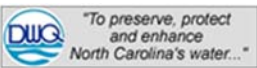
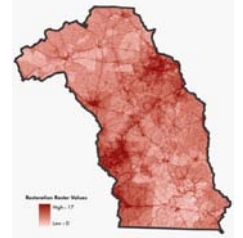
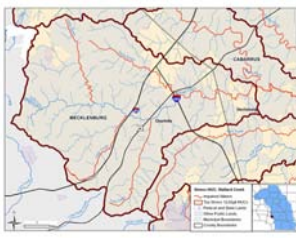
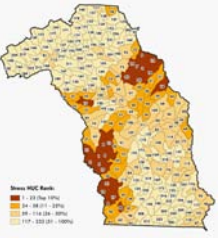


# Yadkin-Pee Dee River Basin Priority Watershed Atlas





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## Introduction

The Yadkin-Pee Dee River Basin is the second-largest river basin in North Carolina, covering twenty counties totaling 7,213 square miles and 5,946 linear river miles. The river basin covers a diverse landscape from Blue Ridge Mountain headwaters to the expansive Charlotte metropolitan area, crossing much of the Piedmont region and including parts of the unusual geology and ecology in the sandy Uwharrie Mountains. Thirty-nine percent (39%) of all rivers and streams, and thirty-six percent (36%) of all lakes and reservoirs within the Yadkin River basin are listed as “impaired” by the NC Division of Water Quality (NC DWQ), meaning they fail to meet water quality standards established by the US Environmental Protection Agency (US EPA) and the NC DWQ. The Yadkin River is also known for its outstanding resource waters, primarily found in the Uwharrie National Forest in Montgomery County and the headwater tributaries of Wilkes and Surry Counties.

Kerr Scott Reservoir, High Rock Lake, Tuckertown Reservoir, Badin Lake, Lake Tillery, and Blewett Falls Lake were all formed by dams erected on the Yadkin-Pee Dee River during the twentieth century. Dam construction and adjacent industrial use and land development fundamentally altered water quality and water use of the river, affecting hydrology and ecology historically found within the river basin. The impacts of these dams in combination with the diversity of historical features, especially land use, cannot be overstated when discussing current water quality conditions within the river basin. The topography, geology, and land use throughout the Yadkin River basin are diverse, presenting a patchwork of land uses, aquatic habitats (including trout-sensitive waters), and urban growth, and challenging the development of a uniform management strategy. There is a need for locally-informed and focused watershed plans reflecting the diversity present within the Yadkin-Pee Dee River basin. Local conditions and history need to inform decision-making on water resource protection and restoration.

The NC DWQ Basinwide Planning Unit exhaustively reviews the water quality, land uses, and growth patterns within each river basin every five years, documenting river basin conditions and notable improvements or degradations. The last *Yadkin-Pee Dee River Basinwide Assessment* was published by NC DWQ in 2008. It is a synthesis of the best-available data characterizing the Yadkin-Pee Dee River Basin, but offers little guidance in regard to basinwide water quality priorities, or developing a strategy to improve or protect water quality. This document’s goal is to address current water quality needs and give river basin stakeholders guidance, while leveraging resources and funding in support of work at the local level.

## Methods

The goal for this basinwide assessment is to rank the 232 12-digit Hydrologic Unit Codes (HUCs) within the North Carolina portion of the Yadkin River Basin both for their conservation potential and their stress vulnerability. A HUC is a topographic-based definition of a watershed, as determined by the US Geological Survey (USGS). HUCs are available at different scales, which offer different scopes of resolution: 8-digit HUCs generally define river basins, 10-digit HUCs define river subbasins, and 12-digit HUCs are commonly accepted as delineating what the US EPA refers to as “local watersheds” of ~40 square miles in area. A mega-regional planning partnership amongst the staffs of four Councils of Governments (COGs) predominantly occupying this river basin worked in concert to analyze the entire river basin and objectively rate its restoration and conservation needs based upon publicly-available data from the NC One Naturally website (<http://www.conservision-nc.net/>). Land use and land cover (LULC) and qualitative water quality data were used to predict stressful or relatively pristine watershed conditions throughout the river basin.

The basin landscape was transformed into a raster grid, containing a matrix of 20 foot by 20 foot cells. A conservation raster was created where each cell contained a value representing the conservation potential for that point within the watershed. A stress raster was also created where each cell contained a value representing the stress vulnerability for that point within the watershed.

### Conservation Raster Creation

The first step in generating this conservation raster was to gather the 14 data variables from various sources and in various data formats (see Table 1). The impervious surface cover, forest cover, and slope layers were downloaded in raster format. However, because they were collected in various resolutions (different grid cell sizes), they had to be resampled, using ArcGIS software, to a constant resolution size of 20 foot cells. The 11 other vector data layers had to be rasterized to a 20 foot cell size using the “Convert to Raster” tool in ArcGIS in order to create a consistent data format for all of the input conservation layers.

Conservation Layers			
Criteria	Data Source	Factors	Possible Points
Low Impervious Surface Cover	National Land Cover Database 2001 (Classes derived by Center for Watershed Protection)	> 20%	0
		10-19%	1
		5-9%	2
		0-4%	3
High Forest Cover	National Land Cover Database 2001	< 50%	0
		> 50%	1
Minor Streams	NC Center for Geographic Information & Analysis (CGIA)	50 ft buffer	3
		100 ft buffer	2
		330 ft buffer	1
Conservation Lands/Easements	One NC Naturally		1
Wetlands	NWI		1
Hydric Soils	SSURGO (classified by USDA)	Partially Hydric	1
		All Hydric	2
Erodible Soils	SSURGO (Classes derived from academic articles)	0 - 0.23	0
		0.24-0.39	1
		0.40-0.49	2
500 yr floodplain	NC Floodplain Mapping Program		1
Steep Slopes	NCDOT LiDAR Elevation Data	>15%	1
Significant Natural Heritage Areas	NC CGIA		1
Existing Greenways	Local Trail Plans	0.25 mile buffer	1
Trout Waters	NC DWQ	25 foot buffer	1
High Quality Waters	NC DWQ	30 foot buffer	1
Outstanding Resource Waters	NC DWQ	30 foot buffer	1
<b>Total Possible Points</b>			<b>20</b>

Table 1: Conservation Analysis Point System

Each of these raster layers was then reclassified based on the factors listed in Table 1, using the ArcGIS Spatial Analyst Extension. For example, the original impervious surface raster consisted of a cell matrix with values ranging from 0 to 100, representing the percentage of impervious cover for each cell. In the reclassification process, cell values ranging from 0 to 4 were given a new value of 3 to signify a higher conservation value due to no impervious cover. Values ranging from 5 to 9 were given a new value of 2; values ranging from 10 to 19 were given a new value of 1; and values ranging from 20 to 100 were given



a new value of 0 to indicate no conservation value due to high impervious cover (see Figure 1a). The same concept was applied to each input data layer (see examples in Figure 1b and 1c).

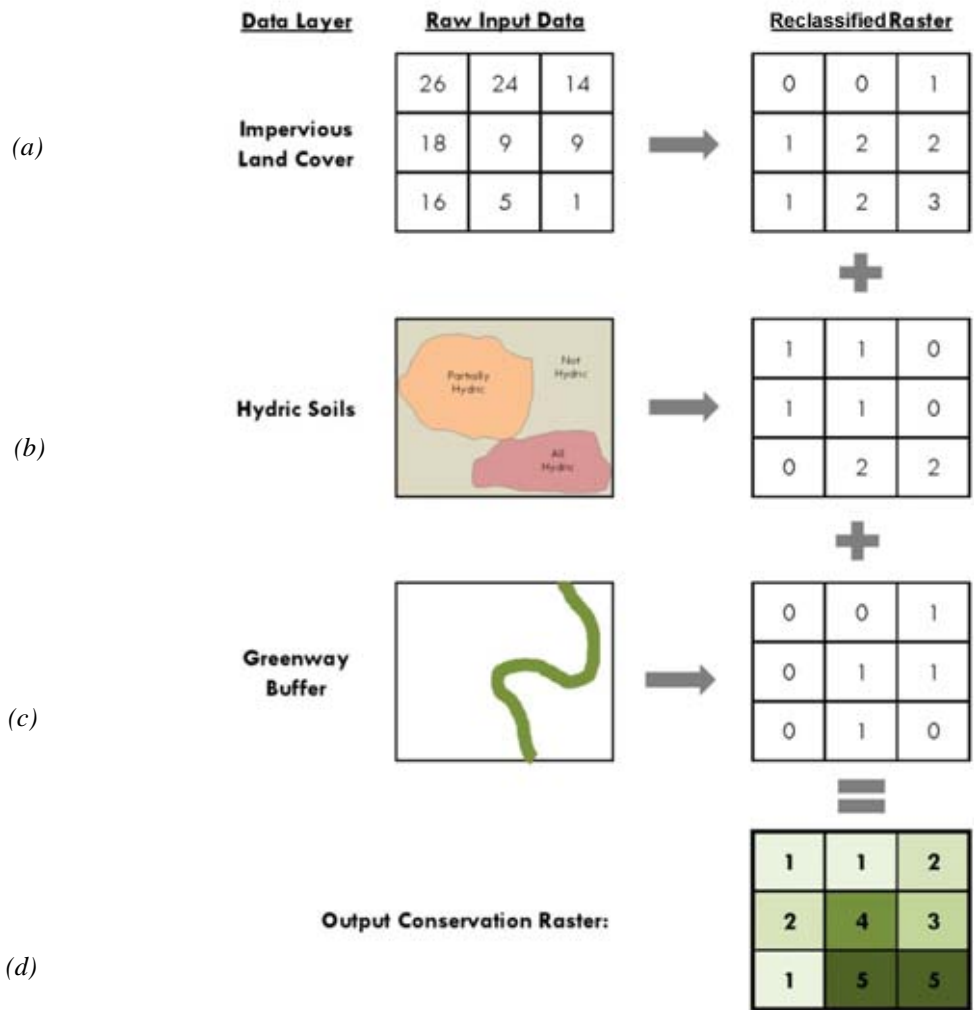


Figure 1: Sample input layers for the creation of the conservation raster. (a) The original raster layer for impervious surface cover was reclassified. (b) The hydric soil polygon vector layer was rasterized and reclassified with new values. (c) The greenway polyline vector layer was buffered, rasterized, and then reclassified with new values. (d) All of the reclassified raster layers were input into the ArcGIS Weighted Sum Tool, which summed each corresponding input cell and created the output conservation raster. Higher values in the output raster represented areas of higher conservation potential.

The 14 reclassified rasters were then input into the ArcGIS Weighted Sum Tool. This tool overlaid the input rasters on top of one another and summed the respective cells into one output conservation value raster (see Figure 1d). This conservation raster represents the conservation potential of the Yadkin River Basin landscape on a continuous array of values, ranging from 0 to 15 (see Figure 2). The maximum possible conservation value that a cell could attain was 20 if that point in space possessed the highest factors for each input data layer, but no cells within the watershed obtained this high of a conservation value. This process attempted to identify areas within the watershed with the highest conservation value for watershed health and function, so that these areas can continue to be preserved in future projects.

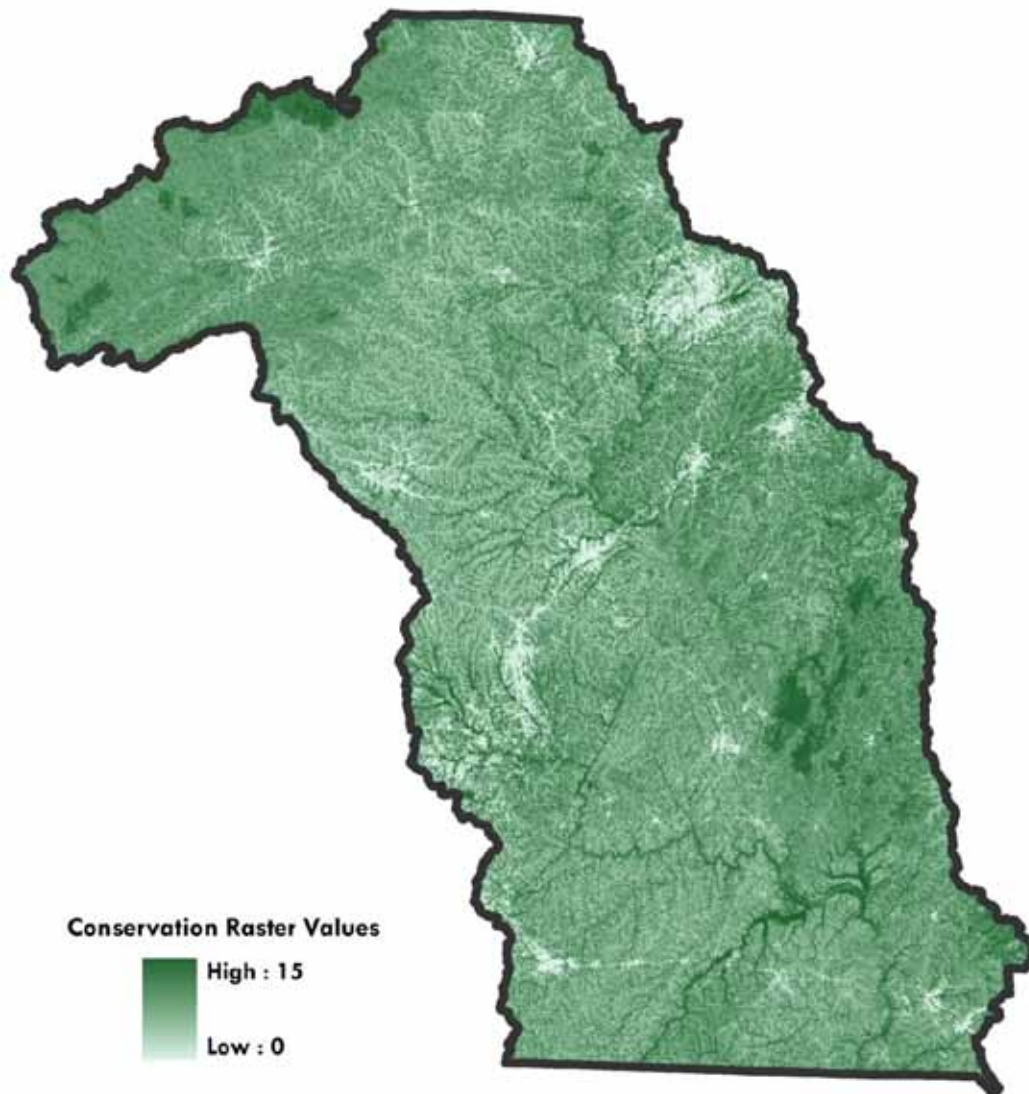


Figure 2: Output conservation raster

In the final step, the output conservation raster and the 12-digit HUC boundaries were input into the ArcGIS “Zonal Statistics” tool, which took the conservation raster and calculated the cell value statistics (mean, minimum, maximum, range, etc) contained within each HUC boundary. The HUCs were ranked in order from highest to lowest mean conservation value (see Figure 3). The mean values ranged from 2.21 to 6.68. The top 10% of the HUCs were selected as the highest priority HUCs for conservation potential.

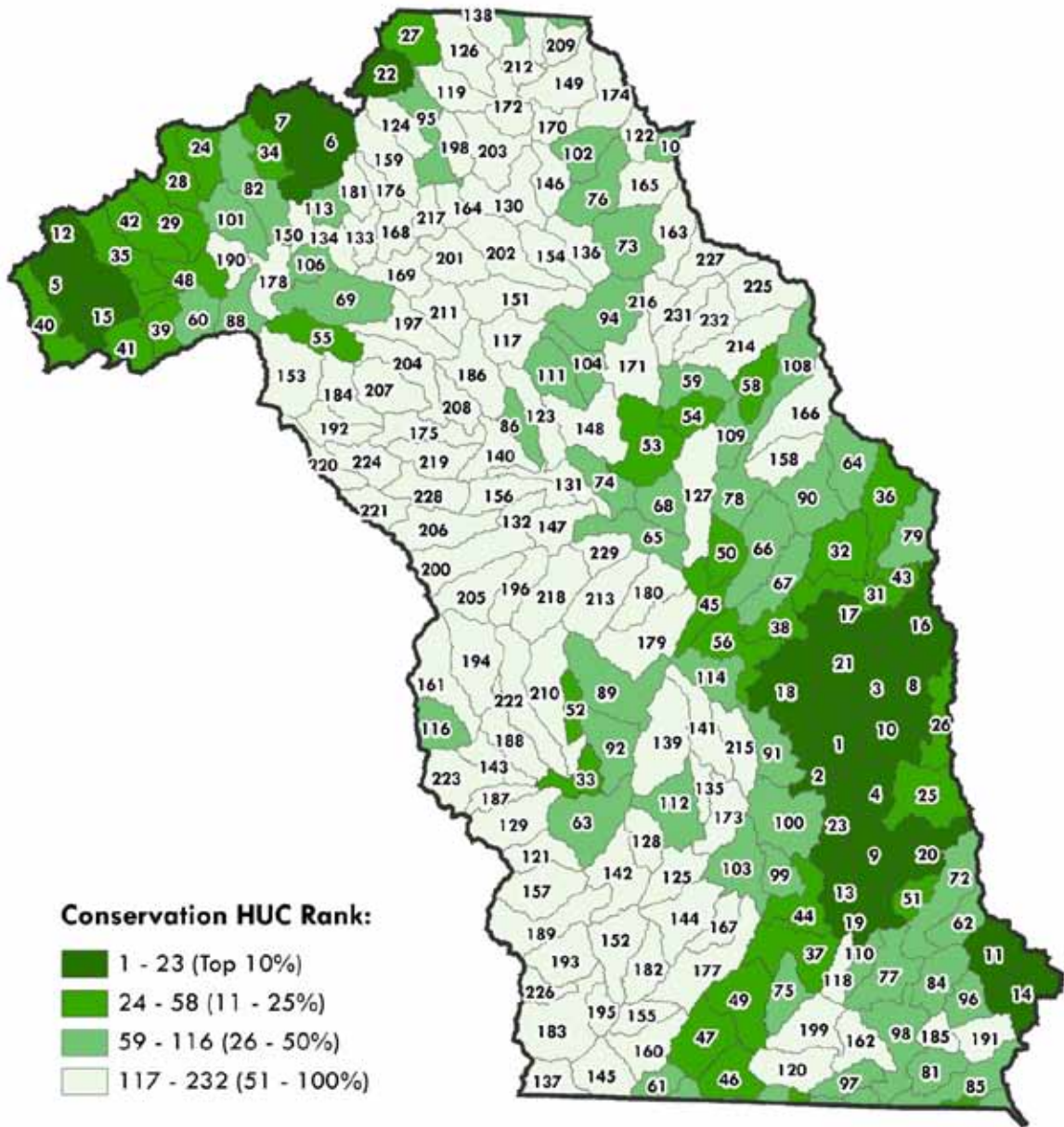


Figure 3: 12-Digit HUC Conservation Ranks (ranked in order from highest to lowest conservation mean value)

**Stress Raster Creation**

The stress raster was generated using the same procedure as the conservation raster. The 12 data layers were collected, converted to raster layers with a 20 foot cell size, and reclassified based on the factors listed in Table 2.

Stress Layers			
Criteria	Data Source	Factors	Possible Points
High Impervious cover	NLCD 2001 (Classes derived from Center for Watershed Protection)	0-4%	0
		5-9%	1
		10-19%	2
		20-100%	3
Low Forest Cover	NLCD 2001	< 50%	1
Minor Streams	NC CGIA	50 ft buffer	3
		100 ft buffer	2
		330 ft buffer	1
Major roads (I, US, NC)	NCDOT	0.25 buffer	1
Wetlands	NWI		1
Hydric Soils	SSURGO (classified by USDA)	Partially Hydric	1
		All Hydric	2
Erodible Soils	SSURGO (Classes derived from academic articles)	0 - 0.23	0
		0.24-0.39	1
		0.40-0.49	2
500 yr floodplain	NC Floodplain Mapping Program		1
Steep Slopes	NCDOT LiDAR Elevation Data	> 15%	1
Estimated Population Density Change (2009 to 2014)	ESRI Census Data (Classes derived by Quantile method for entire watershed)	< 0	0
		0-13	1
		13-75	2
		> 75	3
Animal Operation Permits	CNC CGIA; County Parcels		1
High Impact Zoning	County/Local Data	Commercial, Industrial, Office, Multifamily	1
<b>Total Possible Points</b>			<b>20</b>

Table 2: Stress Analysis Point System

The 12 reclassified rasters were then input into the ArcGIS Weighted Sum Tool to create the final stress raster, representing the vulnerability of the Yadkin River Basin landscape. The maximum possible stress value that a cell could attain was 20 if that point in space possessed the highest factors for each input stress layer, but no cells within the watershed obtained this high of a stress value. The final stress raster ranged in values from 0 to 17 (see Figure 4). This process attempted to identify the highest stress areas with the Yadkin River Basin that require additional analysis and consideration.

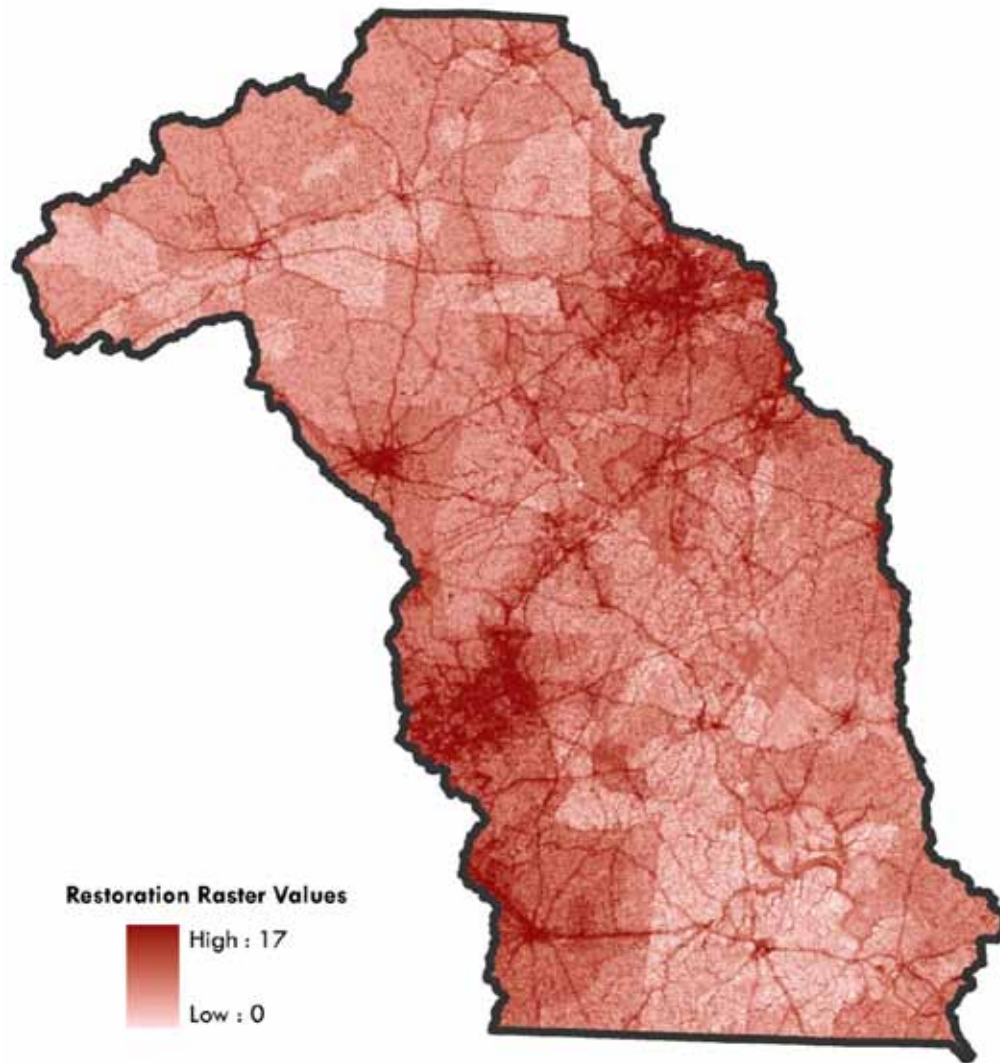


Figure 4: Output stress raster

Similar to the conservation raster, the stress raster and the 12-digit HUC boundaries were input into the ArcGIS “Zonal Statistics” tool to calculate the mean stress value for each HUC. These mean values were ranked in order from highest to lowest mean stress value (see Figure 5). The mean values ranged from 1.17 to 6.86. The top 10% of the HUCs were selected as the highest priority HUCs for stress vulnerability.

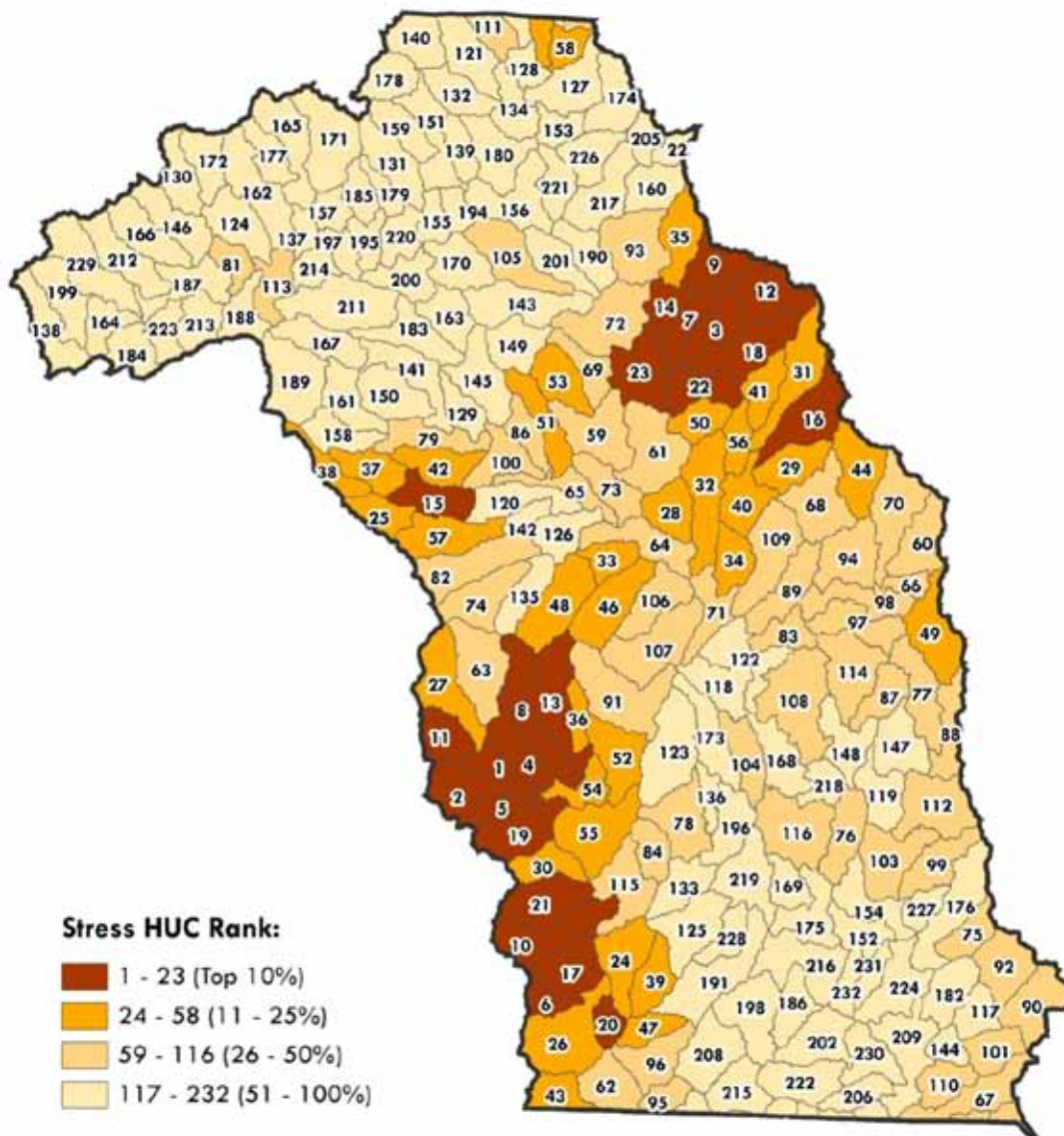


Figure 5: 12-Digit HUC Stress Ranks (ranked in order from highest to lowest stress mean value)

The *Yadkin-Pee Dee River Basin Priority Watershed Atlas* documents the findings of these analyses, detailing the characters of the top 10% most-stressed and best-conserved watersheds within the river basin (Figure 6). In the following pages, the twenty-three priority stress and twenty-three priority conservation watersheds are described in terms of their area, land use, current water quality and ecological habitat conditions, and, briefly, any land use regulations that address the local water quality needs. Local partnerships or ordinances that could aide these local water quality needs but are not in place are recommended.

# Yadkin River Basin: Final HUC Recommendations

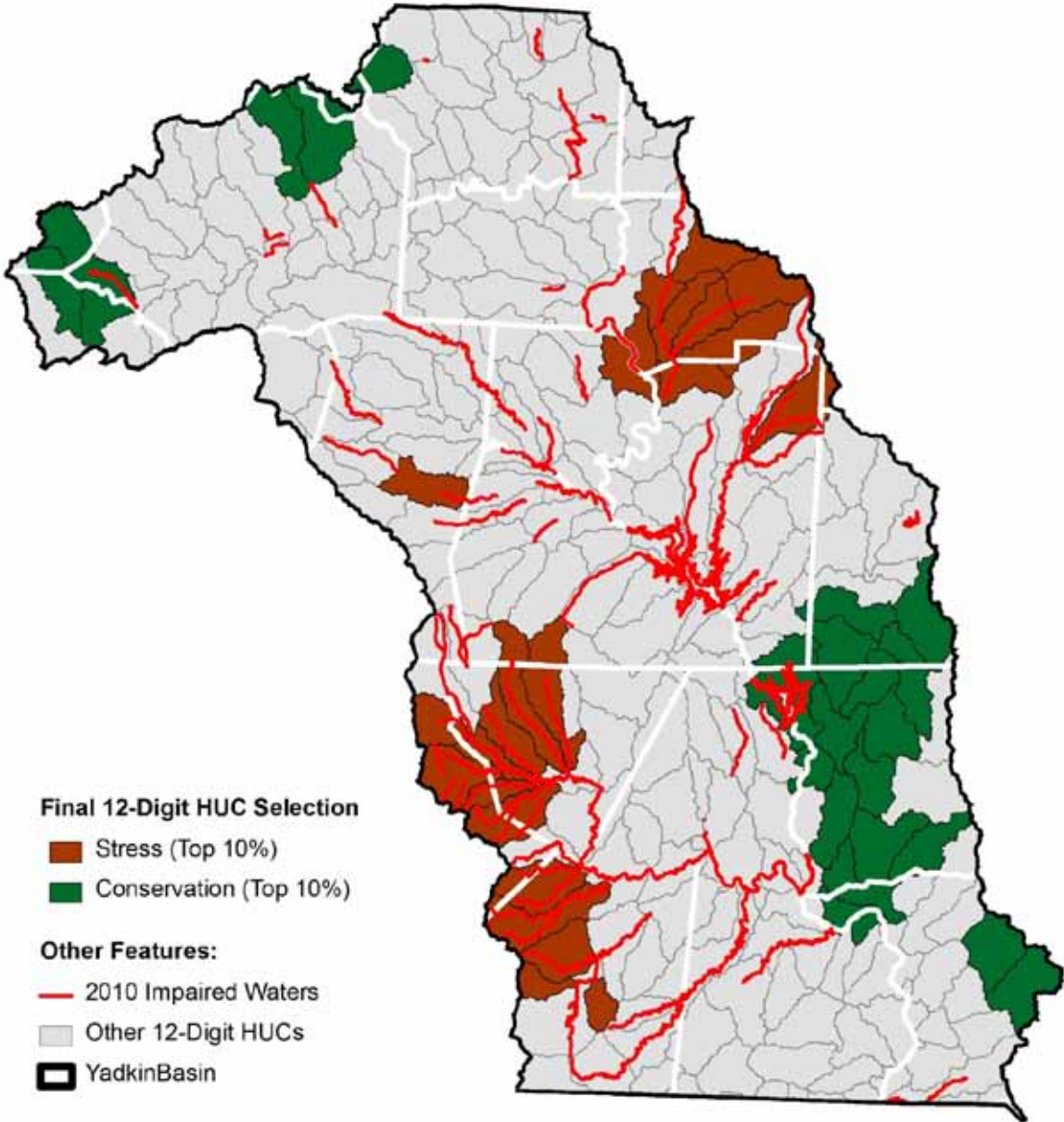


Figure 6: Final HUC Recommendations

The results appear to be highly accurate and predictive in identifying stressed watersheds that possess (highly) impaired waters and environmentally-sustainable conditions where outstanding resource waters are found. 49 of the 128 impaired water features in the Yadkin Pee-Dee River basin are directly addressed through the priority stress watersheds; a further 8 impaired waters are immediately downstream from these priority stress watersheds. If all of these watersheds received immediate support, 30% of impaired waters (10,622 of 35,472 stream miles) would be addressed through comprehensive local watershed planning in 10% of the Yadkin-Pee Dee River Basin's watersheds. 29 of the 49 Yadkin-Pee Dee River Basin's high quality or outstanding resource waters are directly addressed by through the priority conservation watersheds. The watersheds not selected mostly appear to be just outside urban areas, where major transit arteries, small parcels, and few preserved lands are available to create high conservation values. Local watershed planning in the Yadkin-Pee Dee River Basin's top 10% conservation watersheds – as determined here – will directly serve 47%, or 223,279 acres, of the high water quality watershed lands in the river basin.

These analyses demonstrate a clear value in utilizing this GIS methodology in identifying those watersheds most in need of further local attention and that hold the greatest value to the public interest. The high percentage of waters captured by this methodology indicates a value to approach these problems with this tool. Furthermore, the inclusion of many watersheds neighboring high- or poor-quality waters that could revitalize, buffer, and/or prioritize these waters through local efforts is an incalculable value to this approach.

The purpose of these brief local watershed summaries is to describe conditions that must be addressed through concentrated watershed planning and implementation efforts with further funding and support from state, federal, and private entities. This tool is recommended for large-scale, low-resolution (river basin or sub-basin) water resource and water quality planning throughout the state as way to prioritize and guide restoration and conservation work by local stakeholders and funding agencies. It should be used to make initial determinations regarding basinwide water quality priorities and to leverage for further resources to conduct local watershed planning efforts. Immediate initiation of local watershed planning relying upon the US EPA's *Nine Elements of Local Watershed Planning* and the Center for Watershed Protection's research, literature, and watershed planning tools (i.e. the Codes and Ordinance Worksheet) is uniformly recommended for every priority watershed identified within this *Atlas*.

