Kentucky Division of Water
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Website: http://water.ky.gov/waterquality/Pages/TMDLHealthReports.aspx

Strodes Creek Health Report

This watershed health report is an educational tool to relay scientific information to a general audience; it does not represent, and should not replace, assessments for the Integrated Report (IR). For assessment specific information, please refer to the IR at http://water.ky.gov/waterquality/Pages/IntegratedReport.aspx

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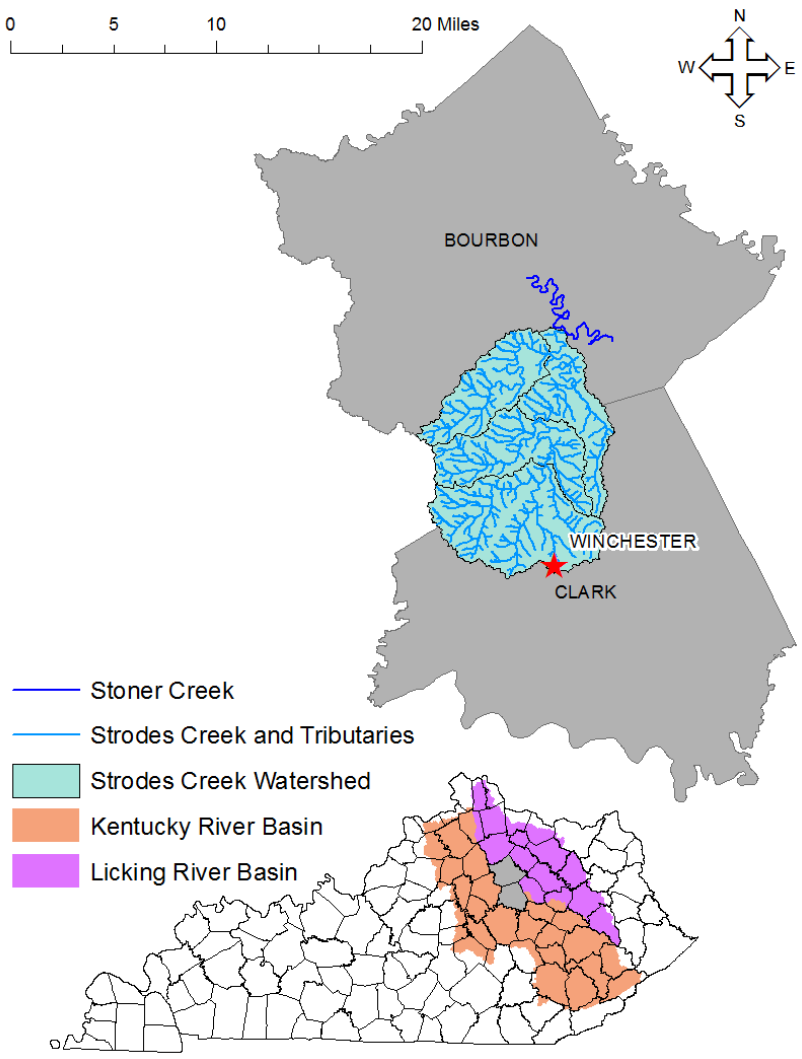
If you live in the Strodes Creek watershed and care about the health of your local waterway, now is the time to get involved! The Kentucky Division of Water (DOW) has been studying Strodes Creek for the past several years, and most of the watershed is sick—too many nutrients, too much bacteria, and algal blooms. The DOW will be providing a health plan, but water quality improvement can only be achieved with YOUR involvement. If you are interested in working with the Kentucky DOW in efforts to improve water quality in Strodes Creek, please contact the Licking River Basin Coordinator, Chad Von Gruenigen, at chad.vongruenigen@ky.gov or at 502-564-3410.

In the 1960s government officials started to realize how polluted streams, rivers, and lakes of the U.S. had become. In 1972, Congress passed laws, known as **The Clean Water Act** (CWA), to protect surface water. The goal of the CWA is for all waters in the U.S. to be safe for swimming, fishing, and drinking (called **designated uses**). The Kentucky DOW is the state agency responsible for carrying out the requirements of the Clean Water Act to reach this goal.

