

Burgis Creek Watershed Plan

Winter 2025



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MCADAMS

Acknowledgments

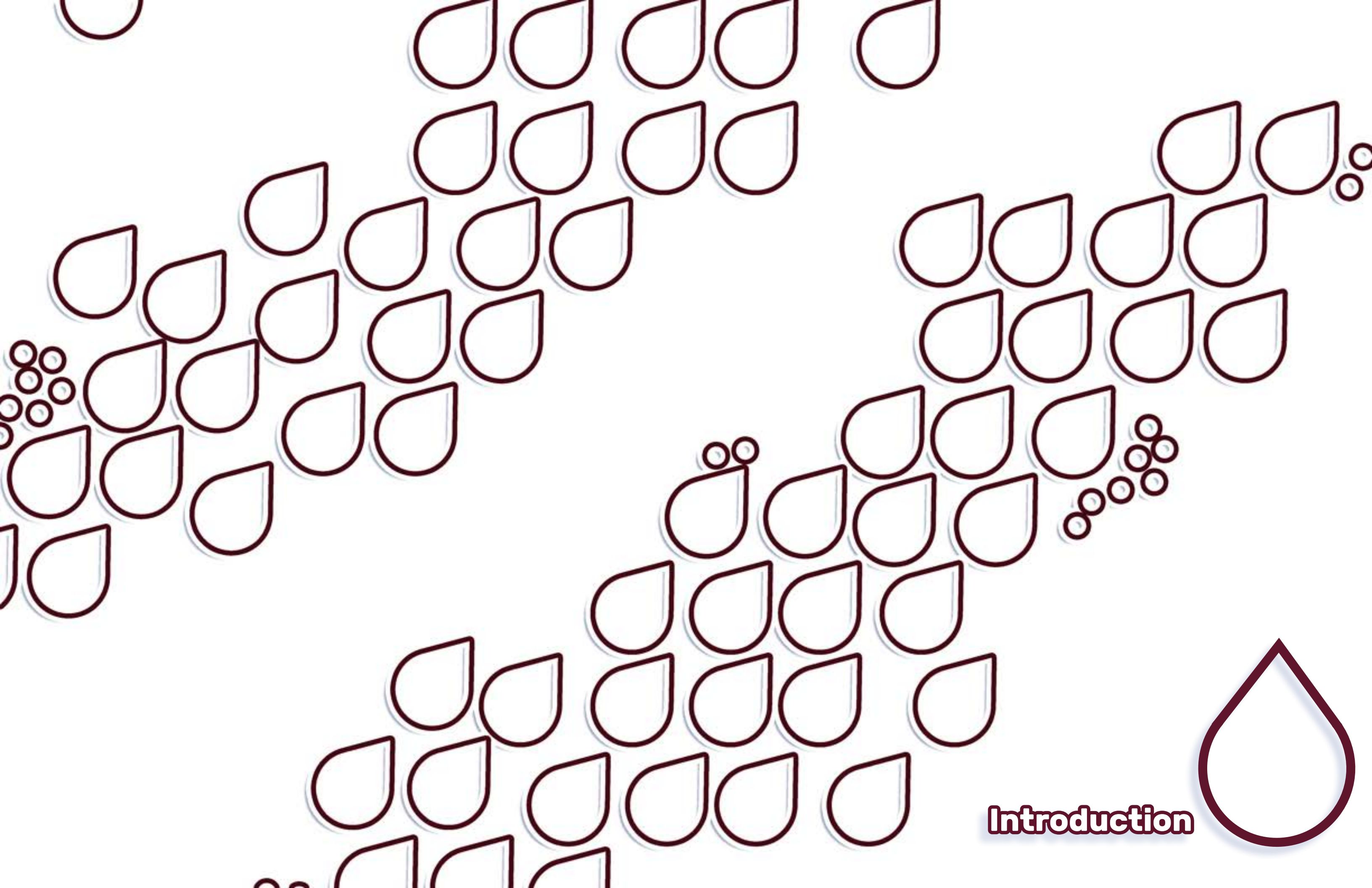
City of Rock Hill
Town of Fort Mill
York County
Catawba Nation

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City of Rock Hill
David Dickson
City Engineer III, Public Works
City of Rock Hill
P.O. Box 11706
Rock Hill, SC 29731-1706
(803) 329-7096

York County
Mark C. Boland, PE, CFM
Development Services Engineer
York County Planning & Development Services
18 W. Liberty St.
York, SC 29745
(803) 909-7243

Town of Fort Mill
LeeAnn Clark
Stormwater Manager
Town of Fort Mill
131 E Elliott Street
Fort Mill, SC 29715
(803) 547-7158



Introduction



Introduction

A watershed is an area of land that channels rainfall and occasionally snowmelt to streams and rivers. All land is part of a watershed, and watersheds do not follow jurisdictional boundaries.

Watersheds play a pivotal role in collecting, filtering, and supplying water to ecosystems and human communities, as shown in Figure 1. Watershed Plans serve as a roadmap to maintain and improve watershed health by providing voluntary recommendations to address known water quality impairments within the watershed. By promoting sustainable land and water management practices, this Watershed Plan seeks to address bacterial, sediment, and nutrient pollution, and help improve low dissolved oxygen (DO) levels within the Burgis Creek Watershed (HUC 030501030602). The goal is to ensure that both natural ecosystems and human communities can thrive and coexist harmoniously.



Figure 1. Diagram of a watershed (University of Maryland)

One of the biggest benefits of creating a Watershed Plan is that it makes the watershed eligible for state and federal grants to address pollution problems in the watershed. One of those funding sources is the Section 319 Nonpoint Source Management Program. These are federal monies that are awarded by the South Carolina Department of Environmental Services (SCDES) to support public education, technical training, and management measures to improve water quality.

The Nine Required Plan Elements

The Nine Required Elements are displayed below that must be included in a Watershed Plan are determined by the United States Environmental Protection Agency (EPA). In combination, these elements explain the community's concerns with the watershed, create a strategy to address those concerns, and include a plan to monitor progress.

- | | |
|--|---|
| A. Identify causes of impairment and pollution sources | F. Create a schedule for implementation of management measures |
| B. Estimate load reductions expected from management measures | G. Describe the interim measurable milestones |
| C. Describe management measures to be implemented | H. Determine criteria to measure success |
| D. Estimate technical and financial assistance needed | I. Create a monitoring plan |
| E. Include informational and educational components | |

The Watershed Planning Process

In the Burgis Creek Watershed, there are many organizations already active and engaged in local water quality issues. Leaders of those organizations were invited to participate as Key Partners in this Watershed Planning process. It would not have been possible to create this Watershed Plan without the assistance of the Key Partners. The Key Partners supported the project in the following ways:

- Creating goals and a schedule for the project;
- Sharing their concerns about the water quality of the watershed;
- Organizing the information into an outline for the document;
- Leading field visits to areas of concern within the watershed;
- Sharing data that was needed to successfully complete the assessment.

In addition to the input from the Key Partners, input from the public was also sought. The Watershed Planning process was highlighted on a local radio show (Rick Lee, WRHI) and the public was invited to provide input via a digital survey. The information gained from the survey was used to identify key pollution issues, pinpoint pollution sources and to prioritize management measures.

The Key Partners included the following communities and organizations:

- Catawba Nation**
- Catawba Riverkeeper**
- City of Rock Hill**
- Town of Fort Mill**
- Keep York County Beautiful**
- Rock Hill Clean and Green**
- South Carolina Department of Environmental Services (SCDES)**
- SC Rural Water Association**
- WRHI FM 100.1**
- York County**
- York Soil and Water Conservation District**

All the management measures presented in a Watershed Plan are strictly voluntary.

Thank you SCDES for your assistance and expertise in the development of this Watershed Plan.



Figure 2. Photo of Manchester Creek in the Burgis Creek Watershed (McAdams)

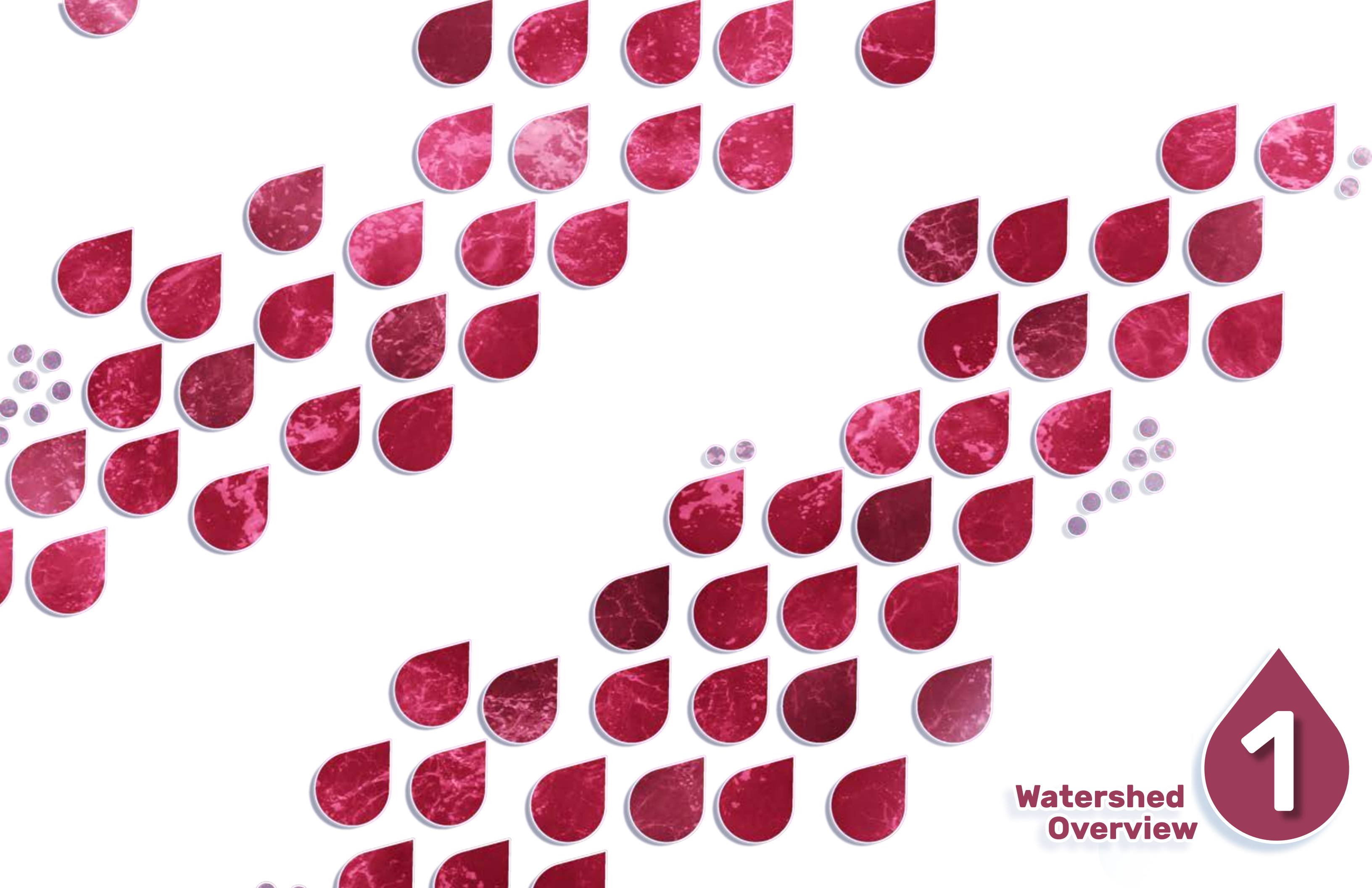
Key Terms

The following key terms are used throughout this document and will be helpful for the reader to understand.

- **Best Management Practices (BMPs)** are structural, vegetative or managerial practices used to treat, prevent or reduce water pollution.
- **Detention Basins** are basins that capture stormwater runoff to reduce flooding and remove pollutants before discharging it at a controlled rate until they are completely drained. Detention basins are designed to be dry between storm events and thus are also called “dry ponds.”
- **Dissolved oxygen (DO)** is the amount of oxygen present in water. It is closely related to Biological Oxygen Demand (BOD), which measures the amount of oxygen required by microorganisms to decompose organic matter. High BOD can lead to lower DO levels, potentially harming aquatic ecosystems.
- ***E. coli*** is the shorter name for the *Escherichia coli* bacteria. This bacteria is found in the fecal matter of humans and animals, and can cause illness in humans, pets, and wildlife.
- **Floodplains** are the low-lying areas that surround rivers and other waterbodies that naturally flood on a frequent basis.
- **Impoundments** are manmade or naturally occurring standing waterbodies, often produced by dams on streams or rivers.
- **Infiltration** is the process by which water moves from the surface into the ground. Infiltration is one of the most effective methods for improving water quality and reducing water quantity.
- **Impaired Waters** are waters listed on the 303(d) list because they do not currently meet State water quality standards after application of required controls for point and nonpoint source pollutants (SCDES, 2022).
- **Intermittent Streams** are streams that have flowing water during certain times of the year, when groundwater and/or precipitation provides water for stream flow.
- **Perennial Streams** are streams that have flowing water year-round during a typical year.
- **Pollutant Loading** is the measure of how much of a particular pollutant reaches a waterbody in a unit of time. For example, the pollutant load may be expressed as pounds of pollutant per day or as tons of pollutant per year.
- **Retention Basins** are basins that capture stormwater runoff to reduce flooding and remove pollutants before discharging it at a controlled rate. Retention basins are designed to permanently hold water between storm events and thus are also called “wet ponds.”
- **Riparian Buffers** are areas adjacent to streams, lakes, and wetlands containing trees, shrubs, and other plants.
- **Runoff** is water from precipitation events that flows over surfaces such as the ground, rooftops, or pavement.
- **Stormwater** is any liquid precipitation, such as rain or snow.
- **Total Nitrogen** includes nitrite (NO₂), nitrate (NO₃), ammonia (NH₃), and organic nitrogen.
- **Total Phosphorus** includes both dissolved phosphorus and particulate forms of phosphorus.
- **Turbidity** is a measure of the cloudiness or haziness of water caused by the presence of suspended particles, primarily sediment. Higher turbidity levels indicate greater amounts of suspended sediment, which can reduce water quality by blocking sunlight and harming aquatic life.
- **Watersheds** are areas of land where all stormwater runoff flows to a common waterbody. Watersheds may be comprised of smaller “sub-watersheds.”
- **Wetlands** are areas where the water table is usually at or near the surface or the land is covered by shallow water.



Figure 3. Pond in Waterford Golf Club (McAdams)



**Watershed
Overview**



Watershed Overview






The Burgis Creek Watershed has many assets that are important to the quality of life, economy, and environment of Rock Hill, Fort Mill, and the surrounding communities.

Watershed Assets

The Burgis Creek Watershed is home to approximately 54,930 people, and most of the land is devoted to providing housing, parks, medical offices, and businesses to support its residents and visitors. The watershed also includes the Rock Hill Operations Center, Walter Y. Elisha Park, Rock Hill BMX Supercross Track, Fort Mill Golf Club, Springs Close Greenway, and York County Catawba Bend Preserve. [Bike trails and parks](#) enable people to enjoy the natural amenities of the area on foot or bicycle.

This watershed is part of the Charlotte metropolitan area, and thus offers a wide variety of employment, academic, and entertainment opportunities to people who live here. The watershed's location relative to major cities is shown in Figure 1.1.

Key Watershed Facts

-  HUC 030501030602
-  128 miles of streams
-  29,102 acres of land
-  Watershed is within the City of Rock Hill, the Town of Fort Mill, Catawba Nation, and York County Jurisdictions
-  Elevation ranges from 472 ft to 722 ft

Data provided by United States Geographical Survey and the South Carolina Watershed Atlas



Figure 1.2 Scenic View of the Fort Mill Golf Club (source: Fort Mill Golf Club, 2023)



Figure 1.3 BMX Riders Amaze Onlookers (Rock Hill BMX Supercross, 2023)

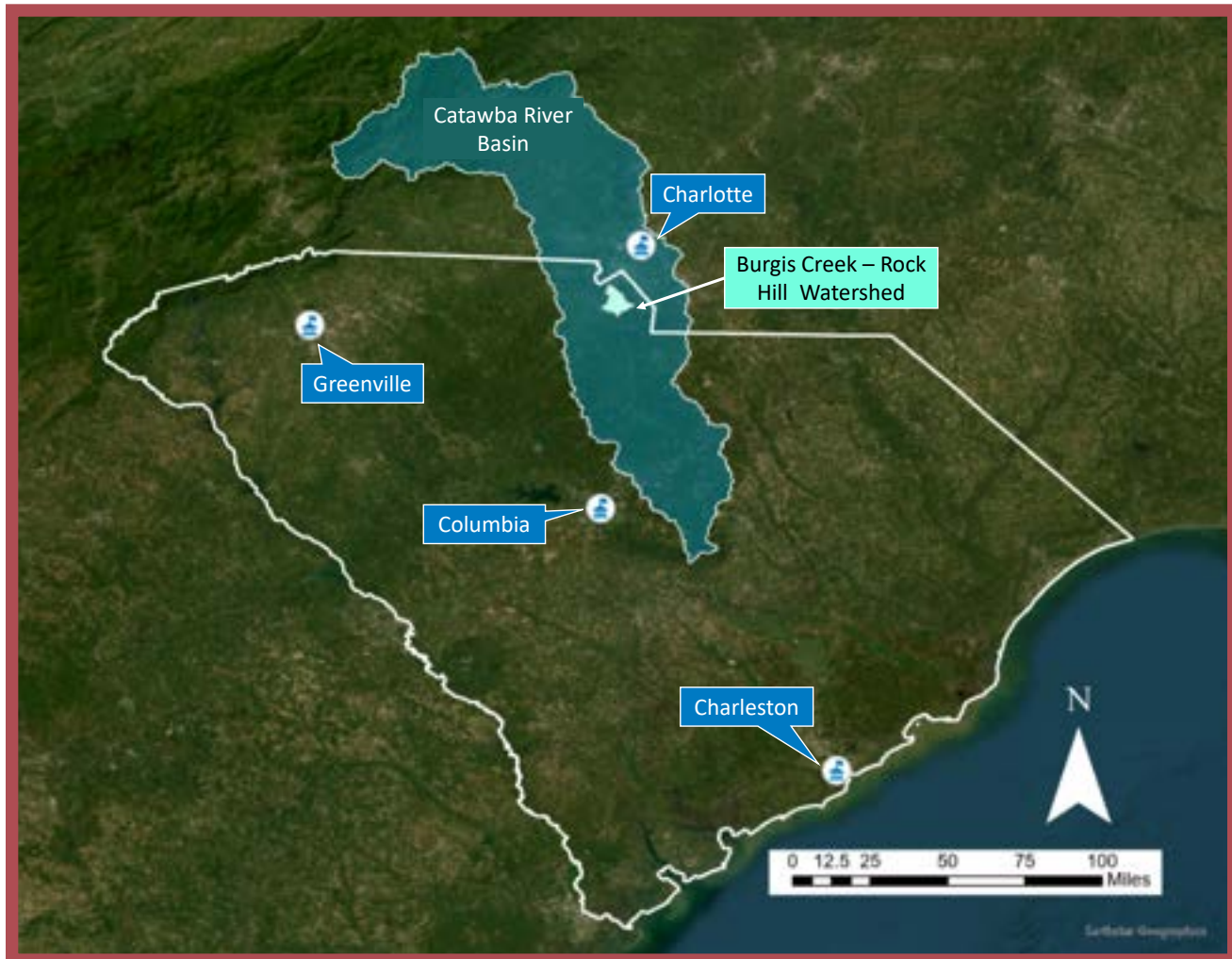


Figure 1.1 Watershed location

Streams & Impoundments

According to the United States Geological Survey (USGS), the Burgis Creek Watershed contains approximately 128 miles of streams. As water moves through the watershed, it collects to form waterways such as intermittent streams, perennial streams, and impoundments. Figure 1.5 shows a perennial stream and Figure 1.6 shows an example of an intermittent stream. This flowing water can also pick up pollutants from the land and carry those pollutants into and through the waterways. A segment of the Catawba River and the following smaller streams are located within the watershed:

- Burgis Creek
- Four Mile Creek
- Hidden Creek
- Johnnytown Branch
- Manchester Creek
- Jones Branch
- Dye Branch

Many small unnamed tributaries to the Catawba River are also a part of the Burgis Creek Watershed.

Perennial streams make up approximately 37% of the total streams, while intermittent streams make up approximately 63%, as shown in Figure 1.4. Even though intermittent streams typically flow for only part of the year, they provide food and habitat for many types of animals. Some of the intermittent streams have been piped under areas of development in the locations where they appear disconnected on the adjacent map (Figure 1.7).

The impoundments shown on the map consist of lakes, ponds and wetlands. Those features are spread evenly throughout the watershed. Although impoundments can be helpful in controlling flooding, they can alter the natural flow regime of streams when they are placed "on-line," or directly in the stream channel. On-line impoundments can cause sediment to build up in stream channels and degrade the habitat of aquatic animals.

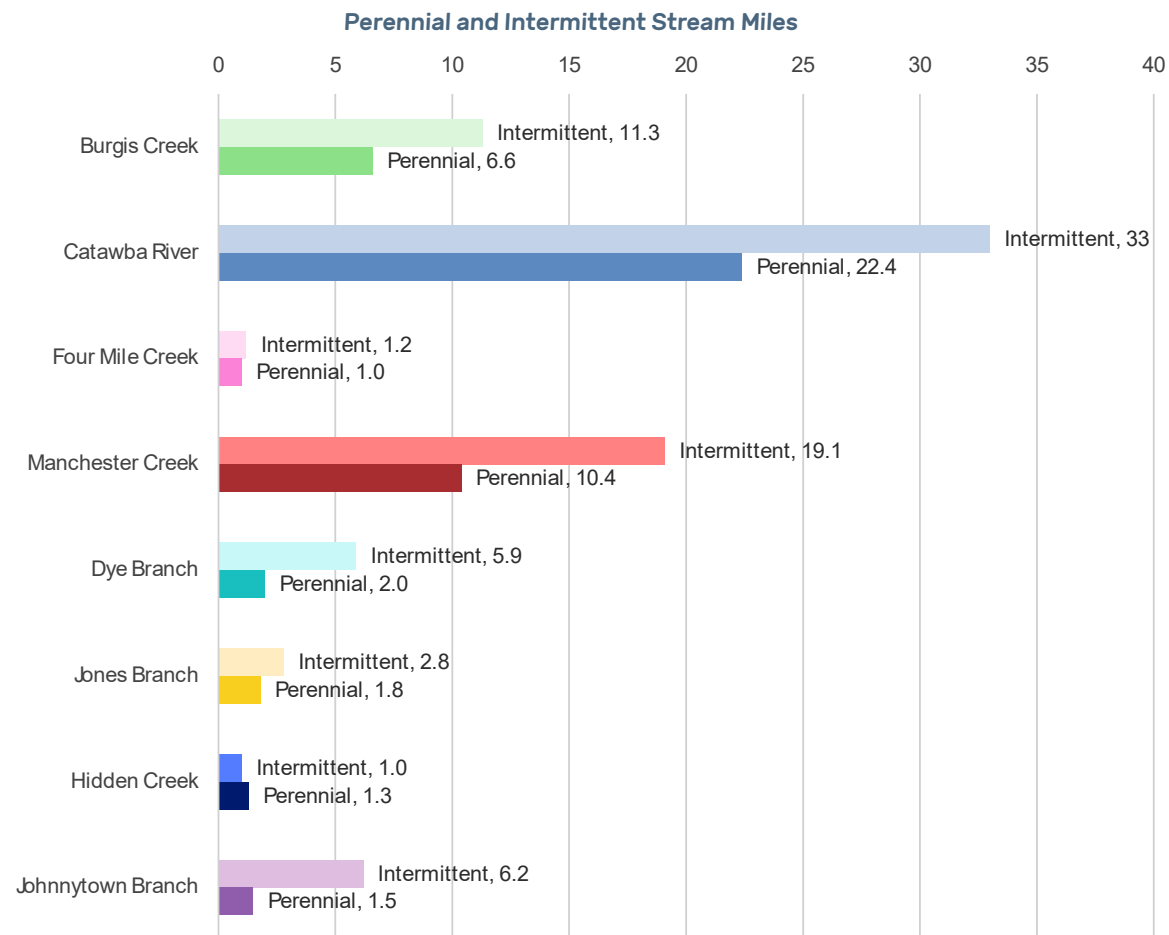


Figure 1.4 Stream miles by type in watershed (USGS)

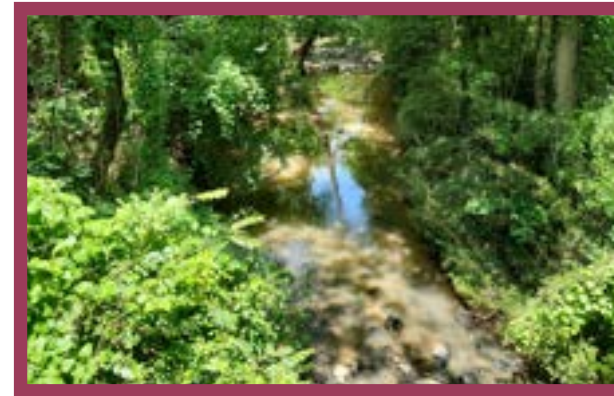


Figure 1.5 A perennial stream in the Burgis Creek Watershed (McAdams)



Figure 1.6 An intermittent stream (Army Corps of Engineers)

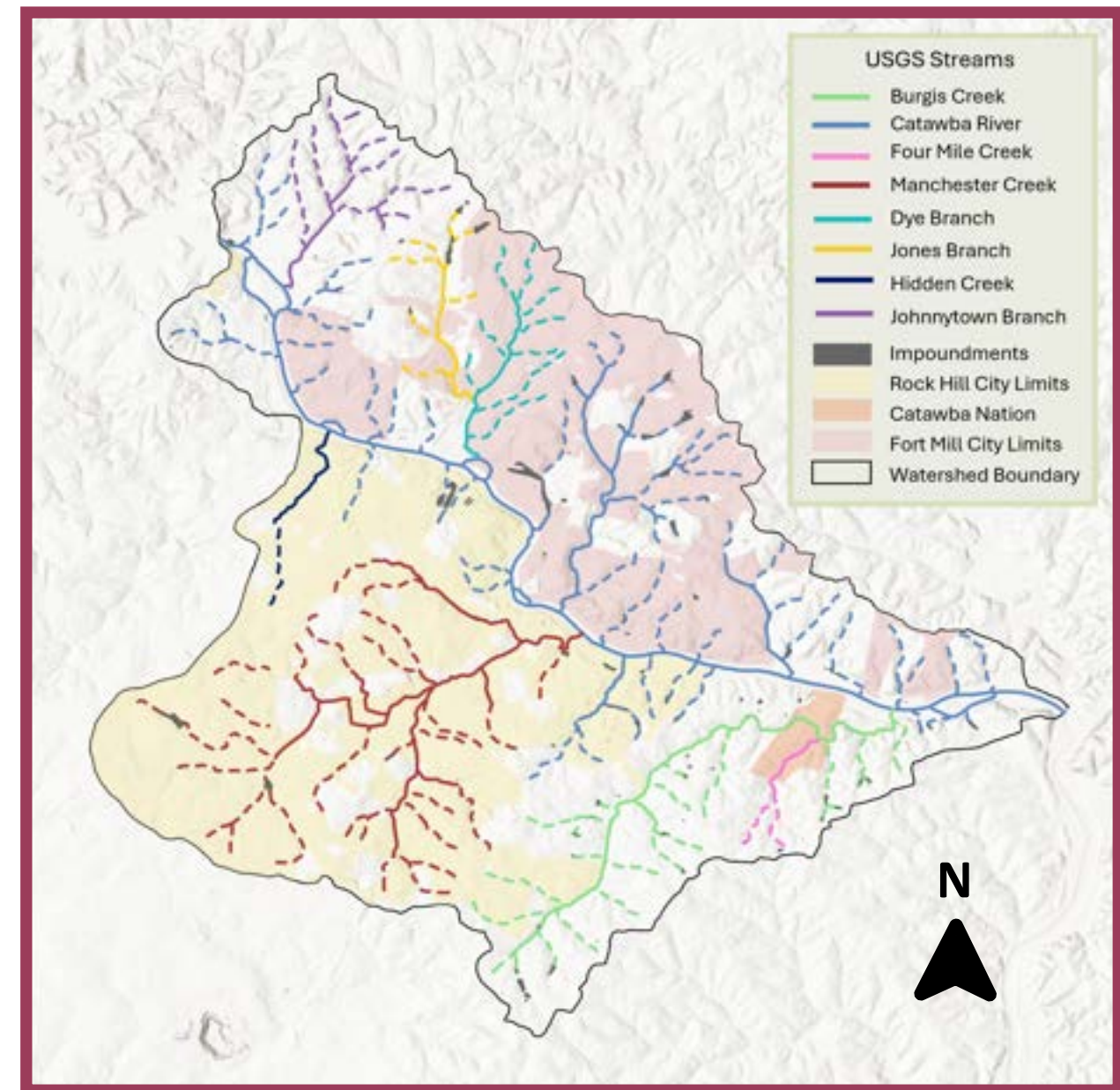


Figure 1.7 Streams and impoundments in watershed (USGS)

Floodplains

Floodplains are the low-lying areas that surround rivers and other waterbodies that naturally flood on a frequent basis, as shown in Figure 1.8. Floodplains are important to a healthy environment because they provide clean water and wildlife habitat. If left undisturbed, floodplains protect citizens from flooding by storing large volumes of stormwater and releasing it slowly over time. The Catawba River has the largest floodplain of the waterbodies, while Manchester Creek and Burgis Creek's floodplains are the widest of the remaining streams.

The Federal Emergency Management Agency (FEMA) categorizes floodplains to reflect the frequency of flooding. FEMA Flood Zone categories are summarized in Figure 1.9. Floodplains within the watershed are shown in Figure 1.10.

| Flood Zone | Risk Level | Description |
|------------|-----------------|--|
| 100-Year | High | Areas with a 1% chance of flooding in any given year and a 26% chance of flooding over the life of a 30-year mortgage. |
| 500-Year | Moderate to Low | Areas with a 0.2% chance of flooding in any given year |

Figure 1.9 Table summarizing FEMA Flood Zones (FEMA 2020)

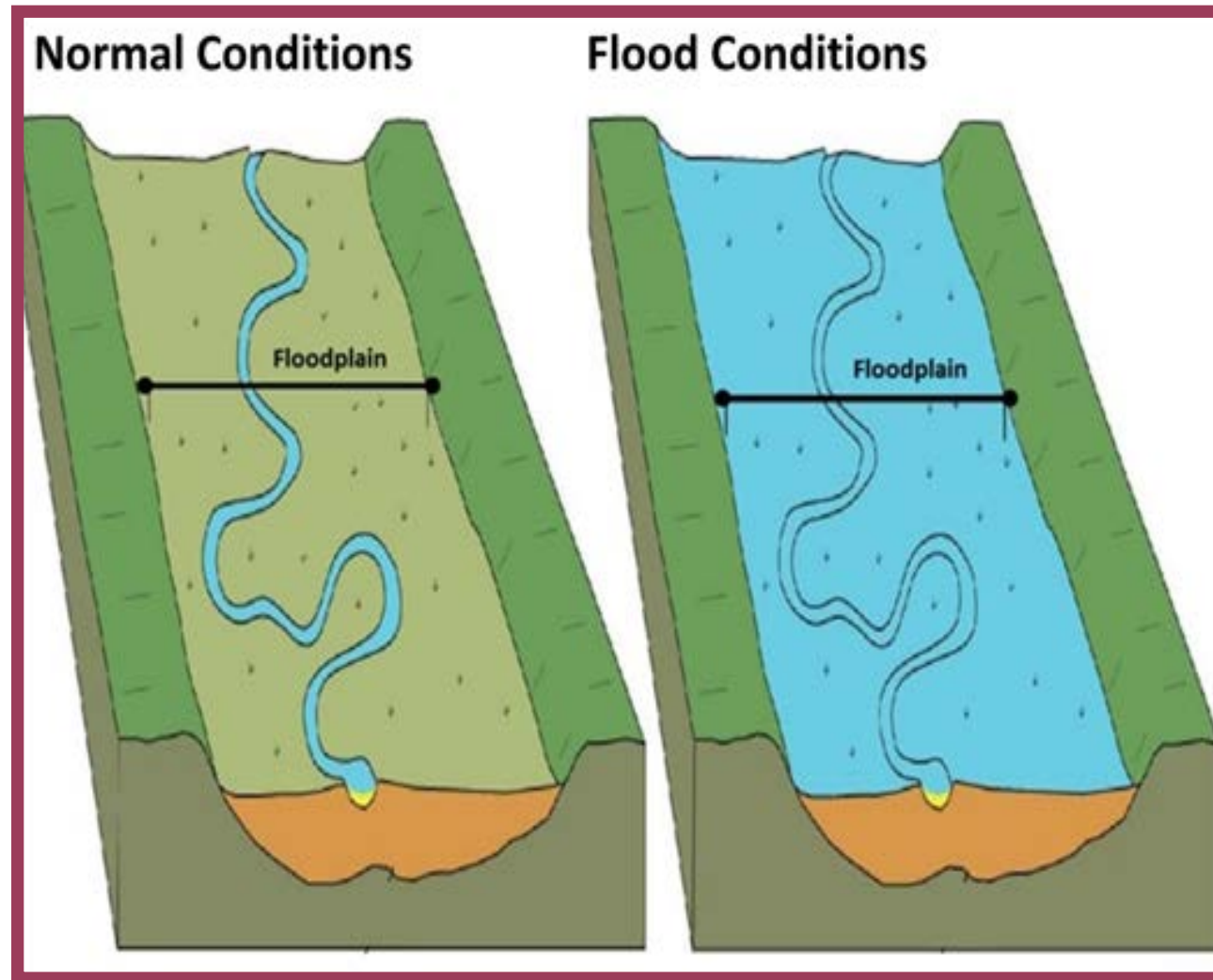


Figure 1.8 Floodplain storing water after a large storm event (City of Austin, Texas)

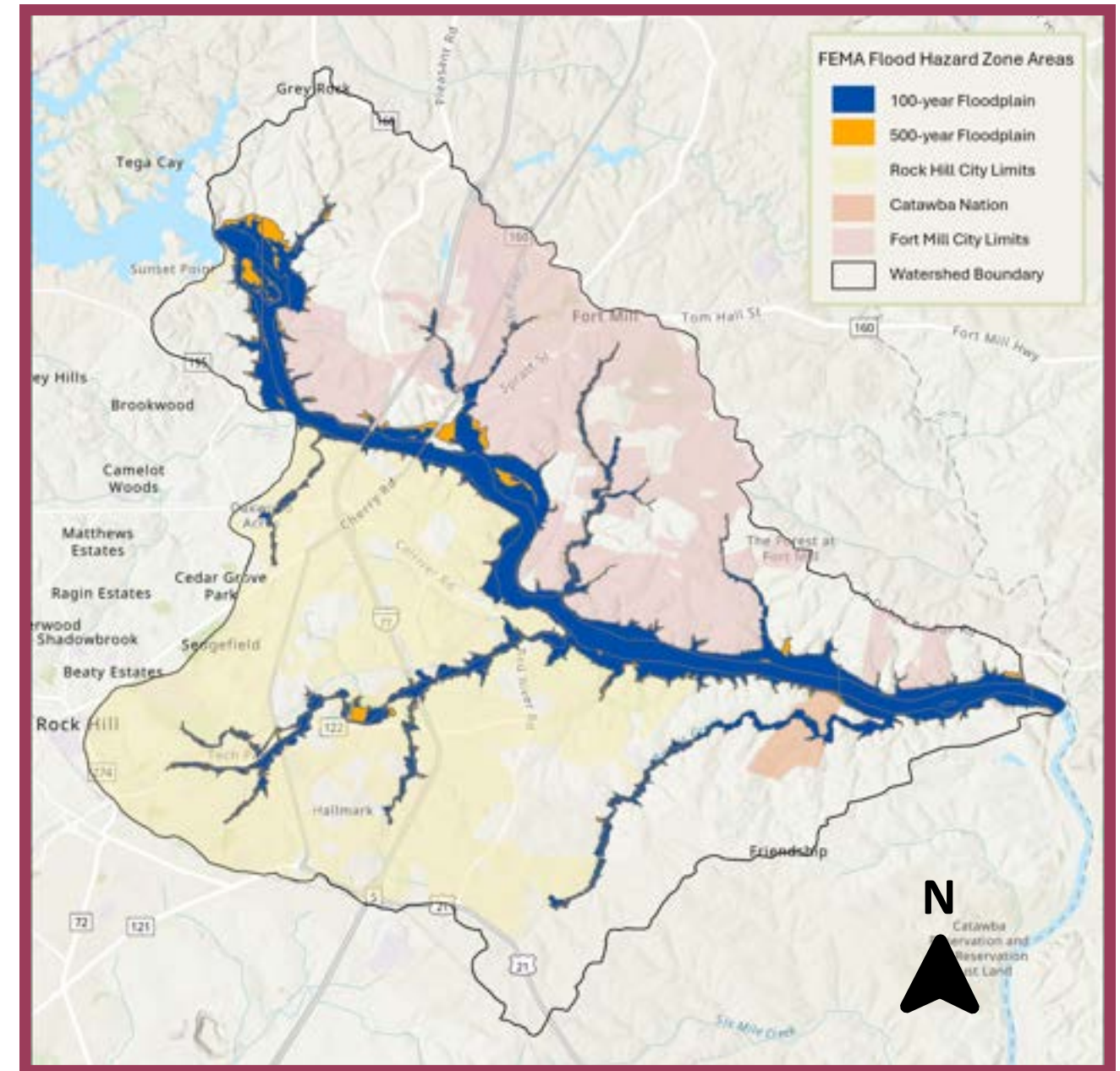


Figure 1.10 Floodplains in watershed

Riparian Buffers

A riparian buffer is a protected area adjacent to a stream, lake, or wetland containing trees, shrubs, and other plants. Riparian buffers, particularly forested buffers adjacent to headwater streams, deliver tremendous benefits, as summarized in Figure 1.11. In a riparian buffer, stormwater and water in the stream interact with soil, plant roots, insects, and other living things that together remove pollutants such as nutrients and harmful bacteria (Klapproth, 2009). Fortunately, all the jurisdictions within this watershed require some protection of riparian buffers. Jurisdictional protections are summarized in Figure 1.12 and shown in Figure 1.13. The benefits of riparian buffers are explained in the figures below.