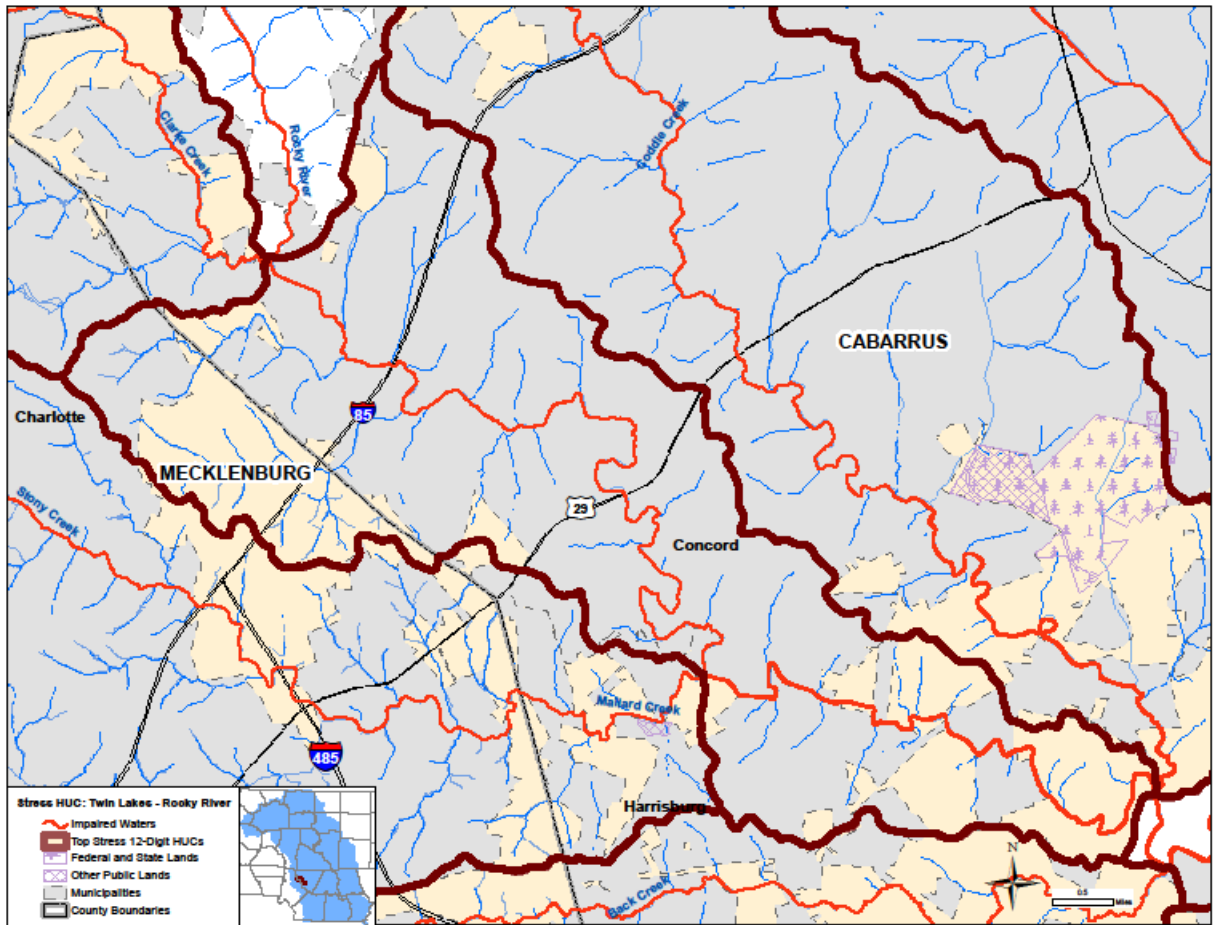


Stress 12-Digit HUCs							
Rank	12-Digit HUC Name	County	Size (Sq. Miles)	Length of Impaired Streams (Miles)	% Developed Land Cover	% Agricultural Lands	% Unmanaged Lands
1	Twin Lakes - Rocky River	Cabarrus, Mecklenburg	18.25	15.35	27.00%	19.22%	53.45%
2	Mallard Creek	Mecklenburg, Cabarrus	41.56	23.47	31.01%	8.00%	60.85%
3	Lower Salem Creek	Forsyth	28.09	10.03	49.02%	7.16%	43.71%
4	Lower Coddle Creek	Cabarrus	31.50	14.40	17.53%	22.09%	60.04%
5	Back Creek	Cabarrus, Mecklenburg	15.48	12.53	19.58%	21.99%	58.37%
6	Bearskin Creek	Union	15.20	0.00	19.66%	26.00%	54.22%
7	Middle Muddy Creek	Forsyth	25.90	4.25	26.95%	7.33%	65.47%
8	Irish Buffalo Creek	Cabarrus, Rowan	46.26	17.38	21.39%	13.52%	64.23%
9	Mill Creek	Forsyth	32.70	0.00	20.33%	6.52%	72.93%
10	Crooked Creek	Union, Mecklenburg	50.51	39.32	10.33%	41.67%	47.92%
11	Clarke Creek	Mecklenburg, Cabarrus	28.15	5.45	8.93%	20.75%	70.13%
12	Upper Salem Creek	Forsyth	41.85	1.97	18.89%	10.96%	68.61%
13	Cold Water Creek	Cabarrus, Rowan	50.28	12.69	21.39%	13.52%	64.23%
14	Upper Muddy Creek	Forsyth	18.93	5.62	12.26%	14.74%	72.36%
15	Middle Fourth Creek	Iredell	30.17	3.15	16.25%	30.06%	53.43%
16	Rich Fork Creek	Davidson, Guilford, Randolph, Forsyth	48.89	18.95	19.69%	15.69%	64.46%
17	Lake Twitty - Stewarts Creek	Union	35.33	9.83 + 0.26 Sq. Miles*	21.39%	13.52%	64.23%
18	South Fork Muddy Creek	Forsyth, Davidson	44.49	0.00	11.51%	23.75%	64.61%
19	Reedy Creek	Cabarrus, Mecklenburg	43.06	32.99	6.16%	15.47%	78.08%
20	Ray's Fork	Union	14.63	0.01	4.74%	46.93%	48.13%
21	Goose Creek	Union, Mecklenburg	42.27	22.27	2.85%	33.39%	63.61%
22	Lower Muddy Creek	Davidson, Forsyth	28.65	5.43	3.72%	36.95%	59.24%
23	Carter's Creek - Yadkin River	Davie, Forsyth, Davidson	42.93	4.75	6.02%	26.72%	65.79%

Conservation 12-Digit HUCs							
Rank	12-Digit HUC Name	County	Size (Sq. Miles)	Length of Impaired Streams (Miles)	% Developed Land Cover	% Agricultural Lands	% Unmanaged Lands
1	Outlet Uwharrie River	Montgomery	31.66	0.00	0.07%	3.25%	96.45%
2	Wood Run - Lake Tillery	Montgomery, Stanly	17.74	0.00	0.06%	1.67%	88.63%
3	Barnes Creek	Montgomery, Randolph	24.08	0.00	0.05%	8.36%	91.55%
4	Rocky Creek	Montgomery	29.36	0.00	1.86%	6.28%	91.74%
5	Buffalo Creek	Caldwell, Watauga, Wilkes	33.04	0.00	0.04%	3.85%	96.11%
6	East Prong Roaring River	Wilkes, Alleghany	56.67	<0.01	0.55%	17.70%	81.74%
7	Middle Prong Roaring River	Wilkes, Alleghany	43.63	0.00	0.29%	13.77%	85.94%
8	West Fork Little River	Montgomery, Randolph	36.43	0.00	0.18%	17.40%	82.22%
9	Big Town Creek - Little River	Montgomery, Richmond	43.08	0.00	0.06%	7.38%	92.38%
10	Denson's Creek	Montgomery	34.78	0.00	1.85%	8.87%	89.11%
11	Rocky Fork Creek	Richmond	38.97	0.00	0.40%	15.48%	84.12%
12	Elk Creek	Watauga, Wilkes, Caldwell	50.53	9.03	0.04%	4.90%	95.06%
13	Little River	Richmond, Montgomery	31.37	0.00	0.32%	14.82%	84.69%
14	Upper Hitchcock Creek	Richmond	44.24	0.00	1.47%	8.63%	88.72%
15	Laytown Creek-Yadkin River	Caldwell, Wilkes	22.38	0.01	0.13%	15.30%	84.56%
16	Little River Headwaters	Randolph, Montgomery	45.70	0.00	3.82%	19.31%	76.66%
17	Uwharrie River Headwaters	Randolph, Davidson	32.90	0.00	0.33%	24.69%	74.83%
18	Badin Lake	Montgomery, Davidson, Stanly, Randolph	66.22	8.89 Sq. Miles*	0.61%	6.96%	78.09%
19	Dry Creek-Pee Dee River	Richmond, Anson, Montgomery	22.33	0.00	0.05%	25.02%	70.96%
20	Cheek Creek	Montgomery, Richmond	32.37	0.00	0.07%	7.72%	92.07%
21	Crow Creek - Uwharrie River	Randolph, Montgomery, Davidson	45.23	0.00	0.13%	20.26%	79.53%
22	Upper Mitchell River	Surry, Alleghany	29.27	0.00	0.13%	2.78%	96.68%
23	Clark's Creek	Montgomery	33.18	<0.01	0.45%	11.47%	87.89%



## 1) Twin Lakes-Rocky River Watershed



Twin Lakes-Rocky River Watershed	
Stress Rank	1
Size (Sq Mi)	18.25
Municipal Area (Sq Mi)	13.53
County Area (Sq Mi)	4.72
Impaired Waters (Miles)	15.35

Twin Lakes-Rocky River Land Use	
Developed	27.02%
Open Space	15.05%
Forest	26.89%
Grassland/Herbaceous	8.35%
Barren Land	0.03%
Pasture/Hay	17.95%
Cultivated Crops	1.27%
Wetlands	3.13%
Open Water	0.32%

## Twin Lakes Rocky River Watershed Water Quality Concerns

- Urban runoff

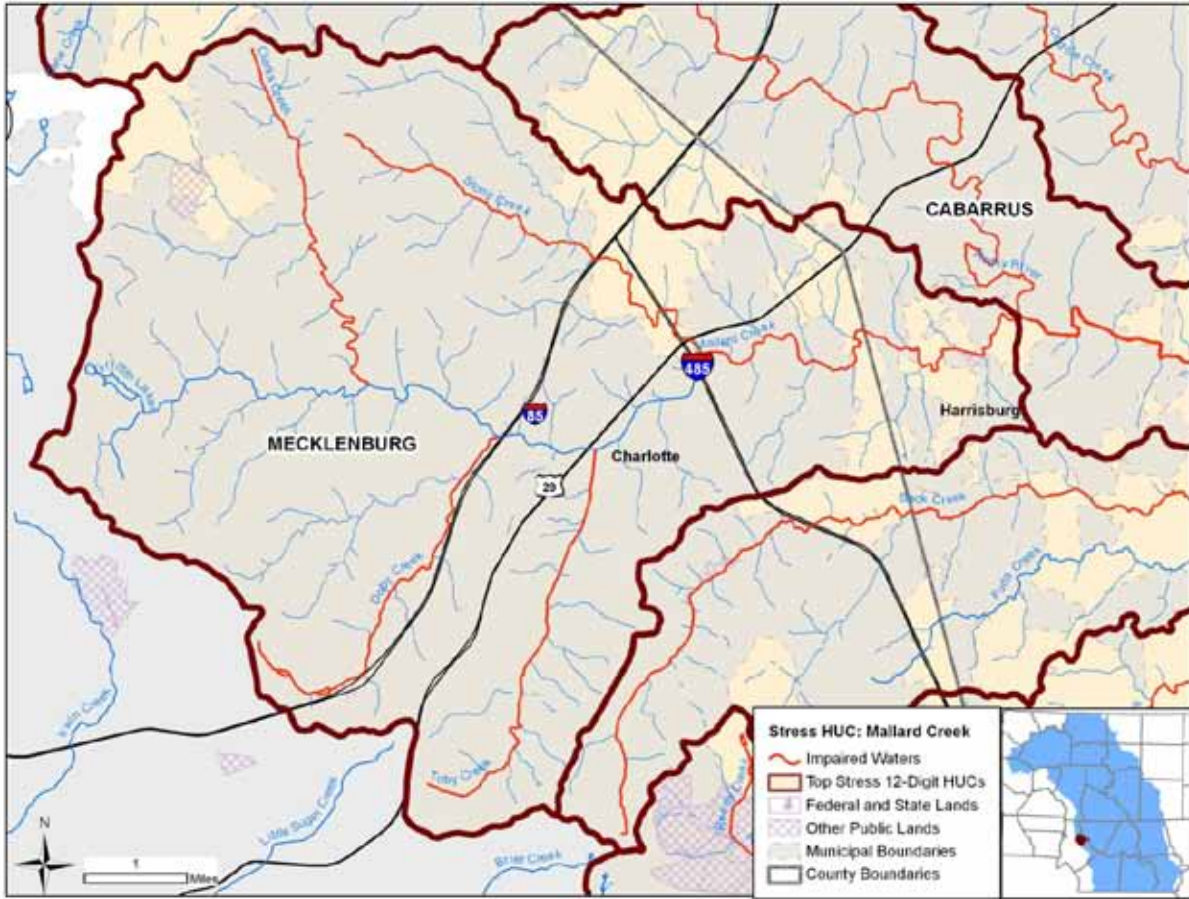
The Twin Lakes Rocky River Watershed encompasses 18 square miles in western Cabarrus County, with a small portion in Mecklenburg County. The watershed includes one stream listed under section 303(d): Rocky River (from source to mouth of Reedy Creek) for fecal coliform and turbidity. Potential sources of impairment for Rocky River include urban runoff. Split by the I-85 corridor, the watershed is home to Charlotte Motor Speedway, Concord Mills Mall and Concord Regional Airport, as well as a number of large subdivisions.

Cabarrus County maintains a Watershed Improvement Council. This 3-member commission works closely with the Cabarrus County Soil and Water Conservation Office and seeks to improve the County's water resources. Activities include efforts to reduce flooding, improve water quality and quantity and to reduce future problems through erosion control, water storage, cover protection, and education. In June 2007, Mecklenburg County established a Post Construction Storm Water Ordinance. The purpose of the ordinance is to control the adverse effects of increased post construction storm water runoff and non-point source pollution associated with new development and redevelopment. It was determined that proper management of construction-related and post-construction storm water runoff will minimize damage to public and private property and infrastructure, safeguard the public health, safety, and general welfare, and protect water and aquatic resources. The City of Concord's Zoning Ordinance includes Water Supply Watershed Protection and Water Body Buffer sections that govern the scale and type of new development.

The Twin Lakes-Rocky River watershed is in Phase Two of the NC Ecosystem Enhancement Program's Lower Yadkin River Basin Local Watershed Plan. The Phase I Study Area was located upstream of Twin Lakes-Rocky River in the Lower Yadkin River subbasin, and documented water quality problems that are indicative of likely water quality stressors within the Twin Lakes-Rocky River Local Watershed. High impervious coverage, urbanizing riparian corridors, and water quality data available upstream and downstream of the local watershed suggest that turbidity, sediment, and fecal coliform problems likely exist within the local watershed.

Existing conservation and restoration efforts can be utilized in the watershed. The predominant land conservancy in the region is the Land Trust for Central Carolina. Land Trust for Central Carolina works with landowners who desire to voluntarily donate conservation easements, with emphasis given to projects that protect large tracts, working farms, properties with ecological and recreational significance, and properties adjacent to other protected land.

## 2) Mallard Creek Watershed



Mallard Creek Watershed	
Stress Rank	2
Size (Sq Mi)	41.56
Municipal Area (Sq Mi)	36.91
County Area (Sq Mi)	4.65
Impaired Waters (Miles)	23.47

Mallard Creek Land Use	
Developed	31.01%
Open Space	28.70%
Forest	28.22%
Grassland/Herbaceous	3.05%
Barren Land	0.06%
Pasture/Hay	7.75%
Cultivated Crops	0.25%
Wetlands	0.82%
Open Water	0.12%

### Mallard Creek Watershed Water Quality Concerns:

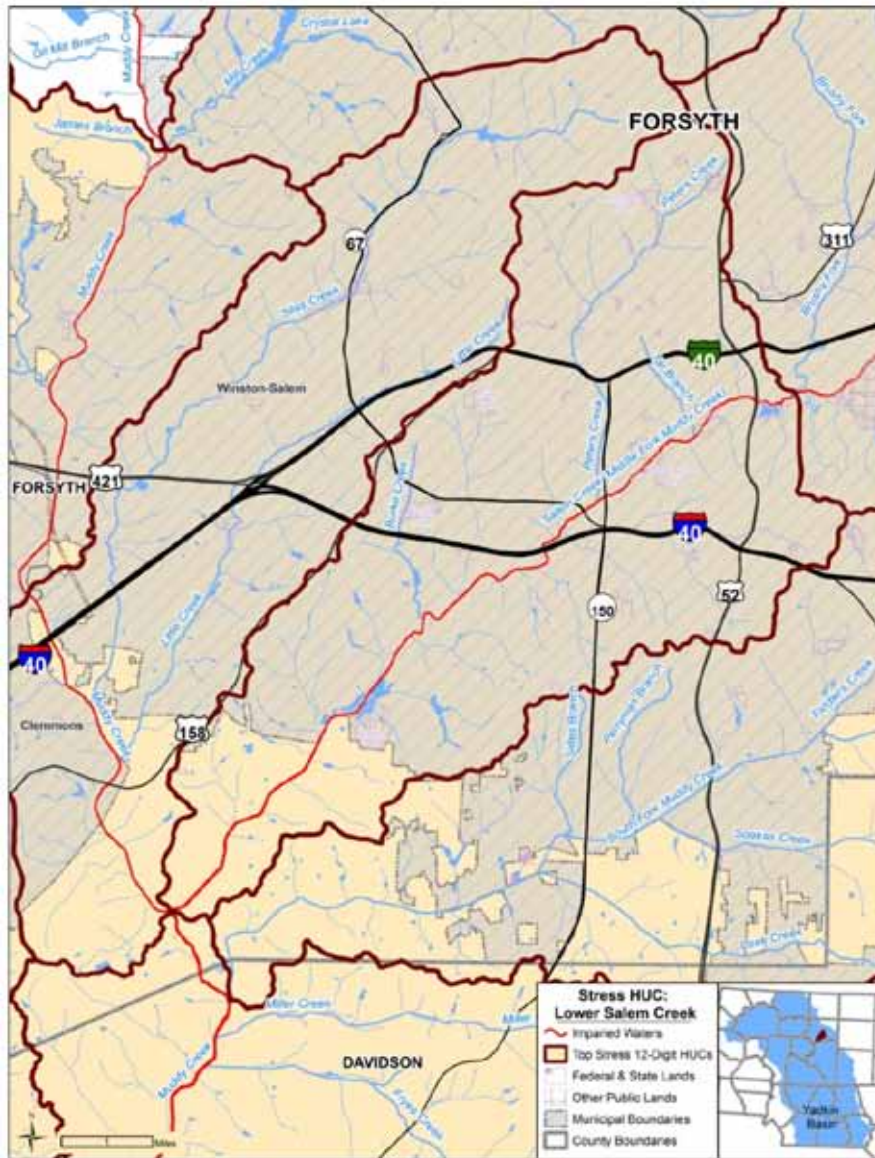
- Stream bank erosion due to construction
- Elevated fecal coliform levels from agricultural activity
- Discharge from the Mallard Creek WWTP

The Mallard Creek Watershed encompasses approximately 41.5 square miles. It is primarily located within Mecklenburg County along the I-85 and NC Highway 29 corridor, with a small portion in western Cabarrus County. Nearly 60% of the Mallard Creek lies within the limits of the City of Charlotte, with the City of Concord and the Town of Harrisburg comprising less than 4%. Although much of this watershed is already developed with residential, commercial and institutional usages, there are still several large (>200 acre) tracts of undeveloped land, some being used for agricultural purposes. Problems noted in this local watershed include: high turbidity and stream bank erosion associated with construction activities, elevated fecal coliform levels associated with agricultural activity and discharge from the Mallard Creek WWTP and isolated flooding.

In 1998, Charlotte and Mecklenburg County adopted the SWIM buffer ordinance. The Surface Water Improvement and Management (SWIM) initiative established buffer zones along creeks in Charlotte and Mecklenburg County. No construction or development is allowed in the buffer zones. The Cabarrus County Zoning Ordinance includes the Water Supply Watershed Protection Overlay District. The overlay district applies within the areas designated by the North Carolina Environmental Management Commission as the critical or protected area of a surface water supply watershed and as shown on the official watershed map for Cabarrus County. The ordinance also includes policies for water body buffer zoneing a minimum 50' vegetative buffer is required along each side of all perennial waters; and no new development is allowed in the buffer area except for water dependent structures and public projects (such as road crossings and greenways where no practicable alternative exists). Cabarrus County maintains a Watershed Improvement Council. This 3-member commission works closely with the Cabarrus County Soil and Water Conservation Office and seeks to improve the County's water resources. Activities include efforts to reduce flooding, improve water quality and quantity and to reduce future problems through erosion control, water storage, cover protection, and education.

In 2004, the North Carolina Ecosystem Enhancement Program (EEP), in conjunction with MACTEC Engineering and Consulting, Inc., completed *Watershed Management Plans and Recommendations* for an area including the Mallard Creek Watershed. Their recommendations for Mallard Creek contained the following elements: watershed improvement projects; recommended institutional measures; Best Management Practices; strategies for future follow-up; strategies for future land use practices; long-term biological and physical/chemical monitoring; and future watershed studies. The full report can be found at [http://www.nceep.net/services/lwps/Clarke\\_Creek/wmp\\_r04-15-05.pdf](http://www.nceep.net/services/lwps/Clarke_Creek/wmp_r04-15-05.pdf).

### 3) Lower Salem Creek Watershed



Lower Salem Creek Watershed	
Stress Rank	3
Size (Sq Mi)	28.09
Municipal Area (Sq Mi)	24.62
County Area (Sq Mi)	3.47
Impaired Waters (Miles)	10.03

Lower Salem Creek Land Use	
Developed	49.02%
Open Space	29.20%
Forest	11.93%
Grassland/Herbaceous	2.37%
Barren Land	0.03%
Pasture/Hay	6.96%
Cultivated Crops	0.20%
Wetlands	0.18%
Open Water	0.11%



Lower Salem Creek Watershed Threats to Water Quality:

- Ongoing fecal discharges to the watershed
- Stormwater impacts from residential and commercial development
- Streambank erosion
- Loss of open space and forestland
- Spills and contamination from vehicular traffic

The Lower Salem Creek Watershed covers 28 square miles in eastern Forsyth County. 88% of the watershed is in the City of Winston-Salem. Land use in the Lower Salem Creek Watershed is 29 % open space, 12% forested, and 49% developed. Lower Salem Creek occupies the urban core of Winston-Salem, including the heavily-used I-40, I-40 BUS, and US-52 corridors, making it prime real estate for industrial and commercial use.

Salem Creek is an impaired stream and has a significant amount of fecal coliform bacteria. Certain measurements in Salem Creek have been over 1000 colonies per ml. The North Carolina standard for fecal coliform bacteria is 200 colonies per ml. Due to high fecal coliform bacteria levels, it is plausible that this is a potential nutrient source and problem for High Rock Lake.

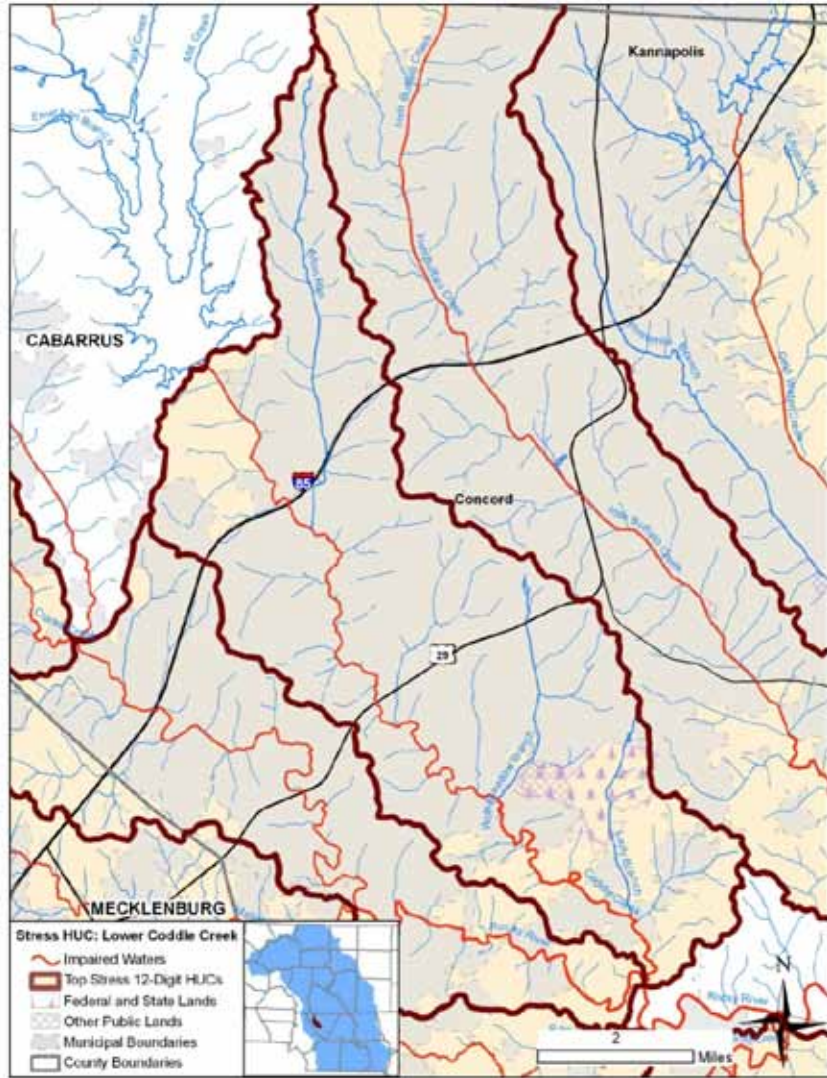
Salem Lake and Salem Creek are headwaters of the Yadkin River and High Rock Lake. Improving Salem Creek’s water quality is important to improving High Rock Lake, which is currently the subject of a TMDL assessment to determine nutrient sources of pollution (<http://h2o.enr.state.nc.us/tmdl/SpecialStudies.htm#HighRockLake>). Publication of this TMDL will likely be followed by state legislation to reduce nutrient and sediment inputs to the watershed, similar to that seen in Jordan Lake and Falls Lake.

Forsyth County has taken steps to protect water quality, and requires riparian buffers for all new development. The Salem Creek Trail and Salem Lake Trail greenways, as well as the Peters Creek Parkway all function as recreational and environmental assets. Salem Creek Trail is 4.5 miles and paved while Salem Lake Trail is 6.5 miles and unpaved.

Forsyth County/Winston-Salem Stormwater Division requires riparian buffers around surface water for all new development (see table). Furthermore, all development in the Lower Salem Creek Watershed is required to submit a Stormwater Management System Plan to the Planning & Zoning Board, which has different watershed regulations related to the development types.

<i>Development or Redevelopment Size</i>	Required Landward Buffer Widths	Undisturbed Buffer Widths (Within Landward Buffer)
0-10 Acres	30 Feet	15 Feet
10-50 Acres	50 Feet	25 Feet
Greater than 50 Acres	100 Feet	50 Feet

#### 4) Lower Coddle Creek Watershed



Lower Coddle Creek Watershed	
Stress Rank	4
Size (Sq Mi)	31.5
Municipal Area (Sq Mi)	24.92
County Area (Sq Mi)	6.58
Impaired Waters (Miles)	14.40

Lower Coddle Creek Land Use	
Developed	17.53%
Open Space	21.14%
Forest	29.22%
Grassland/Herbaceous	7.88%
Barren Land	0.08%
Pasture/Hay	21.52%
Cultivated Crops	0.57%
Wetlands	1.72%
Open Water	0.33%

### Lower Coddle Creek Watershed Threats to Water Quality

- Nonpoint source pollution, largely from stormwater runoff in and around Concord and Kannapolis
- Increased Development

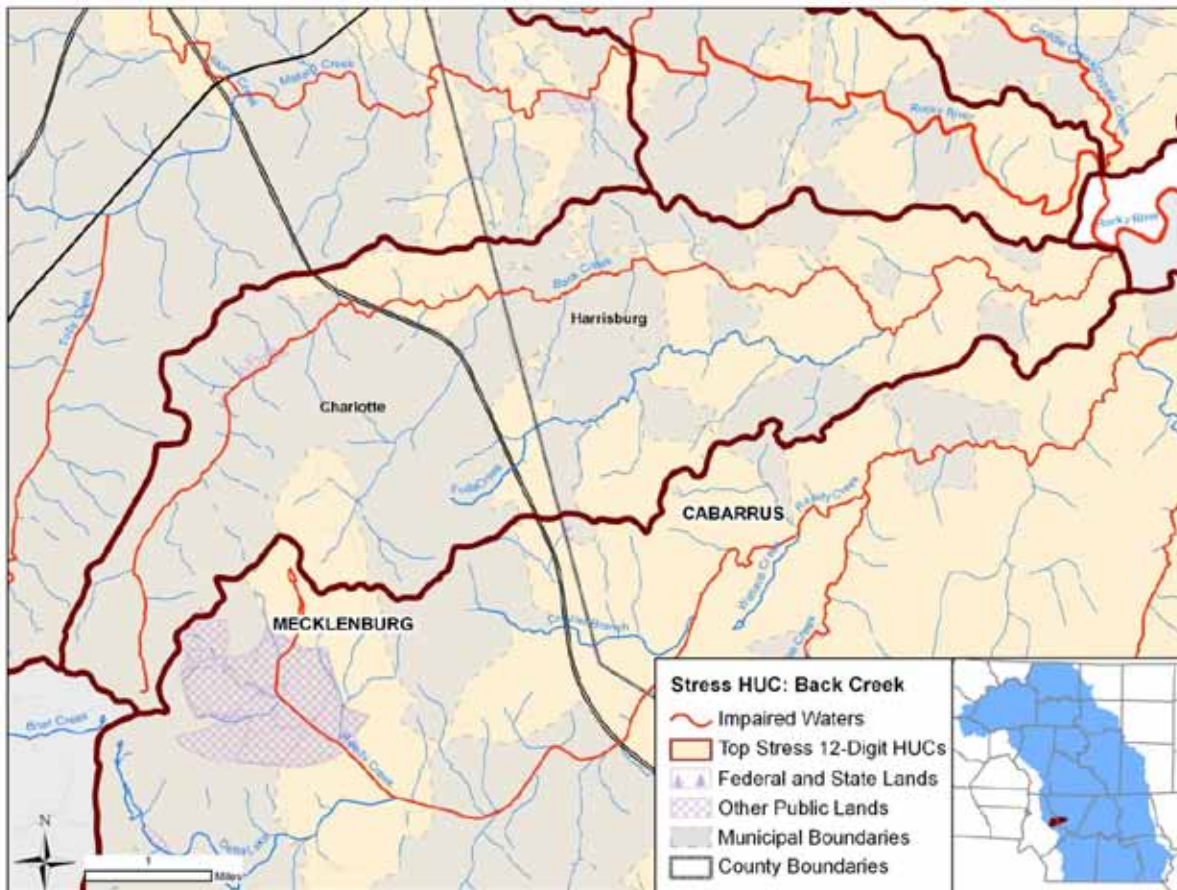
The Lower Coddle Creek Watershed encompasses 31.5 square miles in western Cabarrus County, reaching north to just below the Rowan County border. Coddle Creek flows generally to the south and is characterized by a dendritic drainage pattern. It is located east of the Rocky River main stem and drains to an area south of the North Carolina State Highway 152 and north NC-49 where it drains to the confluence with the Rocky River. The watershed includes Lake Howell (formerly the Coddle Creek Reservoir), a 1,300-acre impoundment that provides raw water for the Coddle Creek Water Treatment Plant and the Kannapolis Water Treatment Plant. Lake Howell's drainage area is designated as a Water Supply II (WS-II) High Quality Waters (HQW).

Coddle Creek is considered impaired for violating turbidity standards and was listed on the state's 303 (d) list in 2008. The most significant functional problems noted in this watershed include: degraded riparian and stream habitats, stream down-cutting and widening, and elevated levels of turbidity, fecal coliforms, nutrients and metals. Increased development in the area has led to an increase in impervious cover, an increase in channelization of stormwater, a decrease in forested riparian corridors along streams, and an increase in floodplain development, ultimately leading to impaired hydrologic function. Water quality functions are impacted by agricultural practices as well as the growing presence of residential subdivisions.

The watershed is governed by the cities of Concord and Kannapolis and Cabarrus County. The Cabarrus County Zoning Ordinance includes the WS-III Water Supply Watershed Protection Overlay District. The ordinance also includes policies for water body buffer zones. A minimum 50' vegetative buffer is required along each side of all perennial waters and no new development is allowed in the buffer area except for water dependent structures and public projects such as road crossings and greenways where no practicable alternative exists. Cabarrus County maintains a Watershed Improvement Council. This 3-member commission works closely with the Cabarrus County Soil and Water Conservation Office and seeks to improve the County's water resources. Activities include efforts to reduce flooding, improve water quality and quantity and to reduce future problems through erosion control, water storage, cover protection, and education.

The City of Concord's Zoning Ordinance also includes WS-II Water Supply Watershed Protection and Water Body Buffer sections that govern the scale and type of new development. A large part of the watershed is located in the watersheds controlled by the National Pollution Discharge Elimination System Phase II Stormwater Permit issued by the State of North Carolina. In 2008, the City of Kannapolis enacted a Stormwater Ordinance to protect the integrity of the watersheds by controlling the adverse effects of increased post-development stormwater runoff and nonpoint and point source pollution associated with new development and redevelopment as well as illicit discharges into municipal stormwater systems.

## 5) Back Creek Watershed



Back Creek Watershed	
Stress Rank	5
Size (Sq Mi)	15.48
Municipal Area (Sq Mi)	9.64
County Area (Sq Mi)	5.84
Impaired Waters (Miles)	12.53

Back Creek Land Use	
Developed	19.58%
Open Space	19.50%
Forest	33.76%
Grassland/Herbaceous	4.55%
Barren Land	0.01%
Pasture/Hay	21.65%
Cultivated Crops	0.34%
Wetlands	0.55%
Open Water	0.07%

## Back Creek Watershed Threats to Water Quality

- Urban runoff

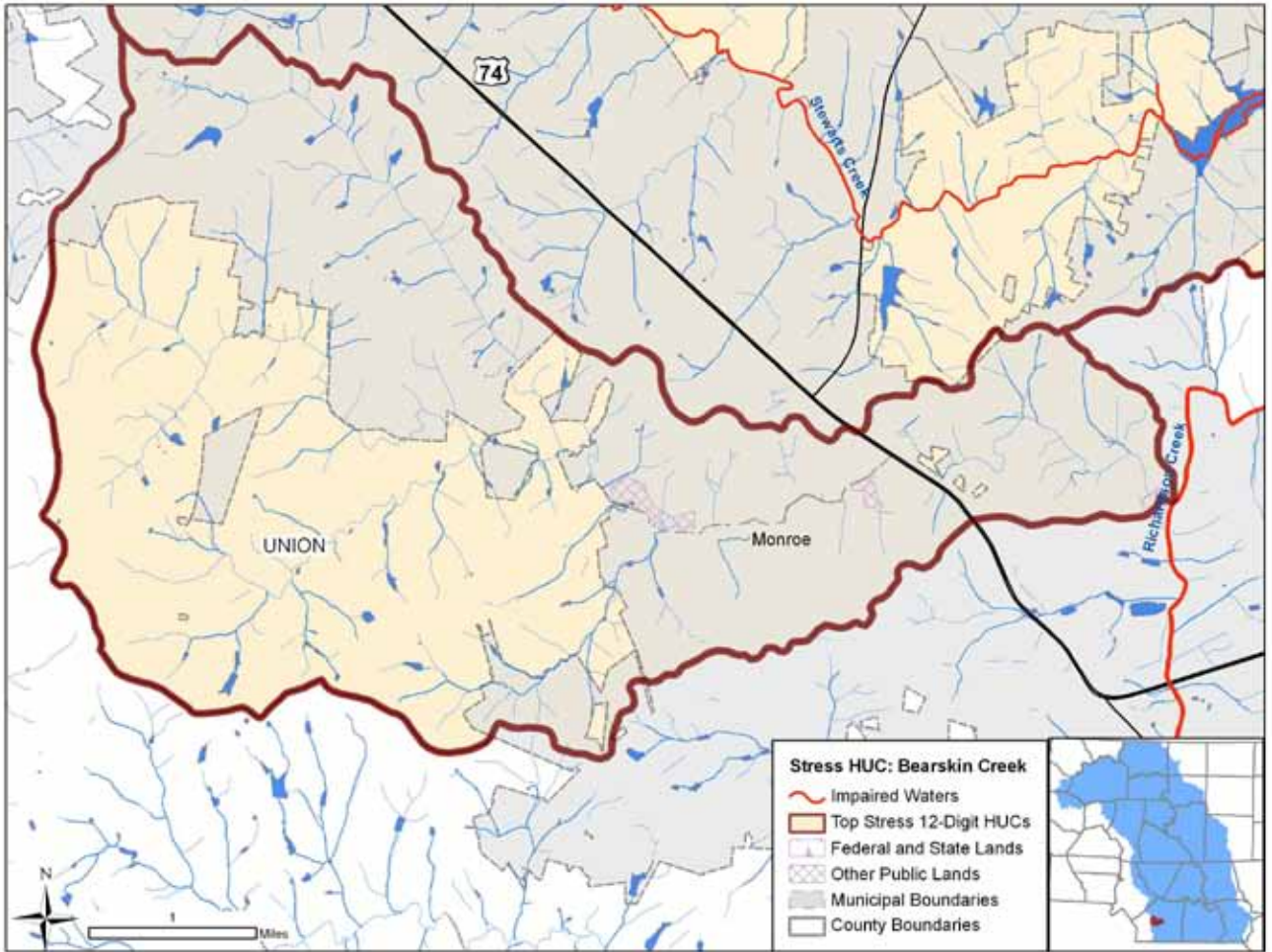
Back Creek Watershed encompasses 15 square miles in western Cabarrus County and eastern Mecklenburg County. Within this watershed, all of Back Creek is listed as impaired for Benthos under section 303(d). Potential sources of impairment for Rocky River include urban runoff. The opening of I-485 through the watershed has led to increased development in the area.

The watershed is governed by the City of Concord, and Cabarrus and Mecklenburg Counties. Cabarrus County maintains a Watershed Improvement Council, a 3-member commission works closely with the Cabarrus County Soil and Water Conservation Office and seeks to improve the County's water resources. Activities include efforts to reduce flooding, improve water quality and quantity and to reduce future problems through erosion control, water storage, cover protection, and education. In June 2007, Mecklenburg County established a Post-Construction Storm Water Ordinance. The purpose of the ordinance is to control the adverse effects of increased post construction storm water runoff and non-point source pollution associated with new development and redevelopment. It was determined that proper management of construction-related and post-construction storm water runoff will minimize damage to public and private property and infrastructure, safeguard the public health, safety, and general welfare, and protect water and aquatic resources. The City of Concord's Zoning Ordinance includes Water Supply Watershed Protection and Water Body Buffer sections that govern the scale and type of new development.

The Back Creek watershed is included in Phase Two of the NC Ecosystem Enhancement Program's Lower Yadkin River Basin Local Watershed Plan. The Phase I Study Area was located upstream of Back Creek in the larger Lower Yadkin River subbasin, and documented water quality problems that are indicative of likely water quality stressors within the Back Creek Local Watershed. High impervious coverage, urbanizing riparian corridors, and water quality data available upstream and downstream of the local watershed suggest that turbidity, sediment, and fecal coliform problems likely exist within the local watershed.

Existing conservation and restoration efforts can be utilized in the watershed. The predominant land conservancy in the region is the Land Trust for Central Carolina. Land Trust for Central Carolina works with landowners who desire to voluntarily donate conservation easements, with emphasis given to projects that protect large tracts, working farms, properties with ecological and recreational significance, and properties adjacent to other protected land.

