Kenney Ridge Community:

Recommendations for Achieving an Exemplary Upper Piedmont Forested Habitat

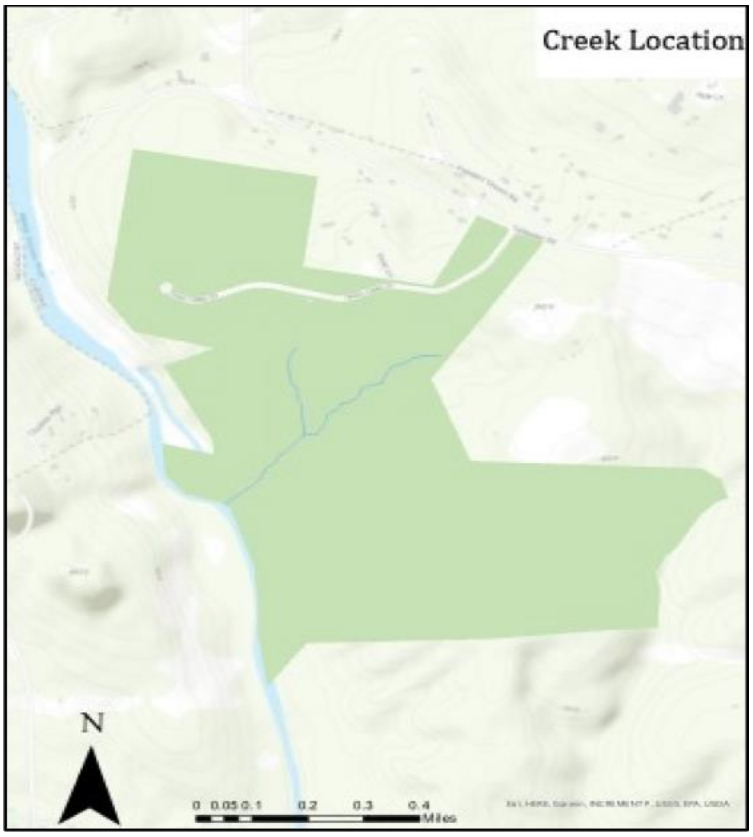

Figure 1. A map of the property and the location of the creek.

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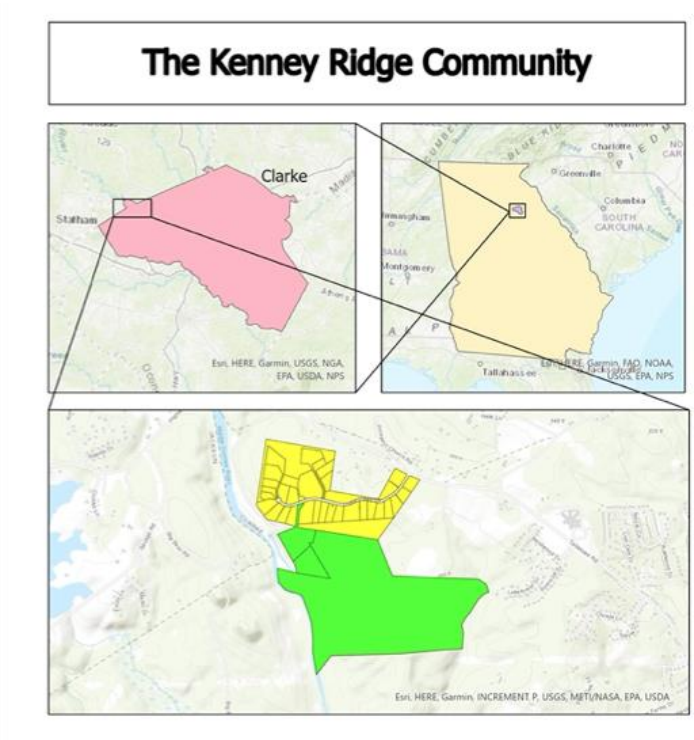
Executive Summary



The Kenney Ridge Property comprises 132 acres of an intentional conservation community in northwest Athens. The property features hiking trails and communal spaces, which foster community engagement. Due to much of that involvement and dedication, there is a strong commitment to promoting sustainable environmental practices.

Our client, Nancy Stangle, serves as co-manager of the Kenney Ridge Community Property and is a long-standing Kenney Ridge Community Association (KRCA) member. With a true devotion to environmental conservation, Nancy is seeking guidance in creating the vision of an exemplary Upper Piedmont forested habitat. Our project aims to assist in establishing an ideal habitat within this community. To achieve this, we recommend planting understory species that will increase stream bank stability and mitigate erosion. Additionally, introducing species such as Nimblewill and Wood Oats will not only support these efforts, but also assist in outcompeting *Microstegium*. For areas of high priority, utilizing the most suitable control method based on the density and size of the patch- such as weed-eating, implementing chemicals, or hand-pulling- can help manage its spread.

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Acknowledgments

We extend our heartfelt gratitude to the residents of the Kenney Ridge Community for allowing us to conduct our senior project on their property. Specifically, thanks to Nancy Stangle for her unwavering support and invaluable guidance throughout our data collection and visits. We enjoyed our time there and appreciated the detailed insights Nancy provided. We are grateful for the community's enthusiasm and commitment to fostering the health of their land.

Additionally, we wish to express our sincere thanks to our instructors, Dr. Elkins and Dr. Hazelton, for their invaluable assistance and support throughout the semester. Your time and dedication were significant in helping us shape our project. We also wish to acknowledge and thank Dr. Lowe and Dr. Shelton for their input and expertise, which greatly contributed to our data collection efforts at Kenney Ridge.

Introduction

The Kenney Ridge Property consists of 132 acres of intentional conservation community in northwest Athens, Georgia. Adjacent to the developed community lies an additional 246 acres that are under the protection of a conservation easement. The property features hiking trails and communal spaces, which allow the community residents to be actively involved. Due to much of that involvement and dedication, there is a strong commitment to promoting sustainable environmental practices.

Our client, Nancy Stangle, serves as co-manager of the Kenney Ridge Community Property and is a long-standing member of the Kenney Ridge Community Association (KRCA). With a true devotion to environmental conservation, Nancy is seeking guidance in creating the vision of an exemplary Upper Piedmont forested habitat. Our project aims to assist in establishing an ideal habitat within this community. We will achieve this by providing recommendations to maximize riparian zone quality, develop a management plan for *Microstegium vimineum*, an invasive exotic plant that is present, and evaluate water quality in the streams within the property.