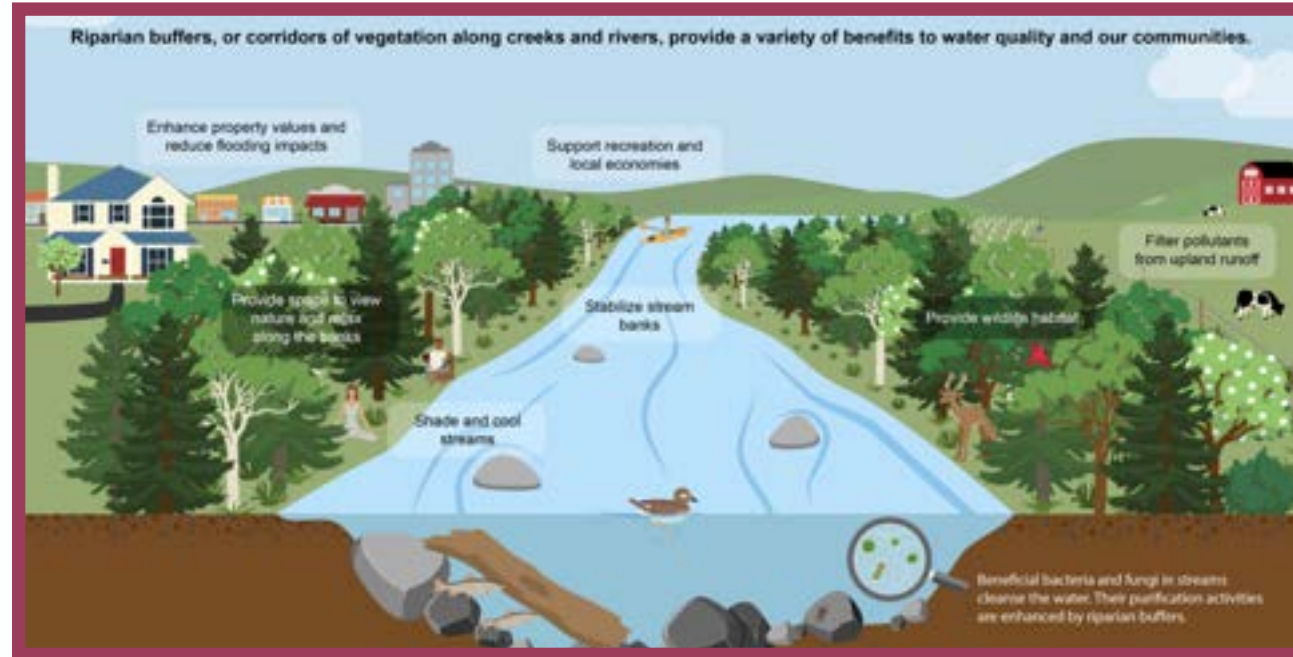


Figure 1.11 Diagram of riparian buffer benefits (Highland)

Rock Hill requires riparian buffer protection in Section 8.4 of the [Rock Hill Zoning Ordinance](#). York County covers riparian buffer protection on pages 340-343 of the [York County, Chapter 155 Code of Ordinances](#). Fort Mill follows the SCDES buffer requirements found in the [SC General Permit for Construction Activities](#).

| Jurisdiction | Waterbody Type | Width (Feet) | Notes |
|--------------|--|--------------|---|
| Rock Hill | Catawba River | 125 | <ul style="list-style-type: none"> 100' undisturbed, 25' transition zone Will span the entire floodplain instead if it is wider than 125' |
| Rock Hill | Perennial Stream | 75 | <ul style="list-style-type: none"> 50' undisturbed, 25' transition zone Will span the entire floodplain if it is wider than 75' |
| Rock Hill | Intermittent Streams, Wetlands & Ponds | 50 | <ul style="list-style-type: none"> 40' undisturbed, 10' transition zone |
| York Co. | Catawba River | 100 | |
| York Co. | Perennial Stream | 50 | |
| Fort Mill | Streams, Ponds, and Wetlands | 30 | <ul style="list-style-type: none"> Undisturbed during construction |

Figure 1.12 Table summarizing riparian buffer width requirements

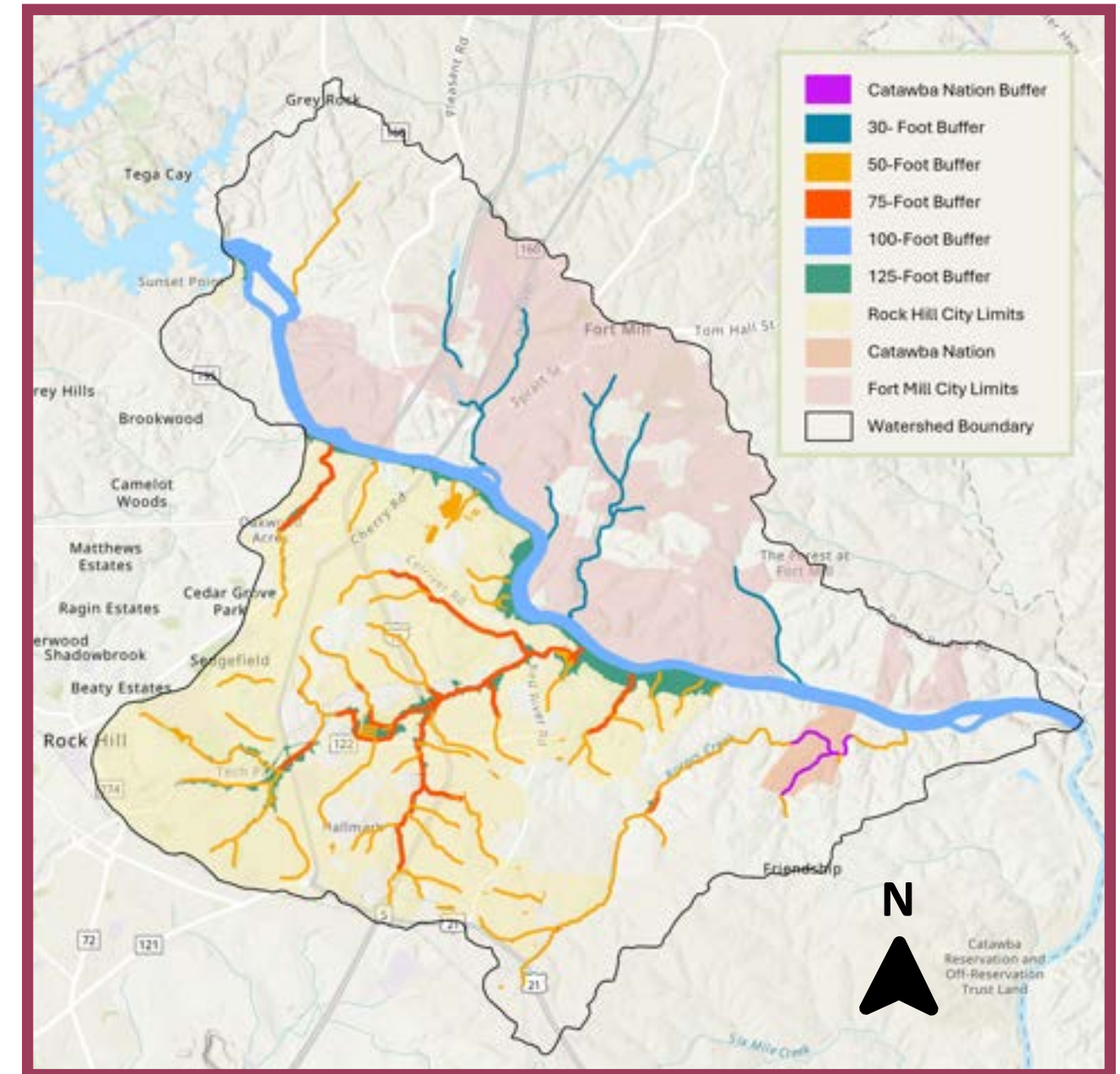


Figure 1.13 Stream buffer limits in watershed

Rock Hill and York County allow some limited activities to balance access to water resources and protection of buffer function. Examples of these uses include:

- Maintaining existing structures;
- Planting additional trees, shrubs, and native plants;
- Removing large debris;
- Stabilizing the shoreline (with approval)
- Installing water-dependent structures such as docks (with approval);
- Installing paths or stairs to water-dependent structures (with limitations on width/area and approval).

Wetlands

The USGS defines wetlands as transitional areas where water is frequently present either just above or below the land surface. Emergent wetlands are dominated by perennial plants that are water-loving and have vegetation present for most of the growing season during most years (Figure 1.14). Forest/shrub wetlands have at least 30% areal coverage of trees and shrubs, and vegetation is present all year but will lose its leaves during the winter (Figure 1.15).

The data to support this watershed assessment was gathered from the [Wetlands Mapper](#), which is maintained by the National Wetlands Inventory Program (under the U.S. Fish and Wildlife Service). Wetlands comprise a total of approximately 161 acres, or less than 1% of the total watershed land area, as shown in Figure 1.16 and 1.17.

Although this is a small percentage of the watershed's overall land area, their contribution is significant because they:

- Provide a home and a food source to a diverse array of microbes, plants, insects, amphibians, reptiles, birds, fish and mammals;
- Prevent flooding by storing stormwater during large rain events;
- Moderate both local and global temperatures.

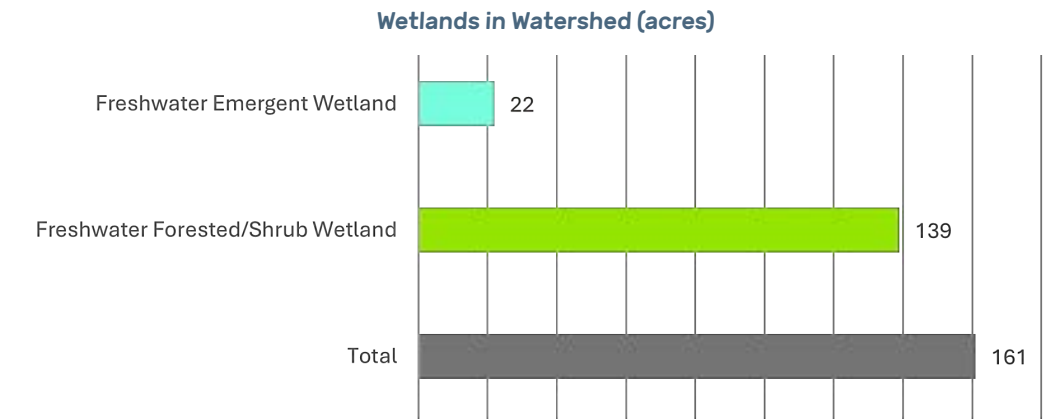


Figure 1.16 Chart showing wetland types in watershed



Figure 1.14 An emergent wetland (US Department of Agriculture)

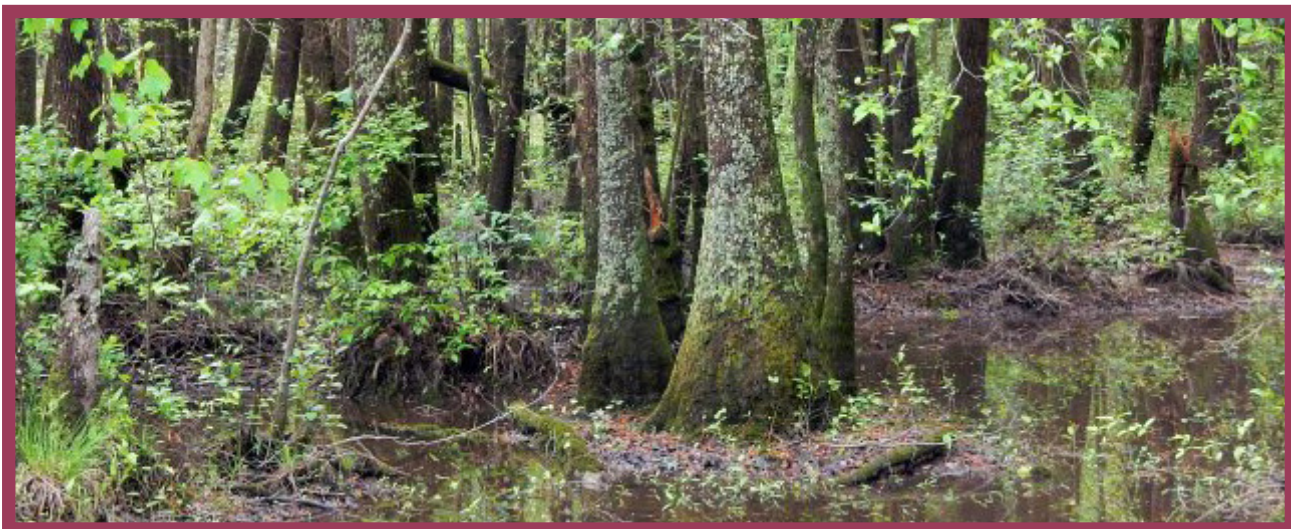


Figure 1.15 A forested wetland (NC Wetlands)

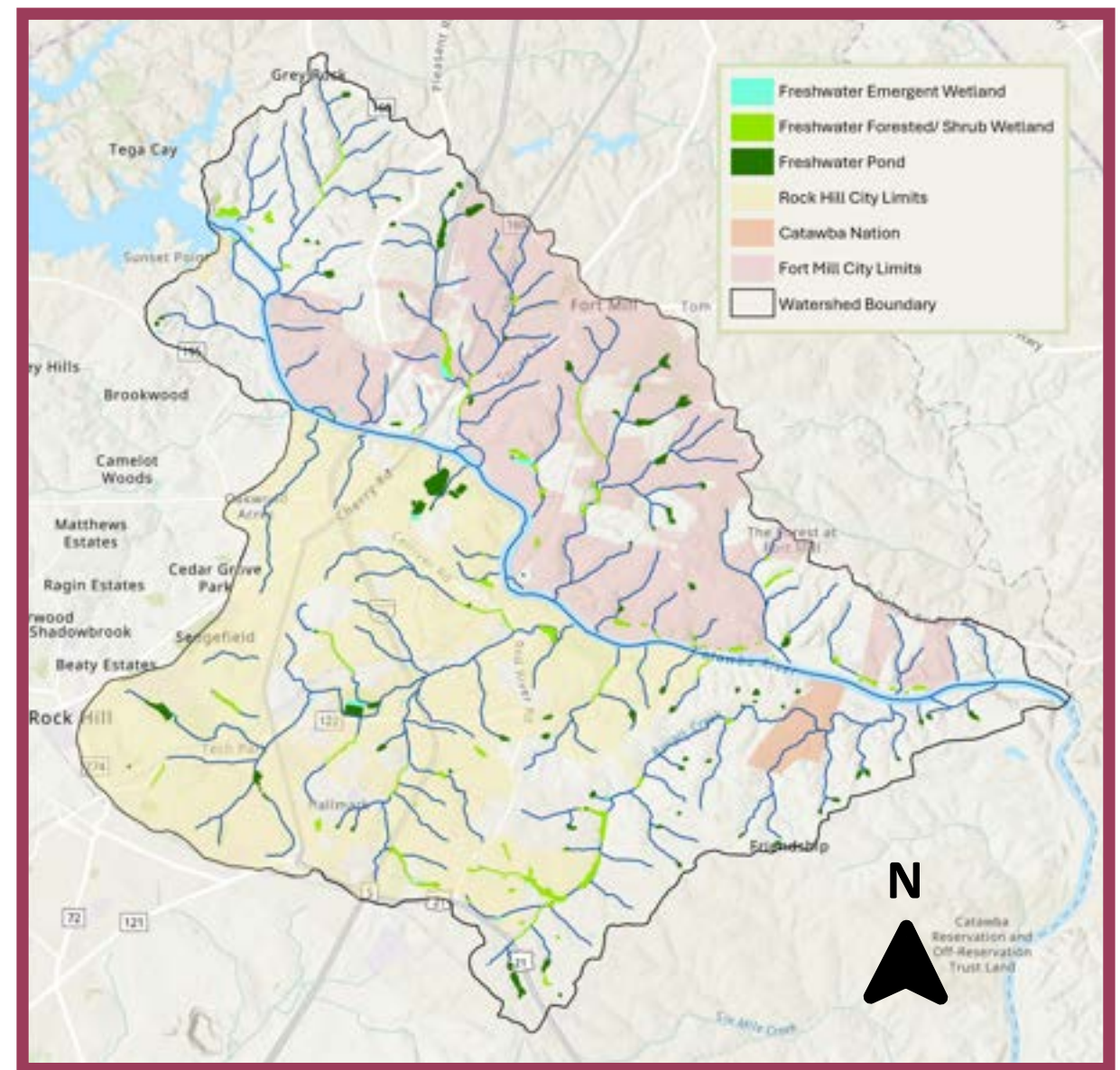


Figure 1.17 Wetlands in watershed

Soils

The United States Department of Agriculture (USDA) groups soils into four hydrologic soil groups (HSGs). HSG A soils are sandier and tend to soak rainwater into the ground rather than producing stormwater runoff. HSG D soils, on the other hand, have more clay particles and do not soak up as much stormwater, and thus produce a high amount of stormwater. A summary of HSGs is provided in Figure 1.18. Highly urban areas are often not classified by the USDA, but often act like HSG D soils due to the soil disturbance and compaction that occur during the construction process. The USDA also includes dual classes like "B/D" and "C/D" as seen below. These soils behave like the first hydrologic soil class when drained, and the second class when undrained.

Soils in the watershed are 33% urban undefined, which is assumed as HSG D. Another 15% of the soils are classified as D, as shown in Figures 1.19 and 1.20. Therefore, a total of 53% of soils in the watershed have high runoff potential and low infiltration rates, resulting in large volumes and high rates of stormwater runoff. This can compromise the functioning of septic systems and make it difficult to implement stormwater BMPs that rely on infiltration to function, effectively such as permeable pavement.

| HSG | Runoff Implications | Soil Properties |
|-----------|--|---|
| A | Low runoff, high infiltration | Less than 10% clay & more than 90% sand or gravel |
| B | Moderately low runoff, moderately high infiltration | 10-20% clay & 50-90% sand |
| B/D | Soil is drained: Moderately low runoff, moderately high infiltration Soil is undrained: High runoff, low infiltration | |
| C | Moderately high runoff, moderately low infiltration | 20-40% clay & less than 50% sand |
| C/D | Soil is drained: Moderately high runoff, moderately low infiltration Soil is undrained: High runoff, low infiltration | |
| D | High runoff, low infiltration | More than 40% clay & less than 50% sand |
| D Assumed | Assumed high runoff, low infiltration | Highly disturbed & compacted from development |

Figure 1.18 Table showing properties of Hydrologic Soil Groups

Soils in Watershed (acres)

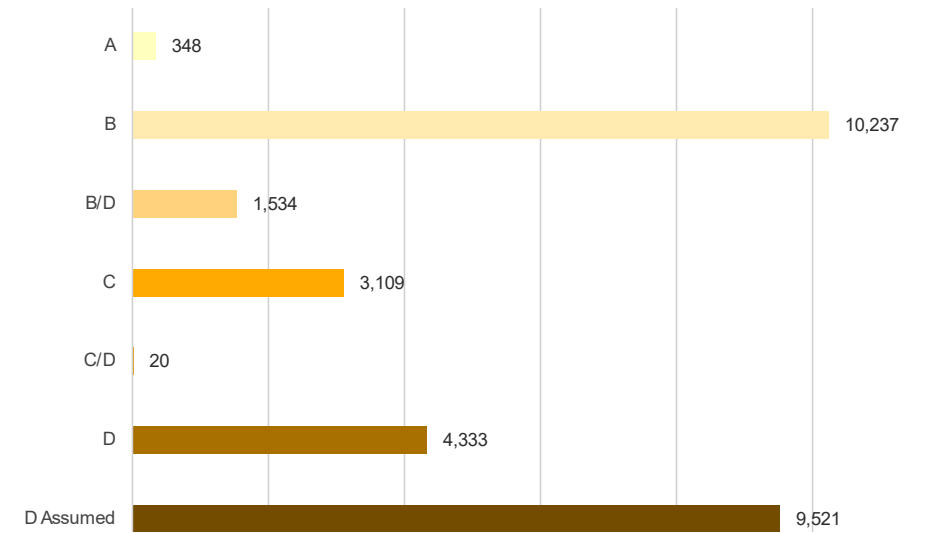


Figure 1.19 Chart showing soils in watershed

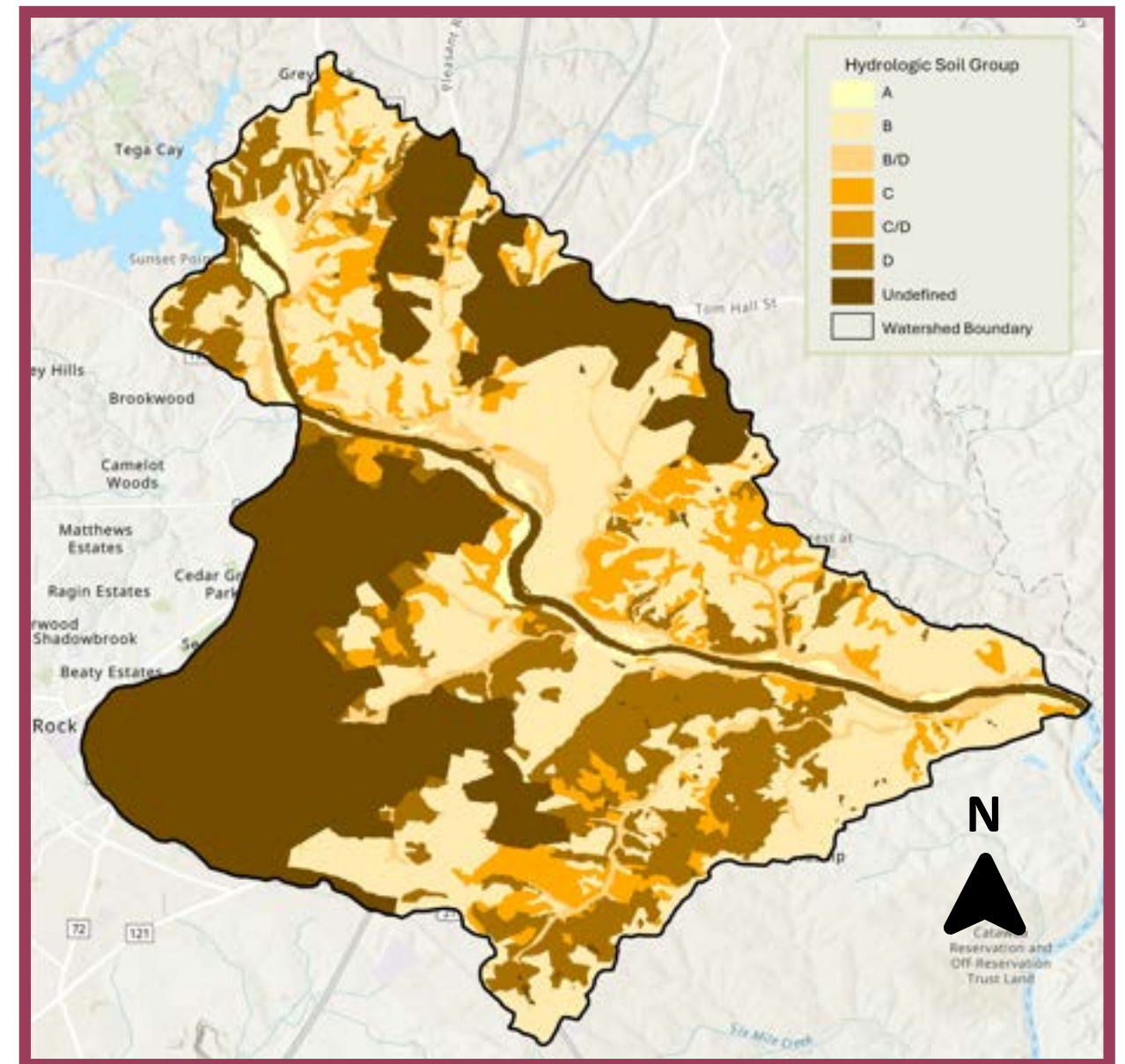


Figure 1.20 Soils in watershed

Topography

Topography plays a crucial role in a watershed because water always flows downhill. The perimeter of a watershed typically contains the highest elevation in the watershed; in fact, a watershed boundary is a ridge that separates one watershed from another. Topographic maps use elevation contour lines or color scales to illustrate the shape of the Earth's surface and usually contain additional geographic features such as roads, rivers, streams, lakes, and jurisdictional boundaries.

In the Burgis Creek Watershed, elevations range between 472 feet to 722 feet above sea level. Figure 1.21 shows that the highest elevations are around the watershed boundary and the lowest are along the Catawba River.

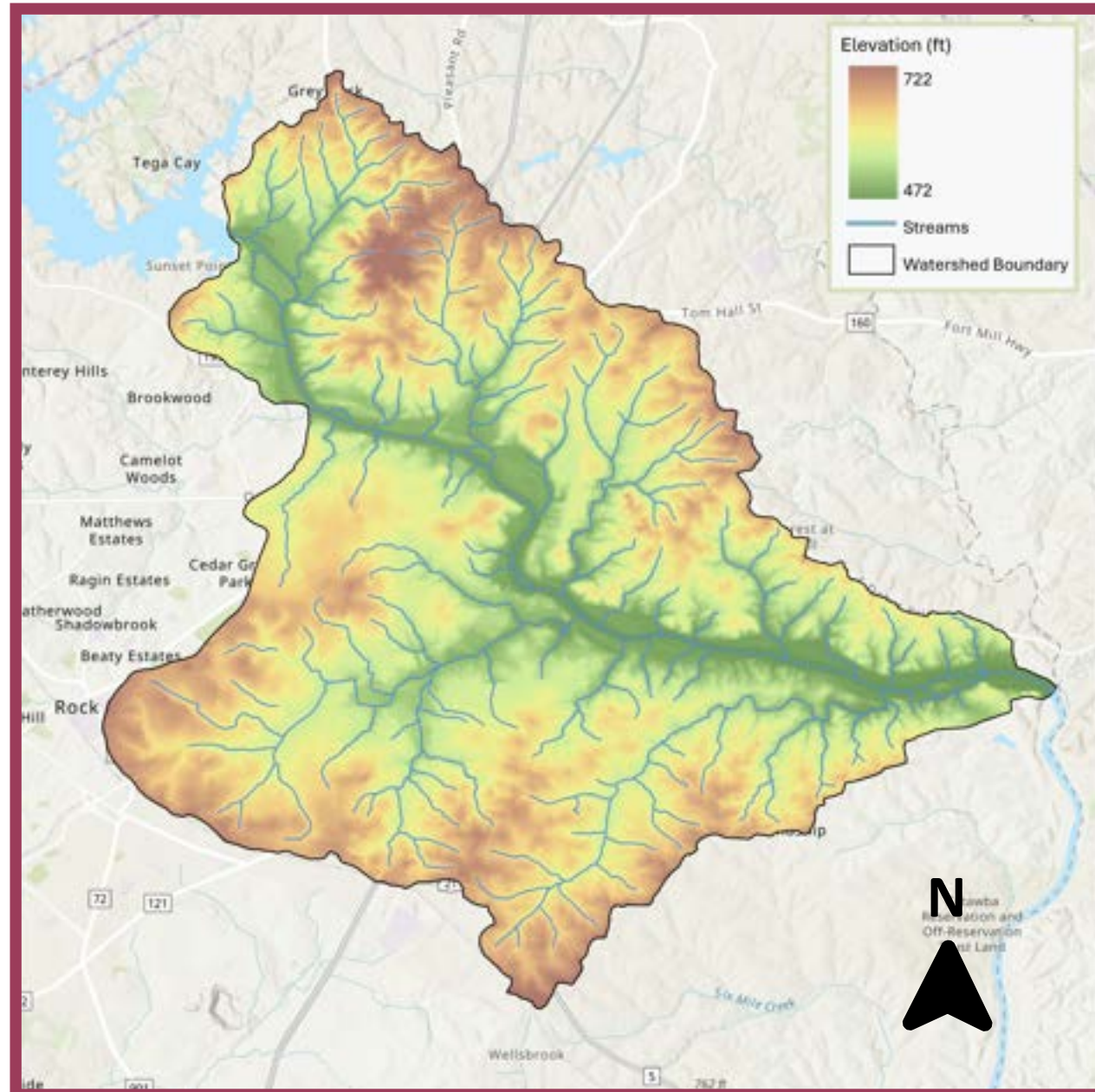


Figure 1.21 Topography in watershed

Land Use

The amount of runoff and types of pollutants generated in a watershed often correspond to land use. According to data sourced from York County, approximately 76% of the watershed is developed, with the remaining 24% forested or undeveloped. Nearly 41% of the land in the Burgis Creek Watershed is comprised of residential development, most of which is single-family residences. These features can be seen in the aerial image of the watershed below (Figure 1.22). Some of the notable non-residential land uses in the watershed include:

- Walter Y. Elisha Park
- Rock Hill BMX Supercross Track
- Rock Hill Outdoor Center Mountain Bike Course
- Fort Mill Golf Club
- Rock Hill Operations Center
- Catawba Bend Preserve

The watershed also contains several parks, including Westminster Park, the Riverwalk, Rock Hill Outdoor Center Greens, Glencairn Garden, Spencer Park, and Northside Recreation Center.



Figure 1.22 Aerial image of watershed

Water Supplies

The City of Rock Hill and the Town of Fort Mill water system and wells are the sources of drinking water within the watershed. Drinking water is withdrawn from Lake Wylie and treated by the City of Rock Hill Water Treatment Plant to remove sediment, bacteria, and other contaminants before being made available for public consumption. This treatment process results in water that exceeds SCDES and EPA quality standards. The Lake Wylie water intake is upstream of the Burgis Creek Watershed, so activities within the watershed will not impact this drinking water source.

Wells withdraw and filter groundwater. The depth of the wells combined with the impermeability of the clay soils common in the watershed help to protect the quality of well water from the

impacts of human activity. There are 17 privately owned and maintained public water supply wells throughout the watershed. These can be seen in Figure 1.23.

Most streams in the Burgis Creek Watershed flow into the Catawba River which runs through the middle of the watershed. There are two surface water withdrawals within the Burgis Creek Watershed, as shown in Figure 1.23. Given that the Burgis Creek Watershed constitutes just 2% of the total area of the larger Catawba River Watershed, activities within the Burgis Creek Watershed are likely to have a minimal impact on the downstream community's water supply. However, as a population grows, it is important to protect the drinking water supply and the watershed from hydrologic changes.

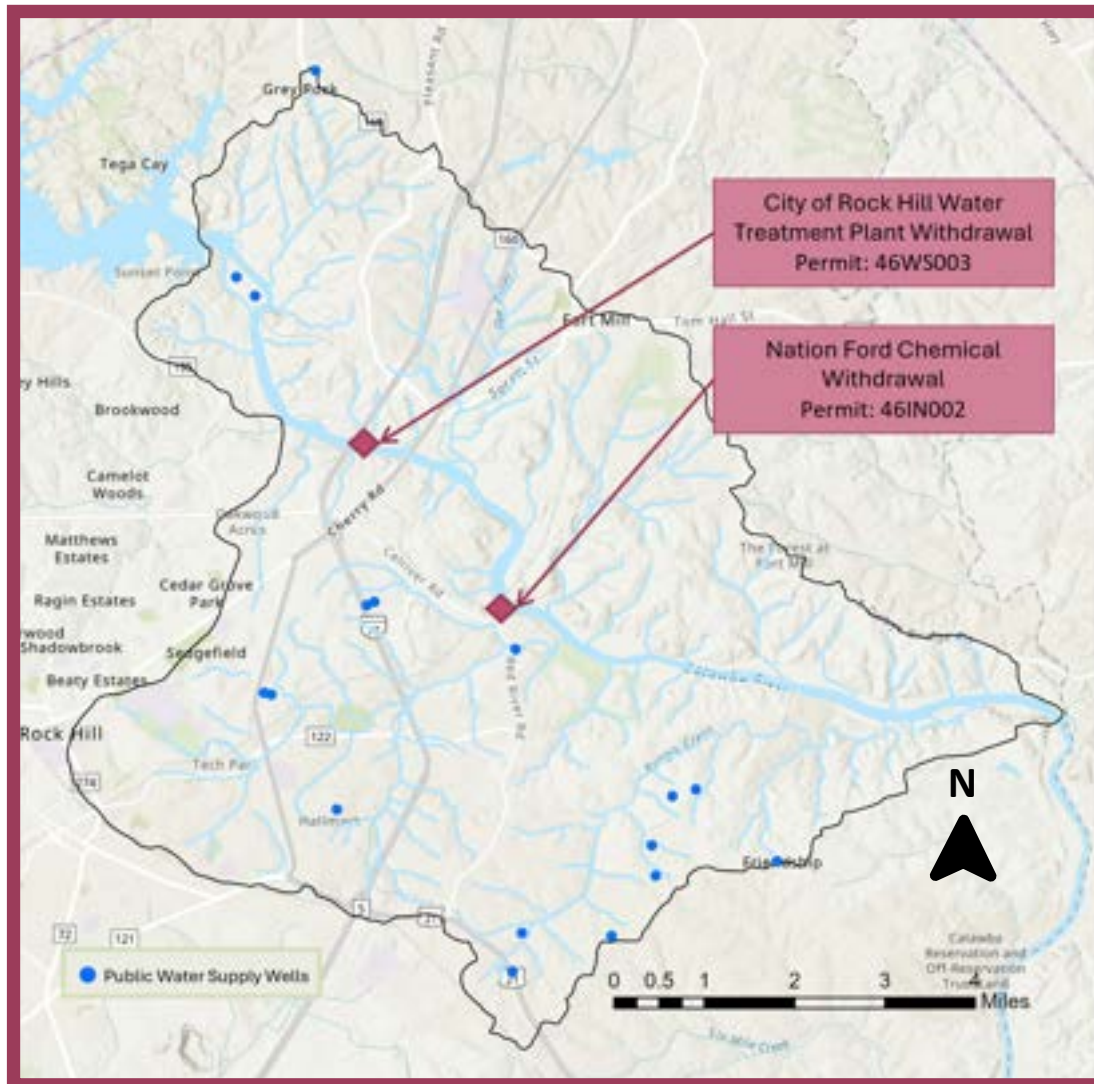


Figure 1.23 Upstream and downstream withdrawals in the watershed

Population & Projected Growth

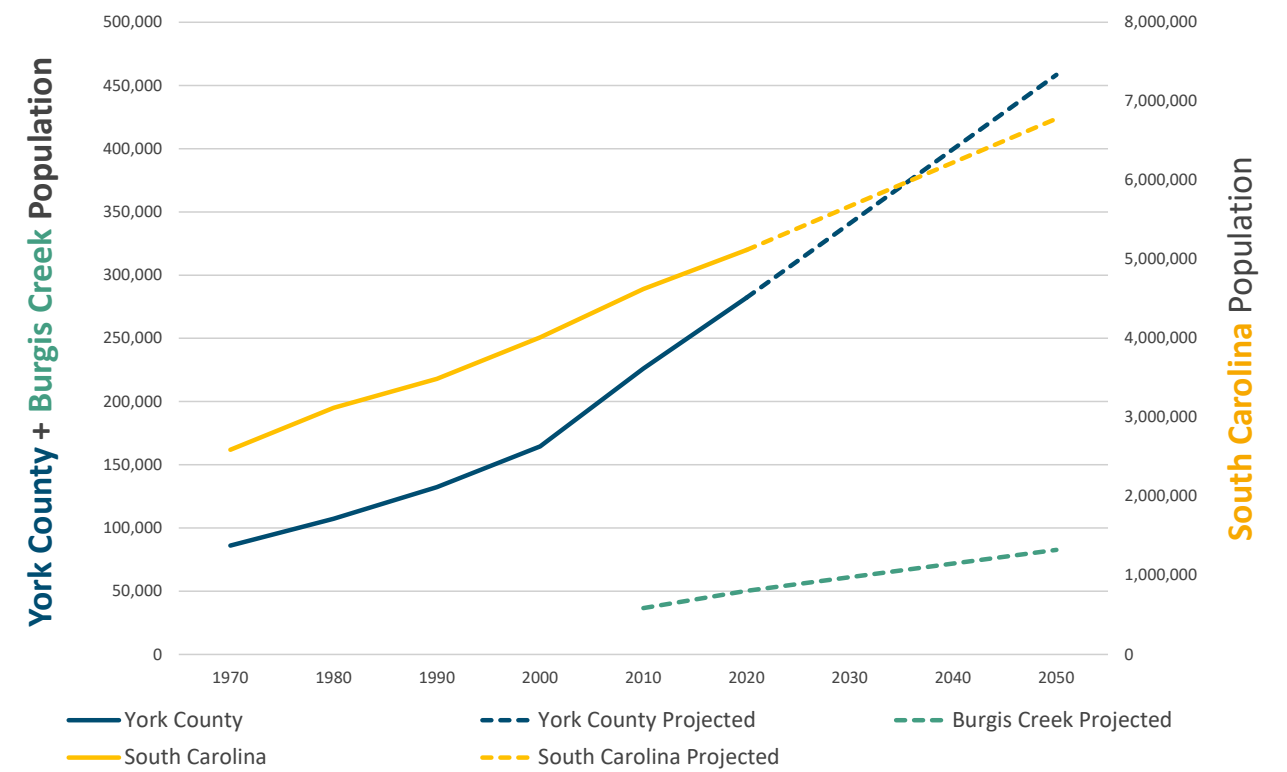


Figure 1.24 Graph depicting future population growth for South Carolina, York County, and the Watershed

In 2020, the Burgis Creek Watershed was home to approximately 50,900 people. Because of the recent changes to U.S. Census tracts, it is not possible to accurately estimate the population within the watershed prior to the 2020 census. However, there is data available that shows the population growth in York County and South Carolina between 1970 and 2020.