Kentucky DOW has developed this health report to inform the residents of Bourbon and Clark counties of efforts to examine the health of the Strodes Creek watershed. We all affect the cleanliness of water, known as **water quality**, because we all live in a watershed. A **watershed** is an area of land where runoff flows to a common stream. When streams come together, the two streams' watersheds combine to make a larger watershed. Many small creeks, such as Pretty Run and Green Creek, flow into Strodes Creek. Eventually, Strodes Creek flows into Stoner Creek, which flows into the South Fork Licking River and is therefore part of the Licking River Watershed (see map on the right).



Many stream segments within the Strodes Creek watershed do not support the **designated uses** required by the CWA. The U.S. Environmental Protection Agency (EPA) requires that states conduct watershed studies on all such waters to calculate the maximum amount of a pollutant a creek can receive and still support a healthy watershed. This amount is known as a **Total Maximum Daily Load**, or **TMDL**. These TMDL reports provide the information needed to make a water quality improvement plan.

Strodes Creek Watershed
Overall Grade: C-

O_2	Dissolved Oxygen	B+	
NE	Nutrient Enrichment	C	
	Specific Conductivity	B-	
	Sediment	C+	
	E. coli	F+	
	Total Habitat		D+
	Aquatic Bugs		D+
	Available Cover		C
	Riparian Zone		D-

From 2014—2015, DOW biologists conducted a watershed study in Strodes Creek to gather scientific information. Based on this information, DOW has given a "report card grade" of **C-** to the **Strodes Creek watershed**. This health report 1) describes the indicators of water quality and biological health that went into assigning the grades, 2) demonstrates what the strengths and weaknesses are at each site and on a watershed scale, and 3) provides information on how water quality and biological health can be improved.

Impaired Waters

Designated Uses assessed for the Strodes Creek watershed are **Aquatic Life** (map on the left) and **Primary Contact Recreation (PCR)** (map on the right). In 2005, Strodes Creek and some of its tributaries were listed as impaired due to a variety of pollutants, including *E. coli*, which impairs PCR, and specific conductivity, nutrients, and sedimentation/ siltation, which impairs Aquatic Life. Segments that have been assessed are highlighted in **1) green** if the water quality is good and the use is supported, **2) yellow** if the water quality is fair and the use is only partially supported and **3) red** if the water quality is poor and the use is not supported. If a segment is **blue**, its uses have not yet been assessed.

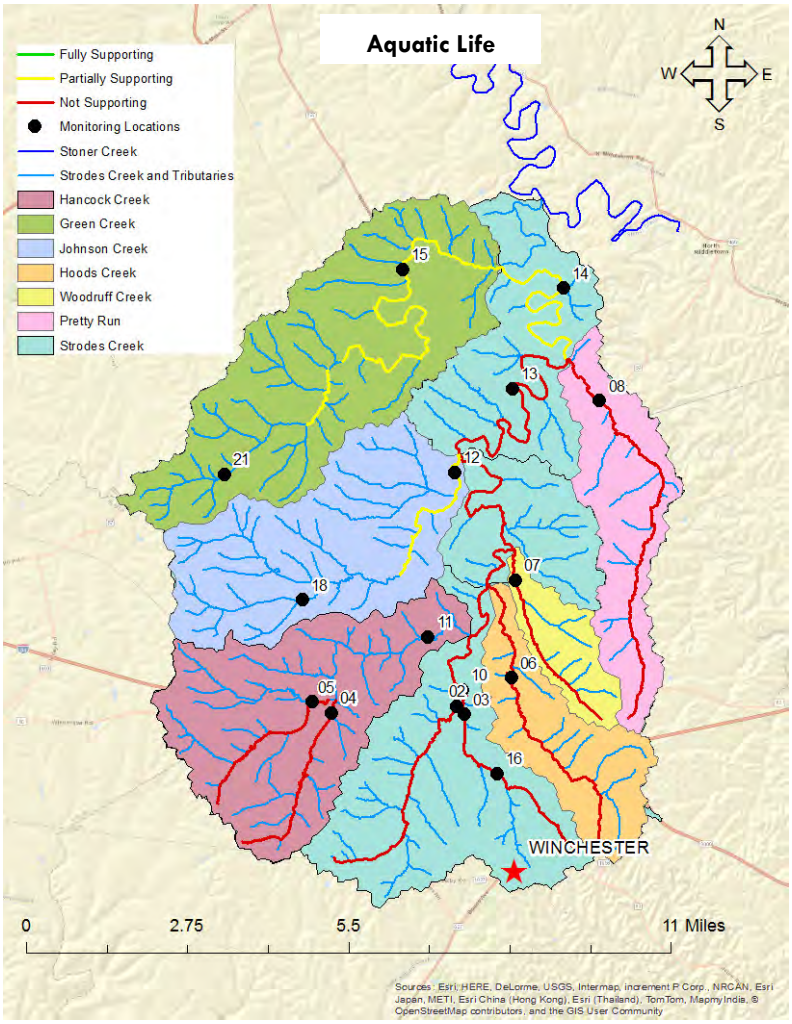
To be impaired for Aquatic Life, the fish and/ or aquatic bug communities have reduced numbers or types. To be impaired for PCR, *E. coli* concentrations exceeded the level considered safe for swimming at least 20 percent of the time from May through October.

