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Hinkston Creek Watershed Health Report

Department for Environmental Protection - Division of Water

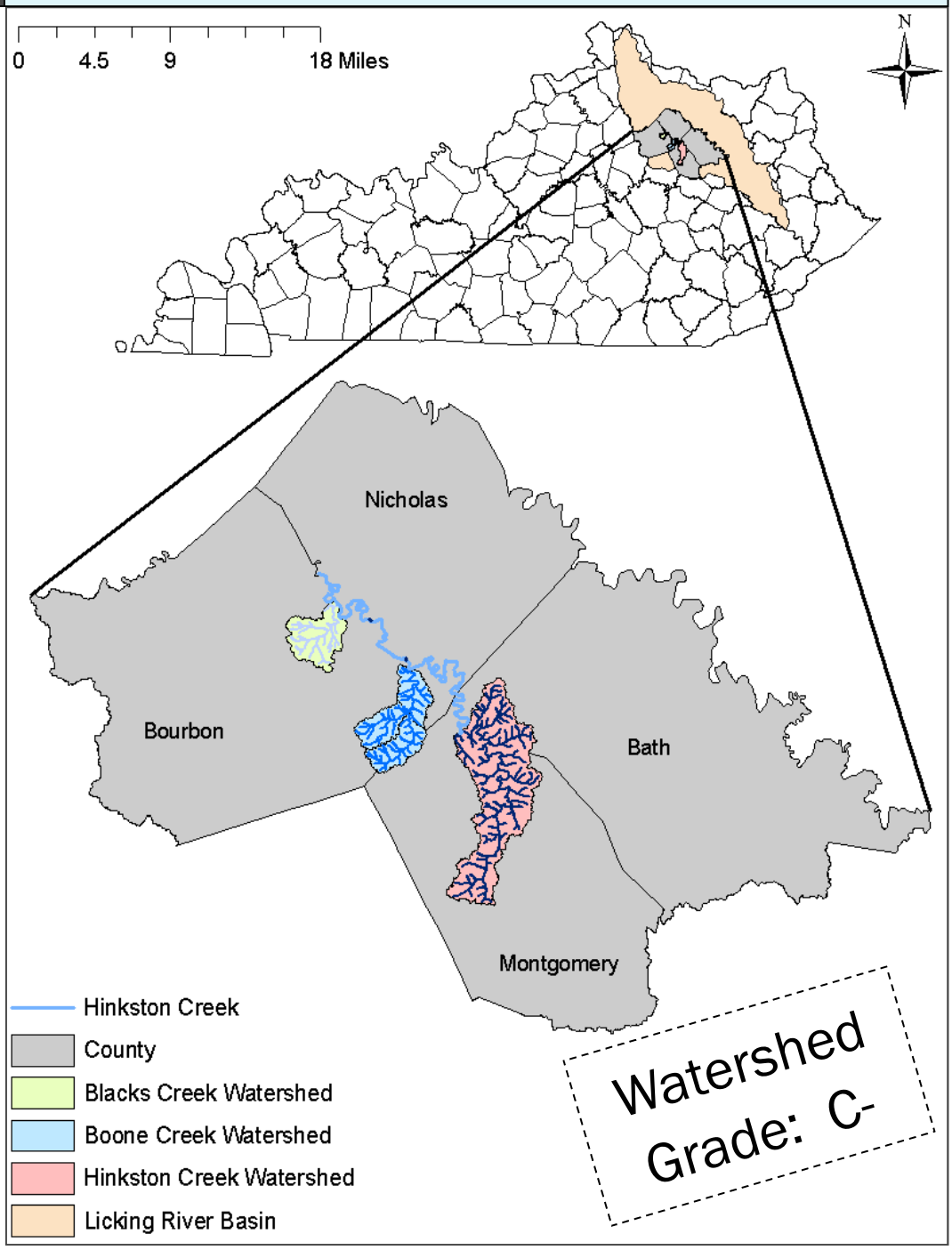
The Kentucky Division of Water (DOW) is the state agency responsible for carrying out the requirements of the Clean Water Act to reach the goal of making all waters in Kentucky safe for swimming and fishing (called **designated uses**).

DOW has developed this health report to inform the residents of Bourbon, Bath and Montgomery counties of efforts to examine the health of the Hinkston Creek 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.

In this report Blacks and Boone Creek, which flow into Hinkston Creek to form the Hinkston Creek Watershed, will be discussed.

Upon initial evaluation, it was determined that many stream segments within the Hinkston Creek Watershed do not support the **uses** required by the Clean Water Act.

The U.S. Environmental Protection Agency (EPA) requires that states conduct watershed studies on all such waters to calculate the maximum amount of pollution a creek can receive and still be healthy. This amount is known as a **Total Maximum Daily Load**, or TMDL.



From 2004 through 2010, DOW biologists conducted year-long studies in each of the watersheds shown in the map above to gather scientific information. Based on this information, the division has given a "report card grade" of a **C** to **Hinkston Creek**, a **C** to **Boone Creek**, a **D** to **Blacks Creek** and a **C-** to the entire **Hinkston Creek Watershed**. This health report explains where the impaired segments are located, describes the signs of health that went into assigning the grades for each watershed and provides information on how the grades can be improved.