Both South Carolina and York County have experienced significant population growth since the 1970s. The population in York County grew 107% between 1970 and 2020. The population in South Carolina grew 66% during the same time (U.S. Census Bureau, 1970-2020). If the population of the Burgis Creek Watershed grows at the same rate as York County, then the projected 2050 population will be 82,641. These growth trends and predictions can be seen in Figure 1.24.

The additional residents in the watershed will help grow the economy of the area; however, they will need additional housing and amenities that will result in converting open space to roads, roofs, and parking lots. It will be crucial to increase efforts to protect the watershed from the hydrologic changes that could result from those land use conversions.

Local Interest in Protection & Restoration

The City of Rock Hill is significantly advancing environmental preservation, especially through its stream restoration initiatives. Several projects in this area have already been completed and are described below. In addition, the City is involved in thorough stream assessments, which help pinpoint potential sites for future restoration efforts.

The wider York County community is also engaging in conservation activities, such as the litter sweeps shown in Figure 1.25. These activities are spearheaded by York County Stormwater and Environmental Compliance, which focuses on protecting local waterbodies. In addition, several conservation organizations are leading efforts to preserve the environment within the watershed.



Figure 1.25 Volunteer litter sweep (Keep York County Beautiful)

Catawba Riverkeeper

Founded in 1997, the Catawba Riverkeeper’s mission is to “preserve, protect, and restore the waters of the Catawba-Wateree River basin for all through education, advocacy, and engagement.” This organization operates in both North and South Carolina and advocates for both the Catawba River and for those who utilize the river for livelihood and recreation.

The Catawba Riverkeeper also offers a plethora of volunteer and special events. These events include annual Riversweeps across more than 50 sites, public cleanup events, a Riverkeeper Explorers Camp, a Trash Trap Program, RiverFest, and Jam at the Dam live music event. More information about the Catawba Riverkeeper can be found on their [website](#) (Catawba Riverkeeper, 2023).



Figure 1.26 Fort Mill 2022 annual RiverSweep

Fort Mill Second Saturday Service

Partnered with the Anne Springs Close Greenway, the Town of Fort Mill offers a monthly volunteer opportunity through their Second Saturday Service program. The program hosts litter clean ups in Fort Mill’s high trash areas. Volunteers can meet monthly at designated locations or pick up supplies to go pick up litter at their preferred location. They encourage individuals, groups, businesses, and students to get involved in this program. Sign up or learn more on their [website](#).



Keep York County Beautiful

Founded via York County Ordinance No. 710 in 2010, the Keep York County Beautiful board is an affiliate of the larger Keep America Beautiful organization. They accomplish their mission of “inspiring and encouraging citizens to take personal responsibility for improving the environment of their York County community” through volunteer cleanup programs, site adoption programs, and public education. These educational outreach efforts include recycling and litter prevention presentations, promoting apartment community recycling and beautification of public spaces, and working with local businesses on waste reduction practices (York County, 2023). More information about the Keep York County Beautiful board can be found on their [website](#) and [Facebook page](#).



Rock Hill Clean & Green

This City-sponsored organization was certified as a Keep America Beautiful affiliate in 1987. It is comprised of 15 volunteers that are appointed by the City Council. Its mission is to “promote litter reduction, beautification and recycling through public awareness, education and special events designed to reach every segment of the population; to make recommendations to city government on programs, policies and codes which impact these issues.” To help accomplish this mission, Rock Hill Clean & Green participates in America Recycles Day, the Earth Day Birthday, the Great American Clean-Up, and sponsors Rock Hill litter pick-ups. As a result of their dedication, Rock Hill Clean & Green won a national award for its environmental education programs among numerous other state and national accomplishments (City of Rock Hill). More information about Rock Hill Clean & Green can be found on their [website](#).



Recent Watershed Improvements

College Ave. Detention Basin

This project installed a detention basin at 350 College Ave in Rock Hill. During heavy rainfall events, the area experienced downstream flooding which caused stream erosion. The goal of the project was to reduce the frequency of flooding, improve water quality by reducing stream velocity, reducing/eliminating downstream bank erosion, etc.



Figure 1.27 Completed Detention Basin on College Ave (City of Rock Hill)



Figure 1.28 Eroded Stream Bank (City of Fort Mill)

Stream Bank Stabilization

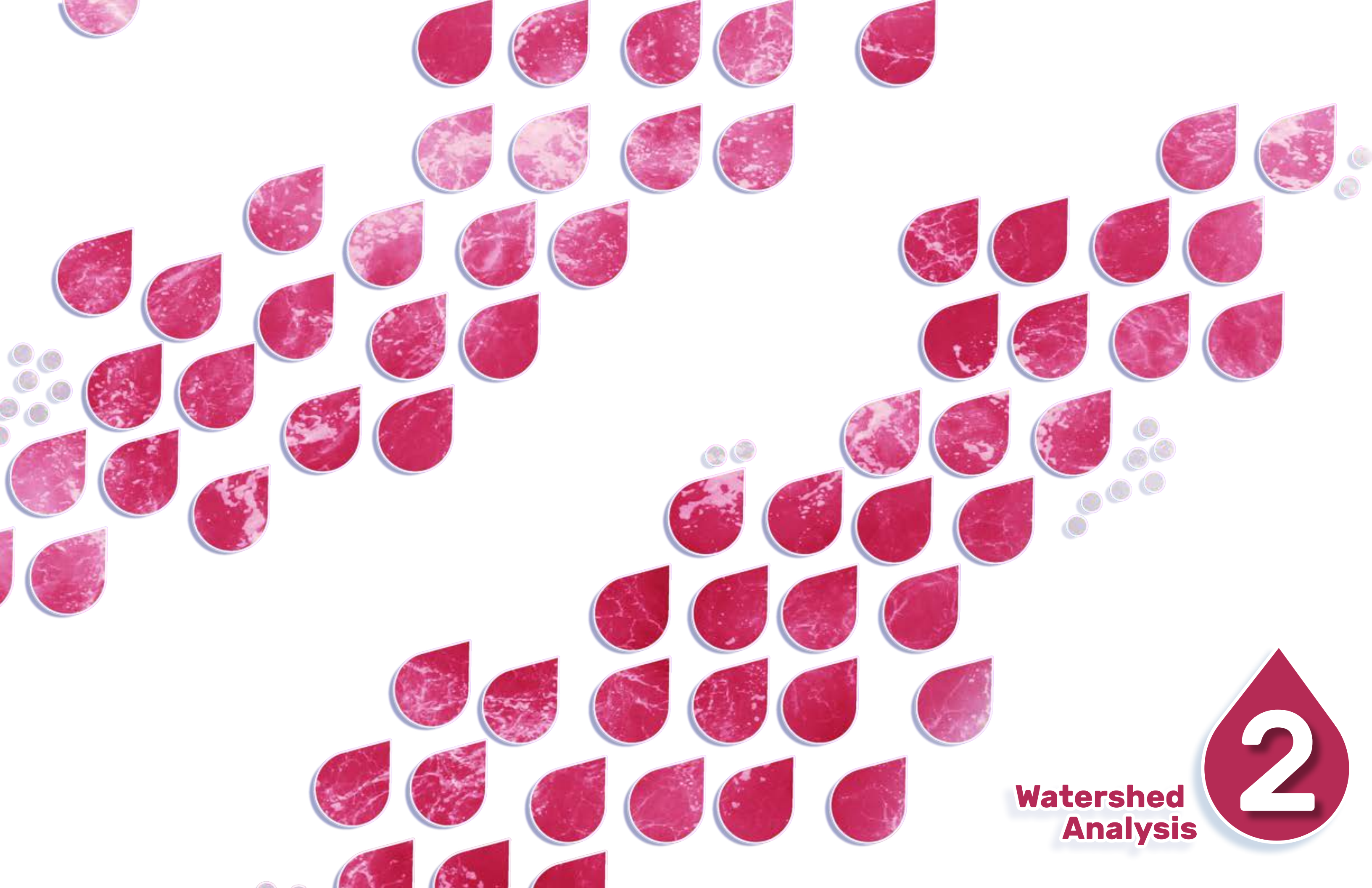
This project aims to restore riparian buffer restoration and provide learning opportunities to local students. High levels of stormwater have caused unstable creek banks, undercutting of trees and erosion of stream banks. Under guidance, students in Fort Mill School District high schools will have the opportunity to propagate native riparian plants, remove invasive plants, and plant the propagated native plants in the riparian zone of a local creek, located in a public park.

Cauthen Street Improvement

This project established a permanent green space by removing the house and other impervious surfaces on the property in Rock Hill. The land was excavated for ponding area, and landscaping was installed. The goal of this green space was to alleviate flooding in the surrounding areas.



Figure 1.29 Completed Cauthen Street Improvement (City of Rock Hill)



**Watershed
Analysis**

2

Watershed Analysis

The [South Carolina Pollution Control Act](#) and [SC Regulation 61-68: Water Quality Classifications and Standards](#) establish a classifying system for the state's waters, assigning uses to each classification, and assigning standards that must be maintained to support those uses.

Water Quality Classification & Standards

The primary goal of these rules is to maintain waters that meet water quality standards and restore waters that do not. A water is considered impaired if it does not meet the standards associated with its water quality classification. All freshwaters (FW) in South Carolina are required to be of sufficient quality to support the uses shown in Figure 2.1.

SC Regulation 61-69: Classified Waters lists the classification and boundaries of waterbodies in South Carolina. The purpose of water quality classifications is to protect water quality as well as public health, safety and welfare. These standards also assist SCDES in making decisions about establishing pollutant limits when it issues wastewater and stormwater permits.

In the Burgis Creek Watershed, all waters are classified as Freshwater (FW). Figure 2.2 summarizes some of the water quality standards associated with the FW classification.

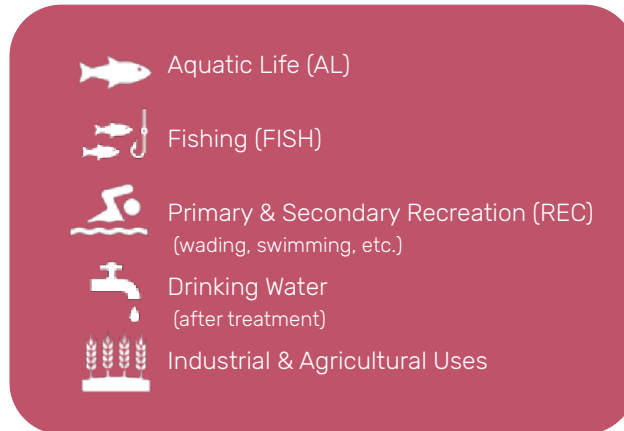


Figure 2.1 Uses that all freshwaters in SC should support

| Pollutant | Water Quality Standard |
|--|--|
| <i>E. coli</i> | Not to exceed 349 CFU / 100 mL for a single sample, and a geometric mean not to exceed 126 CFU / 100 mL for 4 samples within a 30 day period |
| Turbidity | Not to exceed 25 NTUs for lakes, and not to exceed 50 NTUs for other waters |
| pH | 6.0 - 8.5 |
| Dissolved Oxygen | Daily average not less than 5.0 mg/L |
| Nonpoint Source Runoff | Allowed if uses are maintained and protected |
| Garbage, Ashes, Oils, & Sludge | Not allowed |
| Permitted Discharges of Treated Wastes | Allowed if permit conditions are met and uses are maintained and protected |

Figure 2.2 Table summarizing SCDES water quality standards for Freshwater (FW)

Impairments & TMDLS & Watershed Plans

The term "303(d) list" is a state's list of impaired and threatened waters (e.g. stream/river segments, lakes). The EPA requires all states to develop a list of waterbodies that do not meet water quality standards. This requirement comes from Section 303(d) of the Clean Water Act, hence the name for the list. The purpose of the list is to identify impaired waters and the source of impairment so that corrective actions can be taken to improve water quality. EPA mandates that the 303(d) list of impaired waters be developed by the states every two years and submitted to EPA for approval.

In South Carolina, the 303(d) list cycles begin on even-numbered years. In developing [South Carolina's 303\(d\) list](#), SCDES solicits and evaluates all existing and readily available water quality data collected over the previous 5 years.

Figure 2.3 shows the current 303(d) list entries located within the Burgis Creek Watershed.

| BASIN | STATION | DESCRIPTION | 2020 IMPAIRED USE | 2020 STATUS | 2020 CAUSE | 2022 IMPAIRED USE | 2022 STATUS | 2022 CAUSE | PRIORITY RANK |
|---------|---------|----------------------|-------------------|-------------|------------|-------------------|-------------|------------|---------------|
| CATAWBA | CW-014 | CATAWBA RVR AT US 21 | REC | IMPAIRED | ECOLI | REC | IMPAIRED | ECOLI | 3 |

Figure 2.3 SCDES's 303(d) list entry for Burgis Creek

The SC Watershed Atlas displays the state's water quality monitoring sites and 303(d) listed waterbodies and a wide variety of additional watershed data, including water quality classifications, floodplains, permitted discharges, and some additional information as shown in Figure 2.4. SCDES has performed water quality monitoring in the Burgis Creek Watershed, where South Carolina Highway 161 crosses Hidden Creek.

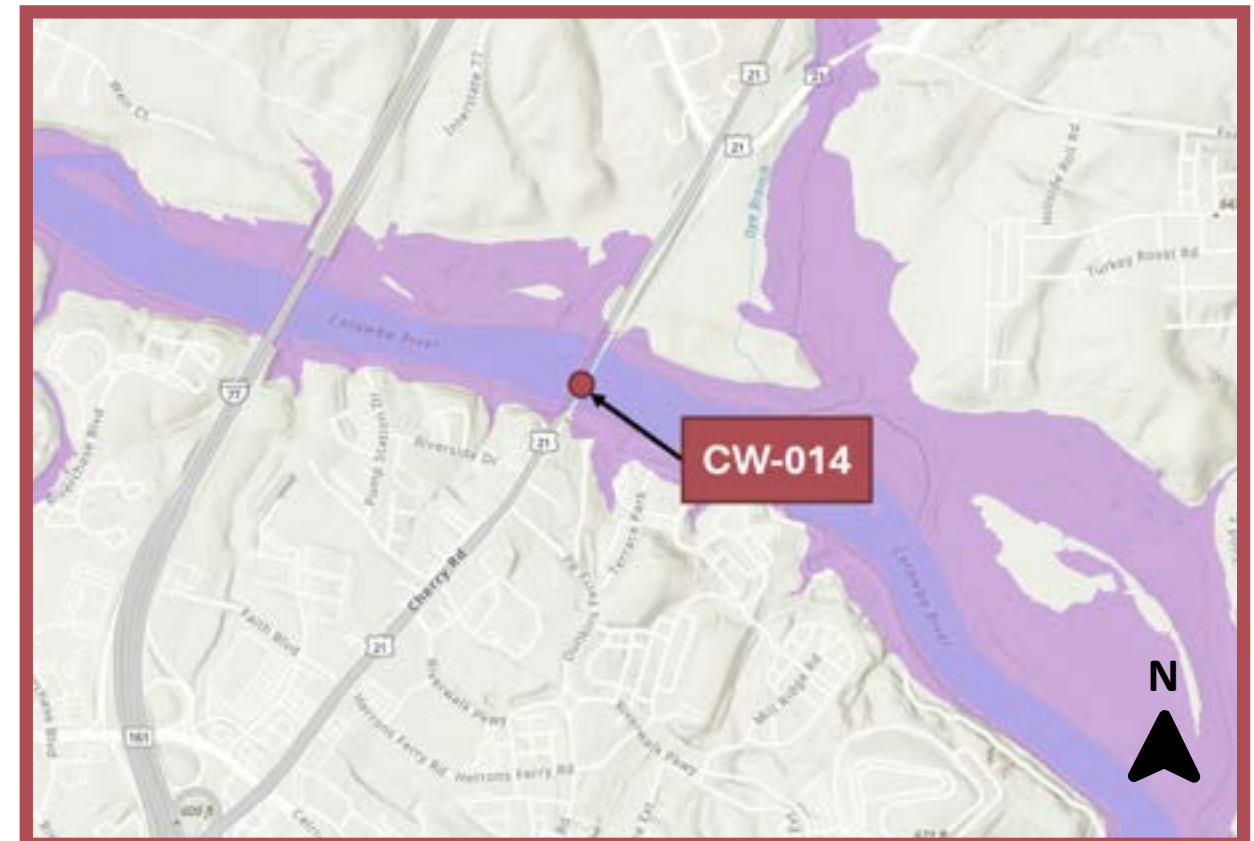


Figure 2.4 Screenshot of SC Watershed Atlas showing an SCDES monitoring station impaired for *E. coli*

Burgis Creek Watershed TMDL

According to the Clean Water Act, each state must develop TMDLs (Total Maximum Daily Loads) for all the waters identified on their Section 303(d) list of impaired waters, according to their priority ranking on that list. The TMDL is a calculation of the load reduction needed for a waterbody to meet its uses and assigns the load reductions required for the various pollutant sources (both point and nonpoint). TMDLs must account for seasonal variations in water quality and provide a margin of safety to account for uncertainty in predicting how well pollutant reductions will result in meeting water quality standards. TMDLs must be approved by both SCDES and the EPA.

The objective of this Watershed Plan is to address the pollutants listed under 303(d) list, with the goal of restoring water quality to such an extent that the implementation of a TMDL may be rendered unnecessary. It is important to clarify that while the plan aims to preempt the need for a TMDL by addressing these pollutants, the achievement of this goal cannot be guaranteed. Should the water quality not reach the required standards, a TMDL may still need to be developed in the future. Waters identified on the 303(d) list can be delisted after they have either met the water quality standards, had a TMDL developed/ approved, or the listing analysis that was conducted contained errors.

Each of the waters listed in the 303(d) list is assigned one of the following priority ranks depending on how soon it will be addressed by a TMDL:

1. **Current: 2022-2024**
2. **Near Term: 2024 - 2026**
3. **Long-Term: After 2026**

CW-014, impaired for *E. coli* in the Burgis Creek Watershed, has been assigned a priority rank of "3," which would allow time for this Watershed Plan to be implemented and, hopefully, for the SC water quality standard to be achieved.

As seen in Figure 2.5, the Burgis Creek Watershed is largely unimpaired aside from a small unnamed tributary in the western portion of the watershed. In 1999, SCDES established a TMDL for fecal coliform bacteria in the Burgis Creek Watershed. Nonpoint source pollution was determined to be the primary cause of fecal coliform within the Burgis Creek Watershed. Sources of this contamination include urban development, pastureland, failing septic systems, leaking sanitary pipes, and livestock activities (SCDES, 2002).

In their efforts to assess and improve water quality within the Burgis Creek Watershed, SCDES established a TMDL monitoring site along Hidden Creek. According to the data presented, this location has reported water quality levels that do not meet the criteria necessary to support its designated uses. These designated uses typically include recreational activities (such as swimming or fishing), supporting aquatic life, or providing safe drinking water.

| Station Number | Attainment Status |
|----------------|-------------------|
| CW-221 | Use Not Supported |

By implementing the management measures discussed in Section 5 to reduce pollutants, this plan will contribute directly to achieving the TMDL goals set for the Burgis Creek Watershed.

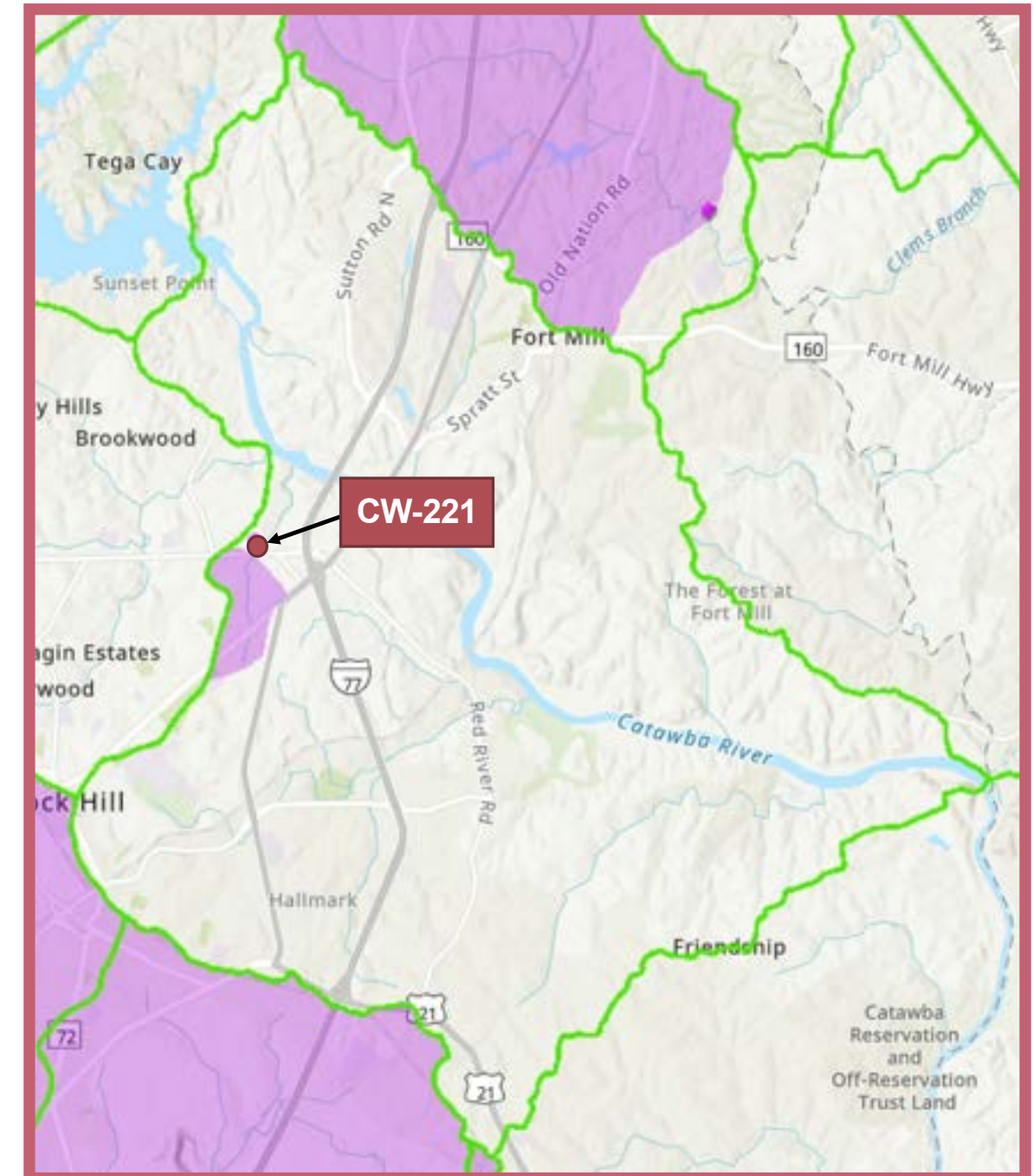


Figure 2.5 Portion of Burgis Creek Watershed with approved TMDL

E. coli Description & Monitoring Data

E. coli, short for *Escherichia coli*, is a type of bacteria found in the fecal matter of farm animals, humans, wildlife, and pets. Although most *E. coli* strains are harmless, some can cause serious illness. These pathogenic strains can contaminate water, which is why SCDES has established water quality standards for this pollutant.

E. coli belongs to a broader group known as fecal coliform bacteria as shown in Figure 2.6. Monitoring for fecal coliform is common in water quality sampling due to the challenges and expenses associated with more specific tests. Since *E. coli* is a subset of fecal coliform, measuring the total fecal coliform can provide an estimate of *E. coli* presence.

In 2013, SCDHEC transitioned from using Fecal Coliform to *E. coli* as the bacterial indicator for assessing bacterial pollution in water bodies. This shift was made to align with more current and reliable methods for detecting bacterial contamination. However, all the SCDES data incorporated into this watershed plan was collected before this change, and is thus reported in terms of Fecal Coliform concentrations. To maintain consistency with the updated standard and enable accurate comparisons, this report converts Fecal Coliform measurements to *E. coli* equivalents. SCDES has determined a conversion ratio where 400 units of Fecal Coliform are equivalent to 349 units of *E. coli*. This conversion ensures that historical data aligns with modern reporting and regulatory standards (SCDES, 2020).

E. coli concentrations are quantified as colony forming units (CFU) per 100 milliliters (mL), with a CFU representing an estimate of the number of viable bacterial cells in a sample. Figure 2.7 illustrates the SCDES sampling results from station CW-221, showing levels against a water quality standard of 349 CFU/100 mL for *E. coli*. The data suggests that a 12% reduction in *E. coli* levels is a necessary goal to meet water quality standards in the Burgis Creek Watershed.

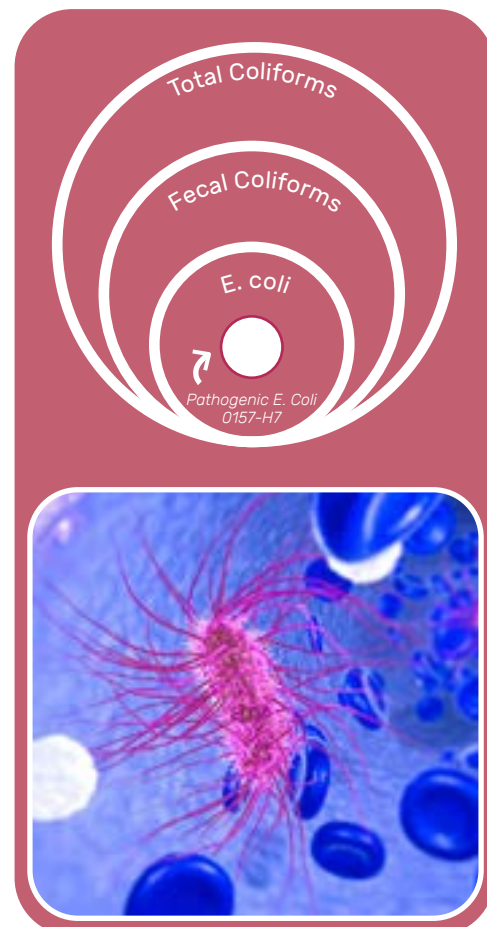


Figure 2.6 *E. coli* explanation and image of *E. coli* bacteria (Alabama Cooperative Extension Service, 2022)

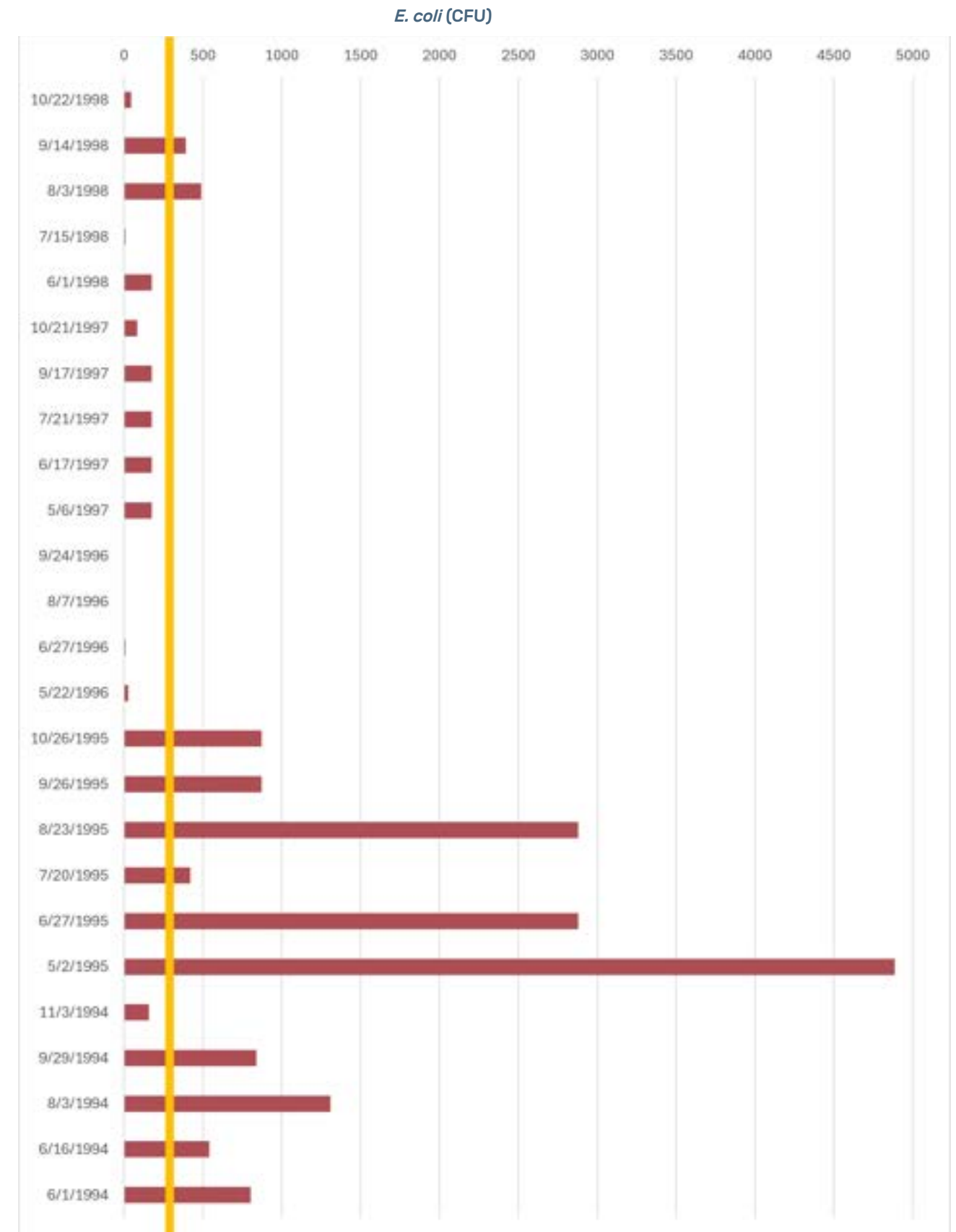


Figure 2.7 Most recent *E. coli* sampling results

Total Nitrogen & Total Phosphorus Description

Nitrogen and phosphorus are both nutrients, which are substances that provide nourishment that is essential for growth and maintenance of life. Although plants and animals require nutrients to survive and thrive, human activities in the watershed can contribute much higher levels of nutrients than are typically found in an undeveloped watershed. Elevated levels of nutrients in waterbodies can trigger an algal bloom, like the one shown in Figure 2.10 below. Algal blooms can be toxic to humans and animals. They also block sunlight that is needed by other aquatic plankton (small plants in the water) and animals, causing them to die and decompose, which then depletes the water of oxygen and endangers the health of the entire ecosystem (Water Science School, 2018).

The main sources of nitrogen and phosphorus in a developed watershed are:

- Fertilizers. Although fertilizer promotes plant growth, when it is improperly applied, excess nutrients can be transported to waterbodies in stormwater runoff or through groundwater via infiltration.
- Human waste. Improperly functioning septic systems and sanitary sewer overflows can cause human waste and its associated nutrients to be transported to waterbodies in stormwater runoff.
- Animal waste. When pet waste is not cleaned up and properly disposed of, or if livestock are not separated from streams, animal waste and its associated nutrients can reach waterbodies through direct deposition or stormwater runoff.
- Atmospheric deposition. Emissions from vehicles contain nitrogen compounds that can be deposited on land and carried to waterbodies in stormwater or deposited directly in waterbodies. Phosphorus can also be carried by the atmosphere and deposited on the land and water.

In this Watershed Plan, nitrogen is measured as Total Nitrogen (TN). TN includes several different nitrogen compounds such as nitrate-nitrate (NO_2 and NO_3 in fertilizer and car emissions), ammonia (NH_3 in fertilizer and animal waste), and organic nitrogen (from plant and animal debris). TN compounds are frequently dissolved in water and can be removed by plant uptake or chemical processes. Figure 2.11 shows the complexities of the nitrogen cycle.

Phosphorus is measured in the Watershed Plan as Total Phosphorus (TP). TP includes several different inorganic compounds as well as organic phosphorus from plant and animal debris. TP is usually easier to remove from stormwater than TN because many of the phosphorus compounds bind with sediment, allowing them to be filtered or settled out. Figure 2.12 shows the phosphorus cycle.

Although the Burgis Creek Watershed is not currently impaired for TN and TP, the goal is to control and reduce the existing sources of nutrients and prevent new ones so that nutrients will not become a cause of impairment to this watershed in the future as the watershed continues to develop.



Figure 2.10 Photo of algal bloom in York County, SC (McAdams)

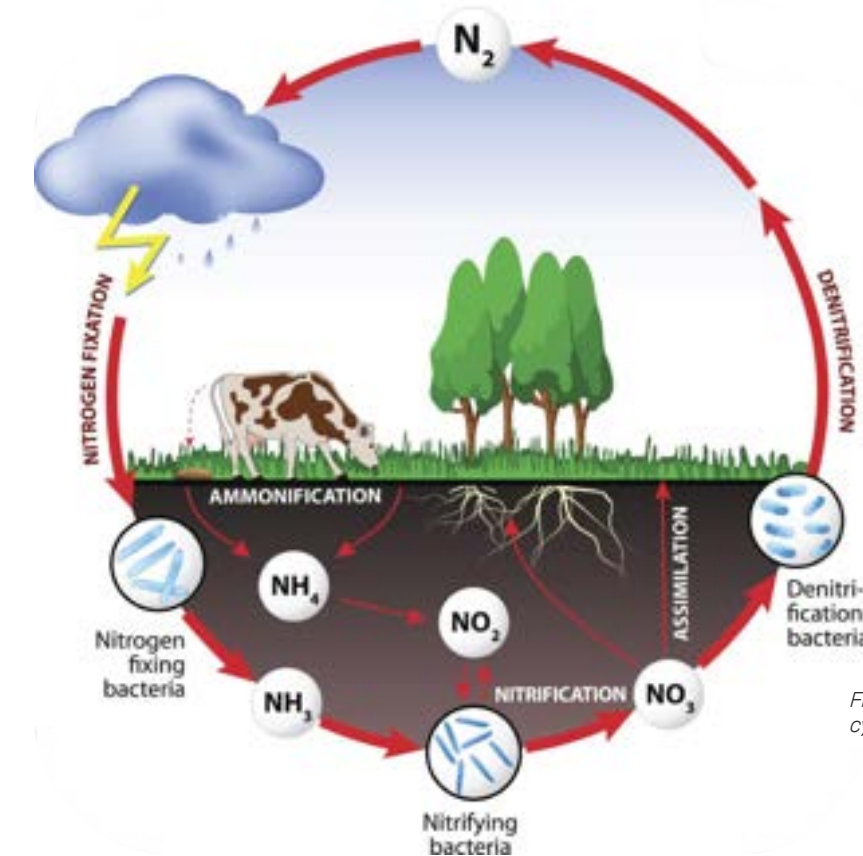


Figure 2.11 The nitrogen cycle (Vermont Public)

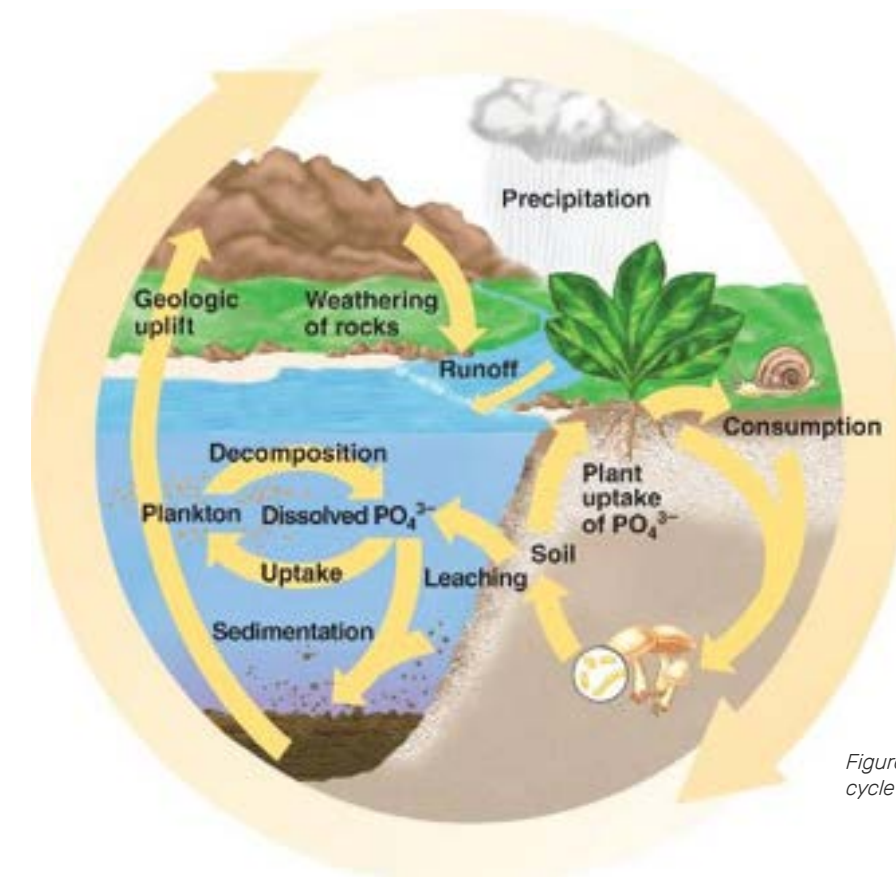


Figure 2.12 The phosphorus cycle (Socratic)

Hydrologic Impacts

The Burgis Creek Watershed is not currently impaired for hydrologic impacts to aquatic life. However, the goal of this Watershed Plan is to prevent “failure to support aquatic life” as a cause of impairment in the future as the watershed continues to develop. As watersheds urbanize, several hydrologic changes occur. Development raises the elevation of low areas, which previously provided storage, and paves over pervious areas, which previously provided opportunities for infiltration. The addition of curb and gutters with storm sewer systems quickly directs more runoff to streams and lakes. Left unchecked, hydrologic impacts cause serious damage to the physical and biological integrity of the receiving stream, such as the flooding and erosion depicted in Figure 2.16 and 2.17. These impacts include:

- Increased speed and volume of flow within the stream compared to pre-development conditions;
- Increased frequency of flooding;
- Wider stream channels due to increased storm flows. Streambanks are undercut and slump into the channel;
- Weakened trees along the streambank due to exposed roots. When these trees fall, a second phase of bank erosion can be triggered;
- Elimination of aquatic habitat through sedimentation;
- Diminished groundwater flow to streams, causing less flow to streams between storm events;
- Decreased aquatic biodiversity as sensitive species are reduced or eliminated;
- Substantially increased pollutant volume entering the stream system;
- Increased stream temperatures, which can further harm aquatic plants and animals.