## 6) Bearskin Creek Watershed



Bearskin Creek Watershed	
Stress Rank	6
Size (Sq Mi)	15.2
Municipal Area (Sq Mi)	8.3
County Area (Sq Mi)	6.9
Impaired Waters (Miles)	N/A

Bearskin Creek Land Use	
Developed	19.66%
Open Space	18.16%
Forest	32.75%
Grassland/Herbaceous	2.87%
Barren Land	0.04%
Pasture/Hay	24.99%
Cultivated Crops	1.01%
Wetlands	0.40%
Open Water	0.12%

### Bearskin Creek

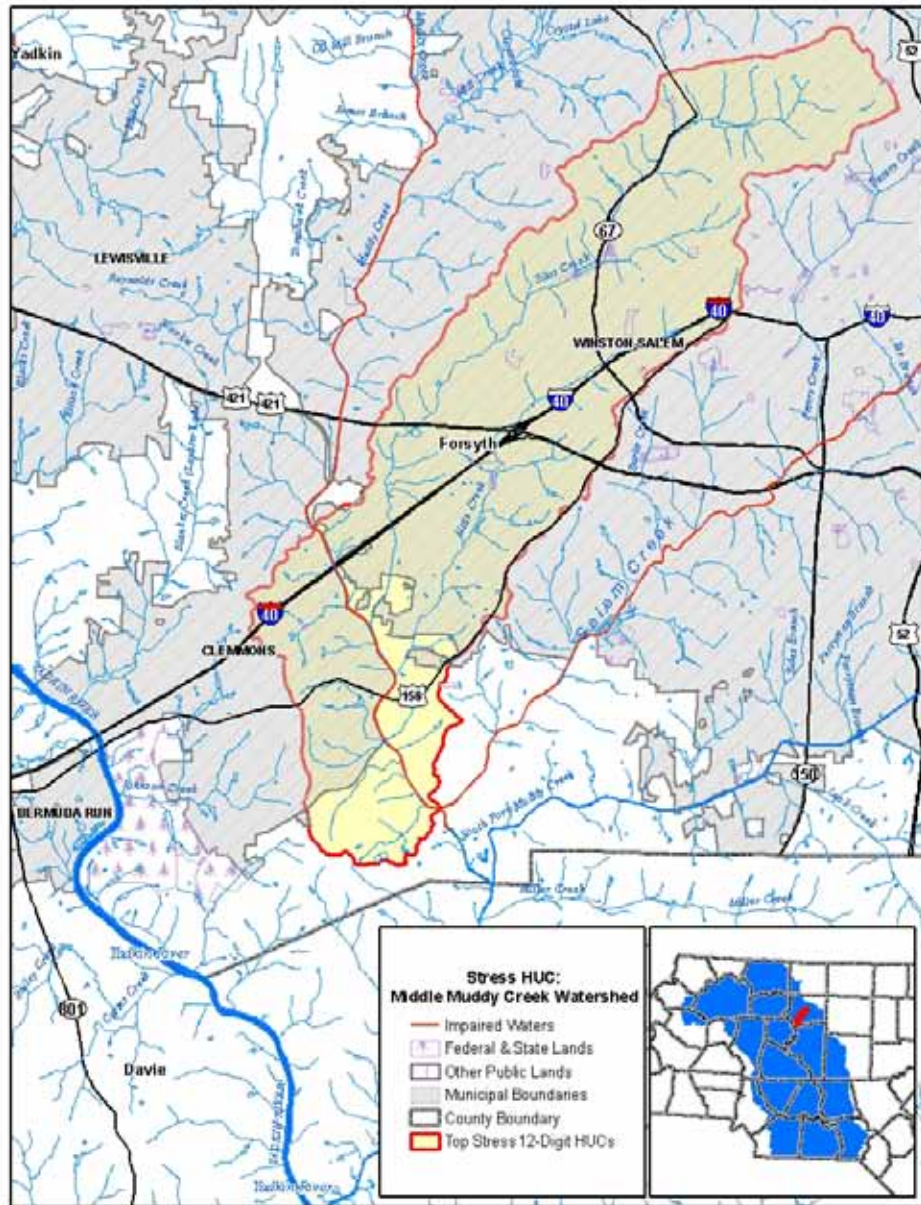
- Increased post-development stormwater runoff
- Nonpoint and point source pollution associated with new development and redevelopment
- Illicit discharges into municipal stormwater systems.

Bearskin Creek watershed is 15.2 square miles and is located in central Union County. There are no impaired streams within this watershed. As described in the 2003 Yadkin Pee-Dee River Basinwide Water Quality Plan, Bearskin Creek flows east through Monroe into Richardson Creek above the Monroe WWTP discharge. The watershed is almost completely developed with a small amount of agricultural land in the headwaters. Union County had a 60.5% growth in population between 2000 and 2009, making it the 14<sup>th</sup> fastest growing county in the country. While Bearskin Creek is not considered impaired, impacts from stormwater runoff in this watershed likely contribute to impairment of Richardson Creek downstream.

Bearskin Creek is governed by the policies of City of Monroe and Union County. In 2007 the City of Monroe passed a Stormwater Management Ordinance establishing minimum requirements and procedures to control the adverse effects of increased post-development stormwater runoff and non-point and point source pollution associated with new development and redevelopment as well as illicit discharges into municipal stormwater systems. It has been determined that proper management of construction-related and post-development stormwater runoff will minimize damage to public and private property and infrastructure; safeguard the public health, safety, and general welfare; and protect water and aquatic resources. Article XXI of Union County's Land Use Ordinance established water supply watershed overlay districts to govern the location, type, and size of new development along its water supply watersheds. In addition the ordinance requires a minimum thirty (30) foot vegetative buffer for development activities along all perennial waters.

Existing conservation and restoration efforts can be utilized in the watershed. The predominant land conservancy in the region is the Catawba Lands Conservancy. The Conservancy works with landowners and public partners to protect open space, important natural areas, significant habitats, forests, and farmland in an eight-county region.

## 7) Middle Muddy Creek Watershed



Middle Muddy Creek Watershed	
Stress Rank	7
Size (Sq. Mi.)	25.90
Municipal Area (Sq. Mi.)	22.70
County Area (Sq. Mi.)	3.20
Impaired Stream (Miles)	4.25

Middle Muddy Creek Landuse	
Developed	26.95%
Open Space	45.26%
Forest	17.02%
Grassland/Herbaceous	2.71%
Barren Land	0.02%
Cultivated Crops	0.17%
Wetlands	0.46%
Open Water	0.11%



Middle Muddy Creek Watershed Threats to Water Quality:

- Stormwater impacts from residential and commercial development
- Streambank erosion
- Loss of open space and forestland
- Spills and contamination from vehicular traffic with I-40 going through the watershed

The Middle Muddy Creek Watershed covers 25.9 square miles in western Forsyth County. 88% of the watershed is in the City of Winston-Salem or the Village of Clemmons. Land use within the Middle Muddy Creek watershed is 45% open space, 27% developed, and 17% forest. However, western Forsyth and eastern Davie Counties have much higher growth rates than their surrounding counties. Putting pressure on the watershed and hurting efforts by Forsyth County to improve it. 0.25 square miles of the watershed is part of public lands.

Muddy Creek is an impaired stream and has a significant amount of fecal coliform bacteria. The NC DWQ has conducted a Muddy Creek TMDL for fecal coliform bacteria, and determined that the majority of it originates in non-point sources, mainly failing septic systems. There is an urgent need to address this watershed problem, and any funding that can bolster County and City efforts to do so is strongly encouraged. Middle Muddy Creek Watershed will need to contend with stormwater mitigation needs as well, but these efforts will do little good if fecal coliform bacteria persists in contaminating these waters.

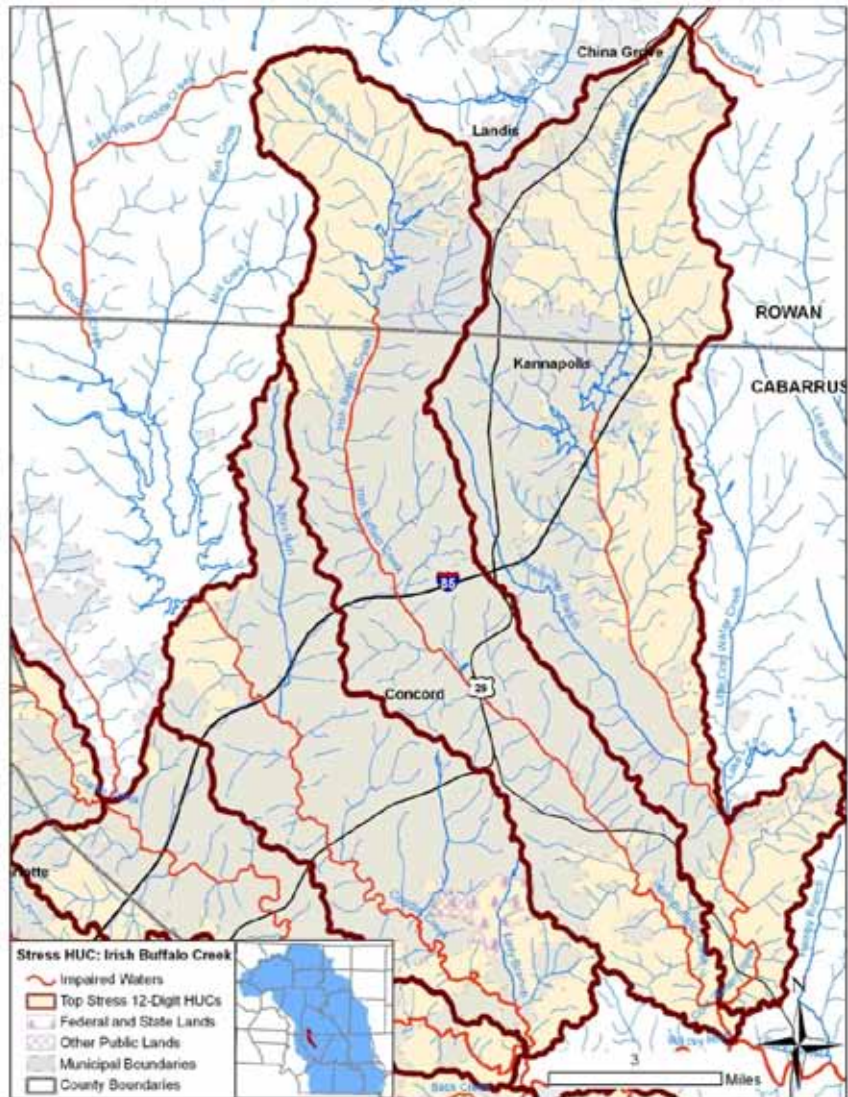
Muddy Creek is a tributary of the Yadkin River, which flows to High Rock Lake. Improving Muddy Creek's water quality is important to improving High Rock Lake, which is currently the subject of a TMDL assessment to determine nutrient sources of pollution (<http://h2o.enr.state.nc.us/tmdl/SpecialStudies.htm#HighRockLake>). Publication of this TMDL will likely be followed by state legislation to reduce nutrient and sediment inputs to the watershed, similar to that seen in Jordan Lake and Falls Lake.

Forsyth County currently has plans to feature parts of Muddy Creek as part of the Mountains-To-Sea Trail. This greenway will help provide needed buffers around Muddy Creek. As of the present, this greenway is still in planning phase.

Forsyth County/Winston-Salem Stormwater Division requires riparian buffers around surface water for all new development (see table). Furthermore, all development in the Middle Muddy Creek Watershed is required to submit a Stormwater Management System Plan to the Planning & Zoning Board, which has different watershed regulations related to the development types.

<i>Development or Redevelopment Size</i>	Required Landward Buffer Widths	Undisturbed Buffer Widths (Within Landward Buffer)
0-10 Acres	30 Feet	15 Feet
10-50 Acres	50 Feet	25 Feet
Greater than 50 Acres	100 Feet	50 Feet

## 8) Irish Buffalo Creek Watershed



Irish Buffalo Creek Watershed	
Stress Rank	8
Size (Sq Mi)	46.26
Municipal Area (Sq Mi)	30.53
County Area (Sq Mi)	15.73
Impaired Waters (Miles)	17.38

Irish Buffalo Creek Land Use	
Developed	21.39%
Open Space	35.50%
Forest	24.45%
Grassland/Herbaceous	3.85%
Barren Land	0.06%
Pasture/Hay	13.04%
Cultivated Crops	0.48%
Wetlands	0.37%
Open Water	0.87%

### Irish Buffalo Creek Threats to Water Quality

- Increased post-development stormwater runoff
- Nonpoint and point source pollution associated with new development and redevelopment
- Illicit discharges into municipal stormwater systems.

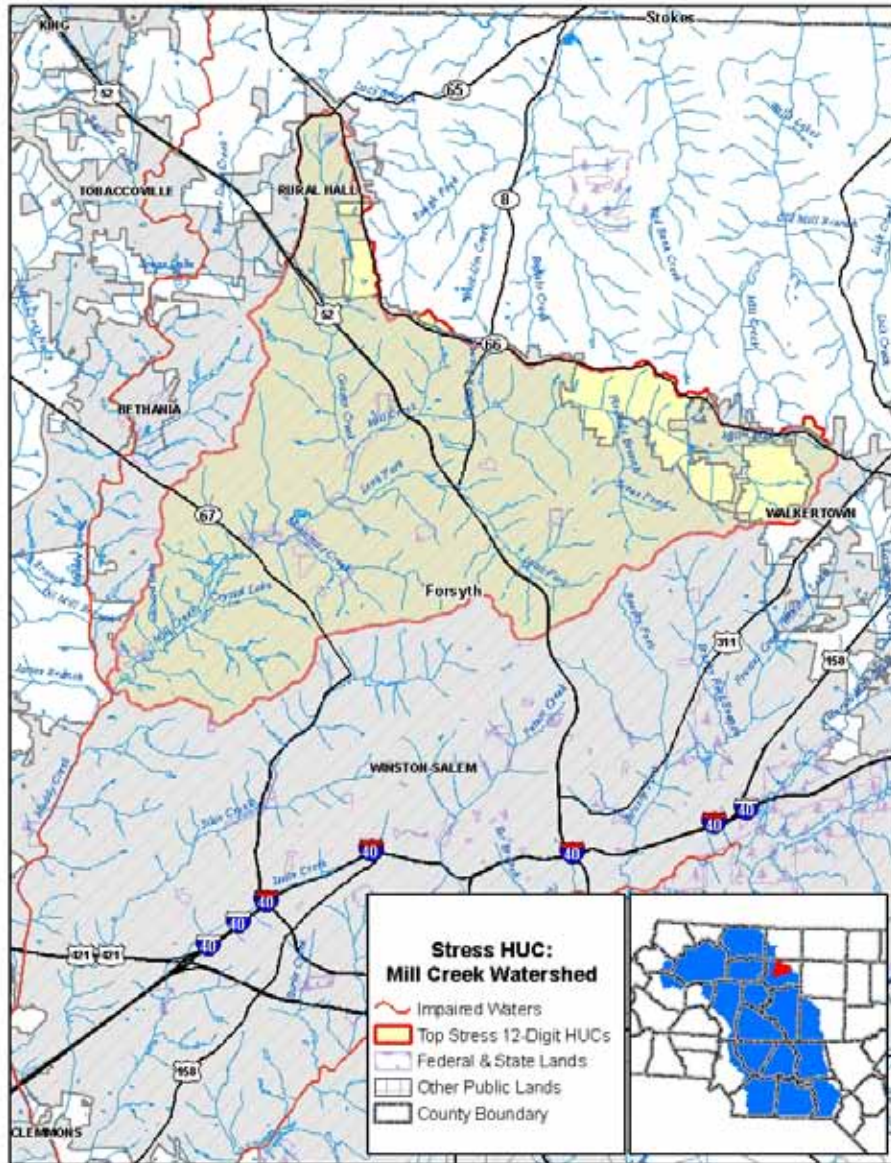
The Irish Buffalo Creek Watershed is 46 square miles. The majority of the watershed is located in north central Cabarrus County with a small portion extending north into Rowan County. Sixteen miles of the lower reach of Irish Buffalo Creek is listed on the 303(d) list as impaired for violating fecal coliform bacteria standards. There is one surface water intake on the lake and one minor NPDES wastewater sites within the watershed.

Lake Kannapolis, located in the watershed, is classified as a protected WS III water supply watershed. The watershed is governed by the municipalities of Concord, Kannapolis and Landis, as well as Rowan and Cabarrus counties. The Cabarrus County Zoning Ordinance includes the Water Supply Watershed Protection Overlay District. The overlay district applies within the areas designated by the North Carolina Environmental Management Commission as the critical or protected area of a surface water supply watershed and as shown on the official watershed map for Cabarrus County. The ordinance also includes policies for water body buffer zones; such as, a minimum 50' vegetative buffer is required along each side of all perennial waters and no new development is allowed in the buffer area except for water dependent structures and public projects (such as road crossings and greenways where no practicable alternative exists). Cabarrus County maintains a Watershed Improvement Council. This 3-member commission works closely with the Cabarrus County Soil and Water Conservation Office and seeks to improve the County's water resources. Activities include efforts to reduce flooding, improve water quality and quantity and to reduce future problems through erosion control, water storage, cover protection, and education.

Rowan County has a watershed overlay district to provide for the protection of public water supplies. The City of Concord's Zoning Ordinance also includes Water Supply Watershed Protection and Water Body Buffer sections that govern the scale and type of new development. A large part of the watershed is located in the watersheds controlled by the National Pollution Discharge Elimination System Phase II Stormwater Permit issued by the State of North Carolina. In 2008, the City of Kannapolis enacted a Stormwater Ordinance to protect the integrity of the watersheds by controlling the adverse effects of increased post-development stormwater runoff and nonpoint and point source pollution associated with new development and redevelopment as well as illicit discharges into municipal stormwater systems. The Zoning Codes of The Town of Landis has established water supply watershed overlay regulations to govern development.

Existing conservation and restoration efforts can be utilized in the watershed. The predominant land conservancy in the region is the Land Trust for Central Carolina. Land Trust for Central Carolina works with landowners who desire to voluntarily donate conservation easements, with emphasis given to projects that protect large tracts, working farms, properties with ecological and recreational significance, and properties adjacent to other protected land.

## 9) Mill Creek Watershed



Mill Creek Watershed	
Stress Rank	9
Size (Sq. Mi.)	32.7
Municipal Area (Sq. Mi.)	29.5
County Area (Sq. Mi.)	3.2
Impaired Stream (Miles)	N/A

Mill Creek Landuse	
Developed	20.33%
Open Space	45.67%
Forest	24.00%
Grassland	2.43%
Barren Land	0.01%
Pasture/Hay	6.23%
Crops	0.29%
Wetlands	0.82%
Open Water	0.23%

### Mill Creek Watershed Threats to Water Quality

- Development
- Streambank erosion
- Loss of open space and forestland

The Mill Creek Watershed covers 32.7 square miles in northern Forsyth County. 90% of the watershed is in the City of Winston-Salem or the Town of Rural Hall. None of the streams within the watershed are impaired, but Mill Creek is a major tributary to Muddy Creek which is impaired for violating fecal bacteria NC standards. The sources of stress are largely non-point, and failing septic systems have been charged with the main source of pollution.

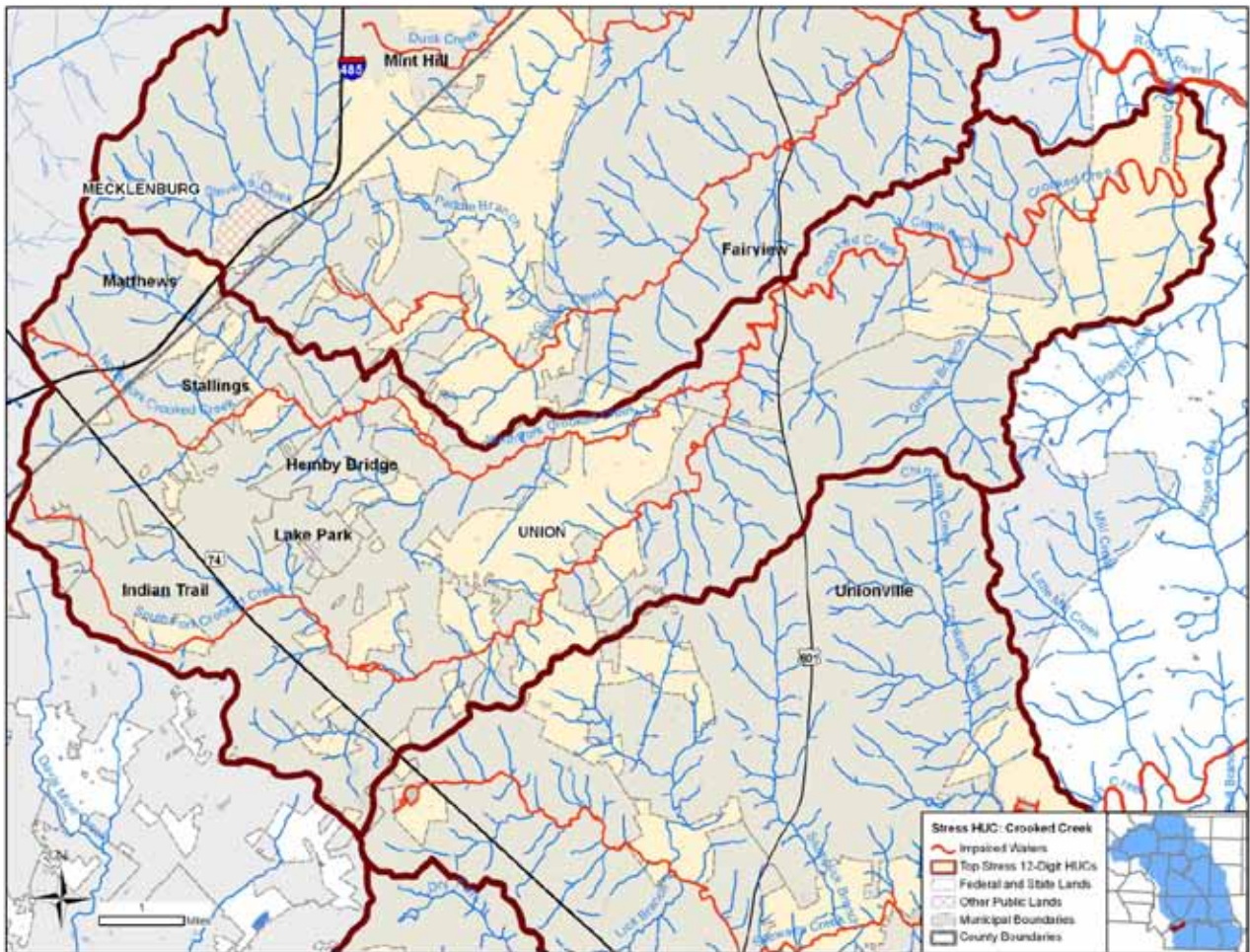
Land use within the Mill Creek Watershed is 46 % open space and 21% developed. However, due to this area being in a municipality that provides sewer and water utilities, the developed area continues to increase, and is likely much higher than the reported 21%. 2.14% of the watershed is public lands. There is no water supply watershed area in the Mill Creek Watershed, nor does it contain anything from the Natural Heritage Program.

Mill Creek's is extremely valuable for two reasons: 1) It is a major tributary to Muddy Creek; and 2) It's an area that will be heavily developed in the future. Plans for the Northern Beltway around Winston-Salem, also known as I-74, is planned to come right through this area. And with increased sewage and water utilities, heavy development is inevitable. What is not inevitable is keeping Mill Creek clean for future generations.

The Forsyth County/Winston-Salem Stormwater Division requires a Stormwater Management System Plan for all new development. It has also taken steps to use riparian buffers around surface water when development occurs. Buffer widths for development around Mill Creek and other streams in watershed is:

<i>Development or Redevelopment Size</i>	Required Landward Buffer Widths	Undisturbed Buffer Widths (Within Landward Buffer)
0-10 Acres	30 Feet	15 Feet
10-50 Acres	50 Feet	25 Feet
Greater than 50 Acres	100 Feet	50 Feet

## 10) Crooked Creek Watershed



Crooked Creek Watershed	
Stress Rank	10
Size (Sq Mi)	50.51
Municipal Area (Sq Mi)	38.11
County Area (Sq Mi)	12.4
Impaired Waters (Miles)	39.32

Crooked Creek Land Use	
Developed	10.33%
Open Space	12.53%
Forest	30.53%
Grassland/Herbaceous	2.51%
Barren Land	0.01%
Pasture/Hay	39.30%
Cultivated Crops	2.37%
Wetlands	2.34%
Open Water	0.07%

### Crooked Creek Watershed Threats to Water Quality:

- Construction
- Stormwater runoff
- Agricultural uses

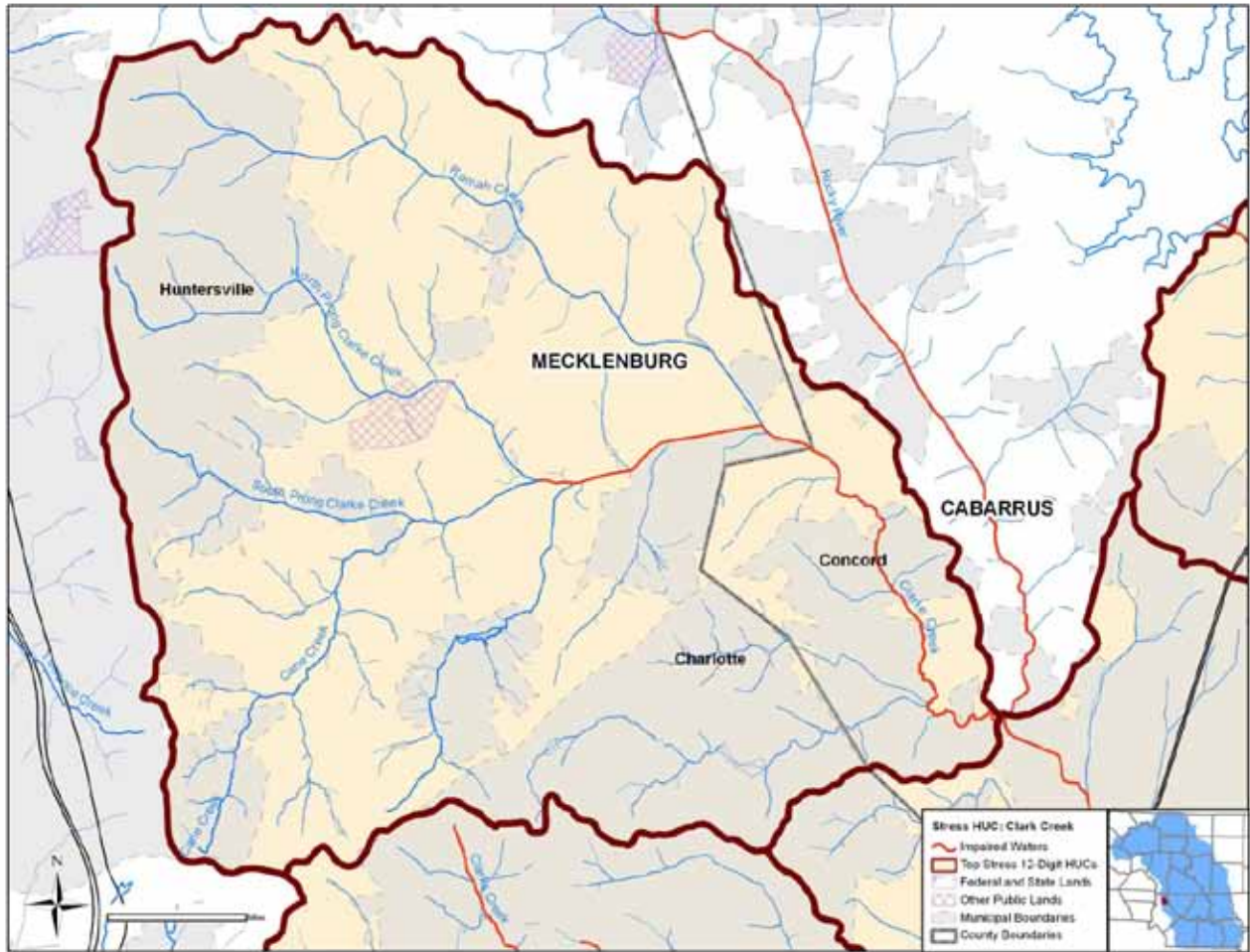
Crooked Creek occupies approximately 51 square miles in a rapidly developing area at the Union County and Mecklenburg County line along the US 74 Corridor. Union County had a 60.5% growth in population between 2000 and 2009, making it the 14<sup>th</sup> fastest growing county in the country. The watershed includes the towns of Matthews, Stallings, Lake Park, Hemby Bridge, Indian Trail, Unionville and Fairview. With this rapid urbanization, potentially significant, indirect, or secondary impacts on water quality and aquatic habitat in the Crooked Creek watershed may be due to the development. The Savannah lilliput (*Toxolama pullus*) is a freshwater mussel located in Crooked Creek that is listed as a species of concern by the federal government. Crooked Creek is one of only two locations in the world where the Savannah lilliput exists in the world.

Crooked Creek is classified as impaired due to poor biological health and failing to meet state bioclassification standards. Construction, stormwater runoff, and agriculture are the likely stressors to aquatic health in Crooked Creek. The current Union County Wastewater Master Plan proposes future additions to gravity sewer lines running along Crooked Creek. As with many slate belt streams in Union County, however, both the North and South Forks of Crooked Creek have little flow during dry periods. As such, these streams have very limited, if any, capacity to assimilate wastewater. Fortunately, wastewater is currently being proposed for treatment at a future plant along Grassy Creek through the use of pump stations and force mains.

The North Carolina Ecosystem Enhancement Program (EEP) has initiated development of a local watershed plan (LWP) for Crooked Creek (and neighboring Goose Creek, Priority Stress Watershed 21, p. 54). In February of 2009, Centralina Council of Governments, in partnership with Tetra Tech, completed Phase I (watershed characterization and preliminary findings) of the plan. The scoping assessment for Goose Creek suggested that its primary stressors are increased peak flows and runoff volumes, sediment and bacteria. Oxygen demanding substances and toxic substances are thought to be a secondary stressor. These stressors, resulting primarily from the lack of historical pre- and post-construction stormwater controls, have resulted in impairments to aquatic habitat in the watershed.

In early 2010, Tetra Tech and Centralina began Phases II and III of the LWP. Phase II is designed to focus on the collection and analysis of additional data for assessing conditions of subwatersheds and reaches, refining the characterization of stressors and restoration goals, and identifying priority areas. Phase III will include an evaluation of and recommendations for management opportunities.

## 11) Clarke Creek Watershed



Clarke Creek Watershed	
Stress Rank	11
Size (Sq Mi)	28.15
Municipal Area (Sq Mi)	12.68
County Area (Sq Mi)	15.47
Impaired Waters (Miles)	5.45

Clarke Creek Land Use	
Developed	8.93%
Open Space	15.16%
Forest	46.05%
Grassland/Herbaceous	6.32%
Barren Land	0.06%
Pasture/Hay	20.16%
Cultivated Crops	0.59%
Wetlands	2.54%
Open Water	0.19%



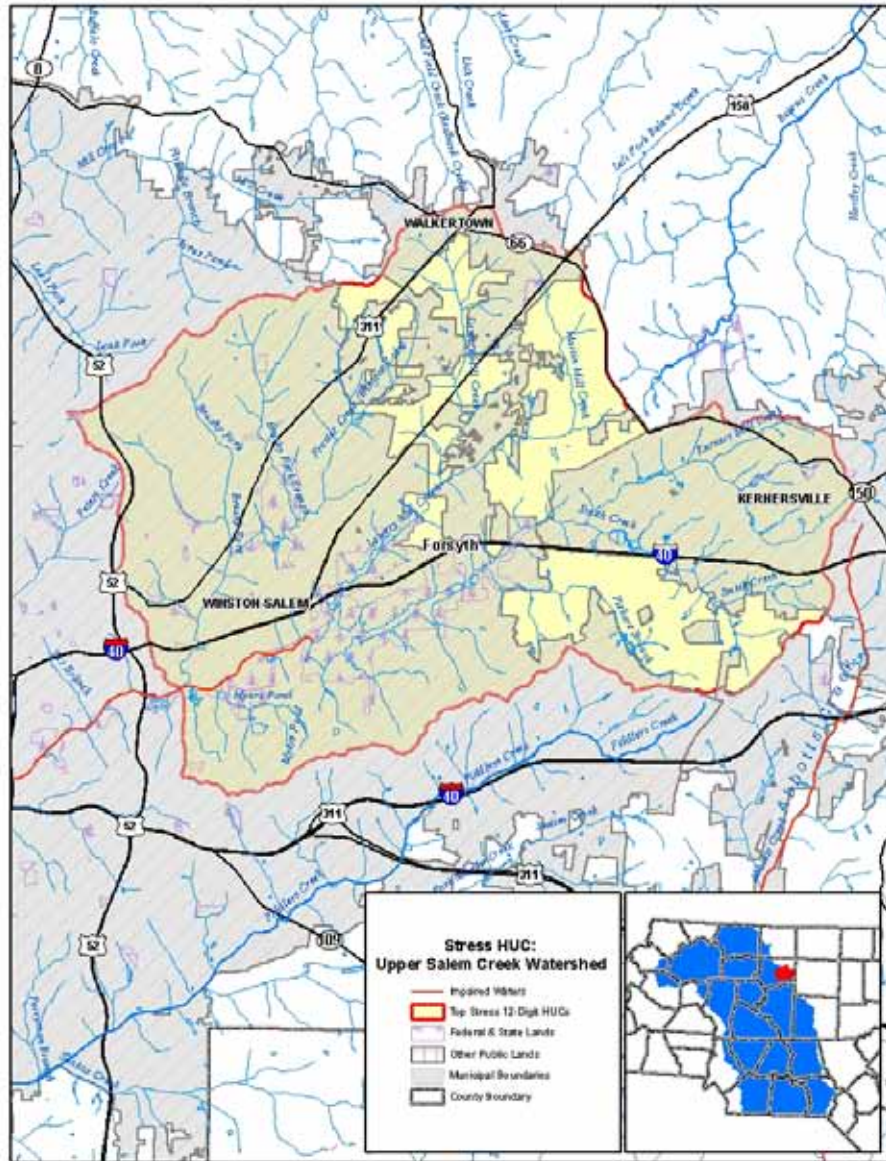
### Clarke Creek Watershed Threats to Water Quality:

- Streambank erosion
- Loss of stream buffer
- Urbanization

The Clarke Creek Watershed encompasses 28 square miles. The watershed is located in north eastern Mecklenburg County. Clarke Creek flows in an easterly direction until it crosses Harris Road at the Cabarrus and Mecklenburg County line. From that point, it dips southward until its confluence with the Upper Rocky River. Five and a half miles of Clarke Creek is listed on the 303(d) list as impaired by stormwater runoff. In December of 2003, the North Carolina Ecosystem Enhancement Program (EEP) completed a Local Watershed Plan that included the Clarke Creek Watershed. This plan was intended as a blueprint and resource guide for local governments in enacting watershed protection policies as well as an atlas for recommended watershed protection/restoration projects.

The watershed is governed by the municipalities of Concord, Charlotte, Huntersville and Cabarrus County. The Zoning Ordinances of both the City of Concord and the Town of Huntersville include Water Supply Watershed Protection and Water Body Buffer sections that govern the scale and type of new development. In 2008, the Town of Huntersville adopted the *Water Quality Design Manual* to establish storm water management requirements and controls to prevent or minimize surface water quality degradation in the streams and lakes within the Town. Low Impact Development (LID) as well as conventional storm water retention and detention structures are the primary mechanisms used to achieve this goal. The goal of LID is to develop site design techniques, strategies, BMPs, and criteria to store, infiltrate, evaporate, retain, and detain runoff on the site to replicate pre-development runoff characteristics and mimic the natural and unique hydrology of the site thereby preventing an increase in pollutant loads above pre-development conditions. This was one of the strategies recommended in the Lower Yadkin River Basin Local Watershed Plan discussed below. In June 2007, Mecklenburg County established a Post-Construction Storm Water Ordinance. The purpose of the ordinance is to control the adverse effects of increased post construction storm water runoff and non-point source pollution associated with new development and redevelopment. The Cabarrus County Zoning Ordinance includes the Water Supply Watershed Protection Overlay District. The overlay district applies within the areas designated by the North Carolina Environmental Management Commission as the critical or protected area of a surface water supply watershed and as shown on the official watershed map for Cabarrus County. The ordinance also includes policies for water body buffer zones; such as, a minimum 50' vegetative buffer is required along each side of all perennial waters and no new development is allowed in the buffer area except for water dependent structures and public projects such as road crossings and greenways where no practicable alternative exists. Cabarrus County maintains a Watershed Improvement Council. This 3-member commission works closely with the Cabarrus County Soil and Water Conservation Office and seeks to improve the County's water resources. Activities include efforts to reduce flooding, improve water quality and quantity and to reduce future problems through erosion control, water storage, cover protection, and education.

## 12) Upper Salem Creek Watershed



Upper Salem Creek Watershed	
Stress Rank	12
Size (Sq. Mi.)	41.85
Municipal Area (Sq. Mi.)	32.93
County Area (Sq. Mi.)	8.92
Impaired Stream (Miles)	1.97

Upper Salem Creek Landuse	
Developed	18.89%
Open Space	36.93%
Forest	27.29%
Grassland	3.28%
Barren Land	0.04%
Pasture	10.75%
Crops	0.21%
Wetlands	1.07%
Open Water	1.48%

Upper Salem Creek Watershed Threats to Water Quality:

- Stormwater impacts from residential and commercial development
- Streambank erosion
- Ongoing fecal discharges to the watershed
- Loss of open space and forestland
- Spills and contamination from vehicular traffic

The Upper Salem Creek Watershed covers 42 square miles in eastern Forsyth County. 79% of the watershed is in the City of Winston-Salem or the Town of Kernersville. Land use in the Upper Salem Creek Watershed is 37 % open space, 27% forested, and 19% developed. Upper Salem Creek Watershed’s position between Winston-Salem and Kernersville and proximity to the Piedmont Triad Airport make it prime real estate for industrial and commercial use. It also has a number of heavy transportation corridors including I-40, Bus-40, and US 52. Salem Lake takes up 1.2 square miles and is part of the Natural Heritage Program as a “regionally significant” natural area. Four square miles of the watershed is owned for public lands, which are mainly city parks that can provide some stormwater benefits.

Salem Creek is an impaired stream and has a significant amount of fecal coliform bacteria. Certain measurements in Salem Creek have been over 1000 colonies per ml. The North Carolina standard for fecal coliform bacteria is 200 colonies per ml. Due to high fecal coliform bacteria levels, it is plausible that this is a potential nutrient source and problem for High Rock Lake.

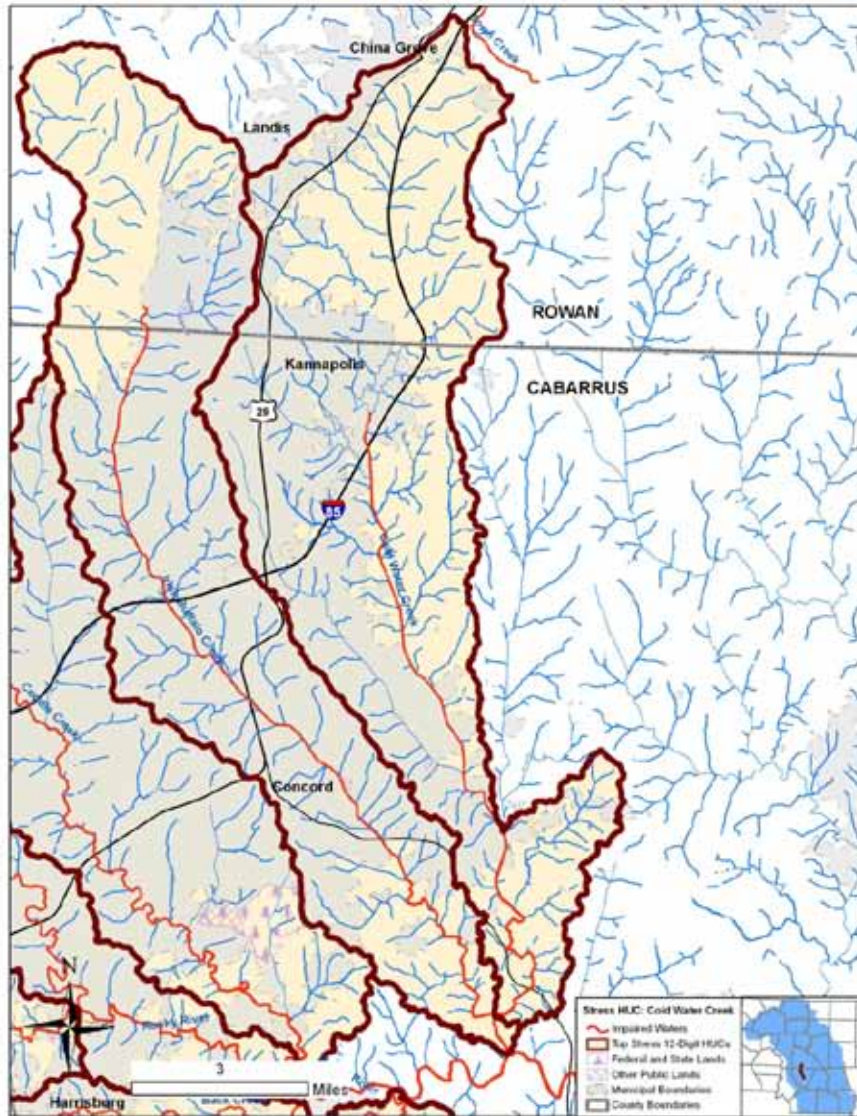
Salem Lake and Salem Creek are headwaters of the Yadkin River and High Rock Lake. Improving Salem Creek’s water quality is important to improving High Rock Lake, which is currently the subject of a TMDL assessment to determine nutrient sources of pollution (<http://h2o.enr.state.nc.us/tmdl/SpecialStudies.htm#HighRockLake>). Publication of this TMDL will likely be followed by state legislation to reduce nutrient and sediment inputs to the watershed, similar to that seen in Jordan Lake and Falls Lake.