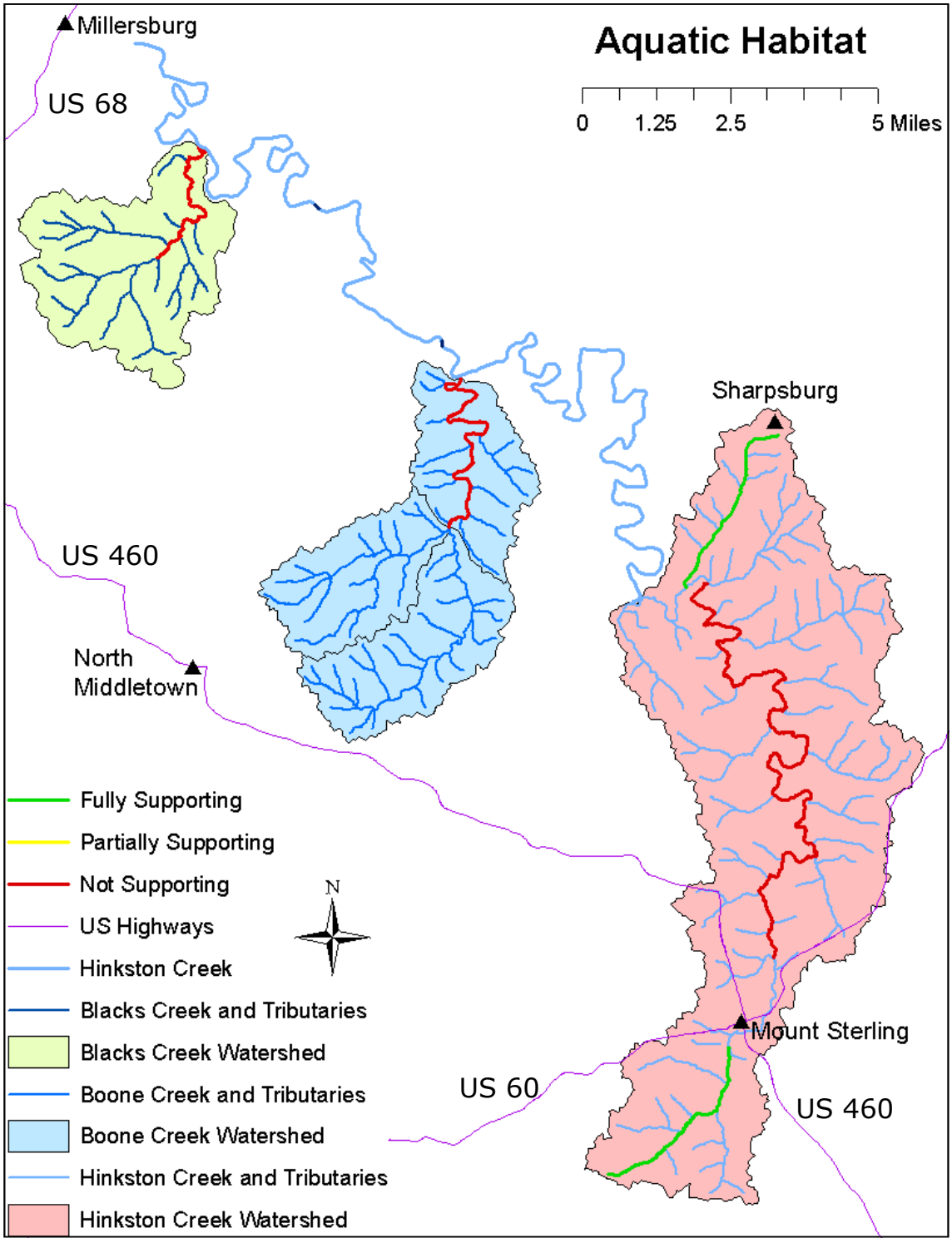
Designated Uses, Impaired Waters and TMDLs

One **Designated Use** for Hinkston Creek Watershed is **Aquatic Habitat:** water quality promotes a healthy population of plants and animals that live in the water. In the map on this page, segments that have been assessed are highlighted in **(1) green** if the water quality is good and the use is supported or **(2) 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. If a **designated use** is not supported, the water is said to be impaired. To be **impaired** for **Aquatic Habitat**, the fish and aquatic bug population have reduced numbers or types.

Another **designated use** for the Hinkston Creek Watershed is **Primary Contact Recreation:** water is safe for human swimming. This use has not yet been assessed and therefore it has not been determined if the Hinkston Creek Watershed supports, or is impaired for, **Primary Contact Recreation.** To be **impaired** for **Primary Contact Recreation**, bacteria concentrations exceed the level considered safe for swimming at least 20 percent of the time from May through October.