Figure 2.14 Streambank erosion caused by hydrologic impacts (Clemson University)

Objective Statement

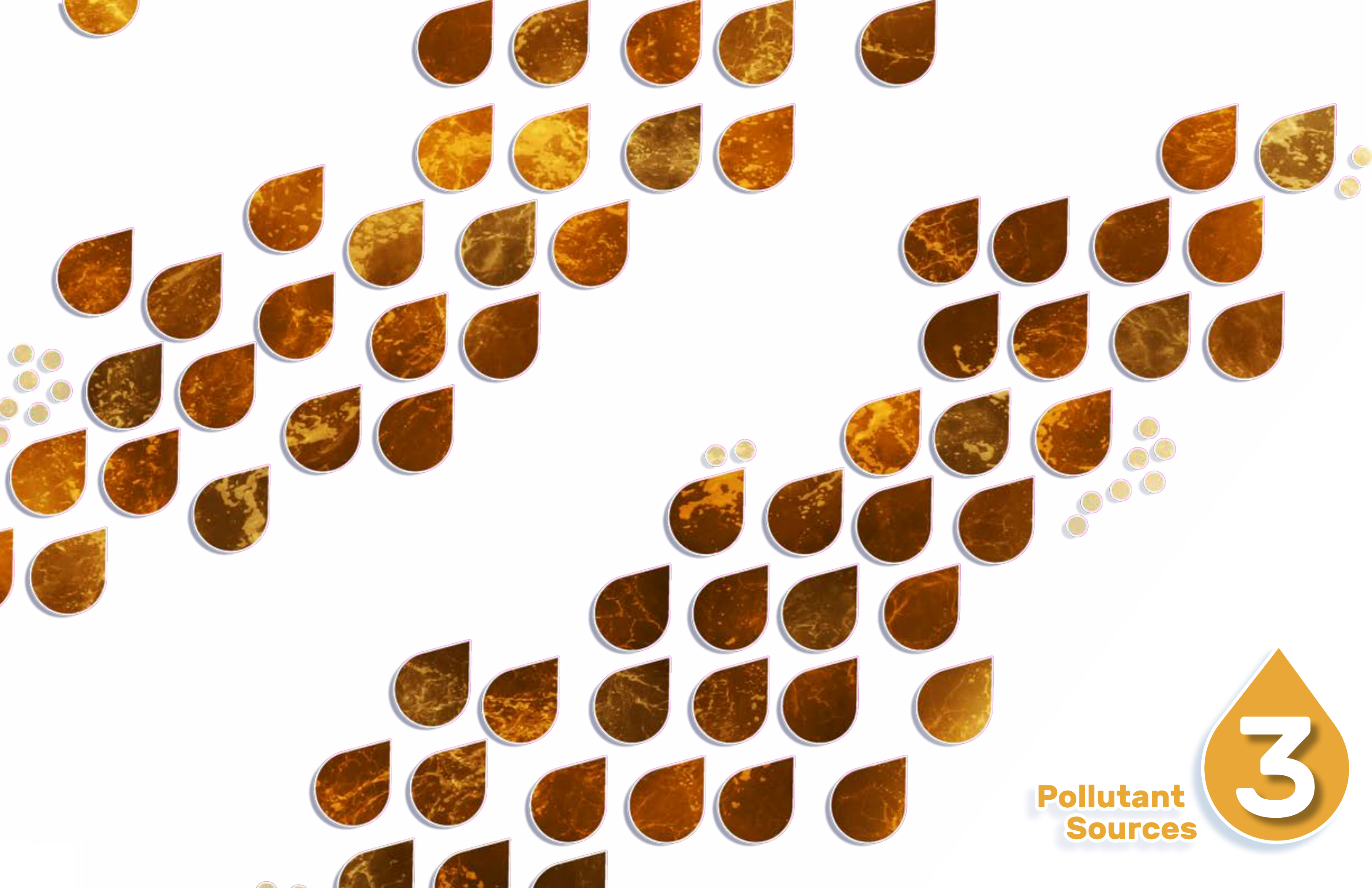
The main objective of this Watershed Plan is to propose management measures that will lead to a sufficient reduction of *E. coli* bacteria within the watershed so that Burgis Creek will meet the required water quality standards. Additional objectives identified by the Key Partners and concerned citizens are to reduce nutrients and hydrologic impacts from development.

More specifically, this Watershed Plan seeks to implement a variety of practical and cost-effective management measures that, when implemented together, achieve the following:

1. Reduce bacteria and nutrients from humans (numeric goal: 12% reduction in *E. coli*, a 9% reduction in TN, and a 21% reduction in TP);
2. Reduce bacteria and nutrients from animals (numeric goal: 12% reduction in *E. coli*, a 9% reduction in TN, and a 21% reduction in TP);
3. Reduce/prevent hydrologic impacts from development (numeric goal: provide at least 5 measures to restore hydrology in the next 5 years while increasing hydrologic protection on new development projects); and
4. Increase education and outreach (no numeric goal).



Figure 2.13 River and creek flooding (Independent Mail)



**Pollutant
Sources**

3



Pollutant Sources

This section addresses Element A – identify causes and sources of pollution and the first part of Element B – estimate pollutant loading.

Summary of Impairments, Causes, Sources & Impacts

Hidden Creek is on the 303(d) list based on water quality monitoring data showing levels of *E. coli* that significantly exceed the SC water quality standard. Therefore, addressing the potential sources for *E. coli* is a focus for this Watershed Plan. Key partners and involved citizens have identified several concerns beyond *E. coli* to address in this Watershed Plan: Total Nitrogen (TN), Total Phosphorus (TP), and hydrologic impacts from impervious surfaces. The causes, sources, and waterbody impacts associated with each of the impairments is described in Figure 3.1.

| Impairment | Causes | Potential Sources | Waterbody Impacts |
|------------------------------------|------------------------|--|---|
| <i>E. coli</i> (from 303d list) | Point Sources | Sanitary sewer leaks/overflows | <ul style="list-style-type: none"> • Health risks to animals • Potentially serious or even fatal health risks to humans • Loss of recreational resources |
| | Septic Systems | Unmaintained and failing septic systems | |
| | Other Nonpoint Sources | Pet waste, geese, wildlife, livestock, and stormwater runoff | |
| TN and TP (from observations) | Point Sources | Sanitary sewer leaks/overflows | <ul style="list-style-type: none"> • Algal blooms • Health risks to humans and animals • Loss of recreational resources |
| | Septic Systems | Unmaintained and failing septic systems | |
| | Other Nonpoint Sources | Excessive fertilizer, pet waste, geese, wildlife, livestock | |
| Sediment (from observations) | Nonpoint Sources | Increased impervious cover, mismanaged construction sites, and runoff from streets, roads and yards. | <ul style="list-style-type: none"> • Eroded streambanks • Loss of riparian habitat and property • Risks to human health and safety |

Figure 3.1 Table summarizing the impairments, causes, sources and impacts in the watershed



Figure 3.2 Point source pollution example (Encyclopædia Britannica, 2023)

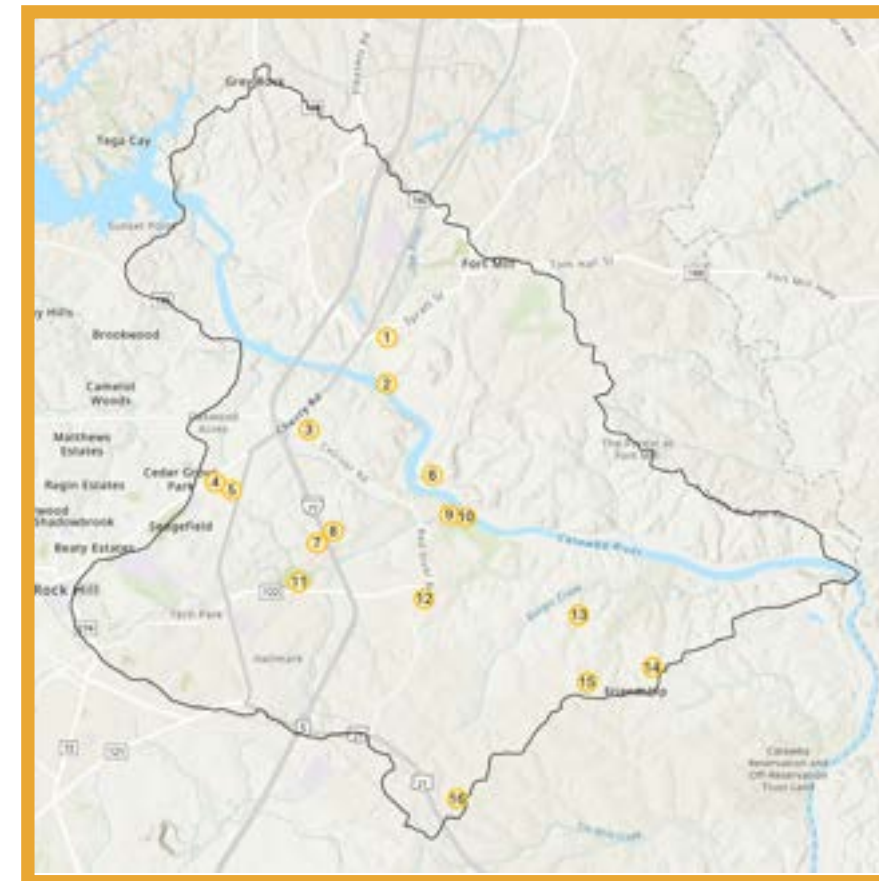


Figure 3.3 Permitted facilities within the watershed

| Site # | Name | Permit |
|--------|--|-----------|
| 1 | Town of Fort Mill | SC0020371 |
| 2 | Fort Mill WWTP | SC002037 |
| 3 | Inchem Corporation | SCG250111 |
| 4 | Rock Hill Water Reclamation Facility-Reuse | ND0086011 |
| 5 | Rock Hill/ City of WTP | SCG646030 |
| 6 | Nation Ford Chemical Company | SC0035360 |
| 7 | Cornerstone Develop/I-77 Mine | SCG730587 |
| 8 | I-77 Mine Site | I-001292 |
| 9 | Rock Hill Manchester Creek WWTP | SC0020443 |
| 10 | Rock Hill/ Manchester Creek | SC0020443 |
| 11 | Rock Hill Water Reclamation | ND0086011 |
| 12 | Rock Hill Water Reclamation Facility-Reuse | ND0086011 |
| 13 | Quail Meadow Park | SC0028622 |
| 14 | City of Rock Hill Manchester Creek WWTP | SC0020443 |
| 15 | City of Rock Hill Manchester Creek WWTP | SC0020443 |
| 16 | City of Rock Hill Manchester Creek WWTP | SC0020443 |

What is Point Source Pollution?

Point source pollution is discharged from a discrete location, such as the end of an outlet pipe as seen in Figure 3.2. Wastewater treatment plants and industries, like the sixteen identified in Figure 3.3 below, are required to have a discharge permit from SCDES to discharge treated wastewater. No one is allowed to discharge untreated wastewater, either intentionally or accidentally.

What is Nonpoint Source Pollution?

Unlike point source pollution, nonpoint source pollution does not have a discrete discharge point. Instead, nonpoint sources are areas where pollutants are present on land and are carried away with stormwater runoff. Examples of nonpoint source pollution include nutrients from fertilizers applied to landscaped areas, *E. coli* from pastures, oil and grease from roadways, and sediment from construction sites.

Sanitary Sewer Overflows (SSOs)

Within the Burgis Creek Watershed, there are no discharges of either treated or untreated wastewater from wastewater treatment plants. However, there have been issues with sanitary sewer lines that have caused releases of *E. coli*, nutrients, sediment, and solid waste. Sanitary sewer systems collect and transport domestic, commercial, and industrial wastewater to treatment facilities. Occasionally, releases of raw sewage known as sanitary sewer overflows (SSOs) can occur. SSOs can contaminate surface waters, causing serious water quality problems, and can back up into homes, causing property damage and threatening public health.

Possible causes of SSOs include:

- Blockages;
- Line breaks;
- Construction activities;
- Root intrusion;
- Lack of proper maintenance;
- Vandalism;
- Stormwater inflow and infiltration that overloads the system.

There are two types of SSOs: main line and service line. Main line SSOs occur from a larger sewer line that collects and carries untreated wastewater from many households or businesses to the wastewater treatment plant. Service line SSOs occur from a smaller line that carries wastewater from a single property to the main line. Figure 3.4 shows the difference between main and service lines.

Since 2021, there have been six main line SSOs in the Burgis Creek Watershed (SCDES 2023). These main line SSOs were spread throughout the watershed as seen in Figure 3.5. These SSOs released a total of 211,665 gallons of raw sewage into the watershed. SSOs are important to address water quality in the Burgis Creek Watershed because *E. coli* is a major pollutant of concern. The specific locations of the main line SSOs are shown in Figure 3.5.

Unlike main line SSOs, service line SSOs are often present for an extended time before the property owner notices them. Some of the signs that a service line is failing include sewage backup and soggy areas in the yard, foul odors, foundation cracks, and lush areas of green grass growth above the sanitary sewer line. It is important for property owners to know the location of their sanitary service lines and to understand the signs of a potential SSO so they will be able to take swift action before an SSO damages their property or becomes a significant source of *E. coli* and nutrients.

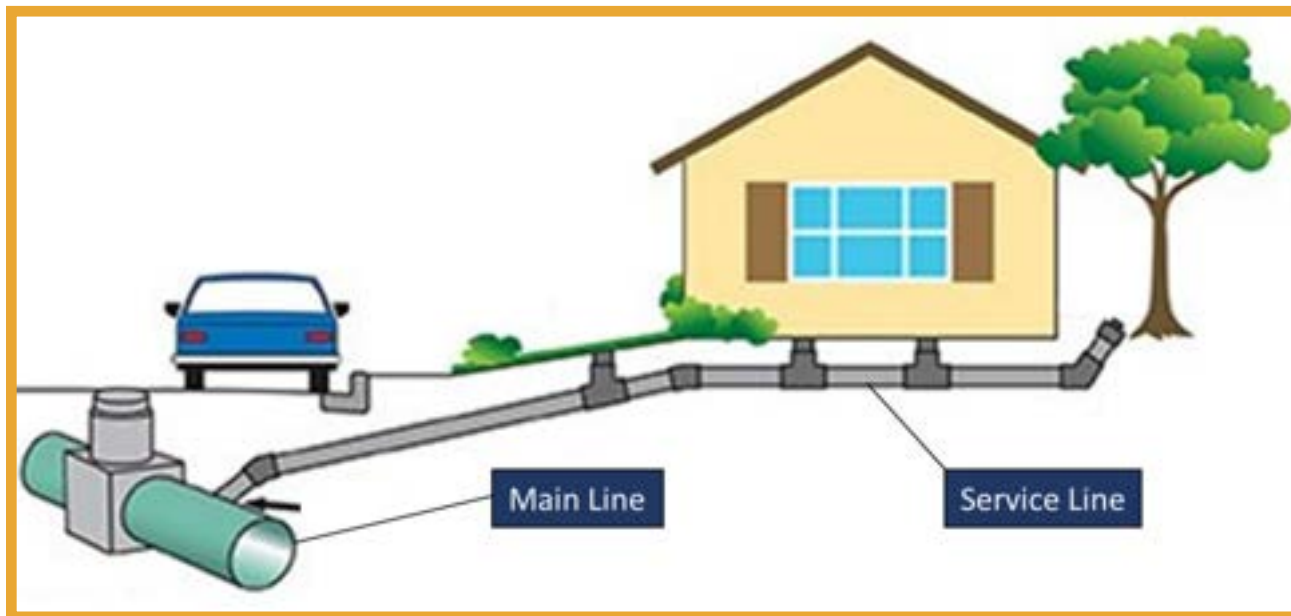


Figure 3.4 Sanitary sewer main line and service line in a typical residence (City of Fargo, North Dakota)

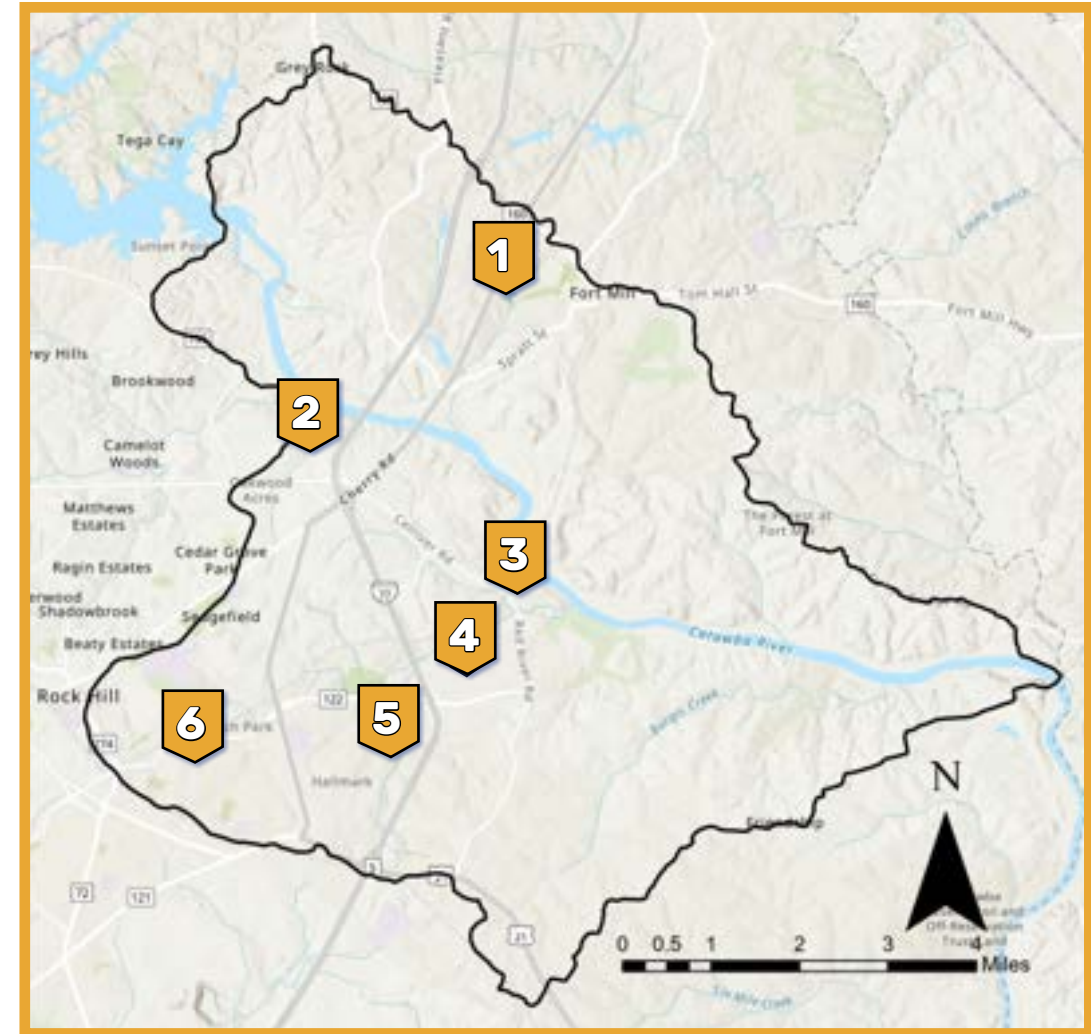


Figure 3.5 Main line SSOs (points 1 through 6) and service line SSOs (heat map) in watershed

1

| | |
|-------------|-------------------------|
| Date | 4/17/2024 |
| Discharge | 350 gallons |
| Cause | Rags/ grease in manhole |
| Remediation | Blockage cleared |

2

| | |
|-------------|---|
| Date | 5/8/2023 |
| Discharge | 5,040 gallons |
| Cause | Grease blockage |
| Remediation | Lime applied to area & blockage cleared |

3

| | |
|-------------|----------------------------|
| Date | 12/23/2021 |
| Discharge | 1,000 gallons |
| Cause | Debris in system |
| Remediation | Absorbent material applied |

4

| | |
|-------------|---|
| Date | 4/27/2023 |
| Discharge | 3,900 gallons |
| Cause | Grease blockage |
| Remediation | Lime applied to area & blockage cleared |

5

| | |
|-------------|---|
| Date | 10/20/2022 |
| Discharge | 180,000 gallons |
| Cause | Grease blockage |
| Remediation | Lime applied to area & blockage cleared |

6

| | |
|-------------|----------------------------|
| Date | 1/9/2024 |
| Discharge | 21,375 gallons |
| Cause | Large volume of stormwater |
| Remediation | Remaining debris cleared |

Septic Systems in Watershed

A septic system consists of a septic tank and a drain field. Wastewater from the household flows into the septic tank, where solids settle at the bottom. The remaining wastewater flows into the drain field, where it is released into the soil through a series of perforated pipes. The soil's physical properties filter out particles, while the microorganisms in the soil break down harmful substances like nitrogen, phosphorus, and pathogens such as *E. coli* bacteria. The effectiveness of a septic system depends on the soil's ability to absorb and filter the wastewater and the proper maintenance of the septic system.

When septic systems fail, untreated wastewater can seep into the groundwater or flow to streams and become a source of *E. coli* and nutrients. The EPA has identified malfunctioning septic systems

as one of the top five sources of groundwater contamination in the country, highlighting the need for proper installation, regular maintenance, and periodic inspections to ensure their effective and safe operation (Gibb, 2022).

As depicted in Figure 3.6, approximately 6,000 parcels within the watershed are estimated to be served by septic systems, representing approximately 32% of the total parcels. This estimate is based on the City of Rock Hill and the Town of Fort Mill's sanitary sewer data because accurate septic system data is not available. This plan recommends the Key Partners generate precise septic system location and condition information. Reliable data is needed for both pollutant modeling and for community outreach and education.

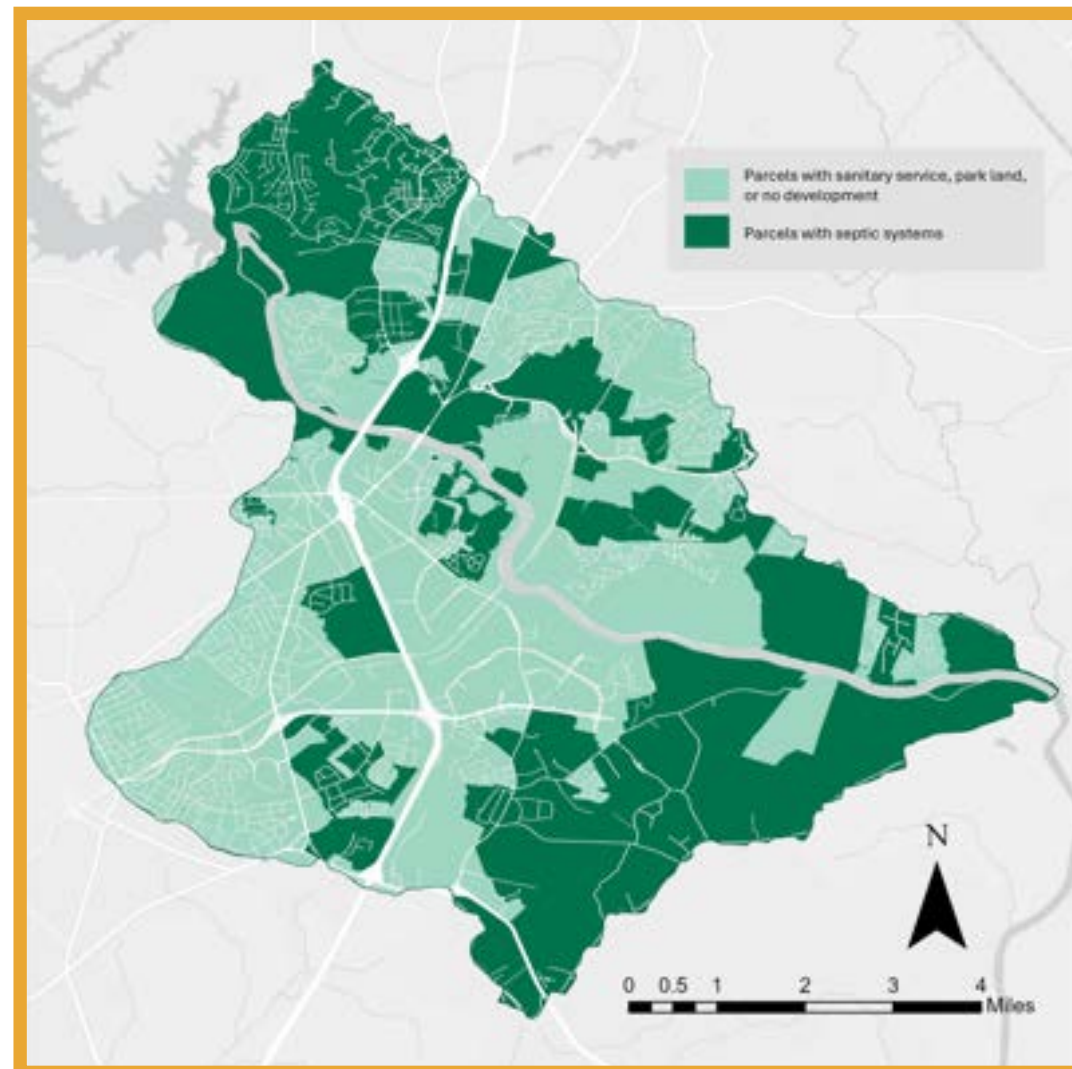


Figure 3.6 Parcels that do not appear to have sanitary service, presumed to have septic systems in watershed

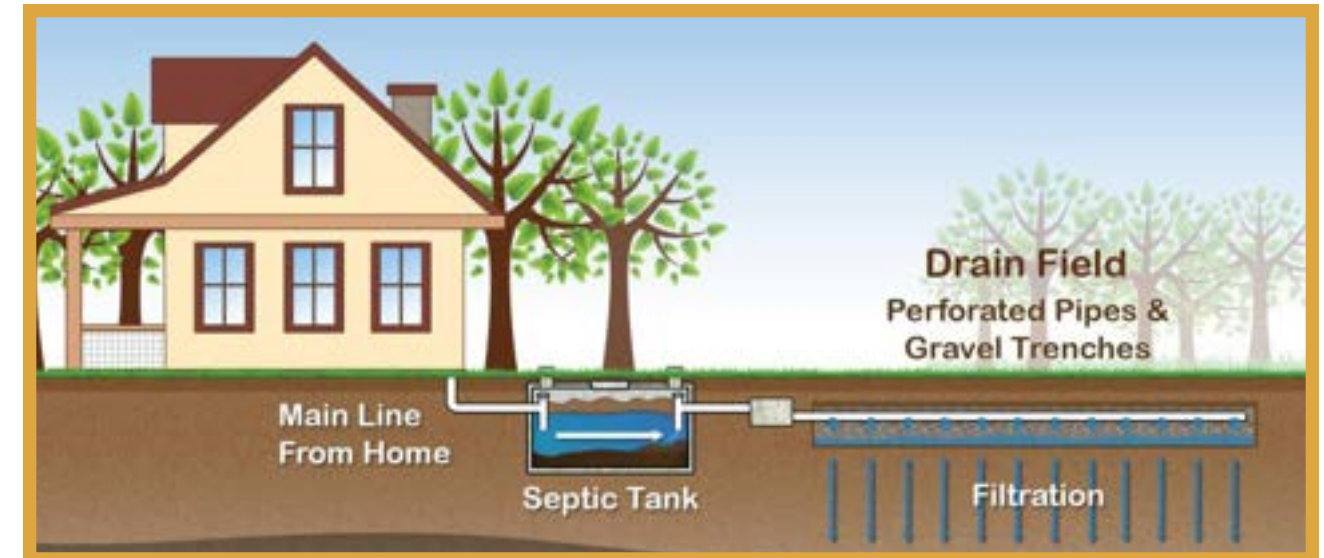


Figure 3.7 Diagram of a septic system (Minnesota Pollution Control Agency 2023)

Figure 3.7 shows how a typical septic system functions. The most clear sign of a septic system failure is a sewage backup that occurs when the tank is clogged or full. Other signs of septic system failures include algal blooms in nearby lakes, slow moving drains, bright green or soggy grass in the yard, standing water, and bad odors. When a septic tank becomes clogged, it is usually necessary to have it pumped out as shown in Figure 3.8.



Figure 3.8 A septic system pump out (Vac-Tec Septic & Water LLC)

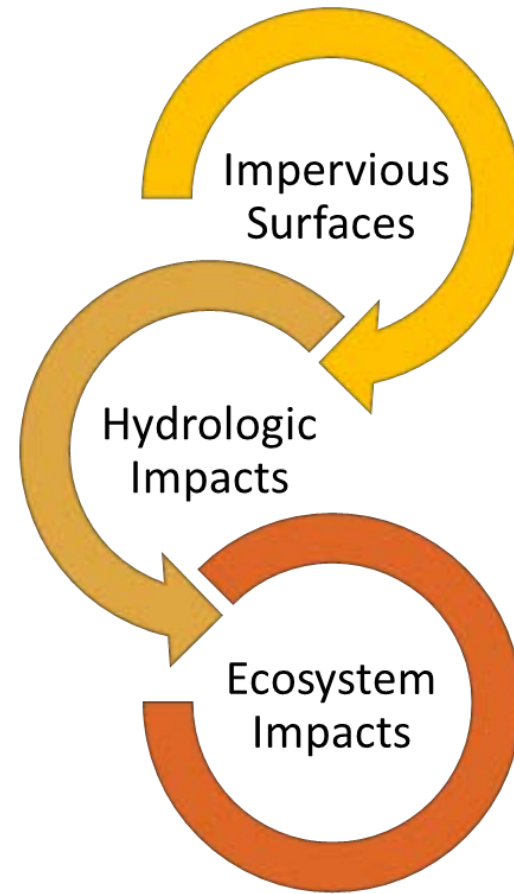
Nonpoint Sources within the Watershed

In the Burgis Creek Watershed, pollution from nonpoint sources far exceeds pollution from point sources. This is also true for most watersheds because the combined volume of stormwater runoff is greater than discharges from wastewater treatment plants, SSOs, and failing septic systems. Some of the stormwater in the watershed is treated in stormwater BMPs, but there is a significant amount of stormwater that enters the streams and impoundments without treatment.

Urban development alters the hydrology and water quality of streams. Roads, parking lots, and buildings increase the impervious cover and restrict the infiltration of precipitation. As a result, stream flows in urban areas often rise rapidly after a rainfall event. This can cause erosion of stream beds and banks and degrade fish spawning and feeding habitats. Other impacts are shown in Figure 3.9. The most common sources of *E. coli* and nutrients in the watershed are fertilizers, pet waste, geese, wildlife, and livestock.

The most prevalent land use in the watershed is residential development which accounts for about 41% of its overall area. Over 23% of the watershed is forested, although this land use may be impacted by future development projects. Pasture comprises a mere 3% of the watershed.

Figure 3.10 shows the relative amounts of each land use type while Figure 3.11 shows the dispersal of land use types throughout the watershed.



Hydrologic Impacts

- Increased Water Volume
- Higher Peak Flows
- Longer Peak Flows Duration
- Warmer Stream Temperatures
- More Pollutant Loading

Ecosystem Impacts

- Flooding
- Degraded Ecosystems
- Impaired Waters

Figure 3.9 Figure summarizing impervious surface impacts

Land Uses in Watershed (acres)

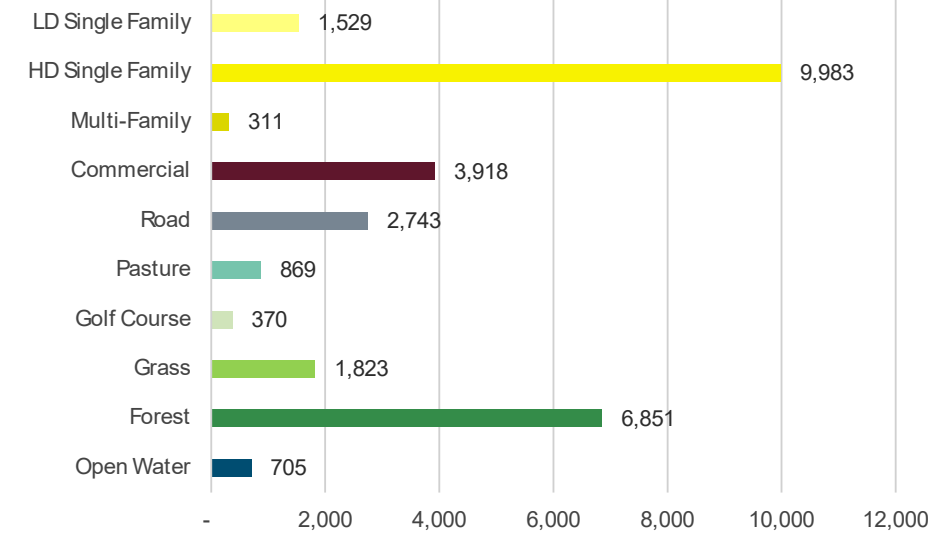


Figure 3.10 Graph summarizing land uses in the watershed (USGS & GIS)

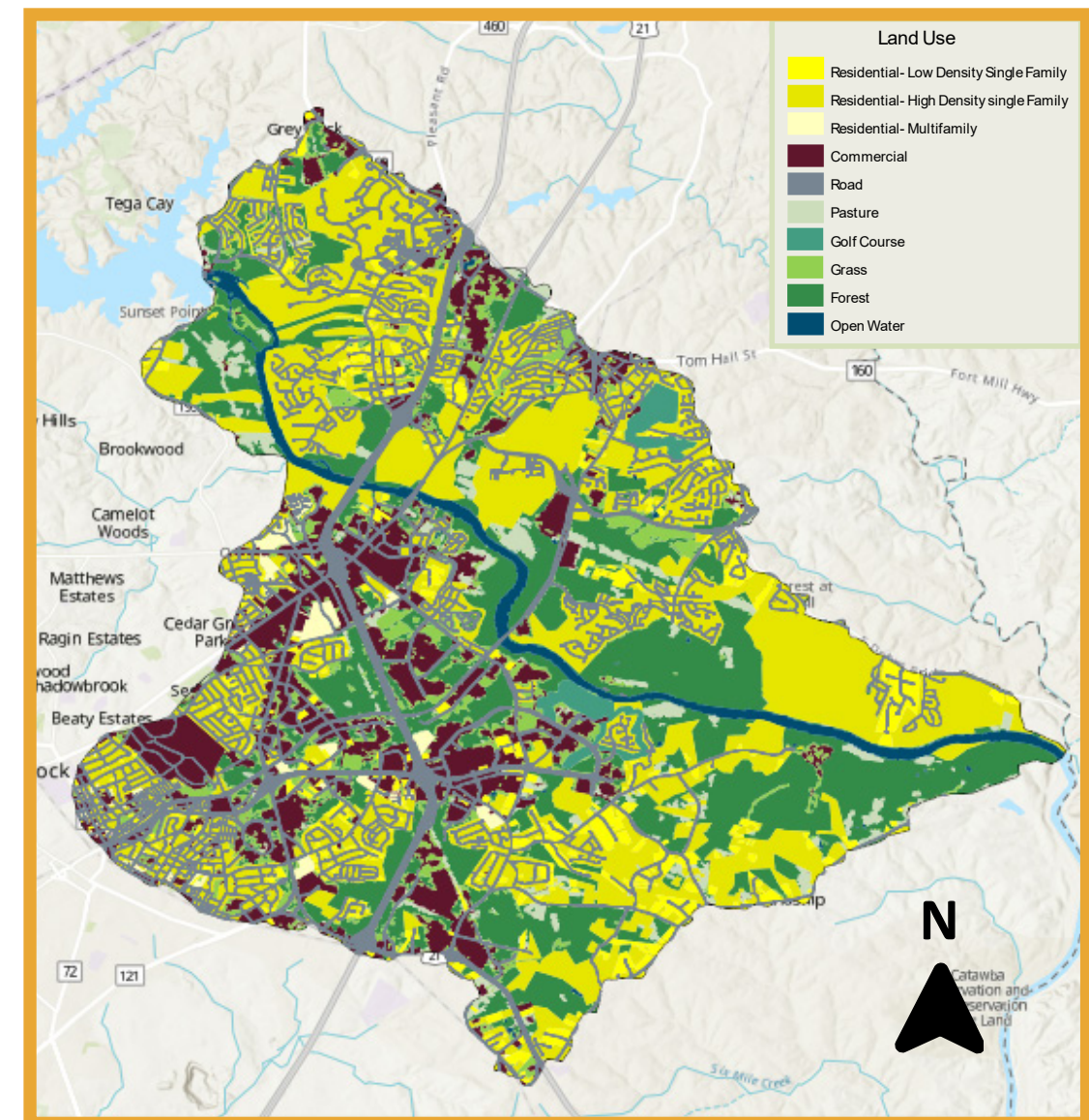


Figure 3.11 Land uses in watershed

Pollutant Loading

The results of the analysis of the pollutants from each source are shown in Figures 3.12 and 3.14 below. They demonstrate that point sources and failing septic systems are relatively small contributors to the overall amount of *E. coli*, BOD, and Turbidity compared to nonpoint sources in the watershed. Nonpoint sources are the largest contributors because they cover all 29,145 acres of the watershed.