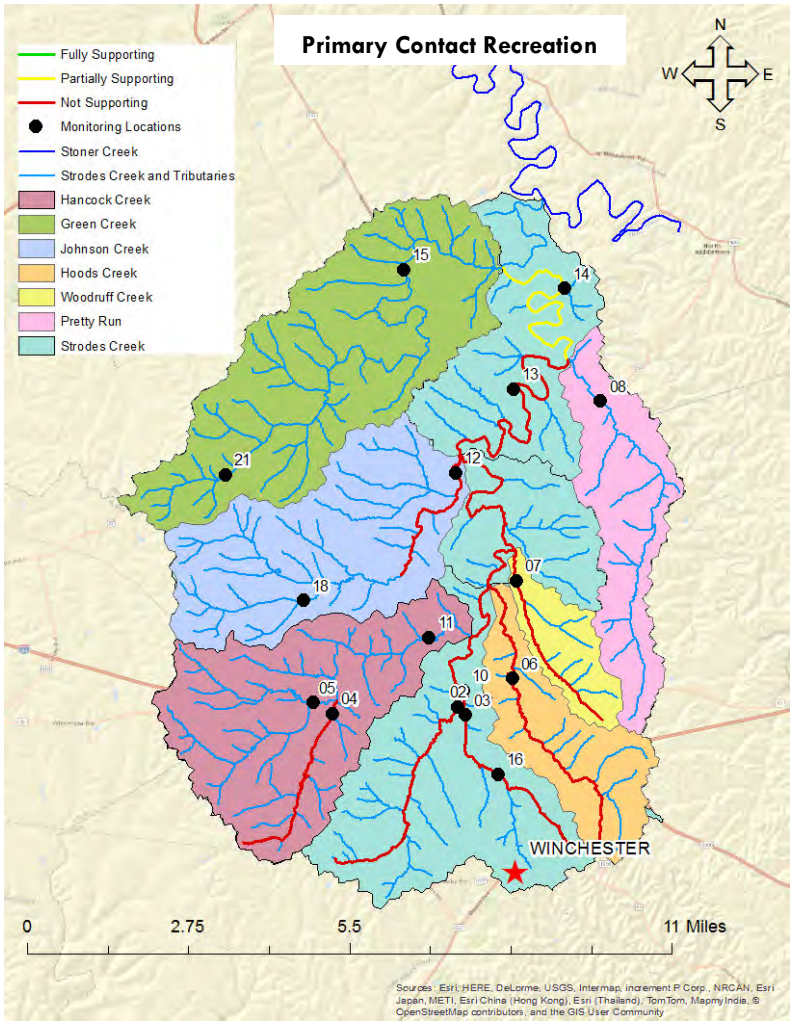
These impairments caused Strodes Creek and most of its tributaries to be studied in 2014 and 2015 to determine the extent of these impairments throughout the watershed at large. Streams that had not been assessed were studied to determine if impairments were present, and streams that had been previously assessed were reassessed for confirmation.