Forsyth County has taken steps to protect water quality, and requires riparian buffers for all new development. The Salem Creek Trail and Salem Lake Trail greenways, as well as the Peters Creek Parkway all function as recreational and environmental assets. Salem Creek Trail is 4.5 miles and paved while Salem Lake Trail is 6.5 miles and unpaved.

Forsyth County/Winston-Salem Stormwater Division requires riparian buffers around surface water for all new development (see table). Furthermore, all development in the Middle Muddy Creek Watershed is required to submit a Stormwater Management System Plan to the Planning & Zoning Board, which has different watershed regulations related to the development types.

<i>Development or Redevelopment Size</i>	Required Landward Buffer Widths	Undisturbed Buffer Widths (Within Landward Buffer)
0-10 Acres	30 Feet	15 Feet
10-50 Acres	50 Feet	25 Feet
Greater than 50 Acres	100 Feet	50 Feet

### 13) Cold Water Creek Watershed



Cold Water Creek Watershed	
Stress Rank	8
Size (Sq Mi)	50.28
Municipal Area (Sq Mi)	23.36
County Area (Sq Mi)	26.92
Impaired Waters (Miles)	12.69

Cold Water Creek Land Use	
Developed	21.39%
Open Space	35.50%
Forest	24.45%
Grassland/Herbaceous	3.85%
Barren Land	0.06%
Pasture/Hay	13.04%
Cultivated Crops	0.48%
Wetlands	0.37%
Open Water	0.87%

### Cold Water Creek

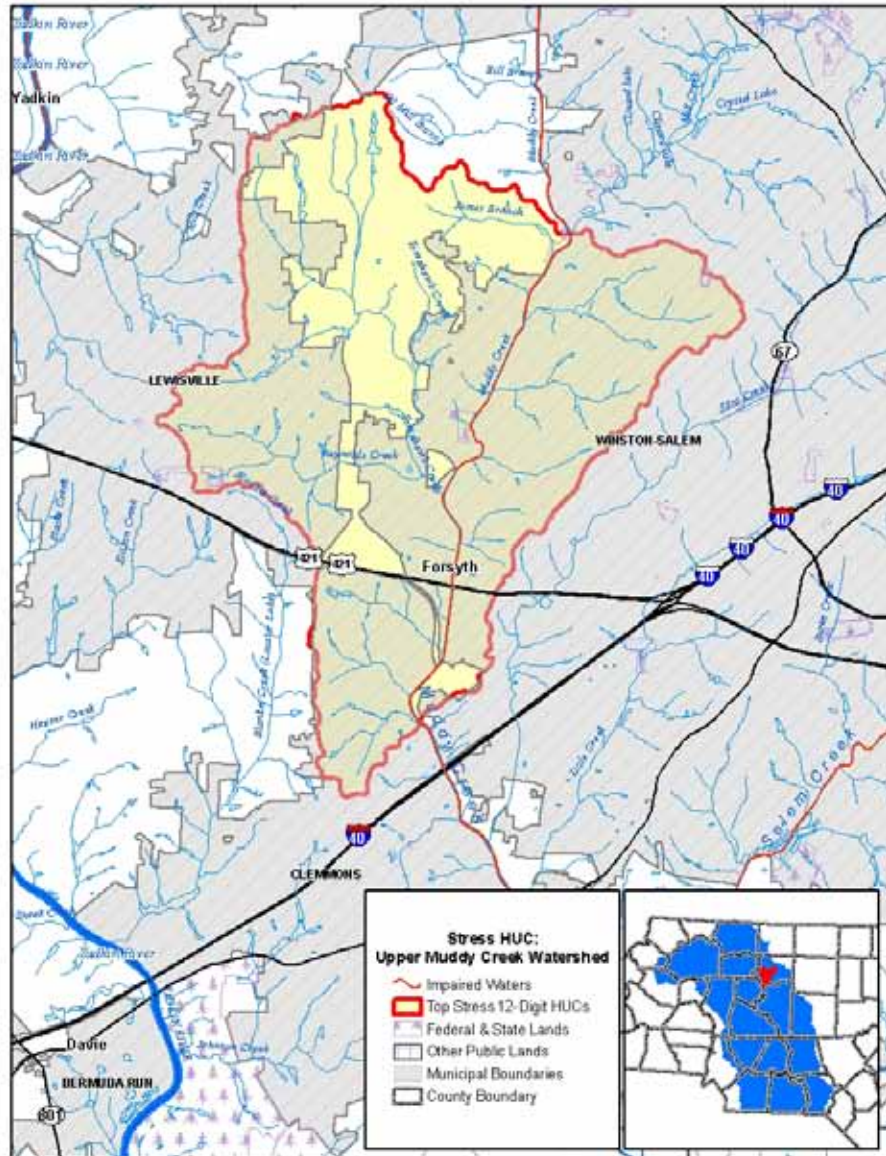
- Increased post-development stormwater runoff
- Nonpoint and point source pollution associated with new development and redevelopment
- Illicit discharges into municipal stormwater systems.

The Cold Water Creek Watershed is 50 square miles. The majority of the watershed is located in north central Cabarrus County with a small portion extending north into Rowan County. Nine miles of the lower reach of Cold Water Creek is listed on the 303(d) list as impaired by fecal coliform bacteria. It was placed on the 303(d) list in 2008 and is on the 2010 draft list. Lake Concord, located in the watershed. This Lake is classified as a protected WS IV. There are two surface water intakes on the lake and two minor NPDES wastewater sites within the watershed.

The watershed is governed by the cities of Concord, Kannapolis, Landis and China Grove as well as Rowan and Cabarrus counties. The Cabarrus County Zoning Ordinance includes the WS-IV Water Supply Watershed Protection Overlay District. The overlay district applies within the areas designated by the North Carolina Environmental Management Commission as the critical or protected area of a surface water supply watershed and as shown on the official watershed map for Cabarrus County. The ordinance also includes policies for water body buffer zones; including a minimum 50' vegetative buffer is required along each side of all perennial waters and no new development allowed in the buffer area except for water dependent structures and public projects such as road crossings and greenways where no practicable alternative exists. Cabarrus County maintains a Watershed Improvement Council. This 3-member commission works closely with the Cabarrus County Soil and Water Conservation Office and seeks to improve the County's water resources. Activities include efforts to reduce flooding, improve water quality and quantity and to reduce future problems through erosion control, water storage, cover protection, and education. Rowan County also has a watershed overlay district to provide for the protection of public water supplies. The City of Concord's Zoning Ordinance also includes Water Supply Watershed Protection and Water Body Buffer sections that govern the scale and type of new development. A large part of the watershed is located in the watersheds controlled by the NPDES Phase II Stormwater Permit issued by the State. In 2008, the City of Kannapolis enacted a Stormwater Ordinance to protect the integrity of the watersheds by controlling the adverse effects of increased post-development stormwater runoff and nonpoint and point source pollution associated with new development and redevelopment as well as illicit discharges into municipal stormwater systems. The Zoning Codes of both the towns of Landis and China Grove have established water supply watershed overlay regulations to govern development.

Existing conservation and restoration efforts can be utilized in the watershed. The predominant land conservancy in the region is the Land Trust for Central Carolina. Land Trust for Central Carolina works with landowners who desire to voluntarily donate conservation easements, with emphasis given to projects that protect large tracts, working farms, properties with ecological and recreational significance, and properties adjacent to other protected land.

## 14) Upper Muddy Creek Watershed



Upper Muddy Creek Watershed	
Stress Rank	14
Size (Sq. Mi.)	18.93
Municipal Area (Sq. Mi.)	13.82
County Area (Sq. Mi.)	5.11
Impaired Stream (Miles)	5.62

Upper Muddy Creek Landuse	
Developed	12.26%
Open Space	36.46%
Forest	31.15%
Grassland	3.92%
Barren Land	0.08%
Pasture	14.42%
Crops	0.32%
Wetlands	0.75%
Open Water	0.58%

Upper Muddy Creek Watershed Threats to Water Quality:

- Ongoing fecal discharges to the watershed
- Stormwater impacts from residential and commercial development
- Streambank erosion
- Loss of open space and forestland

The Upper Muddy Creek Watershed covers 19 square miles in western Forsyth County. 73% of the watershed is in the City of Winston-Salem, Town of Lewisville, or the Village of Clemmons. Land use in the Upper Muddy Creek Watershed is 37% open space, 12% developed, and 31% forest. However, western Forsyth and eastern Davie Counties have much higher growth rates than their surrounding counties. Putting pressure on the watershed and hurting efforts by Forsyth County to improve it. 0.18 square miles of the watershed is part of public lands.

The NC DWQ has conducted a Muddy Creek TMDL for fecal coliform bacteria, and determined that the majority of it originates in non-point sources, mainly failing septic systems. There is an urgent need to address this watershed problem, and any funding that can bolster County and City efforts to do so is strongly encouraged. Middle Muddy Creek Watershed will need to contend with stormwater mitigation needs as well, but these efforts will do little good if fecal coliform bacteria persists in contaminating these waters.

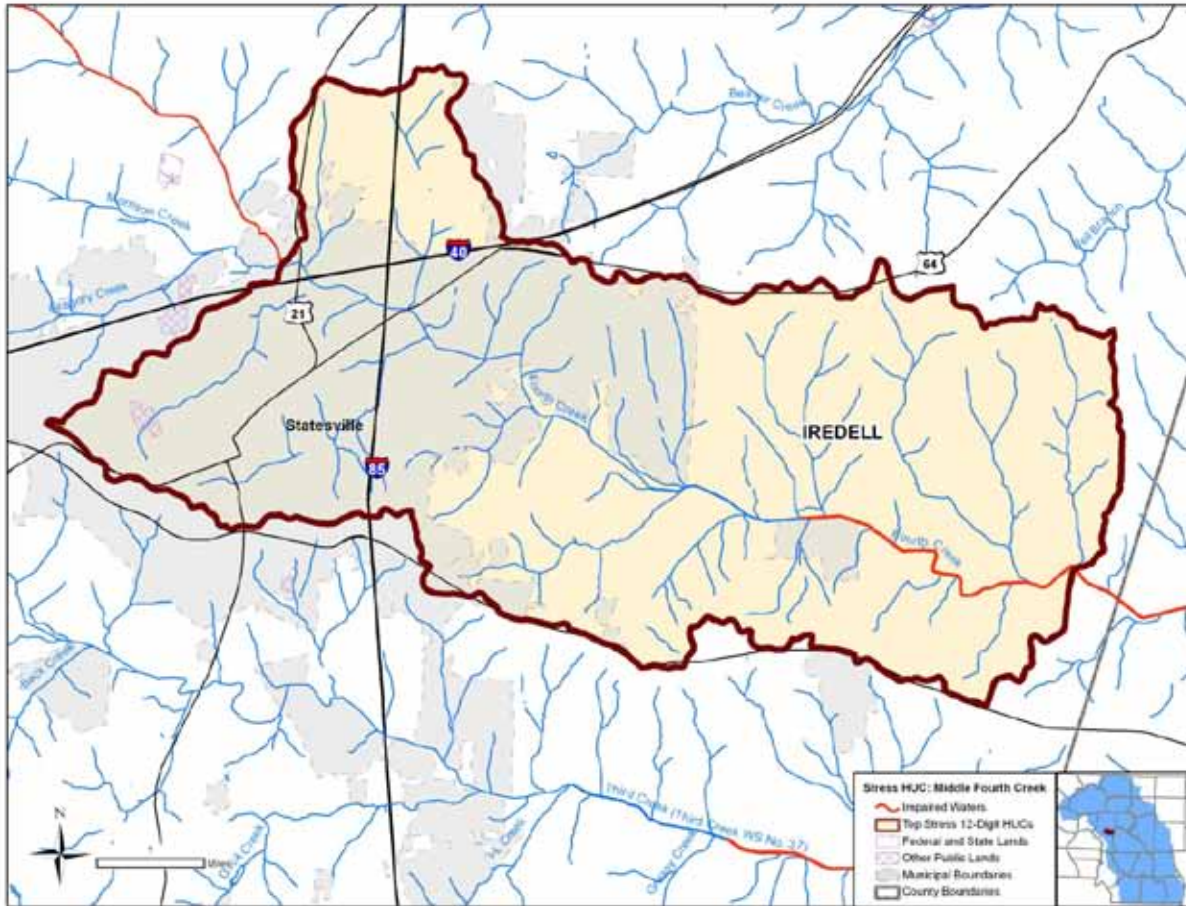
Muddy Creek is a tributary of the Yadkin River, which flows to High Rock Lake. Improving Muddy Creek's water quality is important to improving High Rock Lake, which is currently the subject of a TMDL assessment to determine nutrient sources of pollution (<http://h2o.enr.state.nc.us/tmdl/SpecialStudies.htm#HighRockLake>). Publication of this TMDL will likely be followed by state legislation to reduce nutrient and sediment inputs to the watershed, similar to that seen in Jordan Lake and Falls Lake.

Sections of Muddy Creek are scheduled to be developed as a segment of the Mountains-To-Sea Trail, a key component of the Piedmont urban route. This greenway will help provide needed buffers around Muddy Creek. Presently, this greenway is still in planning phase.

Forsyth County/Winston-Salem Stormwater Division requires riparian buffers around surface water for all new development (see table). Furthermore, all development in the Middle Muddy Creek Watershed is required to submit a Stormwater Management System Plan to the Planning & Zoning Board, which has different watershed regulations related to the development types.

<i>Development or Redevelopment Size</i>	Required Landward Buffer Widths	Undisturbed Buffer Widths (Within Landward Buffer)
0-10 Acres	30 Feet	15 Feet
10-50 Acres	50 Feet	25 Feet
Greater than 50 Acres	100 Feet	50 Feet

## 15) Middle Fourth Creek Watershed



Middle Fourth Creek Watershed	
Stress Rank	15
Size (Sq Mi)	30.17
Municipal Area (Sq Mi)	12.06
County Area (Sq Mi)	18.11
Impaired Waters (Miles)	3.15

Middle Fourth Creek Land Use	
Developed	16.25%
Open Space	21.89%
Forest	27.23%
Grassland/Herbaceous	4.22%
Barren Land	0.01%
Pasture/Hay	29.18%
Cultivated Crops	0.88%
Wetlands	0.08%
Open Water	0.26%



### Middle Fourth Creek Water Quality Concerns

- Agriculture
- Urban runoff

The Middle Fourth Creek watershed covers 30 square miles in central Iredell County, including almost all of the City of Statesville. Fourth Creek is the largest stream in the watershed and originates upstream of Statesville, in an area of agricultural land use. The stream flows southeastward across Iredell County through the city and receives urban stormwater runoff from several small tributaries. Downstream of the city, this catchment is a combination of forested, agricultural and residential land use.

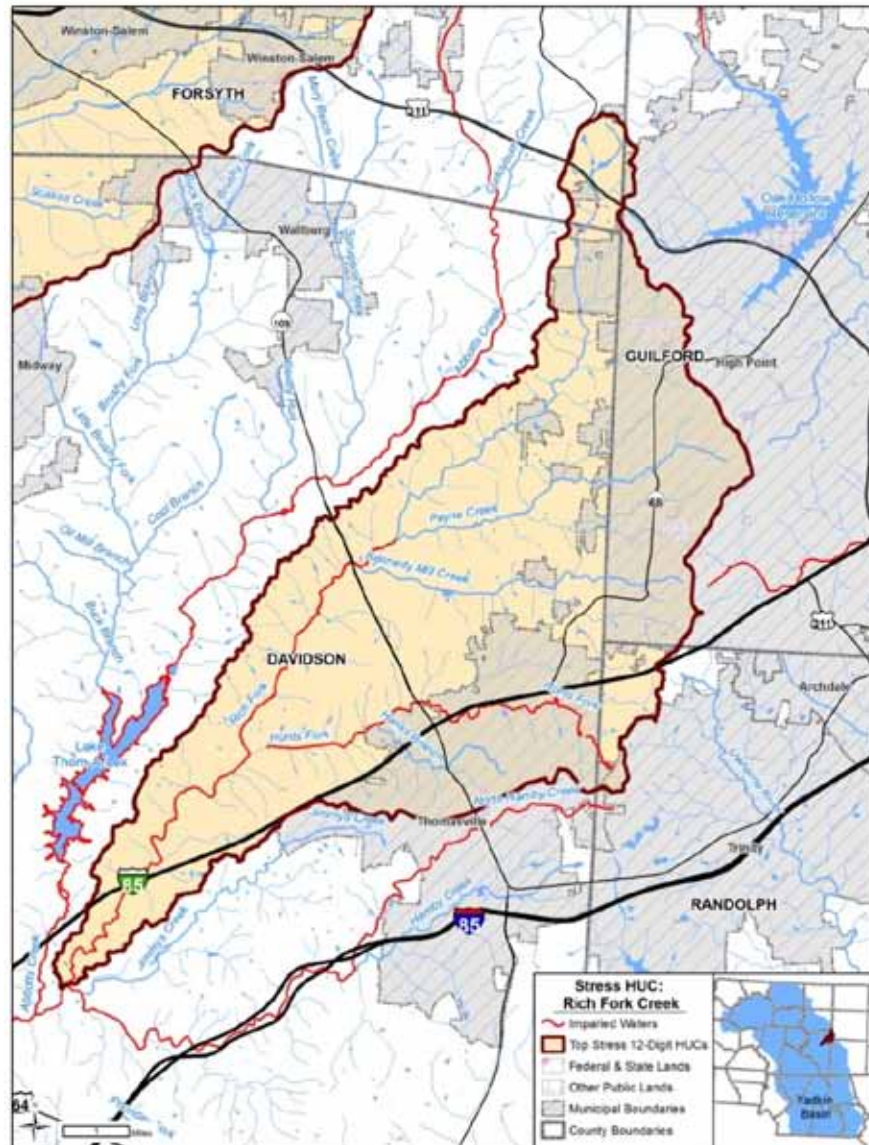
Since 1998, large portions of Fourth Creek have been classified as impaired by the NC Division of Water Quality (DWQ) due to poor ecological conditions. Original analysis determined that the main cause of these conditions was based on biological impairment with the potential source listed as agriculture. In 2004, as residential development grew in this area, the DWQ added urban runoff as a source of impairment. The city of Statesville is permitted to discharge treated wastewater up to 6.0 MGD in Fourth Creek. Many of the streams in the Middle Fourth Creek watershed have moderate to severe bank erosion and are suffering from shifting sandy substrates, channelization and sedimentation.

Fourth Creek is one of the watersheds in the Yadkin-Pee Dee River basin that has been identified by the NC Ecosystem Enhancement Program (EEP) as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed is given a higher priority than a nontargeted watershed for the implementation of EEP restoration projects.

Middle Fourth Creek is governed by the policies of the City of Statesville and Iredell County. The county has a Watershed Protection Ordinance that was originally adopted in 1994 to regulate the location and intensity of new development within a designated watershed.

In 2001 the Clean Water Management Trust Fund funded a grant in the amount of \$1,913,000 for the Land Trust of Central North Carolina to provide funds to acquire fee simple ownership of the riparian, floodplain, and wetland portions of six tracts within the basin, including portions along Fourth Creek. A total of 1,900 acres were protected with all funding sources.

## 16) Rich Fork Creek Watershed



Rich Fork Creek Watershed	
Stress Rank	16
Size (Sq Mi)	48.89
Municipal Area (Sq Mi)	18.52
County Area (Sq Mi)	30.37
Impaired Waters (Miles)	18.95

Rich Fork Creek Land Use	
Developed	19.69%
Open Space	20.39%
Forest	36.85%
Grassland/Herbaceous	5.88%
Barren Land	0.03%
Pasture/Hay	15.05%
Cultivated Crops	0.64%
Wetlands	1.31%
Open Water	0.16%

### Rich Fork Creek Watershed Threats to Water Quality:

- Stormwater impacts from residential and commercial development
- Streambank erosion
- Loss of open space and forestland
- Residential stewardship

The Rich Fork Creek Watershed occupies 49 square miles, primarily in northeastern Davidson County. Davidson County is one of the fastest-developing counties in the Upper Yadkin River Basin, and stormwater management is necessary to curb land use impacts on both water quality and the open spaces. The cities of High Point and Thomasville occupy 38% of the watershed. Recently, the cities have expanded, outpacing the rest of the state (13.5% vs. 10%) (US Census Bureau, 2006).

Rich Fork Creek is listed as impaired by NC DWQ for failing bioclassification standards, reflecting poor ecological conditions. Analysis conducted by DWQ in 2006 determined that the main cause of these conditions was urban stormwater runoff from the Cities of High Point and Thomasville. These studies also indicate conditions have improved, and the Creek now supports adequate dissolved oxygen levels. Recent renovations to the High Point and Thomasville wastewater systems are a large reason for these improvements, but much still needs to be done to make it safe for local residents and ecology.

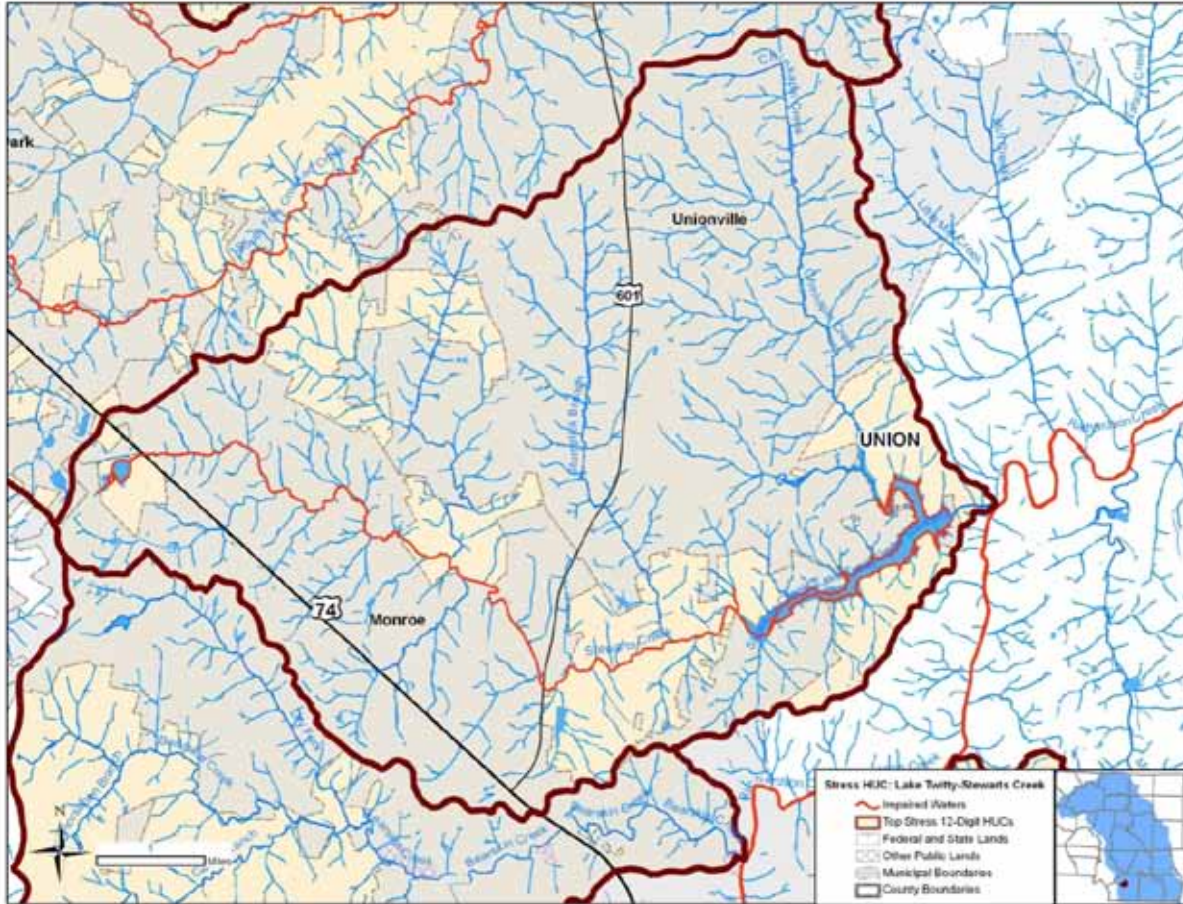
In 2008, the Piedmont Triad Council of Governments (PTCOG) led a study of needs in Rich Fork Creek. The *Rich Fork Creek Watershed Restoration Plan* analyzes watershed conditions and provides guidance on how to create this future through seven policy recommendations and 33 projects that will most effectively improve watershed conditions. The study determined that the main source of pollution to the watershed is stormwater from the urbanized headwaters.

High Point has taken a proactive approach to watershed stewardship, protecting waters from further stresses due to heavy industry and urban growth. 330-foot buffers are mandatory within its limits, but nowhere else in the watershed. The failure to consistently apply ordinances throughout the watershed creates leaves parts of Rich Fork Creek vulnerable to intense development. The three watershed governments have signed Memorandum of Agreement pledging them to partnering on policy measures and projects to improve watershed conditions.

Rich Fork Creek is a tributary of the larger Abbotts Creek watershed, and is a headwater to High Rock Lake. Improving Rich Fork Creek's water quality is important to improving High Rock Lake, which is currently the subject of a TMDL assessment to determine nutrient sources of pollution (<http://h2o.enr.state.nc.us/tmdl/SpecialStudies.htm#HighRockLake>). Publication of this TMDL will likely be followed by state legislation to reduce nutrient and sediment inputs to the watershed, similar to that seen in Jordan Lake and Falls Lake.

Local governments should seek partnership opportunities with the Davidson County Soil & Water Conservation District, NCSU Cooperative Extension County office, and the LandTrust for Central NC through the MOA process. Supporting an open space planning position or enforcement of development ordinances will be an enormous step of progress in this watershed, and a boon to Creek and High Rock Lake water qualities.

## 17) Lake Twitty-Stewarts Creek Watershed



Lake Twitty-Stewarts Creek Watershed	
Stress Rank	17
Size (Sq Mi)	35.33
Municipal Area (Sq Mi)	27.94
County Area (Sq Mi)	7.39
	9.83
Impaired Waters (Miles)	(+0.26 Sq. Mi.)

Lake Twitty-Stewarts Creek Land Use	
Developed	21.39%
Open Space	35.50%
Forest	24.45%
Grassland/Herbaceous	3.85%
Barren Land	0.06%
Pasture/Hay	13.04%
Cultivated Crops	0.48%
Wetlands	0.37%
Open Water	0.87%

### Lake Twitty - Stewarts Creek Watershed Threats to Water Quality

- Runoff from impervious surfaces, agriculture and pasture land
- Increased post-development stormwater runoff
- Nonpoint and point source pollution associated with new development and redevelopment
- Illicit discharges into municipal stormwater systems.

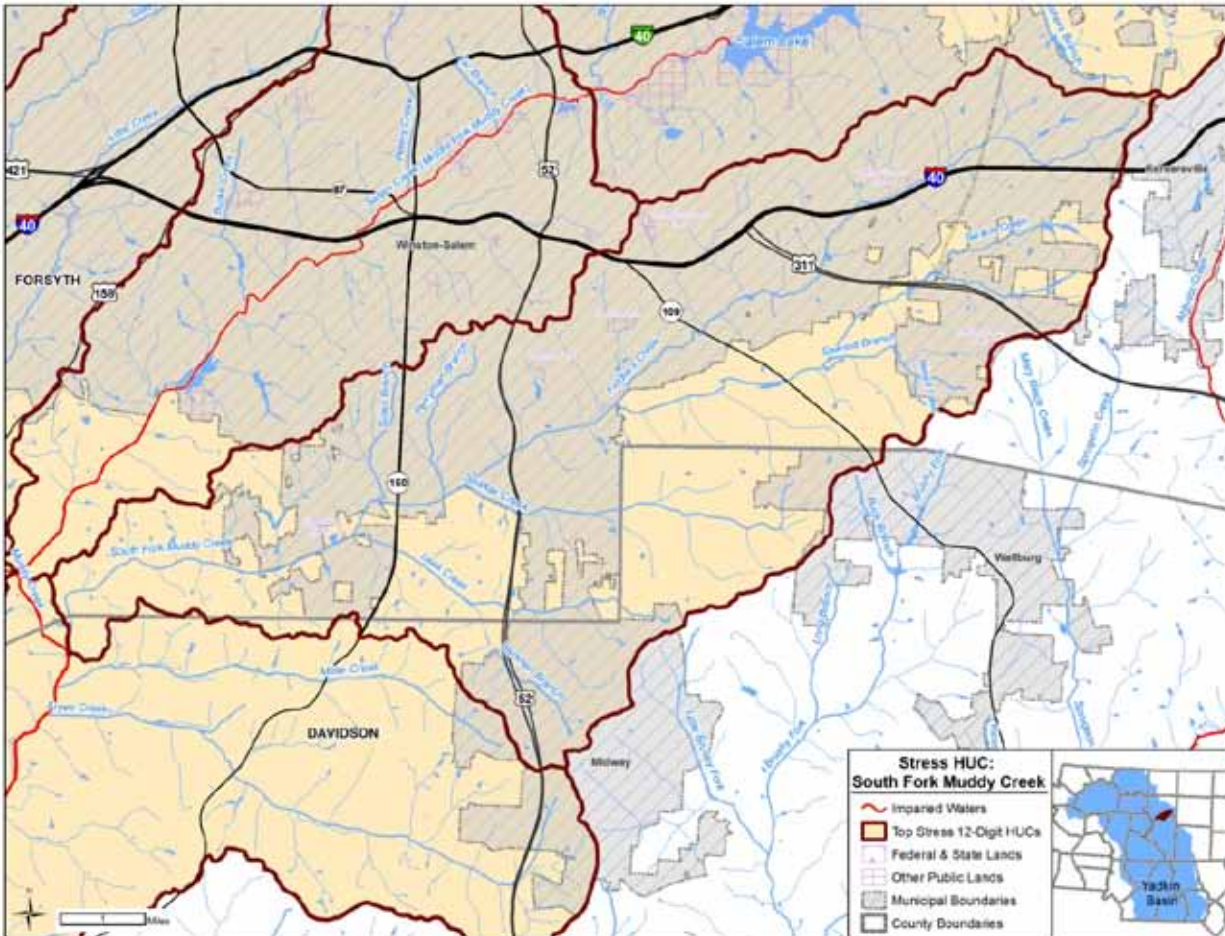
The Lake Twitty-Stewarts Creek watershed is 35 square miles and is located in central Union County. As described in the 2003 Yadkin Pee-Dee River Basinwide Water Quality Plan, the headwaters of Stewarts Creek flow from Monroe and Unionville into Lake Twitty. Stewarts Creek is classified as impaired by the NC Division of Water Quality (DWQ) due to poor ecological conditions. Analysis conducted by DWQ in 2008 determined that the main cause of these conditions was runoff from impervious surfaces, agriculture and pasture land. The same results were recorded in 2010 analysis. The watersheds of several streams, including Chinkapin Creek and Stumplick Branch, are almost completely developed with a large amount of channelization. 14% of the watershed is agricultural, primarily pasture hay.

The Lake Twitty - Stewarts Creek watershed is classified as a protected WS III with a critical area directly around the lake. There are two minor NPDES wastewater sites within the watershed and one surface water intake on Lake Twitty. In addition, the watershed includes a Wildlife Resource Commission priority area and almost 100 miles of Water Supply Waters, including Lake Twitty, which services the City of Monroe.

The watershed is governed by the policies of City of Monroe, Town of Unionville and Union County. In 2007 the City of Monroe passed a Stormwater Management Ordinance establishing minimum requirements and procedures to control the adverse effects of post-development stormwater runoff; non-point and point source pollution from new development and redevelopment; as well as illicit discharges into municipal stormwater systems. It has been determined that proper management of post-development construction stormwater runoff will minimize damage to public and private property and infrastructure; safeguard the public health, safety, and general welfare; and protect water and aquatic resources. Article XXI of Union County's and the Town of Unionville's Land Use Ordinance established water supply watershed overlay districts to govern the location, type, and size of new development along its water supply watersheds. In addition the ordinance requires a minimum thirty (30) foot vegetative buffer for development activities along all perennial waters.

The Stewarts Creek watershed is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the NC Ecosystem Enhancement Program (EEP) as an area with the greatest need and opportunity for stream and wetland restoration efforts. Existing conservation and restoration efforts can be utilized in the watershed. The predominant land conservancy in the region is the Catawba Lands Conservancy. The Conservancy works with landowners and public partners to protect open space, important natural areas, significant habitats, forests, and farmland in an eight-county region.

## 18) South Fork Muddy Creek Watershed



South Fork Muddy Creek Watershed	
Stress Rank	18
Size (Sq. Mi.)	44.49
Municipal Area (Sq. Mi.)	27.96
County Area (Sq. Mi.)	16.53
Impaired Stream (Miles)	N/A

South Fork Muddy Creek Watershed	
Developed	11.38%
Open Space	22.73%
Forest	34.55%
Grassland	6.93%
Barren Land	0.05%
Pasture	22.96%
Crops	0.92%
Wetlands	0.29%
Open Water	0.12%

South Fork Muddy Creek Watershed Threats to Water Quality:

- Development
- Streambank erosion
- Loss of open space and forestland
- Industrial waste
- Pollution from major highways of I-74 and US 311
- Agricultural pollution from registered CAFO

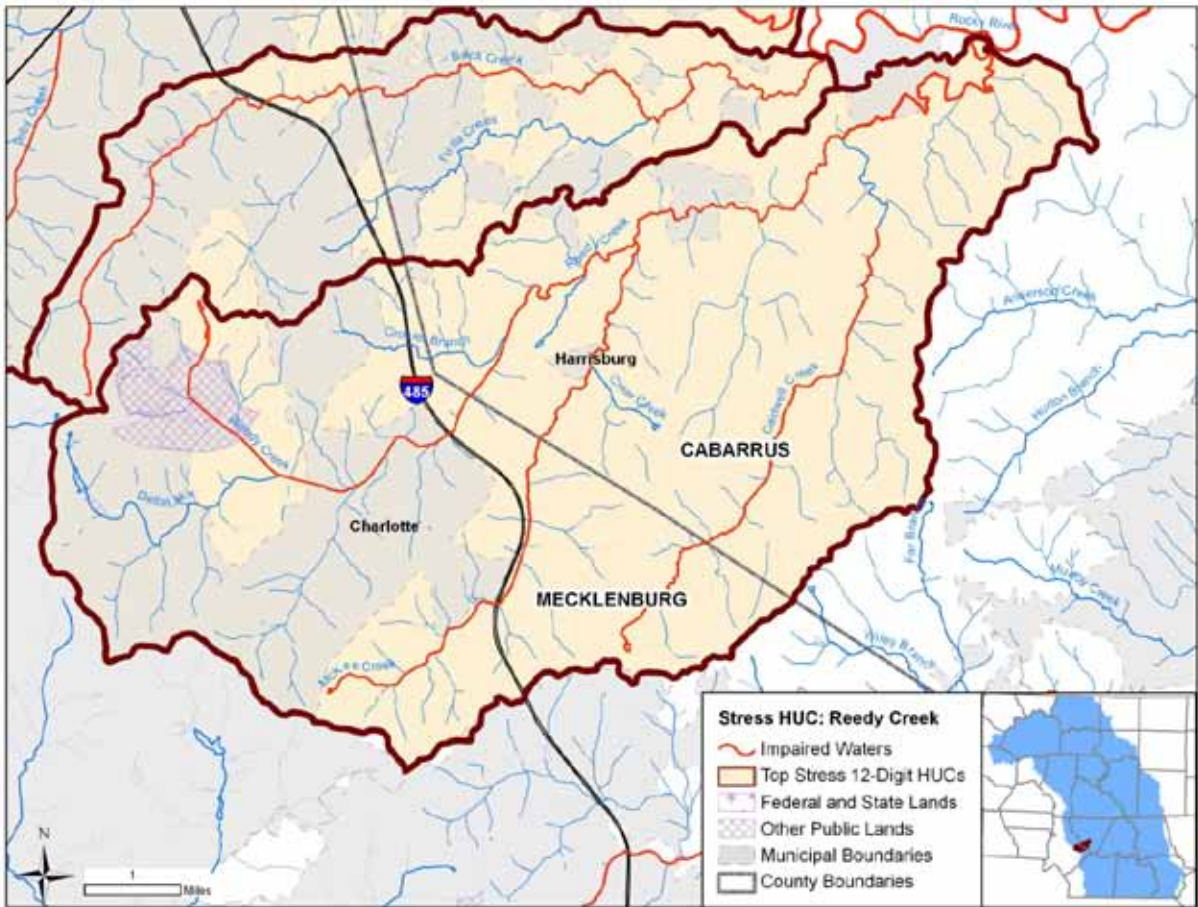
The South Fork Muddy Creek Watershed covers 44 square miles in southern Forsyth County and northern Davidson County. Land use as of 2001 was 35% forest, 23% open space, 23% pasture, and 11% developed. 55% of the watershed is in the City of Winston-Salem. The area between I-40 and US 311 is a major industrial development area for the county. This is where the new Dell Plant was built and Forsyth County is currently selling other pieces of land between these two highways to potential large businesses. So protecting this water is very important for the area.

