increases in siltation and decreases in both instream and stream bank habitat. Channelization, the clear- ing and straightening of stream chan- nels, aggravates both flooding and sedimentation, despite the common notion that it reduces flooding.

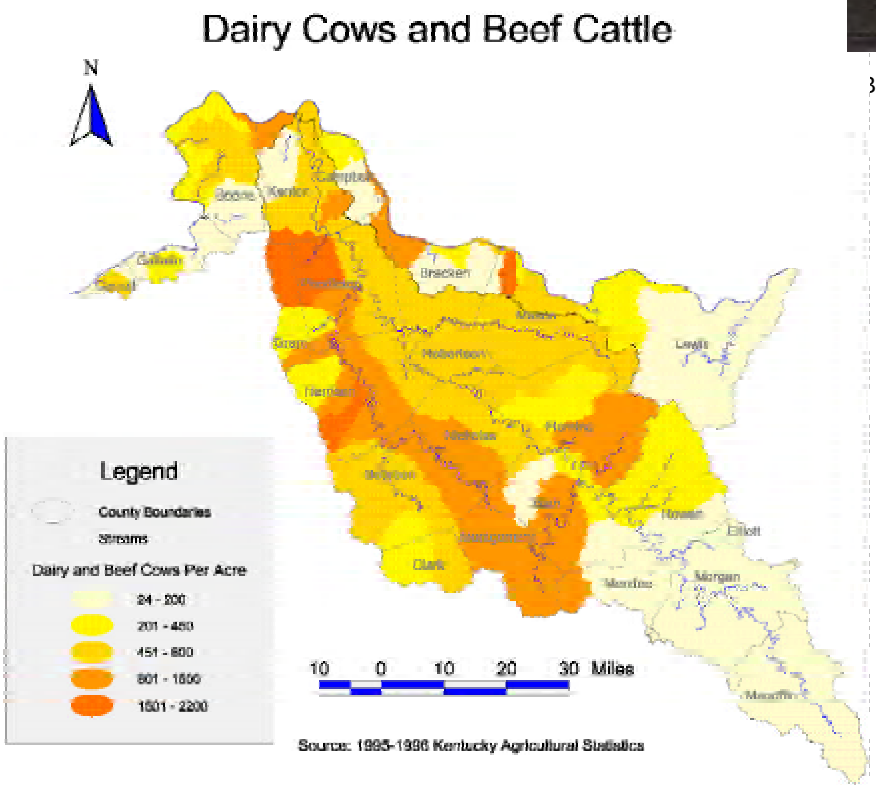
Land activities that can impact water quality

Activity	Impacts
Row cropping	Siltation, erosion, chemical and fertilizer runoff
Livestock production	Manure runoff (excessive nutrients and bacteria), damage to streamside vegetation, bank erosion
Logging	Loss of streamside trees, bank erosion, siltation from roads, increased runoff
Mining	Acidity and sulfates from iron sulfide rocks, sediment, runoff surges
Oil and gas drilling	Brine from drilling, sediments, oily runoff
Residential yards	Lawn and garden chemical and fertilizer runoff, higher runoff velocities
Urban development	Siltation from land clearing, runoff surges (oils and metals) from roofs, roads, parking lots
Industrial facilities	Chemical runoff from material storage areas, soot deposits, runoff surges, spills
Commercial development	Runoff surges (oils and metals) from parking lots, roofs; sediment from land clearing
Stream clearing	Sedimentation, loss of wildlife/mussel habitat, loss of shading (increased temp.), flooding
Channelization	Increased flooding, sedimentation, loss of fish/insect habitat, loss of mussel beds
Construction in floodplains	Increased flooding, siltation, danger to life and property

