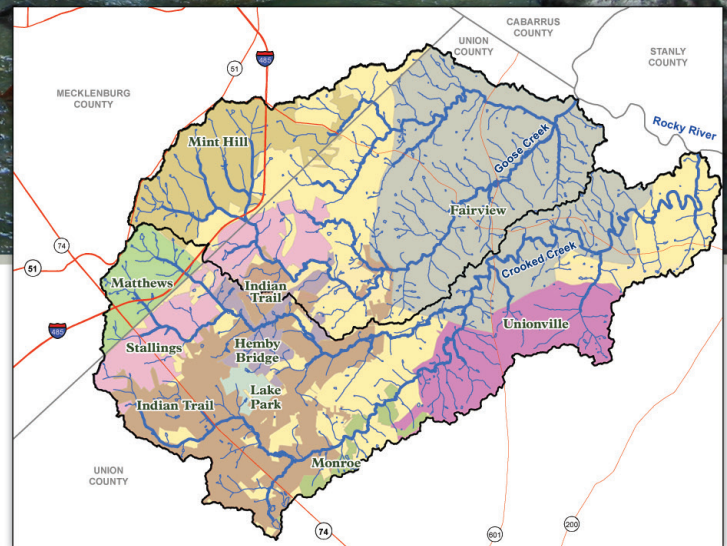


Goose Creek and Crooked Creek Local Watershed Plan

Watershed Management Plan – Phase III

October 2012



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Final



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Abbreviations and Acronyms

BEHI	Bank Erosion Hazard Index
BLM	biotic ligand model
BMP	best management practice
CEM	Channel Evolution Model
GIS	geographic information system
HEC	Hydrologic Engineering Center
HSG	hydrologic soil group
HSPF	Hydrologic Simulation Program–FORTRAN
LID	low impact development
LSPC	Loading Simulation Program C++
LWP	local watershed plan
NCDOT	North Carolina Department of Transportation
NCDWQ	North Carolina Department of Water Quality
NCEEP	North Carolina Ecosystem Enhancement Program
NHEO	Natural Heritage Element Occurrence
NHP	Natural Heritage Program
NLCD	National Land Cover Dataset
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
RAS	River Analysis System
SNHA	Significant Natural Heritage Area
TN	total nitrogen
TSS	total suspended solids
USFWS	U.S. Fish and Wildlife Service
WAR	Watershed Assessment Report
WAT	Watershed Assessment Team
WMP	Watershed Management Plan
WMU	Wetlands Mitigation Unit
WRC	Wildlife Resources Commission
WTT	Watershed Technical Team
WWTP	wastewater treatment plant

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Executive Summary

In 2008 the North Carolina Ecosystem Enhancement Program (NCEEP) initiated development of a local watershed plan (LWP) for the Goose Creek and Crooked Creek watersheds. Phase I of the LWP process started in spring of 2008 and focused on preliminary characterization and identification of data gaps. Phase II began in the spring of 2010 and concentrated on a detailed watershed assessment. The goals of Phase II were to determine the functional status of aquatic systems in the watershed; identify the key stressors and their sources impacting water quality, habitat, and hydrology; determine where management to address these sources and stressors is needed most; and identify potential management opportunities and key assets in the watershed. Also, during this phase, LWP goals and objectives were adopted. A Watershed Assessment Report describes the activities and results of Phase II.

The ongoing success of this LWP is rooted in the active interest and continuing participation of a variety of stakeholders. The stakeholder process was designed to involve several distinct groups, including a Project Administration Team, the Watershed Technical Team, and community stakeholders. The Watershed Technical Team, which consists of up to 40 key and active stakeholders in these watersheds that broadly represent several organizations and interests, emerged as the primary engagement group over the course of LWP Phases I and II. Starting with Phase I, the Watershed Technical Team will have convened 10 times from July 2008 through June 2012.

As a result of efforts in Phase I and Phase II, sediment and increased peak flows/runoff volumes were determined to be the most important and pervasive stressors to watershed function in the Goose Creek and Crooked Creek watersheds. Other stressors are bacteria, nutrients, oxygen-demanding substances, and toxicity-related pollutants from urban, point, and agricultural sources. Phase III of the LWP focused on developing the Watershed Management Plan (WMP) and companion Project Atlas to address these stressors, both under existing and future conditions, through a number of targeted management practices and a prioritization of those practices that selects the opportunities that would best address watershed stressors and restore or protect watershed functions (Table ES-1).

In the WMP, each category of management practice is discussed, including a summary of the identification and prioritization efforts, for the following management types: stream restoration and enhancement, wetland restoration and enhancement, and stormwater best management practices (BMPs). Preservation, agricultural BMPs, point source management, and watershed protection measures are also discussed outside a formal prioritization. Overall, the project prioritization provides a planning tool for implementation.

The effective implementation of the Goose Creek and Crooked Creek watersheds WMP requires a coordinated effort among NCEEP and its partners. NCEEP implements stream and wetland mitigation that involves stream and wetland restoration, enhancement, and preservation. Successful implementation of stormwater BMP retrofits, agricultural BMPs, point source management, and watershed protection measures will largely rely on partnerships among watershed stakeholders.

Three major actions will serve to provide a successful foundation for implementation: (1) NCEEP project implementation, (2) adoption or endorsement of the Watershed Management Plan, and (3) a coordinated management strategy. Those actions provide a foundation for implementing the WMP and are expected to provide a starting point for determining additional actions that might be required. Each of the actions is considered essential to achieving the goals and objectives of the LWP and toward implementing the recommended management opportunities.