The Kenney Ridge Community is registered as an intentional conservation community. Portions of this property have been placed under a conservation easement with the Athens Land Trust since the late 1990s. This is an organization created by Skipper StipeMaas and Nancy Stangle as they were developing the property in the early 90's. Built for conservation and a community land trust, this organization has provided wonderful properties across the state for housing and protected lands. Through much hard work and dedication, Nancy Stangle, alongside the Kenney Ridge Community, has become great stewards of the land to represent the perfect piedmont area property.

Site Description

This property is located on the northwest side of Athens, Georgia along the Oconee River. The varied topography from upland to floodplain provides habitat for many species to flourish. Through the upland, Oaks and Hickories are quite prevalent, filled in by some southern pine species. The understory is largely open with a few small trees growing in the area due to limited sunlight breaching the canopy. Despite not having many understory species, some vines such as greenbrier and muscadine are quite prevalent. Two winding streams flow down the property, bringing a great blend of habitat that increases biodiversity. The streams are spring fed with clear water, eventually merging into a single channel that continues to flow down to the floodplain and into the Oconee River. Both streams express many different mesohabitats just along the streams (mesohabitats are pools, riffles, or varying substrates in a creek). From leaf litter, silty bottom, or rocky bottom there is a healthy blend of locations for wildlife to make home. The floodplain is rich with vegetation. Floodplain trees line the river and stream, canebrakes of River Cane and native grasses fill the rest of the area. Invasive plant species are present in the floodplain of the Oconee River and up the riparian corridor of the streams. Japanese Stiltgrass (*Microstegium vimineum*) and Chinese Privet (*Ligustrum sinense*) make up most of the invasive vegetation on the property.

The Kenney Ridge Property was historically cotton farmland. Previous farming practices led to disturbances on the forest floor. Large drainage ditches can be found along the property, which is likely to have caused some erosion issues through the years.

Figure 2. A photo of the Kenney Ridge stream near the floodplain.

Objectives and Assessment Design

For this project, The Kenney Ridge Community has three main objectives:

1. Maximize riparian zone quality
2. Establish a *Microstegium* management plan
3. Ensure the highest water quality in the streams on the property

We made recommendations for this assessment to help achieve the communities' objectives. We completed a water health survey through water quality testing and macroinvertebrate surveys. Additionally, we completed a *Microstegium* location assessment to locate areas of high *Microstegium* colonization and evaluate potential management strategies. Lastly, we did a canopy survey of the property using Lidar footage from a drone.

Methods

Macroinvertebrate Sampling:

We used the Georgia Adopt-A-Stream Macroinvertebrate form (GA.gov, et al. 2020) to evaluate the macroinvertebrate community. The equipment used for macroinvertebrate collection included d-nets, sieves, buckets, collection jars, a dissection kit, rose bengal solution, a large metal pan, and flagging tape.

We began the sampling by moving the d-net throughout the stream for 10 minutes. In the d-net, we collected leaf litter and sediment to find macroinvertebrates. Once the 10-minute timer was up, we dumped the collected material from the d-nets into a large metal pan and sieves. We sorted through using our hands and dissection kits to find macroinvertebrates. Once found, the macroinvertebrates were placed into collection jars with rose bengal solution. The rose bengal solution preserved the macroinvertebrates for a limited time until it was transferred to a solution with higher ethanol content.

We completed this process on each of the three stream legs for a total of three samples. Each location was marked with flagging tape to keep track of locations for future sampling. The macroinvertebrates were taken to the lab and transferred to a solution with a higher ethanol content. We then sorted the macroinvertebrates we found down to family level of taxonomic identification.

Additionally, we completed another set of three samplings later in the season. This gave us a total of six samplings, including the original set of three. These additional samples were collected in order to get a larger sample size and ensure that the data was accurate.

Water Sampling:

We collected water samples in plastic bottles at each of the macroinvertebrate sampling locations before we disturbed the stream. We placed the samples on ice to preserve the water properties. Once collected, the samples were taken back to the lab to be tested. We performed tests including pH, turbidity, and nitrate levels. Additionally, we took a YSI meter to the stream to take measures of temperature, dissolved oxygen, and conductivity. The stream water levels were relatively low, which made sample collection challenging. We averaged the measurements for each test from all three streams in order to get an overall estimate.

Figure 3. Samantha collecting water quality data using the YSI meter.

Canopy:

To observe the canopy cover and riparian cover around the stream, we collected lidar drone footage. We used a DJI Matrice 300 model drone with a Zenmuse L1 lidar sensor to complete the drone footage. Dr. Tripp Lowe assisted in performing the drone flight on the property. We stationed the base for the flight along the power line right of way on the property. This location is a high point and relatively open allowing us to maintain sight of the drone at all times. We were only able to obtain footage from two sections of the stream. This included the smaller stream leg as well as part of the stream near the floodplain.

Once the footage was taken, we were able to supplement it with US Geological Service lidar footage of the area from 2018 to obtain a full view of the creeks. We used ArcGIS to create the maps from the drone footage we acquired.

Figure 4. Nancy Stangle and Lily with the drone used to take lidar footage.

Microstegium Sampling:

For vegetation sampling, we walked along the riparian zone to determine areas of high *Microstegium* and areas with bare soil. We walked along the riparian zone in 100-meter increments. The three of us walked along the 100-meter increment in a line with 5 meters in between each of us. As we walked along each side of the stream, we noticed and marked areas with portions of *Microstegium*. We used a GPS device to mark where the *Microstegium* areas are located. This GPS data was used to create a map of the areas of *Microstegium* colonization

Microstegium Alternative Assessment:

We created a scaled assessment for different management techniques of *Microstegium.* The techniques were ranked based on effort, cost, effectiveness, and client approval on a scale of 0-5, where 5 is the most preferred option of each metric. Client approval was doubled in order to incorporate our perceived importance of this metric to the client. Each metric was tallied, and total scores were used to evaluate the most desirable method, where a higher score was the most preferred method.