Logging in Rowan County - *Lew Kornman*



Bank failure on Banklick Creek (Kenton County) - *Lew Kornman*



Practices that reduce impacts from land activities

Activity	Management practices
Row cropping	Use conservation tillage, targeted chemical use, strip cropping, and streamside buffers.
Livestock production	Move facilities uphill, install waste treatment systems, stream fencing, and setbacks.
Logging	Skid on the contour, avoid streams, preserve streamside trees, and install water bars.
Mining	Reclaim mined areas, mix acid and alkaline material, add erosion/sediment controls.
Oil and gas drilling	Store or treat wastes from drilling, control sediments and oils.
Residential yards	Reduce/eliminate lawn/garden chemical use, preserve streamside vegetation.
Urban development	Sediment/erosion/stormwater controls, minimize land clearing and pavement, preserve existing trees.
Industrial facilities	Cover stored materials, control/treat runoff, minimize air/water discharges.
Commercial development	Minimize land clearing, control/treat runoff, reduce parking lots/road sizes.
Stream clearing	Minimize clearing, preserve vegetation, promote greenways/buffers.
Channelization	Decrease flooding by reducing or slowing runoff, restore streamside wetlands.
Construction in floodplains	Limit or eliminate development in floodplains.

Broke Leg Falls (Menifee County) - *Lew Kornman*

"I've been to just about every state in the union, and I can tell you this: There's nothing more beautiful than the Licking River valley in the fall of the year. Nothing."

Barry Tonning,
Ky. Waterways Alliance

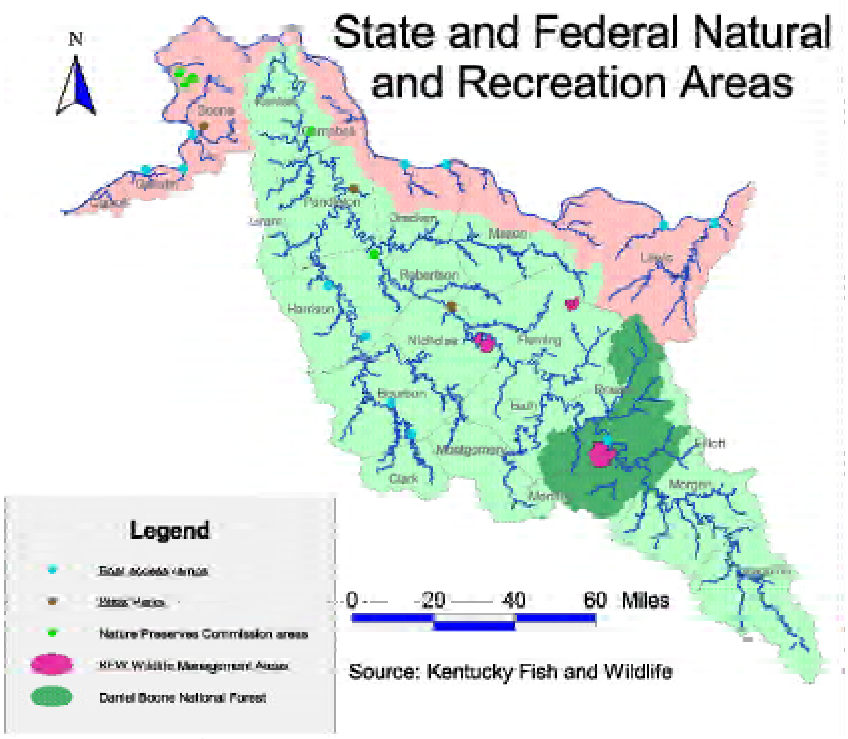
Kinniconick Creek: a living legacy. Kinniconick Creek in Lewis County drains one of the most beautiful and biologically rich watersheds in the east. A native "muskie" stream, Kinniconick is home to more than 60 species of fish including the popeye shiner, trout perch, longhead darter, and several species of bass. The 51-mile stream flows into the Ohio River near Garrison and is bordered by relatively steep terrain formed from shale, siltstone, and sandstone.

Recreational resources

The rivers and streams of the Licking region provide a resource far beyond residential and industrial use. Healthy watersheds support fishing, boating, hunting, hiking, biking, and other outdoor activities important for recreation, social outings, community development, peace of mind, and other quality-of-life amenities. From the headwaters streams of Magoffin County, through the knobs and the Bluegrass regions and on to the Ohio River corridor, the waters of East Central Kentucky have always held a special place in the hearts of the people. Indeed, affection for the watershed and recreational resources has collided with mining, drilling, logging, development, littering, dumping, and inadequate sewage treatment in the watershed.