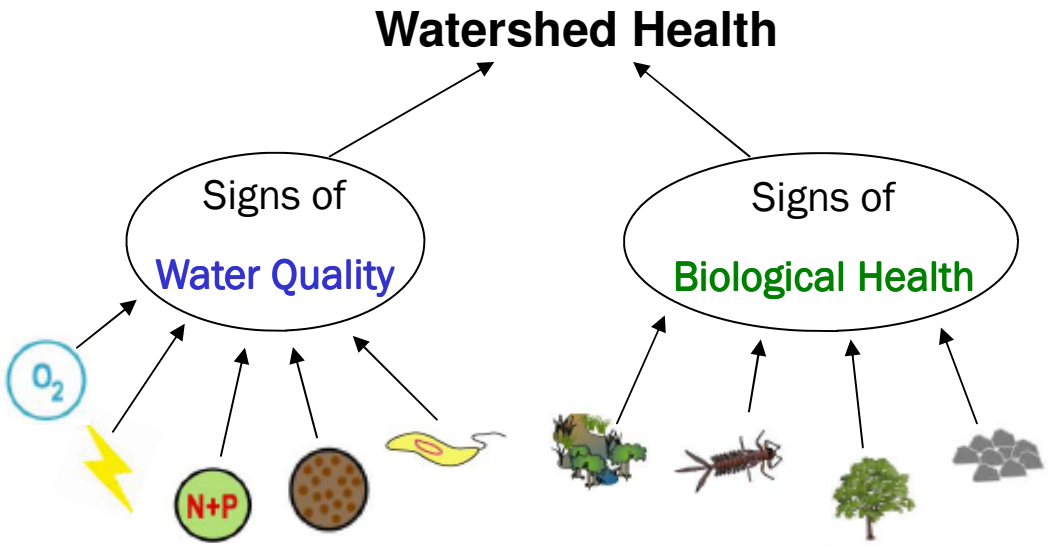
As the map demonstrates, segments of Blacks Creek, Boone Creek and Hinkston Creek are listed as impaired. Therefore, year-long water quality studies were conducted between 2004 and 2010 to collect the data required to calculate a TMDL. The water quality studies focused on collecting information that relates to signs of water quality and signs of biological health, which are described on the next page.

A TMDL report for each watershed will be written as a result of these studies, which will be made available to the public with the goal of improving water quality.



Grading System

1. Information collected was divided into signs of **water quality** or signs of **biological health**.
2. Each sign received a grade, A through F, according to the results of our study, which were compared to health and science requirements and DOW scientific information.
3. The grades from each biological health sign were averaged to achieve a biological health score.
4. Similarly, each sign of water quality was averaged to achieve a water quality score.
5. These two scores were averaged to achieve a **watershed health grade.**



The grades can also be used to compare **sites** or **signs**. For example, one site within a watershed may receive a higher grade than the other sites in that watershed, demonstrating its quality. Or, one sign may receive a higher grade than the other signs, demonstrating that aspect of watershed health is doing better than others.

Signs of Water Quality

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

Specific Conductivity: A measure of the ability of water to conduct an electrical current, which is used for approximating the total dissolved solids content of water. Low specific conductivity is desired, and increasing specific conductivity negatively impacts fish and aquatic bugs.

Nitrogen and Phosphorus (Nutrients): Although natural sources of nutrients exist, major sources of nutrient pollution are typically caused by man's activities and include municipal sewage-treatment plants, industrial outflows, commercial fertilizers and animal waste.

E. Coli: A type of bacteria that lives in the intestinal tract of man and other warm-blooded animals. For a site to receive an F, the *E. coli* concentration was above the level considered safe for swimming 80 to 100 percent of the time. Elevated concentrations of *E. coli* increase the risk of gastrointestinal illness if the water is swallowed or infection if contact is made with an open sore or wound.

Total Suspended Solids (TSS): A measure of the suspended solids in waterbodies. Suspended solids are small particles of solid pollutants that float on the surface of, or are suspended in, water. As TSS increase, fish and aquatic bugs experience stress and alter behavior.

Signs of Biological Health

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

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.

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 each side 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 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.

Blacks Creek

Site #	Creek Name	O_2		N+P							Site Grade
1	Blacks Creek	B	B	C+	F	C	F	D	F	F	**D**
2	Tributary to Blacks Creek	C	C+	C+	F	C	F	D	F	D	**D**
3	Tributary to Blacks Creek	B-	C+	C+	F	C-	F	D	F	D	**D**
4	Blacks Creek	F+	B		F						**D**
	Sign Grade	**C**	**B-**	**C+**	**F**	**C**	**F**	**D**	**F**	**D-**	

Positives

Specific conductivity was fairly good, indicating reasonably low dissolved solids throughout Blacks Creek. However, a few sites (2 and 3) had elevated levels of specific conductivity, indicating poor land management.

Gray Area

For the most part, nitrogen and phosphorous levels were reasonable but rose following rain events due to pollution entering the stream with runoff or failing septic systems.