Since the original listings in 2005, efforts have been made in the Strodes Creek watershed to improve water quality, focusing on Best Management Practices (BMPs) in the headwaters that would reduce bacteria loads. The Strodes Creek Conservancy (SCC) has participated in conservation easements, onsite wastewater projects such as septic pump outs and septic rehabilitation, tree plantings, and agricultural BMPs such as limiting cattle access to waterways.

The most recent study has been finalized and the results indicate that much of the watershed is impaired due to nutrients, sediment, and *E. coli*, while a few areas of the watershed are impaired due to specific conductivity. In fact, every stream studied will be assessed as impaired and included in the 2018 Integrated Report to Congress. The Clean Water Act requires TMDLs to be written for all pollutant impaired streams. The DOW is currently developing a nutrient TMDL for the Strodes Creek watershed, and has prioritized TMDL development for streams in the state with bacteria impairments. The goal of these reports is to improve water quality with help from the community.

This watershed health report, which has a report card style, explains the results of our study, and informs the public about the water quality in the Strodes Creek watershed.





How did Strodes Creek get these grades?

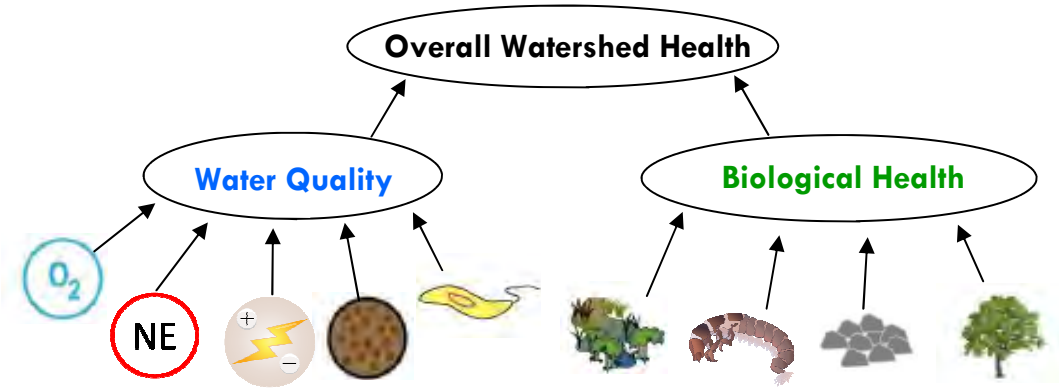
1. Much like a school report card, information was collected during our study about different "subjects" related to the health of Strodes Creek. These subjects were separated into two groups that are used as indicators of water health (**Water Quality**) and stream life (**Biological Health**). Each indicator subject and its icon are explained below.

2. The information collected for each indicator was compared to health and science requirements or Division of Water scientific information. Each indicator received a grade, A through F, based on how well it met the requirements.

3. The grades for each water health indicator were combined to get a **Water Quality** grade.

4. The grades for each stream life indicator were combined to get a **Biological Health** grade.

5. The Water Quality grade and the Biological Health grade were then combined to get the **Overall Watershed Health** grade for Strodes Creek.



For more specific information about the grading process, please visit http://water.ky.gov/waterquality/TMDL%20Health%20Reports/Health_Report_Grade_Explanation.pdf

Water Quality

Dissolved Oxygen (DO): Concentration of oxygen dissolved in water and readily available to fish and other aquatic organisms.

Nutrient Enrichment: Although natural sources of nutrients exist, human activity is a major source of nutrient pollution, including municipal sewage treatment plants, industrial outflows, failing septic systems, commercial fertilizers, and animal waste.

Specific Conductivity: A measure of the ability of water to conduct an electrical current, which is used for approximating the amount of dissolved substances in water. When specific conductivity is elevated above natural levels, it has been shown to negatively impact fish and aquatic bugs.

***E. coli*:** A type of bacteria that lives in the intestinal tract of humans and other warm-blooded animals. The higher the amount of bacteria in the water, the higher the chance of getting sick when recreating in that water. To receive an A or a B, the water quality standard, which seeks to protect human health, must be achieved.