Opportunities abound for accessing and enjoying the rivers and streams of the region and appreciating the unique qualities they offer. Town parks along the Licking River and the smaller streams of the region can be found in West Liberty, Frenchburg, Morehead, Owingsville, Mt. Sterling, Paris, Cynthiana, and most of the cities in Northern Kentucky and along the Ohio River. Cave Run Lake, in the upper third of the Licking basin, is a tremendously popular recreational lake with catfish, largemouth bass, white bass, crappie, and an excellent muskellunge fishery. Hikers can travel throughout the Daniel Boone National Forest along the Sheltowee Trace or dozens of others around Cave Run Lake, or visit the natural areas and wildlife management lands scattered through the region.

A canoe livery on the main stem of the Licking near Falmouth is popular during the warmer weather, along with swimming at Kincaid Lake State Park in Pendleton County, Lake Carnico in Nicholas County, Campbell County Lake south of Covington, Clear Creek and Rebel Trace lakes in Bath County (Daniel Boone National Forest), and Maysville/Mason Co. recreation lake. For larger boats and even more fishing and recreational opportunities, the Ohio River country in Carroll, Gallatin, Boone, Kenton, Campbell, Bracken, Mason and Lewis counties is hard to beat.



Living resources

The Licking River region drains the far western edge of the Eastern Mesophytic Forest, one of the most biologically diverse areas In North America. With its varied geography and wide range of plant and animal species, the region contains some highly valued habitat and important living resources. The Licking River, some of its tributaries, and Kinniconick Creek are rare examples of native muskie streams. A total of 110 species of fish inhabit the region. Largemouth, spotted and smallmouth bass, rock bass, bluegill, crappie and catfish are the most popular for fishing throughout the region. The basin also supports several unique fish species: redside dace, mimic shiner, streamline chub, slender madtom, blue sucker, an occasional paddlefish, and eastern sand, tippecanoe and sharpnose darters. Besides fish, the Licking River is home to more than 50 species of mussels, 11 of which are rare or endangered. Some of these mussels face reproduction problems from cool water discharges from the Cave Run Lake. The recent appearance of the non-native zebra mussel in the basin may also threaten native mussel species. In addition, other fish and mussels face threats related to habitat loss, siltation, and *algal blooms*.

Many birds live throughout the region, but loss of nesting habitat and predation have decreased native and migratory bird populations. Still, more than 248 species of birds have been seen over time at the Minor Clark fish hatchery and the Cave Run Lake area alone. Woodducks, warblers, belted kingfishers, Canada geese, and great blue herons are common; more rare are the tundra swan and marbled gotwit. Bald eagles also overwinter in this area. Woodland birds, including the wild turkey, grouse, and several species of owl, also make their homes in this part of Kentucky.

Wood ducks - *Lew Kornman*

Are algal blooms bad?
Algae is actually a mass of tiny plants that live in the water, and some algae is normal and even necessary for healthy streams. However, when high levels of nutrients – mostly phosphorus and nitrogen from manure and fertilizers – are washed into a stream, algae can become a problem. Since algae are plants, the nutrients (fertilizers) make them grow. Algal blooms can become quite large in the summer as they grow and reproduce, but like all living things they eventually die and decay. Algae is decomposed by bacteria that use oxygen dissolved in the water to breathe – the same oxygen that fish need to keep from suffocating. That's why warm weather algal blooms are sometimes followed by low dissolved-oxygen levels and fish kills.

Wetlands and watershed health
Wetlands help filter pollutants from runoff, reduce flooding, and provide valuable habitat for plants, animals, and other organisms. Kentucky has wetlands associated with rivers, lakes and forested areas, each with its own structure and particular function. While the Licking River region still has nearly 70,000 acres of valuable wetlands, this represents less than one-fifth of the wetland acreage that existed a century ago. Protecting the wetlands that remain and developing new wetlands in areas that were once drained can help ease flooding and improve water quality. Unfortunately, more and more is lost "a little at a time."