High density, single family residential development is the single largest contributor of nonpoint source pollutants since it is the most common land use in the watershed and has a relatively high pollutant loading rate. The highest pollutant loading rates are from multi-family residential and commercial development; however, these are less common land uses in the watershed and therefore do not have as significant of an impact overall in the watershed.

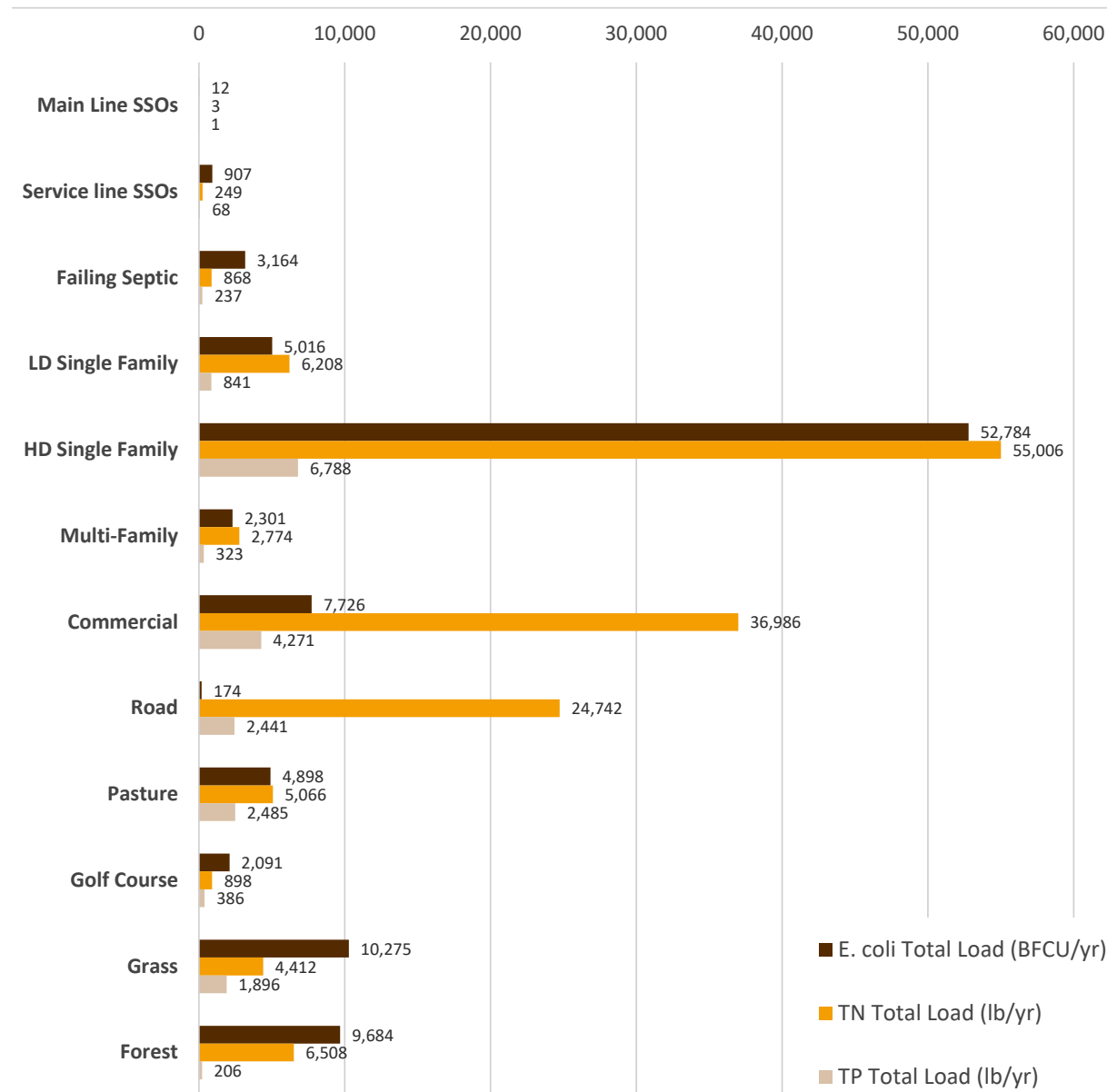


Figure 3.12 *E. coli* & nutrient pollutant source estimate graph

The estimated total loadings of the pollutants of concern to the Burgis Creek Watershed are shown in Figure 3.13.

| <i>E. coli</i> Total Load (BCFU/year) | TN Total Load (lb/yr) | TP Total Load (lb/yr) |
|---------------------------------------|-----------------------|-----------------------|
| 99,031 | 143,721 | 19,943 |

Figure 3.13 Pollutant loading estimate

The estimates of pollutant loading were calculated as follows:

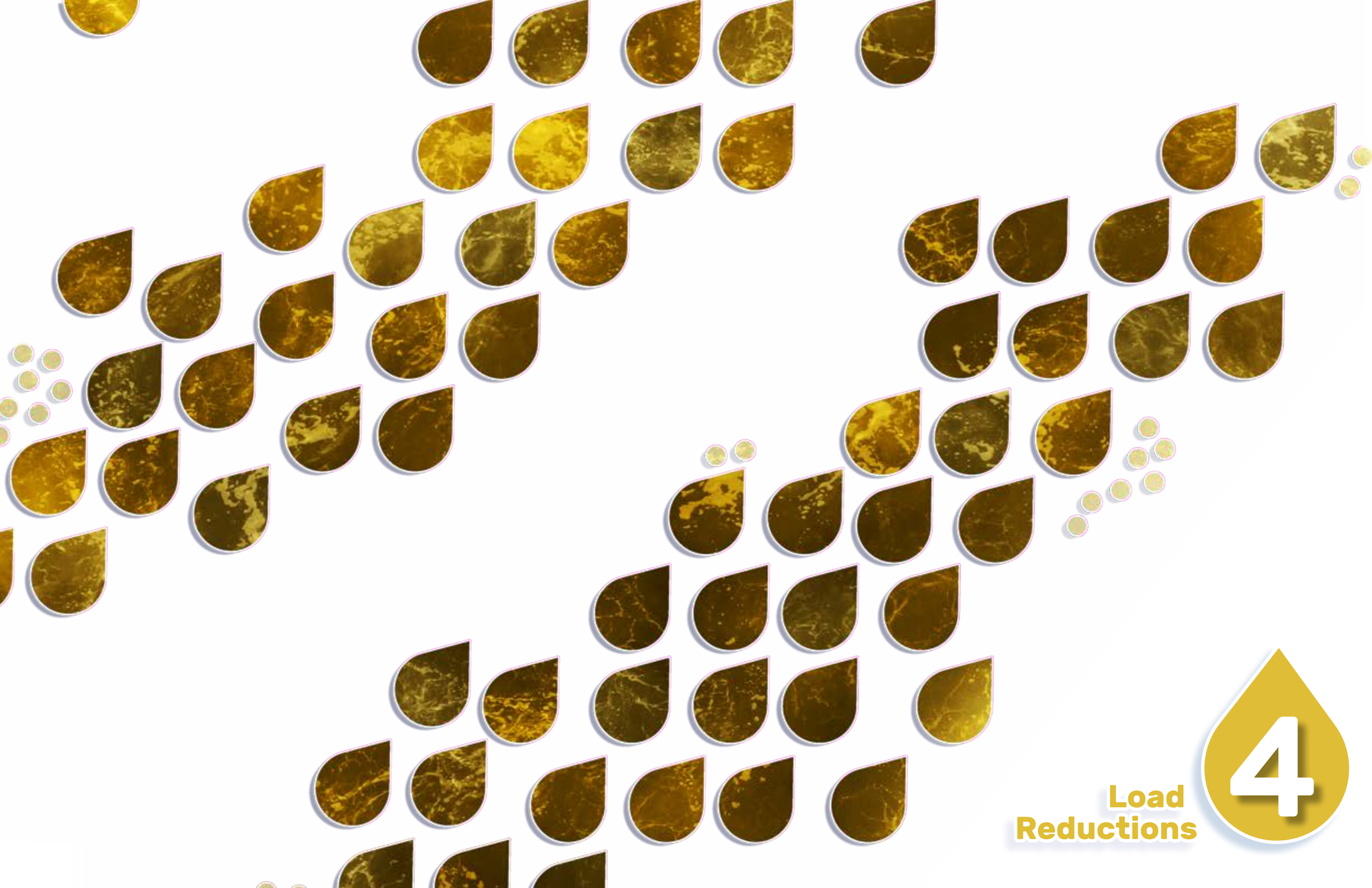
Main Line SSOs: The estimated number of sewer spills annually (1.5) was multiplied by the average volume of the spill (35,278 gallons). Typical concentrations of *E. coli*, TN and TP found in literature were applied to the estimated volume of main line SSOs to estimate the annual pollutant loads.

Service Line SSOs: Data on SSOs was available from approximately one half of the watershed. The number of annual service line SSOs was doubled to account for the missing data. The estimated number of service line SSOs annually (29) was multiplied by the assumed average volume of each service line SSO, which was assumed to be the same volume as the main line SSOs (35,278 gallons) since no data were available. Typical concentrations of *E. coli*, TN and TP found in literature were applied to the service line SSOs to estimate the annual nutrient loads.

Failing Septic: It was estimated that one tenth of the number of septic systems in the watershed (600) are failing. Because septic system often fail over a long period of time, it was estimated that the volume of flow from a failing septic system was twice as large as a typical SSO in the watershed (70,556 gallons). Typical concentrations of *E. coli*, TN and TP found in literature were applied to the estimated volume of main line SSOs to estimate the annual pollutant loads.

Nonpoint Sources: Estimating the pollutant loading from the nonpoint sources was a multi-step process:

- The areas of each type of land use within the watershed were determined using GIS data, parcel data, and aerial photography (see Figure 3.11);
- To estimate *E. coli* loads, SCDES loading rate factors were applied to each type of land use;
- To estimate the TN and TP loads from the land uses, the North Carolina Stormwater Nitrogen and Phosphorus (SNAP) Tool was used;
- The SNAP Tool requires that each land use be broken into the following land covers: roof, roadway, parking/driveway/sidewalk, forest, and landscaped area/grass. The land covers associated with each type of land use were estimated using aerial images of developments within the watershed;
- For each land use, the estimated land covers were input into the SNAP Tool. The SNAP Tool produced the nutrient loading rate for each of the land uses in pounds/acre/year (see Figure 3.13);
- The loading rates in pounds/acre/year estimated using the SNAP tool were multiplied by the acres of each land use to estimate the pounds/year contributed by each land use.



**Load
Reductions**

4

Load Reductions

This section addresses the second part of EPA's Element B – estimate the expected load reductions.

Watershed Plan Review

The watershed is impaired due to exceedances of *E. coli* bacteria in one sampling location in the southern portion of Hidden Creek. SCDES has rated this impairment as Priority 3, meaning a TMDL development for *E. coli* is expected after 2026. In addition to *E. coli*, the Key Partners and citizens in the watershed reported concerns over excessive TN and TP.

The objectives of this Watershed Plan are to improve and protect drinking water sources by:

- Reducing bacteria and nutrients from humans.
- Reducing bacteria and nutrients from animals.
- Reducing hydrologic impacts from development.
- Increasing public education.

To achieve these goals, nearly all the pollutant sources in the watershed will require some level of reduction. Figure 4.1 illustrates the overall pollutant reduction goals within the watershed. The prevalence of each pollutant source and a reduction estimation for each management measure are shown in Figure 4.2.

The expected pollutant removals from individual management measures, along with a description of each measure, are detailed in Section 5. To address each of the nonpoint sources of pollution and meet the objectives outlined in Figure 4.1, a combination of the proposed management measures will be necessary.

For point sources and failing septic systems, the pollutant removals were estimated to be 100% and 75% respectively, as resolving/ significantly decreasing these issues would eliminate pollutant sources. Therefore, even though these sources were not large contributors of pollutants, this Watershed Plan proposes to address a high percentage of these sources.

For nonpoint sources, this Watershed Plan suggests targeting a 20-30% of residential developments and 35% of commercial properties. As the next section will show, management measures on pasture are very cost-effective and thus it is suggested to implement agricultural measures on 60% of this land use. The other land covers can be seen in Figure 4.2.

Targets are not provided for forest land because this is the natural land use and contributes a very low concentration of pollutants.

| | <i>E. coli</i> | TN | TP |
|--|----------------|---------|--------|
| Total Load with No Measures | 108,524 | 146,326 | 20,655 |
| Total Load Removed with Measures | 15,712 | 14,251 | 4,407 |
| Goal = Percentage of Load Removed | 14% | 10% | 21% |

Figure 4.1 Numeric pollutant reduction goals for this plan

| | Total Units | Type of Unit | Units Treated | <i>E. coli</i> Removed | | TN Removed | | TP Removed | | |
|-------------------|-------------|--------------|---------------|------------------------|-----------|---------------|---------|---------------|---------|--------------|
| | | | | (%) | (BFCU/yr) | (%) | (lb/yr) | (%) | (lb/yr) | |
| Main Line SSOs | 1.5 | SSOs/year | 75% | 100% | 9 | 100% | 3 | 100% | 1 | |
| Service Line SSOs | 43 | SSOs/year | 75% | 100% | 680 | 100% | 187 | 100% | 51 | |
| Failing Septic | 600 | Systems | 50% | 100% | 6,328 | 100% | 1,737 | 100% | 474 | |
| LD Single Family | 1,529 | acres | 20% | 35% | 351 | 30% | 372 | 70% | 118 | |
| HD Single Family | 9,983 | acres | 25% | 35% | 4,619 | 30% | 4,125 | 70% | 1,188 | |
| Multi-Family | 311 | acres | 30% | 35% | 242 | 30% | 250 | 70% | 68 | |
| Commercial | 3,918 | acres | 35% | 35% | 946 | 35% | 4,531 | 70% | 1,046 | |
| Road | 2,743 | acres | 10% | 20% | 3 | 30% | 742 | 50% | 122 | |
| Pasture | 869 | acres | 60% | 70% | 2,057 | 60% | 1,824 | 70% | 1,044 | |
| Cropland | 371 | acres | 30% | 35% | 220 | 35% | 94 | 50% | 58 | |
| Grass | 1,823 | acres | 25% | 10% | 257 | 35% | 386 | 50% | 237 | |
| Forest | 6,851 | acres | 0% | 0% | 0 | 0% | 0 | 0% | 0 | |
| Total | | | | | - | 15,712 | - | 14,251 | - | 4,407 |

Figure 4.2 Recommended point source, septic system, and nonpoint source pollutant load removal



**Descriptions of
Management
Measures**

Descriptions of Management Measures

This section addresses EPA's Element C – describe management measures that will achieve load reductions and targeted critical areas.

Summary of Objectives & Management Measures

Figure 5.1 presents the four objectives of this Watershed Plan, each supported by 5–6 management measures aimed at fulfilling these objectives. This section details the management measures associated with Objectives 1, 2, and 3. For management measures related to Objective 4, 'Increase Education & Outreach,' refer to Section 9 of this plan. A summary of pollutant removal effectiveness and implementation costs for each management measure is presented in Figure 5.36 at the end of this section.

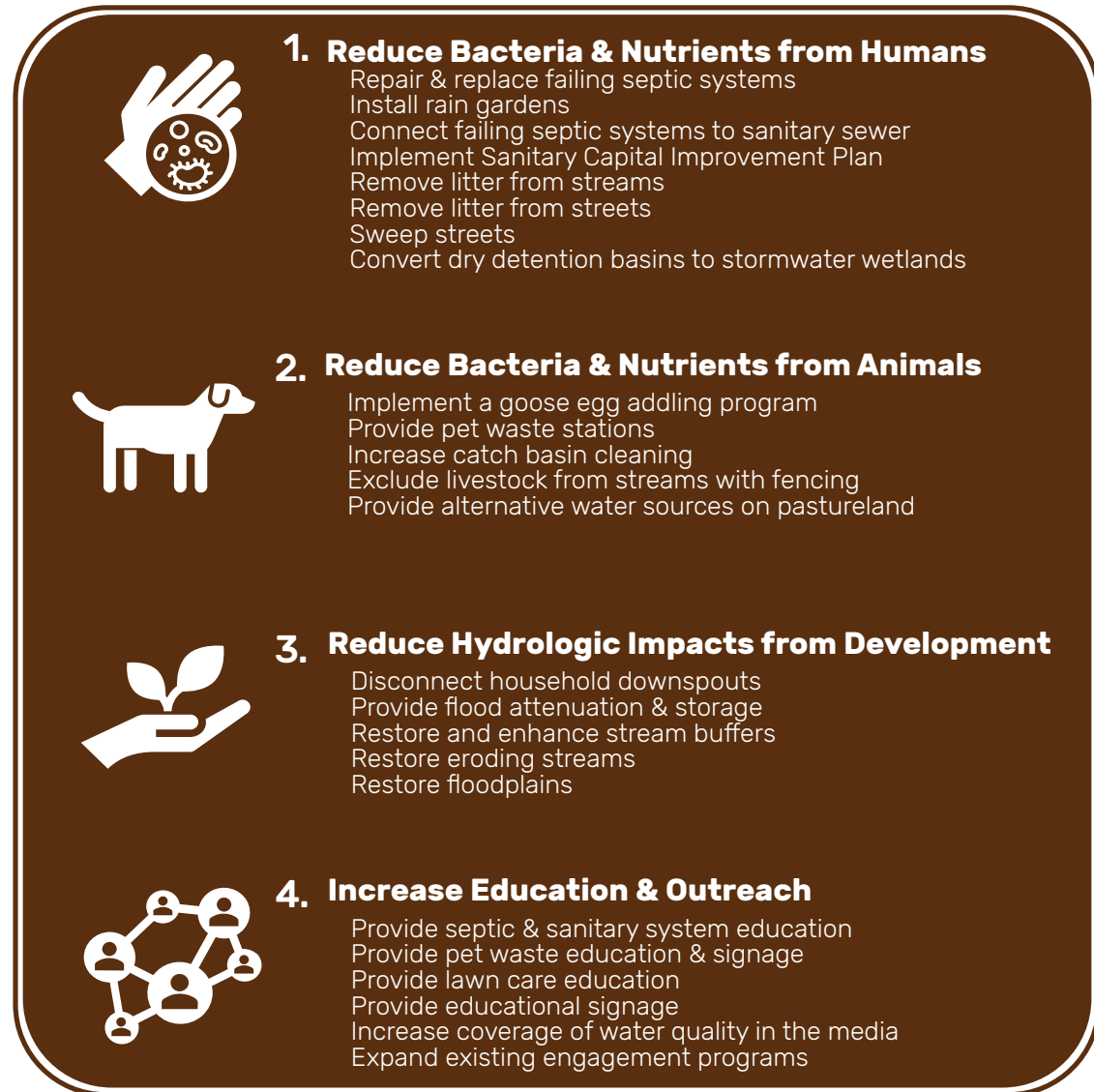


Figure 5.1 Diagram of watershed objectives & management measures

| Removal Effectiveness Key | | |
|---------------------------|--------------------|----------------|
| Not Effective | Somewhat Effective | Very Effective |
| ○ | ◐ | ● |

Objective 1 Measures

Objective 1 measures reduce the bacteria & nutrient pollution from human sources.

1a. Repair, Replace, or Connect Failing Septic Systems

The effectiveness of a septic system depends on the soil's ability to absorb and filter the wastewater and the proper maintenance of the septic system. When a septic system fails, untreated wastewater can seep into the groundwater or flow to streams and become a source of *E. coli* and nutrients. The EPA has identified malfunctioning septic systems as one of the top five sources of groundwater contamination in the county, highlighting the need for proper installation, regular maintenance, and periodic inspections to ensure their effective and safe operation. Repairing or replacing these failing systems reduces the *E. coli*, nitrogen, and phosphorus load to local waterbodies (Gibb, 2022).

If the option is available, property owners facing issues with their septic systems should consider the benefits of connecting to the City of Rock Hill's or the Town of Fort Mill's sanitary sewer system. Sanitary sewers are less likely to fail than septic system, and even in cases of malfunction, the impact is often more contained and managed quickly to minimize environmental impacts. The Manchester Wastewater Treatment Plant is equipped with advanced technologies and processes to treat and purify the water to a much higher standard than what a septic system can achieve. The treated water is safe enough to be released into rivers, lakes, or even used for irrigation.

| Pollutant Removal Effectiveness | | | Cost | Priority Area |
|---------------------------------|----|----|---|---------------------------|
| <i>E. coli</i> | TN | TP | | |
| ● | ● | ● | \$2,400 Per System Connected* \$1,775 Per System Fixed** | Homes with Septic Systems |

Figure 5.2 Septic system fixes at a glance
 *University of North Carolina (2015)
 **Forbes (2023)

1b. Install Rain Gardens

Rain gardens temporarily hold stormwater, allowing it to be naturally treated by native plants and soil infiltration. They offer an aesthetically pleasing solution for stormwater management and are suitable for both residential and commercial environments.



Figure 5.3 Rain Garden (EPA, 2014)

| Pollutant Removal Effectiveness | | | Cost | Priority Area |
|---------------------------------|----|----|---------------|----------------------------------|
| <i>E. coli</i> | TN | TP | | |
| ● | ● | ● | \$25 Per Ft** | Residential and Commercial Areas |

Figure 5.4 Rain gardens at a glance
 *Interstate Commission on the Potomac River basin (2024)

1c. Implement Sanitary

Capital Improvement Plan

Damaged sanitary sewer lines present a significant environmental hazard because they discharge raw sewage directly into the ground and surface waters, and often are sited in low areas adjacent to surface waters. Sanitary sewer overflows (SSOs) are quickly addressed by staff, who repair the breaks and mitigate environmental impact. The implementation of Fort Mill and Rock Hill's Capital Improvement Plan (CIP) will help to address the most urgent sewer infrastructure repairs and replacements and reduce the risk of future SSOs.



Figure 5.5 Repaired section of sanitary sewer line (Paradise Plumbing)

| Pollutant Removal Effectiveness | | | Cost | Priority Area |
|---------------------------------|----|----|-----------------------------|---------------------------|
| <i>E. coli</i> | TN | TP | | |
| ● | ● | ● | \$2.5 Million over 5 Years* | Homes with Septic Systems |

Figure 5.6 CIP implementation at a glance
*City of Rock Hill (2023)

1d. Remove Litter from Streams

Trash in streams is unsightly and can also contribute nutrients and other pollutants and provide food sources for *E. coli* bacteria. For example, plastic waste breaks down into microplastics that are ingested by a wide range of animals and harm their health. The current stream cleanups organized by the Catawba Riverkeeper and Keep York County Beautiful can be continued and expanded to address this issue.



Figure 5.7 Litter clogs the Catawba River (Random Connections)

| Pollutant Removal Effectiveness | | | Cost | Priority Area |
|---------------------------------|----|----|----------------------------|---------------|
| <i>E. coli</i> | TN | TP | | |
| ● | ○ | ○ | \$8,065 per Ton of Litter* | All Streams |

Figure 5.8 Stream litter removal at a glance
*Axios (2023)

1e. Remove Litter from Streets

Compared with stream cleanups, removing litter from streets is significantly more efficient. On streets, volunteers collecting litter can stay dry and avoid the hazards of working in a stream area. Removing litter before it reaches waters avoids disruption and damage to aquatic ecosystems. Rock Hill Clean & Green organizes and promotes street cleanup events; these efforts can be continued and enhanced.



Figure 5.9 Clean & Green volunteers remove trash from streets (Rock Hill Clean and Green)

| Pollutant Removal Effectiveness | | | Cost | Priority Area |
|---------------------------------|----|----|------------------------------------|---------------------------|
| <i>E. coli</i> | TN | TP | | |
| ● | ○ | ○ | \$1,000 per Ton of Litter Removed* | Primary & Secondary Roads |

Figure 5.10 Street litter removal at a glance
*York Daily Record (2019)

1f. Sweep Streets

Streets collect debris, including pet/wildlife waste, leaf litter, yard clippings, trash, and soil, that can be a source of *E. coli* and nutrients. During storm events, streets become conveyances that carry this debris directly to the stream through the storm drainage system. Street sweeping is an efficient way to prevent these pollutants at the source. Ideally, a regular street sweeping schedule could be maintained for primary and secondary roads. Some communities repurpose the collected debris for beneficial uses, such as fill material (EPA, 2021).



Figure 5.11 Street sweeper (North American Power Sweeping Association)

| Pollutant Removal Effectiveness | | | Cost | Priority Area |
|---------------------------------|----|----|--------------------------------|---------------------------|
| <i>E. coli</i> | TN | TP | | |
| ● | ● | ● | \$94 per Mile of Street Swept* | Primary & Secondary Roads |

Figure 5.12 Street sweeping at a glance
*Minnesota Pollution Control Agency (2023)

1g. Convert Dry Detention Basins to Stormwater Wetlands

Dry detention basins have historically been a popular choice for urban stormwater management due to their ability to provide effective flood control over large areas. However, they are not very effective at removing nutrients or *E. coli* from stormwater. Transforming existing dry detention basins into stormwater wetlands is becoming a popular solution. Since the land for these basins is already graded and designated for stormwater management; conversion only requires a modification to the outlet structure and

the addition of wetland plantings. Stormwater wetlands offer substantial improvements over dry detention basins in terms of water quality enhancement. As water flows through the wetland, pollutants are naturally filtered out, both through settling and through biological processes inherent to the wetland ecosystem. Moreover, stormwater wetlands add significant aesthetic value to an area, creating visually appealing landscapes as opposed to the often barren appearance of dry detention basins (EPA, 2005).

| Pollutant Removal Effectiveness | | | Cost | Priority Area |
|---------------------------------|----|----|---------------------------|------------------------------|
| <i>E. Coli</i> | TN | TP | | |
| ● | ● | ● | \$165,000 per Conversion* | Existing Dry Detention Ponds |

Figure 5.13 Dry detention basin conversions at a glance
*Fairfax County (2005)



Figure 5.14 Stormwater wetlands clean water well and look attractive (McAdams)

Objective 2 Measures

Objective 2 measures reduce the bacteria & nutrient pollution from animal sources.

2a. Implement a Goose Egg Addling Program

Goose fecal matter presents a serious water quality concern due to its transmission of *E. coli*, TN and TP, usually directly adjacent to or in a waterbody. Addressing the issue of goose population control in a humane and effective manner is challenging. The most humane and effective strategy is egg addling, a process that prevents eggs from developing into goslings. This method involves treating eggs, preferably those that are 14 days old or younger with 100%

vegetable oil. The oil application obstructs the tiny pores on the eggshell, stopping the embryo's development without harming the adult geese. This approach is more effective than simply destroying the eggs as geese will often reneest and lay more eggs if their initial clutch is destroyed. Egg addling, therefore, presents a sustainable and ethical solution to managing goose populations and mitigating their environmental impact on waterbodies (USDA, 2022).

| Pollutant Removal Effectiveness | | | Cost | Priority Area |
|---------------------------------|----|----|-----------------------|---------------|
| <i>E. coli</i> | TN | TP | | |
| ● | ● | ● | \$60 per Addled Nest* | Impoundments |

Figure 5.15 Goose egg addling at a glance
*University of Nebraska (2010)



Figure 5.16 Oiling goose eggs prevents embryo development (Star Tribune)

2b. Provide Alternative Water Sources on Pastureland

Providing alternative water sources for livestock on pasturelands supports both animal health and water quality protection. Traditionally, livestock wander down to the stream when they need water; however, this leads to contamination from animal waste and increased bank erosion due to animal traffic. By separating the animals from streams and offering them a distinct, clean

water supply, several benefits are achieved. For the livestock, the alternative water is generally cleaner and safer compared to surface waters, potentially improving their health. Moving the water source around the grazing area can also lead to more efficient and uniform grazing patterns, as livestock tend to congregate near water sources.

| Pollutant Removal Effectiveness | | | Cost | Priority Area |
|---------------------------------|----|----|----------------------------------|---------------|
| <i>E. coli</i> | TN | TP | | |
| ● | ● | ◐ | \$37 per Acre of Pasture Served* | Pasture |

Figure 5.17 Alternative water sources at a glance
*USDA, 2000



Figure 5.18 Cow conference by the water cooler (PGG Wrightson)

2c. Exclude Livestock from Streams with Fencing

Fencing off streams to keep livestock out, combined with providing alternative water sources, is an effective dual strategy. It not only preserves water quality by preventing livestock from accessing natural streams, but also ensures that the animals' need for drinking water is adequately met.



Figure 5.19 Livestock fencing (Western Pennsylvania Conservancy)

| Pollutant Removal Effectiveness | | | Cost | Priority Area |
|---------------------------------|----|----|-------------------------------|---------------|
| <i>E. coli</i> | TN | TP | | |
| ● | ● | ◐ | \$2 per linear foot of fence* | Pasture |

Figure 5.20 Livestock exclusion at a glance
*Iowa State University (2012)



Figure 5.21 Five reasons to keep livestock out of rivers (The Freshwater Trust)

2d. Provide Pet Waste Stations

Like goose waste, pet waste is a significant contributor to *E. coli* and nutrient pollution, particularly in urban and suburban areas. Remarkably, a single pet waste station can capture up to 2,250 pounds of dog waste annually, substantially reducing the pollutants entering the watershed. These stations are inexpensive to install and offer an opportunity for public education, reminding pet owners to dispose of their pets' waste properly to preserve the cleanliness and safety of public spaces and water bodies (City of Kirkland, 2020).

Figure 5.22 Pet waste stations keep the grass fun for all (Recycle Away)



| Pollutant Removal Effectiveness | | | Cost | Priority Area |
|---------------------------------|----|----|--------------------|---------------|
| <i>E. coli</i> | TN | TP | | |
| ● | ● | ● | \$200 per Station* | Parks |

Figure 5.23 Pet waste stations at a glance
*Bow Wow Waste (2024)

2e. Increase Catch Basin Cleaning

As their name implies, catch basins often capture debris such as pet/wildlife waste, leaf litter, yard clippings, trash and soils, all of which are sources of *E. coli* and nutrients to streams. Regular cleaning of catch basins removes captured material and associated pollutants and has the added benefit of preventing blockages in the storm drainage system that can lead to flooding.

Figure 5.24 Cleaning dirty catch basins in the Big Apple (NYC Environmental Protection)



| Pollutant Removal Effectiveness | | | Cost | Priority Area |
|---------------------------------|----|----|--------------------------|---------------|
| <i>E. coli</i> | TN | TP | | |
| ● | ● | ● | \$300 per Basin Cleaned* | Paved Roads |

Figure 5.25 Catch basin cleaning at a glance
*FEMA (2020)

Objective 3 Measures

Objective 3 measures reduce the hydrologic impacts caused by development. Although the primary purpose of these measures is to address the increases in volume and velocity of stormwater that occurs when the natural landscape is replaced with roofs, roads, and other hardened surfaces, they also have some benefits for reducing *E. coli* and nutrients.

3a. Disconnect Household Downspouts

Downspouts typically function by channeling stormwater from roofs away from structures. In many instances, downspouts are directly connected to the storm drainage system through pipes or they discharge the water onto paved surfaces that discharge to the storm drainage system. Property owners with directly connected downspouts can disconnect their storm drains and instead direct the stormwater from the roof into gardens or lawns, where most of the water will infiltrate into the soil. This practice reduces the volume of stormwater

and helps to reduce the burden on stormwater pipes and channels. In addition, disconnecting downspouts enhances water quality because the stormwater is filtered through the soil, which removes *E. coli* and nutrients. Disconnecting downspouts can also provide a water source for landscaping (particularly if the homeowner chooses to store the stormwater in a rain barrel so it will be available after storm events). Overall, disconnecting downspouts is a simple yet effective step towards sustainable water management and conservation at the household level (Ruiz et al, 2017).

| Pollutant Removal Effectiveness | | | Cost | Priority Area |
|---------------------------------|----|----|---------------------------------|-------------------|
| <i>E. coli</i> | TN | TP | | |
| ○ | ○ | ○ | \$100 per Downspout Disconnect* | Residential Areas |

Figure 5.26 Downspout disconnection at a glance.
*Nick's Window Cleaning (2017)



Figure 5.27 Downspout disconnect allows stormwater to recharge groundwater (The Pocket)

3b. Provide Flood Attenuation & Storage

The proliferation of streets, homes, and other infrastructure within the watershed increases the presence of impervious surfaces like asphalt, concrete, and roofs that do not absorb stormwater. Consequently, rainwater that would naturally percolate into the ground instead rapidly flows over these hard surfaces to streams that are overwhelmed by the volume and velocity of flows

that are reaching them. Flood attenuation and storage mechanisms, such as retention ponds, can be implemented to capture and temporarily hold stormwater, allowing it to be released gradually over time. This controlled release also provides some pollutant removal through a natural settling processes.

| Pollutant Removal Effectiveness | | | Cost | Priority Area |
|---------------------------------|----|----|--|------------------|
| <i>E. coli</i> | TN | TP | | |
| ● | ● | ● | \$70,000 per Acre of Impervious Treatment* | Entire Watershed |

Figure 5.28 Flood attenuation & storage at a glance
*U.S. EPA (2021)

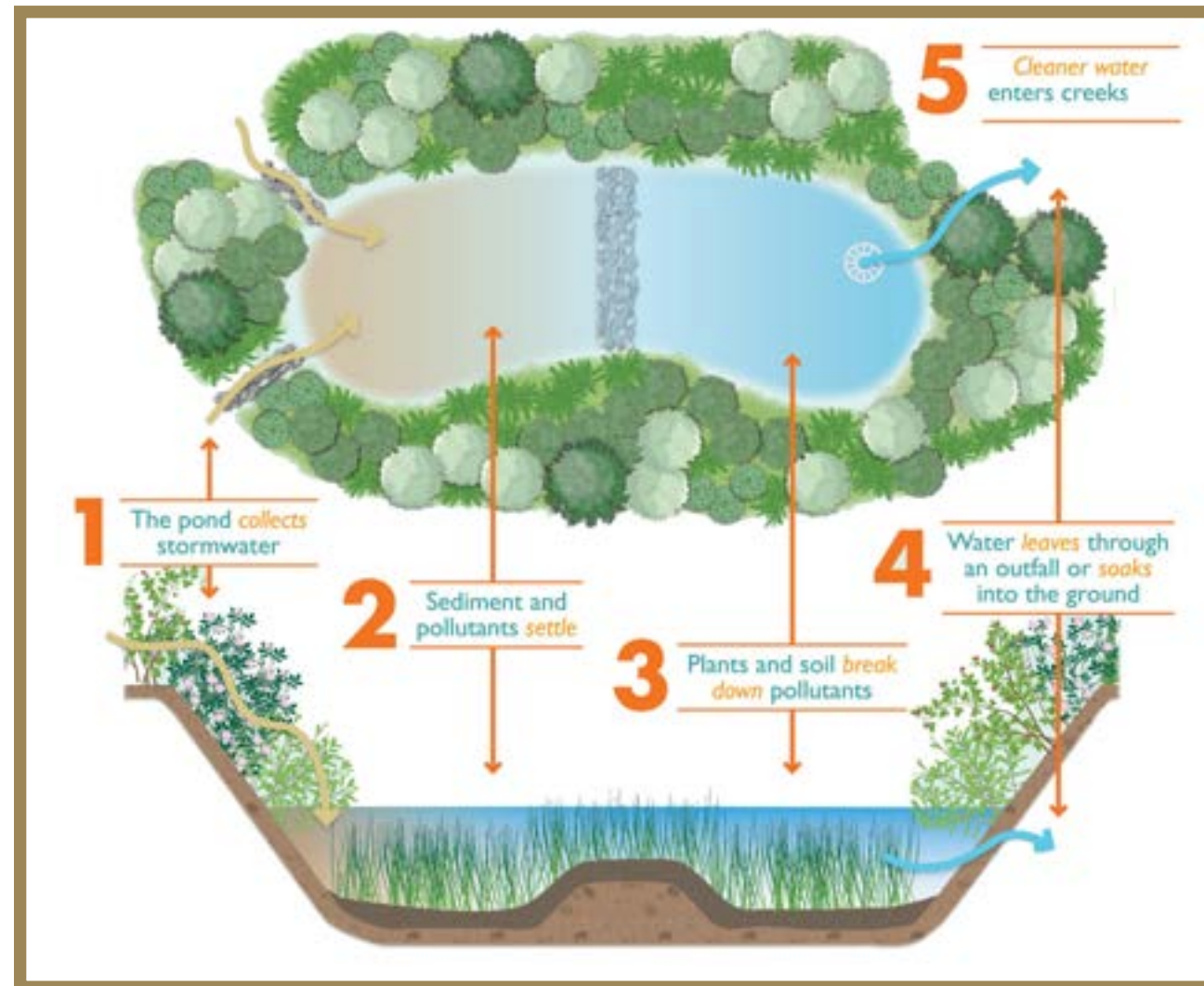


Figure 5.29 Retention pond components and operation (City of Naperville, Illinois)

3c. Restore and Enhance Stream Buffers

Stream buffers are the areas surrounding surface waters that typically extend 50 to 150 feet from the bank. Protecting buffers from development is required by the jurisdictions in this watershed because they have significant environmental benefits. Their primary function is to stabilize the stream bank from erosion and protect developed areas from flooding. The roots of the plants in a stream buffer filter and take up *E. coli* and nutrients and bacteria before they reach the

surface water areas. Areas that lack vegetation often experience accelerated streambank erosion, resulting in steep and sheer banks. These conditions not only degrade the aquatic habitat but also hinder access to the water for both people and wildlife. Stream buffer restoration and enhancement involves removing impervious surfaces from the buffer, grading eroded areas if needed, and providing native plantings.