Sediment: Soil, sand, and minerals washed from land or stream banks into water, usually after rain. Sediment can be suspended in the water column, making the water turbid, or it can deposit on the stream bottom when water flow slows and loses energy. Unstable banks that are eroding disconnect edge habitat from the water, and the sediment that deposits can smother in stream habitat.

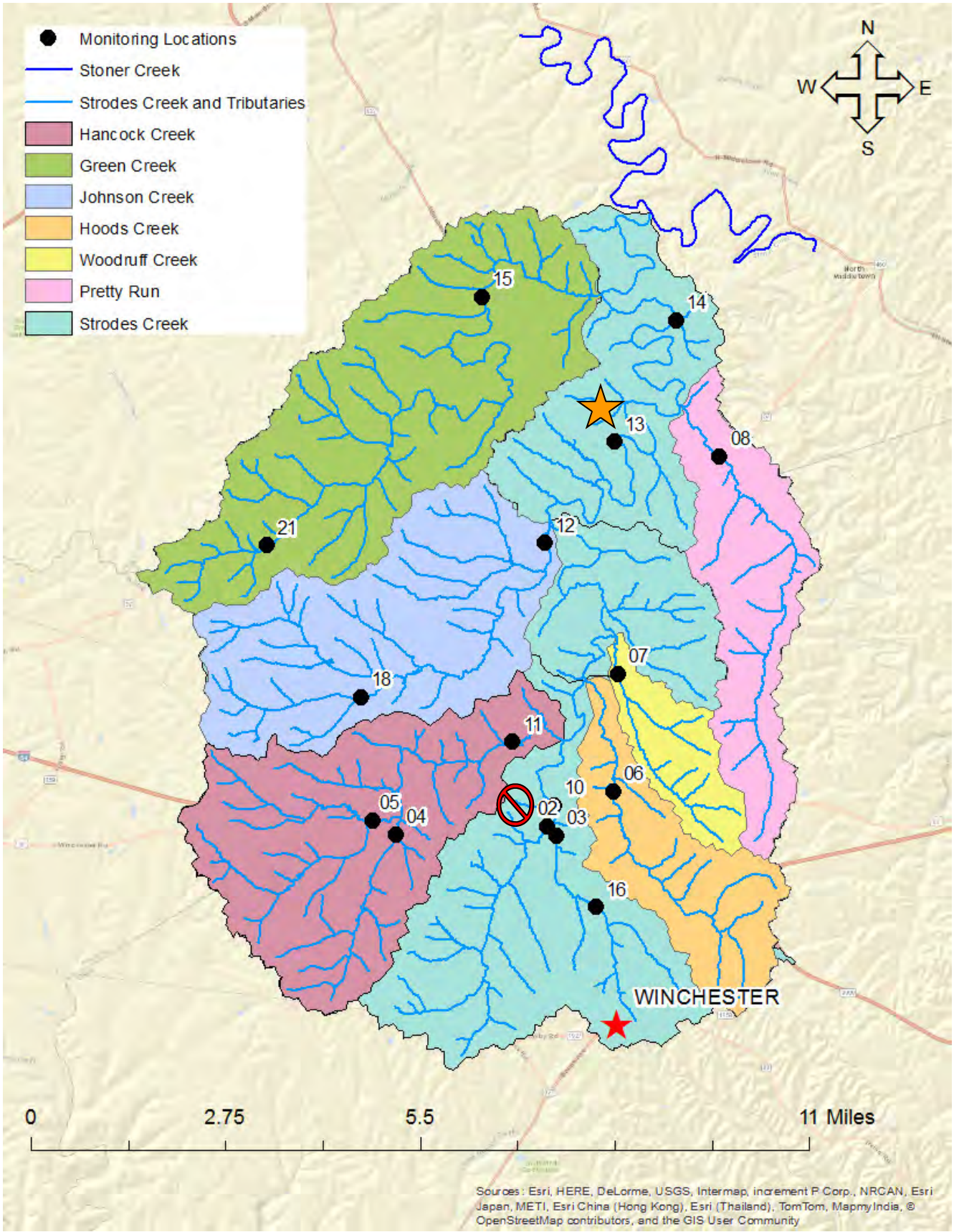
Biological Health

Aquatic Macroinvertebrates (bugs): An animal without a backbone, large enough to be seen with the naked eye. They are often the immature forms of insects that live on land as adults and are an important food source for fish. Different species prefer different habitats, and some are more tolerant of pollution than others.