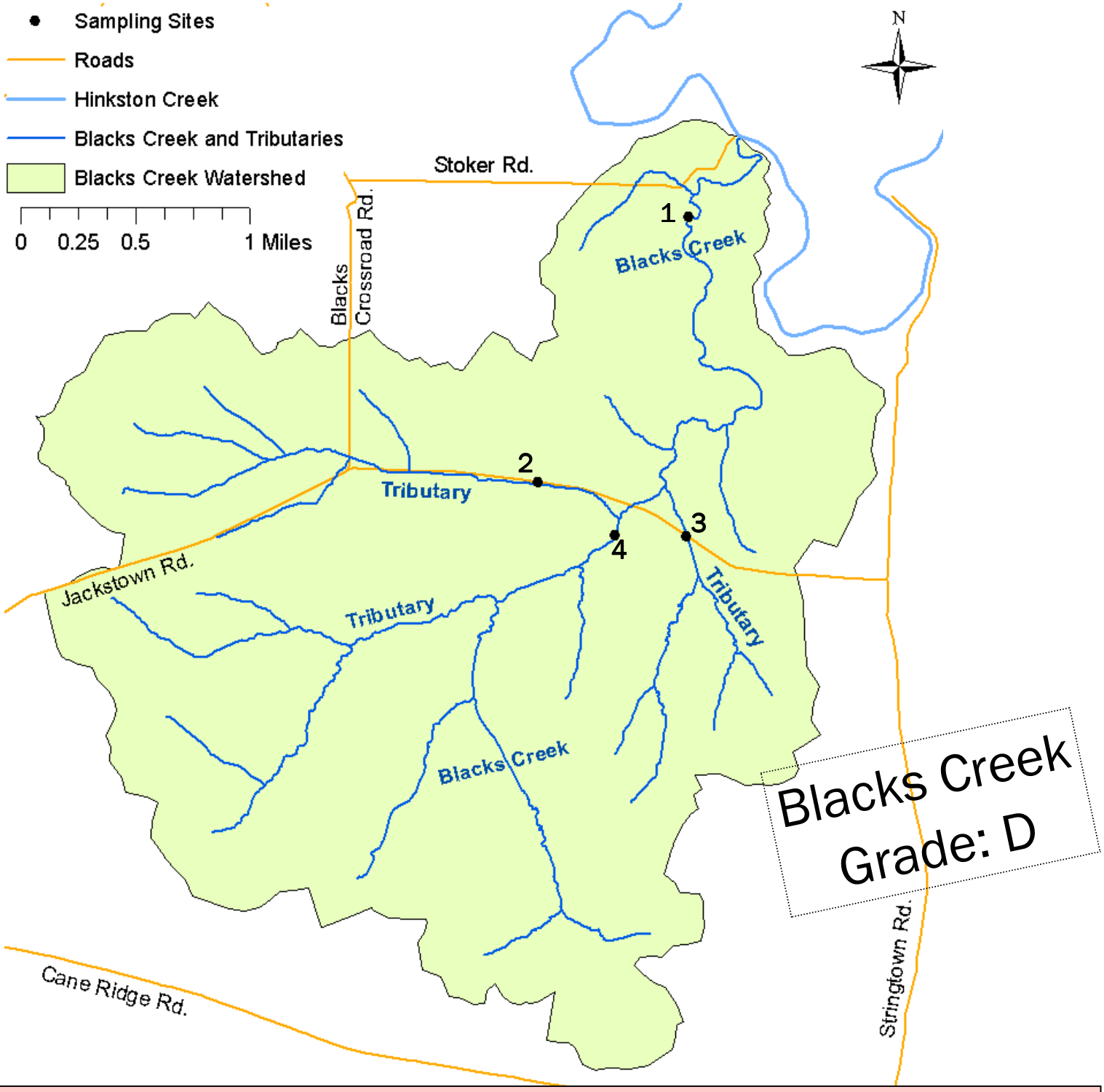
Similarly, TSS levels rose following rain events due to a lack of vegetation and streamside grazing, which destabilizes stream banks, and development, which exposes sediment that can then be washed away.

DO levels at sites 1 and 3 were suitable for fish and aquatic bugs. At site 2, suboptimal oxygen levels have the potential to negatively affect fish and aquatic bugs. At site 4, oxygen levels were very unstable, indicating that an overgrowth of algae is causing extreme highs and lows in DO levels, which stress fish and bug populations and may cause death via asphyxiation.

Negatives

E. coli levels were <u>never</u> below the standard considered safe for swimming during the entire study period. Not only were the *E. coli* levels too high, they were routinely 10 times the level considered safe for swimming and the highest level measured was 59 times the level considered safe for swimming.

Available cover is greatly reduced throughout the watershed. Not only is available cover an important place for fish and bugs to live, feed, hide from predators and mate, it also provides habitat for beneficial bacteria, which are eaten by the bugs that are then eaten by the fish.



Negatives continued

The width of the riparian zone was always less than six yards and was often less than one yard or entirely absent. When trees are cut and banks are cleared, algal communities bloom and water temperatures increase due to a lack of shade, banks become less stable, which increases erosion, and habitat for fish and bugs is reduced.

Habitat, which provides the building blocks for diverse groups of fish and bugs, was almost entirely absent. All sites received Fs in the Blacks Creek Watershed.

Consequently, the bug communities were greatly impacted throughout the watershed, receiving three Ds. Without bugs to eat, many fish will leave the stream in search of food elsewhere.

Boone Creek

Site #	Creek Name	O_2		N+P							Site Grade
1	Boone Creek	B-	B	B-	D	C	F	B	D	C	**C**
2	Boone Creek		A-	B		B	F		F	D	**C-**
3	Boone Creek	B	B	B	F	C+	B	C	B	D	**C**
4	Plum Lick Creek	B-	B	B	F	C	F	B	C	D	**C**
	Sign Grade	**B-**	**B**	**B**	**F+**	**C+**	**D**	**B-**	**C-**	**D**	

Positives

Specific conductivity levels received three B's and one A-, indicating reasonably low dissolved solids throughout Boone Creek.

DO levels were suitable for fish and bugs throughout the Boone Creek Watershed.

Nutrients received three Bs and one B-, indicating that nutrients are near normal levels throughout the Boone Creek Watershed.