Threatened and endangered species in the region

Animals:
Bald eagle
Eastern small-footed bat
Grey bat
Indiana bat
Virginia big-eared bat
Yellow-crowned night-heron

Plants:
Canadian Yew
Cutleaf Meadow-parsnip
Grassleaf Arrowhead
Ground Juniper
Porter's Reedgrass
Rock Skullcap
Rose Pogonia
Rosy Twisted-stalk
Running Buffalo Clover
Short's Goldenrod
Spotted Pondweed
Sweet Pinesap
Wood Lily
White-haired Goldenrod
White Rattlesnake-root
Woodland Beakrush
Yellow Gentian

Mussels:
Elktoe
Fanshell
Salamander
Many other mussels are believed to be extinct

Fishes:
Slender madtom

Source: Kentucky State Nature Preserves Commission and U.S. Fish and Wildlife Service

"The Licking River supports at least one endangered mussel species which indicates water quality is good in some locations. Much data has been obtained which documents pollution impacts near the mouth. However, very little is known about water quality in other areas of the watershed. Hopefully, the information obtained through the Licking River Watershed process will provide a better, overall picture of water quality throughout the basin."

Kevin Flowers,
Ky. Division of Water

Amphibians such as the mudpuppy, hellbender, northern dusky, and northern red salamander and others are found near streams in the area, along with gray tree frogs, northern cricket frogs and spring peepers and turtles like the stinkpot, map, midland painted, and spiny softshell. Snake species include banded watersnake, garter, rough green, and black rat, copperhead and timber rattler. Mammals like the gray and fox squirrel, whitetail deer, chipmunks, gray fox, beaver, muskrat, mink, and river otter can also be seen along the streams and in upland areas.

Muskie - *Lew Kornman*

Kinniconick Creek (Lewis County)

Floods and Droughts:

Too much rainfall and too little rainfall are natural occurrences. However, the difficulties caused by these natural events can be exaggerated or limited by human activity. Most people understand the folly of building in the floodplain of a river, yet few understand that replacing natural vegetation with lawns and pavement can cause floodwaters to rise. There is much to learn about the nature of stream flow, and we are only beginning to understand how the sum of all of our activities affect floods and droughts.

The Drought of 1887 spurred construction of dams on the Ohio River to reduce the impact of periods of low flow on river boat navigation on which the region's economic health depended. Cave Run Lake, a popular recreational area, was constructed for flood prevention in the early 1970s.

The Ohio River is successfully managed for navigation, and Cave Run Lake meets many recreational needs. However, there are significant side effects. During periods of low flow, the water level of the Ohio and Licking Rivers near their confluence in Northern Kentucky is now maintained at least 20 feet higher than what it would be without controls. This elevated water level is common to each tributary to the Ohio River, and is also common to the streams that have been flooded by the construction of the dam at Cave Run Lake. These inflated streams have permanently submerged sand beaches previously used for recreation, wetlands once adjacent to the rivers, farmland, and wildlife habitat.

Fluctuations of rainfall impact groundwater storage and surface water flows. During droughts – especially in the 1980's, some areas of the Licking River region have suffered water shortages. During times of excessive rainfall, areas of the region flood. One devastating example of flooding occurred in the Licking River in March 1997. During a three day period it was estimated that more than 12 inches of rain fell. The streams and rivers of the Licking watershed swelled to record levels. In the city of Falmouth, at the confluence of the South Fork and main stem Licking River, hundreds were left homeless and four deaths were attributed to the flooding.

High flows and water quality

Watershed Watch volunteers collected samples during a rainstorm. The samples were tested to see how much fecal coliform was present in the water. This is a bacterial indicator of human or other animal waste. Fecal coliform was found in very high concentrations. A week later, when stream levels had subsided, volunteers returned to each site for another sample. This time, fecal coliform counts were only a fraction of the levels in the first sample. These results show that stormwater runoff is bringing fecal coliform into the stream from the land. Streams may also become muddier with heavy rainfall.

During times of low stream flow, which occur more often in the late summer and early fall, streams may be less muddy. During times of low flow, most of the water in streams comes from groundwater inflow.