South Fork Muddy Creek is one of the major tributaries into the Yadkin River, which flows to High Rock Lake. Improving South Fork Muddy Creek’s water quality is important to improving High Rock Lake, which is currently the subject of a TMDL assessment to determine nutrient sources of pollution (<http://h2o.enr.state.nc.us/tmdl/SpecialStudies.htm#HighRockLake>). There is one registered Confined Animal Feeding Operation (CAFO) within this watershed, which must be monitored closely to ensure it is not adversely affecting water quality. Publication of this TMDL will likely be followed by state legislation to reduce nutrient and sediment inputs to the watershed, similar to that seen in Jordan Lake and Falls Lake.

Forsyth County/Winston-Salem Stormwater Division requires riparian buffers around surface water for all new development (see table). Furthermore, all development in the Middle Muddy Creek Watershed is required to submit a Stormwater Management System Plan to the Planning & Zoning Board, which has different watershed regulations related to the development types.

<i>Development or Redevelopment Size</i>	Required Landward Buffer Widths	Undisturbed Buffer Widths (Within Landward Buffer)
0-10 Acres	30 Feet	15 Feet
10-50 Acres	50 Feet	25 Feet
Greater than 50 Acres	100 Feet	50 Feet

## 19) Reedy Creek Watershed



Reedy Creek Watershed	
Stress Rank	19
Size (Sq Mi)	43.06
Municipal Area (Sq Mi)	12.54
County Area (Sq Mi)	30.52
Impaired Waters (Miles)	32.99

Reedy Creek Land Use	
Developed	6.16%
Open Space	19.17%
Forest	52.10%
Grassland/Herbaceous	5.20%
Barren Land	0.02%
Pasture/Hay	15.28%
Cultivated Crops	0.19%
Wetlands	1.59%
Open Water	0.30%



### Reedy Creek Watershed Water Quality Concerns

- Historic and ongoing agricultural practices
- Stormwater runoff
- Rapid development, particularly along the I-485 corridor

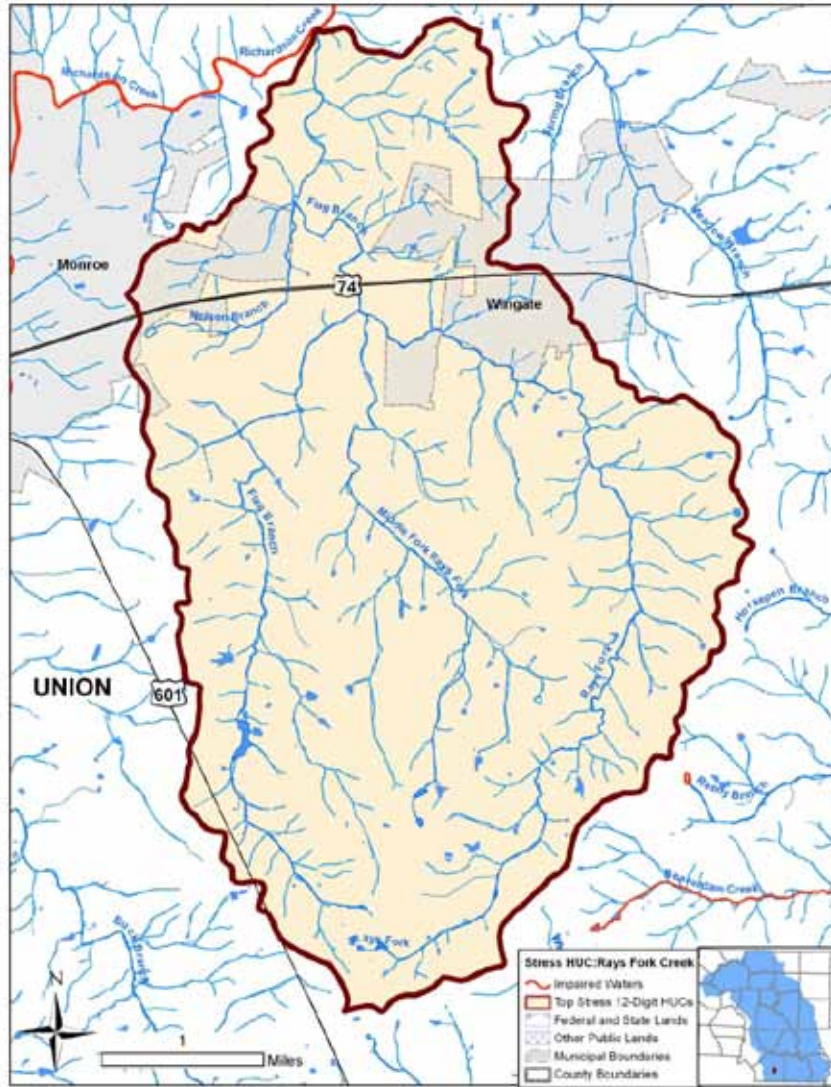
Covering 43 square miles, the Reedy Creek Watershed is located in eastern Mecklenburg County and southwestern Cabarrus County and contains portions of the Cities of Harrisburg and Charlotte. Although the watershed was historically predominantly rural in character, the opening of I-485 led to a substantial increase in development. Problems noted in the watershed include severe bank erosion/channel widening, sedimentation/turbidity, fecal coliforms, nutrients and metals.

In 1998, Charlotte and Mecklenburg County adopted the SWIM buffer ordinance. The Surface Water Improvement and Management (SWIM) initiative established buffer zones along creeks in Charlotte and Mecklenburg County. No construction or development is allowed in the buffer zones. The regulations are intended to apply to streams which are defined as a drainage feature on the land surface for conveying water (outside of a pipe) at the time the Ordinance went into effect.

The Cabarrus County Zoning Ordinance includes the Water Supply Watershed Protection Overlay District. The overlay district applies within the areas designated by the North Carolina Environmental Management Commission as the critical or protected area of a surface water supply watershed and as shown on the official watershed map for Cabarrus County. The ordinance also includes policies for water body buffer zones; such as, a minimum 50' vegetative buffer is required along each side of all perennial waters and no new development is allowed in the buffer area except for water dependent structures and public projects (such as road crossings and greenways where no practicable alternative exists). Cabarrus County maintains a Watershed Improvement Council. This 3-member commission works closely with the Cabarrus County Soil and Water Conservation Office and seeks to improve the County's water resources. Activities include efforts to reduce flooding, improve water quality and quantity and to reduce future problems through erosion control, water storage, cover protection, and education.

In 2004, the North Carolina Ecosystem Enhancement Program (EEP), in conjunction with MACTEC Engineering and Consulting, Inc., completed *Watershed Management Plans and Recommendations* for an area including the Reedy Creek Watershed. Their recommendations for Reedy Creek contained the following elements: watershed improvement projects; recommended institutional measures; Best Management Practices; strategies for future follow-up; strategies for future land use practices; long-term biological and physical/chemical monitoring; and future watershed studies. The full report can be found at [http://www.nceep.net/services/lwps/Clarke\\_Creek/wmp\\_r04-15-05.pdf](http://www.nceep.net/services/lwps/Clarke_Creek/wmp_r04-15-05.pdf).

20) Rays Fork Watershed



Rays Fork Watershed	
Stress Rank	20
Size (Sq Mi)	14.63
Municipal Area (Sq Mi)	1.31
County Area (Sq Mi)	13.32
Impaired Waters (Miles)	0.01

Rays Fork Land Use	
Developed	4.74%
Open Space	7.12%
Forest	37.89%
Grassland/Herbaceous	2.86%
Barren Land	N/A
Pasture/Hay	45.01%
Cultivated Crops	1.92%
Wetlands	0.26%
Open Water	0.21%

### Rays Fork Watershed Water Quality Concerns:

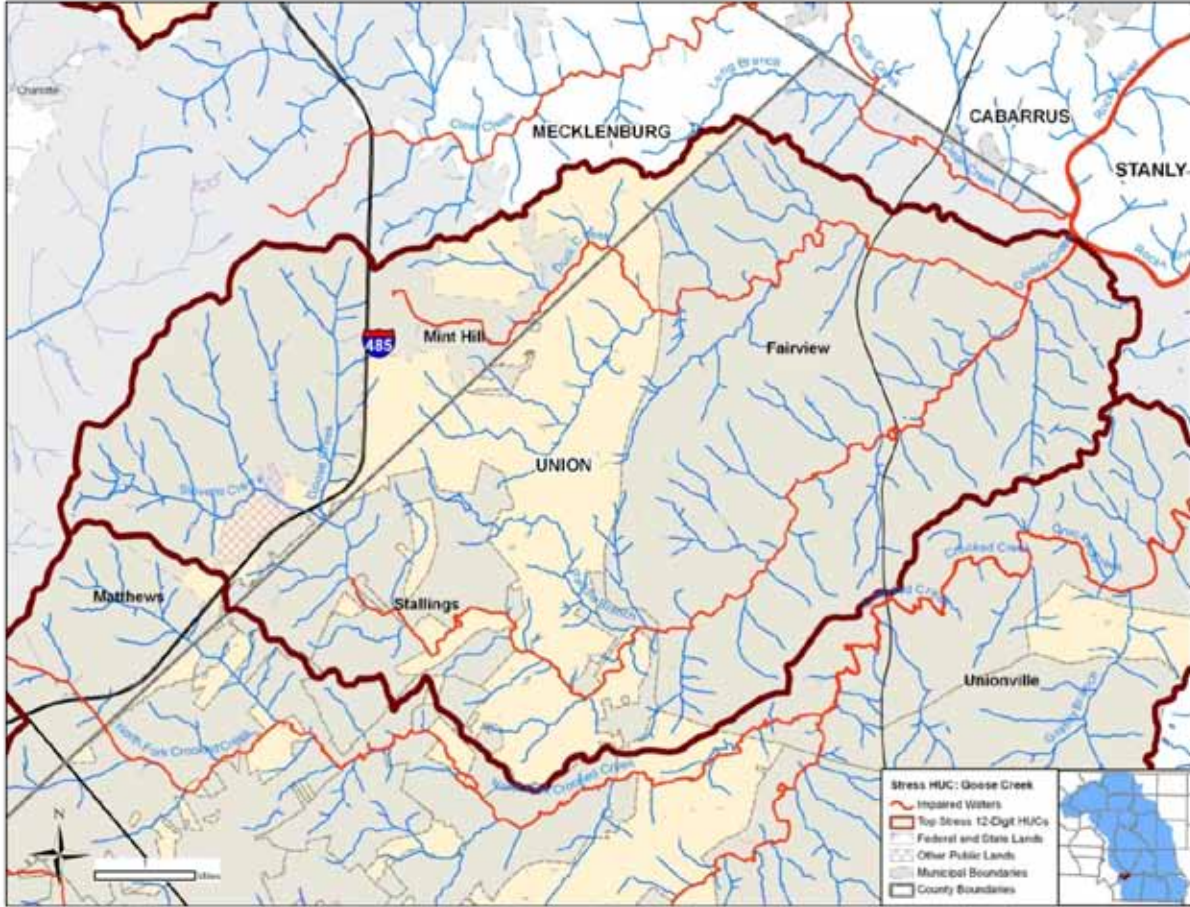
- Urbanization

Rays Fork watershed is 15 square miles and is located in central Union County. There are no impaired streams within this watershed. Rays Fork Creek flows southeast from Flag Branch.

The majority of the watershed is located in Union County. However, small portions are also governed by the policies of the City of Monroe and the Town of Wingate. In 2007 the City of Monroe passed a Stormwater Management Ordinance with the purpose to protect, maintain and enhance the public health, safety, environment and general welfare by establishing minimum requirements and procedures to control the adverse effects of increased post-development stormwater runoff and non-point and point source pollution associated with new development and redevelopment as well as illicit discharges into municipal stormwater systems. It has been determined that proper management of construction-related and post-development stormwater runoff will minimize damage to public and private property and infrastructure; safeguard the public health, safety, and general welfare; and protect water and aquatic resources. Article XXI of Union County's and the Town of Wingate's Land Use Ordinances established water supply watershed overlay districts to govern the location, type, and size of new development along its water supply watersheds. In addition the ordinance requires a minimum thirty (30) foot vegetative buffer for development activities along all perennial waters indicated on the most recent versions of U.S.G.S. 1:24,000 (7.5 minute) scale topographic maps as determined by local government studies.

Existing conservation and restoration efforts can be utilized in the watershed. The predominant land conservancy in the region is the Catawba Lands Conservancy. The Conservancy works with landowners and public partners to protect open space, important natural areas, significant habitats, forests, and farmland in an eight-county region.

## 21) Goose Creek Watershed



Goose Creek Watershed	
Stress Rank	21
Size (Sq Mi)	42.27
Municipal Area (Sq Mi)	31.43
County Area (Sq Mi)	10.93
Impaired Waters (Miles)	22.27

Goose Creek Land Use	
Developed	2.85%
Open Space	12.58%
Forest	46.92%
Grassland/Herbaceous	2.33%
Barren Land	0.01%
Pasture/Hay	32.29%
Cultivated Crops	1.10%
Wetlands	1.77%
Open Water	0.15%

### Goose Creek Watershed Threats to Water Quality

- Small municipal wastewater treatment plants
- Agricultural runoff
- Lack of historical pre- and post-construction stormwater controls

The Goose Creek watershed occupies 42 square miles in Mecklenburg and Union Counties between Charlotte and Monroe. It includes the towns of Mint Hill, Indian Trail, Stallings, Fairview and Hemby Bridge. Goose Creek is home to an existing population of a federally listed endangered fresh water mussel known as the Carolina heelsplitter (*Lasmigona decorata*), and is also listed on the State's list of impaired waters for high fecal coliform bacteria levels. Likely sources for the bacteria are small municipal wastewater treatment plants and agricultural runoff. Development in the watershed further threatens its aquatic health.

To protect water quality conditions and habitat for the Carolina Heelsplitter mussel, a set of management rules was adopted by the NC Environmental Management Commission (effective February 1, 2009). These rules include requirements for:

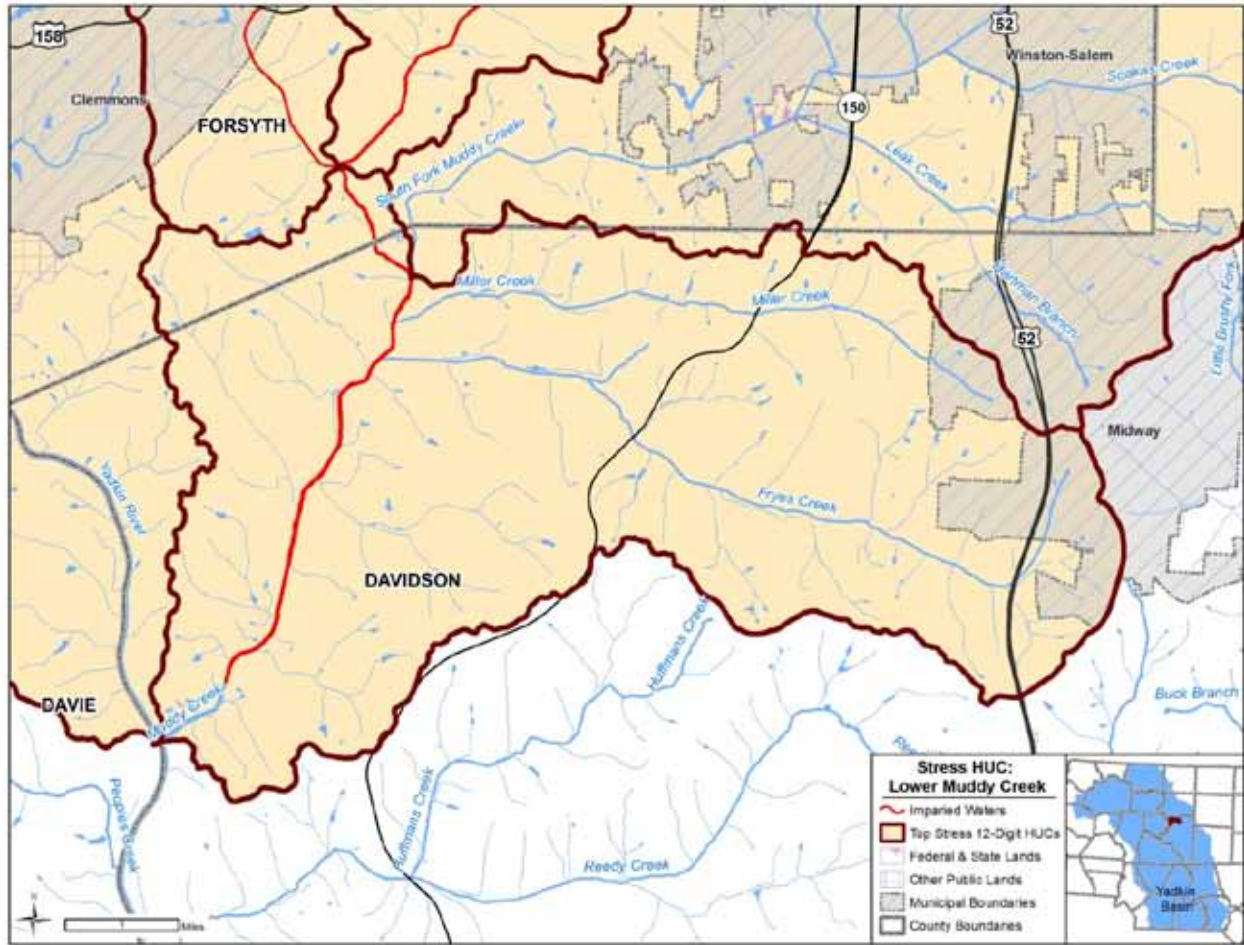
- Stormwater control
- Wastewater control
- Toxic pollutant control
- Riparian buffer protection

Further information on the Goose Creek watershed rules can be found at <http://h2o.enr.state.nc.us/csu/GooseCreek.html>.

The North Carolina Ecosystem Enhancement Program (EEP) has initiated development of a local watershed plan (LWP) for Goose Creek (along with neighboring Crooked Creek, Stress Priority Watershed 10, p. 32). In February of 2009, Centralina Council of Governments, in partnership with Tetra Tech, completed Phase I (watershed characterization and preliminary findings) of the plan. The scoping assessment for Goose Creek suggested that its primary stressors are increased peak flows and runoff volumes, sediment and bacteria. Oxygen demanding substances and toxic substances are thought to be a secondary stressor. These stressors, resulting primarily from the lack of historical pre- and post-construction stormwater controls, have resulted in impairments to aquatic habitat in the watershed.

In early 2010, Tetra Tech and Centralina began Phases II and III of the LWP. Phase II is designed to focus on the collection and analysis of additional data for assessing conditions of subwatersheds and reaches, refining the characterization of stressors and restoration goals, and identifying priority areas. Phase III will include an evaluation of and recommendations for management opportunities.

## 22) Lower Muddy Creek Watershed



Lower Muddy Creek Watershed	
Stress Rank	22
Size (Sq Mi)	28.65
Municipal Area (Sq Mi)	1.87
County Area (Sq Mi)	26.78
Impaired Waters (Miles)	5.43

Lower Muddy Creek Land Use	
Developed	3.72%
Open Space	8.73%
Forest	41.25%
Grassland/Herbaceous	8.02%
Barren Land	0.09%
Pasture/Hay	35.82%
Cultivated Crops	1.13%
Wetlands	1.15%
Open Water	0.10%

### Lower Muddy Creek Watershed Threats to Water Quality:

- Stormwater impacts from residential & commercial development in Clemmons
- Fecal inputs from Salem Creek upstream
- Sediment and stormwater pollution from South Fork Muddy Creek
- Streambank erosion
- Loss of open space and forestland

The Lower Muddy Creek Watershed occupies 28 square miles in Forsyth and Davidson Counties, and flows directly into the Yadkin River. This watershed is only occupied by 4 acres of urban cover from Winston-Salem, but it is suffering the impacts of the rapid development and growth of Clemmons immediately upstream. Lower Muddy Creek was only recently listed as impaired, showing the need to address non-point source pollution in urban areas.

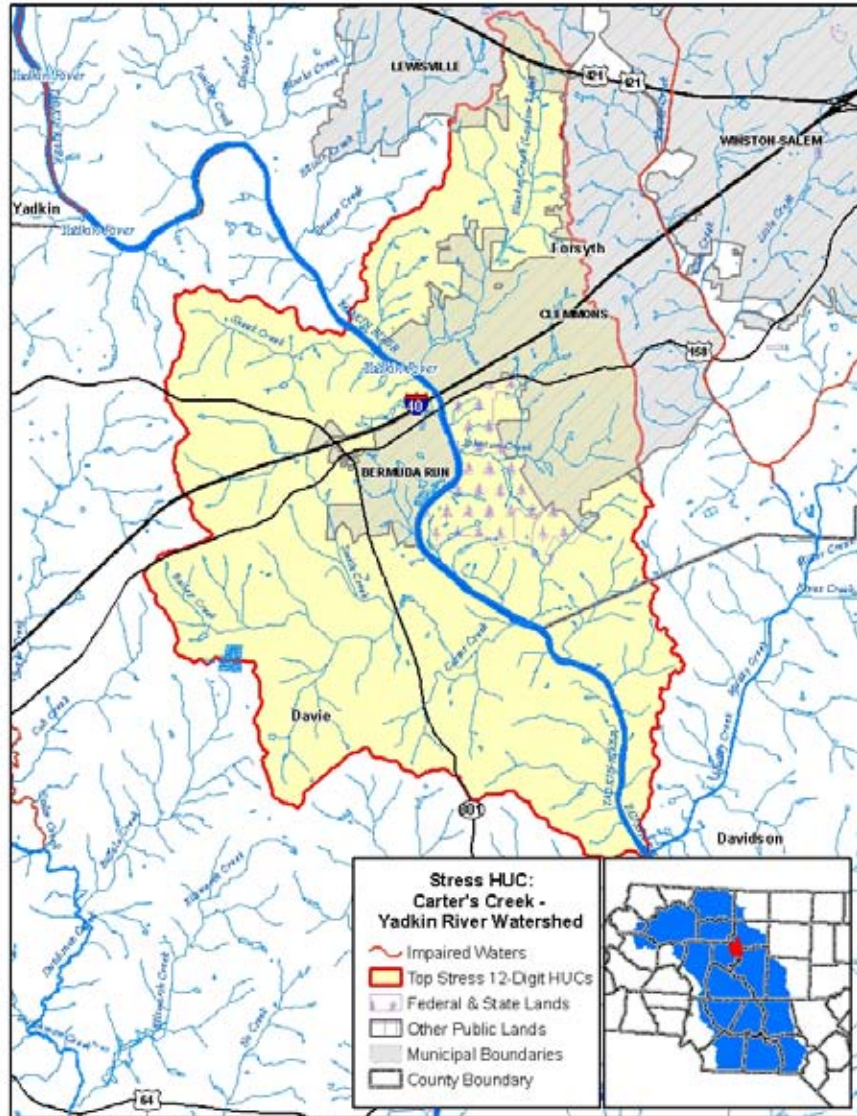
Lower Muddy Creek is classified as impaired by NC DWQ for violating turbidity standards. Non-point source stormwater pollution from Clemmons is listed as the primary source of sediment input. Lower Muddy Creek also receives polluted waters from Salem Creek, a highly-urbanized stream impacted by fecal inputs from failing septic and sewer systems; and the South Fork Muddy Creek, which is suffering the impacts of erosion and non-point source pollution. Salem Creek has undergone a TMDL for its fecal coliform bacteria.

Lower Muddy Creek is governed by the policies of Davidson County and Winston-Salem. While Winston-Salem has instituted some exemplary post-construction requirements for stormwater control, and has taken steps to remediate fecal inputs to urban streams, these policies are not universal. Davidson County needs to improve riparian buffers and stormwater mitigation requirements. Both jurisdictions will be affected by the High Rock Lake TMDL, and can begin addressing nutrient and sediment concerns by addressing Lower Muddy Creek's turbidity problem. NC DWQ is conducting a study of the Lake's water quality to determine the sources of pollution impairing its recreational use and ecology (<http://h2o.enr.state.nc.us/tmdl/SpecialStudies.htm#HighRockLake>). Publication of this TMDL will likely be followed by state legislation to reduce nutrient and sediment inputs to the watershed, similar to that seen in Jordan Lake and Falls Lake.

The recent impairment of the Lower Muddy Creek watershed should be viewed as a warning signal against permitting "business as usual" when it comes to development. Highly erodible soils, steep slopes, and high rates of urbanization call for thoughtful and sustainable land use. Discouraging urban sprawl through development incentives and urban renewal programs for downtown Winston-Salem is highly encouraged. The infill approach to urban renewal must reduce stormwater flows to improve these local water quality conditions.

These local and regional water quality issues call for the creation of a formal partnership among Winston-Salem, Clemmons, Davidson County, Forsyth County, the County Soil & Water Conservation Districts, and Cooperative Extension offices. A provincial approach is much less likely to succeed, and will perpetuate a situation of siloed efforts and squandered energy and funds. Through a partnership, these jurisdictions will be more competitive in seeking public and private support in these efforts to improve water quality, particularly for sediment.

23) Carter's Creek – Yadkin River Watershed



Carters Creek - Yadkin River Watershed	
Stress Rank	23
Size (Sq. Mi.)	42.93
Municipal Area (Sq. Mi.)	9.65
County Area (Sq. Mi.)	33.28
Impaired Stream (Miles)	4.75

Carters Creek - Yadkin River Watershed	
Developed	6.02%
Open Space	17.84%
Forest	40.38%
Grassland	6.90%
Barren Land	0.02%
Pasture	26.33%
Crops	0.39%
Wetlands	0.65%
Open Water	1.43%



Carter’s Creek – Yadkin River Watershed Threats to Water Quality:

- Stormwater impacts from residential, commercial, and industrial development
- Streambank erosion
- Loss of open space and forestland
- Stormwater runoff, spills and contamination from I-40 traffic

The Carter’s Creek – Yadkin River Watershed covers 43 square miles in western Forsyth County and eastern Davie County. 22% of the watershed is in the Village of Clemmons or the Town of Bermuda Run. Land use in the Carter’s Creek – Yadkin River Watershed is mostly rural with 40% forest, 26% pasture, and 18% open space. However, western Forsyth and eastern Davie Counties have much higher growth rates than their surrounding counties, putting pressure on the watershed and hurting efforts by Forsyth County to improve it. Bermuda Run is brand new town that was created in 2001. Water and sewer services have been installed throughout the town and in the immediate vicinity which puts high development pressures in the watershed. 2 square miles of the watershed is part of public lands.

There are no impaired waters in this watershed, however, this is a Critical Area Watershed and the drinking water source for parts of Forsyth County and most of Davie County. These classifications minimize the impacts development can have upon both surface and ground waters.

Carter’s Creek is a direct tributary to the Yadkin River, which flows to High Rock Lake. Improving Carter’s Creek’s water quality is important to improving High Rock Lake, which is currently the subject of a TMDL assessment to determine nutrient sources of pollution (<http://h2o.enr.state.nc.us/tmdl/SpecialStudies.htm#HighRockLake>). Publication of this TMDL will likely be followed by state legislation to reduce nutrient and sediment inputs to the watershed, similar to that seen in Jordan Lake and Falls Lake.

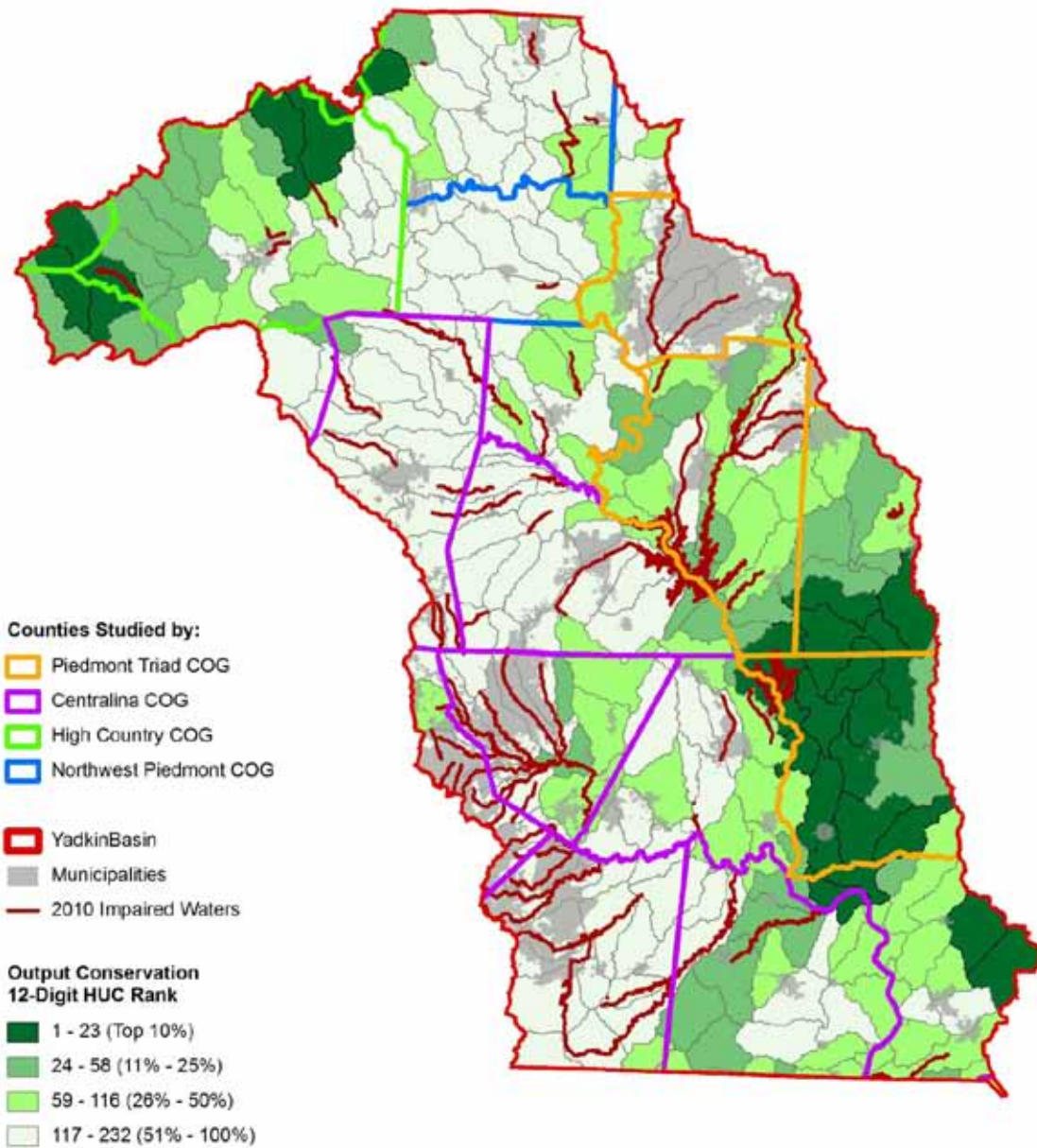
Sections of Carter’s Creek are scheduled to be developed as a segment of the Mountains-To-Sea Trail, a key component of the Piedmont urban route. This greenway will help provide needed buffers around Carter’s Creek. Presently, this greenway is still in planning phase.

Forsyth County/Winston-Salem Stormwater Division requires riparian buffers around surface water for all new development (see table). A minimum 30-foot vegetative buffer is required in Davie County along the Yadkin River. Furthermore, all development in the Carter’s Creek Watershed is required to submit a Stormwater Management System Plan to the Planning & Zoning Board, which has different watershed regulations related to the development types.

<i>Development or Redevelopment Size</i>	Required Landward Buffer Widths	Undisturbed Buffer Widths (Within Landward Buffer)
0-10 Acres	30 Feet	15 Feet
10-50 Acres	50 Feet	25 Feet
Greater than 50 Acres	100 Feet	50 Feet



## Yadkin River Basin: Top Priority Conservation HUCs



## 1) Outlet - Uwharrie River Watershed



Outlet - Uwharrie River Watershed	
Conservation Rank	1
Size (Sq Mi)	31.66
Municipal Area (Sq Mi)	N/A
County Area (Sq Mi)	31.66
Impaired Waters (Miles)	N/A

Outlet - Uwharrie River Land Use	
Developed	0.07%
Open Space	2.05%
Forest	89.19%
Grassland/Herbaceous	4.74%
Barren Land	0.07%
Pasture/Hay	3.25%
Cultivated Crops	0.09%
Wetlands	0.40%
Open Water	0.13%

## Outlet – Uwharrie River Watershed Water Quality Concerns:

- Lack of ordinances that recognize and protect valuable ecological and water quality resources
- Forestry operations in Uwharrie National Forest must use NC Forestry Practice Guidelines (FPGs)
- Stormwater runoff, spills and contamination from NC-109 traffic
- Need for an environmentally-sustainable Uwharrie National Forest management plan
- Loss of open space

About 90% of the 32-square mile Outlet-Uwharrie River Watershed is covered in Uwharrie National Forest lands. There are no significant development centers in this watershed, and only one transit artery (NC 109), so stormwater runoff to the Uwharrie River and its tributaries are insignificant. There is a Watershed IV (WS-IV) designation on these lands that will mainly limit the density of future development in the watershed, ideally preventing stormwater from becoming a source of stress to these waters.

Any timber harvesting that does occur must employ NC DFR Forestry Practice Guidelines (FPGs), which, due to it being a National Forest, are strictly enforced. The Uwharrie National Forest is currently drafting a new management plan, and its draft language indicates a new management direction that will prioritize environmental needs while balancing them with timber interests. This is good news for water quality in the Lower Yadkin River Basin. Though forestry can have detrimental impacts to water quality, timber harvests do not happen often, and the National Forest must, by its charter, preserve the forests and waters for the public good. Though it would be naïve to describe the National Forest areas as “untouched,” it is accurate to state that the presence of the Forest has played a significant role in maintaining clean waters within Montgomery County.

Montgomery County is an area of high ecological richness. It has 66 nationally-significant ecological habitats, and four endangered species. 4 of these nationally-significant habitats are found in the Outlet-Uwharrie River Watershed, which is home to the Lomax Church Longleaf Pine Forest, the Rocky Creek Longleaf Pine Forest and Bogs, the Sand Branch Natural Areas, and the Uwharrie River Aquatic Habitat.

Currently, there are no policies that actively engage these concepts or goals. The WRC has spear-headed efforts in the region through the creation of the Greater Uwharries Conservation Partnership (GUCP), which has invested in innovative GIS-based approaches to prioritizing and protecting these areas and created interjurisdictional recognition of the environmental assets in this region. It could benefit watershed stakeholders to coordinate their policies regarding surrounding environmental attributes through a formal partnership amongst the GUCP, Montgomery County, and the County’s Soil and Water Conservation District and Cooperative Extension offices that reflect these needs. This could lead to a dialogue on the watershed development in general, and *how* stakeholders may want to develop. With so much open space and environmental assets, maintaining growth in current economic centers will minimize infrastructure costs and environmental impact at maximum economic benefit.

## 2) Wood Run Watershed



Wood Run Watershed	
Conservation Rank	2
Size (Sq Mi)	17.74
Municipal Area (Sq Mi)	N/A
County Area (Sq Mi)	17.74
Impaired Waters (Miles)	N/A

Wood Run Land Use	
Developed	0.06%
Open Space	7.67%
Forest	77.08%
Grassland/Herbaceous	3.23%
Barren Land	0.02%
Pasture/Hay	1.64%
Cultivated Crops	0.03%
Wetlands	0.63%
Open Water	9.64%

### Wood Run Watershed Water Quality Concerns:

- Lack of ordinances that recognize and protect valuable ecological and water quality resources
- Forestry operations in Uwharrie National Forest must use NC Forestry Practice Guidelines (FPGs)
- Stormwater runoff, spills and contamination from NC-34 traffic
- Need for an environmentally-sustainable Uwharrie National Forest management plan
- Loss of open space

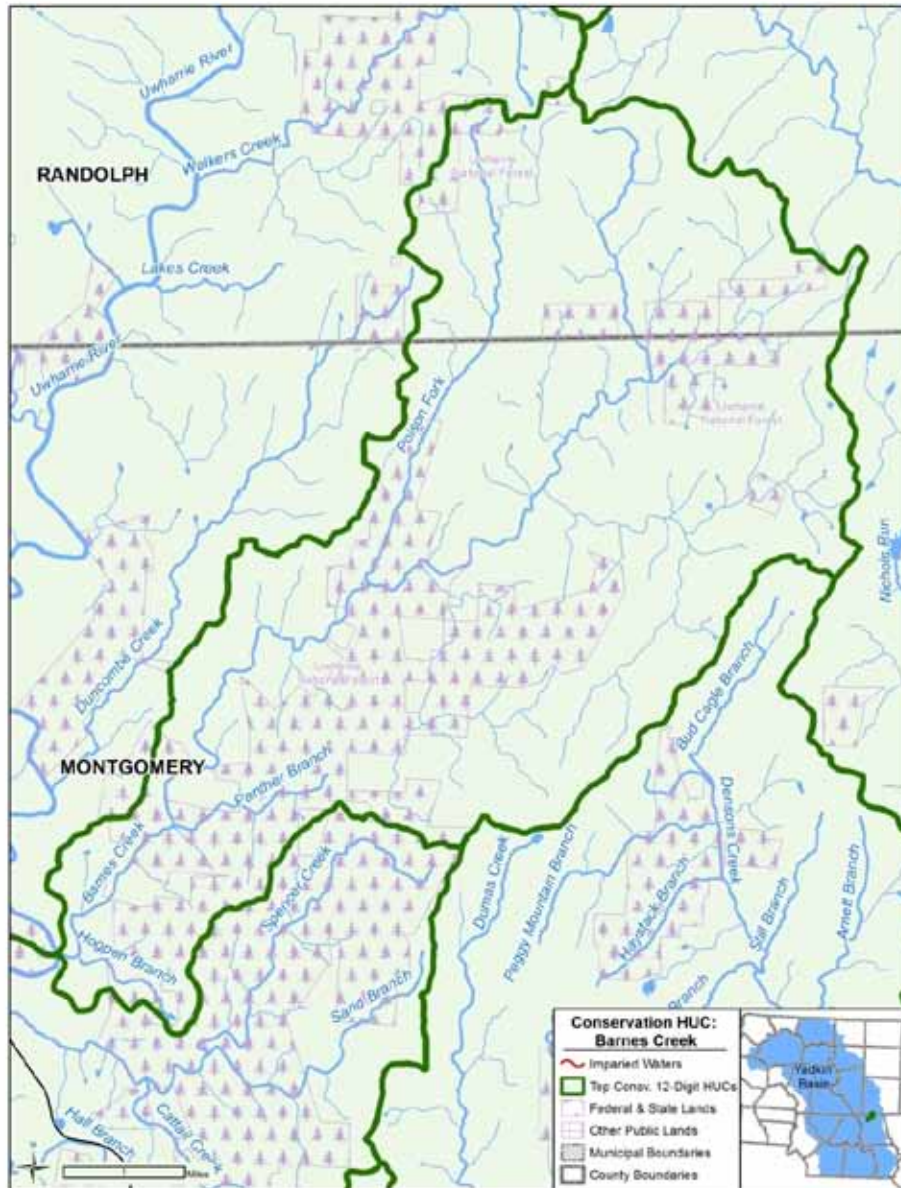
The 18 sq. mi. Wood Run Watershed crosses the Lower Yadkin River just upstream of Lake Tillery and lies in Stanly and Montgomery Counties. Less than 1% of this watershed is developed, leaving almost pristine natural conditions. Four nationally-significant habitats are found in the Woods Run Watershed, which can boast to be the home of the Badin Upland Depression Swamps and Xeric Woodland, Biles Mountain, Morrow Mountain Natural Area, and the Yadkin River Scour Banks. The Greater Uwharrie Conservation Partnership has invested many resources and innovative GIS-based approaches to prioritizing and protecting these areas. Employing their Green Growth Toolbox, federal, state, and county officials can accurately account for their environmental assets, protect them, and then rely upon them as points of interest to the ecotourism population.