Results

Macroinvertebrate Sampling:

We pooled our three sampling spots to create a health assessment of the entire stream. In total, we found 18 different families and 140 individual specimens. Some of these families included dragonflies (Family Gomphidae), stoneflies (Family Peltoperlidae), and mayflies (Families Ephemerellidae, and Heptagiinade). Using ratings from the Georgia Adopt-A-Stream form (GA.gov, et al. 2020), we were able to assign the pollution tolerance of these species. Of the 18 families collected, 12 of them were categorized as low-tolerance species, three of the families were mid-tolerance species, and three families were high-tolerance species. The low tolerance category indicates that these species will live in areas with low pollution levels. Low tolerance species are depicted in figures 7-9. Therefore, the Kenney Ridge Stream has low pollutant levels based on the proportion of intolerant macroinvertebrate families found.

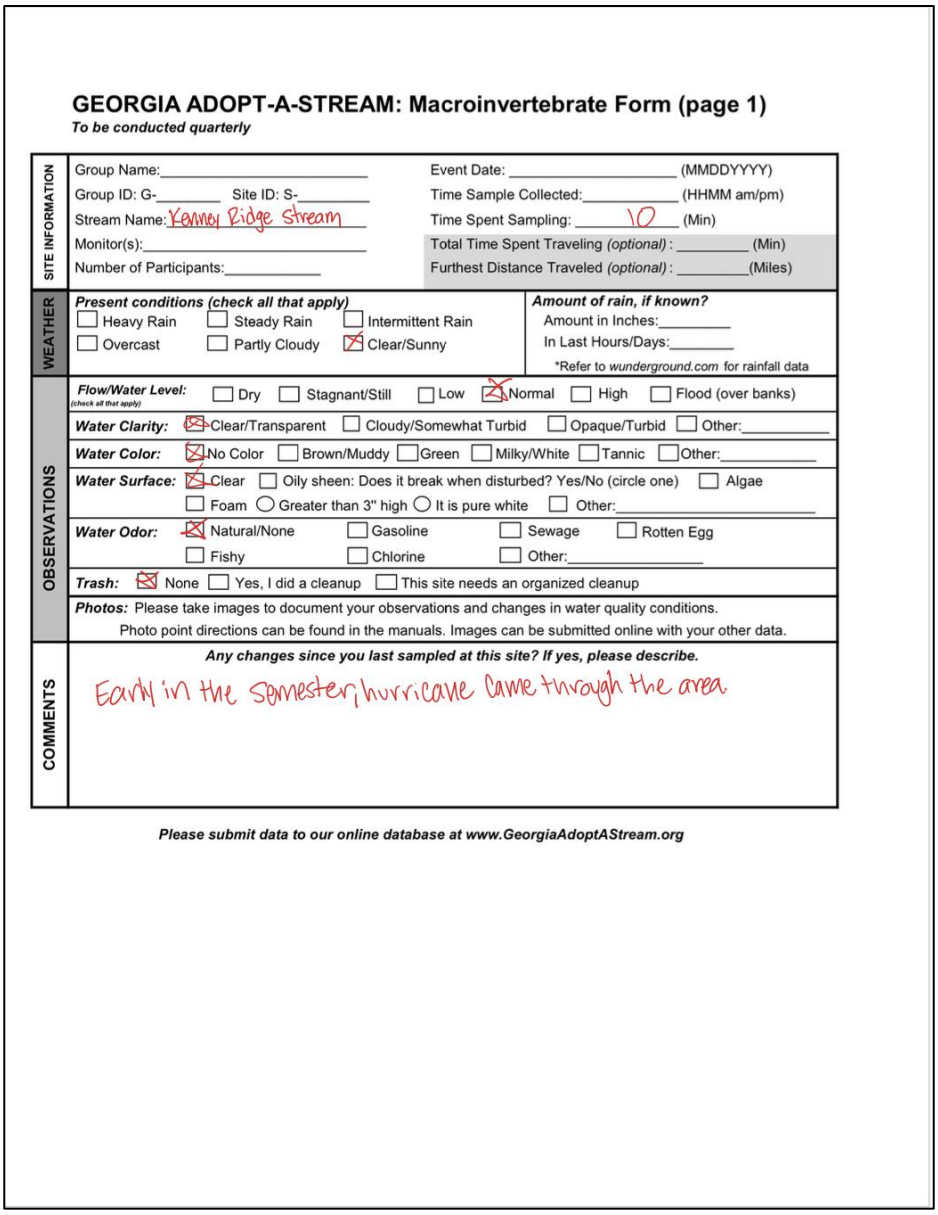
Table 1. Tables of Macroinvertebrates in Relation to Level of Pollution Tolerance

Low Tolerance	Total
Perlidae	9
Perlodidae	12
Peltoperlidae	48
Ephemerellidae	3
Heptageniidae	16
Ephemeridae	6
Hydroptilitdae	3
Hydropsychidae	14
Psephinidae	1
Corydalidae	2
Elmidae	2
Capriidae	1
	117

Medium Tolerance	Total
Gomphidae	5
Diptera	1
Tipulidae	11
	17

High Tolerance	Total
Chironomidae	2
Oligochaeta	4
Simulidae	1
	7

Using the Georgia Adopt-A-Stream form (GA.gov, et al. 2020) mentioned above, we were able to calculate a rating for the stream. Based on the number and type of families found, this stream got a rating of 25, which is considered to be in excellent condition.



GEORGIA ADOPT-A-STREAM: Macroinvertebrate Form (page 1)

To be conducted quarterly

SITE INFORMATION

Group Name:_____ Event Date: _____ (MMDDYYYY)

Group ID: G-_____ Site ID: S-_____ Time Sample Collected:_____ (HHMM am/pm)

Stream Name: Kenney Ridge Stream Time Spent Sampling: 10 (Min)

Monitor(s):_____ Total Time Spent Traveling *(optional)* : _____ (Min)

Number of Participants:_____ Furthest Distance Traveled *(optional)* : _____(Miles)

WEATHER

Present conditions (check all that apply)

☐ Heavy Rain ☐ Steady Rain ☐ Intermittent Rain

☐ Overcast ☐ Partly Cloudy ☒ Clear/Sunny

Amount of rain, if known?

