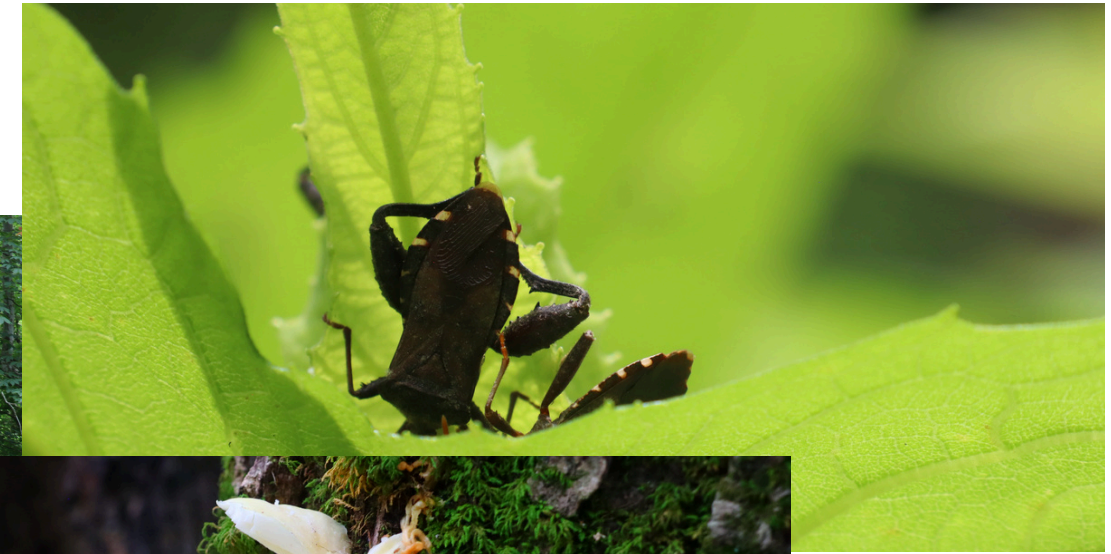


Preliminary Middle Creek Plan (Summarized)

Preliminary Plan

Going Over

1. Historical Background
2. Land Use
3. Tree Canopy
4. Watershed data
5. Biodiversity
6. Public outreach
7. Further suggestions and plans



1. Historial Background

Just along the Ohio River are two historic towns in Boone county known as Mcville and Belleview that reside near Middle Creek. Belleview was once a profiting river town gaining river traffic from 1860 to the early 1900s. Decline in river traffic slowed the towns production greatly, and in 1937 the Ohio River flood overflowed the town and surrounding farmland (BCPL, 2020)

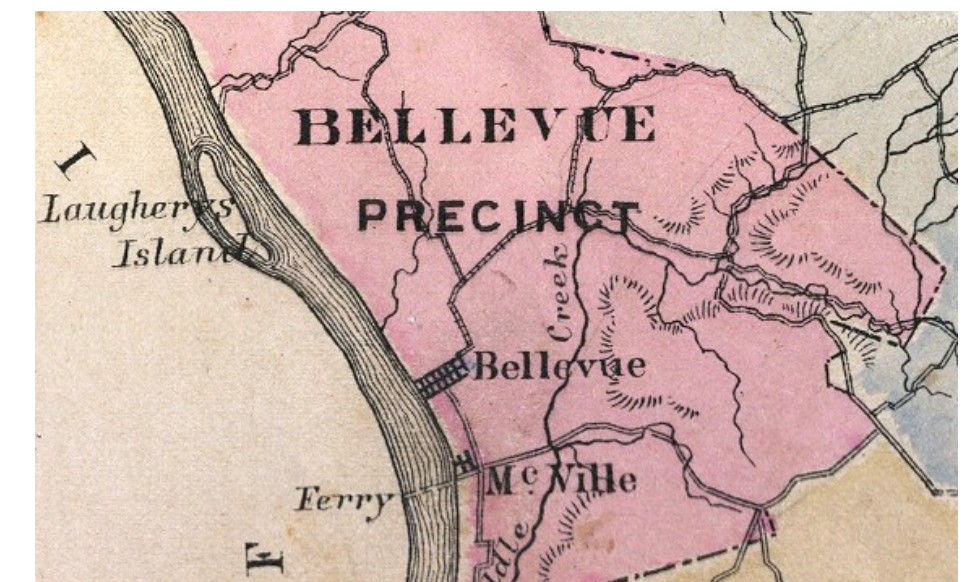
McVille is a smaller town near Bellview along the river that used to be a popular landing area that had a ferry and steamboats. McVille used to have Lock and Damn 38 which was blown up after the construction of Markland Dam in 1962. This event change river levels and flooded both Belleview and Mcville (BCPL, 2020).

Located in the Belleview precinct, near Boone Cliffs, used to be the town of Middle Creek, which is now extinct. Little is known about the previous buildings in Middle Creek that have since been destroyed, however relics of the woodworker Thomas Zane Roberts house and mill still stand along with the Middle Creek cemetery. The mill and similar structures have altered the flow of Middle Creek (BCPL, 2020).

Figure-1. Grave from Middle Creek Baptist Church



(Sourced from The Boone County Public Library)



(Sourced from The Boone County Public Library)

1.2 Background/Land Use: Middle Creek Park

Middle creek park opened in 1993 and has 230 acres of protected land for recreational use. There are six trails and the Camargo loop which are open to the public. The Camargo loop is 127 acres owned by the Boone Conservancy that stewards the site.

Trails at Middle Creek Park are unique from many parks in the area because they are open to horseback riders as well. While this provides a nice natural area for riders to bring their horses, the trails and nearby stream may be impacted by erosion, sedimentation and overall usability of the shared trails. Further management to protect the riparian zone and public trails may be needed.

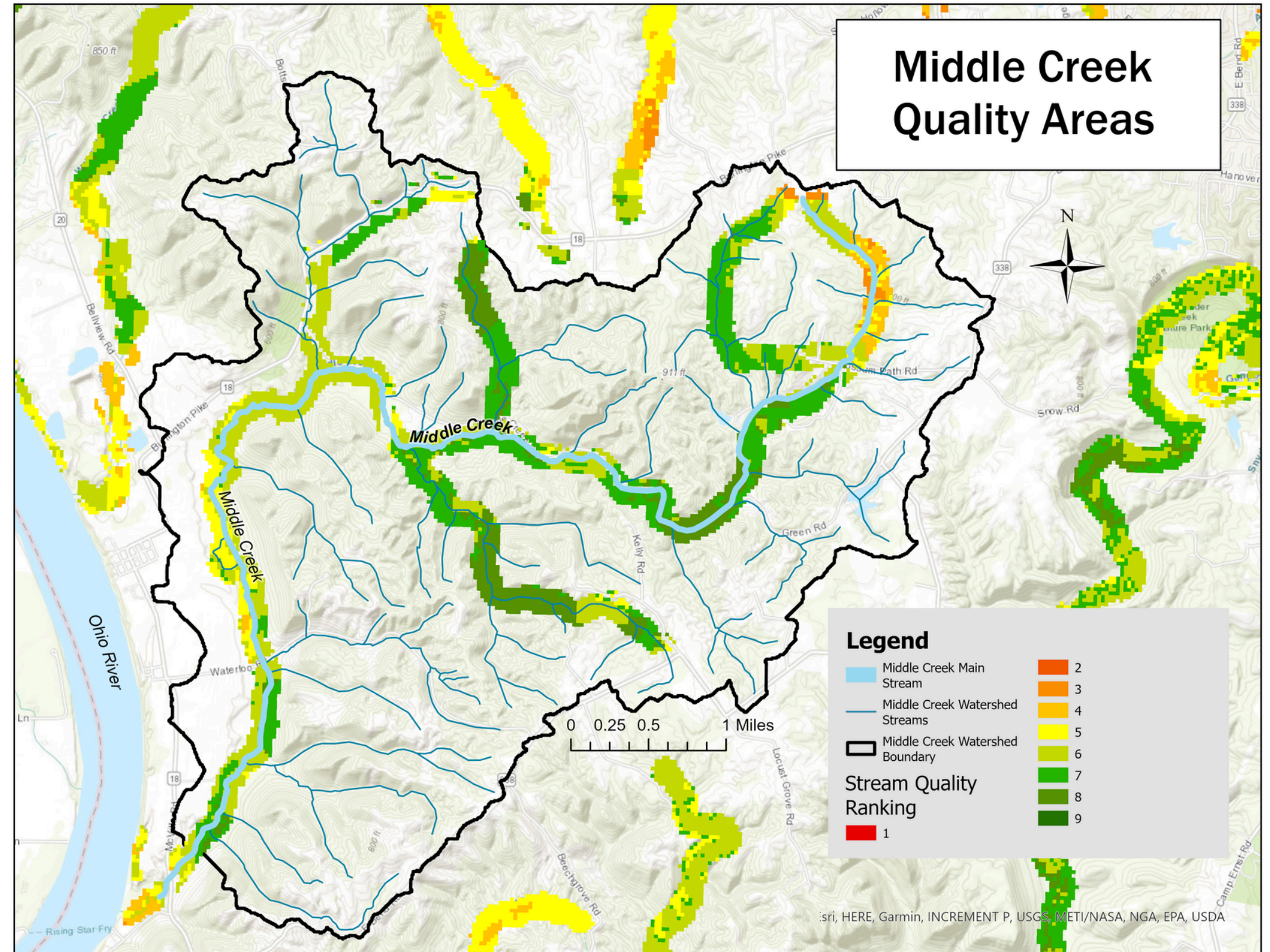
These images show the impacted trails from horses (top right), horse feces (bottom left) near the creek, and an example of the eroding bank and invasive honeysuckle growing from the top of the LDB (bottom right).