Table ES-1. Proposed Management Strategies to Address Stressors in the Goose Creek and Crooked Creek Watersheds

Stressor	Source(s)	Impact(s)	Functional Deficit(s)	Management Recommendations
Increased Peak Flows and Runoff Volumes	Impervious surface, removal of vegetation, direct stormwater discharges	Decreased groundwater recharge and baseflows, channel modification and increased bed/bank erosion (and potential increases in sediment-attached pollutants), substrate disturbance; increased velocities, scour	Impaired aquatic habitat, loss of wetland hydrology/habitat, impaired aquatic organisms	Stream enhancement/restoration, riparian wetland enhancement/restoration, stream buffer restoration, urban stormwater retrofit, non-riparian wetland enhancement/restoration, enhancement of development design
Sediment	Erosion of construction sites, agricultural land, livestock access to streams, streambank and channel erosion, ATV use	Increased deposited sediment in stream channel, increased turbidity/suspended sediment, increases in sediment-associated pollutants (e.g., nutrients, metals)	Impaired aquatic habitat and aquatic organisms	Stream enhancement/restoration, riparian wetland enhancement/restoration, stream buffer restoration, urban stormwater retrofit, agricultural BMPs, wider stream buffer preservation requirements (Crooked Creek), enhancement of development design, strengthening and enforcement of sediment and erosion control requirements
Bacteria	Pets, livestock, wastewater discharges, sewer overflows and leaks, septic tanks, wildlife	Increased count of pathogens in surface and ground water	Increased risk to human health (and aquatic life)	Pet waste management, agricultural waste management, livestock exclusion from streams, reduce sewer overflows and leaks, urban stormwater retrofit, enhancement of development design

Stressor	Source(s)	Impact(s)	Functional Deficit(s)	Management Recommendations
Nutrients and Oxygen-Demanding Substances	Nutrient loading from urban and agricultural runoff, temperature increase in runoff from impervious surfaces, natural sources; wastewater treatment plants, septic systems, direct loading from livestock, other agricultural sources	Excessive algal growth, depletion of dissolved oxygen	Aquatic organism stress and mortality; shifts in aquatic community composition	Point source management, urban stormwater retrofit, agricultural BMPs, nutrient management (agricultural and urban), wider stream buffer preservation requirements (Crooked Creek), site-specific water quality standards for nitrate-nitrite and phosphorus, enhancement of development design, strengthening and enforcement of sediment and erosion control requirements
Toxicity-Related Pollutants: Ammonia, Copper, Pesticides, Chlorine, Other Metals	Wastewater discharges, runoff from impervious surfaces and lawns, golf courses, and agricultural land (manure and agrochemicals)	Increased concentration of toxic chemicals	Toxic effects on aquatic organisms	Point source management, urban stormwater retrofit, pesticide management, nutrient management, enforcement and expansion of toxicity regulations, expansion of pesticide monitoring, establishment of site-specific water quality standards for copper, emergency management procedures

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1 Introduction

In 2008 the North Carolina Ecosystem Enhancement Program (NCEEP) initiated development of a local watershed plan (LWP) for the Goose Creek and Crooked Creek watersheds (Figure 1). The two watersheds, encompassing parts of northern Union County and southeastern Mecklenburg County, are located in the Yadkin Pee Dee River Basin (14-digit hydrologic units 03040105030020 and 03040105040010) and drain to the Rocky River.