Amount in Inches:_____

In Last Hours/Days:_____

*Refer to *wunderground.com* for rainfall data

OBSERVATIONS

Flow/Water Level: *(check all that apply)* ☐ Dry ☐ Stagnant/Still ☐ Low ☒ Normal ☐ High ☐ Flood (over banks)

Water Clarity: ☒ Clear/Transparent ☐ Cloudy/Somewhat Turbid ☐ Opaque/Turbid ☐ Other:_____

Water Color: ☒ No Color ☐ Brown/Muddy ☐ Green ☐ Milky/White ☐ Tannic ☐ Other:_____

Water Surface: ☒ Clear ☐ Oily sheen: Does it break when disturbed? Yes/No (circle one) ☐ Algae

☐ Foam ◯ Greater than 3" high ◯ It is pure white ☐ Other:_____

Water Odor: ☒ Natural/None ☐ Gasoline ☐ Sewage ☐ Rotten Egg

☐ Fishy ☐ Chlorine ☐ Other:_____

Trash: ☒ None ☐ Yes, I did a cleanup ☐ This site needs an organized cleanup

Photos: Please take images to document your observations and changes in water quality conditions.

Photo point directions can be found in the manuals. Images can be submitted online with your other data.

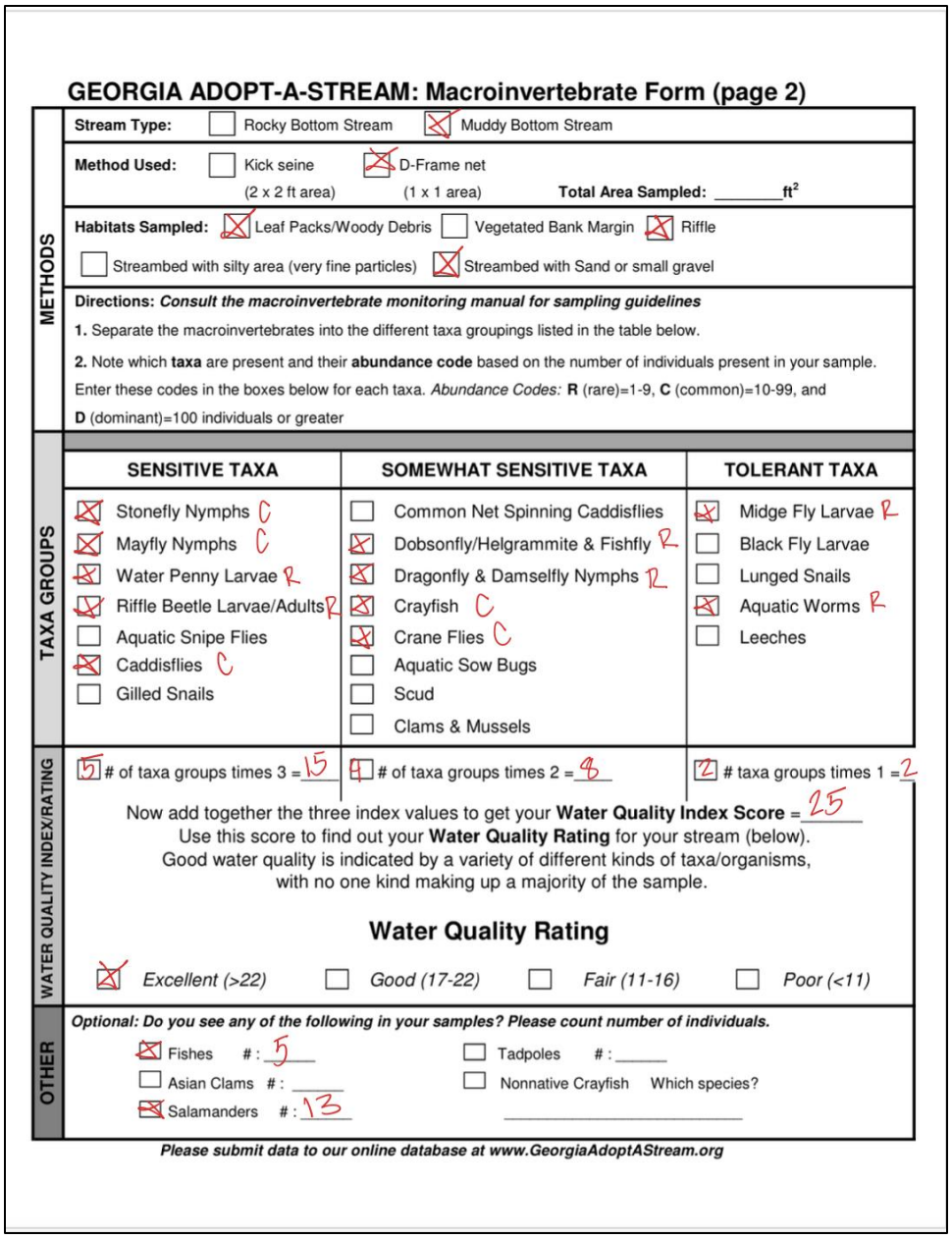
COMMENTS

Any changes since you last sampled at this site? If yes, please describe.

Early in the semester, hurricane came through the area.

Please submit data to our online database at www.GeorgiaAdoptAStream.org

Figure 5. Page one of Georgia Adopt-A-Stream Macroinvertebrate form.



GEORGIA ADOPT-A-STREAM: Macroinvertebrate Form (page 2)

METHODS

Stream Type: ☐ Rocky Bottom Stream ☒ Muddy Bottom Stream

Method Used: ☐ Kick seine (2 x 2 ft area) ☒ D-Frame net (1 x 1 area) **Total Area Sampled:** _____ ft²

Habitats Sampled: ☒ Leaf Packs/Woody Debris ☐ Vegetated Bank Margin ☒ Riffle ☐ Streambed with silty area (very fine particles) ☒ Streambed with Sand or small gravel

Directions: ***Consult the macroinvertebrate monitoring manual for sampling guidelines***

1. Separate the macroinvertebrates into the different taxa groupings listed in the table below.

2. Note which **taxa** are present and their **abundance code** based on the number of individuals present in your sample. Enter these codes in the boxes below for each taxa. *Abundance Codes:* **R** (rare)=1-9, **C** (common)=10-99, and **D** (dominant)=100 individuals or greater

TAXA GROUPS

SENSITIVE TAXA	SOMEWHAT SENSITIVE TAXA	TOLERANT TAXA
☒ Stonefly Nymphs C	☐ Common Net Spinning Caddisflies	☒ Midge Fly Larvae R
☒ Mayfly Nymphs C	☒ Dobsonfly/Helgrammite & Fishfly R	☐ Black Fly Larvae
☒ Water Penny Larvae R	☒ Dragonfly & Damselfly Nymphs R	☐ Lunged Snails
☒ Riffle Beetle Larvae/Adults R	☒ Crayfish C	☒ Aquatic Worms R
☐ Aquatic Snipe Flies	☒ Crane Flies C	☐ Leeches
☒ Caddisflies C	☐ Aquatic Sow Bugs	
☐ Gilled Snails	☐ Scud	
	☐ Clams & Mussels	

WATER QUALITY INDEX/RATING

☒ 5 # of taxa groups times 3 = 15 ☐ 4 # of taxa groups times 2 = 8 ☒ 2 # taxa groups times 1 = 2

Now add together the three index values to get your **Water Quality Index Score** = 25

Use this score to find out your **Water Quality Rating** for your stream (below).
Good water quality is indicated by a variety of different kinds of taxa/organisms, with no one kind making up a majority of the sample.