Scene of flood at Cynthiana, Ky., 1997

"In 1746, Benjamin Franklin wrote, 'When the well's dry, we know the worth of water.' All of us have a mandate to remember that there is no price tag that can be applied to an adequate supply of water and water that is clean and healthy."

Tom Leith,
Licking River Valley RC&D

"We read in the Biblical creation story that God said, 'Let the waters abound with an abundance of living creatures, and let birds fly above the earth across the face of the firmament of the heavens.' Few places on earth have retained the rich diversity from those days when the earth was young. We who live in the Licking River region are fortunate to have such a place that has retained much of this diversity.

We must endeavor to make wise decisions with what we have been provided."

Mike Rice
Ky. Division of Water

What can I do to help?

A variety of actions are needed to improve water quality in the Licking River basin, and nearly everyone who lives in the watershed can help. Support, encouragement and financial assistance will be required to motivate farmers, loggers and developers to adopt erosion and sediment controls. Farmers, homeowners and golf course managers need to reduce the amount of fertilizers and chemicals they apply to their lands. People who own property along the creeks and rivers must recognize the importance of trees, shrubs and tall grasses along the banks and in the floodplains. Educational materials and technical information are needed on the importance of leaving streams alone – avoiding the temptation to channelize them, clear their vegetation, straighten them out, dig up their gravel bars, and control their flows. People who dump trash along creeks or toss litter from their vehicles have to be educated on how they are hurting the environment. Everyone can help.

Several new initiatives are underway to address water pollution caused by activities on the land. The 1998 *Forest Conservation Act* requires trained Master Loggers to be present where timber is being cut, skidded and loaded to ensure that proper measures are taken to preserve streamside trees, minimize road-building impacts and reduce erosion. The *Kentucky Agricultural Water Quality Ac*t provides that farmers must develop soil and water conservation plans to address impacts from plowing, fertilizing, chemical applications, livestock production, and other activities.

But progress cannot be realized just by passing laws – people have to get involved if improvements are to be made. Some people may want to help collect water quality information by becoming a monitoring volunteer, while others might spread the word that trees and native vegetation should be preserved, especially in new development tracts and along streams in our towns and cities. Those who care about the impacts of trash and other debris may wish to participate in cleanup projects to remove these eyesores from the river and its tributaries. We are beginning to have a pretty good understanding of how we should treat the land and its waters in order to maintain a high level of water quality in our Commonwealth.

If you would like more information, please contact the Kentucky Division of Water or other members of the Licking River Region Team listed on the back page of this booklet - or check out the Internet. Thank you for your interest, and your support of healthy watersheds in Kentucky!

Kentucky Watershed Management Framework

This report has been produced as part of Kentucky's Watershed Management Framework, which is a new approach to improving the health of the state's water bodies. 1998 is the first year of a five-year planning and management cycle for the Licking River region. During the second year, several agencies and organizations will conduct extensive monitoring in the region. During the third year, people throughout the region will confer to decide which small watersheds should receive intensified resources during years four and five of the cycle. In year four, improvement plans will be made for the small watersheds selected, and in year five, many agencies and organizations will implement those plans. The cycle then begins again in 2003, with a new evaluation and a new Status Report.

Get connected!

There is a lot of information on the Internet about the Licking River region, watershed health, and related matters. Check out these sites to learn more about the science and practice of watershed management in Kentucky and the nation.

