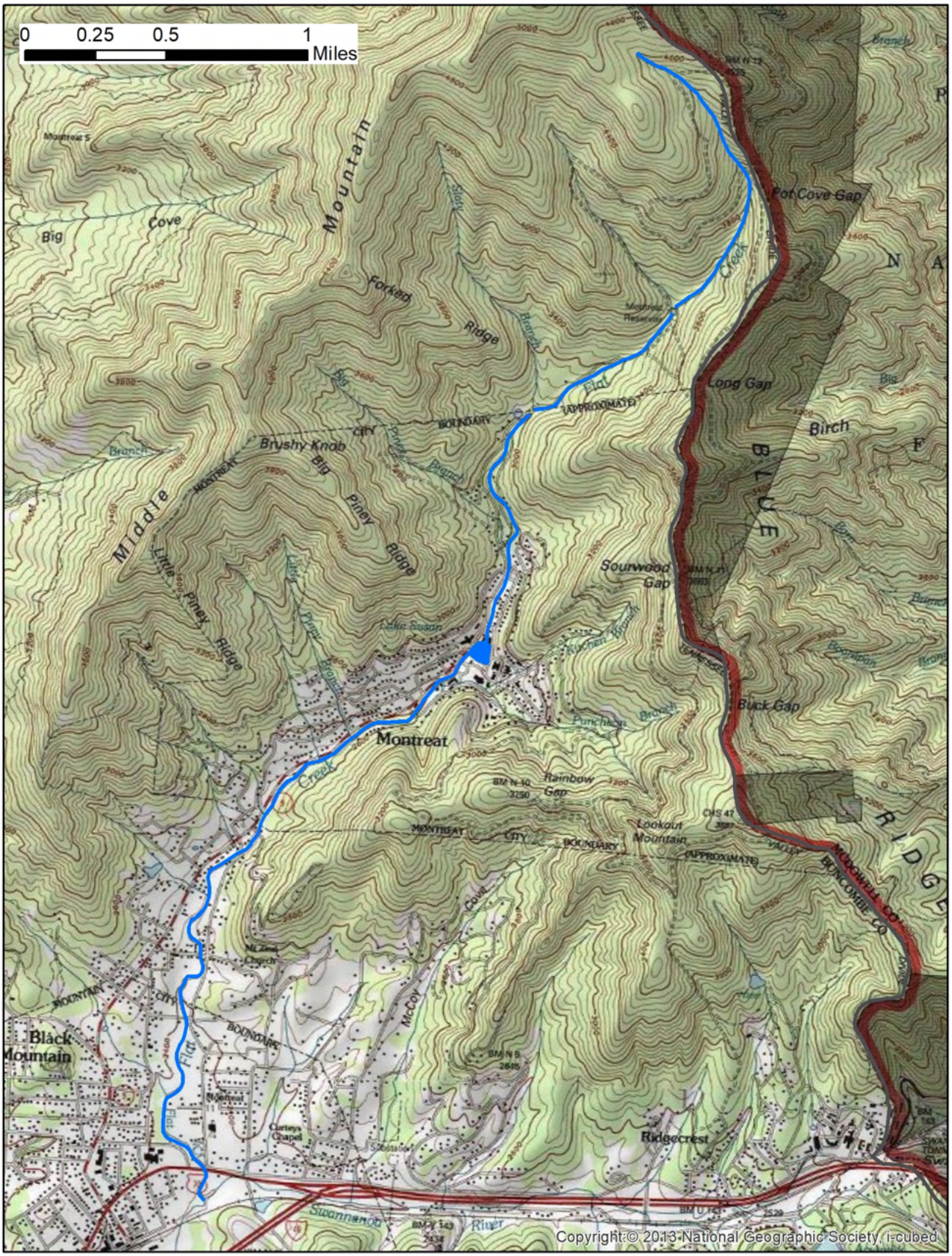
Flat Creek 2040 Science Working Group

Organizational Meeting

May 9, 2025, Black Mountain, North Carolina

A Compilation of Presentations by Participants Actively Engaged with Flat Creek and Its Science, Education and Policy Aspects

Map of Flat Creek Watershed in Montreat and Black Mountain, NC



Contents

A PDF of the final document will be available online at:
https://drive.google.com/drive/folders/1ur4O1MfVdRgKrudA03OjfIxJZpZiXLYi?usp=drive_link

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Ann Marie Traylor, Executive Director, Environmental Quality Institute, Black Mountain, amt@eqilab.org

AGENDA

Time	Session and presentation	Presenter and affiliation
9:40 A.M.	**Workshop welcome, introduction, statement of scope, content, aims**	William Seaman, University of Florida (ret.)
10:00	**Session 1: Science of the Flat Creek watershed, Montreat and Black Mountain---** Moderators: Jake Rash and Ann Marie Traylor To consolidate reliable scientific findings from past and present research, identify possible gaps in knowledge, provide at least a snapshot of the impacts of Hurricane Helene, and promote potential collaboration among attendees in future research and education. (Note: Flat Creek is the only part of the Upper Swannanoa watershed addressed.)	
10:00	History of the Land: Flat Creek	Anne Chesky, Presbyterian Heritage Center
10:10	Geomorphology, Physiography, Abiotic Factors and Data Proxies for Flat Creek	William Seaman, University of Florida (ret.)
10:20	Water Quality of Flat Creek: Volunteer Water Information Network Data	Ann Marie Traylor, Environmental Quality Institute
10:30	An Overview of the Aquatic Biodiversity of Flat Creek	David Gillette, University of North Carolina Asheville
10:40	Hellbenders, Macroinvertebrates, and the Future of Long-Term Research and Monitoring in Flat Creek	Josh Holbrook, Montreat College
10:50	Stand up and stretch!	
11:00	An Update on the Trout Population in Flat Creek, North Carolina	Jacob Rash, North Carolina Wildlife Resources Commission
11:10	Look Backward, Angler. Part One:	Doug Miller, University of North Carolina Asheville
11:20	Look Backward, Angler. Part Two	Doug Miller, University of North Carolina Asheville
11:30	Lake Susan Dredging and Ecological Restoration	Marshall Taylor, Blue Earth Planning, Engineering and Design
11:40	StRAP funded: Flat Creek Streambank Repair	Anne Phillip, Town of Black Mountain
11:50	Question and answer session	Moderators

12:05 P.M.	Group photograph Lunch buffet, on-site	
12:55	**Session 2: Best science-based management practices in the region and in the Flat Creek watershed, Black Mountain and Montreat---**Moderator: David Gillette To inform attendees of how Flat Creek as both an integrated ecosystem and also a body of water under two jurisdictions is managed, as addressed more broadly in town comprehensive plans and also as the focus of storm water management plans; and also to identify emerging needs, if any, for further data, communications, or plan revision over the coming 15 years.	
1:00	Mountain Stream Watershed Planning and Stewardship	Jane Margaret Bell, Land of Sky Regional Council
1:15	Montreat Stormwater Management	Savannah Parrish, Town of Montreat
1:30	PENDING: Flat Creek and the comprehensive planning and stormwater management of Black Mountain	Josh Harrold, Town of Black Mountain
1:45	Questions and comments	Moderator
2:00	Stand up and stretch!	
2:15	**Session 3: Connecting dots and framing futures—** Moderator: Josh Harrold To evaluate and draw conclusions from the information presented in the first two sessions, in terms of identifying possible ways forward in the spirit embodied in the title "Flat Creek 2040."	
2:15	Education in Flat Creek Watershed	Tanya Poole, North Carolina Wildlife Resources Commission
2:35	Rapporteur feedback, panel discussion and debate of questions:	
2:35	Comments, reactions and feedback from contributors	Contributors wishing to give feedback on what has transpired at this meeting are invited to make concise summaries of ideas for how their organization might go forward using information/contacts/resources obtained today. Recommendations for the good of the order?
5-10 mn	Does the Flat Creek watershed qualify as a model for stream ecosystem science, ecological modeling, planning, and stewardship? Follow-up?	
5-10 mn	What are the lessons from extreme weather events, including Hurricane Helene, for scientists, planners and educators? Follow-up?	
5-10 mn	What information, revisions and updates are needed, if any for effective implementation of long-range plans for Flat Creek and its watershed? Follow-up?	All are invited to weigh in on the questions listed, and any others.
5-10 mn	OTHER?	
3:30	**Workshop wrap-up and brief summary, including any next steps, dissemination of results, collaborations, etc.—** Rapporteurs, planning team	
3:50	Evaluation—to complete before adjournment	
4:00	Adjourn	THANK YOU FOR PARTICIPATING!

Introduction to the Flat Creek 2040 Science Workshop

William Seaman, Professor Emeritus, Fisheries and Aquatic Sciences, University of Florida

Welcome to the Flat Creek 2040 Science Workshop! We thank all of our attendees for their great interest, enthusiasm, and engagement with the program. To our knowledge this is the first such meeting of its kind for a Western North Carolina mountain stream ecosystem, and certainly for Flat Creek of Montreat-Black Mountain. Our hope is that this meeting and its printed compilation provide a state-of-knowledge package from which we can assess the health of the system, appreciate its fit in the larger human and natural environment, and have a baseline for tracking, and guiding, future trends in it.

These pages introduce you to the workshop by bringing everyone up to speed concerning its origin and rationale, some of the ecosystem services provided by the watershed, some issues and concerns regarding its present and future status, and giving an overview of the goal, objectives, and format for the subjects covered.

Background

The idea for a meeting of experts to share all known and relevant technical information that would describe the Flat Creek watershed as much as possible came about in summer 2024. The planning team of four individuals came together as an independent entity, functioning as a stand-alone committee not under the auspices of any organization. To our knowledge, there were no other such meetings for any other watershed in western North Carolina. By contrast, as indicated below, there has been considerable engagement of scientists, educators, planners and resource managers, as well as citizens, in awareness, understanding, enjoyment and sustaining the Flat Creek ecosystem locally, and thereby sufficient material for this meeting.

Planning for a technical workshop was well along when Hurricane Helene struck the region on September 27, 2024. While the presentations from invited speakers initially were intended to summarize historical and present information to establish something of a baseline for the conditions and state of Flat Creek, the storm necessarily broadened the thinking of the planning team to address its impacts and the effects on the creek baseline.