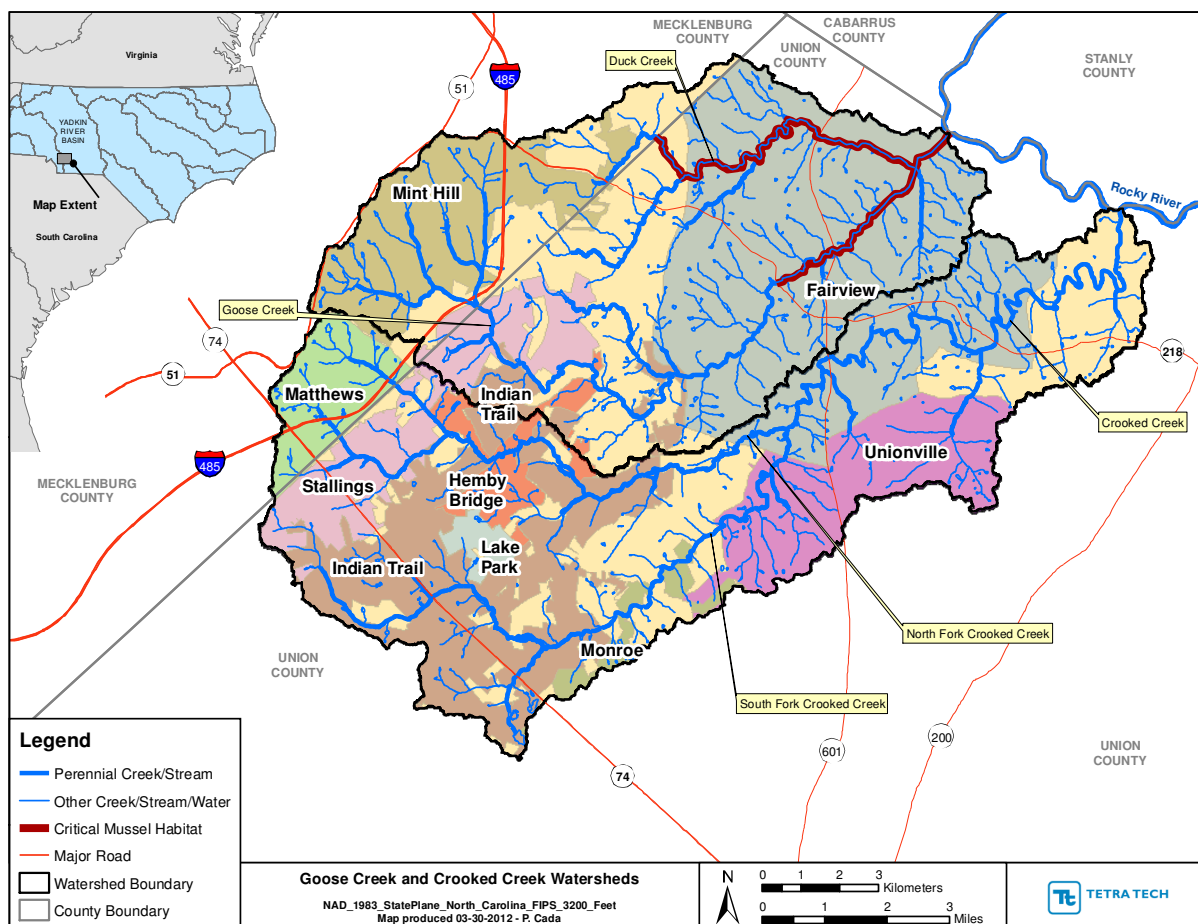


Figure 1. Location Map of Goose Creek and Crooked Creek Watersheds

1.1 NCEEP BACKGROUND

The NCEEP was created in 2003 to provide ecologically effective compensatory mitigation for permitted effects on streams, wetlands and riparian buffers under the Clean Water Act. The cornerstone of NCEEP's approach to compensatory mitigation is to identify high-priority local watersheds (14-digit hydrologic units) within which a detailed assessment of watershed conditions is accomplished through a stakeholder-driven LWP process. NCEEP mitigation projects are designed to address the major watershed stressors occurring at a subwatershed scale in high-priority local watersheds. The primary purpose of NCEEP mitigation projects is to restore or protect key watershed functions, including water quality, hydrology and habitat.

For additional information about the NCEEP program mission and operations, including watershed planning and project implementation, see <http://portal.ncdenr.org/web/eep>.

1.2 NCEEP's LOCAL WATERSHED PLANNING APPROACH

A primary goal of NCEEP's local watershed planning process is to provide a watershed-based approach for identifying and implementing mitigation projects. A detailed assessment of watershed problems and assets at the local scale (14-digit hydrologic units) forms the basis for specific recommendations for restoring/enhancing and protecting local water quality, hydrology and habitat. A local watershed stakeholder team helps to identify and rank watershed solutions, including project sites and broader institutional measures.

The NCEEP LWP development process has four major phases of work.

1. Phase I is the preliminary characterization of watershed conditions, primarily on the basis of geographic information system (GIS) data and existing water quality and habitat information, including some field reconnaissance.
2. Phase II includes field assessment activities, collecting additional monitoring data as determined necessary from Phase I to support the identification of relevant watershed stressors and sources and the identification of priority subwatersheds in which to target watershed improvement efforts. Watershed modeling is another typical component of the Phase II or III work.
3. Phase III integrates watershed assessment data collected in Phases I and II along with stakeholder recommendations in developing two final LWP products: a Project Atlas of ranked watershed project sites (e.g., stream and wetlands restoration/enhancement and preservation projects, and high-priority urban and rural BMP projects); and a Watershed Management Plan (WMP; this document), consisting of recommendations for consideration by local governments, resource agencies, and watershed citizens or groups seeking to protect watershed resources and functions.
4. The focus of Phase IV is on implementing the WMP and the Project Atlas; continuation of stakeholder coordination and communication during Phase IV is important to support this effort and foster the implementation of watershed management strategies beyond mitigation.

For more information on the approach, see <http://portal.ncdenr.org/web/eep/watershed-planning-home>.

1.3 PLANNING AREA DESCRIPTION

The Goose Creek and Crooked Creek watersheds, in Mecklenburg and Union counties, are approximately 42 and 50 square miles, respectively (Figure 1). These watersheds encompass 11 local government jurisdictions: the village of Lake Park, the towns of Fairview, Hemby Bridge, Indian Trail, Matthews, Mint Hill, Stallings, Unionville, the city of Monroe, and Union and Mecklenburg counties.

Aside from the need to provide mitigation in the cataloguing unit containing the Goose Creek and Crooked Creek watersheds, NCEEP chose to develop an LWP for these watersheds for the following primary reasons:

1. Sensitive Aquatic Species: Goose Creek watershed is one of only three watersheds in North Carolina to still support the Carolina heelsplitter (*Lasmigona decorata*), a federally and state-endangered freshwater mussel. The other two watersheds in North Carolina are also in Union County; Waxhaw Creek and Sixmile Creek, which straddles the Mecklenburg and Union County line. Watershed protection and restoration efforts in the Goose Creek watershed would help to protect the existing population of this endangered species and provide the opportunity for this species to reestablish its diminished numbers. Biological research indicates that the heelsplitter population has been reduced to one-half of its historical range in the Goose Creek watershed

(WRC, 2005). In addition, this watershed and the Crooked Creek watershed support several other threatened freshwater mussel (discussed later in this section).

Mussels are extremely sensitive to changes in their environment; i.e., water temperature, flow, pollutants and sediment. The sensitivity of the mussels makes them excellent indicators of stream health. If mussels show a population decline, it should be considered as a potential symptom of lessening or poor stream quality.