2. Land Use

Going off of Tyler Rankin's Project to find the highest quality environmental areas in Boone County, I focused in on Middle Creek and used similar layers with the Greenspace Environmental Mitigation Mapper to show specific parts of Middle Creek that are considered to be the highest quality and lowest quality areas. The high-quality areas are determined by using a weighted raster overlay. The layers that were chosen to determine the quality of the streams and nearby buffer areas that are in proximity to parks and protected areas, recognized biodiversity, forested areas, streams with the highest/lowest risk of degradation, and resilient land. These layers are important for determining how much of the riparian zone is forested, resilient, is or is not at risk of degradation, has biodiversity, and is in or near protected areas. The areas of Middle Creek facing the Ohio River in yellow have been deforested for farmland and the top right section of Middle Creek with spots of orange and yellow have been deforested for residential areas. The lowest areas of Middle Creek received a 3 on the stream quality scale and the highest received an 8.

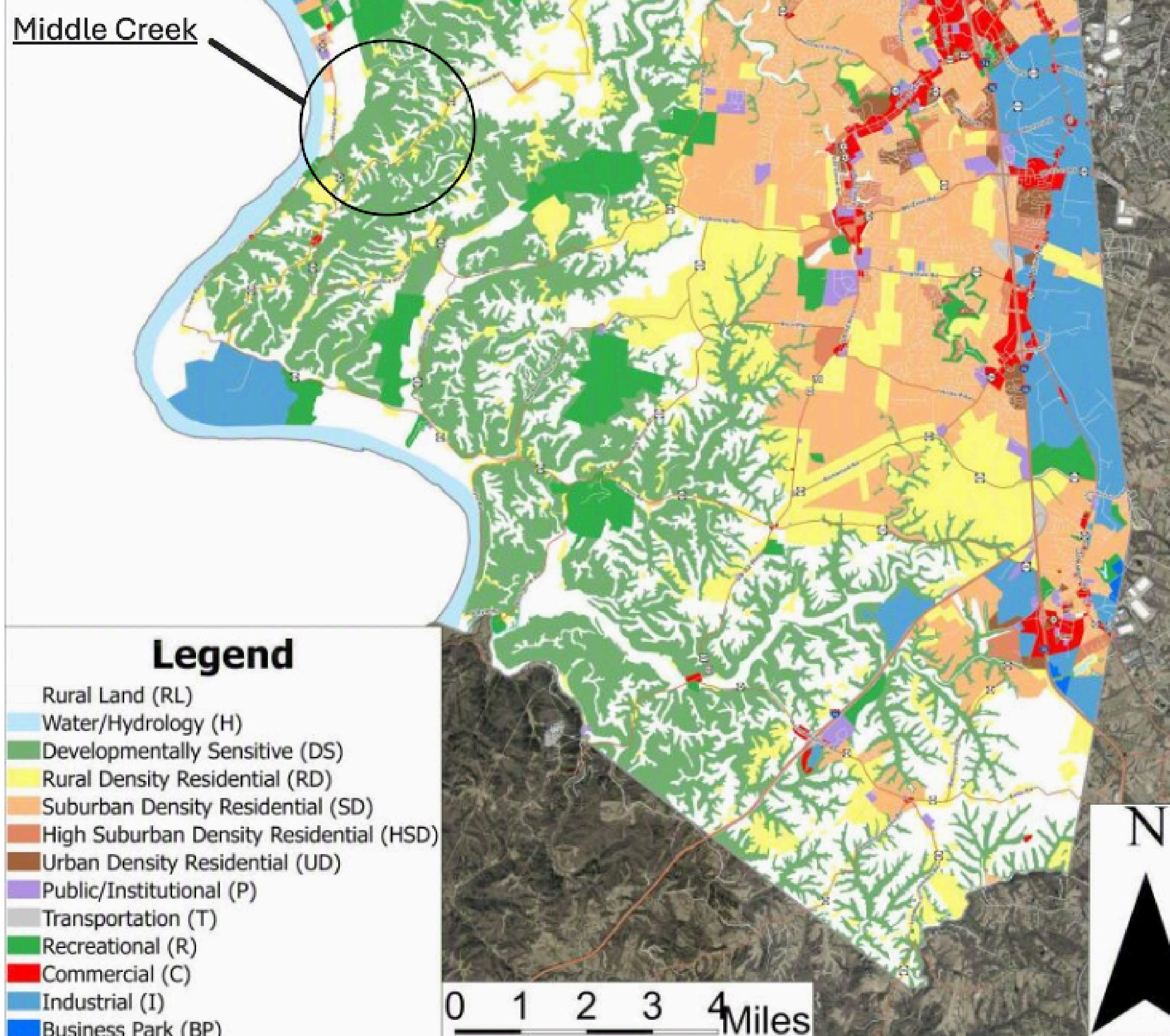
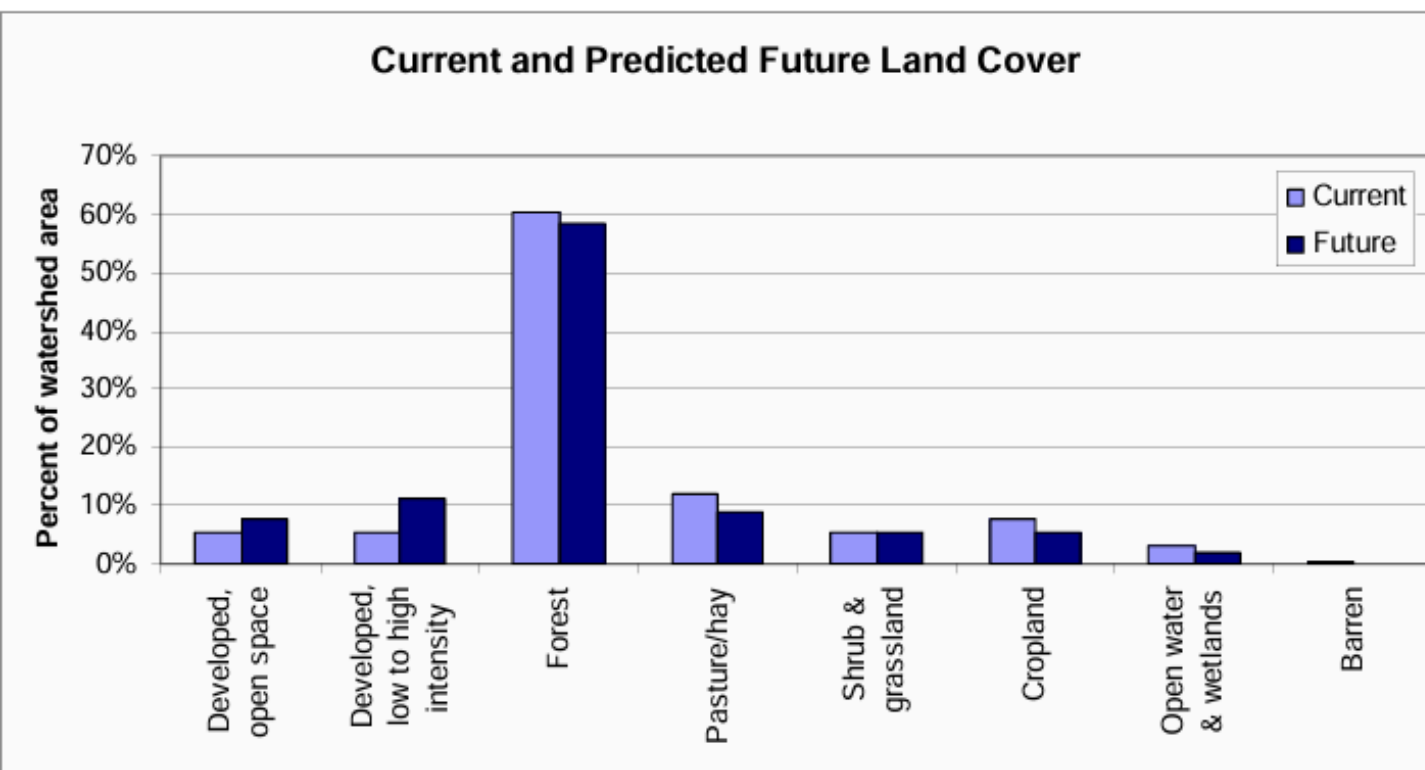
This helps to show that the highest quality areas are those that are forested and within protected areas, so lower quality areas may need protections and reforestation.