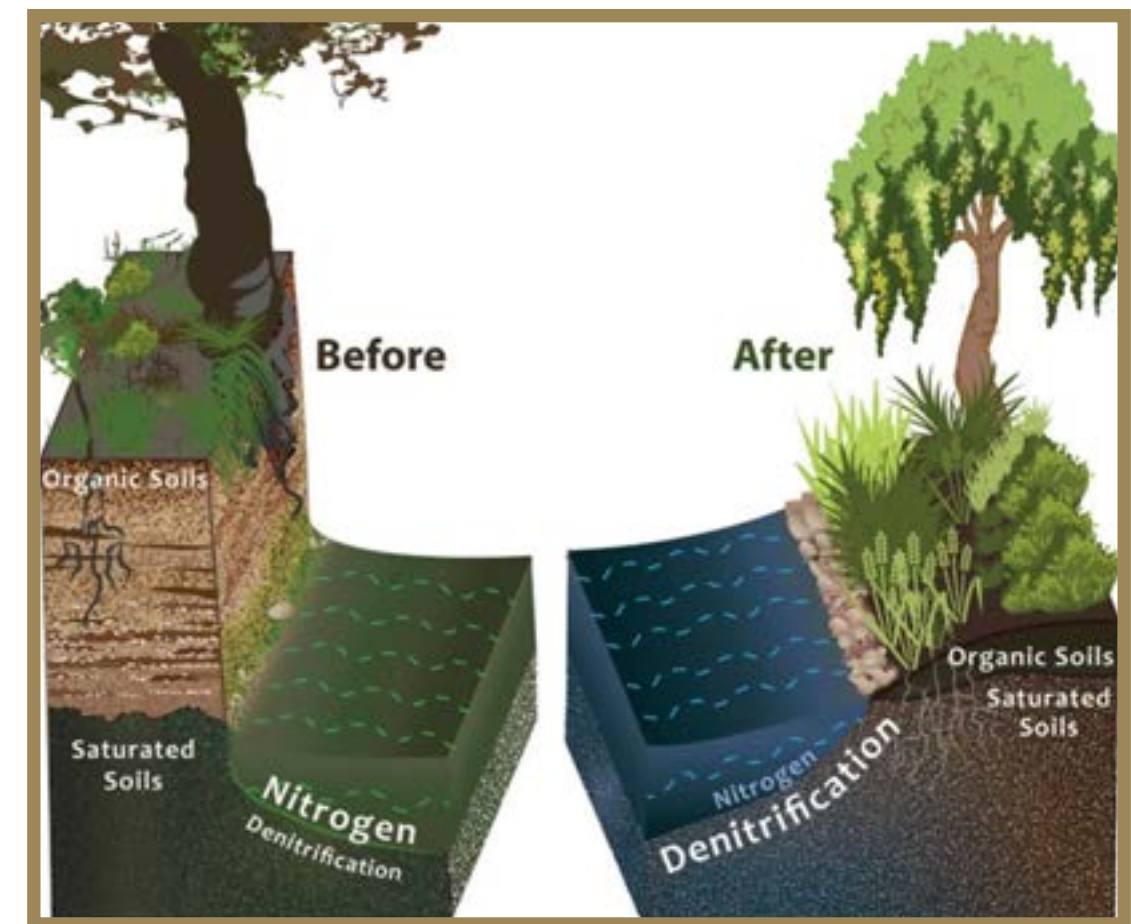


Figure 5.30 Before and after buffer restoration (Urban Ecosystems)

| Pollutant Removal Effectiveness | | | Cost | Priority Area |
|---------------------------------|----|----|---|--------------------------|
| <i>E. coli</i> | TN | TP | | |
| ○ | ● | ◐ | \$850 per Linear Foot of Buffer Restored* | Poorly Vegetated Buffers |

Figure 5.31 Stream buffer restoration and enhancement at a glance
*American Water Resources Association (2012)

3d. Restore Eroding Streams

After a watershed is developed, streams are subject to higher velocities and volumes of stormwater, resulting in the erosion of streambanks and loss of aquatic habitat. In addition, eroding streambanks themselves can become a source of sediment pollution. Stream restoration involves creating a new structure for a stream system that better matches the characteristics of the watershed. Restoring streams reduces stream bank erosion by diminishing the energy of flowing water, which lessens the erosive force exerted on the banks.

Stream restoration projects can also have a cooling effect by increasing vegetation and reducing sedimentation. During a restoration project, the stream bed and floodplain are usually regraded so that water can disperse over the floodplain during large storm events. This dispersion reduces the velocity of surface water, which minimizes erosion and improves the stream's resilience to large storm events. Stream restoration projects also include removing invasive species and planting native plant species which enhances the removal of *E. coli* and nutrients.

| Pollutant Removal Effectiveness | | | Cost | Priority Area |
|---------------------------------|----|----|---|----------------|
| <i>E. coli</i> | TN | TP | | |
| ○ | ◐ | ◑ | \$850 per Linear Foot of Stream Restored* | Eroded Streams |

Figure 5.32 Eroding stream restoration at a glance
*American Water Resources Association (2012)



Figure 5.33 Before and after, Methodist University stream restoration (McAdams)

3e. Restore Floodplains

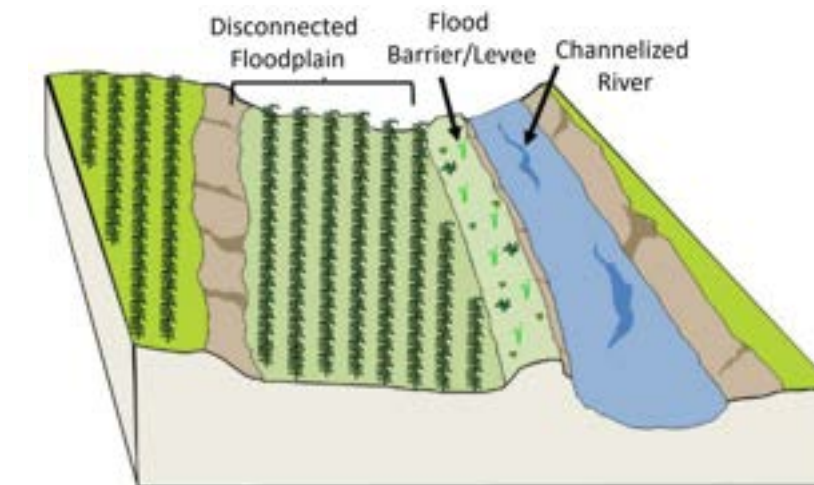
Floodplains offer a multitude of services that include flood protection, erosion control, and habitat for diverse wildlife. However, the development of many floodplains has significantly impaired their capacity to deliver these benefits. Floodplain restoration involves restoring a stream's floodplain through voluntary buyouts of frequently flooded properties within the

floodplain and regrading of the floodplain so it can receive water from the stream when it overflows its banks. Floodplain restoration projects also include planting native species to strengthen the ecological integrity of these areas and bolster their resilience against erosive forces (National Wildlife Federation). The plantings remove TN and TP and reduce vulnerability to flooding.

| Pollutant Removal Effectiveness | | | Cost | Priority Area |
|---------------------------------|----|----|---|----------------------|
| <i>E. coli</i> | TN | TP | | |
| ○ | ● | ◐ | \$15,000 per acre of floodplain restored* | Degraded floodplains |

Figure 5.34 Effectiveness of floodplain restoration
*McAdams

Pre-Restoration



Post-Restoration

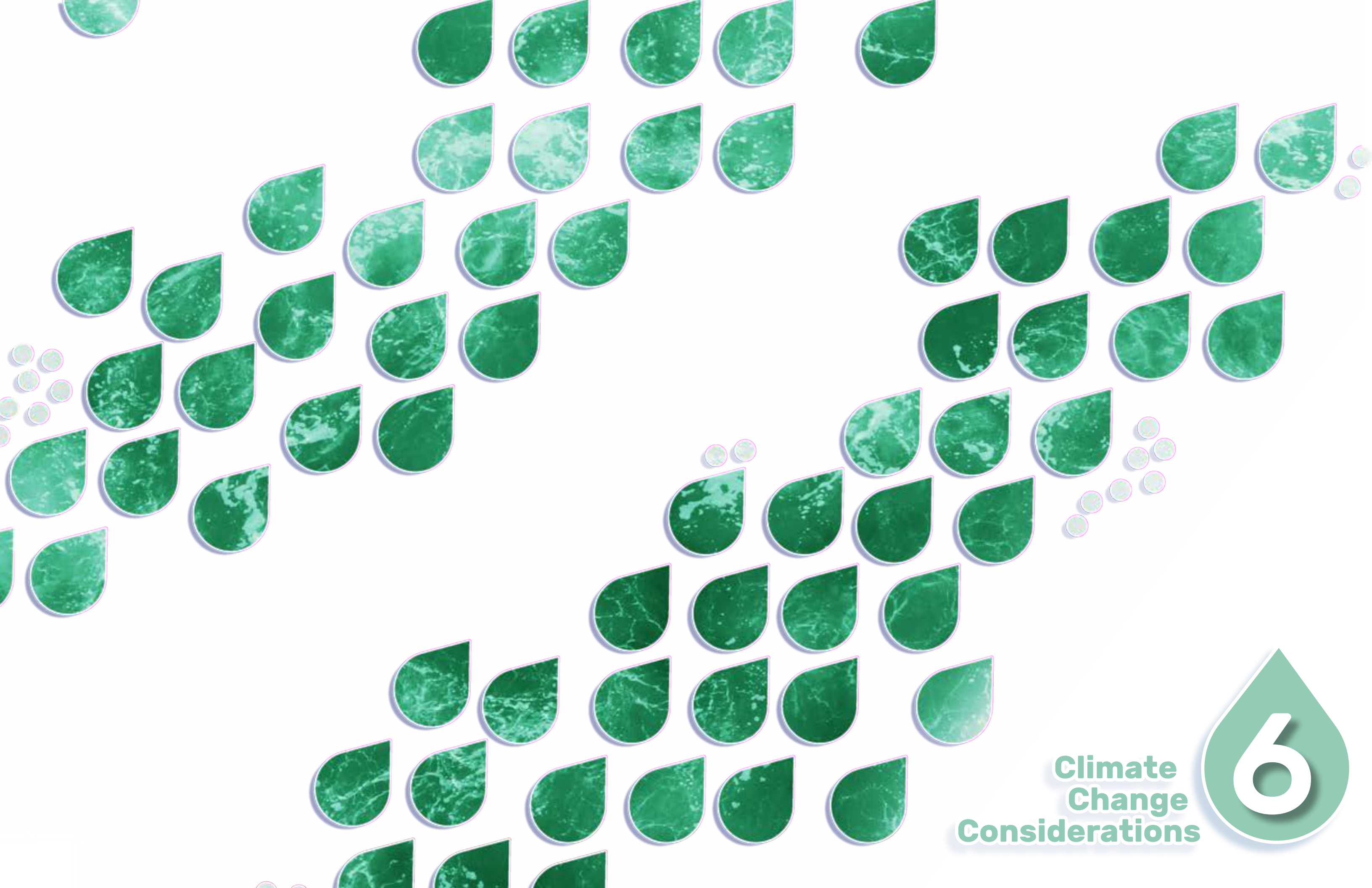


Figure 5.35 Diagram of a floodplain & stream restoration (River Floodplain Restoration)

| Management Measures | Pollutant Removal Effectiveness | | | Cost | | Priority Area |
|---|---------------------------------|----|----|-------------|-------------------------------------|--------------------------------|
| | <i>E. coli</i> | TN | TP | | | |
| Reduce Bacteria + Nutrients from Humans | | | | | | |
| Repair, replace, or connect failing septic systems | ● | ● | ● | \$1,775 | per system fixed | Homes with septic systems |
| | | | | \$2400 | per system connected | |
| Install rain gardens | ● | ● | ● | \$4 | per square foot (residential) | Residential & commercial areas |
| | | | | \$25 | per square foot (commercial) | |
| Implement Rock Hill's wastewater CIP | ● | ● | ● | \$2,500,000 | per fiscal year 2025-2028 | Main sanitary sewer lines |
| Remove litter from streams | ◐ | ○ | ○ | \$8,065 | per ton of litter removed | All streams |
| Remove litter from streets | ◐ | ○ | ○ | \$1,000 | per ton of litter removed | Primary & secondary roads |
| Sweep streets | ◐ | ◐ | ◐ | \$94 | per mile of street swept | Primary & secondary roads |
| Convert dry detention ponds to wetlands | ◐ | ● | ● | \$165,000 | per conversion | Existing dry detention ponds |
| Reduce Bacteria & Nutrients from Animals | | | | | | |
| Implement goose egg addling | ● | ◐ | ◐ | \$60 | per addled nest | Impoundments |
| Provide alternative water sources on pastureland | ● | ● | ◐ | \$37 | per acre of pasture served | Pasture |
| Exclude livestock from streams with fencing | ● | ● | ◐ | \$2 | per linear foot of fence | Pasture |
| Provide pet waste stations | ● | ◐ | ◐ | \$200 | per pet waste station | Parks |
| Increase catch basin cleaning | ◐ | ◐ | ◐ | \$300 | per basin cleaned | Paved roads |
| Reduce Hydrologic Impacts of Development | | | | | | |
| Disconnect household downspouts | ○ | ○ | ○ | \$100 | per downspout disconnected | Residential areas |
| Provide flood attenuation & storage | ◐ | ◐ | ◐ | \$70,000 | per acre of impervious area treated | Entire watershed |
| Restore and enhance stream buffers | ○ | ● | ◐ | \$850 | per linear foot of buffer restored | Poorly vegetated buffers |
| Restore eroding streams | ○ | ◐ | ◐ | \$850 | per linear foot of stream restored | Eroded streams |
| Restore floodplains | ○ | ● | ◐ | \$15,000 | per acre of floodplain restored | Degraded floodplains |

Figure 5.36 Pollutant removal and implementation cost estimate table

Note: All structural management measures/ BMPs will have a maintenance plan that the responsible party will be required to enforce.



**Climate
Change
Considerations**



Climate Change Considerations

Temperature Increases

Average air temperatures within the Burgis Creek Watershed were determined by using data from the National Oceanic and Atmospheric Administration (NOAA) monitoring station located at Winthrop University, which is the closest air temperature monitoring station. Since its inception in 1942, this station has been collecting weather and climate data. Figures 6.1-6.3 show a clear upward trend in air temperatures since the station began recording data. Average summer temperatures have risen by four degrees Fahrenheit and average annual temperatures have risen by one degree Fahrenheit.

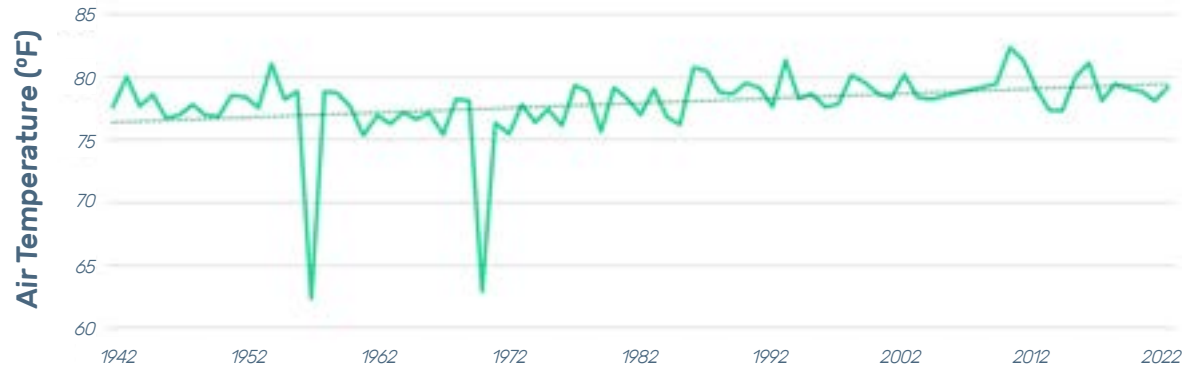


Figure 6.1 Average summer temperatures in the watershed

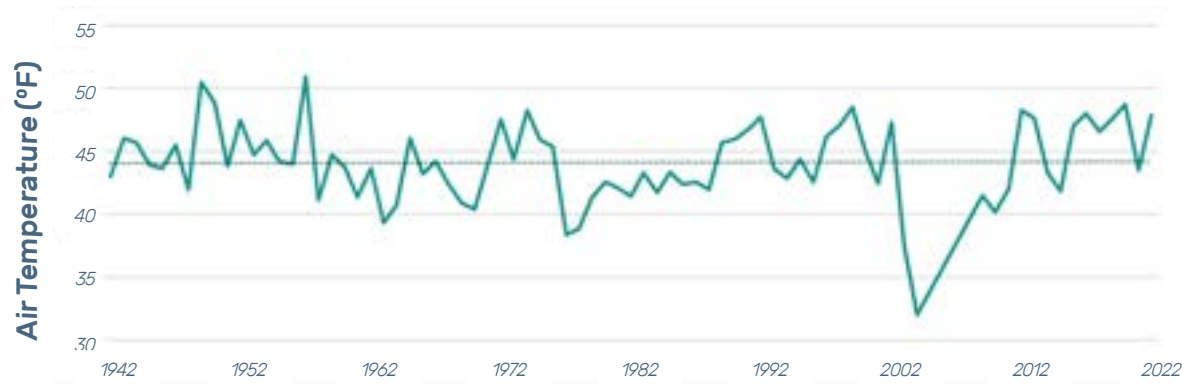


Figure 6.2 Average winter temperatures in the watershed

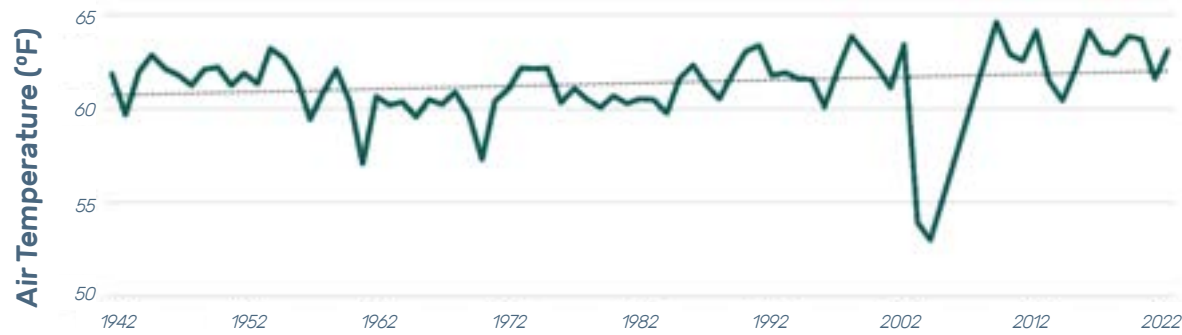


Figure 6.3 Average annual temperatures in the watershed

This increase in air temperature can lead water temperatures to also rise. Rising water temperatures can stimulate the growth of harmful algae, disrupt aquatic species' life cycles, and degrade water quality overall.

Higher Variability in Rainfall

Annual rainfall within the Burgis Creek Watershed was determined by averaging the data from the three closest NOAA monitoring stations. Data from these three stations goes back to 1941. Since then, the variability between dry and wet years has risen significantly, although the average yearly rainfall has remained about the same. This means that the extremities of weather patterns are intensifying, droughts are becoming more severe, and rainy seasons are seeing more excessive downpours. This heightened variability has profound impacts on human, animal, and plant life. For humans, more severe droughts can lead to water shortages, reduced agricultural yields, and economic challenges. Intense rainy seasons can result in flooding, property damage, and increased risks of waterborne illness. Animals may struggle with these rapid changes; droughts reduce the available water while flooding can destroy habitat. Similarly, plant life can be stressed with such erratic rainfall patterns. Prolonged dry spells can reduce plant growth, while excessive rain might inundate plants. Such

shifts in precipitation patterns demand adaptive strategies and sustainable management to mitigate their impacts.

The increasing variability in rainfall patterns coupled with rising air temperatures have led to an uptick in major storm events. Warmer air holds more moisture, which can lead to more intense rainfall during storms, while added heat energy in the atmosphere and ocean contributes to the strength and frequency of such events. These storms can cause significant economic and environmental turmoil, as illustrated in Figure 6.4. Economically, the damage from these storms can be astronomical as they ravage critical infrastructure, halt industry operations, decimate agriculture, and demand enormous resources for recovery and rebuilding efforts. The natural environment is also significantly impacted as major storms can cause habitat destruction, soil erosion, water contamination, and loss of biodiversity. The increased intensity and frequency of these events is evident in Figure 6.5 and 6.6.



Figure 6.4 Storm damage near Rock Hill, SC (The Augusta Chronicle)

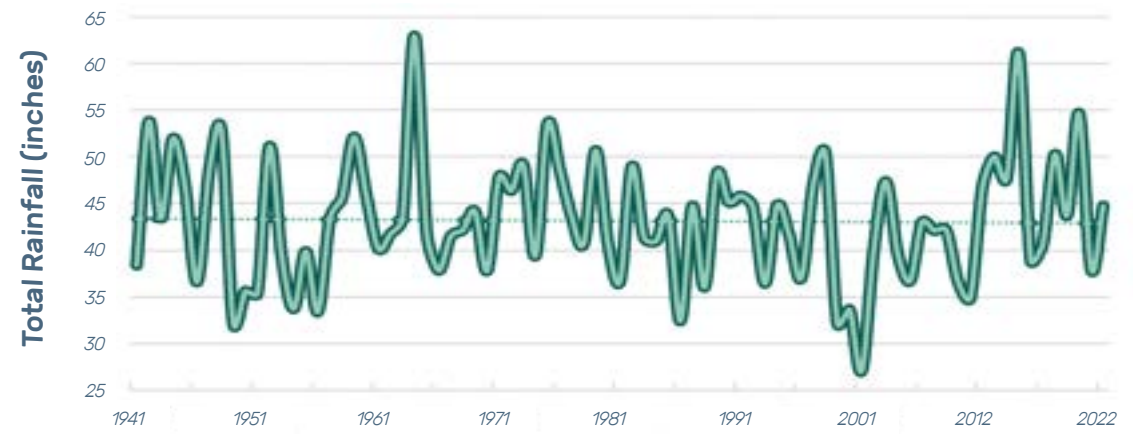


Figure 6.5 Increasing variability in rainfall in the watershed

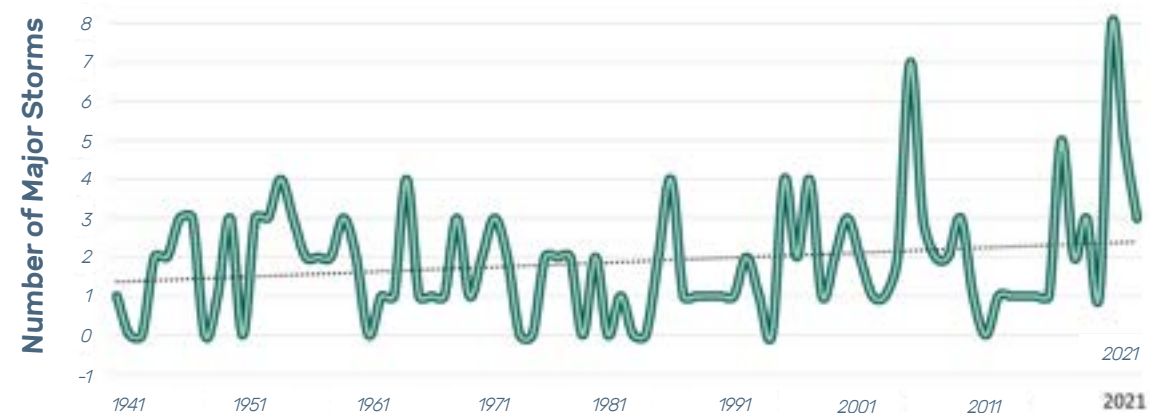


Figure 6.6 Increasing number of major storm events in South Carolina between 1941 and 2021

Methods for Improving Climate Resiliency

Resilient Designs

Resilient design in infrastructure and architecture ensures that communities are better equipped to withstand and rapidly recover from climate-induced disruptions. This includes the construction of buildings and bridges that can endure extreme weather, the elevation of structures in flood-prone areas, and the incorporation of renewable energy systems that remain operational during power outages. Resilient urban planning also entails designing green spaces that reduce heat island effects as shown in Figure 6.7. Green spaces also reduce the burden on drainage systems by managing stormwater. By prioritizing flexibility, redundancy, and adaptability, resilient design enables communities to maintain critical functions during severe weather events and adapt to the evolving patterns of a changing climate.

Rural regions have larger evapotranspiration rates and open spaces reflect solar energy out into space

Cities have less evapotranspiration and buildings trap solar radiation energy out into space

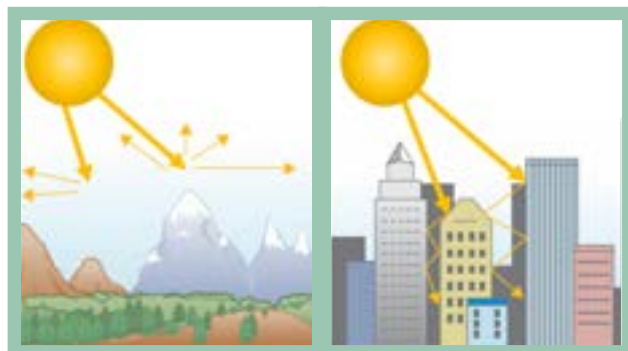


Figure 6.7 Urban heat island effect (Public Health Notes)

Green Stormwater Infrastructure (GSI)

GSI can play a pivotal role in bolstering climate change resiliency. GSI offers innovative solutions to address the increasing rainfall that is associated with climate change. Practices aimed at mimicking pre-development hydrology, like rain gardens, green roofs, stormwater wetlands, and bioswales, are exemplified by a green roof shown in Figure 6.8. These practices can capture, filter, and slowly release stormwater, thus reducing the strain on traditional stormwater infrastructure. By promoting stormwater infiltration, these practices can recharge groundwater supplies, decrease surface runoff, and prevent soil erosion. As recommended in Section 5, implementing rain gardens and stormwater wetlands would be very successful in achieving this. Additionally, GSI helps in reducing the urban heat island effect (a phenomenon where urban areas experience significantly warmer temperatures than the rural surroundings). This can be particularly valuable in moderating the elevated temperatures associated with climate change.



Figure 6.8 A green roof on the rooftop terrace at the SkyGarden Apartment in Charleston, SC (The Post and Courier)

Ecosystem Protection & Restoration

Ecosystem protection and restoration projects, like the one shown in Figure 6.9, bolster climate change resiliency by maintaining and enhancing the natural services ecosystems provide. Healthy wetlands, forests, and other natural areas act as buffers against extreme weather events by absorbing excess rainwater. These ecosystems reduce flooding, stabilize stream banks, and provide barriers to storm surges. They also sequester carbon, helping to mitigate the long-term impacts of climate change. By investing in ecosystem protection and restoration, communities can create a natural defense against the immediate impacts of climate change while contributing to carbon reduction efforts, thereby securing a more resilient future. Investing in the restoration and enhancement of stream buffers, among other practices would protect and restore ecosystems.



Figure 6.9 Stream restoration in Falls Park, SC (Greenville News)

Sustainable Agriculture & Forestry Practices

Sustainable agriculture and forestry practices significantly enhance resilience to climate change by promoting land use that supports both food security and ecosystem health. Agroforestry, conservation tillage, and diversified cropping systems are techniques that enhance soil health, bolster water retention, and diminish vulnerability to droughts and floods. These techniques have the potential to be successful in this watershed. Figure 6.10 illustrates the benefits of agroforestry in this context. These practices also contribute to carbon sequestration, with well-managed farms and forests acting as carbon sinks. By fostering landscapes that are more resistant to pests, diseases, and extreme weather, sustainable practices ensure that communities remain productive in the face of climate variability.

Resilient Regulations + Policies

Resilient regulations and policies form the backbone of community efforts to adapt to climate change, establishing the standards and guidelines that shape sustainable development. By updating building codes to account for increased frequency of extreme weather events, governments can ensure that infrastructure is built to higher safety standards. Zoning laws that prevent construction in high-risk areas such as floodplains reduce vulnerability to natural disasters. Furthermore, regulations that promote the preservation and restoration of natural buffers like wetlands and forests can provide critical ecosystem services. Collectively, these forward-looking regulations and policies lay a strong foundation for community resilience.

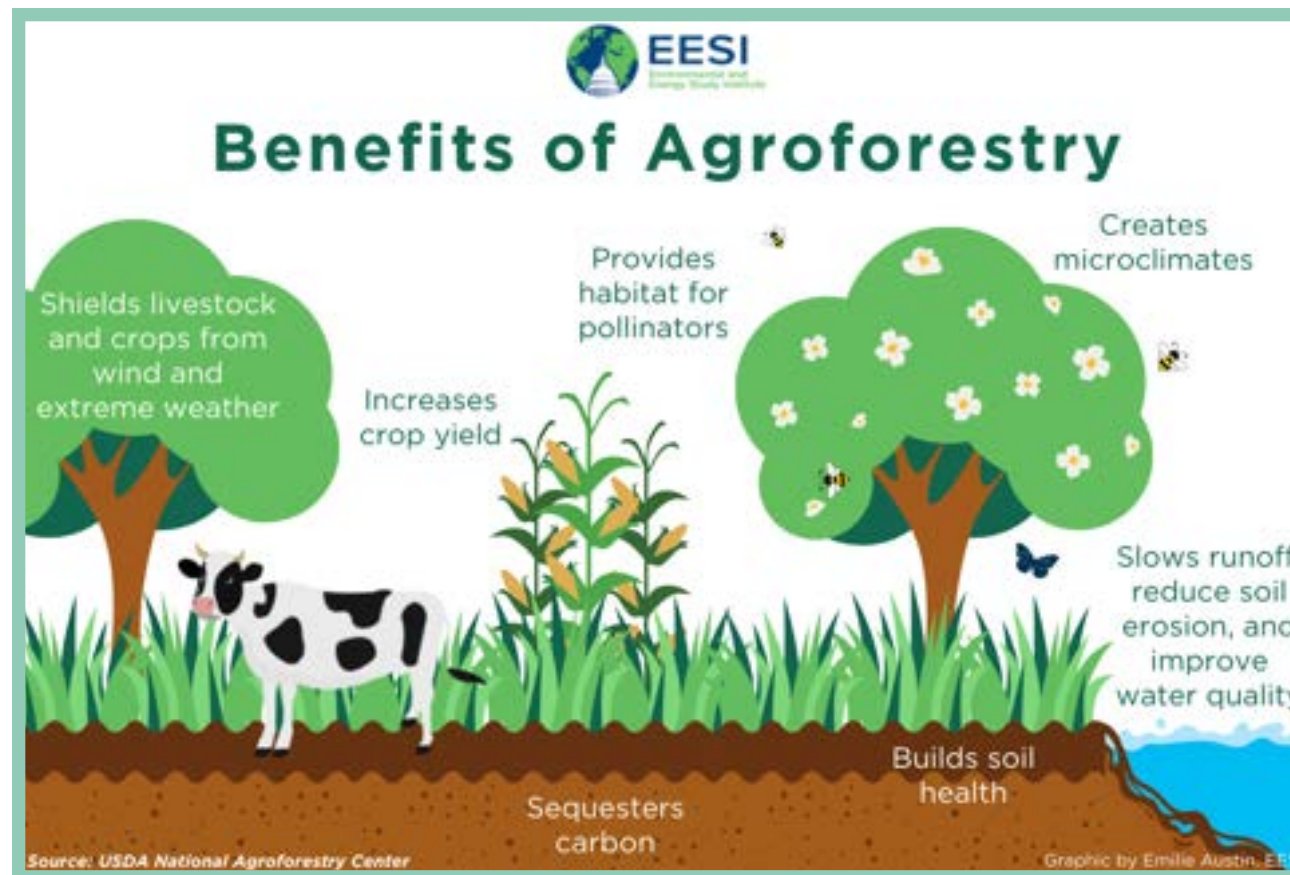
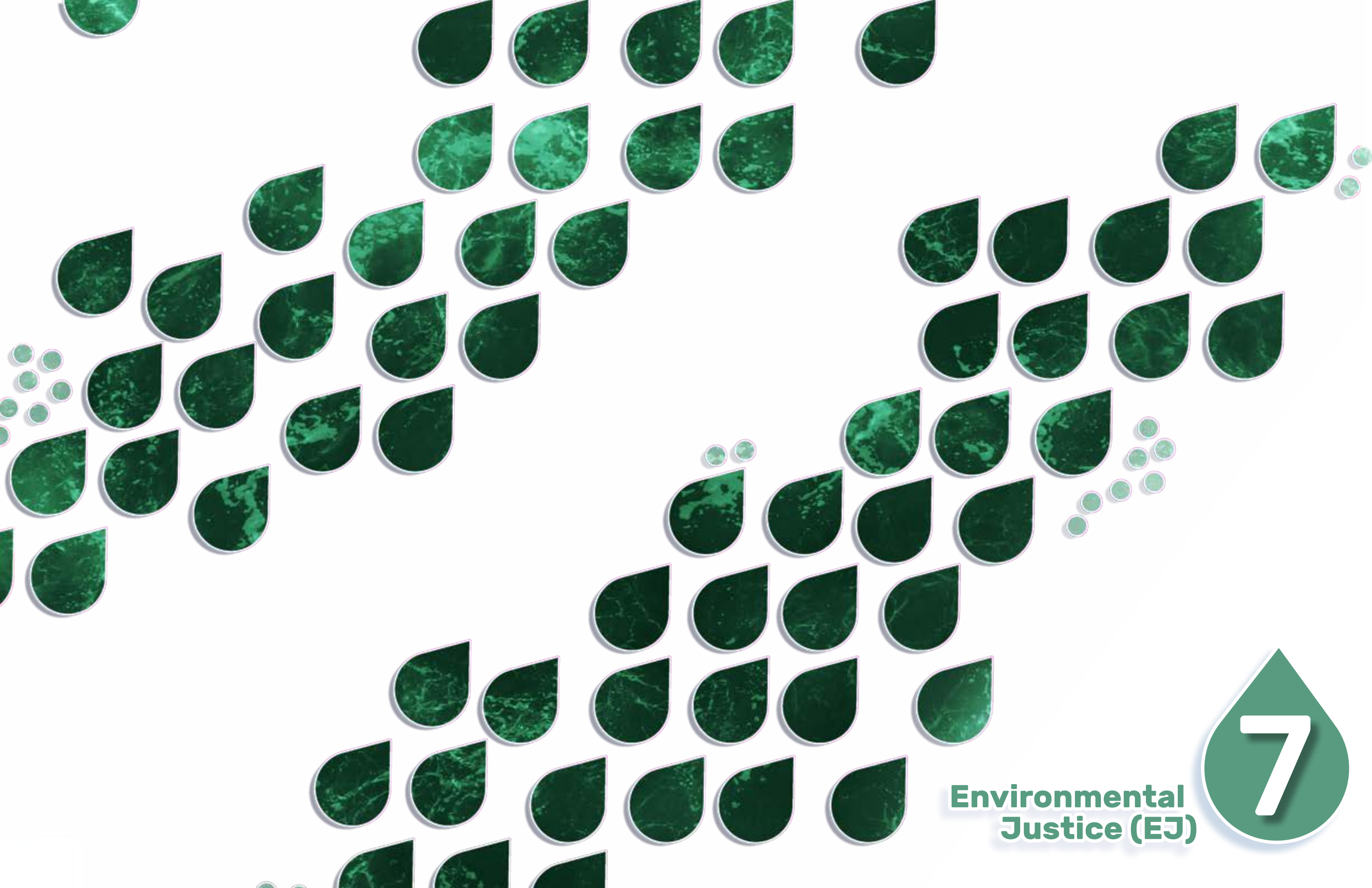


Figure 6.10 Benefits of agroforestry (Environmental and Energy Study Institute 2023)



**Environmental
Justice (EJ)**



Environmental Justice (EJ)

Watershed Demographics

According to the United States Census Bureau, the socio-economic indicators within the Burgis Creek Watershed reflect a community that is more economically prosperous than South Carolina as a whole. Figure 7.1 shows that the watershed's population boasts a median household income of \$89,395, a figure that surpasses South Carolina's overall median household income of \$58,234. Furthermore, the poverty rate within the watershed stands at 9.7%, a rate that is about 5 percentage points lower than the state's poverty rate of 14.6%.