Total Habitat: Stream habitat is assessed by scoring 10 habitat indicators, which are both living and nonliving parts of the surroundings that support an organism, population, or community.

Riparian Zone: A component of total habitat that is defined by the land adjacent to a stream that has distinct soil types and plant communities, which aid in absorbing water and shading the stream. To receive an A, the riparian zone must be at least 18 yards wide on both sides of the stream.

Available Cover: A component of total habitat, which looks at the quantity and variety of structures in the creek that provide fish and aquatic bugs a place to hide, feed, reproduce, and raise young. Examples include cobble and boulders, fallen trees, logs, branches, root mats, undercut banks, and aquatic vegetation.



Best Site: Strodes Creek (13) located off KY-*57* scored the most A's and B's of any site, even though its overall grade was still a C. At this site, the best habitat was present, which received an A, and, not surprisingly, one of the best bug communities was found at this site. However, water quality issues were still present, as can be seen by the C grades for nutrient enrichment and specific conductivity, and the D grade for *E. coli*.

Worst Site: Strodes Creek (02), located on a private road off the Winchester Wastewater Treatment Plant, scored the lowest overall grade of a D. This site is located near a sanitary sewer overflow (SSO) that frequently discharges raw sewage into the environment during storm events. Not surprisingly, almost all of the water quality and biological health indicators received a C or lower.

Creek Name (Site #)	O_2	NE								Site Grade
Strodes Creek (02)	B	C	C-	F+	F	D	D	D	F	D
UT Strodes Creek (03)	C	C	D+	B	C	D	D	B	D	C
UT Hancock Creek (04)	B	C-	B-	C	F	D	D	C	C	C-
Hancock Creek (05)	C	C	C	D+	F	D	D	C	D	D+
Hoods Creek (06)	B	C	C	C+	F	D	D	C	F	D+
Woodruff Creek (07)	B	B-	A	B	F	D	D	D	F	C-
Pretty Run (08)	A	C-	A	B	F	C	C	D	F	C
Strodes Creek (10)	A	C-	D	No Data	D	No Data	No Data	No Data	No Data	C
Hancock Creek (11)	C	C	B	C	D	D	C	C	F	C-
Johnson Creek (12)	A	C-	A	C	F	C	C	B	F	C
Strodes Creek (13)	A	C-	C	B	D	A	B	B	D	C+
Strodes Creek (14)	C	C-	C	C+	D	B	B	B	D	C
Green Creek (15)	A	C	A	B+	F	D	C	D	F	C
UT Strodes Creek (16)	A	D	D	C	F	D	D	C	C	C-
Johnson Creek (18)	A	C-	A	C+	D	D	D	D	F	C-
Green Creek (21)	A	B	A	C	F	D	D	D	F	C-
Subject Grade	B+	C	B-	C+	F+	D+	D+	C	D-	

Let's break it down: Indicator by Indicator

Top of the Class

Dissolved oxygen (DO) was the highest scoring indicator with a B+ overall. Most sites had adequate oxygen in the water year round, which is important for any animal that lives in the water and depends on this oxygen to breath. However, at sites where the score was a B or C, oxygen levels would drop below what is considered adequate for aquatic animals during the summer months when low flow and high temperatures tend to reduce DO, which can stress the aquatic community.

Specific conductivity scored a B– overall. At a majority of the sites, specific conductivity levels were within normal range. However, the sites that were located near or below industrial areas (site 16) or wastewater treatments plants (site 10) tended to have elevated specific conductivity, as the chemicals that get used in those activities can contribute to increased specific conductivity.

The Average

Nutrient Enrichment received a C overall. Evidence of nutrient enrichment on a watershed scale is present. Considering the land use of the Strodes Creek watershed, which is dominated by pasture but is urban in the headwaters, the enrichment is likely related to both point and non-point sources and linked to bacterial inputs. Improving this indicator of water quality would help improve the overall health of the Strodes Creek watershed.