Water Quality Rating

☒ *Excellent (>22)* ☐ *Good (17-22)* ☐ *Fair (11-16)* ☐ *Poor (<11)*

OTHER

Optional: Do you see any of the following in your samples? Please count number of individuals.

☒ Fishes # : 5 ☐ Tadpoles # : _____

☐ Asian Clams # : _____ ☐ Nonnative Crayfish Which species? _____

☒ Salamanders # : 13

Please submit data to our online database at www.GeorgiaAdoptAStream.org

Figure 6. Page two of Georgia Adopt-A-Stream Macroinvertebrate form.

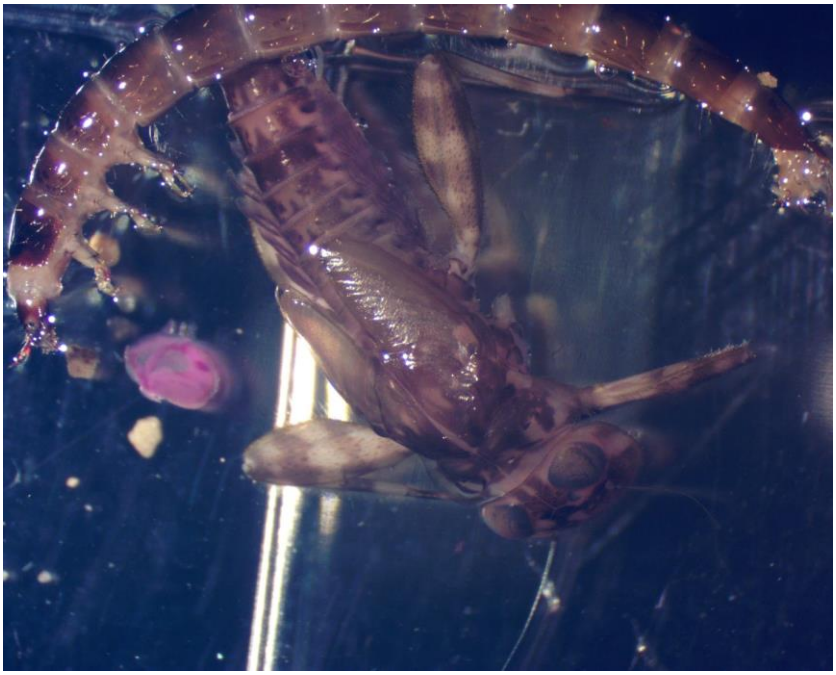


Figure 7. A Macroinvertebrate species from the Heptageniidae family.

Figure 8. A photo of the gills from an Ephemerellidae species.

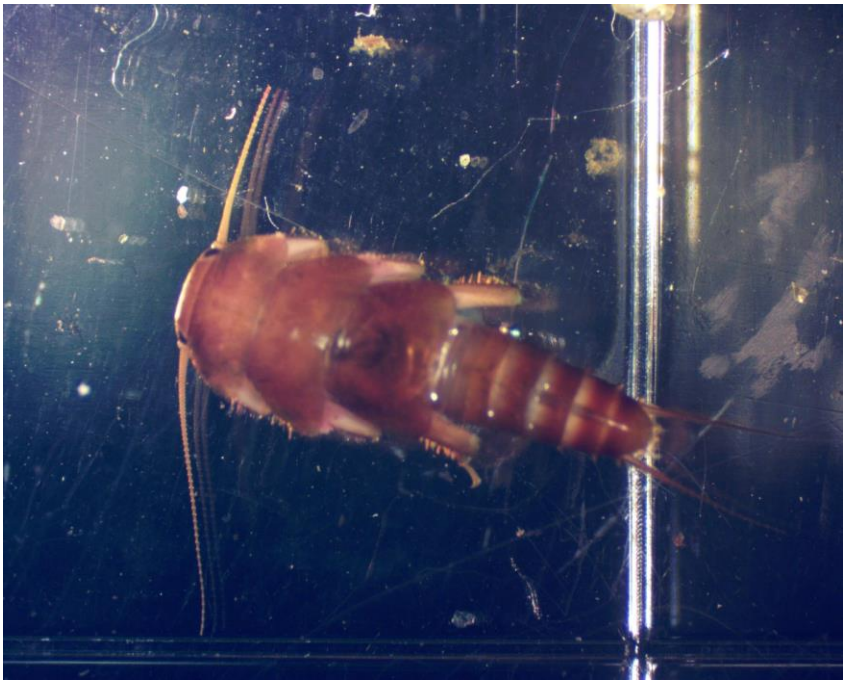


Figure 9. A photo of a Peltoperlidae macroinvertebrate species.

Water Sample:

From our water samples, we found relatively healthy water conditions. Again, we tested for temperature, pH, dissolved oxygen, nitrates, turbidity, and conductivity. We found the water to have a temperature of 16.7 degrees Celsius, a pH of 7.05, a dissolved oxygen level of 10.05 mg/L, nitrate levels of 0.00 ppm, a turbidity level of 11.33 ftu (equivalent to ntu), and conductivity levels of 16.17 us/cm. these water levels are within normal limits for a small stream in the piedmont region of Georgia. However, to ensure that the samples collected contained levels that were considered healthy, we chose to compare our data to the Upper-Oconee Watershed Network.

This organization completed testing in various streams around Athens, but the closest stream in relation to the Kenney Ridge Community was Tallassee Creek located on the Tallassee Tract. When sampling, the UOWN participants located many of the species that our group found,

such as mayflies, stoneflies, crayfish, and midge fly larvae. They also completed a series of water sampling tests, gathering levels of temperature, pH, turbidity, and conductivity. Due to the comparison between the size and health of the two, several of the values differ. However, all data collected suggests good stream health at both sampling points.