2. **Growth and Land Use:** The lower Yadkin River Basin and particularly Union County is experiencing tremendous growth. The Goose Creek and Crooked Creek watersheds border the Union County and Mecklenburg County lines. The Charlotte metropolitan area is rapidly urbanizing; with this growth comes continued road, commercial, and residential development, and the coordinating infrastructure. As a result, mitigation needs will increase. Union County is directly affected by Charlotte's growth and had been identified as the fastest growing county in North Carolina and the 16th fastest in the nation (WRC, 2005). In Union County, land is being converted from its historic use of agriculture to uses such as residential, commercial, and industrial development.
3. **Water Quality:** Both watersheds contain streams listed on North Carolina's 303(d) list of impaired waters (discussed later in this section).
4. **Community Interest:** Residents and local resource professionals have been receptive to NCEEP's presence and have expressed interest in working in partnership to develop a watershed plan and increase public awareness and education. Many stakeholders have cooperated previously on issues related to the Carolina heelsplitter.

The following paragraphs outline characteristics or activities unique to each watershed.

Crooked Creek

The Crooked Creek watershed is the larger of the two watersheds and has at its upper reaches developing areas at the Union County and Mecklenburg County line along the US 74 Corridor. Crooked Creek (along with North Fork Crooked Creek and South Fork Crooked Creek) is on North Carolina's 303(d) list of impaired waters. Crooked Creek and South Fork Crooked Creek are impaired for loss of ecological/biological integrity; Crooked Creek and North Fork Crooked Creek are impaired for turbidity (NCDWQ, 2010; NCDWQ, 2012). A number of state endangered, state threatened, federal species of concern, and significantly rare aquatic species (fishes and mussels) occur in the watershed. The Crooked Creek watershed supports sensitive mussel species including the Carolina creekshell (*Villosa vaughaniana*), Savannah Lilliput (*Toxolasma pullus*), and the Eastern creekshell (*V. delumbis*). Freshwater mussels generally have high sensitivity to excess sedimentation, turbidity, and toxins.

Goose Creek

The Goose Creek watershed is the only watershed in North Carolina that contains impaired stream reaches and an existing population of a federally listed endangered species (i.e., the Carolina heelsplitter). Goose Creek and Duck Creek (a tributary to Goose Creek) are impaired for ecological/biological integrity and bacteria. Goose Creek is also impaired for turbidity according to the draft 2012 303(d) list (NCDWQ, 2012).

The Carolina heelsplitter is a medium-sized freshwater mussel that grows to about 115 mm (4.6 inches) long, with a greenish brown to dark brown shell. The Carolina heelsplitter has a fragmented, relict distribution with only six known populations (Keferl, 1991). In Union County, one small remnant population is in Waxhaw Creek (a tributary to the Catawba River), and another small population is in Goose Creek and its tributary, Duck Creek. In 1990 the species was found upstream of NC 218 in Goose Creek but is now known only downstream of US 601 (Johnson, 2001). In 2002 the U.S. Fish and Wildlife Service (USFWS) designated critical habitat for the species. The *Federal Register* (2002) publication (67

FR 44501 - 44522) includes the following account relative to the Goose Creek watershed. Note that critical habitat represented occupied habitat at the time of designation and might not currently support the species.

Critical Habitat Designation: Carolina heelsplitter—The main stem of Goose Creek, from the NC Highway 218 Bridge, downstream to its confluence with the Rocky River, and the main stem of Duck Creek, from the Mecklenburg/Union County line, downstream to its confluence with Goose Creek.

With only these few populations remaining, a healthy Goose Creek watershed is critically important for the continued existence of the Carolina heelsplitter and other aquatic wildlife.

Goose Creek also supports sensitive mussel species other than the Carolina heelsplitter including Carolina creekshell (*V. vaughaniana*), Eastern creekshell (*V. delumbis*), Atlantic pigtoe (*Fusconaia masoni*), Creeper (*Strophitus undulates*), and Notched rainbow (*V. constricta*).

1.4 LWP TIMELINE

Table 1 provides the timeline for the LWP process. LWP Phase I began in 2008 and lasted 12 months. LWP Phases II and III began in April 2010 and ended in June 2012. Phase IV (Implementation) is initiated as mitigation needs develop or funding for watershed management strategy implementation becomes available.

Table 1. LWP Timeline

LWP Phase	Date Range
Phase I	May 2008–April 2009
Phase II	April 2010–December 2011
Phase III	July 2011–June 2012
Phase IV	July 2012–future

1.5 LWP GOALS AND OBJECTIVES

Goals and objectives for the Goose Creek and Crooked Creek LWP were established to guide plan development and implementation. A goal is a general statement about the desired condition or outcome of the watershed management or restoration strategies. Objectives are specific statements that define what must be true for the goals to be achieved. The objectives provide the foundation for watershed restoration and management decisions.

Goal #1:

Restore, protect, and enhance watershed functions such as hydrology, water quality, and aquatic and terrestrial habitat

Objectives for Goal #1:

- a) Restore, expand, support, and protect beneficial watershed functions and uses including
 - Flood plain function
 - Terrestrial and aquatic habitat

- i. Environmentally sensitive and critical lands
 - 1. Undeveloped natural areas
 - 2. Natural area connectivity
 - ii. Native vegetation
 - iii. Native aquatic biology
 - iv. In-stream habitat
 - Recreation
 - Wetland hydrology
- b) Design and construct projects to restore, maintain, and enhance
 - Stream banks
 - Riparian areas
 - Wildlife habitat areas
 - In-stream habitat
 - Riparian buffers
 - Wetlands
- c) Minimize effects of stormwater runoff and erosion on stream hydrology to promote stable stream morphology and protect aquatic habitat and native tree species
- d) Minimize effects on water quality by pathogens, nutrients, and other pollutants in stormwater runoff
- e) Cooperate with property owners and permitting agencies to detect and eliminate illicit discharges, sanitary sewer overflows, and malfunctioning septic systems to protect human health, enhance water quality and aquatic habitat
- f) Address effects on stream water quality because of livestock access to streams
- g) Address pollutant(s) of concern for state-approved total maximum daily loads and water quality improvement plans