http://www.lickingriver.org Licking River information
http://water.nr.state.ky.us/dow/watrshd.htm statewide context for Kentucky's watershed initiative
http://water.nr.state.ky.us/watch/licking.htm Licking River Watershed Watch volunteer monitoring project
http://state.ky.us/nrepc/water/wwhomepg.htm Ky Division of Water, Water Watch volunteer monitoring
http://water.nr.state.ky.us/dow/ Kentucky Division of Water
http://www.state.ky.us/agencies/nrepc/dnr/forestry/dnrdof.html Kentucky Division of Forestry
http://www.state.ky.us/agencies/nrepc/drn/FAC_flyer.html Ky. Div. of Conservation (agric. and water)
http://water.nr.state.ky.us/303d/ Kentucky list of priority impaired ("TMDL") streams
http://130.11.24.1 Kentucky district of the US Geological Survey
http://www.pipeline.com/~mrrunoff/ Center for Watershed Protection
http://ctic.purdue.edu/ Conservation Technology – good source for agricultural practice recommendations
http://www.usda/gov/stream_restoration/newtofc.html stream corridor restoration guide
http://www.bae.ncsu.edu/bae/programs/extension/wqg/ N. Carolina water quality research center – especially for agric.
http://earthl.epa.gov/owow/nps/ex-bmps.html photos of recommended resource management practices
http://www.epa.gov/owow/monitoring/vol.html volunteer monitoring information
http://www.lib.uconn.edu/canr/ces/nemo/nsmodule/nsdetail.html nonpoint source info for local officials
http://www.epa.gov/owow/nps/ US EPA nonpoint source pollution
http://www.epa.gov/owow/wetlands/ US EPA wetlands information
http://aquatl.ifas.ufl.edu/photocom.html aquatic plant photos, listed by common name
http://www.estd.wvu.edu/nsfc/ information about small-quantity wastewater treatment options
http://www.people.virginia.edu/~sos-iwla/Stream-Study/Key/Key1.html macro invertebrate key
http://www.epa.gov/owowwtr1/monitoring/AWPD/RBP/chlmain.html
US EPA rapid bioassessment protocols for characterizing habitat and other conditions
http://www.amrivers.org/ American Rivers, a river protection organization
http://www.rivernetwork.org/ River Network, a river protection organization

Telephone Contacts

Licking River Basin Watershed project (Pamla Wood):	(502) 564 – 3410
Licking River Watershed Watch (volunteer monitoring):	(606) 873 – 1340
Ohio River Valley Sanitation Commission: (volunteer monitoring)	(800) 359 - 3977
Water Watch (Ken Cooke): (water body adoption and river cleanups)	(502) 564 – 3410
Ohio River Sweep (Ohio R. Valley Sanitation Commission: (cleanups)	(800) 359 - 3977
Illegal dumping (Kentucky Division of Waste Management):	(502) 564 – 6716
Dead animal removal reports (Ky Dept. of Agriculture):	(502) 564 - 3956
Kentucky Waterways Alliance (river protection groups):	(502) 524 – 1774
Forest Conservation Act (Kentucky Division of Forestry):	(502) 564 - 4496
Kentucky Agricultural Water Quality Act:	(502) 564 – 3080
Kentucky Department of Fish and Wildlife Resources:	(502) 564 – 5448

Also try your local District Health Department (cleanup days, septic problems, and illegal dumping), Conservation District office (agricultural practices), RC & D office (agricultural practices), or county Solid Waste Coordinator (illegal dumping).

Licking River Region Team Members

Steve Alexander	U.S. Department of Fish and Wildlife
Dave Daniels	Gateway District Health Department
Kevin Flowers	Ky. Division of Water, Northern Ky. Regional Office
Jason Heath	Ohio River Valley Water Sanitation Commission
Rodney Hitch	Rowan County Government
Marc Hult	Daniel Carter Beard Environmental Education Center
Lew Kornman	Ky. Department of Fish and Wildlife Resources
Tom Leith	Licking River Valley Resource Conservation & Dev. Dist.
Mike Mattox	Slate Creek Nonpoint Source Pollution Project
Marty McCleese	USDA Natural Resources Conservation Service
Susan Patton	Licking River Watershed Watch
Brian Reeder	Morehead State University
Michael Rice	Ky. Division of Water, Morehead Regional Office
Barry Tonning	Kentucky Waterways Alliance
Nathan Sturm	Northern Kentucky Area Development District
Heidi Van Keuren	Northern Kentucky Area Development District
Jon Walker	USDA Forest Service, Daniel Boone National Forest
Pamla Wood	Team Coordinator, Ky. Division of Water

Environmental Protection Cabinet

Kentucky Waterways Alliance

USDA NRCS Natural Resources Conservation Service

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