Table 2. A table showing our water measurements for the Kenney Ridge Stream.

Variable	**Value**
Temperature (C)	16.70
pH	7.05
Dissolved Oxygen (mg/L)	10.05
Nitrates (ppm)	0.00
Conductivity (us/cm)	16.17

Table 3. A table by UOWN showing the water measurements for Tallassee Creek.

Variable	Value
Temperature (C)	16.50
pH	7.08
Turbidity (ntu)	7.05
Conductivity (us/cm)	45.56

Canopy:

After looking at the drone footage we captured, we found that there was heavy canopy cover throughout the property and the riparian zone area. The canopy was largely dominated by overstory trees with minimal understory species. The maps from our drone footage are inserted below (Figures 10-12). They show that there is minimal mid and understory canopy cover on the property.

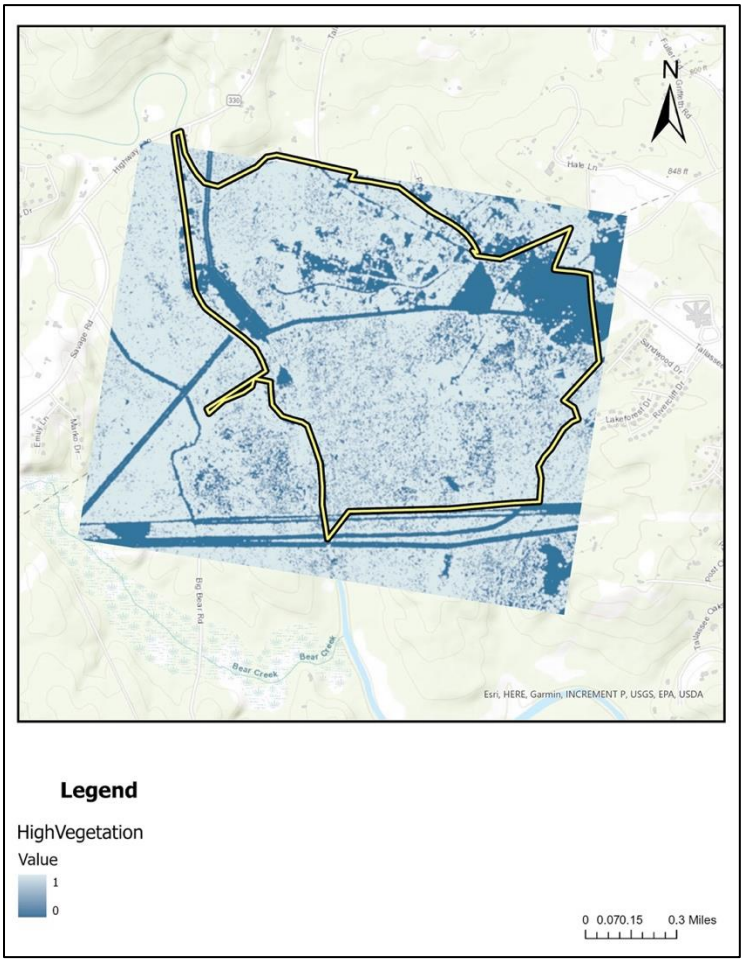


Figure 10. Map of high vegetation Cover. The light blue areas indicate canopy cover and the dark blue areas indicate no canopy cover.

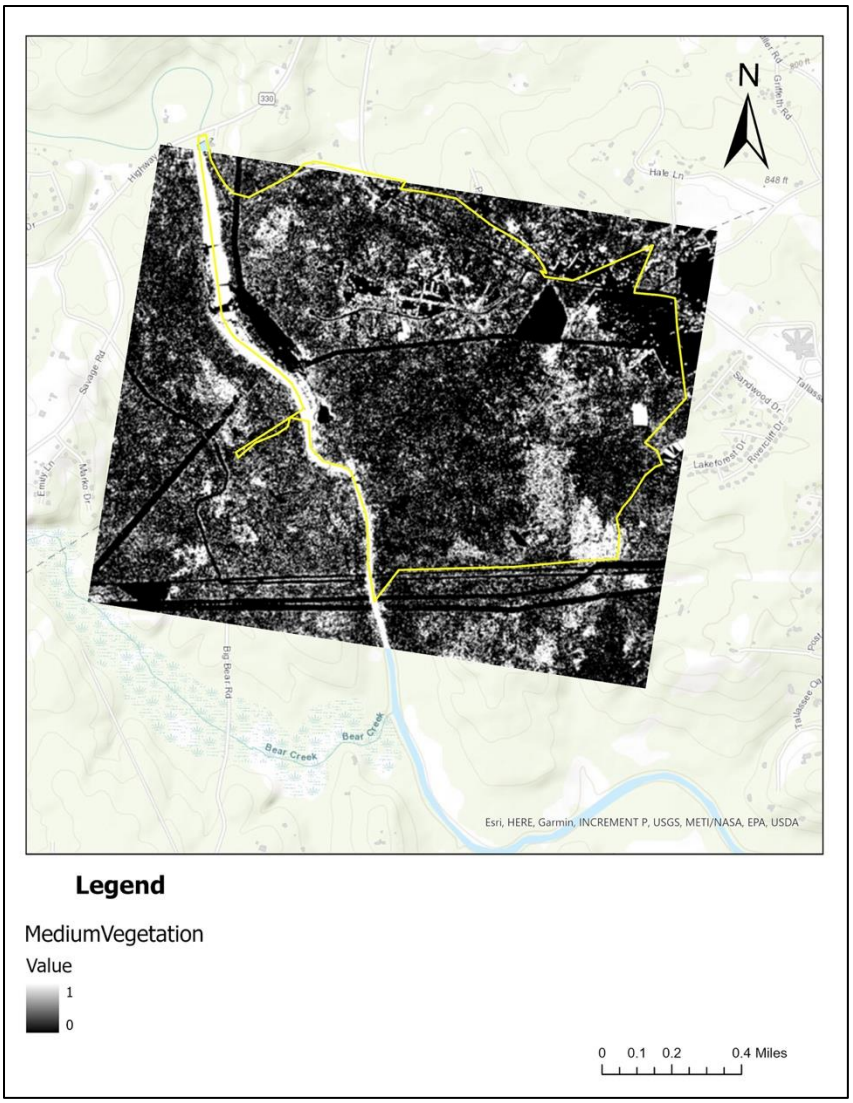


Figure 11. Map of medium vegetation cover. White areas indicate mid-story canopy cover and the black areas indicate no mid-story canopy cover.