2. Land Use

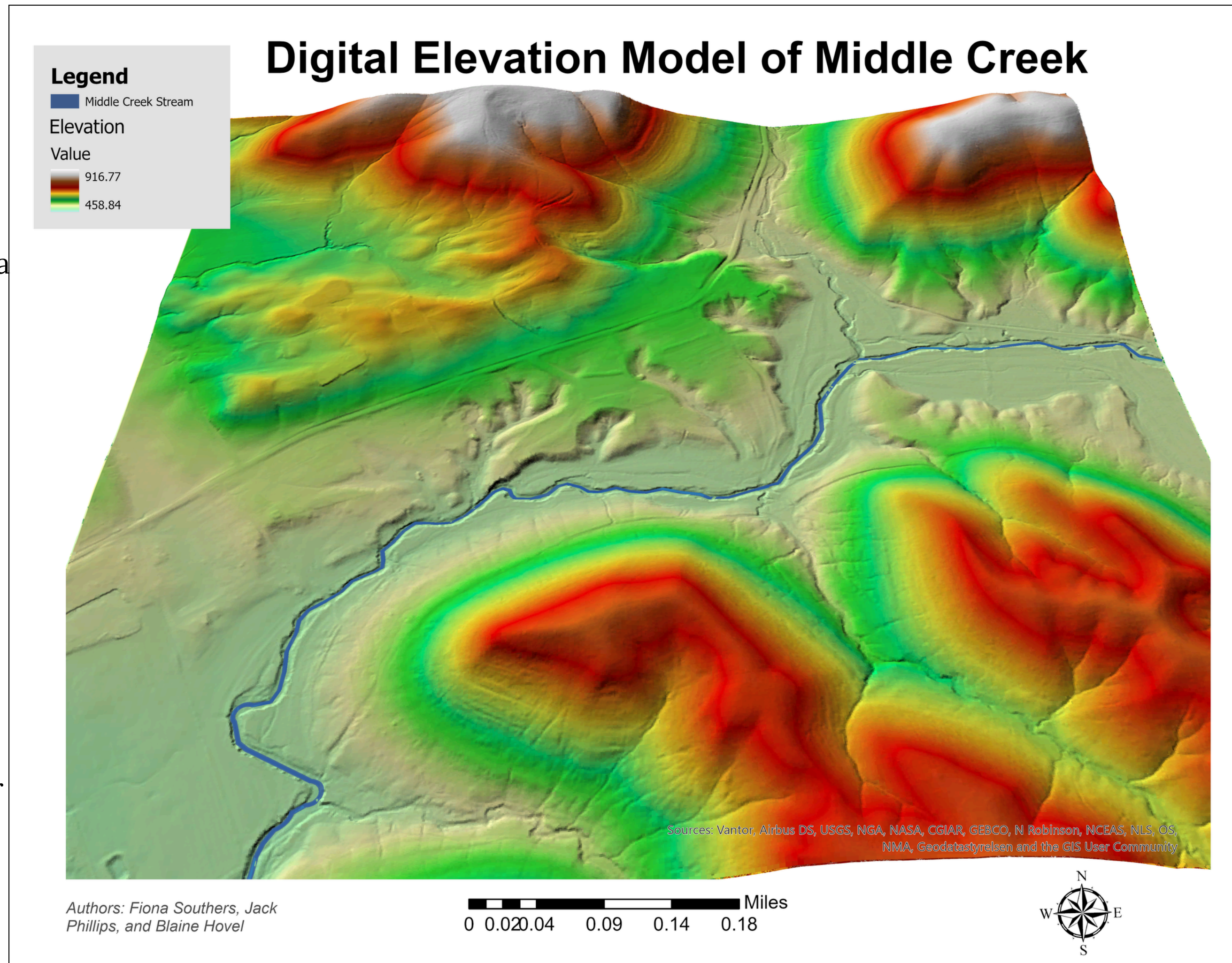
This future land use map is from Boone County Planning Commission made in 2025 and shows predicted land use from 2045. Middle Creek is shown on the map and will continue to be developmentally sensitive areas with small amounts of rural density residential.

This graph from SD1 shows that the predicted land use will continue to be mostly forested areas, but may decline slightly as development gets slightly higher. While this is a very small change, over time without the proper protections, Boone County could lose one of its highest quality streams.