Goal #2:

To minimize negative effects on water quality, aquatic and terrestrial habitat, and hydrology in the watershed by supporting balanced, sustainable, and diverse land use and development, in accordance with existing and future policies

Objectives for Goal #2:

- a) Promote site planning, design, construction and maintenance strategies to maintain or restore hydrology and water quality of the property
- b) Identify strategies that strive to maximize effectiveness, minimize cost, and minimize effects on businesses and residents where possible
- c) Identify restoration and protection strategies that complement comprehensive plans and policies and provide multiple benefits such as recreation and protection of critical lands
- d) Design and construct infrastructure projects (e.g., water/sewer lines, energy transmission lines) in manner that minimizes effects on watershed functions (i.e., water quality, habitat, and hydrology)

- e) Promote design and construct new developments, recreation areas, and such, in manner that minimizes effects on watershed functions, including minimizing impervious areas

Goal #3:

Build partnerships and involve stakeholders in protecting and restoring the watersheds

Objectives for Goal #3:

- a) Increase education, awareness, and stewardship in the watershed
- b) Encourage policy makers to develop policies that support a healthy watershed
- c) Identify and recruit stakeholders and partners in protecting, maintaining, and restoring watersheds in Mecklenburg and Union counties
- d) Report progress toward protection and restoration through monitoring and assessment
- e) Identify funding for implementation
- f) Seek adoption or endorsement of the LWP by each local jurisdiction in the watersheds

2 Stakeholder Involvement

The Goose Creek and Crooked Creek LWP has convened interested stakeholders, allowing for facilitated discussion and reporting of outcomes associated with the planning process. Stakeholders have been engaged in several ways ranging from project oversight and technical input with groups including the Project Administration Team and the Watershed Technical Team (WTT). Stakeholders could be involved through meetings, phone calls, emails, and the LWP websites.

2.1 PROCESS OVERVIEW

2.1.1 Stakeholder Process

The ultimate success of this LWP is rooted in the active interest and continuing participation of a variety of stakeholders. The stakeholder process was designed to involve several groups. In general, these were the Project Administration Team, the WTT, and community stakeholders. With time, the WTT emerged as the primary engagement group; it consists of up to 40 key and active individuals in these watersheds that broadly represent several organizations and interests.

2.1.2 Watershed Technical Team

The WTT served in a steering capacity for all phases of this plan. Membership included key individuals and groups with strategic and specialized knowledge related to the watersheds, including an existing base of individuals and organizations that have met through previous watershed planning initiatives in the Goose Creek watershed. This team provided guidance, accuracy checks, and feedback on LWP goals and objectives, assessment and characterization activities, regulatory and institutional measures, and local, site-specific knowledge. Members of the WTT have also provided input on implementing the LWP.

The WTT is composed of representatives from the 11 jurisdictions in the watershed area (Mecklenburg County, Union County, Fairview, Hemby Bridge, Indian Trail, Lake Park, Matthews, Mint Hill, Monroe, Stallings, and Unionville). In addition, representatives from other organizations included such organizations as the Catawba Land Conservancy, Natural Resources Conservation Service (NRCS), Soil and Water Conservation District representatives, North Carolina Cooperative Extension Service, North Carolina Wildlife Resources Commission (WRC) and the USFWS, water quality consultants/engineers, and the North Carolina Department of Water Quality (NCDWQ). Appendix A provides a list of participants over the course of all phases of the project.

Over the course of LWP development, the WTT emerged as an active consortium of experts and community stakeholders. Additional individuals and organizations with local area knowledge and interests will continue to be welcome members of the WTT as the LWP process seeks long-term engagement and ownership of watershed activities, especially after NCEEP has completed its formal involvement in the area.

2.1.3 Project Administration Team

The Project Administration Team provided an arena in which lead project partners coordinated with each other on logistics and contract management issues throughout the course of the LWP. The team has also been responsible for overall decision making and guiding the activities of the LWP and ensuring ongoing coordination with the complementary Clean Water Action section 319 grant titled *Rocky River Watershed Improvement Projects*. The Project Administration Team—composed of representatives from Centralina Council of Governments (Centralina COG), NCDWQ, NCEEP, and Tetra Tech—convened 12 times beginning in spring 2008 (the start of LWP Phase I).

2.2 LWP MEETING ACTIVITIES

Over the course of LWP development, the WTT convened 10 times—once at the Centralina COG office, once at the Union County offices, and the remainder at the Indian Trail Civic Center. Meeting dates and an outline of topics are provided in Table 2 below.