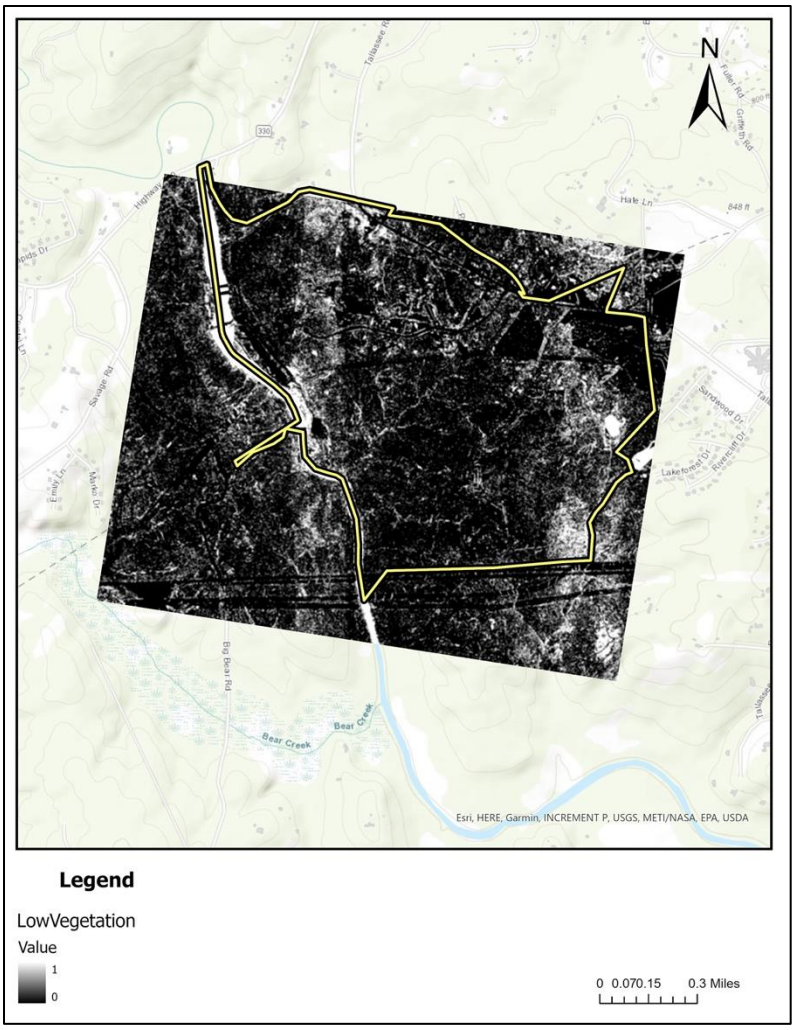


Figure 12. Map of low vegetation cover. White areas indicate understory canopy cover and black areas indicate no understory canopy cover.

Microstegium:

The highly invasive *Microstegium*, or Japanese stiltgrass, was found throughout the property. As an annual species, stiltgrass primarily thrives in shaded, moist, and disturbed areas. Typically, an infestation begins in these disturbed areas and can inadvertently spread to more undisturbed zones. A single plant can yield almost 1,000 seeds that can stay viable in the soil for up to 5 years. The seeds can float, so it is likely that the invasive be found rooted near or around a stream bank or be prevalent in a floodplain area. The property has been impacted by past agricultural practices leading to flooding issues; therefore, it is easy for the invasive to disperse this way (Neal and Judge 2023).

Based on our assessment, there were multiple areas of Japanese stiltgrass colonization. The *Microstegium* areas were mostly located near the stream bank and were least populated in areas with minimal water. We found large patches of dead *Microstegium* around the spring of the longer leg of the stream as well as in the floodplain area. The ridge areas and sloped portions of the property had very little *Microstegium* colonization. The map created by the GPS data will help the client focus their control efforts on specific areas of *Microstegium*. Overall, the *Microstegium* is still confined well and only requires control near the stream banks.

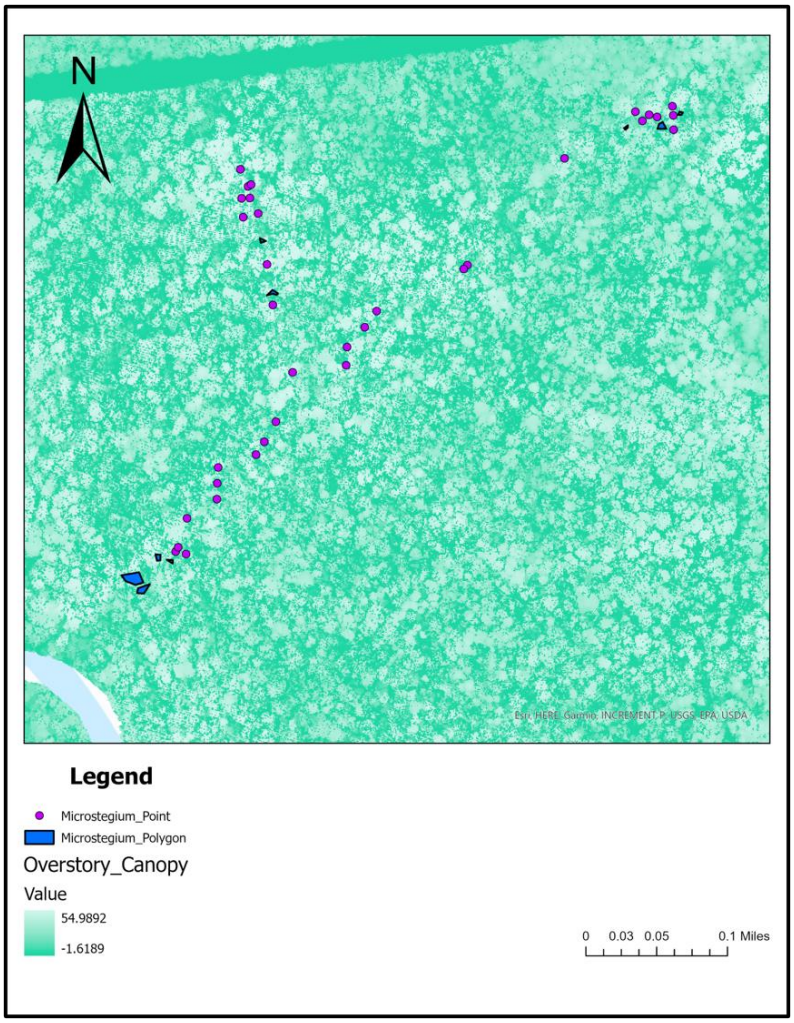


Figure 13. A map of *Microstegium* areas on top of an overstory canopy map. The purple dots on the map indicate small patches of *Microstegium*. The larger blue polygons indicate larger patches of *Microstegium*.