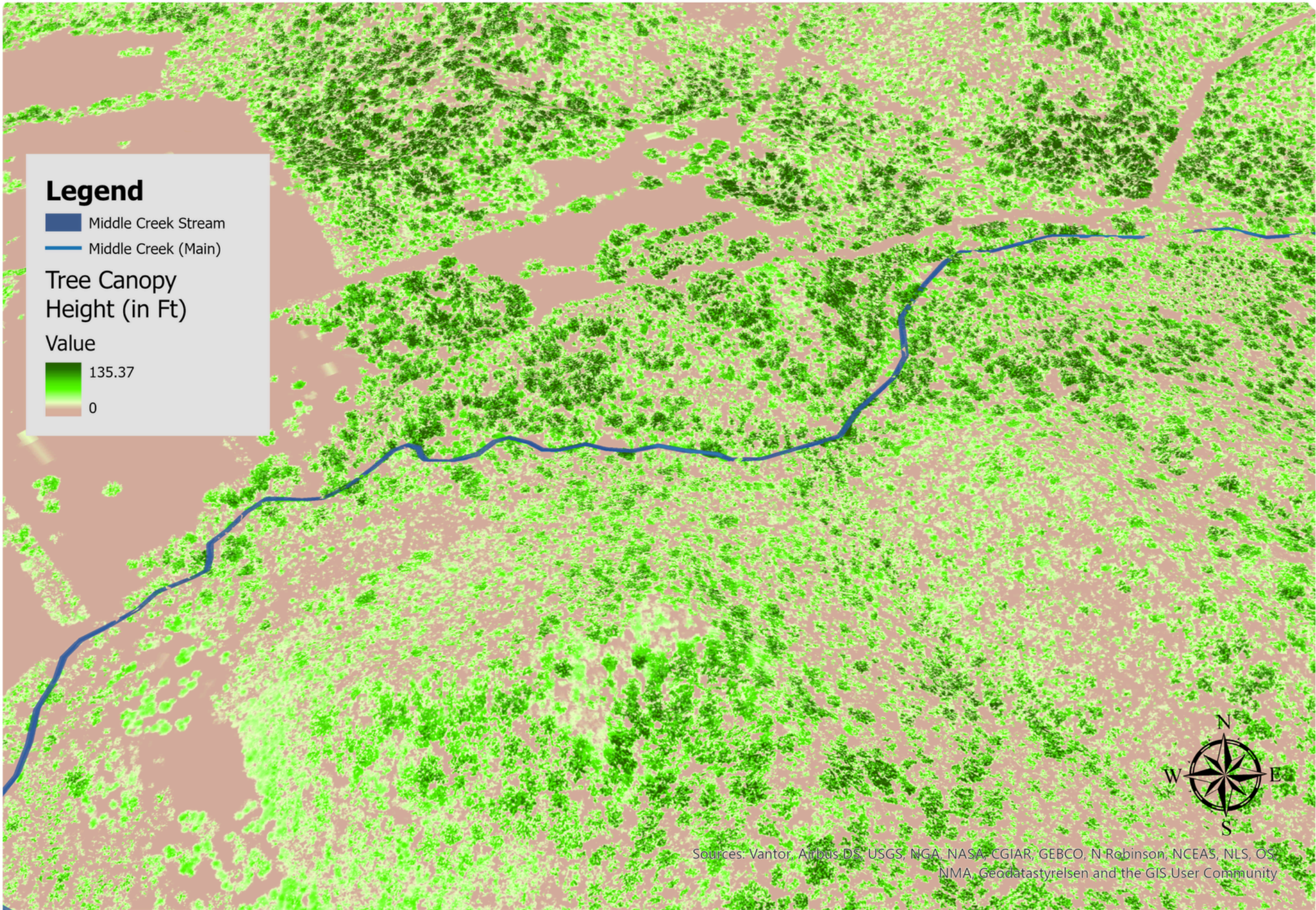
2. Land Use

The map shows the elevation of the area surrounding Middle Creek where the highest ground points are shown as red. The highest point reaches 916.77 ft and data was collected using a remote sensing technology called Light Detection And Ranging also known as LiDAR. LiDAR uses pulsed lasers from planes or drones to get three-dimension surface maps. The elevation of the region is important to map and determine for areas around waterbodies to better understand ecosystems, climate, and precipitation. Elevation can help predict natural disasters (floods), water drainage, weather events, and where to put potential rain gardens or detention basins in the area.



3.Tree Canopy

Tree Height Elevation Using LiDAR



The tree canopy height model from LiDAR data shows the highest and lowest heights of trees in feet by removing classifying the houses and ground separate from the trees, then creating a digital surface model (DSM) and digital terrain model (DTM) and subtracting the DSM from the DTM. Then, I removed any extra noise through geoprocessing. The highest tree canopy height is about 135.37 ft . The darker areas show taller trees and the lighter areas show young trees. The tallest canopy of trees begin 200ft from the stream and the elevation changes in 42ft. This helps show where the oldest trees and highest tree elevation is around Middle Creek.

4. Watershed Data

Although originally warm water aquatic habitat was previously listed as impaired, in 2025 it was delisted and it is now considered to be fully supporting as a category 2b for biological, habitat, and physical/chemical parameters. Middle Creek is listed on 303(d) because it is considered to be not supporting the primary contact recreation hydrologic feature as a category 5. To help restore impaired sections of Middle Creek and protect high quality areas, this watershed plan proposed by the Boone County Conservation District has been created. This plan will aid the upcoming stream restoration in Middle Creek by providing past and present assessment data on the important physical characteristics, biological assessments, and current land/recreational usage.

The KDOW listed Middle Creek as a Priority Basin using an assessment summary that gave Middle Creek an overall category of 5 from mile 0.2 to 7.7. This highlights one of the main goals of this watershed plan is to show that even high-quality streams need to be protected so they can continue to be beneficial habitats for local wildlife and human recreation. Watersheds are constantly changing over time naturally and from human involvement, so nicer areas such as Middle Creek need to be prioritized just the same.