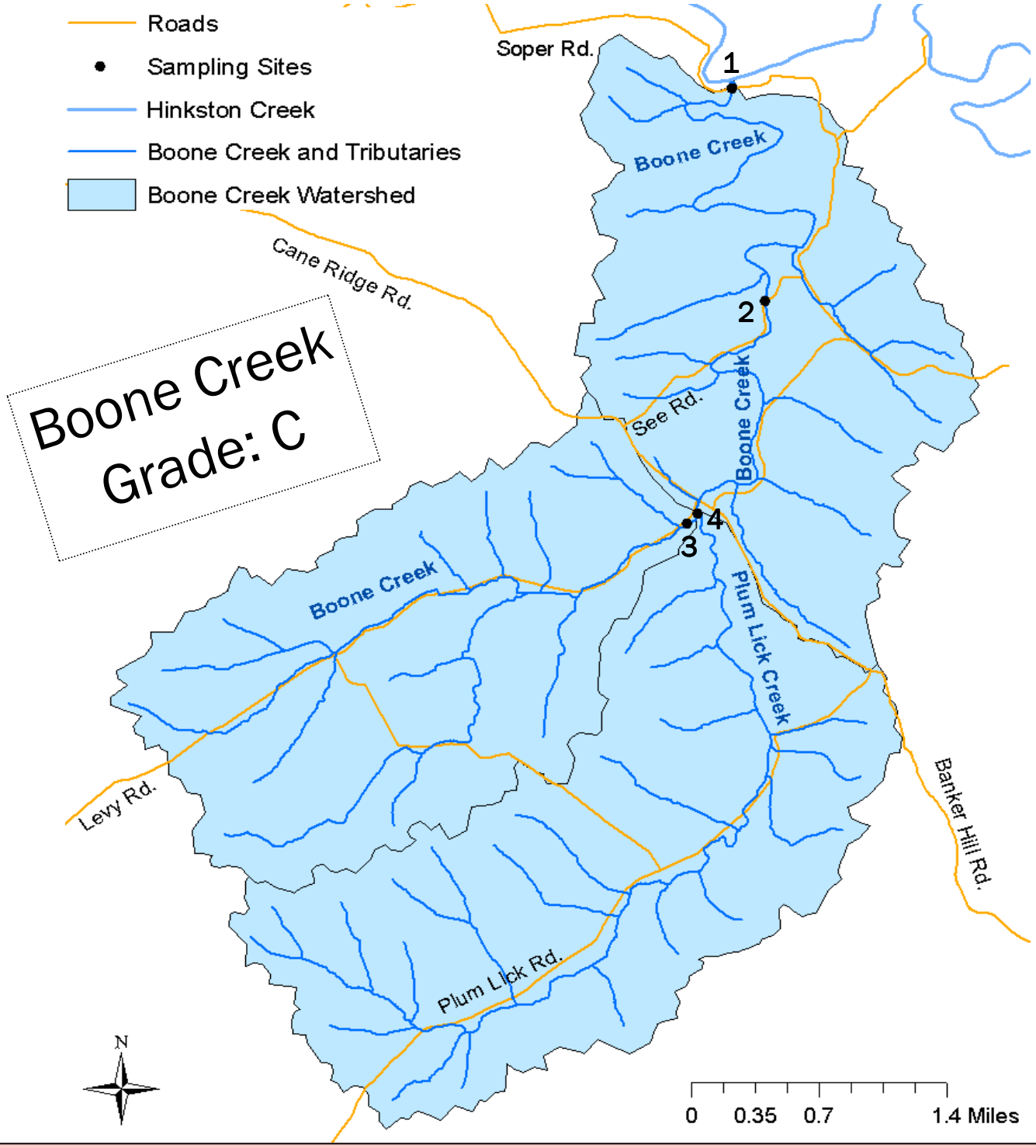
Relatively good bug communities observed in the Boone Creek Watershed is the result of many factors working together:

1. Suitable DO, specific conductivity and nutrient levels ensured the water quality was good enough to support a healthy bug community.
2. An improved riparian zone provided shade, which kept water temperatures low, and prevented overgrowth of algae, which can outcompete bugs for space, since they require sunlight for growth.

Gray Area

TSS levels rose following rain events due to a lack of vegetation and streamside grazing, which destabilizes stream banks, and development, which exposes sediment that can then be washed away.

The width of the riparian zone ranged from good to bad throughout the Boone Creek Watershed. For a riparian zone to receive a B, the width must be greater than then 12 yards on both sides of the stream, while to receive an F, the width must be less than 6 yards on both sides of the stream. When trees are cut and banks are cleared, algal communities bloom and water temperatures increase due to a lack of shade, banks become less stable, which increases erosion, and habitat for fish and bugs is reduced.



Negatives

E. coli levels were above the standard considered safe for swimming 80 to 100% of the time if the grade was an F, or 60 to 80% of the time if the grade was a D. The highest measured *E. coli* value was 82 times greater than the standard considered safe for swimming.

Both Habitat and Available Cover are greatly reduced throughout the Boone Creek Watershed. Habitat provides the building blocks for diverse groups of fish and bugs; available cover is an important place for fish and bugs to live, feed, hide from predators and mate, and it also provides habitat for beneficial bacteria, which are eaten by the bugs that are then eaten by the fish. Although relatively good bug communities were observed within the Boone Creek Watershed due to fairly good water quality, they probably did not receive As due to a lack of habitat and available cover. Additionally, if habitat and available cover continue to degrade, the bug communities will most likely decline.