Alternatives Assessment:

After ranking our techniques, manual removal came out as the most preferred method. Manual removal followed by revegetation came in at a close second based on its higher predicted effectiveness despite the latter approach being the most costly in price and effort.

Table 4. A table showing the removal techniques of *Microstegium* and their ranking in each category.

Options	Effort	Cost	Effectiveness	Client Approval	Total
Manual removal	2	4	2	4*2=8	16
Chemical Removal	4	2	4	1*2=2	12
Flame Weeding	3	3	3	2*2=4	13
Mowing	3	3	3	2*2=4	13
Manual Removal and Revegetation	1	1	4	4*2=8	14
Do Nothing	5	5	0	0 *2=0	10

Discussion and Recommendations

Stream Health:

We found the Kenney Ridge stream to be a healthy stream based on both the macroinvertebrate sampling as well as the water quality tests. Due to this, we believe that not much restoration is needed to improve stream health, though maintaining a healthy riparian vegetation community is recommended and discussed further below. We further recommend continuing to be good stewards of the stream by planting native plants that can outcompete invasives and manage runoff. Species recommended to outcompete invasives and manage runoff are mentioned below in the canopy and microstegium recommendations. The plants recommended will be beneficial for all three objectives.

Canopy:

Based on the maps we created, and the limited coverage of understory species compared to midstory and overstory, we recommend planting understory species. Planting understory species will increase the vegetative diversity in the riparian zone. In addition, adding more understory species will help increase stream bank stability. Erosion on stream banks occurs as a result of water movement and other natural processes. Planting understory species will help mitigate any erosion that may occur because the roots stabilize the soil while leaves and stems limit rainfall impact and slow overland flow. Some species we recommend for this area include Wood Oats (*Chasmanthium sessiliflorum*) and Nimble-will (*Muhlenbergia schreberi*). Wood oats are a species that is often recommended for stream bank stability restoration. It prefers part-sun to shaded areas and provides food for birds and small mammals. Nimble-will, also suggested for *Microstegium* control, forms mats that help with erosion control (Athens-Clarke County).

The map in Figure 10 shows the abundance of overstory tree coverage. With a closed canopy, as seen at Kenney Ridge, there is less light able to penetrate to the forest floor. This can result in fewer understory species occurring on the forest floor. One way to fix this is through the use of pruning. Pruning will help create areas for sunlight to penetrate through the overstory and reach the forest floor. Pruning allows trees to remain standing and in their natural state while allowing the sunlight through (Sandler 2024). It is advised to hire an arborist to assist in the pruning to ensure that the pruning is done in a clean and safe fashion. Pruning does have the risk of exposing the tree to diseases and ensuring clean pruning will help prevent infection.

***Microstegium*:**

Our recommendations for *Microstegium* control will vary based on the size of the colonization area. In areas designated as smaller portions (purple points on Figure 13), we recommend the continued practice of community workdays using manual control by pulling the grass. Pulling grass before it seeds is ideal to prevent unwittingly dispersing seeds and ensure that spread of *Microstegium* does not continue. We also recommend pulling the *Microstegium* during early to mid-summer before it begins to flower. The flowering range for *Microstegium* is mid-September to late October (Neal and Judge 2023).

Figure 14. A photo showing a small portion of *Microstegium* that can be controlled by manual pulling.

In places designated as large colonization areas (blue polygons on Figure 13), we recommend using more aggressive control methods. One recommendation is the use of flame weeding. This method is ideal in moist areas where the threat of the fire getting out of control is mitigated. Flame weeding is practiced during the seedling stage of a plant (Beitz Thomson and Frye). This will ensure the seedlings are controlled before seed production. It would be best to do this control during late winter as *Microstegium* begins to seed during early to mid-spring. A possible downside to flame weeding is the habitat and vegetation around the targeted species. The flame weeding has the potential to kill off some of the wanted vegetation surrounding the invasive species and therefore is recommended for heavily infested areas with not much native vegetation.

Mowing or weed-eating is another great technique for larger colonies of *Microstegium*. A large mowing operation in late summer has been found to be effective for reducing seed

production. The most effective method to control the *Microstegium* in a large colony would be chemical spraying. We recommend carrying this out on large, established patches of the plant to stop its spread. Glyphosate, the active ingredient in Roundup, has been shown to perform well on invasive species. High soil absorption of the chemical limits leaching and spread of the chemical to other plants, although it should be applied carefully. With an average half-life of around two months, the ecosystem can return to normal. There are glyphosate mixtures that are non-toxic, but certain mixtures can cause damage to wildlife (Tu et al. Pg 7e1). Sethoxydim is another chemical control agent that works well to fight grasses. This chemical has an average half-life in soil of a few days. Known to be low-toxicity and does not affect broadleaf or woody plants. One downside is the chemicals low soil absorption which can lead to spread on the property (Tu et al. pg 7J.1). Our client has expressed a preference for non-chemical strategies, but it is important to note as an effective method should the *Microstegium* infestation progress to the point that other methods become impractical.

Lastly, revegetation of native plants after control techniques is highly recommended and known to be an effective method in blocking the return of invasive plants and returning the habitat to its natural state. As mentioned previously, Wood Oats and Nimblewill can be two effective plants for this purpose as well as assisting in erosion control. Although this can be a costly endeavor, grants and state programs may help mitigate those costs and we recommend contacting the local UGA Cooperative Extension Office (706-613-3640, or online at: https://extension.uga.edu/county-offices/clarke/agriculture-and-natural-resources.html) for technical expertise and information on incentives and cost-share programs.

Figure 15. A photo showing a large area of *Microstegium* in the floodplain.

Literature Cited

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