Setting

According to the National Wild and Scenic Rivers System, North Carolina has approximately 37,853 miles of river (https://www.rivers.gov/north-carolina), although we are not sure how far their definition of river goes in the direction of the smallest headwaters. Meanwhile, we only guess as to how many thousands of mountain streams there are in western North Carolina. That said, the subject of our meeting today, Flat Creek, might seem nothing more than a rounding error. (As an aside, note that we are talking about Flat Creek in eastern Buncombe County, North Carolina, not the one that flows in the Broad River area to our South, nor the

settlement in the Weaverville area to our North, nor the one in the Nantahala National Forest to our West.) When it comes to mapping, however, there are numerous sources that at least show the location, length and drainage boundaries of stream systems. One of the better maps available for Flat Creek appears in Figure 1. The North Carolina Stream Mapping Project, led by N.C. Center for Geographic Information and Analysis, an agency in the Department of Information Technology (https://www.nconemap.gov/pages/streams), is one organization doing such maps (Figure 2). A few pictures below characterize some of the key features of Flat Creek and its watershed (Figure 3).

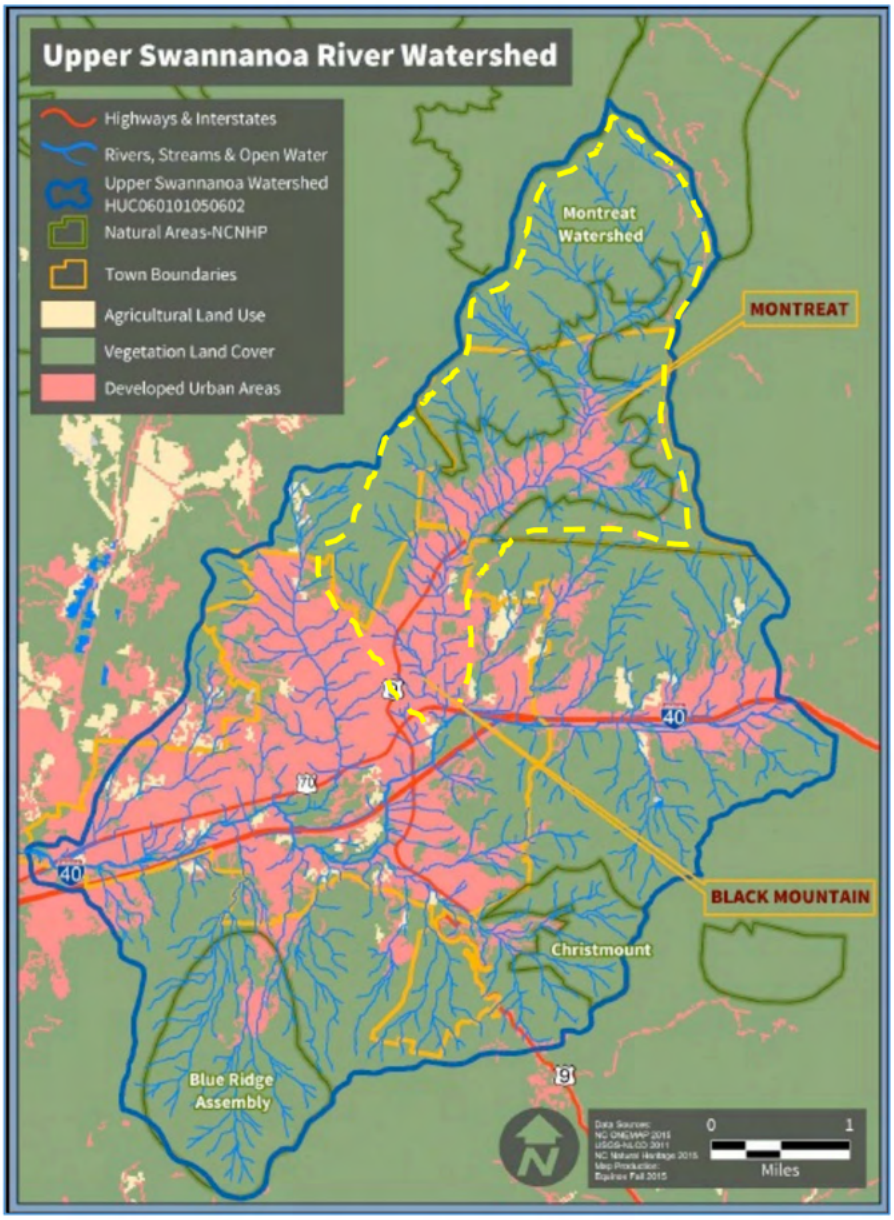
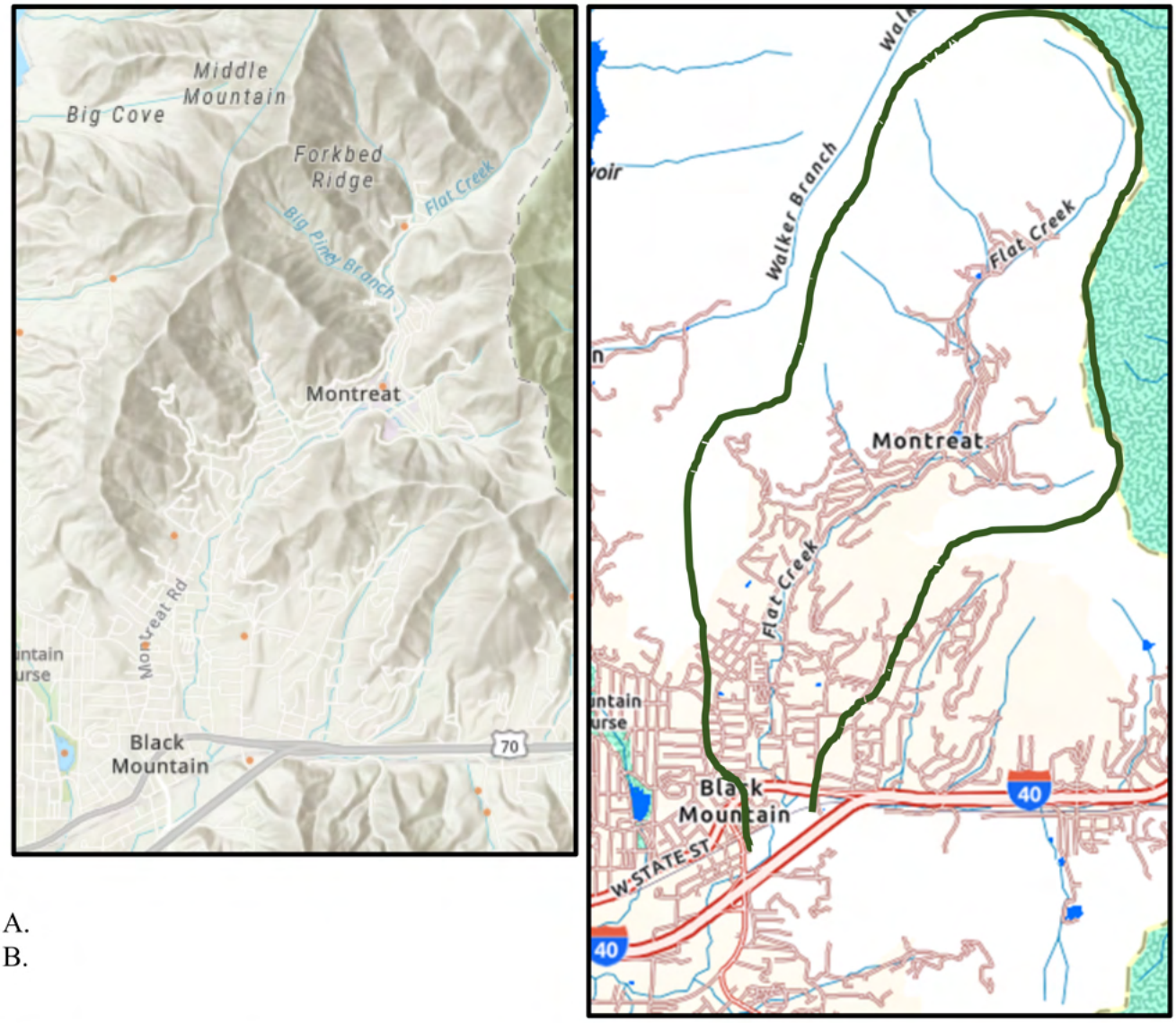


Figure 1. Approximate boundary of the Flat Creek watershed (dashed yellow line) as part of the Upper Swannanoa River drainage (solid blue line). Note gradation of principal land uses from headwaters to confluence with Swannanoa River in Black Mountain. (Source: Upper Swannanoa River Watershed Plan.)



A.
B.

Figure 2. Representative maps from North Carolina Stream Mapping Project. A, Tributaries and main channel of Flat Creek watershed and other streams, also illustrating resolution of map. B, Principal roads in Flat Creek watershed (boundary depicted by dark green line), layered with watercourse. Note: See Figure 1 for map scale. (Source: https://www.arcgis.com/home/webmap/viewer.html?panel=gallery&layers=15024c57c1464697b678f3a6bfeda5f8.)

Figure 3. Some pictures to frame visions for Flat Creek 2040.

Flat Creek Peaks and Valleys: Some Concerns and Responses

A recent visit to the area by a town comprehensive planning consultant group identified what they called "peaks and valleys" in the watershed. These included favorite places and also benefits, sometimes called ecosystem services, that were valued by stakeholders, as well as concerns and hotspots needing attention in the way of conservation and restoration. Valued Flat Creek services and activities include recreational fishing, access to green spaces along the creek, wildlife biodiversity, construction sites, water play areas for children, education, sites for meditation, climate moderation, and floodplain stormwater storage areas, among others.

Meanwhile, sediment from stormwater runoff has been declared as the top surface water pollutant nationwide, according to numerous sources. As to problem areas concerning integrity of Flat Creek waters and streambanks, the following is excerpted from the 2016 Upper Swannanoa River (USRW) Watershed Management Plan (https://files.nc.gov/ncdeq/Water%20Quality/Planning/NPU/319/WatershedMGTPlans_9element/Final-Upper_SwannanoaR_WMP012016.pdf):

- "While much of the land at higher elevations is forested, flatter land at lower elevations has become urbanized. Although heavy industry and agriculture no long have a major presence in the watershed, commercial, institutional, and residential development associated with urbanization has accelerated.
- "This development has significantly increased the amount of impervious surface, be it from buildings, roads, or parking lots. This has decreased the ability of the watershed to absorb stormwater.
- "The removal of forest cover and the conversion of other land to open space consisting of turf and lawns also has contributed to the stormwater runoff problems.
- "Stormwater runoff from these less pervious surfaces has increased the volume, peak flows, and peak flow frequencies of the USRW. This has resulted in the erosion of stream banks and the degradation of aquatic habitat.
- "In addition, the loss of woody riparian vegetation associated with changes in land use adjacent to streams have contributed to streambank instability and increased erosion."