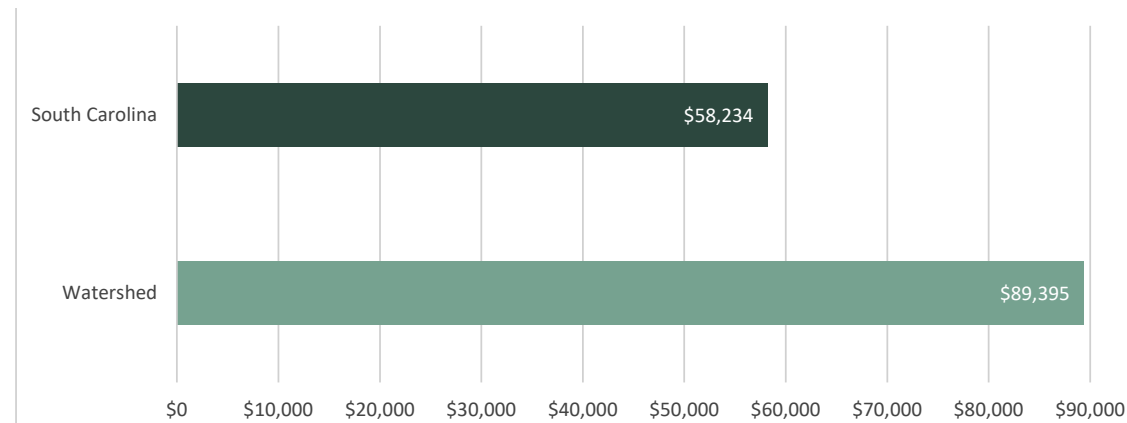


Figure 7.1 Median household income of watershed residents compared with South Carolina residents (US Census Bureau)

Figure 7.2 illustrates that the racial demographics also differ between the Burgis Creek and the overall demographics of South Carolina. The Burgis Creek Watershed's white population is only 3% smaller than in the rest of the state while the Black population is 8% smaller than in the rest of the state.

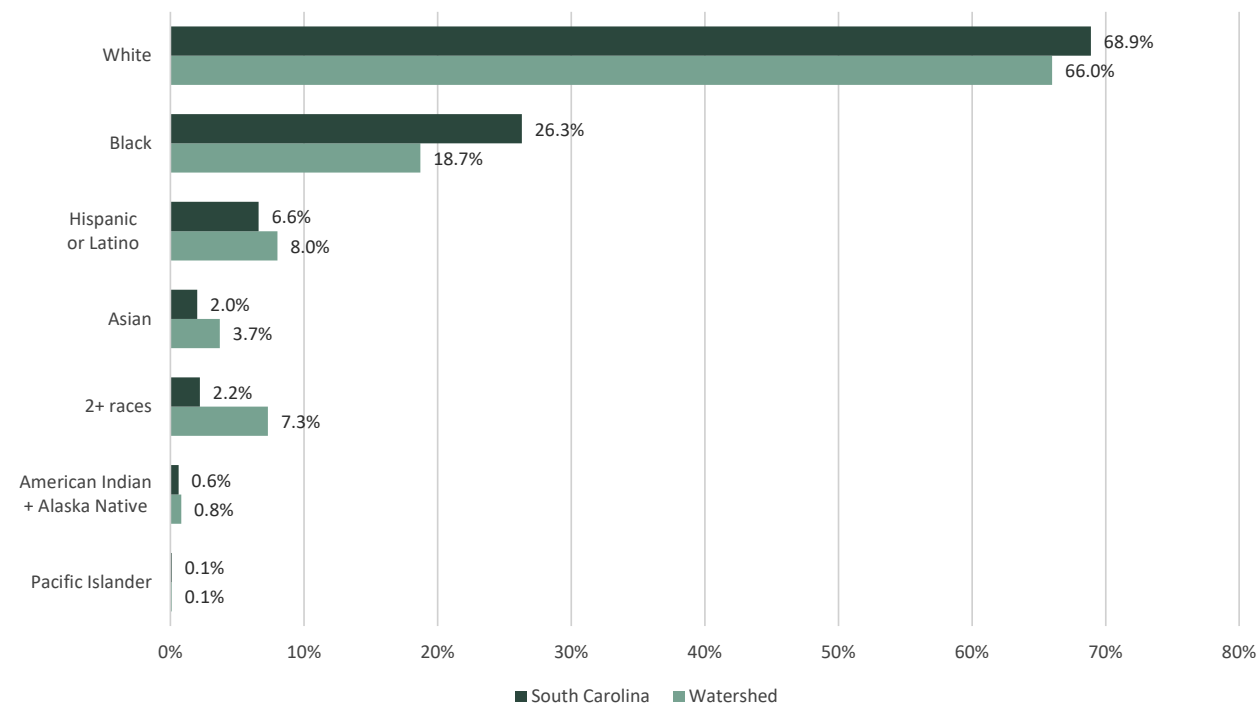


Figure 7.2 Demographics of watershed residents compared with South Carolina residents (US Census Bureau)

Environmental Justice Considerations

Environmental Justice (EJ) plays a critical role in planning efforts as it ensures equitable access to natural resources and protection from environmental hazards for all communities, especially those that have been historically marginalized. By integrating EJ principles, the disproportionate impact of pollution and water-related issues on marginalized communities may be addressed, which fosters fairness in the distribution of environmental benefits and burdens. Involving marginalized communities in the planning process brings diverse perspectives and cultural lenses to the table and promotes more effective and culturally sensitive management strategies. This inclusive approach helps to create a sustainable and comprehensive Watershed Plan that is equitable to all community members. Section 9 details the specific efforts to engage communities.

Engaging with Leaders

Local community leaders representing marginalized groups including the York County Boys and Girls Club, Family Promise of York County, and the York County Council for Aging should be engaged early and often when pursuing EJ. These leaders often have a deep understanding of the community's dynamics and can provide valuable insights into the most effective methods of communication. They serve as bridges between the community and decision-makers, ensuring that the concerns and needs of different groups are brought to the forefront. Public input sessions should recognize and respect the contributions, heritage, and culture of all community members. This fosters a sense of respect and belonging but also ensures that water quality initiatives are responsive to the unique dynamics of each community. By embracing this approach, EJ becomes not just a policy initiative but a practice that genuinely resonates with and empowers the diverse voices it aims to represent.

Choosing the Public Forums

Deciding on the format for public input is also important. Options may include online platforms, town hall meetings, stakeholder groups, or other interactive forums. Section 9 details the type of solicitation of public input used to inform this plan. These sessions should be accessible to everyone, considering different schedules, locations, and preferences. By offering various formats, the likelihood of broad participation is increased, enabling voices from all corners of the community to be heard. Advertising the public input sessions through diverse channels also supports EJ. Using a variety of approaches including radio, print media, and social media ensures that the information reaches a wide audience. Each of these approaches have a different reach and impact, making it possible to engage with a broader spectrum of the community. Communication during these sessions should be inclusive and accessible. Offering options in non-English languages like Spanish and providing American Sign Language (ASL) if needed boosts inclusivity. Additionally, using non-technical language helps to demystify projects and make the information understandable and relatable to all community members.



Figure 7.3 Rock Hill, SC Christmas event (Southern Living, 2023)

Distributing Benefits & Burdens

For new projects, the focus should be on creating a balance where the benefits are shared equitably across the community. This includes access to clean air and water, recreational spaces, and other environmental goods. Burdens, such as pollution or resource depletion, should not be disproportionately placed on certain groups, particularly those who are economically disadvantaged or belong to minority communities.

Equitable distribution requires a nuanced understanding of the community's demographic and socio-economic landscape, ensuring that the outcomes of any environmental project do not exacerbate existing inequalities.

For example, implementing a sliding scale for septic repair or replacement could be effective at reducing financial burden. Prices of repair would be adjusted based on one's ability to pay, so that everyone could get the benefit of assistance.

Removing Barriers

Removing barriers to existing benefits is another critical aspect of ensuring equitable access. These barriers can be economic, such as fees that limit access to certain amenities or services. For example, imposing a fee to enter a museum can exclude lower-income individuals and families, thus denying them the benefits of the space. Physical barriers, like fences or other structures that restrict access to environmental amenities, can also be obstacles. These barriers not only physically exclude people but can also symbolize social and economic divides, reinforcing feelings of exclusion and inequality.

Institutional barriers are often more challenging to identify and dismantle. These include policies and practices that prevent meaningful engagement of all community members in environmental decision-making. Institutional barriers could manifest as complex bureaucratic processes, lack of transparency, or a decision-making framework that does not consider the voices of marginalized groups. Overcoming these barriers requires a systemic change in how institutions operate and engage with communities.

In conclusion, EJ's focus on equitable access requires a multi-dimensional approach that addresses various barriers and ensures fair distribution of environmental benefits and burdens. It demands a commitment to understanding and dismantling the structures that perpetuate inequality, ensuring that environmental policies and projects are inclusive and equitable for all community members.



Figure 7.4 Clean Up Aiken, SC Volunteers keep their community clean (Clean Up Aiken)



Figure 7.5 Clean Up Aiken, SC Volunteers keep their community clean (Clean Up Aiken)



Figure 7.8 Northwestern High School Litter Clean Up Day (Rock Hill Clean and Green)

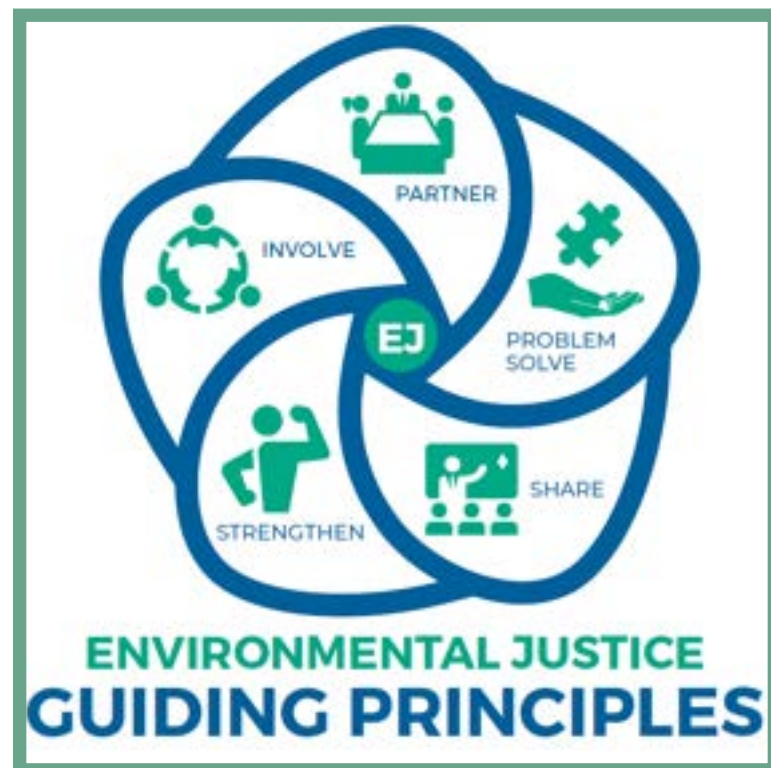


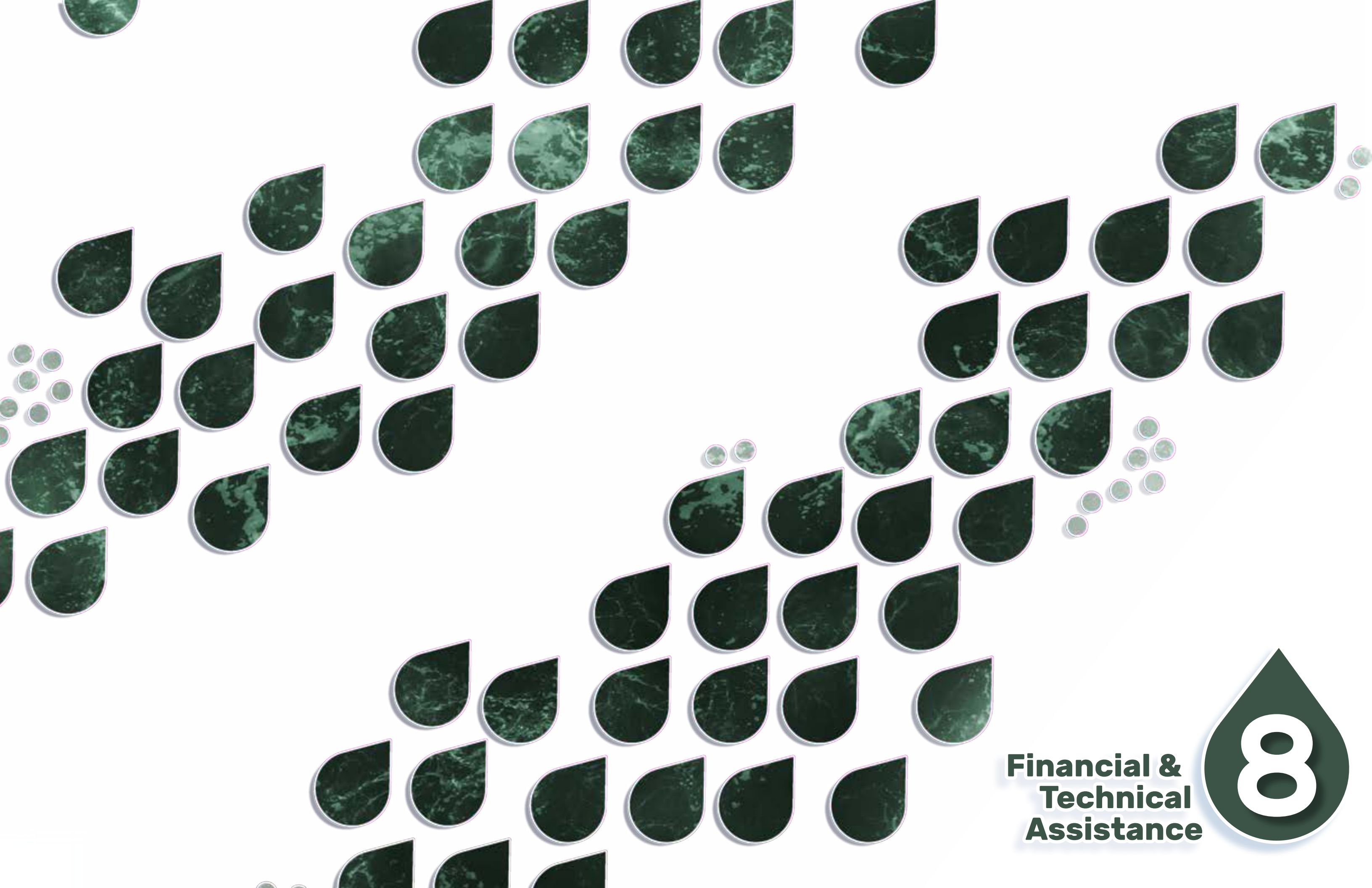
Figure 7.6 Environmental Justice Guiding Principles (SCDES, 2024)



Figure 7.7 Keep American Clean Presidents Circle recognition (Rock Hill Clean and Green)



Figure 7.9 Cherry Park Rock Hill (Flickr).



**Financial &
Technical
Assistance**





Financial & Technical Assistance

This section addresses EPA's Element D – estimate amounts of technical and financial assistance and the relevant authorities to implement the plan.

Cost Estimate for Watershed Plan

The yearly cost of implementing the management measures is estimated in Figure 8.1. The total cost for all twenty years is approximately \$10.8 million; however, of that cost \$10.1 million is for the Capital Improvement Plan. The remainder of the Watershed Plan implementation will cost \$743,635.

Figure 8.1 Estimated costs for Watershed Plan implementation

| | Cost Per unit | | 2025-2028 | | 2029-2032 | | 2033-2036 | | 2037-2040 | | Annual cost from 2041 onwards | |
|--|---------------------------|-------------------------------------|-------------|-------------|-----------|-----------|-----------|----------|-------------|-----------|-------------------------------|-----------|
| | | | # | Cost | # | Cost | # | Cost | # | Cost | # | Cost |
| 1. Reduce Bacteria & Nutrients from Humans | | | | | | | | | | | | |
| Repair, replace, or connect failing septic systems | \$2,000 | per system fixed | 30 | \$60,000 | 30 | \$60,000 | 30 | \$60,000 | 30 | \$60,000 | 30 | \$60,000 |
| Install rain gardens | \$25 | per square foot | 2,000 | \$50,000 | 2,000 | \$50,000 | 2,000 | \$50,000 | 2,000 | \$50,000 | 2,000 | \$50,000 |
| Implement Rock Hill's wastewater CIP | \$2,500,000 | over five years | 0.8 | \$2,000,000 | 0.2 | \$500,000 | 0 | \$0 | 0 | \$0 | 0 | \$0 |
| Remove litter from streams | \$8,065 | per ton of litter | 2 | \$16,130 | 2 | \$16,130 | 2 | \$16,130 | 2 | \$16,130 | 2 | \$16,130 |
| Remove litter from streets | \$1,000 | per ton of litter | 5 | \$5,000 | 5 | \$5,000 | 5 | \$5,000 | 5 | \$5,000 | 5 | \$5,000 |
| Sweep streets | \$94 | per mile of street swept | 25 | \$2,350 | 25 | \$2,350 | 25 | \$2,350 | 25 | \$2,350 | 25 | \$2,350 |
| Convert dry detention ponds to wetlands | \$165,000 | per conversion | 0 | \$0 | 0 | \$0 | 0 | \$0 | 2 | \$330,000 | 1 | \$165,000 |
| 2. Reduce Bacteria & Nutrients from Animals | | | | | | | | | | | | |
| Implement goose egg addling | \$60 | per addled nest | 0 | \$0 | 0 | \$0 | 0 | \$0 | 40 | \$2,400 | 40 | \$2,400 |
| Provide alternative water sources on pastureland | \$37 | per acre of pasture served | 0 | \$0 | 70 | \$2,960 | 70 | \$2,590 | 70 | \$2,590 | 70 | \$2,590 |
| Exclude livestock from streams with fencing | \$2 | per linear foot of fence | 0 | \$0 | 4,000 | \$8,000 | 4,000 | \$8,000 | 4,000 | \$8,000 | 4,000 | \$8,000 |
| Provide pet waste stations | \$200 | per station | 0 | \$0 | 100 | \$20,000 | 100 | \$20,000 | 100 | \$20,000 | 100 | \$20,000 |
| Increase catch basin cleaning | \$300 | per basin cleaned | 0 | \$0 | 100 | \$30,000 | 100 | \$30,000 | 100 | \$30,000 | 100 | \$30,000 |
| 3. Reduce Hydrologic Impacts from Development | | | | | | | | | | | | |
| Disconnect household downspouts | \$100 | per downspout disconnected | 0 | \$0 | 0 | \$0 | 0 | \$0 | 25 | \$2,500 | 25 | \$2,500 |
| Provide flood attenuation & storage | \$70,000 | per acre of impervious area treated | 0 | \$0 | 0 | \$0 | 0 | \$0 | 5 | \$350,000 | 5 | \$350,000 |
| Restore and enhance stream buffers | \$850 | per linear foot of buffer restored | 0 | \$0 | 100 | \$85,000 | 100 | \$85,000 | 100 | \$85,000 | 100 | \$85,000 |
| Restore eroding streams | \$850 | per linear foot of stream restored | 0 | \$0 | 100 | \$85,000 | 100 | \$85,000 | 100 | \$85,000 | 100 | \$85,000 |
| Restore floodplains | \$15,000 | per acre of floodplain restored | 0 | \$0 | 2 | \$30,000 | 2 | \$30,000 | 2 | \$30,000 | 2 | \$30,000 |
| 4. Increase Education & Outreach | | | | | | | | | | | | |
| Provide septic & sanitary system education | \$10,000 | per year | 1 | \$10,000 | 1 | \$10,000 | 1 | \$10,000 | 1 | \$10,000 | 1 | \$10,000 |
| Provide pet waste education & signage | \$10,000 | per year | 1 | \$10,000 | 1 | \$10,000 | 1 | \$10,000 | 1 | \$10,000 | 1 | \$10,000 |
| Provide lawn care education | \$2 | per household or business | 0 | \$0 | 5,000 | \$10,000 | 5,000 | \$10,000 | 1 | \$2 | 1 | 2 |
| Provide educational signage | \$200 | per installed sign | 10 | \$2,000 | 2 | \$400 | 2 | \$400 | 2 | \$400 | 2 | \$400 |
| Increase media coverage | \$10,000 | per year | 5 | \$50,000 | 5 | \$50,000 | 5 | \$50,000 | 5 | \$50,000 | 5 | \$50,000 |
| Expand existing education program | \$5,000 | per year | 1 | \$5,000 | 1 | \$5,000 | 1 | \$5,000 | 1 | \$5,000 | 1 | \$5,000 |
| Totals | Total cost for period | | \$2,210,480 | | \$979,470 | | \$479,470 | | \$1,154,372 | | \$989,372 | |
| | Annual cost during period | | \$552,620 | | \$244,868 | | \$119,868 | | \$288,593 | | | |

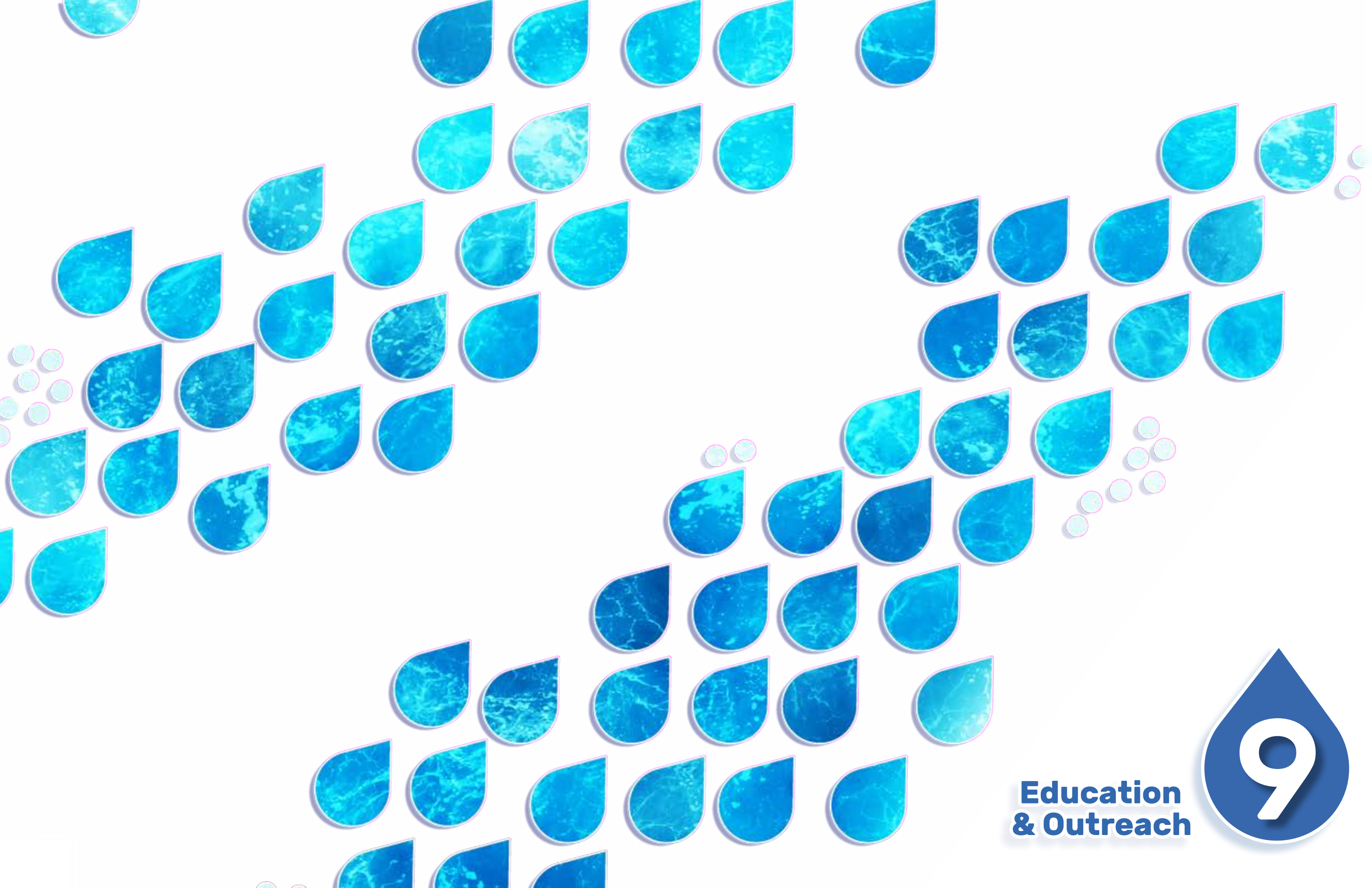
Funding Sources & Partners

Successfully implementing this Watershed Plan will require funding and partners who can assist by providing volunteers and technical assistance. Specific expertise may be needed for management measure design, siting, and construction and implementing education and outreach programs. Figure 8.2 below provides information about programs and organizations that can help provide the needed resources.

Figure 8.2 Sources of support for implementing the Watershed Plan

| | Funding Sources | | | | | | Volunteer Assistance | | | Financial & Technical Assistance | | |
|--|-----------------|-------------------------|------------|-----------|------------------|------------------|-------------------------|---------------------|---------------------|----------------------------------|-------------------------------|----------------------|
| | Section 319 | SC State Revolving Fund | USDA EQIP* | FEMA BRIC | Rock Hill SW Fee | Fort Mill SW Fee | Rock Hill Clean & Green | Catawba Riverkeeper | Keep York Beautiful | DES Watersheds Program | York Co Cooperative Extension | York Co Soil & Water |
| 1. Reduce Bacteria & Nutrients from Humans | | | | | | | | | | | | |
| Repair & replace failing septic systems | ● | | | | | | | | | ● | | |
| Connect failing septic systems to sanitary sewer | ● | ● | | | | | | | | ● | | |
| Install rain gardens (residential) | ● | ● | | | ● | ● | ● | | | ● | | |
| Install rain gardens (commercial) | ● | ● | | | ● | ● | ● | | | ● | | |
| Implement Rock Hill's wastewater CIP | | ● | | | | | | | | | | |
| Remove litter from streams | | | | | ● | ● | ● | ● | ● | | | |
| Remove litter from streets | | | | | ● | ● | ● | ● | ● | | | |
| Sweep streets | | | | | ● | ● | | | | | | |
| Convert dry detention ponds to wetlands | ● | | | | ● | ● | | | | ● | ● | |
| 2. Reduce Bacteria & Nutrients from Animals | | | | | | | | | | | | |
| Implement goose egg addling | | | | | | | | | | | ● | |
| Provide pet waste stations | ● | | | | | | | | | ● | | |
| Increase catch basin cleaning | | | | | ● | ● | | | | | | |
| Exclude livestock from streams with fencing | ● | | ● | | | | | | | ● | | ● |
| Provide alternative water sources on pastureland | ● | | ● | | | | | | | ● | | ● |
| 3. Reduce Hydrologic Impacts from Development | | | | | | | | | | | | |
| Disconnect household downspouts | ● | | | | ● | ● | ● | ● | ● | ● | ● | |
| Provide flood attenuation & storage | ● | | | ● | ● | ● | | | | ● | | |
| Restore and enhance stream buffers | ● | | | ● | ● | ● | | | | ● | ● | ● |
| Restore eroding streams | ● | | | ● | ● | ● | | | | ● | ● | |
| Restore floodplains | ● | | | ● | ● | ● | | | | ● | ● | |
| 4. Increase Education & Outreach | | | | | | | | | | | | |
| Provide septic & sanitary system education | ● | | | | ● | ● | ● | ● | ● | ● | ● | |
| Provide pet waste education & signage | ● | | | | ● | ● | ● | ● | ● | ● | ● | |
| Provide lawn care education | ● | | | | ● | ● | ● | ● | ● | ● | ● | |
| Provide educational signage | ● | | | | ● | ● | | | | ● | | |
| Increase coverage of water quality in the media | | | | | ● | ● | ● | ● | ● | | | |
| Expand existing education program | | | | | ● | ● | ● | ● | ● | | | ● |

*EQIP- Environmental Quality Incentives Program



**Education
& Outreach**





Education & Outreach

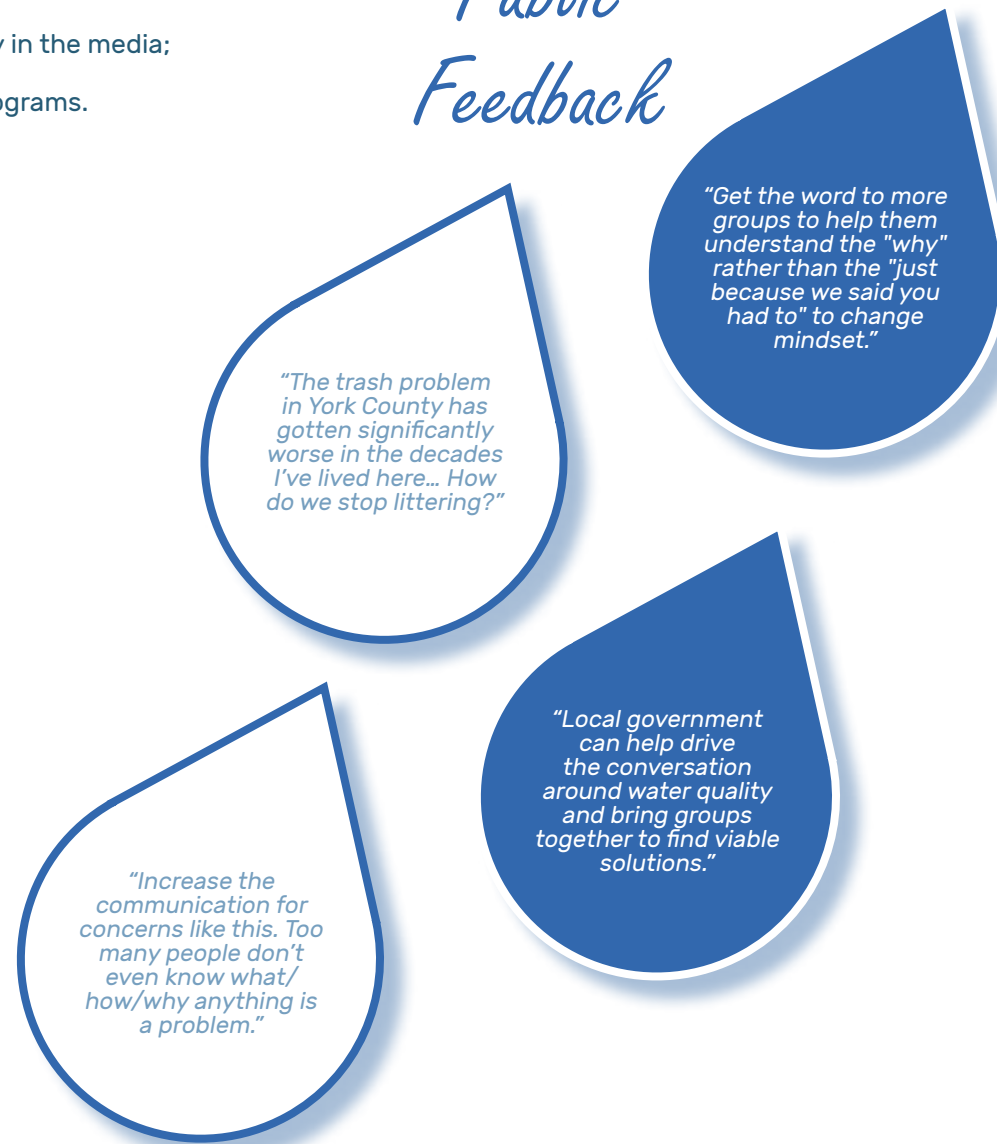
This section addresses EPA's Element E – develop an information/education component.

Overview

Engaging the community through education and outreach fosters awareness and understanding of watershed issues among the people who live, work, and play in the Burgis Creek Watershed. Citizens who are well-informed about the impacts of their actions on the watershed are more likely to participate in conservation efforts and adopt environmentally responsible behaviors. Effective public education can also build community support for the Watershed Plan, ensuring sustained commitment and involvement from local stakeholders. Objective 4 of this Watershed Plan is to increase education and outreach by:

- Providing education for septic + sanitary systems;
- Providing pet waste education + signage;
- Providing lawn care education;
- Providing educational signage;
- Increasing coverage of water quality in the media;
- Expanding existing engagement programs.

Public Feedback



Current Public Perceptions

Public input was collected through ArcGIS's web-based Survey123 platform. The survey was promoted via multiple channels to ensure broad community engagement. The local radio station WRHI advertised the survey and it was published on the official City of Rock Hill website. The survey garnered a total of 107 responses.

The survey was divided into two distinct versions based on the respondent's self-reported familiarity with environmental issues. This approach ensured each respondent was presented with questions aligned to their familiarity with watershed issues.

A total of 19 respondents classified themselves as highly familiar with environmental issues and were directed to a more specialized version of the survey. This version incorporated in-depth questions regarding water quality and utilized industry-specific terminology.

The remaining respondents received a more generalized questionnaire, specifically designed to be comprehensible to a broad audience. A total of 88 respondents participated in this version of the survey.

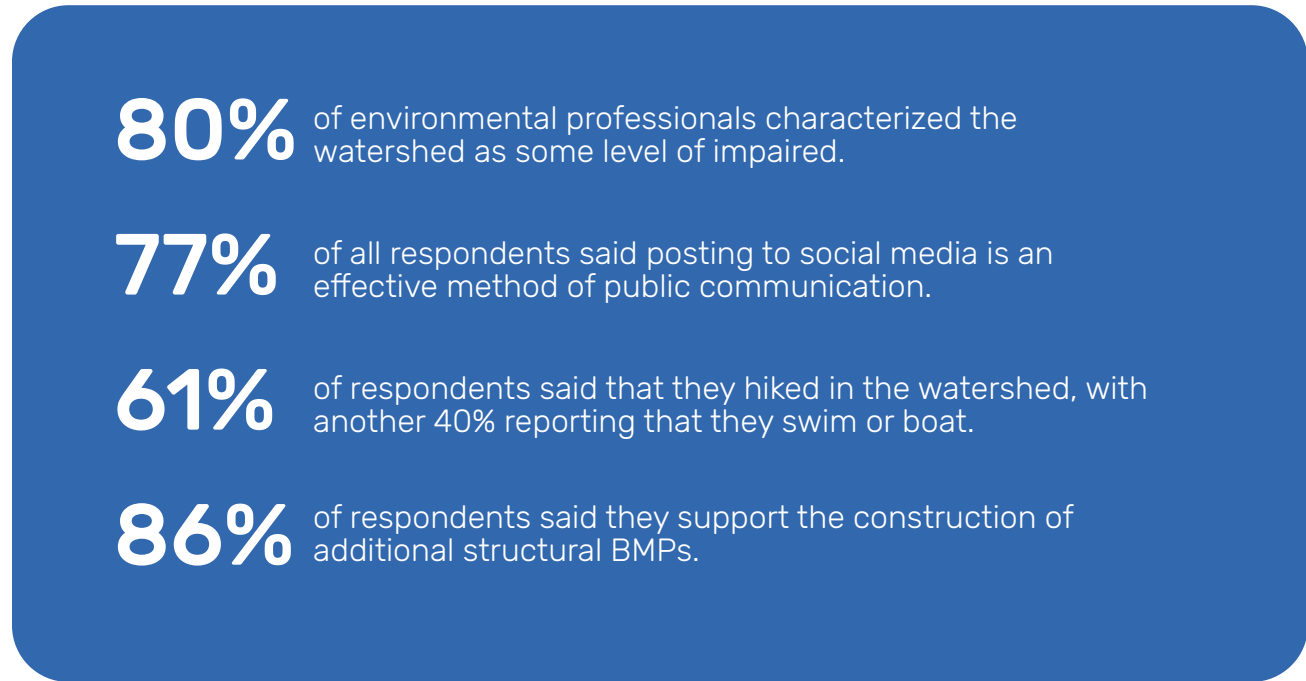


Figure 9.1 Summary of survey responses.

Ten Methods to Make it Fun and Creative

Many issues are competing for the attention of the public and it can be challenging to encourage the community to prioritize watershed protection. Ensuring that education and outreach activities are fun and creative will draw more attention from the public than a serious or even a negative message. Here are a few big picture tips to engage the public in the Burgis Creek Watershed:

1. Engage audiences by offering interactive content like quizzes, polls, and contests. This approach captures attention and encourages participation, makes them feel connected to the watershed. Interactive content can be shared easily, increasing your brand's reach.
2. Some of these topics, particularly pet waste management, can easily be made humorous. People are much more likely to remember the message when you have made them laugh.
3. Use social media to cater to the ways in which younger generations receive information.
4. Set up tables where people are already gathered, including community events such as Catawba Fest, ChristmasVille, the Strawberry Festival and the Come-See-Me Festival, can spread the message much further than trying to hold a separate event solely focused on watershed issues.
5. Provide educational signage at relevant locations such as parks, stormwater BMPs, and in pet stores (for pet waste management) so people see the message at the moment when it is pertinent.
6. Engage local radio shows, like WRHI, to provide updates on the implementation of the Watershed Plan, ensuring the community stays informed and engaged. Work with local news stations such as WBTB, WCNC, or WSOC to showcase more significant watershed achievements and initiatives.
7. Continue to foster partnerships and create new ones to help spread the message.
8. Create an integrated campaign that uses a variety of media and approaches to be more effective. People generally need to hear a message multiple times from different sources before they will act.
9. Work with the Art Council of York County to create programs, exhibits, and events that promote watershed awareness and health.
10. Be willing to think outside the box on how to approach watershed education.