With 10% of the watershed occupied by open waters the health and use of these waters must be preserved for local and downstream users. This is especially relevant given the watershed's immediate proximity to Lake Tillery. Recognizing by downstream users of the value of sustainable land use by upstream residents is a topic of increasing interest in water resources. Perhaps the best demonstration of this relationship is in the protection of the New York City, which the City pays millions of dollars a year to protect its Catskill/Delaware River watershed that lies up to 125 miles upstream from the City (WAC).

The rural nature of the County is a key reason for Wood Run Watershed's pristine conditions. Perhaps the greatest water quality benefit is the presence of the Uwharrie National Forest, which occupies almost all of this watershed. Any timber harvesting that occurs here must employ FPGs mandated by NC DFR, and which, due it being a National Forest, are strictly enforced. There is a WS-IV designation on these lands that will mainly limit the density of future development in the watershed, ideally preventing stormwater from becoming a source of stress to these waters.

The WRC has spear-headed efforts in the region through the creation of the Greater Uwharries Conservation Partnership (GUCP), which has invested in innovative GIS-based approaches to prioritizing and protecting these areas and created interjurisdictional recognition of the environmental assets in this region. It could benefit watershed stakeholders to coordinate their policies regarding surrounding environmental attributes through a formal partnership amongst the GUCP, Montgomery County, and the County's Soil and Water Conservation District and Cooperative Extension offices that reflect these needs. This could lead to a dialogue on the watershed development in general, and *how* stakeholders may want to develop. With so much open space and environmental assets, maintaining growth in current economic centers will minimize infrastructure costs and environmental impact at maximum economic benefit.

### 3) Barnes Creek Watershed



Barnes Creek Watershed	
Conservation Rank	3
Size (Sq Mi)	24.08
Municipal Area (Sq Mi)	N/A
County Area (Sq Mi)	24.08
Impaired Waters (Miles)	N/A

Barnes Creek Land Use	
Developed	0.05%
Open Space	1.70%
Forest	81.82%
Grassland/Herbaceous	7.42%
Barren Land	0.22%
Pasture/Hay	7.94%
Cultivated Crops	0.42%
Wetlands	0.39%
Open Water	0.02%



### Barnes Creek Watershed Water Quality Concerns:

- Inconsistent ordinances to recognize and protect valuable ecological and water quality resources
- Forestry operations in Uwharrie National Forest must use NC Forestry Practice Guidelines (FPGs)
- Need for an environmentally-sustainable Uwharrie National Forest management plan
- Loss of open space

Though the lands and waters here remain in healthy conditions, the 24-sq. mi. Barnes Creek watershed highlights the need for improved inter-jurisdictional communication and policies for watershed management. Barnes Creek is currently designated as an Outstanding Resources Water. However, the watershed in Montgomery County is at a significantly higher risk of being developed than those in Randolph County. Randolph County not only employs proactive development regulations to limit the impacts to local water quality, but this particular watershed lies within the Uwharrie River Natural Heritage Corridor, which ensures that the area will be preserved for recreation, viewing, and environmental habitat through mandatory buffers and slope restrictions. None of these provisions exist in Montgomery County.

Currently, there are no policies that actively engage these concepts or goals. The WRC has spear-headed efforts in the region through the creation of the Greater Uwharries Conservation Partnership (GUCP), which has invested in innovative GIS-based approaches to prioritizing and protecting these areas and created interjurisdictional recognition of the environmental assets in this region. It could benefit watershed stakeholders to coordinate their policies regarding surrounding environmental attributes through a formal partnership amongst the GUCP, Montgomery County, and the County's Soil and Water Conservation District and Cooperative Extension offices that reflect these needs. This could lead to a dialogue on the watershed development in general, and *how* stakeholders may want to develop. With so much open space and environmental assets, maintaining growth in current economic centers will minimize infrastructure costs and environmental impact at maximum economic benefit.

Montgomery County is an area of high ecological richness. It has 66 nationally-significant ecological habitats, and four endangered species. Two of these nationally-significant habitats are found in the Barnes Creek Watershed, which is home to the Barnes Creek/Poison Fork Aquatic Habitat and the Uwharrie River Aquatic Habitat. These waters used to be the home of the Carolina elktoe, which is now extinct. The Barnes Creek/Poison Fork Aquatic Habitat lies almost entirely within Montgomery County, and could potentially face impacts from local development; the headwaters and much of the stream length of the latter mostly fall in Randolph County, and is protected by their Natural Heritage Corridor overlay zone. Only at the confluence of Barnes Creek with the Uwharrie River, where a WS-IV overlays the landscape, do DENR regulations offer any protections against development densities. Much of Poison Fork does lie in the Uwharrie National Forest, which affords it protections from impacts that are not timber harvesting. Any efforts that could shore the environmental protections in both of these streams will be welcome.

#### 4) Rocky Creek Watershed



Rocky Creek Watershed	
Conservation Rank	4
Size (Sq Mi)	29.36
Municipal Area (Sq Mi)	1.01
County Area (Sq Mi)	28.34
Impaired Waters (Miles)	N/A

Rocky Creek Land Use	
Developed	1.86%
Open Space	4.67%
Forest	75.52%
Grassland/Herbaceous	10.31%
Barren Land	0.77%
Pasture/Hay	5.90%
Cultivated Crops	0.38%
Wetlands	0.47%
Open Water	0.11%

## Rocky Creek Watershed Water Quality Concerns:

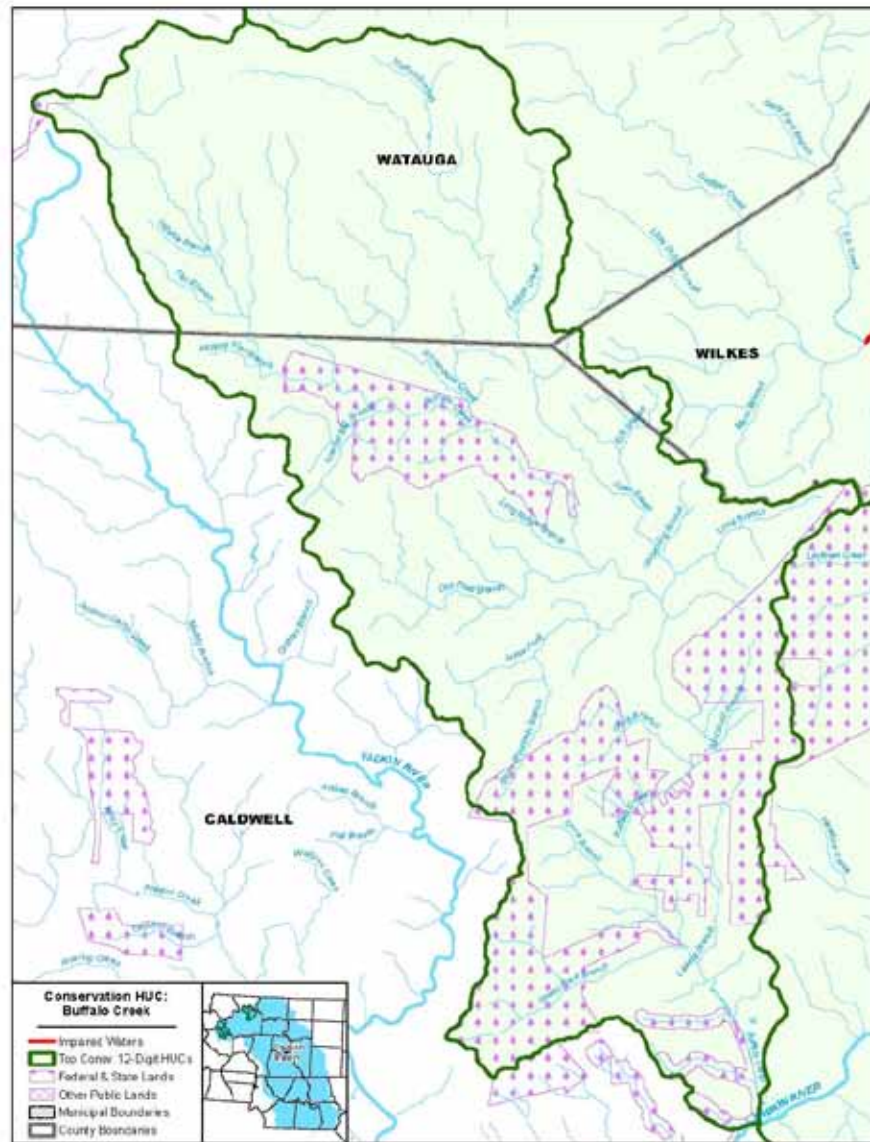
- Inconsistent ordinances to recognize and protect valuable ecological and water quality resources
- Forestry operations in Uwharrie National Forest must use NC Forestry Practice Guidelines (FPGs)
- Loss of open space from sprawl around Troy
- Stormwater runoff, spills and contamination from NC-109 & NC-134 traffic
- Need for an environmentally-sustainable Uwharrie National Forest management plan

The 29-sq. mi. Rocky Creek watershed may be the conservation watershed at the greatest risk from development in Montgomery County. This both illustrates how little of Montgomery County is undeveloped and the sensitivity of highly-valuable ecological habitats. There are no watershed regulations in the area to protect water quality from development, and perhaps a third of the watershed area is occupied by the Uwharrie National Forest, which is relatively little compared to other areas in Montgomery County. The 0.5-square mile of the Town of Troy is the only significant urban cover within this watershed, and in combination with the major transit routes of NC-109 and NC-24, demonstrates the only impervious surfaces in this watershed. However, from a watershed perspective, the location of the Town is concerning, as it occupies the Warner Creek headwaters subwatershed. Thus far, this has not had a significant impact upon water quality, but any steps that Troy can take to minimize its sprawl and prevent affecting the water quality in Warner Creek or downstream, the better.

Montgomery County is an area of high ecological richness. It has 66 nationally-significant ecological habitats, and four endangered species. Six of these nationally-significant habitats are found in the Barnes Creek Watershed, which is home to the Clark's Grove Longleaf Pine Forest and the Lomax Church Longleaf Pine Forest, the Roberdo Bog and Longleaf Pine Forest, and the Rocky Creek Longleaf Pine Forest and Bogs. These sites are all home to the endangered longleaf pine and the red-cockaded woodpecker. The watershed also features the Pleasant Grove Bog and Pine Savanna and the Upper Little River Aquatic Habitat. All of these sites are located downstream of the Town of Troy, highlighting the need to limit the environmental impacts of development.

Currently, there are no policies that actively engage these concepts or goals. The WRC has spear-headed efforts in the region through the creation of the Greater Uwharries Conservation Partnership (GUCP), which has invested in innovative GIS-based approaches to prioritizing and protecting these areas and created interjurisdictional recognition of the environmental assets in this region. It could benefit watershed stakeholders to coordinate their policies regarding surrounding environmental attributes through a formal partnership amongst the GUCP, Montgomery County, and the County's Soil and Water Conservation District and Cooperative Extension offices that reflect these needs. This could lead to a dialogue on the watershed development in general, and *how* stakeholders may want to develop. With so much open space and environmental assets, maintaining growth in current economic centers will minimize infrastructure costs and environmental impact at maximum economic benefit.

## 5) Buffalo Creek Watershed



Buffalo Creek	
Conservation Rank	5
Size (Sq Mi)	33.04
Municipal Area (Sq Mi)	N/A
County Area (Sq Mi)	33.04
Impaired Water (Miles)	N/A

Buffalo Creek Land Use	
Developed	0.04%
Open Space	2.30%
Forest	92.56%
Grassland/Herbaceous	1.12%
Barren Land	0.06%
Pasture/Hay	3.77%
Cultivated Crops	0.08%
Wetlands	0.07%
Open Water	0.00%

### Buffalo Creek Watershed Water Quality Concerns:

- sedimentation - from logging, cropland, and development activities
- streambank erosion
- loss of farmland and forestland

The Buffalo Creek watershed covers 33 square miles in northern Caldwell County and southeastern Watauga County. The watershed is virtually undeveloped, with good water quality. All streams in the watershed are classified C, with supplemental Trout Waters (Tr) classification. No streams in the watershed have High Quality Waters (HQW) or Outstanding Resource Waters (ORW) classifications. No streams in the watershed are impaired or impacted.

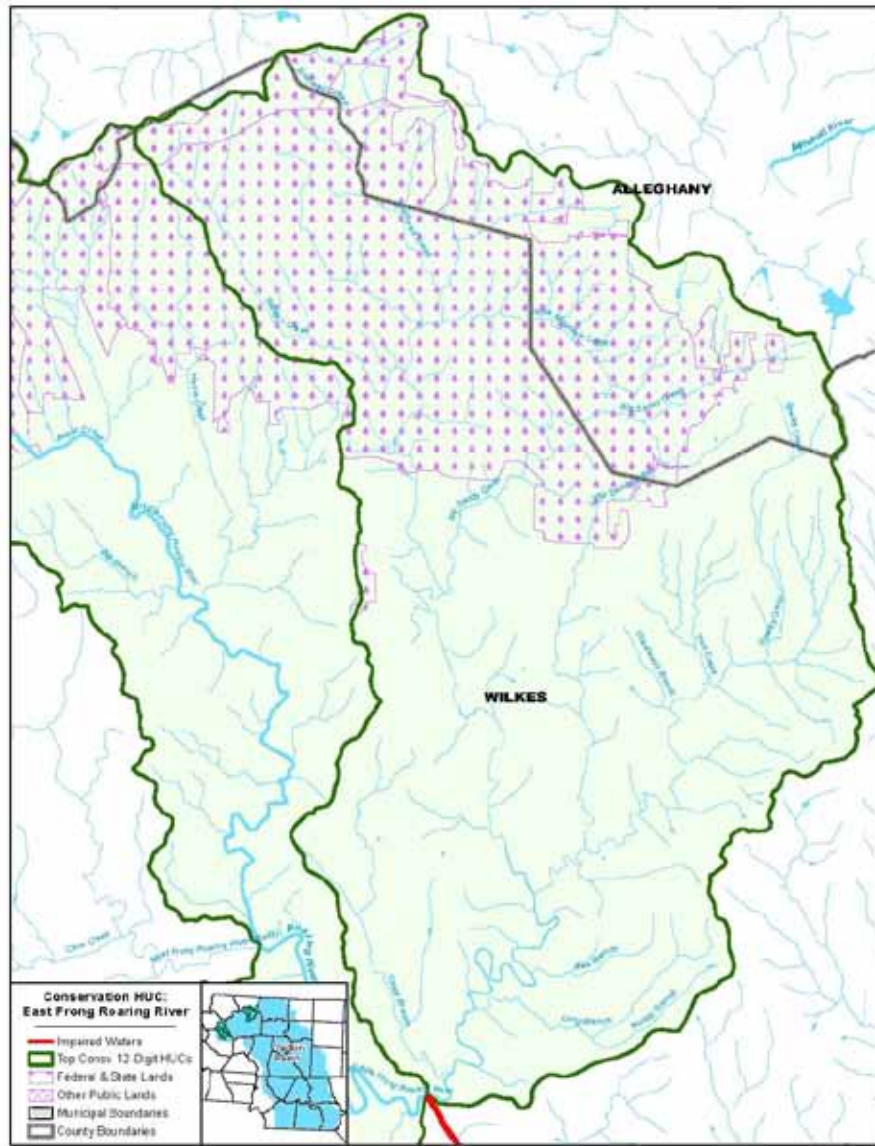
Land use in the area is 93% forested and 4% pasture, with only 0.04% developed. Seven square miles, or 20% of the watershed, is public lands. There is no water supply watershed area in the Buffalo Creek watershed. Based on NC Natural Heritage Program data, the watershed contains a total of ten square miles of Significant Natural Heritage Areas, and 21 Natural Heritage Element Occurrences.

Existing conservation and restoration efforts can be utilized in the watershed. The predominant land conservancy in the region is the Foothills Conservancy. Foothills Conservancy works with landowners and public partners to protect open space, important natural areas, significant habitats, forests, and farmland in an eight-county region. The USDA Natural Resource Conservation Service provides technical and financial assistance to install best management practices (BMPs) on private lands. The NC Division of Soil and Water Conservation administers the NC Agriculture Cost Share Program, which provides 75% of the cost of installing BMPs that address agricultural non-point source pollution.

Regulatory water quality protection measures existing in the watershed consist of the 25-foot undisturbed buffer requirement along streams classified as Trout Waters.

The Buffalo Creek watershed can benefit from site-specific agricultural/forestry BMP and stream restoration projects. Additionally, land conservation efforts should focus on working farms and lands adjacent to existing public lands in the southern portion of the watershed.

6) East Prong Roaring River Watershed



East Prong Roaring River	
Conservation Rank	6
Size (Sq Mi)	56.67
Municipal Area (Sq Mi)	N/A
County Area (Sq Mi)	56.67
Impaired Water (Miles)	<.01

East Prong Roaring River Land Use	
Developed	0.55%
Open Space	3.67%
Forest	75.03%
Grassland/Herbaceous	2.95%
Barren Land	0.01%
Pasture/Hay	17.38%
Cultivated Crops	0.32%
Wetlands	0.08%
Open Water	0.01%

### East Prong Creek Watershed Water Quality Concerns:

- livestock access to streams
- sedimentation - from cropland and development activities
- streambank erosion
- loss of farmland and forestland

The East Prong Roaring River watershed covers 57 square miles in northeastern Wilkes County and southeastern Alleghany County. The watershed is relatively undeveloped, with good water quality. All streams in the watershed are classified C, with many streams in the northern portion of the watershed having a Trout Waters (Tr) supplemental classification. Garden Creek and Big Sandy Creek are further classified as High Quality Waters (HQW), and Widows Creek, Bullhead Creek, and Rich Mountain Creek are classified as Outstanding Resource Waters (ORW). No streams in the watershed are impaired or impacted.

Land use in the area is 75% forested and 17% pasture, with only 0.5% developed. Twenty square miles, or 35% of the watershed, is public lands. There is no water supply watershed area in the East Prong Roaring River watershed, but the watershed does contain public water supplies. These consist of wells serving neighborhoods, businesses, schools, or campgrounds.

Based on NC Natural Heritage Program data, the watershed contains a total of 20 square miles of Significant Natural Heritage Areas, and 26 Natural Heritage Element Occurrences.

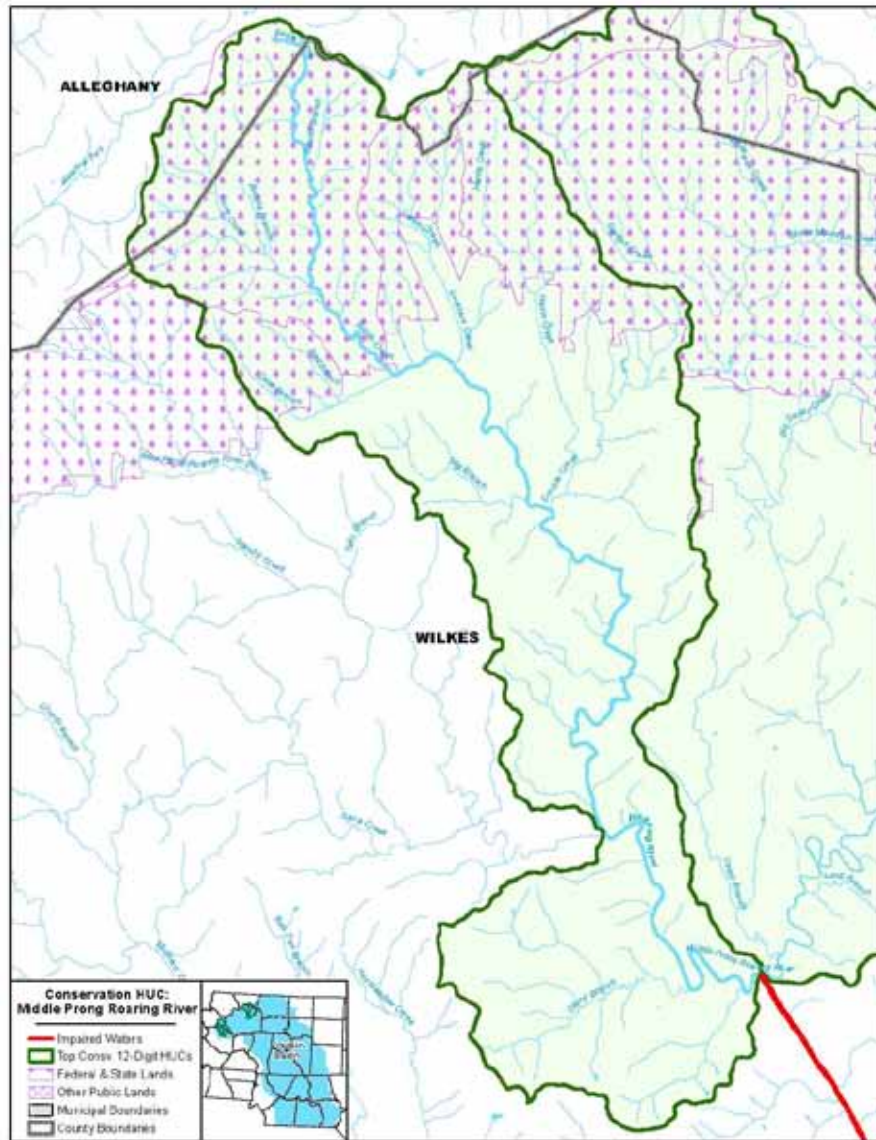
Existing conservation and restoration efforts can be utilized in the watershed. The predominant land conservancy in the region is the Blue Ridge Conservancy. Blue Ridge Conservancy works with landowners who desire to voluntarily donate conservation easements, with emphasis given to projects that protect large tracts, working farms, properties with ecological and recreational significance, and properties adjacent to other protected land. The Blue Ridge Conservancy has worked to protect 230 acres in the East Prong Roaring River watershed.

The USDA Natural Resource Conservation Service provides technical and financial assistance to install best management practices (BMPs) on private lands. The NC Division of Soil and Water Conservation administers the NC Agriculture Cost Share Program, which provides 75% of the cost of installing BMPs that address agricultural non-point source pollution.

Regulatory water quality protection measures exist along streams classified as Trout Waters, and in HQW and ORW watersheds. Twenty-five foot undisturbed buffers are required along trout streams, and development densities are limited in HQW and ORW watersheds.

The East Prong Roaring River watershed can benefit from site-specific agricultural BMP and stream restoration projects. Additionally, land conservation efforts should focus on working farms and lands adjacent to existing public lands in the northern portion of the watershed.

## 7) Middle Prong Roaring River Watershed



Middle Prong Roaring River	
Conservation Rank	7
Size (Sq Mi)	43.63
Municipal Area (Sq Mi)	N/A
County Area (Sq Mi)	43.63
Impaired Water (Miles)	N/A

Middle Prong Roaring River Land Use	
Developed	0.29%
Open Space	2.80%
Forest	79.60%
Grassland/Herbaceous	3.36%
Barren Land	0.02%
Pasture/Hay	13.37%
Cultivated Crops	0.40%
Wetlands	0.16%
Open Water	0.01%



### East Prong Creek Watershed Water Quality Concerns:

- livestock access to streams
- sedimentation - from cropland and development activities
- streambank erosion
- loss of farmland and forestland

The Middle Prong Roaring River watershed covers 44 square miles in northeastern Wilkes County. The watershed is relatively undeveloped, with good water quality. All streams in the watershed are classified C, with many streams in the northern portion of the watershed having a Trout Waters (Tr) supplemental classification. Harris Creek is further classified as High Quality Waters (HQW), and Basin Creek is classified as Outstanding Resource Waters (ORW). No streams in the watershed are impaired or impacted.

Land use in the area is 80% forested and 13% pasture, with only 0.3% developed. Sixteen square miles, or 36% of the watershed, is public lands. There is no water supply watershed area in the Middle Prong Roaring River watershed, but the watershed does contain public water supplies. These consist of wells serving neighborhoods, businesses, schools, or campgrounds.

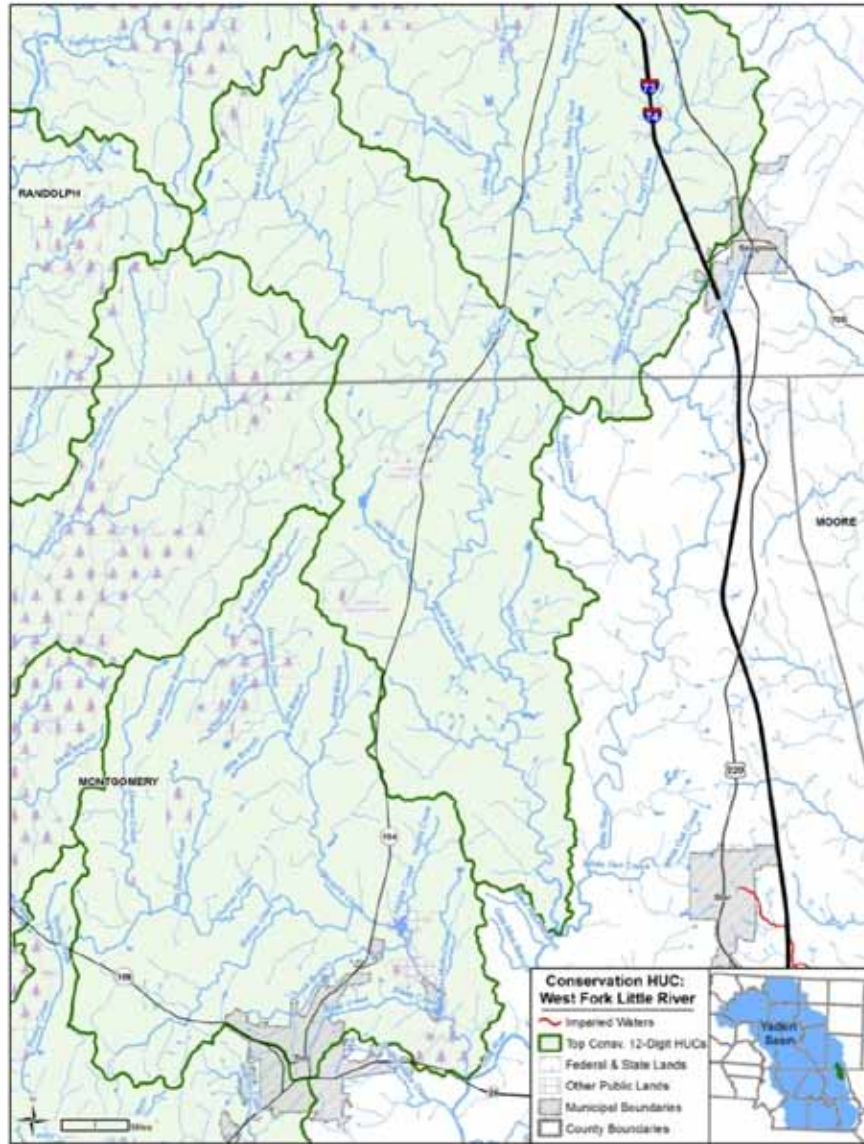
Based on NC Natural Heritage Program data, the watershed contains a total of 11.5 square miles of Significant Natural Heritage Areas, and 15 Natural Heritage Element Occurrences.

Existing conservation and restoration efforts can be utilized in the watershed. The predominant land conservancy in the region is the Blue Ridge Conservancy. Blue Ridge Conservancy works with landowners who desire to voluntarily donate conservation easements, with emphasis given to projects that protect large tracts, working farms, properties with ecological and recreational significance, and properties adjacent to other protected land. The USDA Natural Resource Conservation Service provides technical and financial assistance to install best management practices (BMPs) on private lands. The NC Division of Soil and Water Conservation administers the NC Agriculture Cost Share Program, which provides 75% of the cost of installing BMPs that address agricultural non-point source pollution.

Regulatory water quality protection measures exist along streams classified as Trout Waters, and in HQW watersheds. Twenty-five foot undisturbed buffers are required along trout streams, and development densities are limited in HQW and ORW watersheds.

The Middle Prong Roaring River watershed can benefit from site-specific agricultural BMP and stream restoration projects. Additionally, land conservation efforts should focus on working farms and lands adjacent to existing public lands in the northern portion of the watershed.

## 8) West Fork Little River Watershed



West Fork Little River Watershed	
Conservation Rank	8
Size (Sq Mi)	36.43
Municipal Area (Sq Mi)	N/A
County Area (Sq Mi)	36.43
Impaired Waters (Miles)	N/A

West Fork Little River Land Use	
Developed	0.18%
Open Space	2.84%
Forest	68.90%
Grassland/Herbaceous	9.65%
Barren Land	0.15%
Pasture/Hay	16.50%
Cultivated Crops	0.90%
Wetlands	0.68%
Open Water	0.21%

## West Fork Little Creek Watershed Water Quality Concerns:

- Inconsistent ordinances to recognize and protect valuable ecological and water quality resources
- Impacts from livestock
- Loss of open space due to development along I-73/74

The 36-sq. mi. West Fork Little Creek watershed is perhaps the most vulnerable area amongst the priority conservation watersheds in the Uwharrie National Forests region. Though the watershed is almost completely uninhabited, with only 0.18% of the land developed for any use, it also not protected from development in any way. This a more pressing issue due to the presence of a large, registered livestock operation in this watershed.

There are small, unconnected patches of Uwharrie National Forest lands within the watershed. The drafted Uwharrie National Forest management plan should attempt to unify these patches of land to minimize the “edge effect.” The edge effect refers to the phenomenon when species in small habitat areas are more exposed and therefore vulnerable to impacts (i.e. predators or invasive species) than larger habitats that insulate sensitive species through larger interior areas. Comments from the Wildlife Resources Commission (WRC), the LandTrust for Central NC, and the Soil & Water Conservation District office need to ensure that this need is included in the Uwharrie National Forest management plan.

Montgomery County is an area of high ecological richness. It has 66 nationally-significant ecological habitats, and four endangered species. One of these nationally-significant habitats, the West Fork-Little River Aquatic Habitat, is found in this watershed. It is home to the endangered longleaf pine and the red-cockaded woodpecker. The watershed also features three state-significant habitat areas.

Montgomery County land use offers few watershed protections. Randolph County ordinances require riparian buffers and the consideration of environmental factors. Randolph County also applies a Natural Heritage Corridor overlay district to the riparian zone, which limits development for the preservation of water quality and viewsheds. The pristine nature of this watershed must be maintained, so that its rural nature and recreational appeal are preserved for residents and visitors. It is recommended that Montgomery County create an open space planning and management program to identify and protect natural resources valuable to the County’s economy. An Open Space Management program in this watershed could coordinate efforts with the Uwharrie National Forest and LTCNC to ensure that rural lands and natural resources are protected and sustainably managed.

The WRC has spear-headed efforts in the region through the creation of the Greater Uwharries Conservation Partnership (GUCP), which has invested in innovative GIS-based approaches to prioritizing and protecting these areas and created interjurisdictional recognition of the environmental assets in this region. It could benefit watershed stakeholders to coordinate their policies regarding surrounding environmental attributes through a formal partnership amongst the GUCP, Montgomery County, and the County’s Soil and Water Conservation District and Cooperative Extension offices that reflect these needs.

## 9) Big Town Creek Watershed



Big Town Creek Watershed	
Conservation Rank	9
Size (Sq Mi)	43.08
Municipal Area (Sq Mi)	N/A
County Area (Sq Mi)	43.08
Impaired Waters (Miles)	N/A

Big Town Creek Land Use	
Developed	0.06%
Open Space	2.19%
Forest	78.81%
Grassland/Herbaceous	8.84%
Barren Land	0.62%
Pasture/Hay	6.33%
Cultivated Crops	1.05%
Wetlands	1.92%
Open Water	0.19%

### Big Town Creek Watershed Water Quality Concerns:

- Inconsistent ordinances to recognize and protect valuable ecological and water quality resources
- Impacts from livestock
- Loss of open space due to sprawl development from Mt. Gilead

Big Town Creek Watershed covers 43 sq. mi. just east of Mt. Gilead in Montgomery County. It is largely uninhabited, with only 0.06% of its 43 square miles developed. There are only a couple of patches of the Uwharrie National Forest – most of this land is privately-held forestland, with a few scattered farms, including one registered confined animal feeding operation (CAFO). With growth in Mt. Gilead, this could be a development node within Montgomery County, as NC 731 crosses through it and NC 109 skirts its northwestern perimeter.

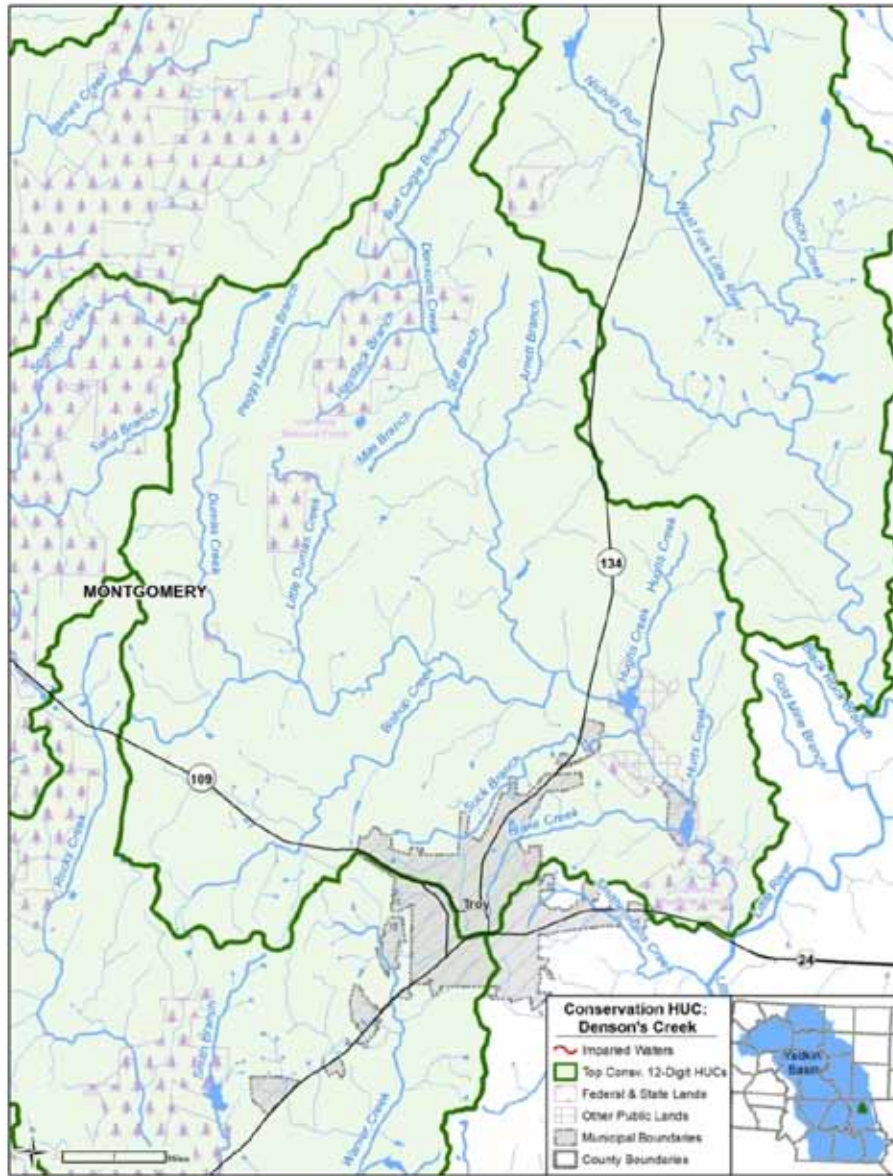
Montgomery County is an area of high ecological richness. It has 66 nationally-significant ecological habitats, and four endangered species. Several state-significant habitats, including one that supports the Atlantic pigtoe, a globally-endangered mussel, are found in the Big Town Creek watershed. The watershed also features the Town Creek Indian Mound, a historically-valuable site that was a key feature of local life and culture for the ancient Pee Dee Tribe. The watershed also lies a mere 4 miles from Lake Baden, a recreational hotspot in the watershed.

Lying entirely within Montgomery County and outside of any water supply watersheds, there are few regulations regarding the environmental impact of development within the Big Town Creek Watershed. Though the waters of this area are acknowledged to be healthy, there is the potential that the area could grow, and there is little beyond the Atlantic pigtoe's endangered species classification that will check development impacts in the watershed. Incorporating some of the policy features Randolph County has, namely Natural Heritage Corridor and watershed overlay districts could both better protect water quality and invest in the ecotourism potential of the County. Through such measures, and with the support of increased state and federal funding, Montgomery County ecological features throughout can directly benefit its local economy.

Montgomery County is shockingly rich in environmental diversity and unique features. That Big Town Creek Watershed is a lesser example of these attributes while still hosting one endangered species and the remnants of an ancient Native American civilization is only a testament of the County's wealth. Montgomery County lies about 45 minutes from both the Charlotte metropolitan area and the Triad metropolitan area. It is a destination for people seeking recreation at Badin Lake and at Uwharrie National Forest. However, the ecotourism economy could be encouraged to bring greater income to the County.