Locally, and in comparison to other areas, there has been a relatively large and constructive response to such issues by various governmental offices, non-profit organizations and citizens alike in the Flat Creek watershed. As the planning team worked to arrange this meeting, on more than one occasion Flat Creek was considered as a model system in terms of the quality, quantity and diversity of various attentions to it by informed individuals and entities.

Consider these tangibles in the Black Mountain-Montreat shared watershed:

- Both towns have greenways along parts of the creek as a means of serving recreational and educational interests.
- Both towns have updated stormwater management plans.
- Close to the boundary between the towns, an all-access facility is being developed creekside, with considerable external funding.

- Even before Hurricane Helene struck, Black Mountain had received a substantial grant for stream restoration including portions of Flat Creek.
- Meanwhile, in 2020 Montreat was the site of a first-ever stream water quality citizen science project.
- Montreat hosts a creekside Blue Ridge Parkway Foundation TRACK Trail, serving youth and family education. (Black Mountain, meanwhile, has a TRACK Trail downstream on the Swannanoa River in the Veterans Park.)
- Both towns support creekside North Carolina Arboretum eco-Explore hotspots, also serving youth and family education.

In addition, one indication of the value placed by citizens on Flat Creek comes from a 2020 survey of Montreat residents, whereby the "health of Flat Creek" and "stormwater and flooding" were the top two issues that concerned 235 respondents, out of eight issues (Table 1). As reported in this document, the Flat Creek watershed factors prominently in the comprehensive plans of both Black Mountain and Montreat.

Table 1. Levels of concern among 235 survey respondents for different aspects of future community life in Montreat. (Highest level = 5.0.) Source: *Town of Montreat Community Assessment Survey Summary Results, Conducted January-February 2020.*

Issue	Score
Health of Flat Creek	4.7
Stormwater and flooding	4.6
Development/redevelop of land/structures	4.2
Population growth	3.9
Attracting younger people as residents	3.6
Increasing the tax base	3.3
Offering wider variety of housing to renters	2.9
Commercial/Retail development	2.7

From just these examples we may conclude that Flat Creek over its six-mile journey can indeed be used as a model system, a "shining star." As the meeting unfolds, we shall see how closely Flat Creek approaches being a model system from which other watersheds can learn.

Finally, this part of the introduction closes with some "breaking news." As this compilation was going to press, we had confirmation that the Montreat Landcare Committee at its May 2025 meeting voted to fund a water quality study for the Montreat portion of Flat Creek. While a modest amount, it represents a significant fraction of the Landcare annual budget, and importantly the research will generate data for comparison with a similar effort conducted in 2020 as a citizen science project, and also will contribute to post-hurricane, science-based assessment and restoration activities. Also, if pending funds are approved by a statewide aquatic sciences organization, a companion study will be supported in the Black Mountain section of Flat Creek, thus giving us a systemwide assessment of water quality conditions. This is really good breaking news!

Aims and Plan of the Flat Creek 2040 Workshop

In a nutshell, the meeting aims to determine scientific and policy findings, interest, necessity, feasibility and expertise for insuring that technically sound and realistic blueprints exist, or can be framed, to guide stewardship and sustainability of Flat Creek. Based on this goal, the planning team for the meeting established four objectives:

1. **Scientific Knowledge**—To establish, quantifying to the degree possible, ambient conditions of Flat Creek as measured biologically, culturally, physico-chemically, etc. to provide the scientific foundation for a "state of the creek" assessment, including some attention to impacts of Hurricane Helene. Data gaps are identified too.

2. **Watershed Planning**—To update all parties on the status, trends and needs of watershed planning under the purview of the towns of Black Mountain and Montreat, with consideration of feasibility— and desirability— of revising or augmenting existing plans for long-term stewardship of Flat Creek.

3. **Collaborations** —To foster acquaintances, exchange of information, and possible coordination and synergies among technical stakeholders concerning Flat Creek, while identifying opportunities, knowledge gaps and follow-ups concerning research, education, and policy.

4. **Shining Star**—To determine both how realistic it is to characterize the Flat Creek watershed as a model for research, education and policy efforts that can be useful to other mountain localities, and also evaluate the potential for developing an ecosystem model of the Flat Creek watershed.

By design, we have limited attendance at this meeting to persons actively engaged with firsthand activities concerning Flat Creek and its watershed. The experts here today represent a critical mass of knowledge, experience and interest, and together enable us to use this meeting as an organizational session to evaluate whether a continuing—and expanded—working group would be worthwhile.

Rest assured that based on the outcomes of this meeting it seems vital to cast a wider net to include other organizations than those represented here today. As we organized this meeting we had numerous suggestions and recommendations for additional individuals and organizations to involve. The French Broad River Valley is fortunate to have a rich variety of academic, agency and non-profit interests working over a broad range of scientific, educational, outreach and stewardship activities. A good example would be the work of the North Carolina Wildlife Resources Commission and Warren Wilson College to reintroduce the Swannanoa darter, *Etheostoma swannanoa*, a small bottom-dwelling fish, into the upper Swannanoa River.

Note that today's subject matter deals exclusively with just Flat Creek, from its headwaters in the high mountains to its confluence with the Swannanoa River, a distance of just over 6 miles (Figure 1). That said, the plan for the day is to receive oral presentations scheduled in three sessions. Accompanying written material is contained in this compilation. A PDF also is available. Times for presentation are short, reflecting the "lightning" aspect for sharing a lot of information concisely. In recognition of heavy workloads expanded by post-storm recovery and

restoration priorities, contributors were given options as to how they formatted written material, one being to simply provide a one-page summary presenting key information items and findings, or else provide a set of slides or a more detailed, typical written narrative. (These options were well received.) This material also will be used in future communications. The three sessions include:

Session 1: Science of the Flat Creek Watershed, Montreat and Black Mountain-The aims of this session are to consolidate reliable scientific findings from past and present research, identify possible gaps in knowledge, provide at least a snapshot of the impacts of Hurricane Helene, and promote potential collaboration among attendees in future research and education.

Session 2: Best Science-based Management Practices in the Region and in the Flat Creek Watershed, Black Mountain and Montreat--The aims of this session are to inform attendees of how Flat Creek as both an integrated ecosystem and also a body of water under two jurisdictions is managed, as addressed more broadly in town comprehensive plans and also as the focus of stormwater management plans; and also to identify emerging needs, if any, for further data, communications, or plan revision over the coming 15 years.

Session 3: Flat Creek 2040: Connecting Dots and Framing Futures--The aim of this session is to evaluate and draw conclusions from the information presented in the first two sessions, in terms of identifying possible ways forward in the spirit embodied in the title "Flat Creek 2040." Rather than have one single person serve as rapporteur to capture the highlights and takeaways from this diverse assemblage, we are trying to be creative by having a number of speakers from the first two sessions give appropriate conclusions during this session.

Anticipating Outcomes and Follow-ups

Obviously we can't know all the outcomes of this meeting just as we are getting started. However, as the content has evolved it is clear that education and outreach is a priority that spans the various policy, research and educational perspectives represented. In fact, in addition to the newly funded water quality study named above, the planning team and thereby the working group has been invited by the Montreat Conference Center to develop a creekside walk, whereby interested citizens can learn about the ecology and various benefits and issues concerning Flat Creek, as a new offering in its summertime hiking and outings program.

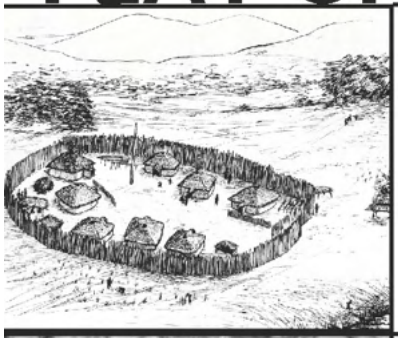
The summaries by individual rapporteurs will be reviewed by the planning team and any other interested persons. We anticipate developing a summary of this meeting in a written digest and a slide program for presentation to audiences as diverse as elected town council members and homeowner groups. Reaching out to a wider array of entities and experts will be planned.

Acknowledgments

We thank the Black Mountain Presbyterian Church for free use of the meeting space, its electronic equipment and video system, and use of kitchen facilities. Compilation and printing of this document was done by the Environmental Quality Institute team in Black Mountain. Dynamite Roasting Company supplied the coffee. Morning and afternoon refreshments and a luncheon buffet were prepared and served by Anne Seaman of Montreat.

HISTORY OF THE LAND: FLAT CREEK

ANNE CHESKY, PRESBYTERIAN HERITAGE CENTER IN MONTREAT



~10,000BCE – 1785: NATIVE AMERICAN HABITATION

Archaeological sites in the Swannanoa Valley show that Native Americans have inhabited the valley for at least 12,000 years. Between 1000-1450, at least one Cherokee village was located along the Swannanoa River about 10 miles from Flat Creek (Warren Wilson, site 31BN29). Cherokee people embraced the river's floodplain for agricultural production of corn, beans, and squash.

Until 1785, when members of the Cherokee Nation signed the Treaty of Holston with the United States, all NC land west of Black Mountain (known then as Grey Eagle) was Cherokee Territory. Notably, in the late 1990s, a hiker on Montreat's Greybeard Trail discovered six potsherds made 1,200 - 2,000 years prior.

Samuel Davidson Grave, c1784

1785: SCOTS-IRISH & AFRICAN SETTLERS ARRIVE

Just before the Swannanoa Valley had been officially ceded by the Cherokee, members of the Davidson and Alexander families moved west forming the Swannanoa Settlement, the first permanent settlement of non-indigenous people in what would become western North Carolina at the confluence of Bee Tree Creek and the Swannanoa River. The community was not only home to these Scots-Irish immigrants; men, women, and children of African descent were enslaved in the settlement.

The Davidsons erected a grist mill and a saw mill on Bee Tree Creek c1792.