Hinkston Creek

Site #	Creek Name	O_2		N+P						Site Grade
1	Hinkston Creek					A	F	D	B	**C**
2	Hinkston Creek	B-	A-	B-	D	F	D	F	D	**C-**
3	Tributary to Hinkston Creek	B-	C-	B-	C	F	D	F	C	**D+**
4	Lane Branch	D	C+	B	C-	F	B	F	B	**C-**
5	Bennett Branch	C+	B	C	D-	F	C	C	C	**C-**
6	Tributary to Hinkston Creek	B-	C+	C-	D	F	C	C	B	**C**
7	Hinkston Creek	B-	B-	B-	C+					**B-**
8	Hinkston Creek	C+	C-	C	C	D	C	D	C	**C**
9	Hinkston Creek	C	C	C-	B-					**C**
10	Tributary to Hinkston Creek	B	D	C	F+					**C-**
11	Hinkston Creek	C-	C	C	C	F	C	D	C	**C-**
	Sign Grade	**C**	**C**	**C**	**C-**	**D-**	**C-**	**D**	**C+**	

E. coli was not collected along Hinkston Creek, but Blacks Creek, Boone Creek and other tributaries with similar land use, which all flow into Hinkston Creek, had high levels of *E. coli*. Therefore, it is likely that Hinkston Creek also has elevated levels of *E. coli.*

Gray Area

DO levels at sites 2, 3, 6, 7 and 10 were mostly suitable for fish and aquatic bugs. At the remaining sites, DO levels were consistently at the C or D grade level throughout the Hinkston Creek Watershed. These suboptimal oxygen levels have the potential to negatively affect fish and aquatic bugs.

Except at sites 2, 5 and 7, specific conductivity levels were outside their optimal ranges, which could negatively impact fish and bug communities since dissolved solids can interfere with normal behavior.

Gray Area continued

For the most part, nitrogen and phosphorous levels were reasonable but rose following rain events due to pollution entering the stream with runoff, discharges or failing septic systems.

Similarly, TSS levels rose following rain events due to a lack of vegetation and streamside grazing, which destabilizes stream banks, and development, which exposes sediment that can then be washed away. Some sites had extreme levels of TSS (sites 2, 5, 6 and 10) demonstrating that sediment is entering the stream during all conditions.

Available cover ranged from a B to a D in the Hinkston Creek Watershed, with C being the most common grade. Available cover is an important place for fish and bugs to live, feed, hide from predators and mate, and it also provides habitat for beneficial bacteria, which are eaten by the bugs that are then eaten by the fish.

Bugs ranged from a B to an F in the Hinkston Creek Watershed, with C being the most common grade. Degraded water quality and shifting habitat probably account for the mid-level grades.

Negatives

Habitat, which provides the building blocks for diverse groups of fish and bugs, was greatly reduced or entirely absent (grade of F) throughout the Hinkston Creek Watershed, except at site 1, which received an A.

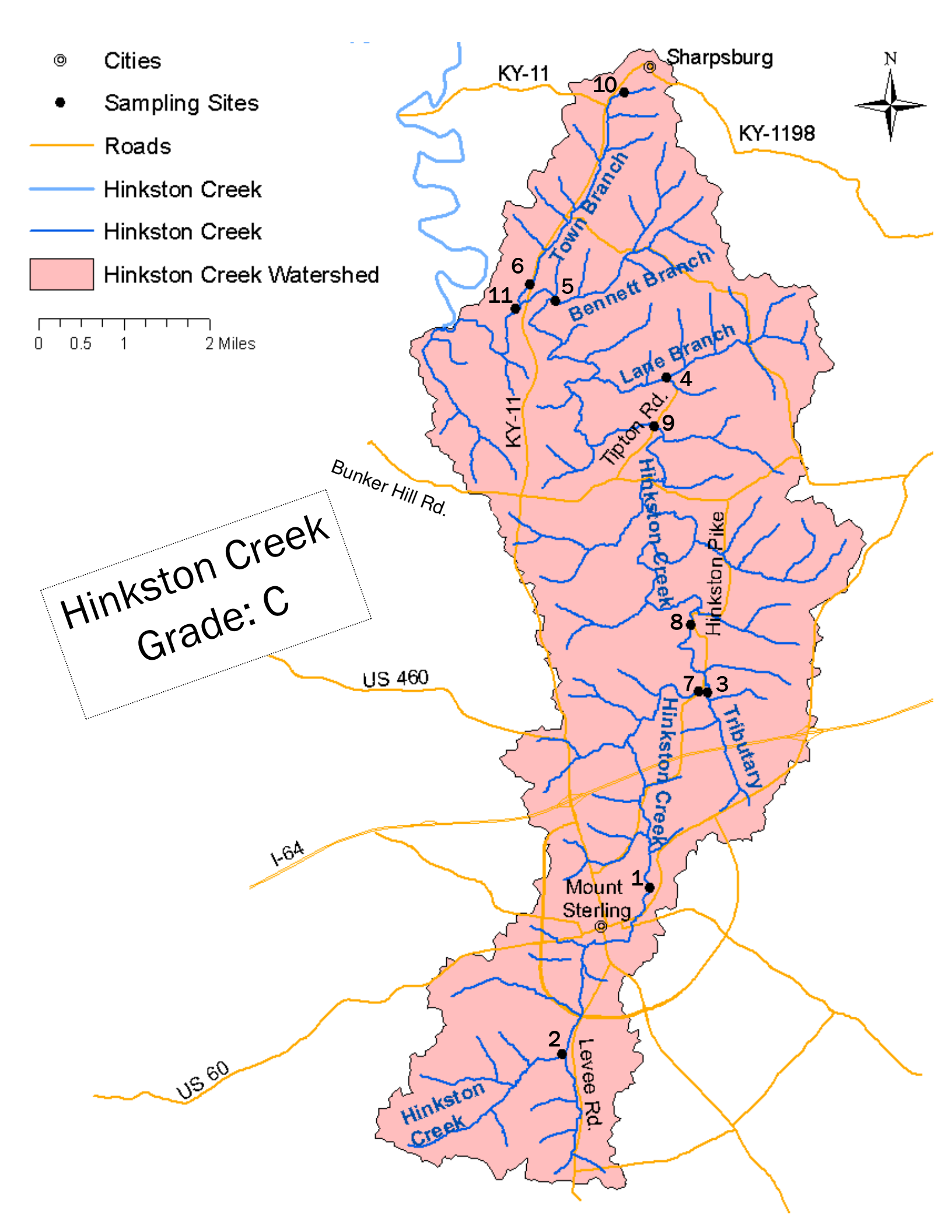
The width of the riparian zone was reduced or absent throughout the Hinkston Creek Watershed. When trees are cut and banks are cleared, algal communities bloom and water temperatures increase due to a lack of shade, banks become less stable, which increases erosion, and habitat for fish and bugs is reduced.