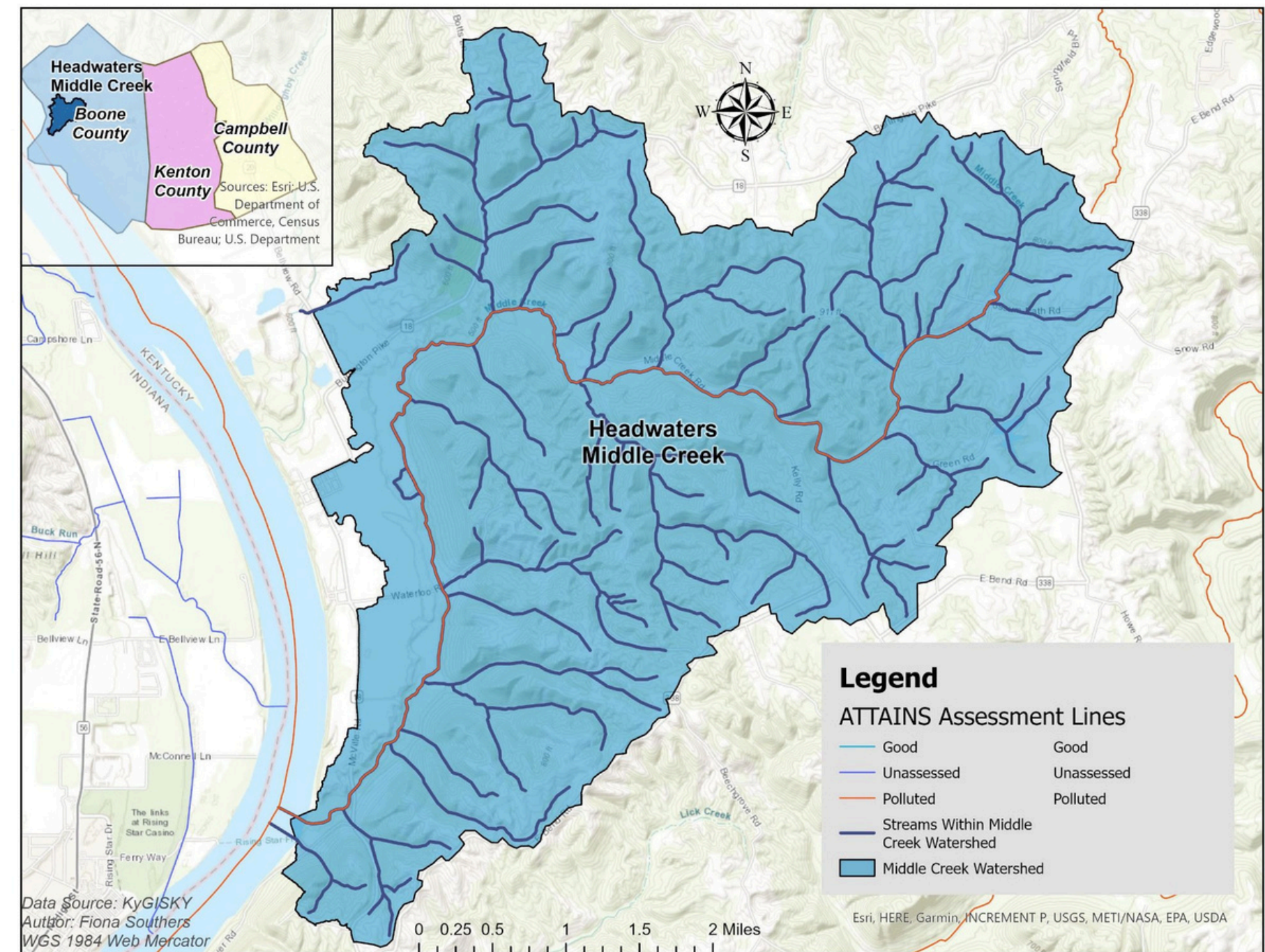


Figure 5.2 Middle Creek Watershed showing impacted streams

Data from SD1 showed that there are cattle and horses present in Middle Creek, but no CAFOs. 60% of this watershed may be serviced by septic systems and not sanitary sewers. Reports from the health department show that 10% of the septic systems may be operating incorrectly.

4. Watershed Data- Previous Water quality

Date	Par_Name	Qualifier	Meas_Units	RL	MDL	TRL
5/4/2021	tot-NH3		mg/L-N	0.25	0.094	0.15
5/4/2021	Ecoli	24200	#/100ml	1	1	4
5/4/2021	tot-NO3+NO2	0.254	mg/L-N	0.05	0.016	0.05
5/4/2021	PO4_as_P	0.146	mg/L-P	0.03	0.008	0.01
5/4/2021	TKN	8.7	mg/L-N	0.32	0.102	0.2
5/4/2021	TN	8.954	mg/L-N	0.32	0.102	0.2
5/4/2021	TP	5.01	mg/L-P	0.08	0.028	0.04
5/4/2021	TSS	3125	mg/L	3	1.4	1.5
5/4/2021	w-Temp	16.2	degrees Celsius			
5/4/2021	pH	8.04	su			
5/4/2021	DO	9.6	mg/L			
5/4/2021	field-Cond@25	155.3	micro-siemens/cm @			
5/4/2021	field-Turbidity (NTU)	2396.3	NTU			

Date: 7/8/2025	995.753
E. coli	900
field-Cond@25	537
w-Temp	22.7
TSS	12
DO	8.53
pH	8.42
TN	0.675
TKN	0.366
tot-TP	0.309
TP	0.106
tot-NH3	

Entity	Dates	Parameters Sampled	Sampling Locations ^b	Number of Samples
NKU	2003	Fecal coliform, alkalinity, chloride, hardness, conductivity, sulfate, TSS, temperature, nutrients	Middle Cr. RM 0.5	1 sample (9/6/2003)
NKU	2001, 2003	Fecal coliform, E. coli, dissolved oxygen (DO), pH	Middle Cr. RM 0.5	2 samples (8/25/2001 & 7/10/2003)
NKU	2002	Atrazine, DO, pH, temperature	Middle Cr. RM 0.5	1 sample (5/18/2002)
LRWW	2003	Fecal coliform	Middle Cr. RM 0.5	2 samples (7/12/2002 & 5/14/2003)
LRWW	2004	Fecal coliform, E. coli	Middle Cr. RM 0.5	3 samples (5/22/2004, 7/1/2004 & 9/13/2004)
Conservation District	2005-2006	Fecal coliform, E. coli, alkalinity, chloride, DO, pH, conductivity, sulfate, temperature, nutrients	Middle Cr. RM 1.8, 7.3	5 samples (May, July, & Sept of 2005; May & July of 2006)
SD1	2006	Fecal coliform, E. coli, DO, pH, conductivity, turbidity, temperature	Landing Cr. RM 1.4; Lick Cr. RM 1.6; Middle Cr. RM 1.8, 5.5	2 samples from baseline survey (9/27/2006 & 10/16/2006)
SD1	2007	Fecal coliform, E. coli, carbonaceous biological oxygen demand (5-day), DO, pH, conductivity, turbidity, TSS, temperature, turbidity, nutrients	Landing Cr. RM 1.4; Lick Cr. RM 1.6; Middle Cr. RM 1.8, 5.5	1 Sample (7/31/2007)
SD1	2008 ^a	Fecal coliform, E. coli, carbonaceous biological oxygen demand (5-day), DO, pH, conductivity, turbidity, TSS, temperature, turbidity, nutrients	Landing Cr. RM 1.4; Lick Cr. RM 1.6; Middle Cr. RM 1.8, 5.5	1 Sample (10/21/2008)

^a Data not analyzed in Section 4.3

^b RM = River mile

Previous sampling parameters and number of samples taken

2025 sampling showed that the water quality was better than in 2021. In 2021 the E. coli, TSS, phosphorus, and nitrogen was very high indicating poor water quality during that time possibly due to a storm causing runoff. Middle Creek is a good example of how stormwater runoff can impact even high quality streams, but Middle Creek is a good example of how creeks with riparian buffers can recover better than those in urban areas.

4. Watershed Data- Current Water quality

Kentucky Watershed Watch Monitoring Data Form

Sampler Names: Alex Trimpe, Emma FSS Site ID# Participants: # adults 3, # youth 0

Latitude: 36.99910 Longitude: -84.80753 Date: 07/13/2026 Start Time at Site: 1:03 AM Total Volunteer Minutes: (Travel+Sampling) Miles Driven: 20

Current Weather: Clear/Sunny, Overcast, Intermittent Rain, Steady Rain, Heavy Rain

Rainfall in last 48 hours (Round up): 0", 0.1", 0.5", 1", 1.5", >1.5"

Water Color: Clear, Brown / Muddy, Green, White, Grey, Orange, Other: None, Rotten eggs, Chlorine, Rancid, sour, Gas, petro, Musty, Sweet, fruity, Sharp, pungent, Other: None, Oil sheen, Algae, Suds/Foam, Sewage, Erosion

Stream Flow: Visual: Flood, Bankfull, Normal, Low, Pondered, Dry

Trash / Litter: None, Minor, Several Bags, Tires / Large Debris, Abundant / Dump Site

Turbidity (visual): Clear, Slightly Cloudy, Cloudy, Very Turbid

Pictures: Upstream, Downstream, Other:

Water Temperature: 25.56°C pH: 8.0 SU Dissolved Oxygen: 6.25 mg/L Conductivity: 518 µS/cm

Bacteria: R-Card Method

Possible Bacterial Sources: Duck/Goose, Human, Livestock, Pet Waste, Wildlife

Other Observations or Measurements: Blunt nose minnow, damselfly

Kentucky Watershed Watch

Kentucky Watershed Watch Monitoring Data Form

Sampler Names: Alex Trimpe, Emma FSS, Matt Site ID# Participants: # adults 2, # youth 0

Latitude: 38.99910 Longitude: -84.80753 Date: 05/15/2026 Start Time at Site: 1:41 AM Total Volunteer Minutes: (Travel+Sampling) Miles Driven: 15.8

Current Weather: Clear/Sunny, Overcast, Intermittent Rain, Steady Rain, Heavy Rain

Rainfall in last 48 hours (Round up): 0", 0.1", 0.5", 1", 1.5", >1.5"