1796: LAND SPECULATION BEGINS

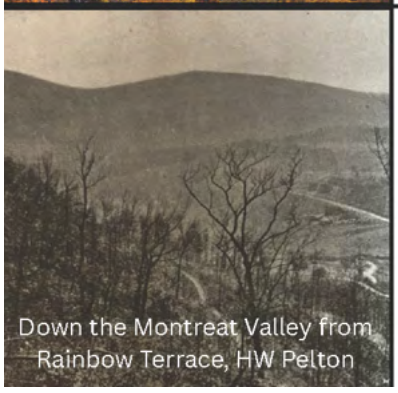
In the late 1700s, NC began issuing land grants in WNC. A standard grant size was 640 acres for a single man at a rate of two pounds and ten shillings per 100 acres. Though some land in the Swannanoa Valley had already been awarded, in 1795, NC began allowing speculators to apply for enormous land tracts without regard to existing landholders. John Gray Blount from eastern NC acquired 320,640 acres that spanned from the top Blue Ridge to Flat Creek, down Flat Creek to the Swannanoa River, and west to the French Broad. But the taxes proved too much, and the land was sold by the sheriff to the highest bidder in 1798. The highest bidder - Blount's agent - who would immediately begin selling the land in small tracts for Blount's benefit. [Buncombe Register of Deeds, Book/Page, 4/462, 4/230]

Glassmine Falls

1855: TESTING FOR COPPER & MINERALS

During the first half of the 19th century, the land around Flat Creek was divided into smaller tracts, with about 20,000 acres east of Flat Creek, north of the Swannanoa River, and west of the Blue Ridge coming into possession of Samuel W. Davidson (the son of an original member of the Swannanoa Settlement) and James W. Patton in 1845. In 1855, Davidson and Patton granted the Tennessee Cold Water Mining Company a 5-year access to test for "copper ores and minerals, metallic and fossil substances," with the understanding that if anything was found, Davidson and Patton would keep a cut of the mineral interests and allow the mining company "full and free use of timber, water, earth and all other things necessary for a mining operation on said lands." [Buncombe Register of Deeds, Book/Page, 23/257, 25/507, 25/528]

It appears the mineral speculation amounted to nothing. However, some mica mining did occur in the Black Mountain Range above Montreat.



Down the Montreat Valley from Rainbow Terrace, HW Pelton

C1870 – 1888: FARMING

After Davidson and Patton died, David L. Swain (NC Governor from 1832-1835) acquired half of the tract, including the land around Flat Creek. After Swain's death, his widow sold 500 acres on both sides of Flat Creek to William Kelly for $150. According to the 1871 deed, Kelly was already living on this land at the time. [Deed 34/508]

William Kelly (b. 1827) married Emelia Allison (1829-1870) in 1850 in McDowell County. According to census data, the couple and their children moved to Buncombe prior to 1860. William's occupation was listed as "farmer" in the censuses from 1850 - 1880. The Kellys eventually owned at least 1760 acres "on the headwaters of Flat Creek." [62/147]

Montreat Office,
former home of Anderson Kelly

1888 – 1897: SHEEP

Willliam's son, Anderson Kelly, was born in 1859 in Black Mountain. He married Ruth Dawson in 1879 and, in 1880, the couple lived on Montreat property. Anderson built a six-room house with a loft, located near the present-day "John C. Collins" boulder just inside the Montreat Gate. The Kelly family farmed the land.

In 1888, William sold 1760 acres on the headwaters of Flat Creek including Little Piney Mountain and the top of Big Piney Mountain to D. Cady and Georgene H. Champlain for $3,000. The Champlains came down from the North to operate a sheep farm on the land. The Champlains moved into Anderson's house, and Anderson, who ran the farm, cut logs and built a cabin further up the cove, which later became the Montreat Office. [US Census; Deed 62/147; Anderson, *Story of Montreat*, 1949]

Though the sheep ranch ultimately failed, much of the valley floor was clearcut.

Assembly Drive, 1901

1897: MOUNTAIN RETREAT ASSOCIATION

The Mountain Retreat Association (MRA) was chartered in 1897. Congregational minister John C. Collins acquired three tracts of land containing over 4,300 acres (including the 1,760 acre Champlain/Kelly tract) for the MRA. Collins noted that, "lumber, of w hich there is an abundance and of all kinds, with sawmills within easy distance, can be had for about half the price (as a rule), at which it can be had in the north."

During the 20th century, the economy transitioned from agriculture to tourism. Mr. Frank Elwood Brown, Architect, came to Montreat in 1898 and was present for the first division of lots and noted that "Montreat was all wild and uncultivated land whien I went it; wild indeed...At one time I had a camp of some twenty mountain men at work building roads and bridges, shacks and cabins and also started work on the foundations for the first hotel...."

The Alba Hotel was constructed in 1907 from Montreat timber, which was hauled by oxen to a saw mill near the present-day site of Anderson Auditorium.

Crews gathered cobblestone to construct buildings. RC Anderson recalled ,"the valves in the dam forming the lake were opened and the water rushed down the stream for a mile to the lower boundary of the grounds, and the rushing current of the water washed up as much of the cobblestone as we had in the beginning. This process was repeated whenever the supply of the cobblestone was exhausted." Assembly Inn (1928) was the last to solely use cobblestones on its exterior.
[Anderson, *Story of Montreat*, 1949]

Logging on Mt. Mitchell, c1910s

1911: MT MITCHELL RAILROAD & 1916: FLOOD

Beginning around 1912, timbering began in the mountains above Montreat. To haul timber, workers built, the Mt. Mitchell Railroad, a narrow gauge logging railroad that began in Black Mountain traveled through Montreat and culminated near the peak of Mt. Mitchell. The mainly spruce and balsam lumber was hauled down the mountain and dumped in a holding pond at the Black Mountain Lumber Mill. Mt. Mitchell State Park would soon protect the pea Exposed soils resulted in erosion and landslides especially during flood events. k, and WWI ended logging operations, but not before denuding the old-growth forest. [Schwarzkopf, *A History of Mt. Mitchell*, 1985]

In 1916, when WNC experienced the worst flooding in recorded history (prior to 2024), railroad representatives reported, "the waters were coming down the mountain and many logs were carried away and piles of timber overturned." Robert McClure, a Montreat summer staffer, recalled, "logs and debris [washed] down the mountain, backed up over and behind the spillway, causing the level of the lake to overflow the dam...before rushing down stream and taking all bridges."

Sparks from the railroad also set off wildfires.

Montreat Reservoir, Alice
Margaret Dickinson, 1908

1900S: MONTREAT RESERVOIR & POWER PLANT

Until 1947, Flat Creek supplied electricity to Montreat with a hydroelectric plant, that was located near the present-day Montreat Campground. Until 1980, when a well-based system was installed, with intakes on Flat Creek and its tributaries.
[Standaert, Postcard History, 2009]

According to an account by Carl Kerlee in 1992, "Montreat had its own power plant to generate electricity. The plant was located about one-half mile up Greybeard Trail above Assembly Inn. The water was taken from the stream that feeds Lake Susan about one mile above the power plant. It was piped to a small lake on a mountain adjacent to the power plant before being piped down a steep incline to the generator in the power plant. " John H. Kelly, Anderson Kelly's son, helped with the operation of the plant and lived in a cabin next to the plant.
[Parris, *A History of Black Mountain and Its People*, 1992.]

Geomorphology, Physiography, Abiotic Factors and Data Proxies for Flat Creek

William Seaman, Fisheries and Aquatic Sciences, University of Florida (ret.)

Many years ago working with a colleague in an extension service project to train experienced scuba divers in the observation and monitoring of human-made reefs on the floor of the Florida ocean, I was struck by one of his sayings, namely that "Zero is a real number." In this case he was referring to an underwater sampling sheet listing the species of fishes known to inhabit reefs in the area. If the citizen science diver did not see a species, they needed to record a zero. As I did research on Flat Creek, Eastern Buncombe County— not to be confused with Flat Creek in Weaverville, nor with Flat Creek just across the divide, flowing toward Lake Lure--I felt like one of those divers who was not seeing expected fish species on the checklist.

When I started out to organize this presentation my aim was to complement the other contributions before you this morning, with their focus on biological, atmospheric and restoration sciences. In other words, what are the geographic, physiographic, non-biological, and geomorphologic attributes specific to Flat Creek and its watershed as they occur in Montreat and Black Mountain? Surely, the technical literature must address our creek, right? As it turns out, the best source of collected geophysical information specific to Flat Creek is Wikipedia! I hasten to add that the stormwater management plans for Black Mountain and Montreat have some valuable descriptions. Rather than abandon these topics, my principal aim is to identify proxy data and observations of possible use in framing new research, education and policy efforts.

Before sharing information that I did find, I mention some definitions:

- Geomorphology— "*is the study of landforms and the processes that shape them. In essence, landforms reflect an interaction between Earth's tectonic framework and its atmospheric canopy, and the biota they both suppor*t" (Mitchell 2015). Figure 1 provides a diagram from which an entire textbook could be generated, showing the interaction of tectonic and climate drivers. I include it as one framework for what an ecosystem model might include.

- Abiotic components—are "*the non-living chemical and physical factors in the environment that affect ecosystems. Abiotic components play a crucial role in all of biology. Abiotic factors are broadly grouped into physiographic, edaphic and climactic factors and atmospheric gases*" (Siyavula 2025). Principal attributes of the environment that fall into these groupings include slope, altitude, soil pH and structure, sunlight, temperature, wind and water.

Figure 1 shows many of the components geophysical factors at work in shaping landscapes and the drainages in them.

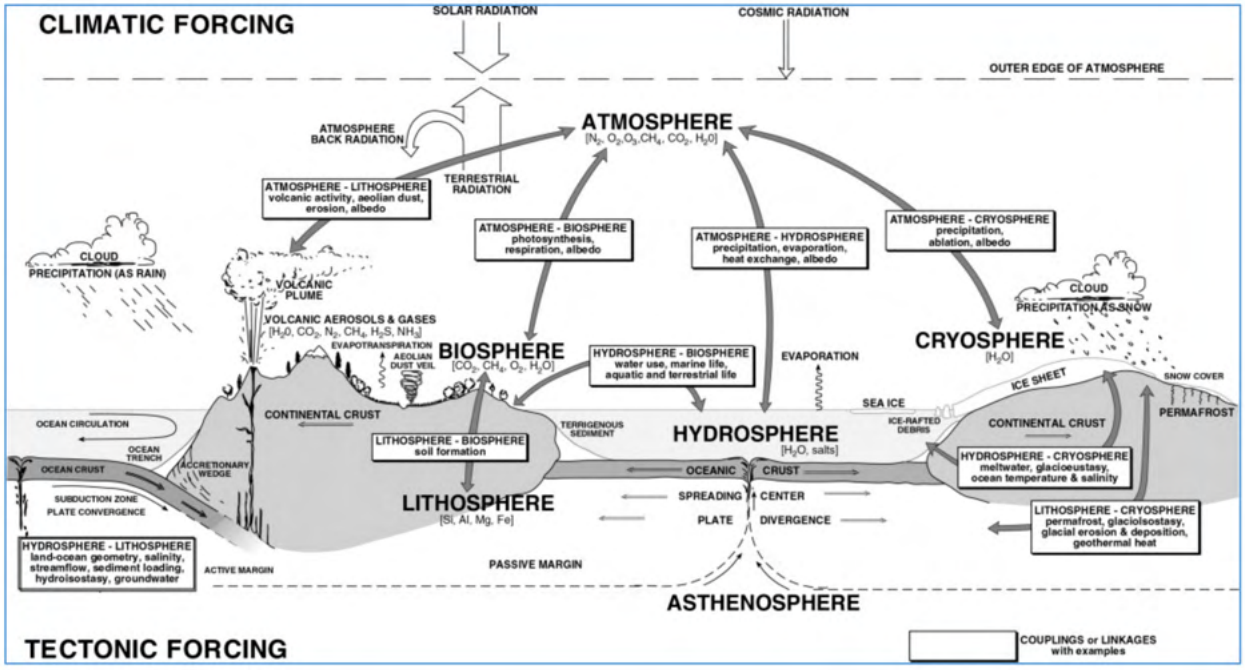


Figure 1. Tectonic and climatic forcing of Earth systems. Reproduced from Orme, A.R., 2002. Tectonism, climate, and landscape. pp. 3–35 In: Orme, A.R. (Ed.), The Physical Geography of North America. Oxford University Press, New York.