The WRC has spear-headed efforts in the region through the creation of the Greater Uwharries Conservation Partnership, which has invested in innovative GIS-based approaches to prioritizing and protecting these areas and created interjurisdictional recognition of the environmental assets in this region. Their efforts need to be capitalized upon with a concrete partnership that leads to uniform policies to protect natural resources of the region. This will allow all stakeholders to coordinate their habitat protection and economic development efforts and minimize duplication of efforts, as well as synthesizing the work already done into comprehensive planning efforts.

## 10) Denson's Creek Watershed



Denson's Creek Watershed	
Conservation Rank	10
Size (Sq Mi)	34.78
Municipal Area (Sq Mi)	1.65
County Area (Sq Mi)	33.13
Impaired Waters (Miles)	N/A

Denson's Creek Land Use	
Developed	1.85%
Open Space	4.69%
Forest	73.20%
Grassland/Herbaceous	10.81%
Barren Land	0.22%
Pasture/Hay	8.26%
Cultivated Crops	0.61%
Wetlands	0.19%
Open Water	0.17%

### Denson's Creek Watershed Water Quality Concerns:

- Inconsistent ordinances to recognize and protect valuable ecological and water quality resources
- Forestry operations in Uwharrie National Forest must use NC Forestry Practice Guidelines (FPGs)
- Loss of open space from sprawl around Troy
- Stormwater runoff, spills and contamination from NC-109 & NC-134 traffic
- Need for an environmentally-sustainable Uwharrie National Forest management plan

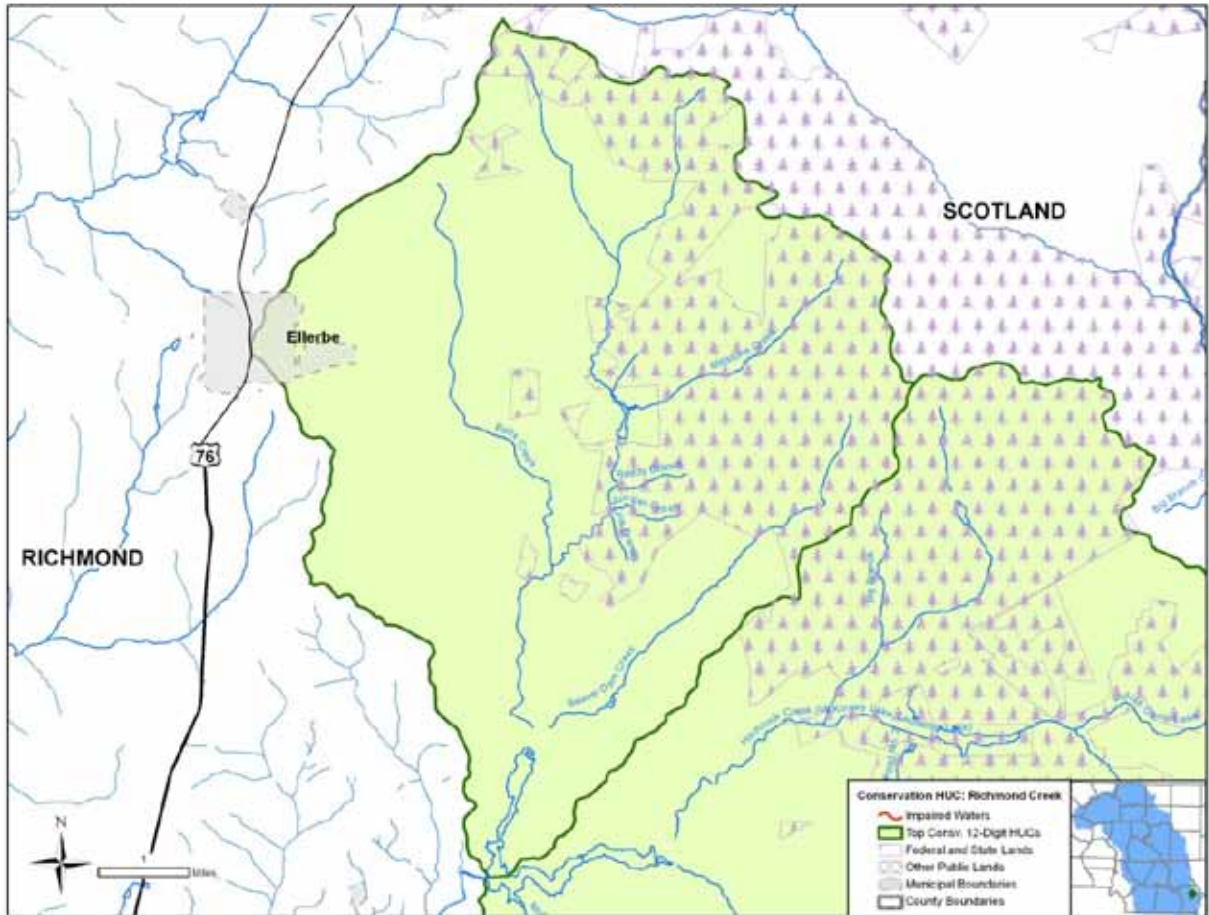
The 35-sq. mi. Denson's Creek Watershed could be a guiding demonstration of how to balance economic development needs with local environmental needs. Though Troy occupies the southern reaches of the watershed, its impacts to catchment streams appear to be insignificant thus far. Troy is lightly developed – developed land only occupies 1.85% of the watershed's area – which may account for this minimal impact.

Montgomery County is an area of high ecological richness. It has 66 nationally-significant ecological habitats, and four endangered species. Three of these nationally-significant habitats are found in the Denson's Creek Watershed, which is home to the Rocky Creek Longleaf Pine Forest and Bogs, the Sand Branch Natural Area, and the Denson's Creek Aquatic Habitat. The Denson's Creek Slopes, where the Schweinitz's sunflower – a federally-endangered flower – can be found, lies just outside of the Troy town limits. The watershed also features the Upper Denson's Creek and Abner Mountain, Tower Bog, and the Arnett Branch Longleaf Pine Forest. All of these sites are located upstream of the Town of Troy, highlighting the need to limit the environmental impacts of development.

The Carolina Elktoe offers a warning to developing communities. Once found in Denson's Creek, just downstream of Troy, it is now extinct, likely due to large sediment loads to the Creek. The pristine nature of this watershed must be maintained, so that its rural nature and recreational appeal are preserved for residents and visitors. It is recommended that Montgomery County create an open space planning and management program to identify and protect natural resources valuable to the County's economy. An Open Space Management program in this watershed could coordinate efforts with the Uwharrie National Forest and LTCNC to ensure that rural lands and natural resources are protected and sustainably managed.

Currently, there are no policies that actively engage these concepts or goals. The WRC has spear-headed efforts in the region through the creation of the Greater Uwharries Conservation Partnership (GUCP), which has invested in innovative GIS-based approaches to prioritizing and protecting these areas and created interjurisdictional recognition of the environmental assets in this region. It could benefit watershed stakeholders to coordinate their policies regarding surrounding environmental attributes through a formal partnership amongst the GUCP, Montgomery County, and the County's Soil and Water Conservation District and Cooperative Extension offices that reflect these needs. This could lead to a dialogue on the watershed development in general, and *how* stakeholders may want to develop. With so much open space and environmental assets, maintaining growth in current economic centers will minimize infrastructure costs and environmental impact at maximum economic benefit.

## 11) Rocky Fork Creek Watershed



Rocky Fork Creek Watershed	
Conservation Rank	11
Size (Sq Mi)	38.97
Municipal Area (Sq Mi)	0.54
County Area (Sq Mi)	38.43
Impaired Waters (Miles)	N/A

Rocky Fork Creek Land Use	
Developed	0.40%
Open Space	7.06%
Forest	55.42%
Grassland/Herbaceous	18.38%
Barren Land	2.47%
Pasture/Hay	7.82%
Cultivated Crops	7.66%
Wetlands	0.79%
Open Water	0.40%



## Rocky Fork Creek Watershed Threats to Water Quality

- livestock access to streams
- sedimentation - from cropland and development activities
- streambank erosion
- loss of farmland and forestland

The Rocky Fork Creek Watershed is 39 square miles and is located in north eastern part of Richmond County. There are no impaired streams in this watershed. Several stream corridors, watersheds, and ecosystems in Richmond County were identified by the North Carolina Natural Heritage Program as significant. The upper portions of Rocky Fork and Beaverdam drain the western section of the Sand Hills Game Land (SGL) in Richmond County. SGL is composed of large areas mostly in Richmond and Scotland Counties. SGL contains an ecosystem that is nearly undisturbed, supports a high diversity of flora and fauna, and provides a population pool of longleaf pine. The N.C. Wildlife Commission manages the SGL for public use. The game land is open for hunting, hiking, horseback riding, and nature study. The Department of Defense also uses the game land for training exercises.

The majority of this watershed is governed by the policies of Richmond County. A small portion of the western side of the watershed is within the boundaries of the Town of Ellerbe. The watershed is sparsely populated and characterized by large tracts of forest and agricultural land. In 2001, Richmond County amended their ordinance to include a WS-III water supply watershed overlay district. The purpose of this overlay district is to protect the drinking water supply of the County and its municipal jurisdictions from runoff contamination from large-scale development. There are two parts to a Water Supply Watershed; the Critical Area; and the Balance of the Watershed. Criteria for development in both these areas of the Watershed have been mandated by the N.C. General Assembly and incorporated in to this Ordinance. Special provisions are provided for more intensive use of land by way of cluster development and buffer areas. Proper land development techniques will be the key to the utilization of land area, which falls under this district.

Existing conservation and restoration efforts can be utilized in the watershed. The predominant land conservancy in the region is the Land Trust of Central North Carolina. The land trust works with landowners and public partners to protect open space, important natural areas, significant habitats, forests, and farmland in a five-county region. Just west of the watershed, the Land Trust preserved 115 acres in a permanent protected conservation easement. Known as Bill Webb Farm, it possesses both Uwharrie type ecosystems, with mountain-like streams, and sandhills ecotomes, with longleaf pine and flat lands.

## 12) Elk Creek Watershed



Elk Creek	
Conservation Rank	12
Size (Sq Mi)	50.53
Municipal Area (Sq Mi)	N/A
County Area (Sq Mi)	50.53
Impaired Water (Miles)	9.03

Elk Creek Land Use	
Developed	0.04%
Open Space	2.85%
Forest	90.66%
Grassland/Herbaceous	1.42%
Barren Land	0.03%
Pasture/Hay	4.83%
Cultivated Crops	0.07%
Wetlands	0.10%
Open Water	0.01%

### Elk Creek Watershed Water Quality Concerns:

- livestock access to streams
- sedimentation - from cropland and development activities
- streambank erosion
- loss of farmland and forestland

The Elk Creek watershed covers 51 square miles in southeastern Watauga County and western Wilkes County. The watershed is relatively undeveloped and, with the exception of the lower section of Elk Creek, has high quality water officially recognized by NC DWQ. Most streams in the watershed are classified B, with supplemental Trout Waters (Tr) classification (the remaining streams are classified C,Tr). Additionally, the entire watershed is classified as Outstanding Resource Waters (ORW). Nine miles of the lower reach of Elk Creek is listed on the 303(d) list as impaired by fecal coliform bacteria. The potential source is agriculture.

Land use in the area is 91% forested and 5% pasture. Two square miles, or 4.5% of the watershed, is public lands. There is no water supply watershed area in the Elk Creek watershed. Based on NC Natural Heritage Program data, the watershed contains a total of four square miles of Significant Natural Heritage Areas, and 24 Natural Heritage Element Occurrences.

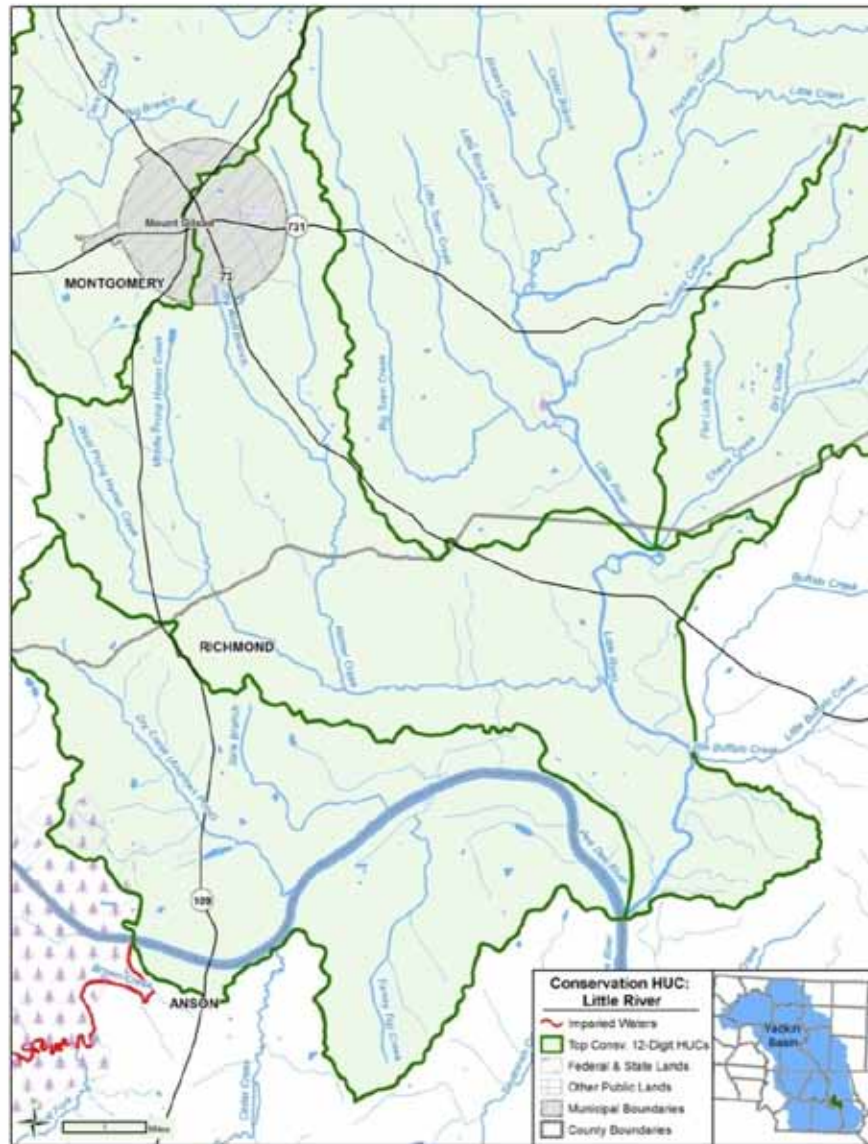
Existing conservation and restoration efforts can be utilized in the watershed. The predominant land conservancy in the region is the Blue Ridge Conservancy. Blue Ridge Conservancy works with landowners who desire to voluntarily donate conservation easements, with emphasis given to projects that protect large tracts, working farms, properties with ecological and recreational significance, and properties adjacent to other protected land. The Blue Ridge Conservancy has worked to protect three tracts totaling 796 acres in the Elk Creek watershed.

The USDA Natural Resource Conservation Service provides technical and financial assistance to install best management practices (BMPs) on private lands. The NC Division of Soil and Water Conservation administers the NC Agriculture Cost Share Program, which provides 75% of the cost of installing BMPs that address agricultural non-point source pollution.

Regulatory water quality protection measures exist along streams classified as Trout Waters, and in ORW watersheds. Twenty-five foot undisturbed buffers are required along trout streams, and development densities are limited in ORW watersheds.

The Elk Creek watershed can benefit from site-specific agricultural/forestry BMP and stream restoration projects, specifically adjacent to the impaired section of Elk Creek. Additionally, land conservation efforts should focus on working farms and forestland.

### 13) Little River Watershed



Little River Watershed	
Conservation Rank	13
Size (Sq Mi)	31.37
Municipal Area (Sq Mi)	1.60
County Area (Sq Mi)	29.77
Impaired Waters (Miles)	N/A

Little River Land Use	
Developed	0.32%
Open Space	4.26%
Forest	64.00%
Grassland/Herbaceous	11.59%
Barren Land	0.77%
Pasture/Hay	12.12%
Cultivated Crops	2.70%
Wetlands	4.07%
Open Water	0.19%

### Little River Watershed Water Quality Concerns:

- sedimentation - from logging, cropland, and development activities
- nutrients – from logging and agriculture
- development – Mt. Gilead and state routes lie on hydrologically-valuable land
- streambank erosion

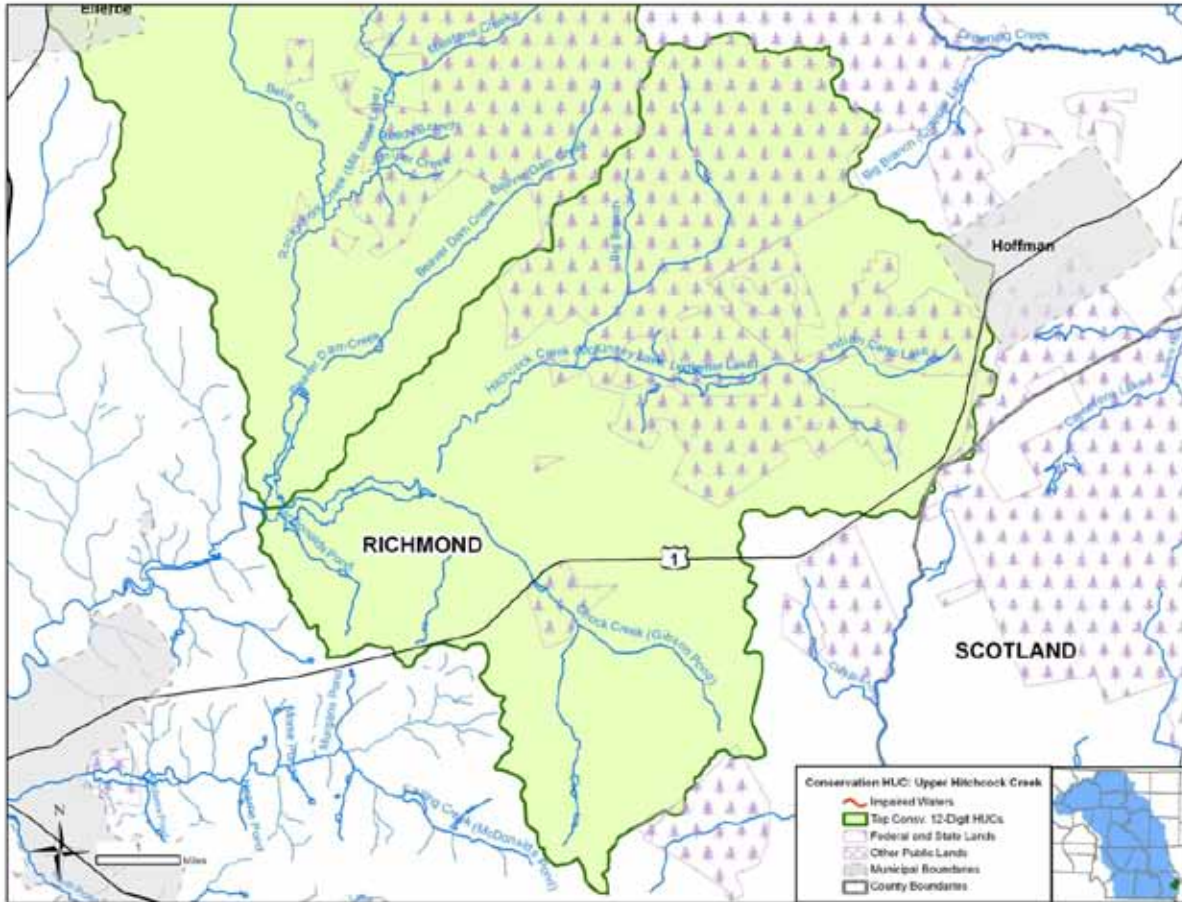
The Little River Watershed is 31 square miles in size and features the ecologically-valuable Little River, a direct tributary to the Pee Dee River in Richmond County. There is little development, and all of it concentrated in Mt. Gilead in the headwaters. Unusual for Montgomery County, the Uwharrie National Forest does not have any land in this watershed, though 21 square miles are forested. Another 15 square miles are dedicated to agriculture. Runoff from agricultural and forestry operations could have an impact to these waters.

A WS-IV classification of the most downstream area of the Little River watershed protects Blewett Falls Lake from the impacts of development. Richmond County has employed a conservation overlay on the Lower Little River corridor to protect the ecological health in the River. It is highly recommended that Montgomery County extend this overlay district within their boundary.

Three state routes that cross this watershed, all meeting in Mt. Gilead. This is the entirety of development within the Little River Watershed, but development centered around these corridors could be disastrous for ecological and aquatic health if not carefully shepherded. Mt. Gilead lies in the headwaters of this watershed, which is hydrologically the most sensitive area of a watershed. The pristine nature of this watershed must be maintained, so that its rural nature and recreational appeal are preserved for residents and visitors. It is recommended that an open space planning and management program be created to identify and protect natural resources valuable to the County's economy. An Open Space Management program in this watershed could coordinate efforts with the Uwharrie National Forest and LTCNC to ensure that rural lands and natural resources are protected and sustainably managed.

Currently, there are no policies that actively engage these concepts or goals. The WRC has spear-headed efforts in the region through the creation of the Greater Uwharries Conservation Partnership (GUCP), which has invested in innovative GIS-based approaches to prioritizing and protecting these areas and created interjurisdictional recognition of the environmental assets in this region. It could benefit watershed stakeholders to coordinate their policies regarding surrounding environmental attributes through a formal partnership amongst the GUCP, Montgomery County, and the County's Soil and Water Conservation District and Cooperative Extension offices that reflect these needs. This could lead to a dialogue on the watershed development in general, and *how* stakeholders may want to develop. With so much open space and environmental assets, maintaining growth in current economic centers will minimize infrastructure costs and environmental impact at maximum economic benefit.

## 14) Upper Hitchcock Creek Watershed



Upper Hitchcock Creek Watershed	
Conservation Rank	14
Size (Sq Mi)	44.24
Municipal Area (Sq Mi)	0.27
County Area (Sq Mi)	43.97
Impaired Waters (Miles)	N/A

Upper Hitchcock Creek Land Use	
Developed	1.47%
Open Space	8.10%
Forest	49.09%
Grassland/Herbaceous	20.56%
Barren Land	0.71%
Pasture/Hay	2.51%
Cultivated Crops	6.12%
Wetlands	10.26%
Open Water	1.18%

## Upper Hitchcock Creek Watershed Threats to Water Quality

- livestock access to streams
- sedimentation - from cropland and development activities
- streambank erosion
- loss of farmland and forestland

The Upper Hitchcock Creek Watershed occupies 44 square miles in eastern Richmond County. There are no impaired streams in this watershed. Several stream corridors, watersheds, and ecosystems in Richmond County were identified by the North Carolina Natural Heritage Program as state-significant.

Along with other creeks in the area, Hitchcock Creek drains the western section of the Sand Hills Game Land (SGL) in Richmond County. SGL is composed of large areas mostly in Richmond and Scotland Counties. SGL contains an ecosystem that is nearly intact, supports a high diversity of flora and fauna, and provides a population pool for longleaf pine. The N.C. Wildlife Commission manages the SGL for public use. The game land is open for hunting, hiking, horseback riding, and nature study. The Department of Defense also uses the game land for training exercises.

The majority of this watershed is governed by the policies of Richmond County. A small portion of the western side of the watershed is within the boundaries of the Town of Hoffman. The watershed is sparsely populated and characterized by large tracts of forest and agricultural land. In 2001, Richmond County amended their ordinance to include a WS-III water supply watershed overlay district. The purpose of this overlay district is to protect the drinking water supply of the County and its municipal jurisdictions from runoff contamination from large-scale development. There are two parts to a Water Supply Watershed; the Critical Area; and the Balance of the Watershed. Criteria for development in both these areas of the Watershed have been mandated by the N.C. General Assembly and incorporated in to this Ordinance. Special provisions are provided for more intensive use of land by way of cluster development and buffer areas. Proper land development techniques will be the key to the utilization of land area, which falls under this district.

Existing conservation and restoration efforts can be utilized in the watershed. The predominant land conservancy in the region is the Land Trust of Central North Carolina. The land trust works with landowners and public partners to protect open space, important natural areas, significant habitats, forests, and farmland in a five-county region.

## 15) Laytown Creek - Yadkin River Watershed



Laytown Creek-Yadkin River	
Conservation Rank	15
Size (Sq Mi)	22.38
Municipal Area (Sq Mi)	0.00
County Area (Sq Mi)	22.38
Impaired Water (Miles)	0.01

Laytown Creek-Yadkin River Land Use	
Developed	0.13%
Open Space	3.04%
Forest	77.02%
Grassland/Herbaceous	3.98%
Barren Land	0.09%
Pasture/Hay	14.17%
Cultivated Crops	1.13%
Wetlands	0.43%
Open Water	0.01%



### Laytown Creek - Yadkin River Watershed Water Quality Concerns:

- livestock access to streams
- sedimentation - from cropland and development activities
- streambank erosion
- loss of farmland and forestland

The Laytown Creek - Yadkin River watershed covers 22 square miles in northeastern Caldwell County. The watershed is relatively undeveloped, with good water quality. The major streams and the portion of the Yadkin River in the watershed are classified C, with supplemental Trout Waters (Tr) classification. No streams in the watershed have High Quality Waters (HQW) or Outstanding Resource Waters (ORW) classifications. No streams in the watershed are impaired or impacted.

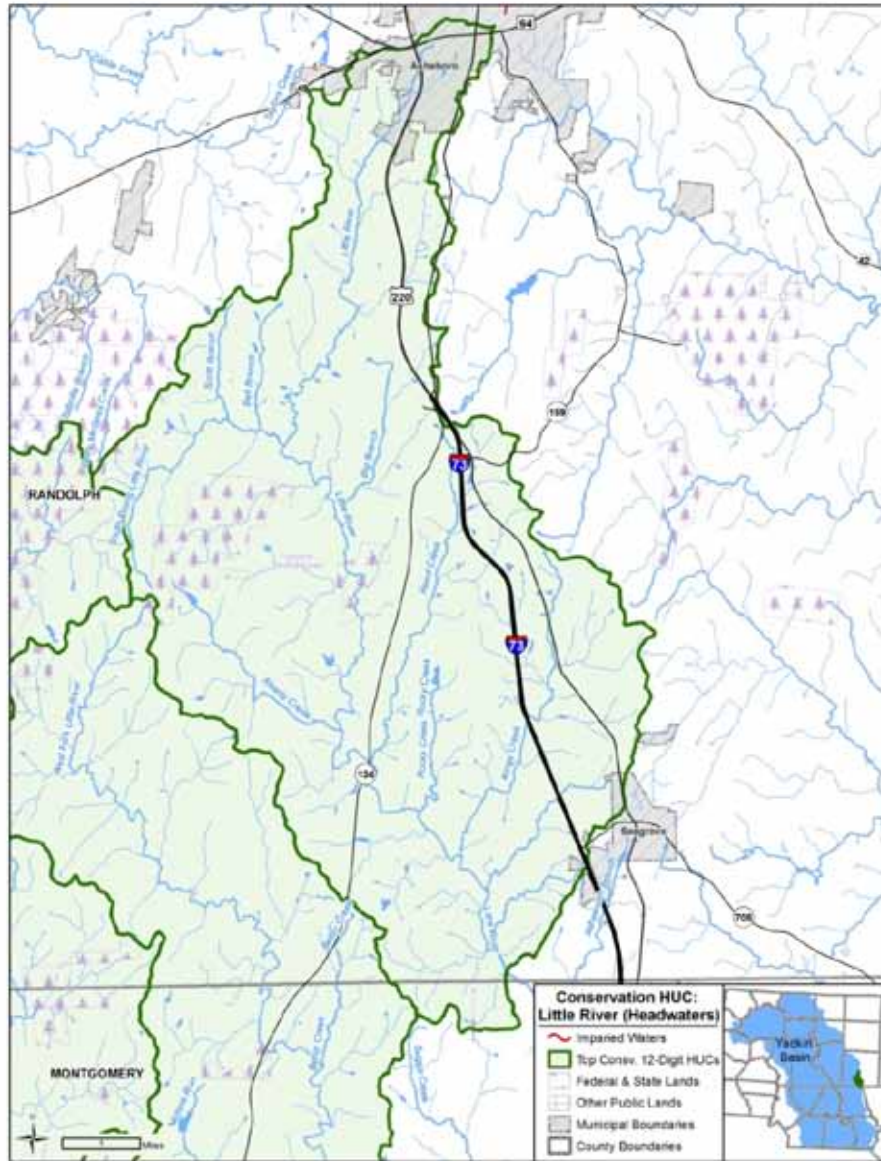
Land use in the area is 77% forested and 14% pasture. Three square miles, or 15% of the watershed, is public lands. There is no water supply watershed area in the Laytown Creek - Yadkin River watershed. Based on NC Natural Heritage Program data, the watershed contains a total of five square miles of Significant Natural Heritage Areas, and 10 Natural Heritage Element Occurrences.

Existing conservation and restoration efforts can be utilized in the watershed. The predominant land conservancy in the region is the Foothills Conservancy. Foothills Conservancy works with landowners and public partners to protect open space, important natural areas, significant habitats, forests, and farmland in an eight-county region. The USDA Natural Resource Conservation Service provides technical and financial assistance to install best management practices (BMPs) on private lands. The NC Division of Soil and Water Conservation administers the NC Agriculture Cost Share Program, which provides 75% of the cost of installing BMPs that address agricultural non-point source pollution.

Regulatory water quality protection measures existing in the watershed consist of the 25-foot undisturbed buffer requirement along streams classified as Trout Waters.

The Laytown Creek - Yadkin River watershed can benefit from site-specific agricultural/forestry BMP and stream restoration projects. Additionally, land conservation efforts should focus on working farms and lands adjacent to existing public lands in the northern portion of the watershed.

## 16) Little River Headwaters Watershed



Headwaters - Little River Watershed	
Conservation Rank	16
Size (Sq Mi)	45.70
Municipal Area (Sq Mi)	1.67
County Area (Sq Mi)	44.03
Impaired Waters (Miles)	N/A

Headwaters - Little River Land Use	
Developed	3.82%
Open Space	6.54%
Forest	63.53%
Grassland/Herbaceous	5.81%
Barren Land	0.04%
Pasture/Hay	18.66%
Cultivated Crops	0.65%
Wetlands	0.74%
Open Water	0.22%

## Little River Headwaters Watershed Water Quality Concerns:

- Stormwater runoff from sprawl development in Asheboro
- Stormwater, industrial spills and contamination from NC-49 & I-73/74 traffic
- Inconsistent ordinances to recognize and protect valuable ecological and water quality resources
- Loss of open space from sprawl around Asheboro
- Need for an environmentally-sustainable Uwharrie National Forest management plan

The 46-sq. mi. Little River Headwaters Watershed is a headwater of the Yadkin River, and, specifically, the Little River, which does not reach the larger river basin until it has turned into the Pee Dee River in Richmond County. The Little River originates in the City of Asheboro and flows through Randolph and Montgomery Counties largely undisturbed, and is currently known to be supportive of indigenous ecology, including the nationally-significant Black Ankle Bog and the federally-endangered Schweinitz's sunflower. It is important to ensure that this situation persists.

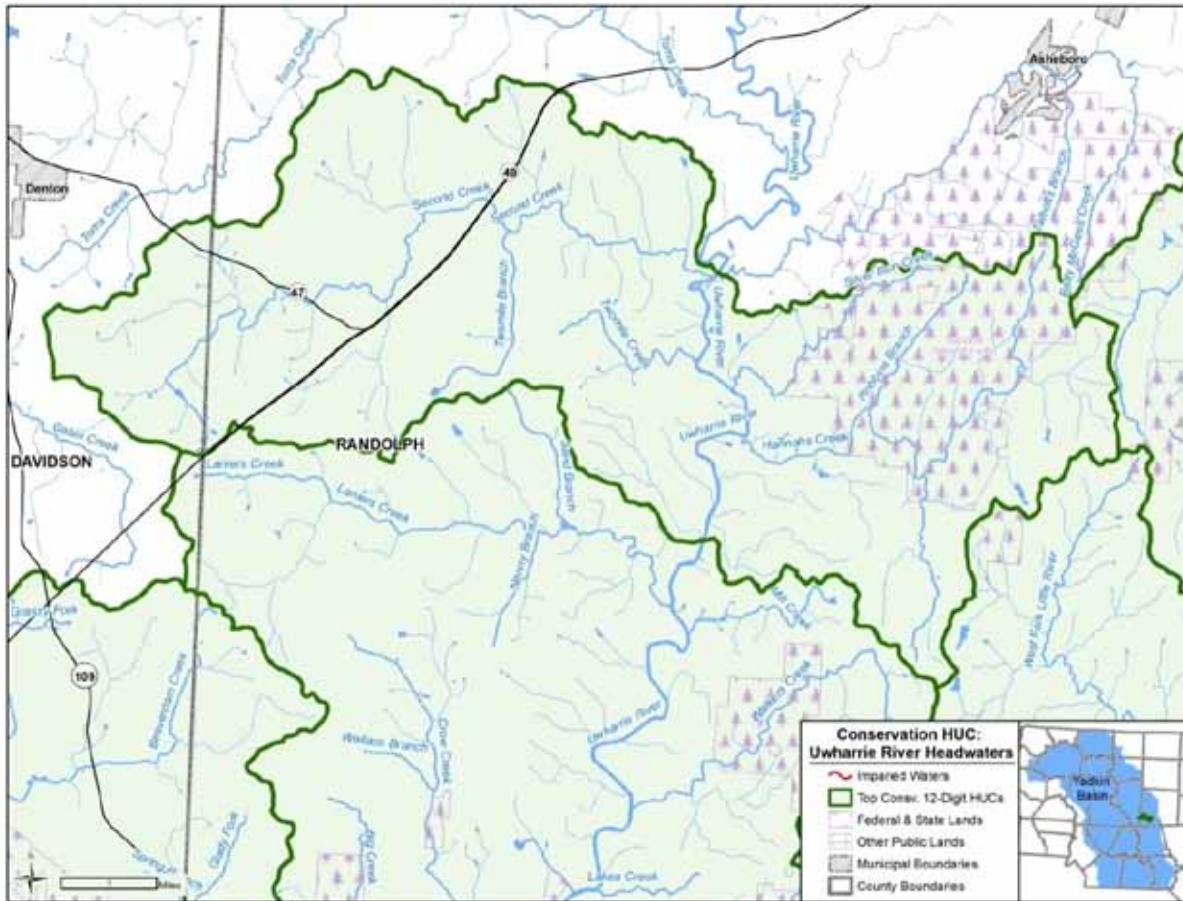
Randolph County offers a number of land use protections for this watershed, which is found in an area covered by multiple land use zones specifying certain types of development. The bulk of this area lies in Rural Growth Areas (RGAs), where prohibitions on development on steep slopes, within the 100-year floodplain, and other environmentally-sensitive areas exist. RGAs also require ground and surface water protections through mandatory riparian buffers.

The rural nature of the County is a key reason for the Little River Headwaters Watershed's pristine conditions. Perhaps the greatest water quality benefit is the presence of the Uwharrie National Forest, which occupies almost all of this watershed. Any timber harvesting that occurs here must employ FPGs mandated by NC DFR, and which, due to it being a National Forest, are strictly enforced. The Uwharrie National Forest is in the midst of receiving a new draft management plan, and it is important to include environmental considerations in it.

The Little River's origins are in Asheboro, which does not guarantee the water quality protections Randolph County does. The Little River is extremely vulnerable to development impacts, lying at the intersection of two major transit thoroughfares in Randolph County, I-73/US 220 and NC 49. The Asheboro Development Ordinance needs to be amended to include Low Impact Development and/or Smart Growth requirements for this watershed.

As the headwaters of such a significant tributary to the larger river basin, it is necessary to ensure that the Little River Headwaters are protected as vital resources. The WRC has spear-headed efforts in the region through the creation of the Greater Uwharries Conservation Partnership, which has invested in innovative GIS-based approaches to prioritizing and protecting these areas and created interjurisdictional recognition of the environmental assets in this region. Their efforts need to be capitalized upon with a concrete partnership that leads to uniform policies to protect natural resources of the region. This could lead to a dialogue on the watershed development in general, and *how* stakeholders may want to develop. With so much open space and environmental assets, maintaining growth in current economic centers will minimize infrastructure costs and environmental impact at maximum economic benefit.