Water Color: Clear, Brown / Muddy, Green, White, Grey, Orange, Other: None, Rotten eggs, Chlorine, Rancid, sour, Gas, petro, Musty, Sweet, fruity, Sharp, pungent, Other: None, Oil sheen, Algae, Suds/Foam, Sewage, Erosion

Stream Flow: Visual: Flood, Bankfull, Normal, Low, Pondered, Dry

Trash / Litter: None, Minor, Several Bags, Tires / Large Debris, Abundant / Dump Site

Turbidity (visual): Clear, Slightly Cloudy, Cloudy, Very Turbid

Pictures: Upstream, Downstream, Other:

Water Temperature: 58°F / 14.4°C pH: 8.0 SU Dissolved Oxygen: 7.8 mg/L Conductivity: 482 µS/cm

Bacteria: R-Card Method

Possible Bacterial Sources: Duck/Goose, Human, Livestock, Pet Waste, Wildlife

Other Observations or Measurements: downstream cloudy ponding, two lined salamanders, sunfish & madtom

Kentucky Watershed Watch

These pages show other monitoring data that was observed in Middle Creek included weather, water color, odor, water surface, litter, stream flow, rainfall, and turbidity. The physical observations for May 2026 showed that there was 0" inches of rainfall in the last 48 hours and the weather was overcast. The water color was clear, there was no odor, slightly turbid, and nothing on the water surface. There was minor trash present, the water was cloudy looking downstream. Organisms that were noted on the sampling day were a Long-eared Sunfish, Madtom, and multiple Two-lined Salamanders.

Date/Site #	pH	Temperature	Conductivity	E. Coli (3 Samples)	Dissolved Oxygen
5/14/2026	8.0 SU	11.67 Degrees Celsius	482 cm	0	7.8 mg/L
7/13/2026	8 SU	25.56 Degrees Celsius	518 cm	400 E.coli/100mL	6.75 mg/L

These two sampling results are better than previous years and show good water quality, but these samples were taken in a different location than SD1's and upstream from the park where human impact is more likely to happen.

4. Watershed data:Potential Sources ofPollutants/Erosion

The water quality standard from EPA as of 2025 did not meet the criteria due to Escherichia coli (E. coli) pathogen levels present. The suspected sources are from agriculture; non-point source; on-site treatment systems (septic systems); packaged plants or other permitted small flow discharges. The priority for a TMDL (Total Maximum Daily load) regarding primary contact recreation is high for Middle Creek. The secondary contact recreation, fish consumption, and domestic water supply has not been assessed (figure 1-3).

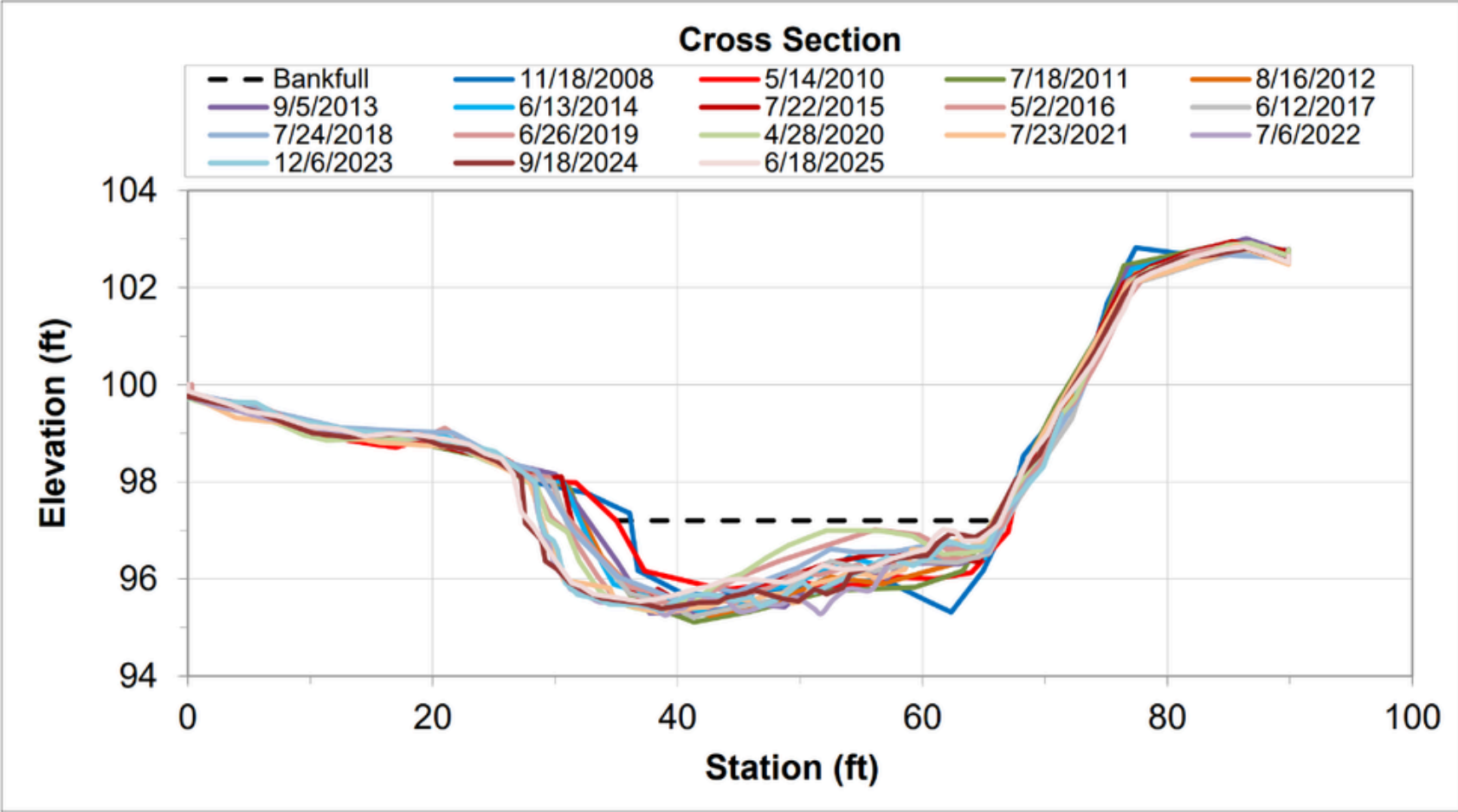
SD1 in their characterization report assessed that the main impacts to biological health in Middle Creek would more likely be from be from runoff and erosion causing suspended sediments rather than urban pollutants.

Middle Creek soil is a higher sand content than other most soil in the area from glacial outwash. Soil with a low percentage of finer grained content will be more susceptible to erosion, landslides, and mass wasting events.