Geophysical and Geomorphological Knowledge of Flat Creek

To begin with some vital statistics, as it flows from its source at 4,600 feet elevation on the slopes of Greybeard Mountain, to its confluence with the Swannanoa River at elevation 2,359 feet, Flat Creek drains 6.04 square miles (15.6 km^2) of land area, and receives about 52.4 inches/year of precipitation. This information comes from Wikipedia. See https://en.wikipedia.org/wiki/Flat_Creek_(Swannanoa_River_tributary. At the front of this compilation a map of the drainage is given.

Meanwhile, according to the 2011 National Land Cover Dataset the two largest covers of the watershed are deciduous forest, 75%, and low density residential, 18%. See Table 1. See https://watersgeo.epa.gov/watershedreport/?comid=22161000

Table 1. Coverage of Flat Creek watershed according to natural and human sources. Source:

2011 National Land Cover Dataset	Watershed Total
Open Water (11)	0%
Low Intensity Residential (21)	18.00%
Commercial (23)	0.61%
Deciduous Forest (41)	75.58%
Evergreen Forest (42)	1.04%
Mixed Forest (43)	2.22%
Other	2.54%

The only mention of observations specific to Flat Creek by an organization such as an agency or academic entity appears in a 1991 report of a set of three samples at locations near its source (in Montreat) that describe the substrate of the stream, with the largest material classified as boulder, 55%, followed by cobble at 25%, and both gravel and sand at 10%, with no silt. This information comes from the North Carolina Department of Environmental Quality, North Carolina Division of Water Resources, with thanks to the Asheville Regional Office. The format for the DEQ sampling report from one of the sites, which are assigned to the Southern Crystalline Ridges and Mountains category, is reproduced in Figure 2. As you can see, "zero" is a real number in many of the cells in the chart. Here is information, however dated, but which may have reference to future restoration efforts. A recent item that needs verification is that there may be deepening of Flat Creek in Montreat as a means of handling larger volumes of water.

Apparently these are the only such data for the Flat Creek watershed.

Benthos Site Details

Waterbody	Location	Station ID	Date	Bioclassification
FLAT CR	AB BIG PINEY BR	EB084	11 Dec 1991	Good

County	8 digit HUC	Latitude	Longitude	Elevation (ft)
Buncombe	06010105	35.652500	-82.296667	2786

Level IV Ecoregion	Drainage Area (mi2)	Stream Width (m)	Stream Depth (m)
Southern Crystalline Ridges and Mountains	2.5	4.0	0.3

Landuse Percentages								
Year	Forest	Developed	Impervious	Cultivation	Grass / Shrub	Wetland	Water	Barren
2011	0.0	0.0	0.0	0.0	0.0 / 0.0	0.0	0.0	0.0
2006	0.0	0.0	0.0	0.0	0.0 / 0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0 / 0.0	0.0	0.0	0.0
1992	0.0	0.0		0.0	/	0.0	0.0	0.0

Water Quality Parameters	1991
Temperature (°C)	0.0
Dissolved Oxygen(mg/L)	0.0
Specific Conductance (µS/cm)	0.0
pH (s.u.)	0.0

Substrate Percentages	1991
Boulder	55
Cobble	25
Gravel	10
Sand	10
Silt	0
Other	

Habitat Assessment Scores (max score)	0

Water Clarity	

Sample Date	Sample ID	Method	ST	EPT	BI	EPT BI	Bioclassification
11 Dec 1991	5770	EPT	--	35	--	1.60	Good

Figure 2. Physical sampling records from Big Piney Branch, upper Flat Creek, Montreat, dated December 11, 1991. Note number of observations not recorded.

Can Observations and Data from Other Streams Serve as Proxy for Flat Creek?

As a whole, there is a lack of research on mountain streams in Western North Carolina. For example, an article by David Leigh of the University of Georgia carries this introduction:

"Small streams are understudied in the Southern Blue Ridge Mountains, yet they constitute a huge portion of the drainage network and are relevant with respect to human impact on the landscape and stream restoration efforts." See

David S. Leigh. 2010. Morphology and Channel Evolution of Small Streams in the Southern Blue Ridge Mountains of Western North Carolina Southeastern Geographer, Volume 50, Number 4, Winter 2010, pp. 397-421

file:///C:/Users/Home%20Office/Downloads/Morphology_and_Channel_Evolution_of_Small_Streams_-1.pdf

Similarly, an article by Price et al., concerning effects of watershed land use and geomorphology in the southern Blue Ridge Mountains, stated, "*While it has been shown in many settings that both human land use and natural topographic variability influence stream baseflows, their interactions and relative influences have remained unresolved*." See https://cfpub.epa.gov/si/si_public_record_Report.cfm?LAB=NERL&dirEntryID=216000.

In view of the situation, I have done a limited search for peer-reviewed journal articles primarily, and limited gray literature, concerning studies of geomorphology, geophysical and abiotic attributes of mountain streams in our region, say within a hundred miles or so of Flat Creek. Below are three examples of research not occurring locally. They are offered as examples of possible future new areas of study, possibly as new investigators become aware of current Flat Creek research, education, and restoration.

Stream processes

In turning to the literature then, it seems useful to be sure that a broader array of natural resource scientists and managers have a grasp of the basic principles and terminologies of geomorphology as they address conservation and restoration of watersheds, such as what is occurring in our area. In this regard, the North Carolina Extension Service offers guidance concerning "Natural Stream Processes," whereby it defines "fluvial geomorphology" thusly: *"While streams and rivers vary greatly in size, shape, slope, and bed materials, all streams share common characteristics. Streams have left and right streambanks (looking downstream) and streambeds consisting of mixtures of bedrock, boulders, cobble, gravel, sand, or silt/clay. Other physical characteristics shared by some stream types include pools, riffles, steps, point bars, meanders, floodplains and terraces. All of these characteristics are related to the interactions among climate, geology, topography, vegetation and land use of the watershed. The study of these interactions and the resulting streams and rivers is called fluvial geomorphology.*" See https://content.ces.ncsu.edu/natural-stream-processes.

Watershed geomorphology to explain flow

"Baseflow" refers to streamflow sustained between precipitation and snowmelt events, contributed from storage reservoirs such as bedrock, saprolite, alluvium, or soil. See file:///C:/Users/Home%20Office/Downloads/PRICE%2009%20132A_AAG2010-1.PDF.

In an attempt to determine the influence of human land use and watershed geomorphic characteristics to explain baseflow variability in the southern Blue Ridge Mountains of North Carolina and Georgia, Price et al. (2010) assessed a comprehensive suite of watershed characteristics, including factors of watershed topography, channel network morphometry, soils, land use, and precipitation in 35 watersheds. Using multiple regression analysis they determined that geomorphic factors of drainage density and slope variability showed the strongest relationships to baseflow in this region.

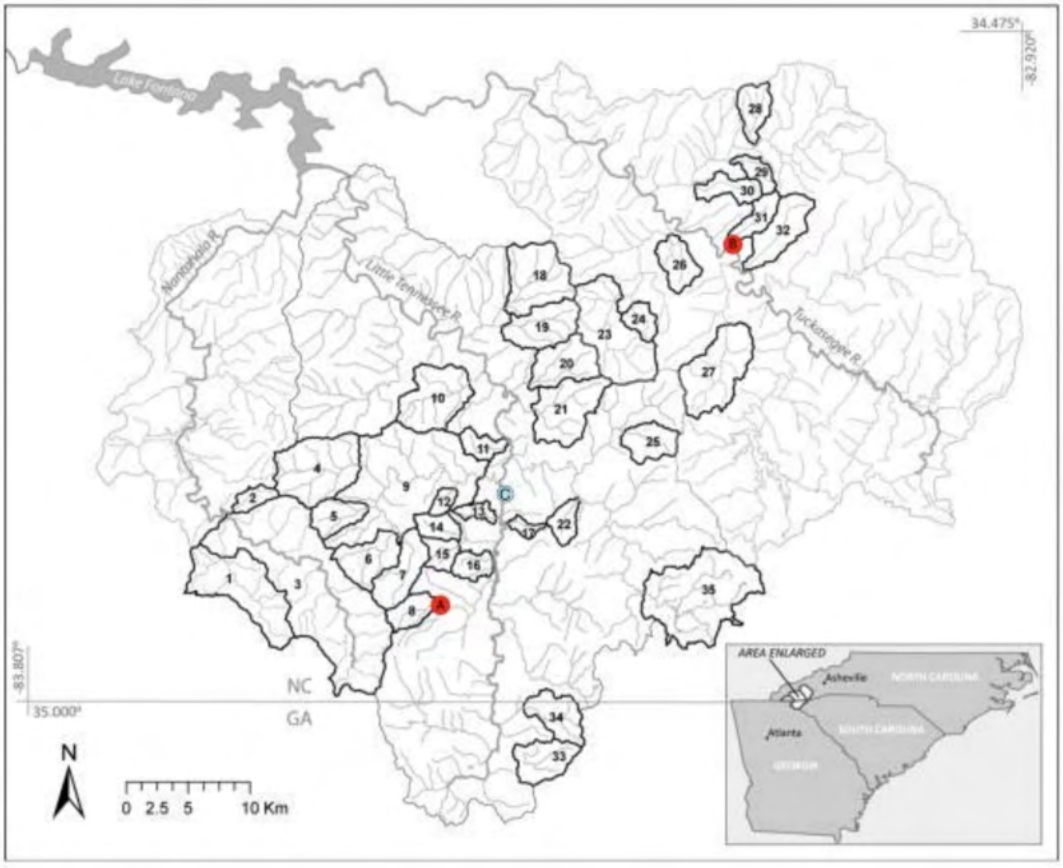


Figure 3. Location of monitored watersheds in Western North Carolina and South Carolina for study of base flow dynamics. (Source: Price et al. 2010.)