Table 2. LWP Meetings

WTT Meeting Date	Purpose
July 17, 2008	Phase I: The purpose of this meeting was to convey information relevant to the LWP process, have an overview of the watersheds, to figure out what data and information are missing/needed and to lay the course for the duration of the project
September 11, 2008	Phase I: This meeting's main objectives were to review preliminary results of field study and scoping analysis, and to gather input on development regulations and policies in the watershed area
January 28, 2009	Phase I: This meeting addressed both technical and policy-related areas. Centralina provided a presentation on developments in regulations and policy in communities the region
February 19, 2009	Phase I: A fourth supplemental meeting of key Union County WTT representatives was held to bring these individuals key points and information from the January 28, 2009, meeting
July 20, 2010	Phase II kickoff, convey LWP process to date and going forward, overview of watersheds, initiate Goals and Objectives discussion, discuss project timeline
December 15, 2010	Overview of regulatory and institutional measures assessment, Goals and Objectives input, water quality overview, and stream and wetland assessment updates
March 29, 2011	Field site visits to two locations in the watersheds that illustrate preservation and mitigation activities being conducted by project partners, update of regulatory and institutional measures assessment, review of watershed model being conducted in coordination with 319 funds
August 3, 2011	Presentation of subwatershed prioritization findings, roadmap, input, and guidance on LWP Phase III, Goose Creek Site-Specific Management Plan, NCDWQ monitoring
March 8, 2012	Presentation of draft Project Atlas and feedback session, and Watershed Assessment Report review and wrap up
May 23, 2012	Review of the Phase III Watershed Management Plan, Phases II and III Local Watershed Plan debrief and wrap up, and looking ahead to LWP Phase IV

3 Watershed Characterization

A detailed characterization of the Goose Creek and Crooked Creek watersheds was developed to provide the information needed to more fully understand the stressors threatening watershed functions, the sources of those stressors, and the management needed to restore and protect those functions. For the purposes of this discussion, stressors are forces in the watershed, usually resulting from human activities, that could degrade watershed functions. For instance, urban stormwater runoff is a common stressor with the potential to adversely affect aquatic habitat, water quality, and hydrologic functions in a watershed.

The LWP process included a coordinated and collaborative watershed assessment, documented in detail through a series of reports and technical memoranda. The following summary is derived from the Phase I Preliminary Findings Report (Centralina Council of Governments, 2009), the Phase II Watershed Assessment Report (WAR) (NCEEP, 2012a), and many supporting documents.

3.1 ASSESSMENT METHODOLOGY

The preliminary findings for the Goose Creek and Crooked Creek watersheds provided a review of the existing data and assessments, field reconnaissance, other scoping analyses, and developing conceptual models describing the linkages between sources, stressors, and impacts (Centralina Council of Governments, 2009; Tetra Tech, 2008). The Phase I hypothesis was that the primary stressors in both watersheds are increased peak flows and runoff volumes, sediment, and bacteria. Oxygen-demanding substances, nutrients, and toxic substances were thought to be secondary stressors. The preliminary assessment suggested that sediment and increased peak flows/runoff volumes are the most important and pervasive stressors to watershed function. These stressors, resulting primarily from the lack of historical pre- and post-construction stormwater control, have resulted in impairments to aquatic biota in both watersheds.

The Phase I report identified the following key questions for further assessment in Phases II and III of the LWP:

1. Where have the greatest impacts (for each stressor) occurred, or where are they likely to occur in the future?
2. What management opportunities can address the stressors in the priority areas?
3. Which management opportunities are the most cost-effective and feasible?
4. How should the watershed management plan and recommended opportunities be implemented?
5. In addition to NCEEP, who are the potential stakeholders that can help implement the LWP?

Additional goals of the Phase II watershed assessment were to

6. Determine the functional integrity of streams and other aquatic systems in the watershed
7. Identify the key stressors and their sources impacting water quality, habitat, and hydrology and determine where they are focused
8. Identify key assets in the watershed

Phase II data collection and assessment were developed on the basis of these questions and goals. A combination of monitoring, field assessment, and modeling were conducted to support detailed watershed characterization and assessment. Many partners collaborated with NCEEP to support these efforts including the NCDWQ Watershed Assessment Team (WAT), NCDWQ Biological Assessment Unit, USFWS, North Carolina Department of Transportation (NCDOT) Biological Surveys Group, and the

Centralina COG. Table 3 shows the types of monitoring and assessment conducted along with the corresponding entity and documentation reference.

Table 3. Monitoring and Modeling for the Goose Creek and Crooked Creek LWP

Monitoring and Assessment Task	Responsible Entity	Reference
Water Quality Monitoring	NCDWQ	NCDWQ 2011
Biological Monitoring	NCDWQ (Benthic Macroinvertebrates) NCDOT (Fish)	NCDWQ 2009, 2011; NCDOT 2011
Habitat Monitoring	NCEEP (with support from Tetra Tech) NCDWQ	Tetra Tech 2008, 2010; NCDWQ 2011
Stream Field Assessment	NCEEP (with support from Tetra Tech)	Tetra Tech 2008, 2010
Watershed Modeling	Centralina COG (with support from Tetra Tech)	Tetra Tech 2012a, 2012b, 2012c, 2012d
Biotic Ligand Modeling	NCDWQ (Monitoring) and USFWS (Biotic Ligand Modeling)	USFWS 2012

3.2 WATERSHED CHARACTERISTICS

The Goose Creek and Crooked Creek watersheds are approximately 42 and 50 square miles, respectively and home to 11 local government jurisdictions: Lake Park, Fairview, Hemby Bridge, Indian Trail, Matthews, Mint Hill, Stallings, Unionville, the city of Monroe, and Union and Mecklenburg counties. On the basis of GIS analysis of US Census data, approximately 32,000 people lived the watersheds in 2000 (Centralina Council of Governments, 2009).

All streams in the watershed are classified as C surface waters, in which aquatic life propagation/ protection and secondary recreation are designated as the best uses. Stream reaches in Goose Creek, Duck Creek, and South Fork Crooked Creek, were listed as impaired on the 2010 303(d) list because of loss of ecological/biological integrity (NCDWQ, 2010). Goose Creek is also impaired for fecal coliform bacteria and subject to a total maximum daily load developed by Mecklenburg County and NCDWQ. Crooked Creek and North Fork Crooked Creek are impaired for turbidity. North Carolina's draft 2012 303(d) list adds Goose Creek and North Fork Crooked Creek to the turbidity and loss of ecological/biological integrity, respectively (NCDWQ, 2012).