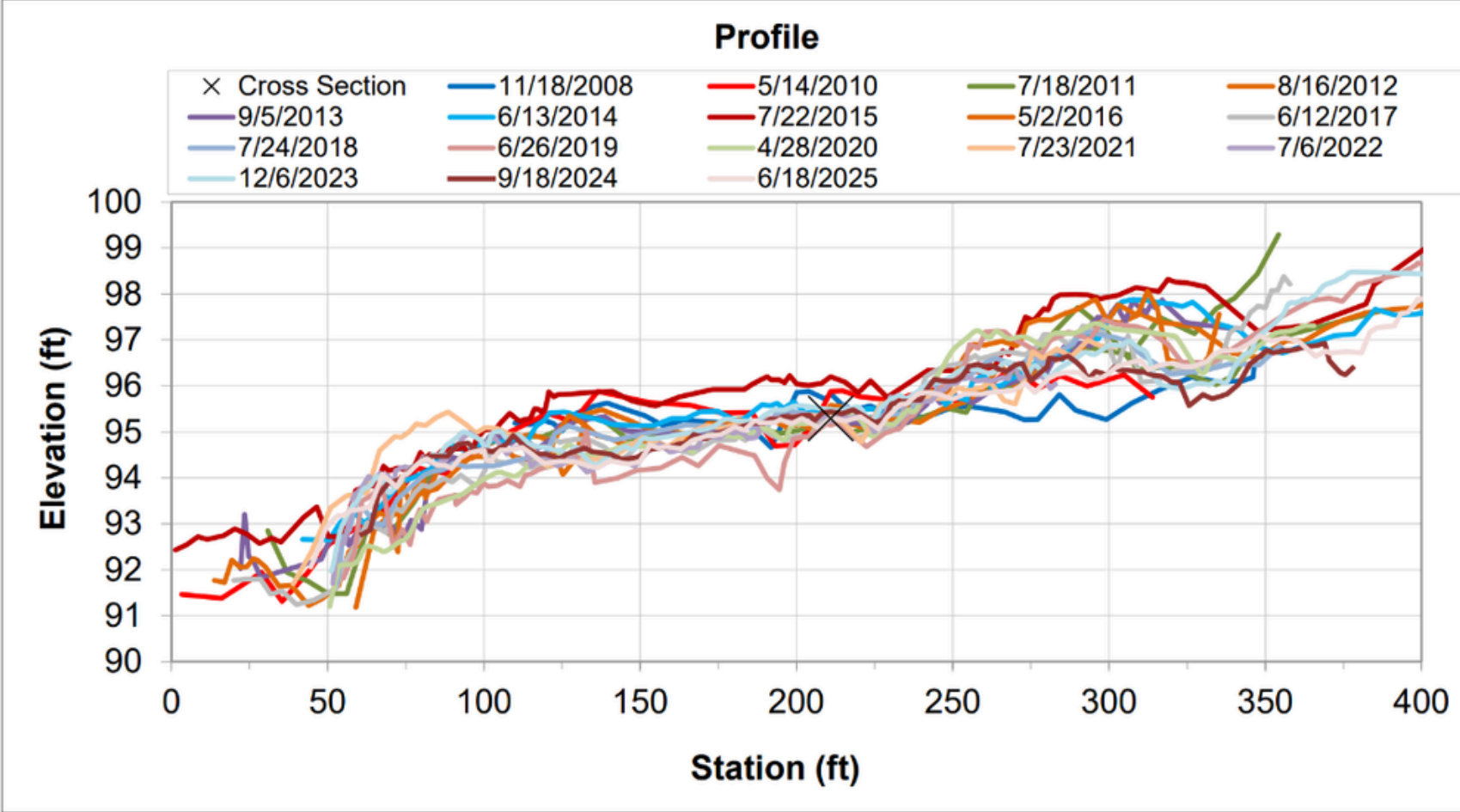
2026 303(d) Streams: Middle Creek 0.2 to 7.7	
AU_ID	KY-3901
AU Name	Middle Creek 0.2 to 7.7
AU Description	Ohio River backwaters to pond
River Basin	Ohio River
County	Boone
WAH	Full Support-2B
CAH	Not Assessed-N/A
OSRW	Not Assessed-N/A
PCR	Non Support-5
SCR	Not Assessed-3
Fish Consumption	Not Assessed-3
DWS	Not Assessed-3
Assessment Summary	View

Figure 5.1 303(d) from EPA

4. Watershed data: Hydromodification

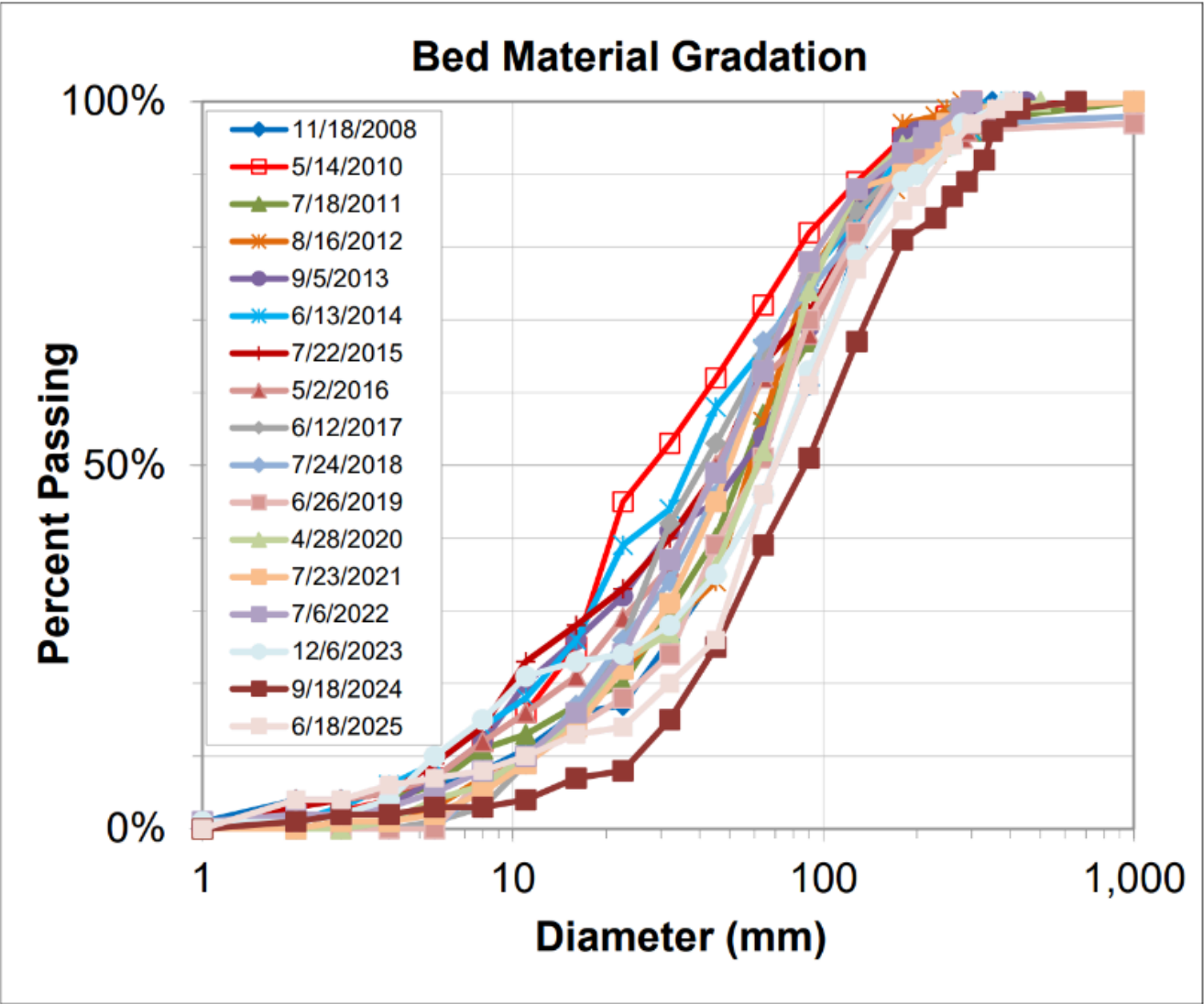


Measures how the stream is impacted over time by human activity. A non-impacted stream will have lines overlapping over top of each other showing less changes. Middle Creek has changed throughout the years with some spikes due to storms and heavy water flows where several feet of the left bank widened, but the cross sections has been gradually changing back to its previous size and shape.



shows how much riparian areas can help the stream naturally recover better than urban streams.

Distribution of sediment on the stream bed.