Modeling, geomorphology and habitat

Finally, the importance of tree canopy and shade over mountain streams as a contributor to cooler water temperatures and habitat quality is commonly recognized. A so-called keystone species is the hemlock tree. Using four study areas, Jocassee Gorges and the Ellicott Rock Wilderness in northwestern South Carolina, and the Shining Rock Wilderness and Great Smoky Mountains National Park in western North Carolina (Figure 4), Abella (2003) devised a "geomorphic quantification system" and a "classification tree model" to predict the presence or absence of eastern hemlock (*Tsuga canadensis*) ecosystems in northwestern South Carolina. The quantitative model correctly identified 86% of sites actually supporting a hemlock ecosystem. A take away message here is that such modeling might be useful in restoration of streambank vegetation in the Flat Creek/Swannanoa Valley region.

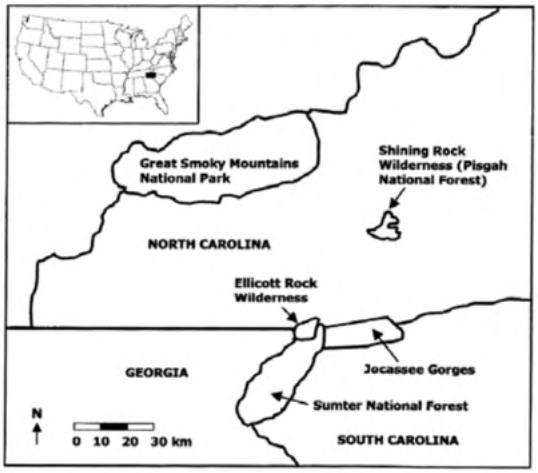


Figure 4. Location of four study sites concerned with prediction of vegetation based on analysis of geomorphic factors. (Source: Abela 2003.)

Acknowledgment: Andrew W. Moore, P.G., Regional Supervisor, Division of Water Resources, North Carolina Department of Environmental Quality, Asheville Regional Office, Andrew.W.Moore@deq.nc.gov

Citations and Other Reading

Abella, S. R. 2003. Quantifying ecosystem geomorphology of the southern Appalachian Mountains. Physical Geography 24(6): 488-501. https://digitalscholarship.unlv.edu/sea_fac_articles/55

Mitchell, N. C. 2015. Tectonism, Climate, and Geomorphology Spatial and Temporal Perspectives. In: Reference Module in Earth Systems and Environmental Sciences. Science Direct, Elsevier, https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/geomorphology#definition

Orme, A.R. 2002. Tectonism, climate, and landscape. pp. 3–35 In: Orme, A.R. (Ed.), The Physical Geography of North America. Oxford University Press, New York.

Price, K., A. J. Parker, C. R. Jackson, T. Reitan, AND J. Dowd. Effects of Watershed Land Use and Geomorphology on Stream Baseflows In the Southern Blue Ridge Mountains, NC and GA. Presented at Association of American Geographers Annual Meeting, Washington, DC, April 14 - 18, 2010.

Siyavula, 2025. Chapter 8.5, Ecosystems. https://www.siyavula.com/read/za/life-sciences/grade-10/biosphere-to-ecosystems/08-biosphere-to-ecosystems-05

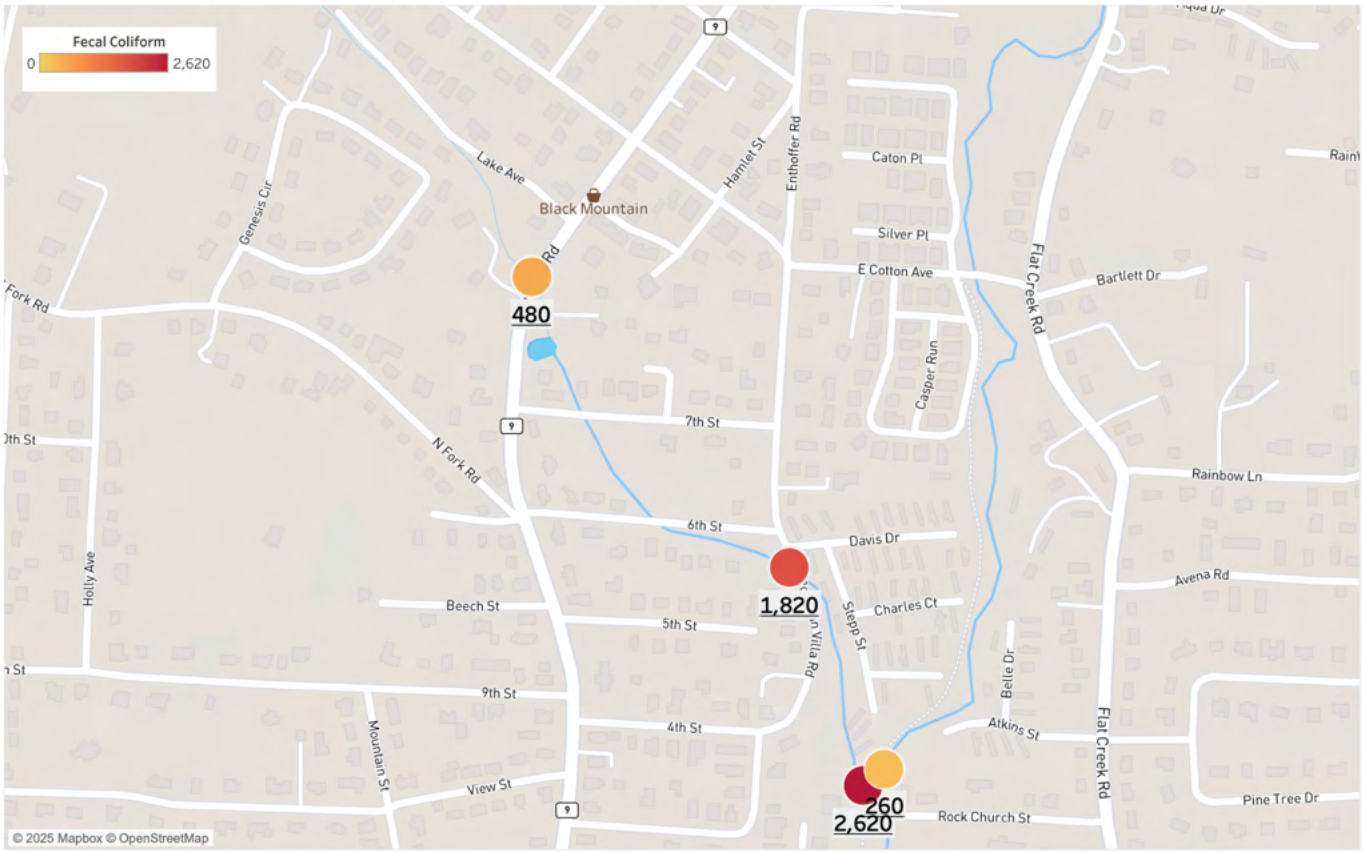
Water Quality of Flat Creek: Volunteer Water Information Network Data

Ann Marie Traylor, Executive Director
The Environmental Quality Institute (*eqilab.org*)

Overview - The Volunteer Water Information Network (VWIN) is a stream and lake monitoring program that began in 1990. VWIN analysis in 2019 and 2020 revealed nearly pristine conditions in the Flat Creek watershed. In September 2024, Hurricane Helene caused widespread destruction throughout Flat Creek and the Swannanoa River Watershed. Initial testing on May 5, 2025, showed surprisingly low turbidity after a heavy overnight rainstorm (nearly 1 NTU in Flat Creek).

EQI has been following up on high E. coli levels found in the Swannanoa River by DEQ and the Swannanoa Watershed Action Network (SWAN). Fecal coliform testing before and after Hurricane Helene shows that the highest levels are in a small unnamed tributary to Flat Creek. This stream originates west of Montreat Road in Black Mountain and enters Flat Creek at the Greenway footbridge. The Metropolitan Sewerage District has conducted leak tests to no avail. EQI will continue efforts to find the source.

Fecal coliform (CFU/100mL) on 5-6-2025; off map - Flat Creek at Montreat Gate <20



An Overview of the Aquatic Biodiversity of Flat Creek

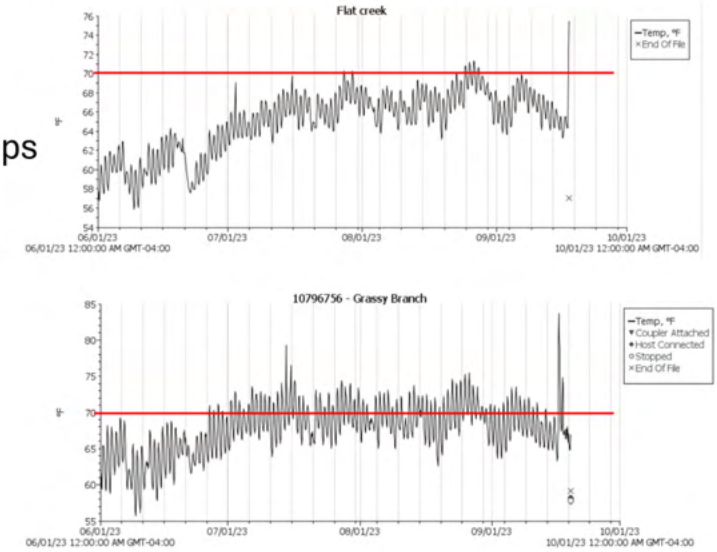
D. Gillette, Professor of Environmental Science

University of North Carolina Asheville

Overview.—Flat Creek below Lake Susan at Montreat harbors a diverse community of fishes and invertebrates. Temperatures at Flat Creek are cooler than most other large tributaries of the upper Swannanoa River (see figure below for comparison to Camp Branch – red line is at 70º Fahrenheit), yet the waters remain warm enough year-round to support many low-elevation species. Like many of our mountain streams, rates of primary production are low, leading to lower populations of benthic macroinvertebrates than sites further down in the watershed. But the Insects that persist are generally indicators of good water quality. Students from UNC Asheville have sampled Flat Creek on several occasions beginning in Fall of 2016. These efforts have documented a total of 18 fish species in Flat Creek, of which nine "core species" were present on each sampling occasion. These nine include coldwater species such as Rainbow Trout (*Oncorhynchus mykiss*) and Mottled Sculpin (*Cottus bairdii*), and warmwater species such as Warpaint Shiner (*Luxilus coccogenis*) and River Chub (*Nocomis micropogon*). Flat Creek also provides excellent habitat for Brook Trout (*Salvelinus fontinalis*), the only trout species native to the eastern United States. UNCA students recently had the opportunity to sample Flat Creek before and after Tropical Storm Helene, documenting a post-storm decline from 14 to 8 fish species, and a dramatic drop in macroinvertebrate populations. One student will be collaborating with RiverLink, a local non-profit, to investigate recovery of aquatic biodiversity in Flat Creek and seven other tributaries to the Swannanoa River this summer. Flat Creek has provided UNCA students with an inspiring example of what a high-quality mountain stream looks like, and we look forward to continuing this collaboration with the Montreat and Black Mountain communities for years to come.