The Goose Creek watershed supports a population of the Carolina heelsplitter, which is listed as endangered at the federal level and critically endangered at the state level. The population is known to exist along two creeks in the planning area, Goose Creek and Duck Creek, and is one of nine surviving populations of the species in its known range. Historically, the species populated portions of the Catawba, Pee Dee, Savannah, and Saluda river basins (EMC, 2007). In 2002 USFWS designated specific stream reaches as critical habitat for the Carolina heelsplitter along Goose Creek and Duck Creek. Goose Creek and Crooked Creek also support sensitive mussel species other than the Carolina heelsplitter including the Carolina creekshell, Atlantic pigtoe, Savannah lilliput, creeper, notched rainbow and eastern creekshell. Freshwater mussels generally have high sensitivity to excess sedimentation, turbidity, and toxins.

3.2.1 Land Use, Imperviousness, and Point Sources

Existing land use and land cover in the watersheds were compiled from a number of sources such as National Land Cover Dataset (NLCD) satellite imagery, local cadastral data (i.e., tax parcels) from Union and Mecklenburg counties, and the USFS/DOI LANDFIRE dataset for forest cover (Figure 2).

When the two watersheds are compared, both have similar percentages of developed land, but the Crooked Creek watershed has a slightly higher percentage of high-density development, particularly in commercial land uses. Crooked Creek also has a higher percentage of agricultural land whereas Goose Creek has a higher percentage of natural area (forest, wetland, and others).

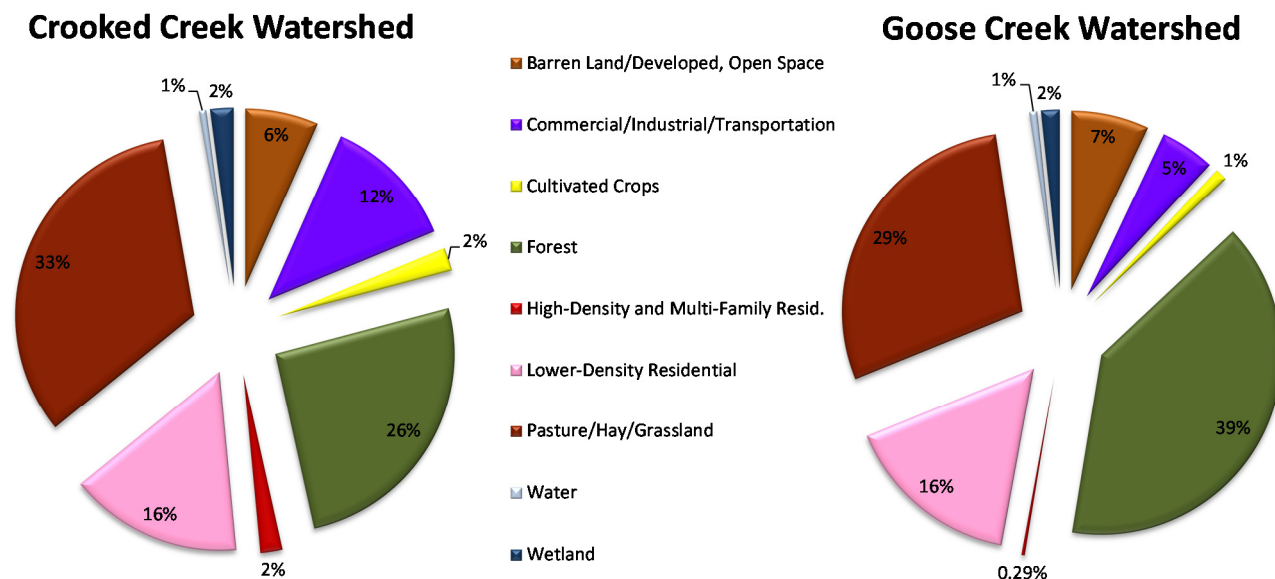


Figure 2. Current Land Use Distribution in the Goose Creek and Crooked Creek Watersheds

Figure 3 displays land use for the two watersheds along with subwatersheds delineated using high-resolution digital elevation model data. Much of the development in both watersheds has occurred in the headwaters, and much of the agricultural and forested land exists in the lower reaches.

Impervious cover was also estimated using the 2001 NLCD impervious surface grid. The NLCD coverage was updated with three other GIS coverages: (1) a buffered road GIS coverage, (2) planimetrics in Mecklenburg County (buildings, roads, and parking lots), and (3) building footprints in Union County. The average imperviousness for Goose Creek and Crooked Creek watersheds were estimated to be 5.3 and 9.9 percent, respectively. However, much of the impervious cover is concentrated in the headwaters.

Through National Pollutant Discharge Elimination System (NPDES) wastewater discharge permitting, eight wastewater treatment plants (WWTPs) have permits to discharge effluent to streams in Goose Creek and Crooked Creek watersheds (Figure 3). Crooked Creek WWTP #2 and Grassy Branch WWTP are municipal WWTPs operated by Union County Public Works. The remaining nonmunicipal plants treat wastewater for residential developments. The NPDES program classifies discharges as *major* (1 million gallons per day or more) and *minor* (less than 1 million gallons per day) on the basis of permitted flow. Crooked Creek WWTP #2 is a major discharger; the rest are minor dischargers. Hunley Creek WWTP connected to Union County's 12 Mile Creek WWTP as of May 10, 2006, which discharges outside the watershed. Fairfield Plantation has also connected to Union County's plant.