5. Biodiversity:Plant and Animal Abundance

Order	Common Name	Total Individuals	Dominant Genus (Count)
Amphipoda	Freshwater scuds	85	<i>Crangonyx</i> (49)
Basommatophora	Freshwater limpets	9	<i>Ferrissia</i> (6)
Coleoptera	Aquatic beetles	488	<i>Stenelmis</i> (212)
Cypriniformes	Minnows, dace & suckers	199	<i>Campostoma</i> (88)
Perciformes	Darters, sunfish & bass	149	<i>Etheostoma</i> (106)
Diptera	True flies	4,546	<i>Simulium</i> (1,011)
Ephemeroptera	Mayflies	1,759	<i>Baetis</i> (1,113)
Trichoptera	Caddisflies	1,204	<i>Ochrotrichia</i> (541)
Tricoptera*	Caddisflies	1	<i>Phylocentropus</i> (1)
Plecoptera	Stoneflies	1,006	<i>Amphinemura</i> (720)
Megaloptera	Dobsonflies, fishflies &	27	<i>Corydalis</i> (18)
Odonata	Dragonflies & damselflies	21	<i>Calopteryx</i> (12)
Hydropsychoidea	Net-spinning caddisflies	20	<i>Hydropsyche</i> (20)
Haplotaxida	Aquatic worms	21	Unidentified (21)
Isopoda	Aquatic isopods	275	<i>Lirceus</i> (270)
Decapoda	Crayfish	22	Unidentified (10)
Lumbriculida	Blackworms	8	Unidentified (8)
Veneroida	Freshwater clams	13	<i>Pisidium</i> (11)
Neotaenioglossa	Freshwater snails	0	<i>Amnicola</i> (0)
Tricladida	Freshwater planarians	8	Rusty (8)
Grand Total	All taxa	9,870	—

From 2006-2025

Bull Frog Tadpole



Blacknose Dace?



Rusty Crayfish



Milk Snake



Common Water snake



Fan-tailed Darter



Jewel Weed

Species that have been found in 2026

Fish: Fan-tailed Darter, Rainbow Darter, Spot-Fin Shiner, Madtom, Blacknose Dace, and Long Eared Sunfish.

Birds can be good indicators as well because if they are there, then there must be good fish to eat: Indigo Bunting, Yellow-Billed Cuckoo, Scarlet Tananger, Pileated Woodpecker, Red-Bellied Woodpecker, Eastern Towhee, Gray Catbird, Blue Gray Gnatcatcher, Kentucky Warbler, Black Vulture, and Belted Kingfisher, ect.

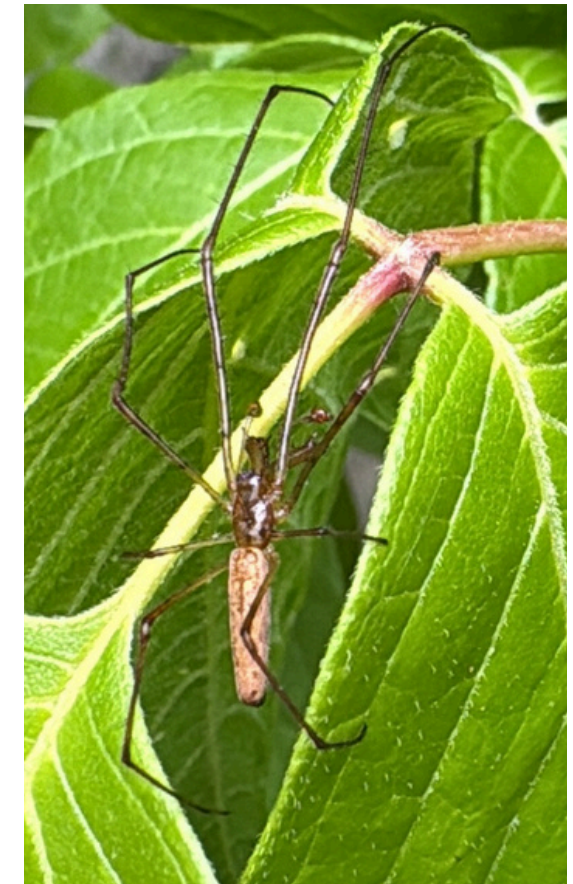
Reptiles and Amphibians: Milk Snake, Bull Frog tadpole, Common Water snake

Macroinvertebrates: Rusty Crayfish, Riffle Beetles, aquatic worms

5. Biodiversity: Plant and Animal Abundance



Damselflies



Common Long Jawed Orb Weaver



Assassin bugs

Insects: Assassin bugs,
Jewel Wing Damselflies,
Tiger Swallowtail, Black
Swallowtail, Spice Bush
Swallowtail, Shpinx Moth,
Common Long Jawed Orb
Weaver



Sphinx Moth Catapillar

5. Biodiversity: Watershed health indicator species



Rainbow Darter



Crane fly larva

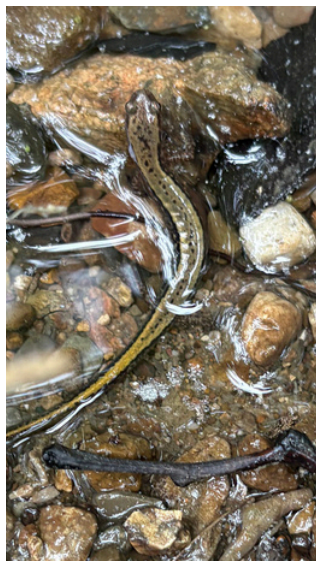


Hellgrammite

Jefferson Salamander in the larval stage



Two-lined Salamanders



Signs of good water quality because they have low pollution tolerance. Macroinvertebrates that have been found are Mayflies, dobson fly larvae, stone fly larva crane fly larvae (Moderate), caddisflies, and water pennies

Protected Species found: Running Buffalo Clover



6. Public Outreach



Get the community involved by sharing what is happening with the stream restoration (Link on the Right) and what they can do as farmers or residential homeowners to protect the creek.

Information for Landowners

1. Plant and/or protect existing native trees and shrubs around the creek or yard.
2. Try not to mow along the stream.
3. If you have livestock, consider fencing to limit stream access.
4. Don't dredge, fill, dump, or backfill stream channels or floodplain areas.
5. Store soil, mulch, compost, yard waste and firewood far from the stream
6. Avoid putting structures directly near the streams
7. Monitor the stream for noticeable changes.
8. Partner with local organizations or get professionals to address stream issues.
9. Get septic systems maintained if needed

7. Further Suggestions and Plans

1. Continuous monthly water quality monitoring of Middle Creek throughout the year with the help of volunteers to get the community involved.
2. Separate horse trails that are not adjacent to the creek like the hiking trails are to protect the stability and quality of the stream as well as trail usability.
3. Stormwater management through public outreach to nearby residents.
4. Protecting the natural wetlands around Middle Creek by monitoring, provide enhancements on wetlands by restoring native vegetation, and making sure they are not destroyed.
5. Protection for the high-quality areas by easements or partnerships.
6. Add more riparian buffers for parts the Middle Creek that intersect with or are within a short distance of the road. Install a stormwater wetland, rain garden, or larger detention basin by the road to temporarily collect water from the road.
7. Communicate with the health department to have septic systems looked at to ensure they do not fail and contaminate groundwater and drinking supplies.
8. Communicate with private landowners on how they can protect the creek near their homes. Offer assistance if able through volunteer planting or invasive removal events.

7. Further Suggestions and Planning: What still needs to be done?

Finish organizing sections, there is a lot of data, but it needs to be organized. Go in depth on the specific BMPs that could be used. Go into what funding will be needed for the plan such as to enhancing, protect, and/or restoring wetlands. Make any needed adjustments to the watershed plan document.

The making it happen section is still needed as well.

Once this is done, action can be taken to make real changes.



Thank you all for being here and for giving me the resources that I needed to start to plan. Everybody in this room has contributed greatly and I hope to hear ideas from you all about how everyone can best contribute and how to make real action happen to keep Middle Creek a great resource for Boone County!

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Idea sharing time!