Cooler water Temps at Flat Creek...

- Data from 2020, 2022 and 2023 (shown)



Hellbenders, Macroinvertebrates, and the Future of Long-Term Research and Monitoring in Flat Creek

Josh Holbrook, Assistant Professor of Biology and Environmental Science
Montreat College

Photo credit: Montreat College via WLOS website

An Update on the Trout Population in Flat Creek, North Carolina

J. Rash, Coldwater Research Coordinator
North Carolina Wildlife Resources Commission

Overview.—As the only trout native to North Carolina, Brook Trout *Salvelinus fontinalis* are of significant ecological and cultural importance. Unfortunately, they only live in a small fraction of waters where they once thrived, but the North Carolina Wildlife Resources Commission (NCWRC) works with conservation partners to establish Brook Trout populations where they have been lost. Reliant upon clean and cold water (preferred temperatures < 60°F), a fishless, upstream reach of Flat Creek (Figure 1) was found to be an ideal location to reintroduce Brook Trout sourced from local native populations (source populations are determined via extensive genetic testing) in 2007. Self-sustaining Rainbow Trout *Oncorhynchus mykiss* (preferred temperatures: 54–66°F), occupied Flat Creek below the restoration site, and subsequent samples (2011, 2013, 2017, 2024, and 2025) have documented Brook Trout reproduction and downstream expansion and the continued presence of self-sustaining Rainbow Trout. The NCWRC will continue to monitor trout in Flat Creek and evaluate potential Brook Trout conservation efforts with partners.

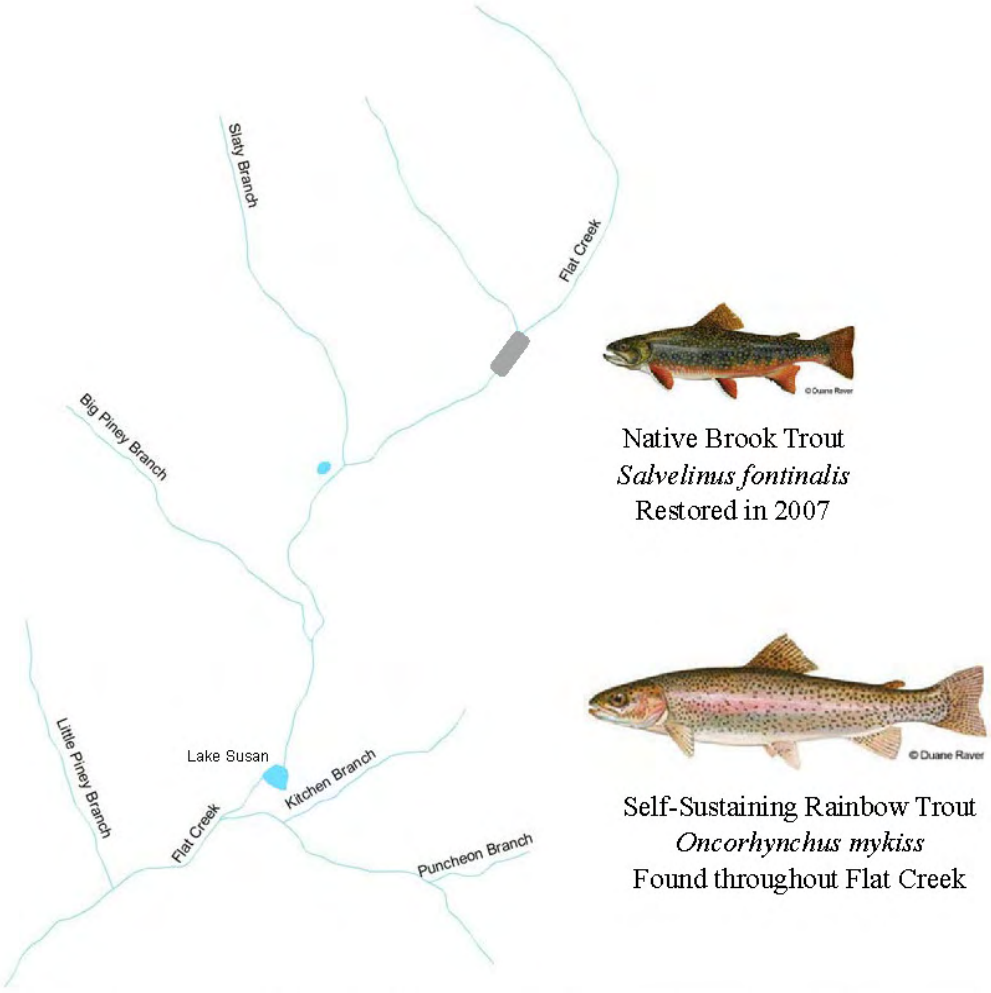


Figure 1.—Map of Flat Creek, North Carolina. Gray box indicates reach of native Brook Trout restoration (2007).

Look Backward, Angler

D. K. Miller, Professor, Department of Atmospheric Sciences
University of North Carolina Asheville

Overview – Stream ecosystems of western North Carolina are vulnerable to a variety of high impact scenarios in which they are threatened by flooding and extreme flow rates. The perspective of this talk will be on weather- and soil-related considerations when anticipating a high impact scenario. The first part of the presentation will focus on more common weather elements observed in western North Carolina (WNC) that can combine with uncommon (unfavorable) timing of various weather and soil factors to create disruptions to stream ecosystems. Examples of warm and cools season events will be examined. The second part of the presentation will focus on uncommon weather elements, utilizing Helene as a recent example, to explore the various weather and soil factors that create historic disruptions to stream ecosystems. The 'look backward' refers to an examination of weather- and soil-related considerations in space (headwaters) and time (soil moisture trend) to anticipate the unfavorable superposition of numerous elements leading to significant stream disruptions (and danger to anglers).

Lake Susan Dredging and Ecological Restoration

Marshall Taylor
Blue Earth Planning, Engineering and Design

Project Goals

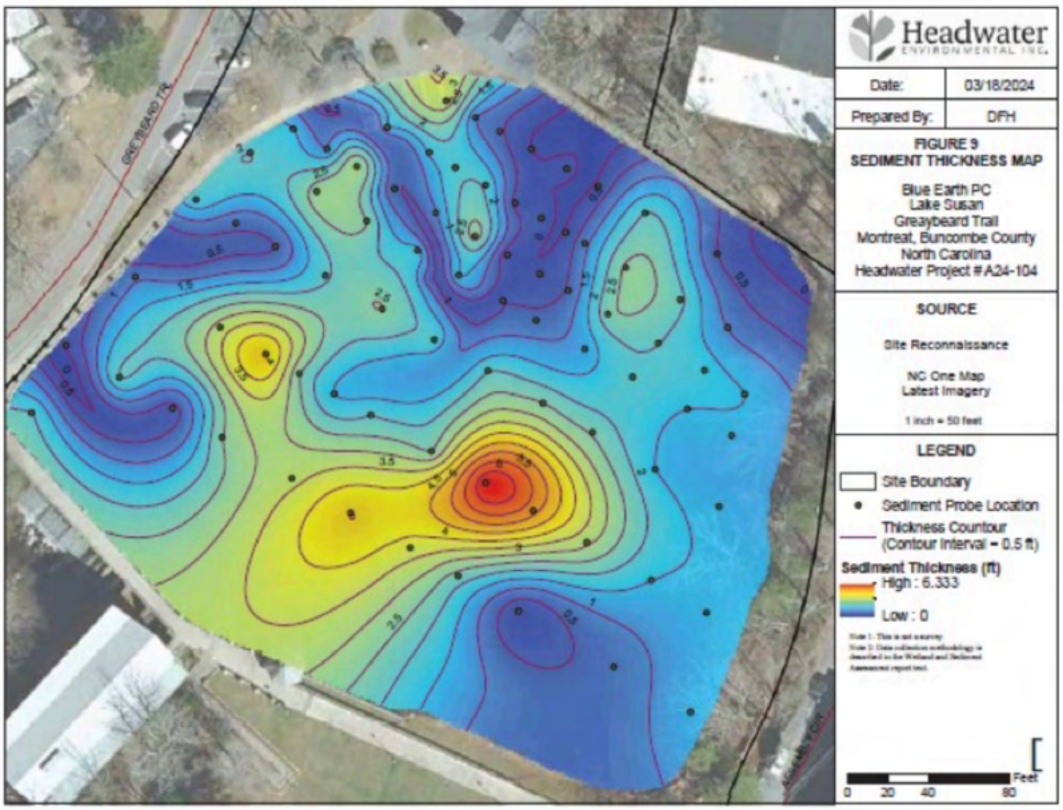
- Restore and enhance the ecological function and recreational and aesthetic value of Lake Susan
- Provide stream restoration and bank stabilization along Flat Creek

Ecology

- Deep Water Habitat
- Water Quality
- Sediment Capture Capacity
- Wetlands and Submerged Aquatic Vegetation
- Stream Restoration and Bank Stabilization

Recreation

- Access
- Open Water Area



StRAP funded: Flat Creek Streambank Repair

Anne Phillip, Stormwater Technician and Floodplain Administrator
Town of Black Mountain