Habitat 101 Corner

- Compare the amount of instream material for aquatic bugs and fish to utilize for colonization, hiding and feeding.
- Compare the amount of food sources.
- Compare the amount of stream shading.
- Compare the number of stream bends, which slow water and reduce its energy, thereby reducing flood potential.
- Compare the stability of the banks.
- Compare the potential for sediment from the banks to erode when vegetative protection is lacking.

*Photos from Barbour et al. 1999

Optimal Range	Poor Range
	
	
	


Cities
Sampling Sites
Roads
Hinkston Creek
Hinkston Creek
Hinkston Creek Watershed
0 0.5 1 2 Miles
N
Sharpsburg
KY-11
KY-1198
10
Town Branch
6
11
5
Bennett Branch
Lane Branch
4
KY-11
Tipton Rd.
9
Bunker Hill Rd.
Hinkston Creek
Hinkston Pike
8
US 460
7
3
Hinkston Creek
Tributary
I-64
Mount Sterling
1
2
Levee Rd.
US 60
Hinkston Creek
Hinkston Creek
Grade: C

Aquatic Macroinvertebrates "bugs" 101

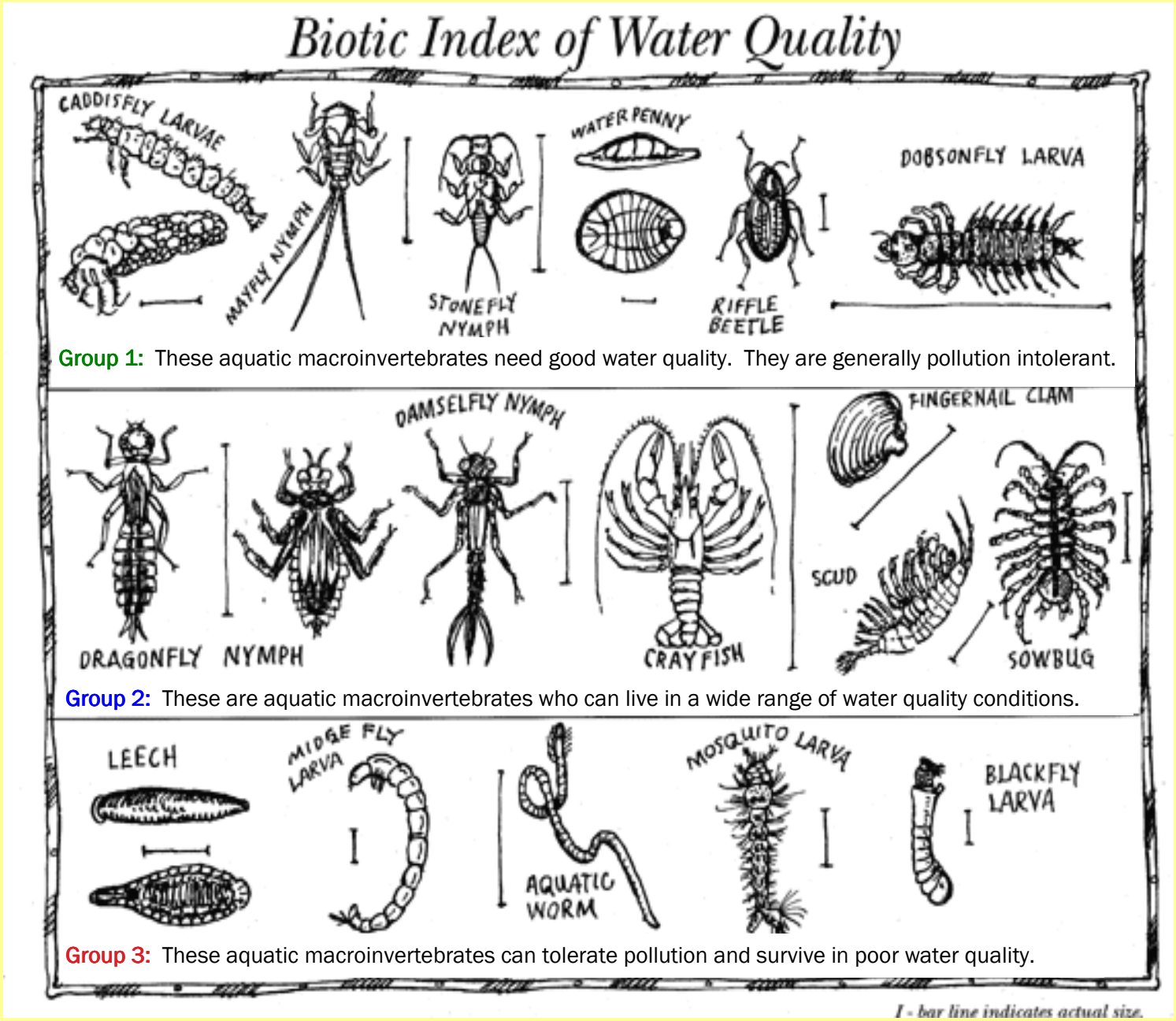


Image from: http://www.epa.gov/superfund/students/clas_act/spring/critter.htm

The Biotic Index of Water Quality shows how aquatic macroinvertebrates, or bugs, can help biologists decide if water quality is good, fair or poor. There are many different kinds of bugs living in Kentucky's streams, and some are more sensitive to pollution than others.