Outreach & Education Management Measures

State and local governments have already developed a wide variety of effective and entertaining outreach and education materials for the topics identified in this Watershed Plan. Before developing new materials, it is recommended to consider the resources that already exist and to borrow ideas and approaches that have already worked elsewhere.

4a. Provide Septic & Sanitary System Education

Malfunctioning septic systems and leaking sanitary pipes are a source of *E. coli* and nutrient pollution. Property owners with septic systems need to hear the following messages:

- Here's how to recognize and respond to signs of service line or septic system malfunctions;
- You can prevent failures and clogs by properly disposing of grease and toxic substances;
- Here's how to maintain septic systems so it can protect your home, family and the environment.

| Resources | From |
|---|-------------------------------|
| SepticSmart Educational Materials | EPA |
| How a Septic Tank System Works | SCDES |
| Be Septic Safe | Clemson Cooperative Extension |



Figure 9.2 EPA "Do your part, be septic smart!" poster (EPA, 2024)

4b. Provide Pet Waste Education & Signage

Pet waste is a source of *E. coli* and nutrients. Pet owners need to hear the following messages:

- Cleaning up after you pets protects water quality and keeps outdoor amenities safe for everyone;
- This is part of your responsibility as a pet owner;
- It just takes a little planning and effort to pick up after your pet.



Figure 9.3 Pet waste education can be whimsical (Dog Poop Signs – A SmartSign Store)

| Resources | From |
|---|--|
| Please Clean Up After Your Pet | Beaufort County, SC |
| Trash the Poop | Columbia, SC |
| Pick it Up! | Richland County, SC |
| Pet Waste Management | EPA |
| It's Your Duty to Pick up their Doody | Durham, NC |
| Scoop It, Bag It, Trash It! | Maryland Dept. of Environmental Protection |

4c. Provide Lawn Care Education

Improper or excessive application of lawn care products is a significant source of nutrient pollution. Property owners and lawn care professionals need to hear the following

- Applying lawn care products at the correct times, and in the correct amounts, protects water quality, keeps lawns lush, and saves money;
- When too much fertilizer is applied to lawns, it can wind up in everyone's streams and lakes and cause algal blooms;
- These algal blooms can be dangerous to humans and pets.



Figure 9.4 Organic lawn care infographic (TurfGrowers)

| Resources | From |
|---|--------------------------------|
| Grasscycling | SCDES |
| Water Quality and Lawn Care | NC State Cooperative Extension |
| 16 Steps for Eco-Friendly Lawn Care | Lawn Love |
| Healthy Lawn, Healthy Environment | EPA |
| Carolina Lawns: A Guide to Maintaining Quality Turf | NC State Cooperative Extension |

4d. Provide Educational Signage & Increase Coverage of Water Quality in the Media

A lack of familiarity with water quality issues can lead people to inadvertently take actions that negatively impact the health of the watershed. All residents need to hear the following messages:

- Being knowledgeable and proactive when it comes to protecting water quality is everybody's business;
- There are many ways that individuals can affect everyone's water quality;
- Stormwater BMPs require regular maintenance.



Figure 9.5 Educational signage is an easy way to provide public education about stormwater issues (McAdams)

| Resources | From |
|---|-----------------|
| What Does a Swim Advisory Mean? | SCDES |
| Carolina Clear – Rain Gardens | WBTW |
| Stream Bank Stabilization | Upstate Forever |
| Stormwater Solutions | Wilmington, NC |
| See It, Report It. | Wilmington, NC |

4e. Expand Existing Education Programs

Residents want to help improve the environmental conditions within the watershed but may not know how. All residents need to hear the following messages:

- There are many programs, initiatives, and ways to get involved with protecting water quality within the watershed;
- Your contributions can make a meaningful difference.



Figure 9.6 The Adopt-a-Stream program provides education while keeping waterways clean (SCDES)

| Resources | From |
|---|----------------------------|
| Adopt a Stream Program | SCDES & Clemson University |
| Catawba Riverkeeper | Catawba Riverkeeper |
| Rock Hill Clean & Green | City of Rock Hill |
| Keep York County Beautiful | York County, SC |
| Adopt a Storm Drain | Town of Fort Mill |



**Implementation
Timeline &
Milestones**

10



Implementation Timeline & Milestones

This section addresses EPA's Elements F and G – develop a project schedule and describe the interim, measurable milestones.

Overview

The most important part of Watershed Planning is to implement the management measures. This process is more successful if each management measure is separated into a series of interim milestones with a schedule for each milestone, as shown in Figure 10.1a and 10.1b. The implementation timeline for this Watershed Plan puts education and outreach programs at

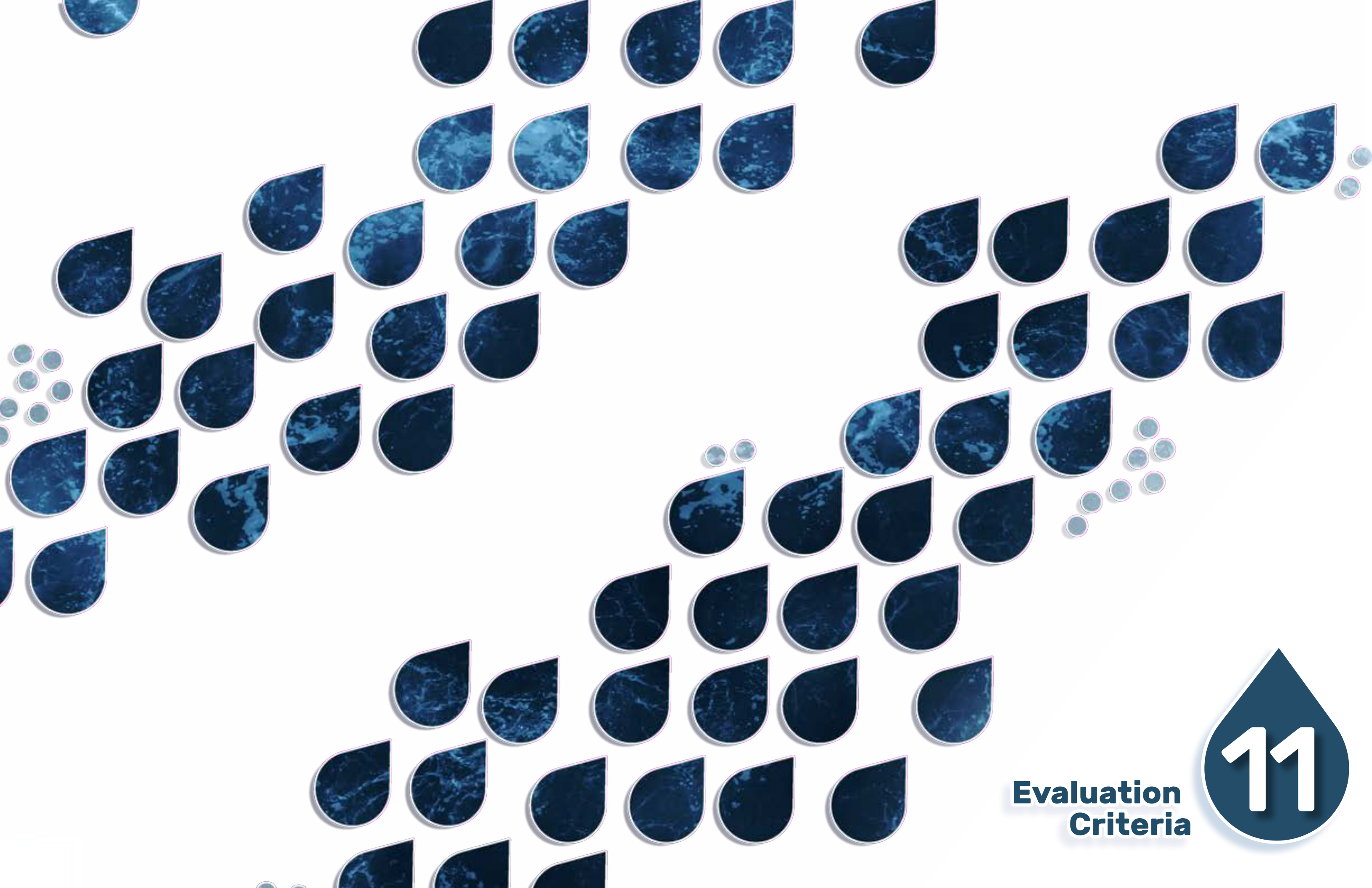
the beginning of the implementation process to engage citizens and stakeholders while planning for some of the on-the-ground measures is conducted. Goals and milestones will change over time as the Key Partners and others involved in implementing plan learn from their efforts and make refinements. This implementation timeline will likely be modified over time, as many could be implemented earlier or later than proposed.

| Management Measures | Milestones | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 | 2041+ | |
|---|--|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|-------|--|
| Provide educational signage | Determine location/content for signage | ● | | | | | | | | | | | | | | | | | |
| | Design signage | | ● | | | | | | | | | | | | | | | | |
| | Identify funding for signs | | | ● | | | | | | | | | | | | | | | |
| | Install signs | | | ● | | | | | | | | | | | | | | | |
| | Ongoing maintenance of signs | | | | → | | | | | | | | | | | | | | |
| Increase coverage of water quality in the media | Determine which outlets to use | | ● | | | | | | | | | | | | | | | | |
| | Create/update content | | ● | | | ● | | | ● | | | ● | | | ● | | | ● | |
| | Identify funding & free coverage opportunities | | ● | | | | | | | | | | | | | | | | |
| | Create/update schedule for media coverage | | | ● | | | | | ● | | | | | ● | | | | ● | |
| | Execute media coverage plan | | | → | | | | | | | | | | | | | | | |
| Expand existing engagement programs | Determine needs of existing programs | | ● | | | | | ● | | | | | ● | | | | | ● | |
| | Create & executes plan to address needs | | | → | | | | | | | | | | | | | | | |
| Provide education for septic & sanitary systems | Contact homeowners via mail & media | | | ● | | | | | ● | | | | | ● | | | | | |
| | Provide workshops & educational materials | | | ● | | | | | ● | | | | | ● | | | | | |
| Repair/replace failing septic systems or connect failing septic systems to sanitary sewer | Identify funding sources/cost-share | | | | ● | | | | | | | | | | | | | | |
| | Visit homes & determine solutions needed | | | | ● | | | | ● | | | | | ● | | | | | |
| | Implement needed solutions | | | | | → | | | | | | | | | | | | | |
| | Ensure ongoing maintenance of solution | | | | | | → | | | | | | | | | | | | |
| Install rain gardens (residential & commercial) | Identify funding sources/cost-share | | | | ● | | | | | ● | | | | | | | | | |
| | Contact owners via mail & media | | | | ● | | | | | ● | | | | | ● | | | | |
| | Provide workshops & educational materials | | | | ● | | | | | ● | | | | | ● | | | | |
| | Provide design & installation support | | | | | → | | | | | | | | | ● | | | | |
| | Ensuring ongoing maintenance of rain gardens | | | | | | → | | | | | | | | | | | | |
| ● Time limited task | | | | | | | | | | | | | | | | | | | |
| → Ongoing Task | | | | | | | | | | | | | | | | | | | |

Figure 10.1a Management measures implementation timeline

| Management Measures | Milestones | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 | 2041+ |
|--|--|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|-------|
| Provide alternative water sources on pastureland | Contact pasture owners | → | | | | | | ● | | | | | ● | | | | | ● |
| | Provide funding & technical assistance | → | | | | | | → | | | | | | | | | | |
| Exclude livestock from streams with fencing | Contact pasture owners | | | | | | | ● | | | | | ● | | | | | ● |
| | Provide funding & technical assistance | | | | | | | → | | | | | | | | | | |
| Provide pet waste education & signage | Design or select pet education materials | | ● | | | | | ● | | | | | ● | | | | | ● |
| | Provide education via vets & media | | | → | | | | | | | | | | | | | | |
| | Install signs in parks & other targeted areas | | | ● | | | | | ● | | | | | ● | | | | |
| Provide pet waste stations | Target locations to install pet waste stations | | | | | ● | | | | | ● | | | | | ● | | |
| | Identify funding | | | | | ● | | | | | | | | | | ● | | |
| | Install & maintain stations | | | | | | → | | | | | | | | | | | |
| Disconnect household downspouts | Identify funding sources/cost-share | | | | | ● | | | | | ● | | | | | ● | | |
| | Contact homeowners via mail & media | | | | | ● | | | | | ● | | | | | ● | | |
| | Provide funding & technical assistance | | | | | | → | | | | | | | | | | | |
| Provide lawn care education | Design or select lawn education materials | | | | | | | ● | | | | | ● | | | | | ● |
| | Distribute materials to property owners | | | | | | | ● | | | | | ● | | | | | ● |
| Implement goose egg addling & install beaver pond levelers | Contact owners of ponds with geese or beavers | | | | | | | | | ● | | | | | ● | | | |
| | Identify funding | | | | | | | | | ● | | | | | ● | | | |
| | Implement addling & install devices | | | | | | | | | | → | | | | | | | |
| Remove litter from streams & streets | Convene existing outreach organizations | | | | | | | | | | | ● | | | | | | |
| | Assess & prioritize needs | | | | | | | | | | | ● | | | | | | |
| | Create a schedule for cleanup activities | | | | | | | | | | | ● | | | | | | |
| | Implement schedule | | | | | | | | | | | | → | | | | | |
| Sweep streets | Assess & prioritize needs | | | ● | | | | | | | | | | | | | ● | |
| | Create a schedule for sweeping activities | | | | → | | | | | | | | | | | | | |
| Increase catch basin cleaning | Assess & prioritize needs | | | | | | | | | | | ● | | | | | ● | |
| | Create a schedule for cleaning | | | | | | | | | | | | → | | | | | |
| Restore & enhance stream buffers, eroding streams and impacted floodplains | Identify priorities | | | | | | | | | | | | | ● | | | | |
| | Seek grant funding | | | | | | | | | | | | | | ● | | | |
| | Implement stream & buffer enhancements | | | | | | | | | | | | | | | → | | |
| Convert dry detention ponds to wetlands | Identify priorities | | | | | | | | | | | | | | ● | | | |
| | Seek grant funding | | | | | | | | | | | | | | | ● | | |
| | Implement dry detention pond conversions | | | | | | | | | | | | | | | | → | |
| Update stormwater ordinance & provide flood attenuation & storage | Identify priorities | | | | | | | | | | | | | | | ● | | |
| | Seek grant funding | | | | | | | | | | | | | | | | ● | |
| | Implement flood attenuation & storage | | | | | | | | | | | | | | | | | → |
| ● Time limited task | | | | | | | | | | | | | | | | | | |
| → Ongoing Task | | | | | | | | | | | | | | | | | | |

Figure 10.1b Management measures implementation timeline



**Evaluation
Criteria**



Evaluation Criteria

This section addresses EPA's Element H – identify indicators to measure progress.

Overview

The recommended management measures will be implemented by numerous organizations in multiple locations. Therefore, the contributors need to track their progress and to view the efforts of others. This will enable the Key Partners to make data-driven decisions about which measures are most cost-effective and emphasize those measures in future efforts. This section provides metrics for tracking implementation and a recommendation to create a digital watershed dashboard to facilitate seamless teamwork between partners.

Digital Watershed Dashboard

A digital dashboard, like the example shown in Figure 11.1, is a powerful analysis tool that can allow Key Partners to track, analyze and report on Watershed Plan progress. This dashboard would be a repository of both locational and descriptive information for tracking the progress of Watershed Plan implementation. ArcGIS Survey123 is an excellent platform for digital dashboards because it integrates with existing GIS systems and can be customized based on the preferences of the watershed partners.

Benefits of a Digital Dashboard

Seamless Communication of Real-Time Data:

Immediately after data is entered by a Key Partner, it can be viewed by other partners and, if desired, the public.

Ability to View Data in a Map or List Format:

Watershed Plan data can be viewed on a map or in a list format based on the needs of different users. For Key Partners, this means the ability to cast either a wide or narrow net over the data, focusing on the details most pertinent to their roles and responsibilities. With interactive data visualizations, digital dashboards allow for improved decision-making process and continuous growth.

Ability to Connect Watershed Efforts with Water Quality Data:

Being able to simultaneously view the locations and timing of management measures with water quality data is the only way to draw conclusions about the effectiveness of the efforts.

Opportunity for Public Outreach

If the dashboard were made publicly available, the successes and ongoing efforts of the Watershed Plan could be showcased, which would bolster community engagement and support. This approach would inform the public and foster a sense of collective responsibility and accomplishment.

Evaluation Criteria

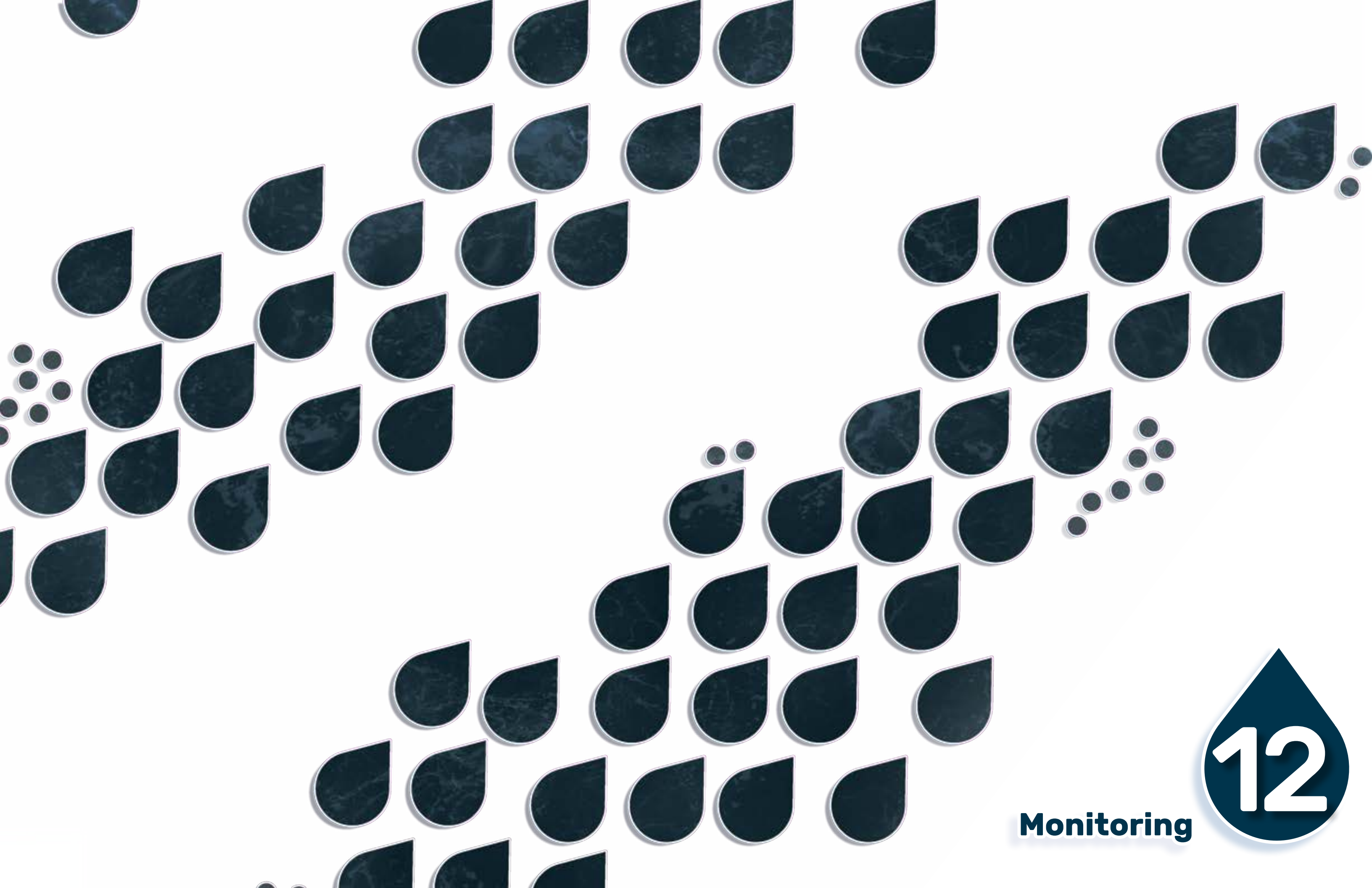
The tracking metric for each management measure is provided in Figure 11.2 below.

| | Tracking Metric |
|--|--|
| Overall Plan Objectives | |
| Reduce <i>E. coli</i> load by 12% | Concentration of <i>E. coli</i> in water samples |
| Reduce TN load by 9% | Concentration of TN in water samples |
| Reduce TP load by 21% | Concentration of TP in water samples |
| 1. Reduce Bacteria & Nutrients from Humans | |
| Repair, replace, and connect failing septic systems | # of repaired/replaced septic systems |
| Install rain gardens | # of rain gardens installed |
| Implement Rock Hill's wastewater CIP | # of sanitary sewer repairs |
| Remove litter from streams | Tons of litter removed from streams |
| Remove litter from streets | Tons of litter removed from streets/ROW |
| Sweep streets | Miles of streets swept |
| Convert dry detention ponds to wetlands | # of wetland conversions |
| 2. Reduce Bacteria & Nutrients from Animals | |
| Implement goose egg addling | # of addled goose nests |
| Provide pet waste stations | # of installed pet waste stations |
| Increase catch basin cleaning | # of catch basins cleaned |
| Exclude livestock from streams with fencing | Feet of fencing installed along pastureland |
| Provide alternative water sources on pastureland | Acres of pasture served by alternative water sources |
| 3. Reduce Hydrologic Impacts from Development | |
| Disconnect household downspouts | # of household downspout disconnections |
| Provide flood attenuation & storage | # of flood attenuation BMPs installed |
| Restore and enhance stream buffers | Miles of restored/enhanced stream buffers |
| Restore eroding streams | Miles of restored stream banks |
| Restore floodplains | Acres of restored floodplains |
| 4. Increase Education & Outreach | |
| Provide septic & sanitary system education | # of citizens educated about septic & sanitary systems |
| Provide pet waste education & signage | # of citizens educated about pet waste |
| Provide lawn care education | # of citizens educated about lawn care |
| Provide educational signage | # of educational signs installed |
| Increase coverage of water quality in the media | # of water quality news stories |
| Expand existing education programs | # of new volunteers |



Figure 11.1 Example of digital tracking dashboard (McAdams)

Figure 11.2 Tracking metric for measurement measures



Monitoring

12

Monitoring

This section addresses EPA's Element I – develop a monitoring component.

Overview

Without consistent and systematic monitoring, it is impossible to determine if the implemented management measures are effectively enhancing water quality in the watershed. By conducting thorough water quality evaluations, the evaluation criteria can be compared against real world conditions. This ensures that water quality improvements are on the right track and provides valuable insights for continuous improvement and adaptation of the management strategies.

The City of Rock Hill and the Town of Fort Mill, after verifying that water quality samples from points 1-6 comply with SCDES standards, should formally request that SCDES resume its sampling efforts, which would include these additional 5 sites. This data may be used to support the removal of the watershed from the 303(d) list.

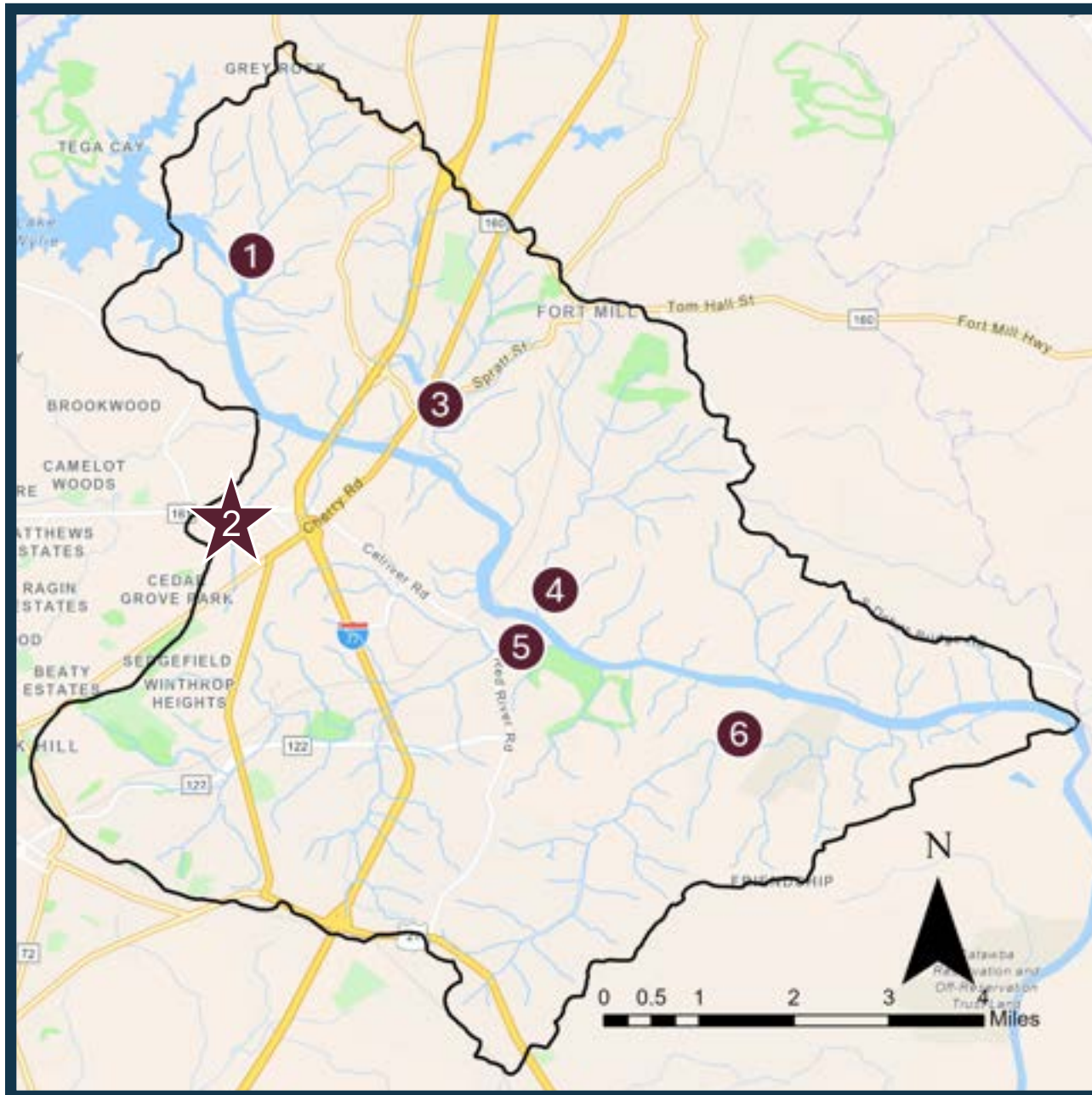


Figure 12.1 Existing and proposed sampling points in watershed map

Sampling Points

There is currently one established SCDES monitoring points within the Burgis Creek Watershed. This point is labeled as 2 on the watershed map seen in Figure 12.1. Samples were last collected from these monitoring points in 1998.

This plan recommends DES resume sample activities at the existing sample site and establishing five new sample locations to fully understand the impact of implemented management measures. The access point and selection reasons for each sample point are shown in Figure 12.2 below.



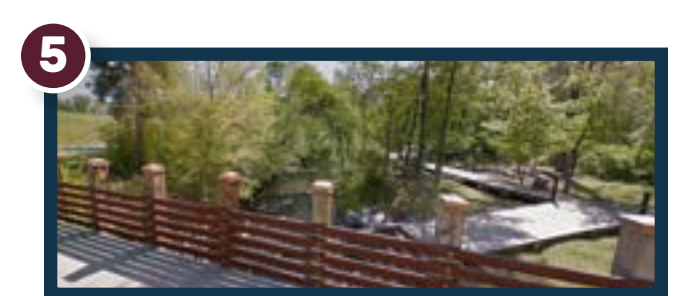
Access: New Gray Rock Rd
Reason to Sample: This site would show the pollutant levels of the Johnnytown Branch.



Access: Sparkling Brook Parkway
Reason to Sample: The results from this location will help determine the health of a large off shoot stream of the Catawba River.



Access: Celanese Rd
Reason to Sample: This site is an existing SCDES 303(d) list and TMDL monitoring site. The results from this location will help determine the overall health of Hidden Creek.



Access: River Park Wetlands Trail
Reason to Sample: The results from this location will help determine the health of the Manchester Creek.



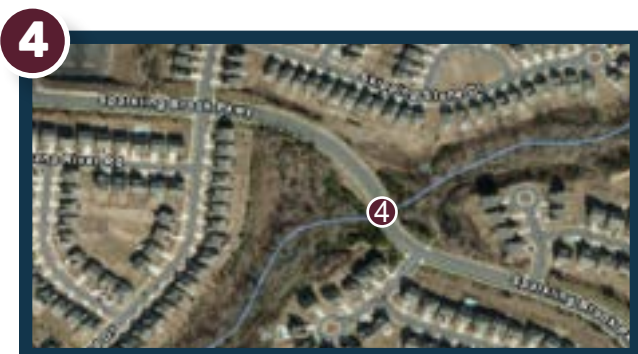
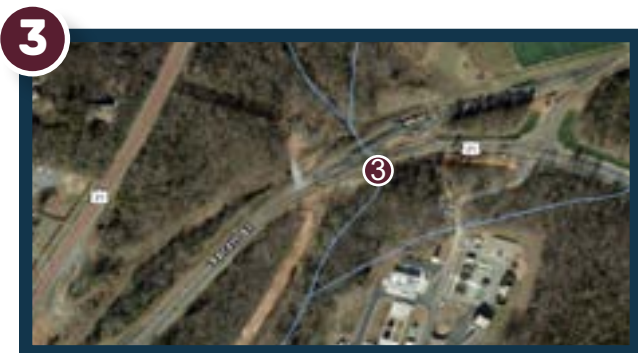
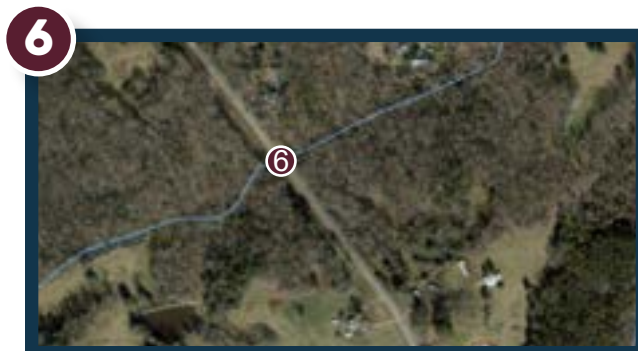
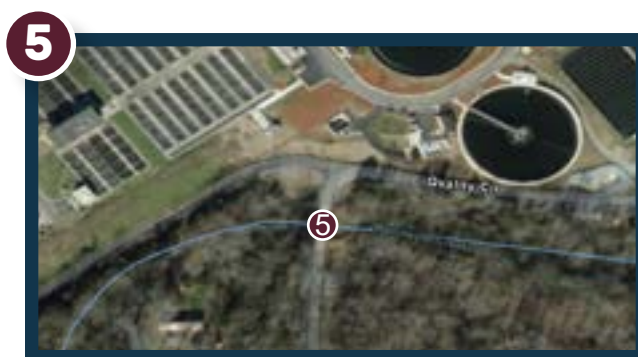
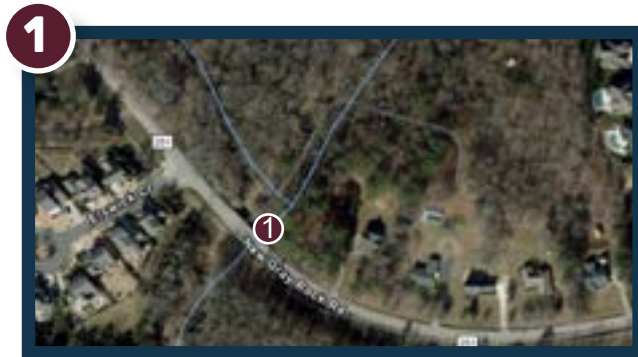
Access: Spratt St.
Reason to Sample: This site would show the pollutant levels of Dye Branch.



Access: White Horse Road
Reason to Sample: The results from this location will help determine the health of the Burgis Creek.

Figure 12.2 Existing and proposed sampling points in watershed summary

Figure 12.3 below shows the detailed locations for each sample point.



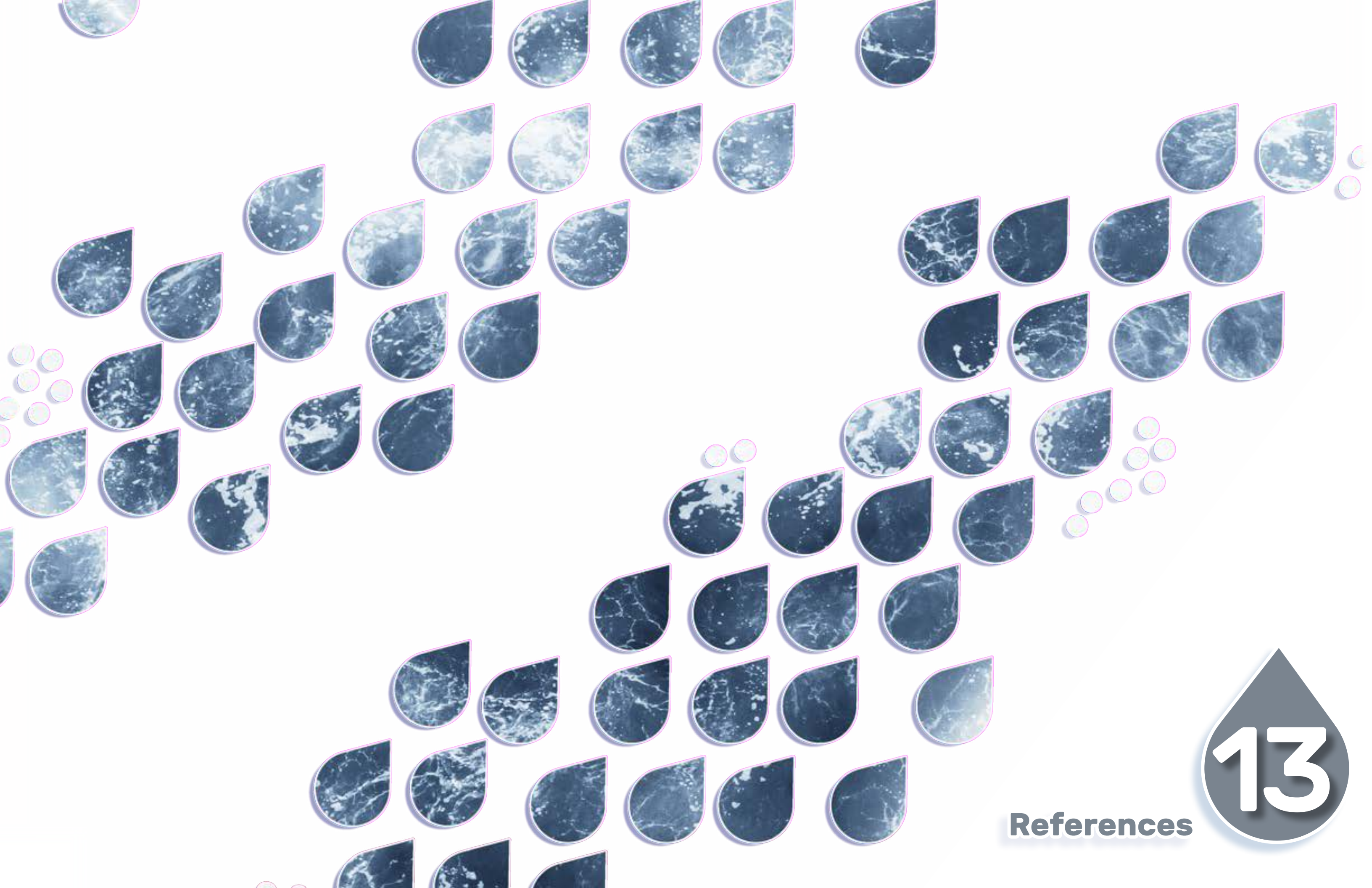
Sampling Parameters

When? Samples from each monitoring site should be collected monthly. This is the same monitoring schedule implemented by SCDES and required by the Adopt-a-Stream program.

What? To monitor the success of this Watershed Plan, sampling results must include *E. coli*, Total Nitrogen (TN), and Total Phosphorus (TP).

How? For those eager to play an active role in enhancing the water quality of the Burgis Creek Watershed, participating in the [Adopt-a-Stream](#) program is an excellent opportunity. This program empowers community members by providing them with the necessary tools and training to collect valid water quality samples. By engaging in this initiative, participants can contribute to the success of this Watershed Plan.

Figure 12.3 Detailed sampling locations



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Burgis Creek Watershed Plan

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