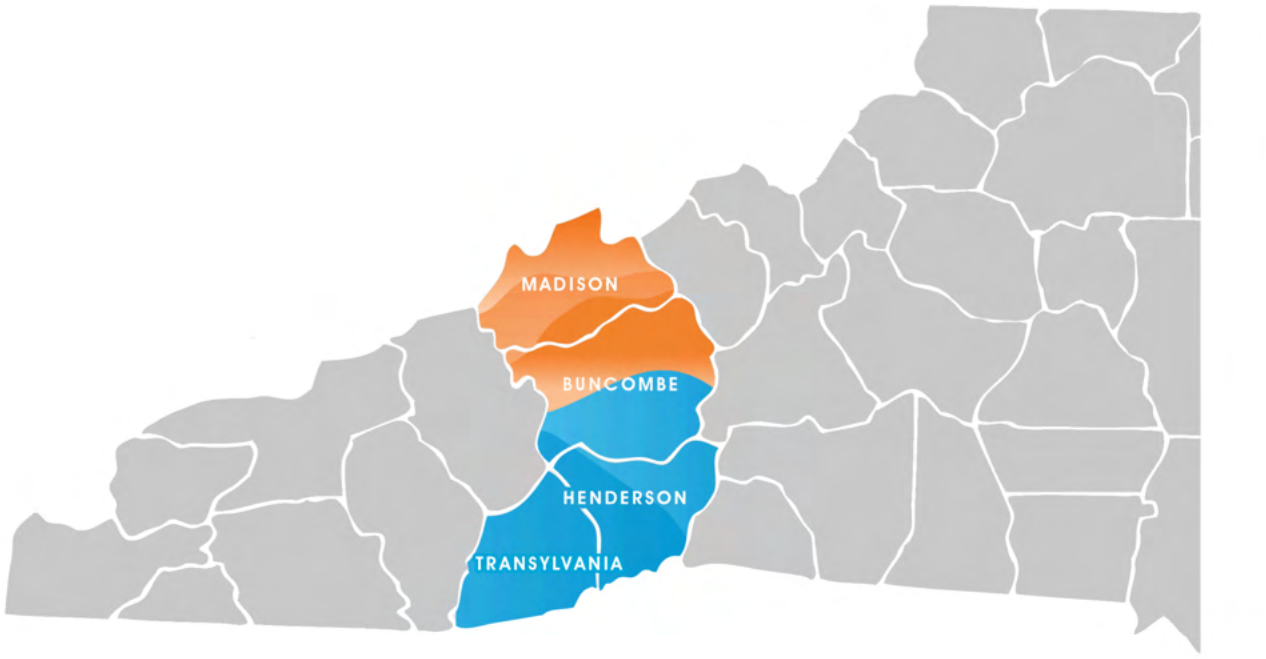
The Streamflow Rehabilitation Assistance Program (StRAP) provides grants to projects that help reduce flooding by protecting and restoring the drainage infrastructure of North Carolina's waterways.

Post-Helene:

- USACE contractors conduct stream debris removal in Flat Creek
- “Leaners and Hangers” removal
- Once completed, our engineer will revisit Flat Creek to assess potential streambank repair
- We will contact property owners along Flat Creek and discuss proposed project design

Mountain Stream Watershed Planning and Stewardship

Jane Margaret Bell, Regional Planner, Water Resources
Land of Sky Regional Council



Montreat Stormwater Management

Savannah Parrish, Town Manager
Town of Montreat

Insights From Montreat Tomorrow Comprehensive Plan

Stormwater Challenges in Montreat

- Some areas lack **adequate stormwater facilities**.
- **Aging pipes and culverts** need replacement or upgrades.
- Steep terrain accelerates runoff and **increases erosion**.

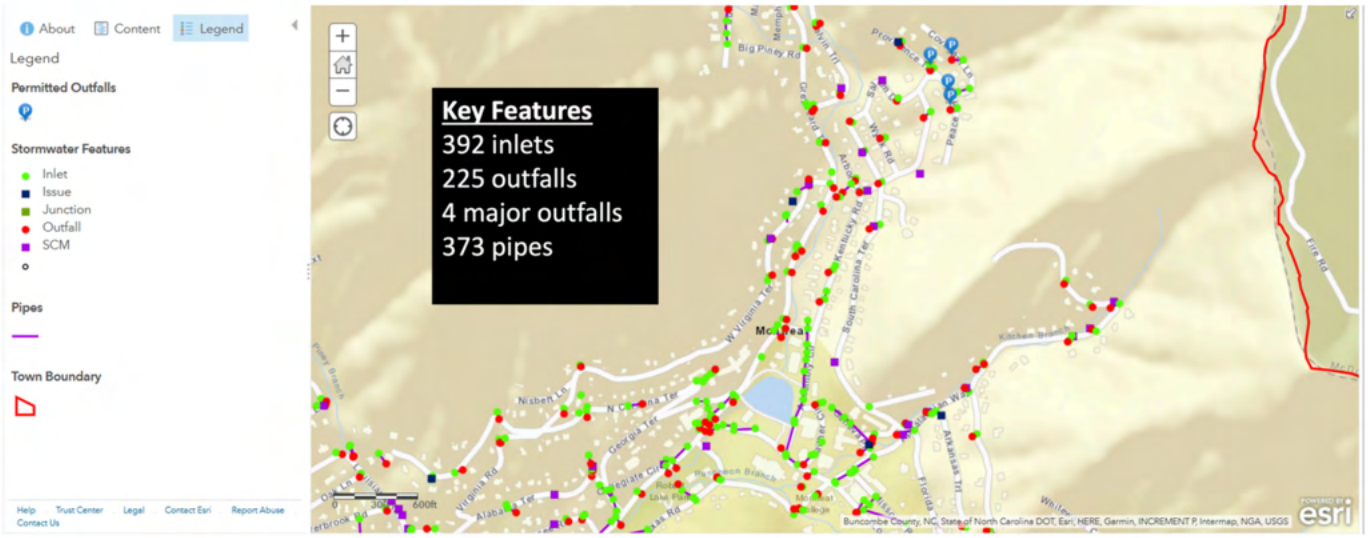
Community Goals

- Maintain and improve **existing stormwater infrastructure**.
- **Incorporate green infrastructure**: permeable pavements, rain gardens, bioswales.
- Implement **stormwater best practices** in all new developments.

Future Planning

- Develop a **comprehensive stormwater management plan**.
- Encourage **low-impact development** techniques.
- Seek **funding and grants** for stormwater upgrades.

Montreat's Stormwater System Inventory



http://arcg.is/1vmD5H

Black Mountain Stormwater Management

Josh Harrold, Town Manager
Town of Black Mountain

FINAL REPORT

Submitted to:
Town of Black Mountain

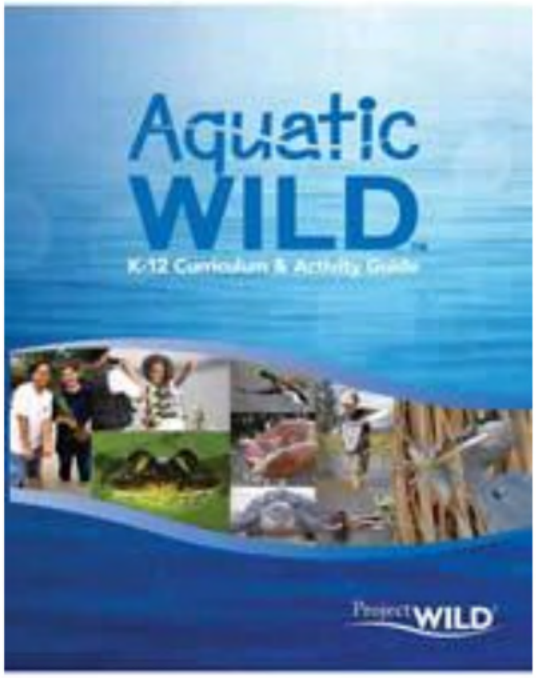
September 2, 2022

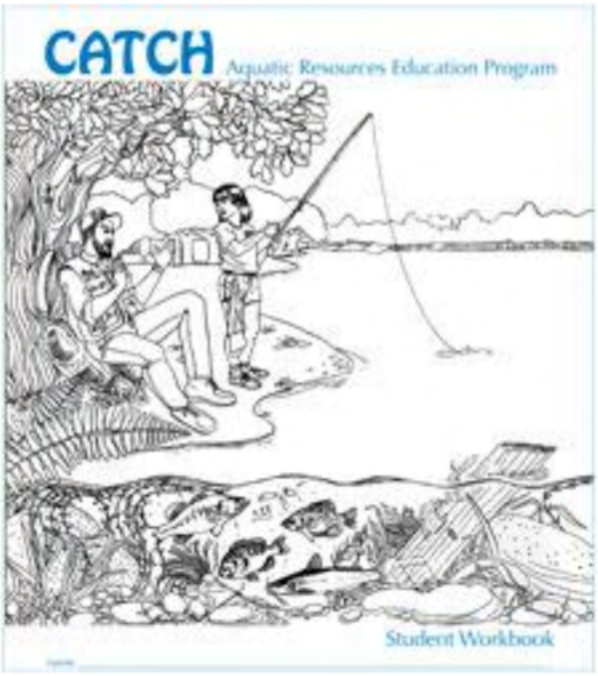
TOWN OF BLACK MOUNTAIN STORMWATER MASTER PLAN UPDATE

Wildlands Project No.: W20259

Education in Flat Creek Watershed

Tanya Poole, Conservation Initiatives Engagement Coordinator
North Carolina Wildlife Resources Commission





Flat Creek 2040 Science Meeting: Participant Evaluation and Recommendations

May 9, 2025

Before leaving the meeting please give us your candid and constructive comments concerning the following:
1. How did the meeting address your expectations, fully, in part, or not at all, in terms of the information presented, networking, possible future projects and collaborations, etc.? What particular expectations did you have? Ideas for future meetings?

2. Was there a single most significant bit of information, contact, or follow-up activity that you care to mention?

3. Do you have any thoughts and suggestions concerning future such meetings? Such as, more focused subject matter, or more extensive regional coverage, or subgroups dedicated to a single topic. Or, annual checkups and updates such as today's concerning the watershed?

4. Do you have a personal vision for Flat Creek 2040 in terms of stewardship of the watershed over the next 15 years, and if so, can you state it and how to get there?

5. Please identify individuals from any academic, agency, non-profit and media organizations working in the greater Swannanoa and French Broad River systems who might be interested in engagement with the Flat Creek watershed. Give contact information if you would like for us to send them a copy of this document.

6. Shall we keep you on the mailing list for the Flat Creek 2040 working group?

7. Other:

Name (optional): _____

THANK YOU!