In **Group 1**, stoneflies are considered the most sensitive to pollution and are therefore the first kind of bug to disappear when water quality begins to degrade. Stoneflies are also very particular about their habitat, so even when water quality is good but the habitat has been removed, stoneflies quickly disappear from the stream.

Bugs from **Group 2** are found over a wide range of water quality conditions, but will disappear if the water quality reaches a poor level. The larval (or nymph) stage of dragonflies and damselflies are aquatic bugs, and these familiar land bugs require water for part of their life cycle.

Lastly, **Group 3** consists of the bugs that can tolerate pollution and degraded habitat. Leeches, midge flies and black fly larvae are among the toughest, and they can still be found in streams when all other bug groups have disappeared.

Summary: Room for improvement, but some have more work to do than others

Best Site: Hinkston Creek site 7, located off Hinkston Pike, which received B-s in all categories except for TSS (C+). However, biological signs were not collected at this site, which could potentially lower Site 7's grade since biological signs tended to score lower than water quality signs.

Best Watershed: Boone Creek Watershed was the healthiest watershed, receiving a C. However, Boone Creek has room for improvement, especially when it comes to *E. coli* and habitat scores.

Best Sign: Specific Conductivity was the sign of watershed health that consistently received the highest grade, demonstrating that the dissolved solid content of Hinkston Creek's waterways was near normal levels.

Worst Site: Tributary to Blacks Creek, site 3, located at Jackstown Road, which received a D. Along this stream, there is no riparian zone and no vegetation except for mowed grass. Therefore, nutrients and feces enter the stream without being absorbed, degrading water quality and biological health.

Worst Watershed: Blacks Creek Watershed, with a majority of its signs of watershed health being listed as negatives and all of its sites receiving Ds.

Worst Sign: *E. coli* received an F at every site where *E. coli* was measured, except for Boone Site 1, where it received a D. This indicates that 80 to 100% of the time *E. coli* levels are above the standard considered safe for swimming and are often 10 times greater than the standard.

What can you do?

- Make every effort to **protect the good** that remains. Work with local government and land owners to protect areas that are less degraded and improve land management to minimize further degradation.
- **Trees are the best way to protect and restore water quality and biological health.**
  - ◊ Leave in place or establish vegetation alongside streams to provide natural filters that stabilize stream banks, minimize erosion, regulate water flow, provide shade, retain sediment and absorb excess nutrients.
  - ◊ Plant trees and do not mow within 18 yards of the stream bank.
- **To keep water safe for swimming,** keep animals out of the streams, which will limit the amount of animal waste entering the waterways, reduce excess nutrients, and protect habitat.
- **To improve habitat,** allow fallen trees, logs, leaves, gravel, cobble and boulders to remain in the stream to create habitat for fish and bugs to feed, find refuge and reproduce.
- **To reduce TSS,** maintain streamside vegetation, plant cover crops, install settling ponds, reduce animal access to streamside grazing and guard waterways during construction activities.
- **To reduce nutrients**
  - ◊ Use chemicals and pesticides according to labels and fertilizers based on soil test results. Limit uses and store and dispose of properly.
  - ◊ Report failing septic systems.
  - ◊ Reduce runoff by increasing pervious surfaces and by installing filter strips, rain barrels or rain gardens.
  - ◊ Properly dispose of pet waste.
  - ◊ Keep animals out of the stream.
- Keep grass clippings, petroleum products, trash, and litter out of storm drains; this material enters the stream directly without treatment.
- Service your vehicle regularly to prevent oil and antifreeze leaks and reduce noxious emissions.
- Become a certified citizen **volunteer** water quality monitor or establish a program in your local community or watershed.

Where to go for more information

Making changes at home and work
- Bluegrass PRIDE at www.bgpride.org/gallery1.htm

Volunteering
- Watershed Watch in Kentucky at water.ky.gov/wsw/Pages/default.aspx or contact Jo Ann Palmer at 800-928-0045 or JoAnn.Palmer@ky.gov

Purchasing or planting native trees and plants
- Division of Forestry: forestry.ky.gov/Pages/default.aspx
- Kentucky Native Plant Society: www.knps.org/plant_resources.html

Grants and Programs
- KY's Nonpoint Source (Runoff) Pollution program: water.ky.gov/nsp/Pages/default.aspx
- KY's Natural Resource Conservation Service: www.ky.nrcs.usda.gov/
- KY's 319 Grant program: water.ky.gov/Funding/Pages/NonpointSource.aspx or contact James Roe at 502-564-3410 or James.Roe@ky.gov
- Hinkston Creek Watershed Protection Project: http://www.hinkstoncreek.org/index.html
- KY's Department of Agriculture **free** farm chemical collections: http://www.kyagr.com/consumer/envsvs/technical/FarmChemicals.htm