## 17) Uwharrie River Headwaters Watershed



Uwharrie River Headwaters Watershed	
Conservation Rank	17
Size (Sq Mi)	32.90
Municipal Area (Sq Mi)	N/A
County Area (Sq Mi)	32.90
Impaired Waters (Miles)	N/A

Uwharrie River Headwaters Land Use	
Developed	0.33%
Open Space	2.00%
Forest	65.05%
Grassland/Herbaceous	6.56%
Barren Land	0.08%
Pasture/Hay	23.93%
Cultivated Crops	0.76%
Wetlands	1.14%
Open Water	0.16%

### Uwharrie River Headwaters Watershed Water Quality Concerns:

- Stormwater, industrial spills and contamination from NC-49 & NC-47 traffic
- Inconsistent ordinances to recognize and protect valuable ecological and water quality resources
- Impacts from Uwharrie National Forest timber operations
- Loss of open space from sprawl around Asheboro
- Need for an environmentally-sustainable Uwharrie National Forest management plan

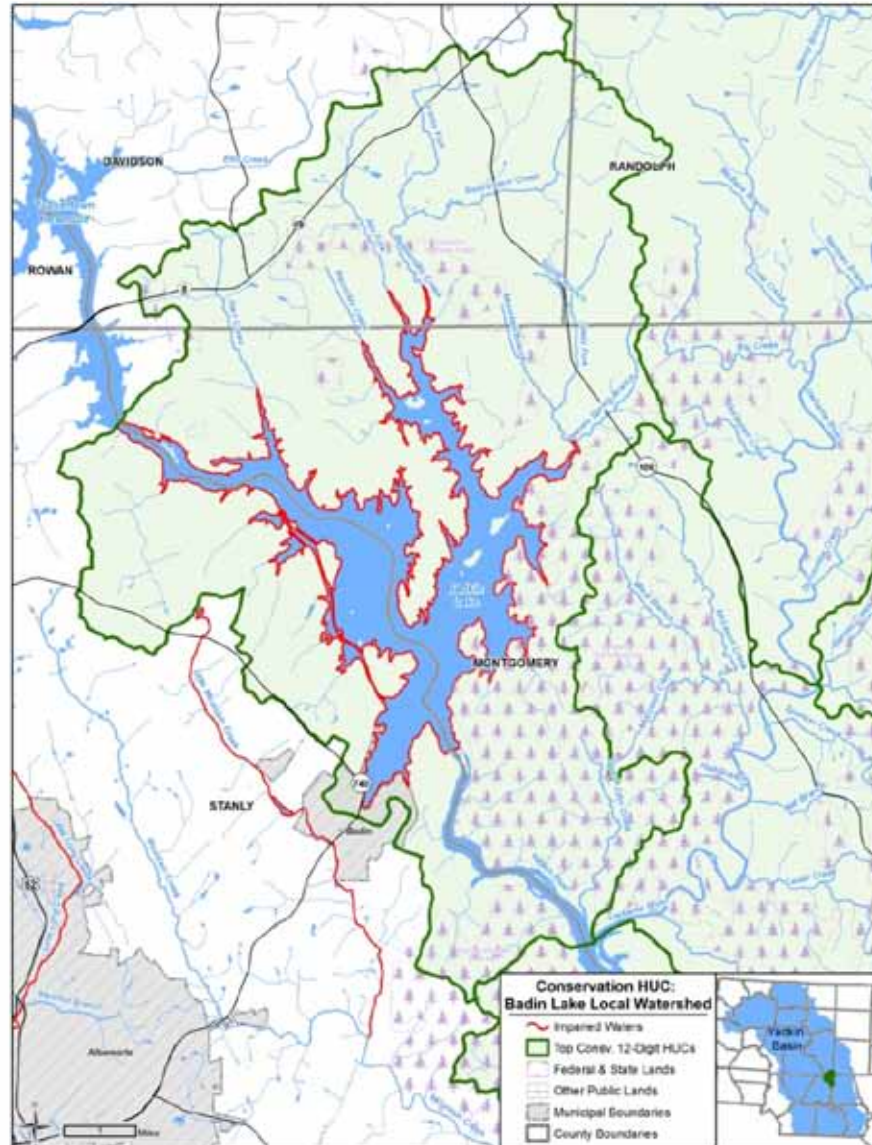
This 33 sq. mi. watershed encompasses the Second Creek and Hannah's Creek subwatersheds, collectively the Uwharrie River headwaters. While this is not an ecologically-sensitive area, it is crucial for supporting endangered freshwater mollusks downstream. Local agriculture could be devastating to aquatic life if not carefully managed. Randolph County has a number of watershed ordinances to protect water quality from development and agricultural impacts. Further, this particular watershed lies in a Rural Growth Area (RGA) and the Uwharrie River Natural Heritage Corridor to minimize development impacts to the environment and maximize scenic and riparian buffers to protect both ecologically-sensitive and rural heritage areas.

Montgomery County is an area of high ecological richness. It has 66 nationally-significant ecological habitats, and four endangered species. One of these nationally-significant habitats, the Birkhead Mountain Wilderness area, is found in the Uwharrie River Headwaters Watershed, which is also home to the state-significant South Fork Second Creek and Uwharrie River Aquatic Habitats. The Birkhead Mountain Wilderness is managed by the Uwharrie National Forest, but there is a Small Area Plan (SAP) surrounding the Wilderness administered by Randolph County.

A small part of the watershed exists in Davidson County, and is therefore less protected. This location has low development potential and watershed degradation is unlikely, though possible. The pristine nature of this watershed must be maintained, so that its rural nature and recreational appeal are preserved for residents and visitors. It is recommended that an open space planning and management program be created to identify and protect natural resources valuable to the regional economy. An Open Space Management program in this watershed could coordinate efforts with the Uwharrie National Forest and LTCNC to ensure that rural lands and natural resources are protected and sustainably managed.

Currently, there are no policies that actively engage these concepts or goals. The WRC has spear-headed efforts in the region through the creation of the Greater Uwharries Conservation Partnership (GUCP), which has invested in innovative GIS-based approaches to prioritizing and protecting these areas and created interjurisdictional recognition of the environmental assets in this region. It could benefit watershed stakeholders to coordinate their policies regarding surrounding environmental attributes through a formal partnership amongst the GUCP, Davidson County, and the County's Soil and Water Conservation District and Cooperative Extension offices that reflect these needs. This will also lead to a dialogue on the watershed development in general, and *how* stakeholders may want to develop. With so much open space and environmental assets, maintaining growth in current economic centers will minimize infrastructure costs and environmental impact at maximum economic benefit.

## 18) Badin Lake Local Watershed



Badin Lake Local Watershed	
Conservation Rank	18
Size (Sq Mi)	66.22
Municipal Area (Sq Mi)	0.62
County Area (Sq Mi)	65.60
Impaired Waters (Sq Miles)	8.89

Badin Lake Local Watershed Land Use	
Developed	0.61%
Open Space	4.54%
Forest	67.55%
Grassland/Herbaceous	5.65%
Barren Land	0.19%
Pasture/Hay	6.80%
Cultivated Crops	0.16%
Wetlands	0.16%
Open Water	14.35%

### Badin Lake Local Watershed Water Quality Concerns:

- PCB contamination of Lake sediment and ecology
- Impacts from Uwharrie National Forest timber operations and agriculture
- Recreation impacts to habitats and stream stability
- Inconsistent ordinances to recognize and protect valuable ecological and water quality resources
- Need for an environmentally-sustainable Uwharrie National Forest management plan
- Need for an environmentally-sustainable Badin Lake recreation plan

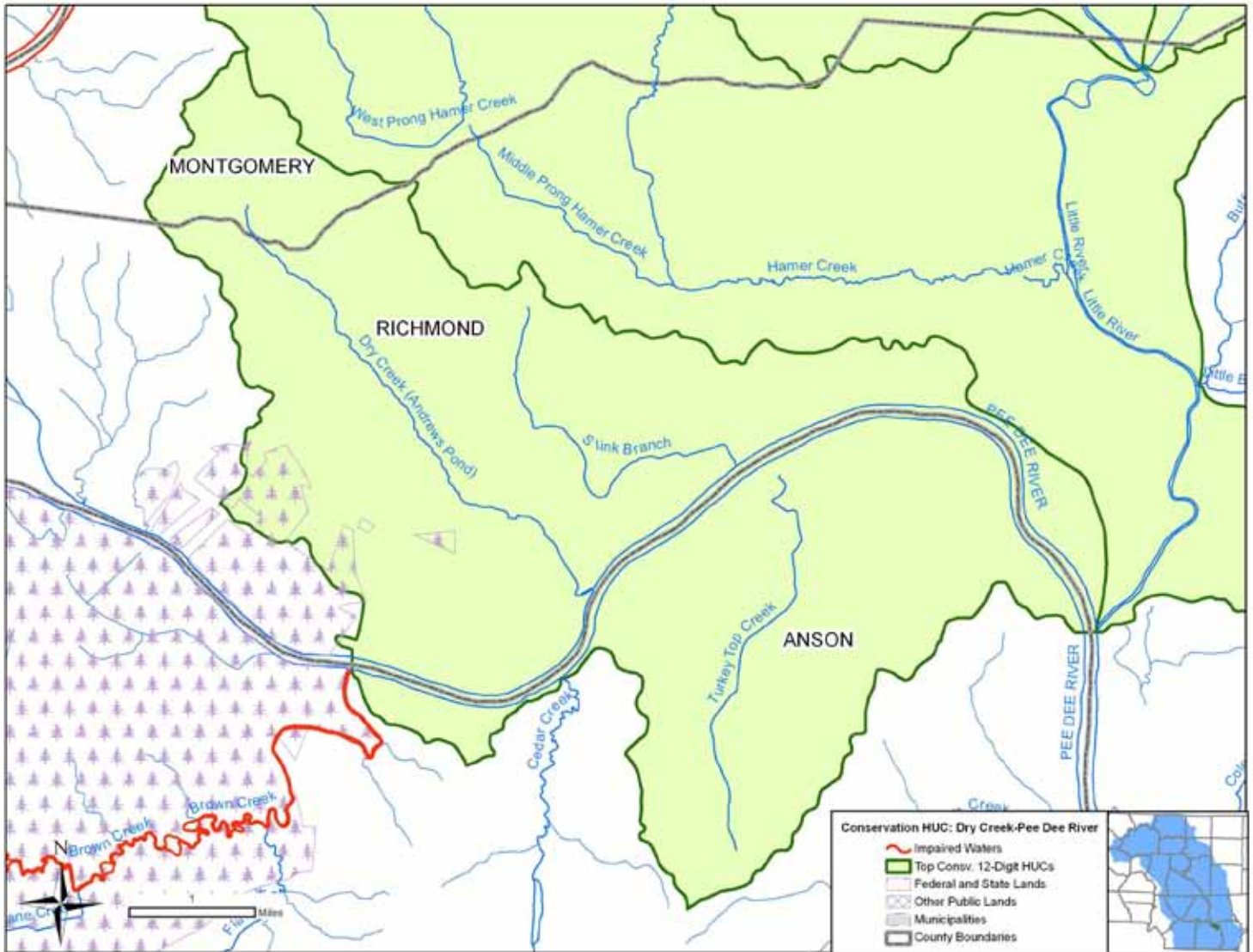
The 66-sq. mi Badin Lake Local Watershed offers a unique water quality management scenario. Badin Lake is impaired for fish consumption due to PCB contamination of its sediment. This is an historical impact from the aluminum smelting operation run by ALCOA that has permanently polluted the Lake's ecology. Though PCBs do naturally degrade in the environment, the time it will take to rehabilitate the Lake and ensure that PCBs are no longer bioaccumulating in fish is unknown. It is also unknown if a dredging operation will effectively remove these contaminants.

Montgomery County is an area of high ecological richness. It has 66 nationally-significant ecological habitats, and four endangered species. Six of these nationally-significant habitats are found in the Badin Lake Watershed: Biles Mountain Natural Area, Morrow Mountain Natural Area, Badin Upland Depression Swamps and Xeric Woodland, the Yadkin River scour banks, and the Uwharrie River aquatic habitat. This watershed is 4 state-significant species, including the Schweinitz's Sunflower.

The Lake is a source of economic revenue that needs to be maintained in good health – it is currently only impaired for PCBs. 4 square miles of the Badin Lake watershed have been developed, and this seems largely focused on the Town of Badin. Montgomery County land use offers few watershed protections. The relatively pristine nature of this watershed must be maintained, so that its rural nature and recreational appeal are preserved for residents and visitors. It is recommended that Montgomery County create an open space planning and management program to identify and protect natural resources valuable to the County's economy.

The Badin Lake Local Watershed is a valuable area to local communities and the entire Yadkin-Pee Dee River Basin. It is necessary to ensure that Badin Lake is protected as an ecological and economic resource. The WRC has spear-headed efforts in the region through the creation of the Greater Uwharries Conservation Partnership (GUCP), which has invested in innovative GIS-based approaches to prioritizing and protecting these areas and created interjurisdictional recognition of the environmental assets in this region. It could benefit watershed stakeholders to coordinate policies regarding surrounding environmental attributes through a formal partnership amongst the GUCP, Montgomery County, Stanly County, and the County's Soil and Water Conservation District and Cooperative Extension offices that reflect these needs. This could lead to a dialogue on the Badin Lake regional development, and *how* it may want to develop. With so much open space and environmental assets, maintaining growth in current economic centers will minimize infrastructure costs and environmental impact at maximum economic benefit.

## 19) Dry Creek – Pee Dee River Watershed



Dry Creek-Pee Dee River Watershed	
Conservation Rank	19
Size (Sq Mi)	22.33
Municipal Area (Sq Mi)	N/A
County Area (Sq Mi)	22.33
Impaired Waters (Miles)	N/A

Dry Creek-Pee Dee River Land Use	
Developed	0.05%
Open Space	3.51%
Forest	50.94%
Grassland/Herbaceous	11.69%
Barren Land	0.47%
Pasture/Hay	20.45%
Cultivated Crops	4.57%
Wetlands	4.35%
Open Water	3.98%



## Dry Creek-Pee Dee River Threats to Water Quality

- Sedimentation from logging, cropland and development activities
- Nutrients from logging and agriculture
- Lack of zoning in Montgomery and Anson Counties

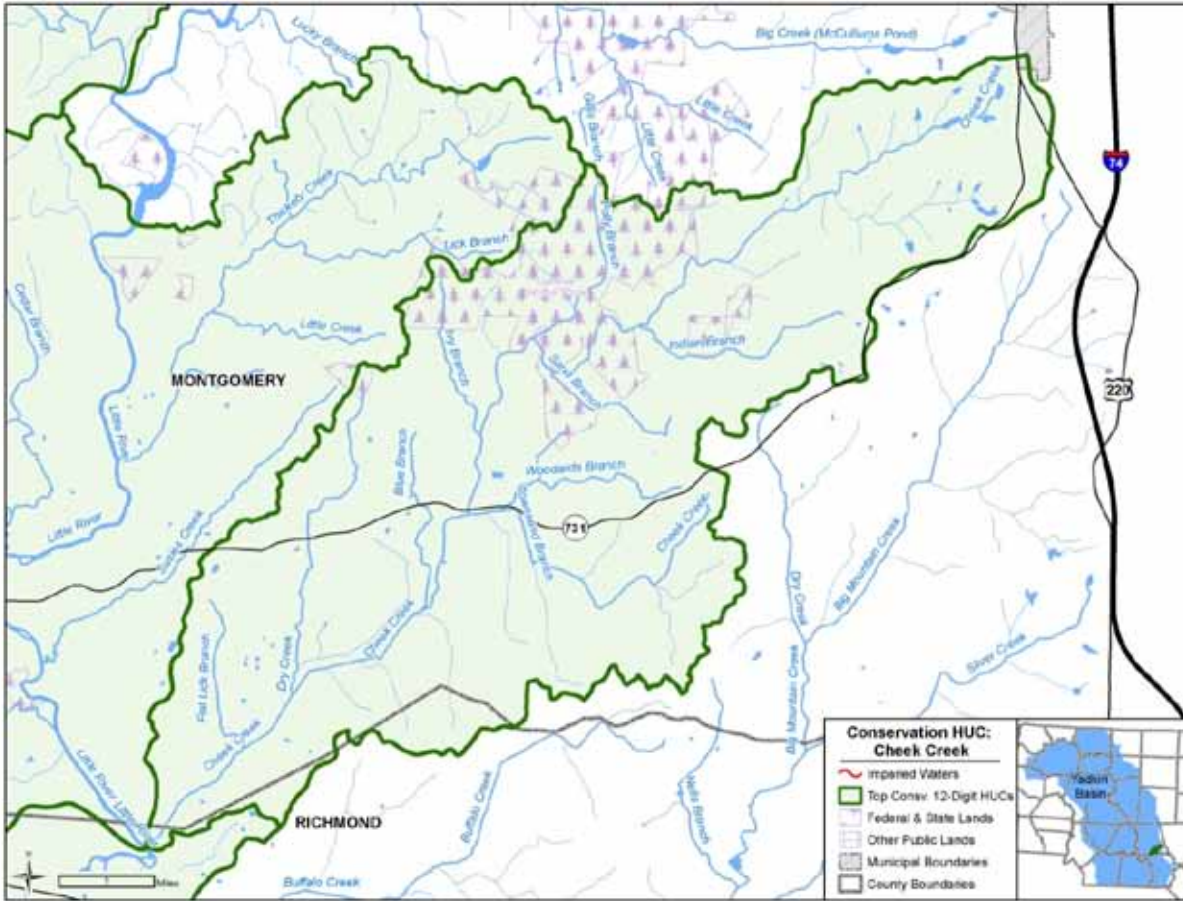
The Dry Creek-Pee Dee River Watershed occupies 22 square miles, primarily in Anson and Richmond Counties, with a small portion in Montgomery County. There are no impaired streams in this watershed.

Well under 1% of the land in the watershed is developed. More than half is forest. The watershed is governed by the policies of Richmond, Anson and Montgomery Counties. There are no municipalities within the watershed. Neither Montgomery nor Anson County currently has traditional zoning in the watershed. However, Anson County does have a water supply watershed overlay district in effect (see below) and is currently working on a plan for zoning the entire county. The portion of the watershed in Richmond County is zoned AR (Agricultural Residential). This district was established primarily for rural, agricultural and sparsely spaced residential development. It is characterized by lack of public utilities and distance to the main arterial roads of Richmond County.

Approximately one-third of the watershed is classified as WS-IV water supply watershed. In April 1997, Anson County amended their ordinance to include a water supply watershed overlay district. The purpose of this overlay district is to protect the drinking water supply of the County and its municipal jurisdictions from runoff contamination from large-scale development. There are two parts to a Water Supply Watershed; the Critical Area; and the Balance of the Watershed. Criteria for development in both these areas of the Watershed have been mandated by the N.C. General Assembly and incorporated in to this Ordinance. Special provisions are provided for more intensive use of land by way of cluster development and buffer areas. Proper land development techniques will be the key to the utilization of land area, which falls under this district.

The watershed also contains a small portion of the Pee Dee National Wildlife Refuge. The refuge lands are comprised of 3,000 acres of bottomland hardwoods, 1,200 acres of upland pine forest; and 4,300 acres of croplands, old fields, moist soil units and mixed pine hardwoods. It is also home to 180 bird, 49 amphibian and reptile, 28 mammal, and 20 fish species.

## 20) Cheek Creek Watershed



Cheek Creek Watershed	
Conservation Rank	20
Size (Sq Mi)	32.37
Municipal Area (Sq Mi)	0.02
County Area (Sq Mi)	32.35
Impaired Waters (Miles)	N/A

Cheek Creek Land Use	
Developed	0.07%
Open Space	2.47%
Forest	75.31%
Grassland/Herbaceous	12.02%
Barren Land	0.35%
Pasture/Hay	4.70%
Cultivated Crops	3.02%
Wetlands	1.92%
Open Water	0.14%

### Cheek Creek Watershed Water Quality Concerns:

- No environmental considerations in planning and development documents
- Sedimentation from logging and cropland, and development activities
- Streambank erosion

The 32-sq. mi. Cheek Creek Watershed is similar to many Montgomery County priority conservation watersheds: almost completely undeveloped, largely protected by National Forest lands, and with one state route crossing through its boundaries. This rural watershed has no watershed protections for its Class C waters. Much of eastern Montgomery County is not within a water supply watershed, and the County has not taken steps to ensure the sustainable protection and management of its waters or lands. 5% of its area is used for agriculture.

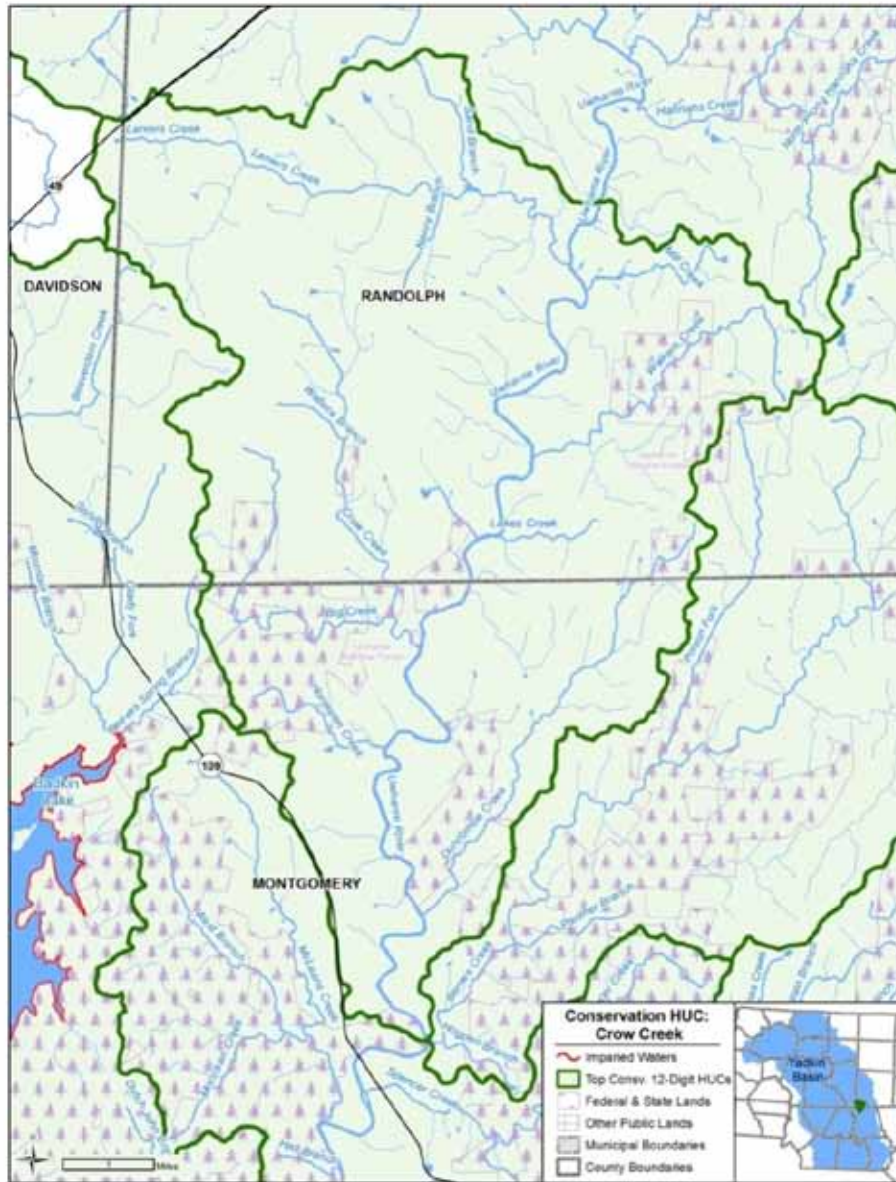
Montgomery County is an area of high ecological richness. It has 66 nationally-significant ecological habitats, and four endangered species. The Cheek Creek watershed hosts the even more rare and globally-significant Ravine Sedge. While NEPA requirements will protect the habitat of this federally-endangered species, more ecological treasures may be available to the residents and visitors of this watershed and Montgomery County.

The largely rural nature of the County is a large reason for the pristine conditions in the Cheek Creek Watershed. Given the watershed's distance from any other towns or cities, it seems unlikely that development will occur here. There are no significant development nodes in this watershed. I-74 does pass just outside the watershed boundary, which could make this an area of commercial development that could threaten ecological habitats, but this is not a present concern.

Montgomery County land use offers few watershed protections. The pristine nature of this watershed must be maintained, so that its rural nature and recreational appeal are preserved for residents and visitors. It is recommended that Montgomery County create an open space planning and management program to identify and protect natural resources valuable to the County's economy. An Open Space Management program in this watershed could coordinate efforts with the Uwharrie National Forest and LTCNC to ensure that rural lands and natural resources are protected and sustainably managed.

Currently, there are no policies that actively engage these concepts or goals. The WRC has spear-headed efforts in the region through the creation of the Greater Uwharries Conservation Partnership (GUCP), which has invested in innovative GIS-based approaches to prioritizing and protecting these areas and created interjurisdictional recognition of the environmental assets in this region. It could benefit watershed stakeholders to coordinate their policies regarding surrounding environmental attributes through a formal partnership amongst the GUCP, Montgomery County, and the County's Soil and Water Conservation District and Cooperative Extension offices that reflect these needs. This will also lead to a dialogue on the development of Montgomery County in general, and *how* it may want to develop. With so much open space and environmental assets, maintaining growth in current economic centers will minimize infrastructure costs and environmental impact at maximum economic benefit.

## 21) Crow Creek Watershed



Crow Creek Watershed	
Conservation Rank	21
Size (Sq Mi)	45.23
Municipal Area (Sq Mi)	N/A
County Area (Sq Mi)	45.23
Impaired Waters (Miles)	N/A

Crow Creek Land Use	
Developed	0.13%
Open Space	2.17%
Forest	68.27%
Grassland/Herbaceous	8.46%
Barren Land	0.09%
Pasture/Hay	19.56%
Cultivated Crops	0.70%
Wetlands	0.54%
Open Water	0.08%

### Crow Creek Watershed Water Quality Concerns:

- Inconsistent ordinances to recognize and protect valuable ecological and water quality resources
- Impacts from agricultural operations
- Impacts from Uwharrie National Forest timber operations
- Need for an environmentally-sustainable Uwharrie National Forest management plan

The 45-sq. mi. Crow Creek watershed's fate is directly dependent upon the new management strategy for the lands, waters, and resources of the Uwharrie National Forest. Given that 20% of the land area in the watershed is included within the Forest's boundaries, and that many of these areas are in the headwaters for this watershed, Forest policies are perhaps the most influential to the fate of water quality here. Should the USFS determine that natural resources protection – particularly water – a management priority, then Crow Creek (and Badin Lake downstream) will be securely and sustainably managed for the future. However, if the management plan focuses on resources from a harvesting and extraction perspective, then water quality in this conservation priority is a concern, even if Forestry Practice Guidelines are used. Commenting and collaboration among the USFS, LTCNC, Randolph County, Montgomery County, and ALCOA (which has a vested interest in the water quality of Badin Lake) can only ensure that the long-term watershed needs of Crow Creek are met.

The Randolph County headwaters are currently protected as a Rural Growth Area, where high-intensity development is prohibited. Furthermore, Randolph County requires scenic and riparian buffers within RGAs to preserve its natural and cultural heritages. The downstream area of Crow Creek where it flows into the Uwharrie River are almost entirely within National Forest lands. This is a great motivator for Montgomery County to become involved in the drafted Uwharrie National Forest management plan; any changes in land use there will have a direct impact on downstream in Montgomery County. This is even more pressing given that two state-endangered species – the Atlantic pigtoe and Agoyan Cataract moss – are found in the Uwharrie River just within Montgomery County. It is recommended that Montgomery County create an open space planning and management program to identify and protect natural resources valuable to the County's economy. An Open Space Management program in this watershed could coordinate efforts with the Uwharrie National Forest and LTCNC to ensure that rural lands and natural resources are protected and sustainably managed.

Currently, there are no policies that actively engage these concepts or goals. The WRC has spear-headed efforts in the region through the creation of the Greater Uwharries Conservation Partnership (GUCP), which has invested in innovative GIS-based approaches to prioritizing and protecting these areas and created interjurisdictional recognition of the environmental assets in this region. It could benefit watershed stakeholders to coordinate their policies regarding surrounding environmental attributes through a formal partnership amongst the GUCP, Montgomery County, and the County's Soil and Water Conservation District and Cooperative Extension offices that reflect these needs. This will also lead to a dialogue on the development of Montgomery County in general, and *how* it may want to develop. With so much open space and environmental assets, maintaining growth in current economic centers will minimize infrastructure costs and environmental impact at maximum economic benefit.



### Upper Mitchell River Watershed Water Quality Concerns:

- Sedimentation from logging, cropland, and development activities
- Streambank erosion
- Loss of farmland and forestland

The Upper Mitchell River watershed covers 29.27 square miles in western Surry County and eastern Alleghany County. The watershed is virtually undeveloped, with good water quality. There are 10.5 miles worth of High Quality Streams and Trout Designated Streams. No streams in the watershed are impaired or impacted.

Land use in the area is 93 % forested and only 0.13% developed. 2.68 square miles, or 9.15% of the watershed, is public lands. There is no water supply watershed area in the Upper Mitchell River Watershed. Based on NC Natural Heritage Program data, the watershed contains a total of 10.8 square miles of Significant Natural Heritage Areas or 36.9% of the watershed.

The Mitchell River could be used as a good resource on how to educate and work with existing land owners in keeping a valuable resource clean for the next generation. Land owners have provided easements along the Mitchell River to provide trout fishing throughout the 10.5 miles of trout waters in this area. This is an economic benefit to an area that receives very little tourism otherwise. And can help bring economic oriented politicians together with environmental groups. As part of the easement, the Mitchell River Coalition helps keep the green space up around the Mitchell River and works at keeping the river clean through testing, litter pick-up, & planting of grass, and other forms of stopping erosion.

The Mitchell River Coalition is a public-private partnership can be used as a model in how to keep rivers clean and useable for today and tomorrow. It consists of land owners adjacent to the Mitchell River, Surry Soil and Water Conservation District, Natural Resource Conservation Service, Pilot View RC & D, North Carolina Cooperative Extension, & Piedmont Land Conservancy. Many private organizations have also provided funding for these project including Basic Creek Realty and Duke Power.

### 23) Clark's Creek Watershed



Clark's Creek Watershed	
Conservation Rank	23
Size (Sq Mi)	33.18
Municipal Area (Sq Mi)	1.79
County Area (Sq Mi)	31.39
Impaired Waters (Miles)	<0.01%

Clark's Creek Land Use	
Developed	0.45%
Open Space	5.33%
Forest	71.64%
Grassland/Herbaceous	10.03%
Barren Land	0.38%
Pasture/Hay	10.93%
Cultivated Crops	0.54%
Wetlands	0.51%
Open Water	0.18%



### Clark's Creek Watershed Water Quality Concerns:

- Inconsistent ordinances to recognize and protect valuable ecological and water quality resources
- Sedimentation from logging, cropland, and development activities
- Streambank erosion
- Loss of open space and forested lands to development

The 33-sq. mi. Clark's Creek watershed lies in western Montgomery County, draining to the Yadkin River just downstream of the Lake Tillery impoundment. It is almost entirely undeveloped, though residential growth in Mt. Gilead is evident in the downstream area of the watershed. With only a small area occupied by the Uwharrie National Forest, it can be estimated that the 24 acres of forestland and 4 acres of cultivated lands are managed for agricultural purposes, with periodic timber harvesting and annual crop management.

This rural watershed has no watershed protections for its Class C waters. It shares a boundary with a WS-IV water supply watershed for Lake Tillery, but is not included within that watershed. Montgomery County has few watershed or land use regulations to protect water quality. This is significant not only to preserve the good quality streams and creeks within the Clark's Creek watershed, but also to protect the nationally-significant ecological areas that include two longleaf pine stands and an extremely rare upland pool in the Sandhills region. Currently, they have been identified as the Roberdo Bog and the Longleaf Pine Forest, but more ecological treasures may be available to the residents and visitors of this watershed and Montgomery County.

The largely rural nature of the County is a large reason for the pristine conditions in the Clark's Creek Watershed. Given the watershed's distance from any other towns or cities, it seems unlikely that development will occur here. There are no significant development nodes or transit arteries in this watershed. The pristine nature of this watershed must be maintained, so that its rural nature and recreational appeal are preserved for residents and visitors. It is recommended that Montgomery County create an open space planning and management program to identify and protect natural resources valuable to the County's economy. An Open Space Management program in this watershed could coordinate efforts with the Uwharrie National Forest and LTCNC to ensure that rural lands and natural resources are protected and sustainably managed.

Currently, there are no policies that actively engage these concepts or goals. The WRC has spear-headed efforts in the region through the creation of the Greater Uwharries Conservation Partnership (GUCP), which has invested in innovative GIS-based approaches to prioritizing and protecting these areas and created interjurisdictional recognition of the environmental assets in this region. It could benefit watershed stakeholders to coordinate their policies regarding surrounding environmental attributes through a formal partnership amongst the GUCP, Montgomery County, and the County's Soil and Water Conservation District and Cooperative Extension offices that reflect these needs. This will also lead to a dialogue on the development of Montgomery County in general, and *how* it may want to develop. With so much open space and environmental assets, maintaining growth in current economic centers will minimize infrastructure costs and environmental impact at maximum economic benefit.

## Summary

The *Yadkin-Pee Dee River Basin Priority Watershed Atlas* clearly shows the need for better support of local and regional government initiatives to protect and restore watersheds. While some communities have taken the initiative by adopting local ordinances and practices to accomplish *Atlas* goals, their capacity to fully execute the intentions are – and will be – limited by the variant needs and limited budgets of local governments and non-profits. Under the current economic climate, these needs are only amplified. Federal and state programs, as well as private organizations, could subsidize the emerging field of ecosystem services – providing social and environmental benefits through increased funding for locally-driven watershed protection and restoration. The two useful resources for local governments and non-profits considering watershed protection and/or restoration are the US EPA’s *Nine Elements of Local Watershed Planning* and the Center of Watershed Planning’s (CWP) principles (US EPA, 2008; CWP)

Forty-nine (49) of the 128 impaired water features in the Yadkin Pee-Dee River basin are directly addressed through the priority stress watersheds listed in the *Yadkin-Pee Dee River Basin Priority Watershed Atlas*; a further 8 impaired waters are immediately downstream from these priority stress watersheds. If all of these watersheds received immediate support, 30% of impaired waters (10,622 of 35,472 stream miles) will be addressed through comprehensive local watershed planning in 10% of the Yadkin-Pee Dee River Basin’s watersheds. Twenty-nine (29) of the 49 Yadkin-Pee Dee River Basin’s high quality or outstanding resource waters are directly addressed through priority conservation watersheds listed in the *Yadkin-Pee Dee River Basin Priority Watershed Atlas*. Local watershed planning in the Yadkin-Pee Dee River Basin’s top 10% conservation watersheds – as determined here – will directly serve 47%, or 223,279 acres, of the high water quality watershed lands in the river basin.

The findings of this project reveal the cost of development without foresight. Of the 128 impaired waters in the Yadkin-Pee Dee River basin, 92 are in cities or towns, demonstrating the negative impacts traditional planning and development can have upon watershed health and function. The Triad and greater Charlotte areas are two of the three fastest-growing regions in NC, and, thus far, have relied upon sprawling residential development to serve growth. The priority stress watershed data largely reflects a common yet unsustainable land development pattern that has degraded ancient watersheds in just a few decades. Furthermore, the water quality impacts of transportation corridors needs to be fully recognized by NC DOT, and better protections mandated for the priority watersheds their roads transverse. The stormwater, heavy metal, and nutrient burdens supplied by NC DOT projects must be recognized and aggressively addressed for both pristine and impaired waters. The impacts from urban development and roads within degraded watersheds demonstrate how communities in currently healthy watersheds jeopardize environmental and public health if not addressed.

Some communities are proactively addressing their environmental footprints, applying Smart Growth and Low Impact Development tools to future development (Smart Growth Network; NRDC, 2001). As watershed nutrient reduction rulemaking and proposed nutrient threshold standards make clear, preventative practices must be employed, or the true cost of damaging land use practices will simply be passed down to future generations, who will have to contend with much more expensive restoration needs (NC DWQ; Schlegel, 2008-2009). Strong political support will be required on the part of local elected officials to reign in developments’ environmental footprint.

Successful watershed planning relies upon partnerships amongst public, private, and non-profit interests. No one stakeholder can hope to fully protect or restore a watershed – it requires a stewardship ethic amongst all citizenry and those decision makers who determine of land use and water resource policy. By focusing on the *Atlas*’ priority watersheds within the Yadkin-Pee Dee River Basin, immediate efforts to create such partnerships should be taken so that a coalition of interests can use this data to pursue further

support from state, federal, and private funding resources. Large credit is due to partnerships that already exist (e.g. Greater Uwharrie Conservation Partnership, Mitchell River Watershed group), and it is hoped that this document will aid their efforts and be leveraged for further public and private support. Consultation with existing watershed stakeholder partnerships is highly recommended for communities new to watershed management.

Sustainable planning approaches should be used in healthy watershed communities, and especially those in high priority conservation watersheds. The ecosystem services of these watersheds for both local and downstream communities need to be recognized through programs and funding so that there is an incentive for protection. These services can be immediate and intrinsic (flood control, game lands, preservation of cultural heritage, hiking, open space, etc.). Currently, no federal, state, or local public entity recognizes these needs, or respects the value of protecting healthy watersheds for the welfare of downstream communities. The NC Sustainable Communities Initiative formed in 2009 has not yet created any programming for such a perspective, despite the evidence from multiple watershed studies that watershed protection is needed for sustainable community growth (NC GA, 2009). Some rural communities have developed relationships with non-profits including land trusts to protect valuable natural and aesthetic areas: an appealing feature to many planning to visit or relocate to these rural areas.

The purpose of this *Atlas* is to identify areas that are in the greatest need of support to either protect existing valuable resources or to immediately address degraded watersheds that threaten ecological and human health. The 46 Yadkin-Pee Dee River basin watersheds identified by this project need immediate attention to ensure users are provided with clean, resource-rich waters long into the future. Applying local watershed planning initiatives (relying upon the US EPA's *Nine Elements of Local Watershed Planning* and CWP watershed restoration planning principles) to strategically characterize, assess, and plan for these 46 watersheds is recommended as the next step for local and regional governments. This project is intended to be but the first step in ensuring the sustainable management of clean and healthy waters throughout the Yadkin-Pee Dee River Basin. This planning process and GIS model is scalable and adaptable for every river basin in North Carolina, and could perhaps be expanded to prioritize watersheds statewide.

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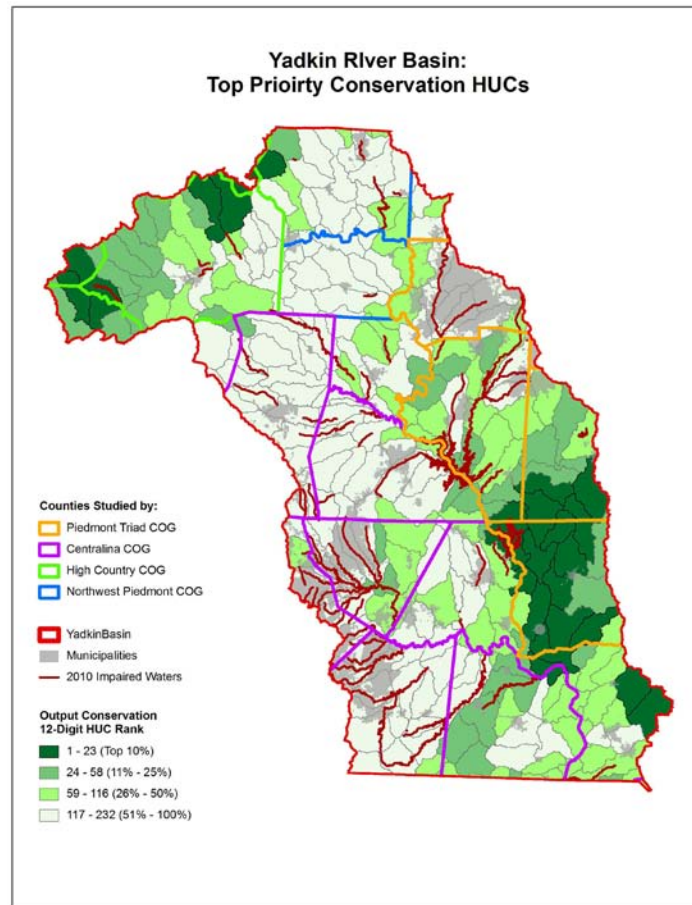
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# Yadkin-Pee Dee River Basin Top Priority Conservation HUCs





# Yadkin-Pee Dee River Basin Top Priority Stress HUCs