Sediment ranged greatly throughout the Strodes Creek watershed. Some sites were in the B range, while others were in the F range. Sedimentation tends to be a more localized problem within a watershed. Some areas may be a source of sediment, meaning the sediment is getting washed away, while other areas may be a sink of sediment, meaning the sediment settles and can bury available habitat. Controlling storm water runoff and maintaining riparian buffers along a stream bank can help minimize the erosion potential of a streambank.

Available Cover ranged between a B and a D, with a C being the most common grade. Available cover is reduced or removed from most sites throughout the watershed. Available cover comes in many varieties, including rocks, undercut banks, roots, wood, leaf packs, and vegetation. The more types of cover present in a stream, the more types of organisms that can occupy those spaces, which they need to hide, feed, reproduce, and raise young.

Needs Improvement

Aquatic macroinvertebrates (bugs) scored a D+ on average, and the most common grade was a D. Aquatic bugs can be thought of as the canary in the coal mine; when their populations decrease, it's a warning sign of water quality and habitat problems. They are sensitive to many factors, so when multiple factors are causing them stress, such as elevated nutrients, specific conductivity, and sedimentation, their numbers and types tend to decrease substantially. However, it is no coincidence that the two sites that scored a B (13 and 14) were also the two sites with the highest habitat scores, demonstrating intact habitat goes a long way in protecting our aquatic communities.

Habitat received a D+ on average, and the most common grade was a D, meaning habitat is severely degraded throughout the Strodes Creek watershed. The two sites that received an A or B (13 and 14) are located in the lower part of the watershed, which is larger and therefore less altered than the headwater areas of Strodes Creek and its tributaries. This area is very important to the overall health of the watershed and should be protected and maintained.

Riparian Zone scored a D– on average, and was almost entirely absent throughout the watershed. Most trees within the riparian zone and along the stream bank have been removed. Any remaining riparian zone should be protected and new riparian zones should be established. A shaded stream has cooler water temperatures and less sunlight to enhance algal growth, while trees and their roots help stabilize banks and provide important habitat for fish and bugs.

E. coli was the lowest scoring indicator with an F+ on average. *E. coli* levels were above the standard considered safe for swimming 67 to 100% of the time if the grade was an F, 34 to 68% of the time if the grade was a D, and 21 to 34% of the time if the grade was a C. When *E. coli* levels are elevated there is an increased risk of gastrointestinal illness if the water is swallowed, or an infection if contact is made with an open sore or wound. Use caution when swimming or wading in Strodes Creek and its tributaries, especially after rain events when the water is brown.

Conclusions and Resources

To keep water safe for swimming

- Maintain functional septic systems and replace failing septic systems.
- Properly dispose of pet waste.
- Reduce animal access to streamside grazing.
- Refer to the Division of Water's Swimming Advisory page: http://water.ky.gov/waterquality/Pages/SwimmingAdvisories.aspx

To reduce sediment and/ or nutrient inputs

- Maintain streamside vegetation and give the stream a "buffer" from human activities.
- Plant cover crops.
- Install settling ponds.
- Reduce animal access to streamside grazing.
- Guard waterways during construction activities.
- Check the weather before applying fertilizers and pesticides to be sure they will be absorbed before it rains.

Available Resources

- KY's Department of Agriculture **free** farm chemical collections: http://www.kyagr.com/consumer/envsvs/technical/FarmChemicals.html
- KY's 319 Grant program: water.ky.gov/Funding/Pages/NonpointSource.aspx or contact James Roe at james.roe@ky.gov.
- Kentucky's Total Maximum Daily Load (TMDL) program: http://water.ky.gov/waterquality/Pages/TMDLProgram.aspx
- To stay informed, **LIKE** 'Kentucky Watershed Health Reports' on Facebook.
- Curious about the health of you local waterway? Check out Division of Water's ***new*** Water Health Portal at http://watermaps.ky.gov/

How can I help?

- Water quality can only improve if you help! Want to help? Contact the Licking River Basin Coordinator, Chad Von Gruenigen, at chad.vongruenigen@ky.gov or at 502-564-3410.