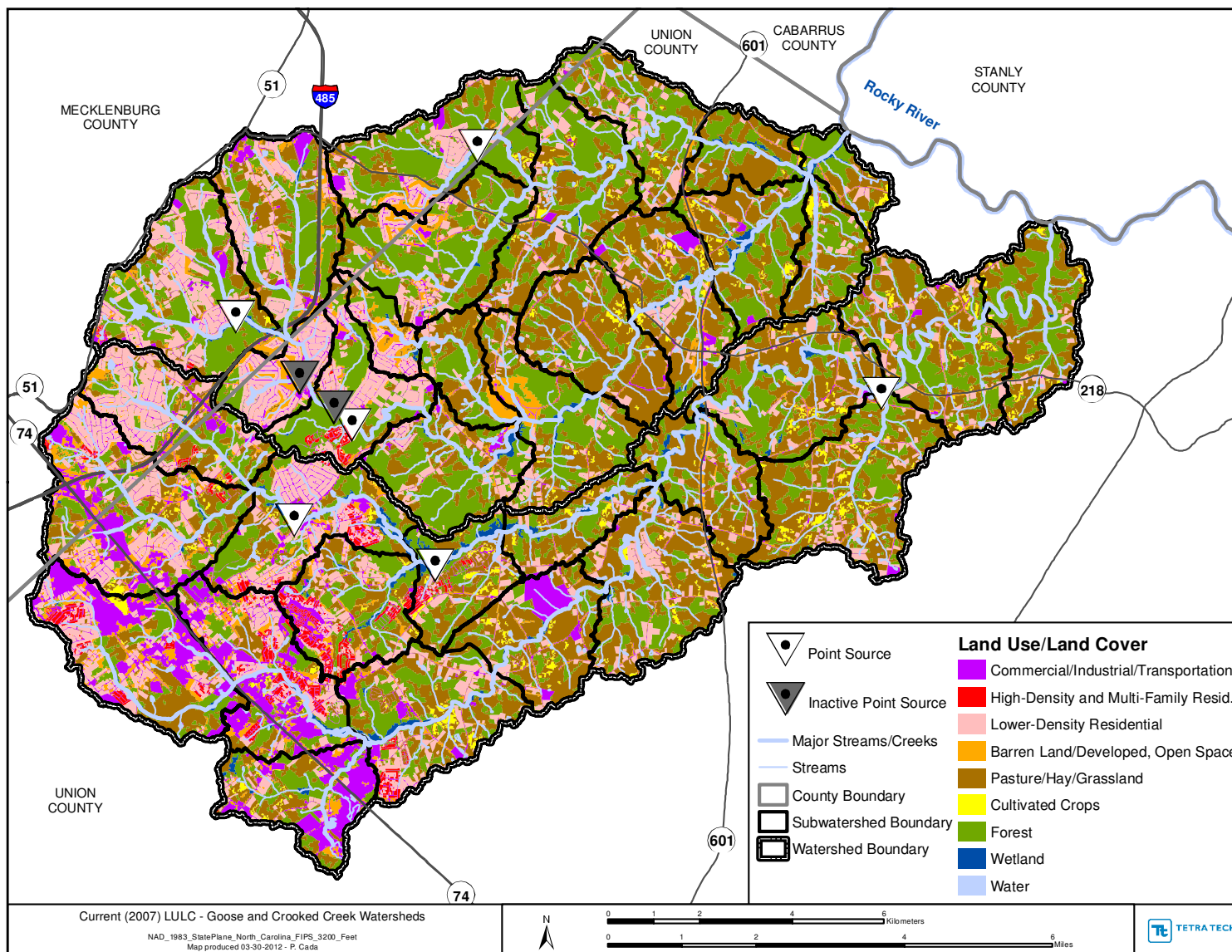


Figure 3. Land Use/Land Cover and Point Sources in the Goose Creek and Crooked Creek Watersheds

3.2.2 Soils and Geology

A soil's hydrologic group defines its ability to infiltrate rainfall. Four groups (A, B, C, D) exist, ranging from A soils that support high infiltration rates to D soils that support low infiltration rates. County-level soil GIS data files were obtained from SSURGO to develop a hydrologic soil group (HSG) GIS coverage. Both watersheds were composed almost entirely of HSG B and C soils, with no A soils, and a very small percentage of D soils.

Underlying geology can affect the natural background characteristics of a watershed. Of particular note in the Goose Creek and Crooked Creek watersheds, geologic differences affect baseflow in streams. North Carolina geology maps identify the majority of the Goose Creek and Crooked Creek watersheds as being in the Charlotte Belt, with only a portion of the most downstream areas in the Carolina Slate Belt (argillite zone). The argillite zone Carolina Slate Belt has one of the lowest low-flow regimes in the state, with a median 7Q10 flow of 0.001 cubic feet per second per square mile; the Charlotte Belt has a median 7Q10 flow of 0.064 cubic feet per second per square mile (Giese and Mason, 1993). This suggests the low-flow regimes will differ in the upper and lower parts of the watersheds.

Daniel and Dahlen (2002) identified a band in the middle of the Goose Creek and Crooked Creek watersheds as the *Gold Hill Shear Zone*. Its lithology is dominated by metasedimentary phyllite and differs from the Charlotte Belt to the west (metavolcanic, undifferentiated) and the Carolina Slate Belt to the east (metasedimentary argillite). The low-flow geology of this zone differs from the Charlotte Belt to the west, at least in the vicinity of these watersheds. On the basis of this information, the Crooked Creek and Goose Creek watersheds were grouped into three zones by subwatershed (Figure 4).

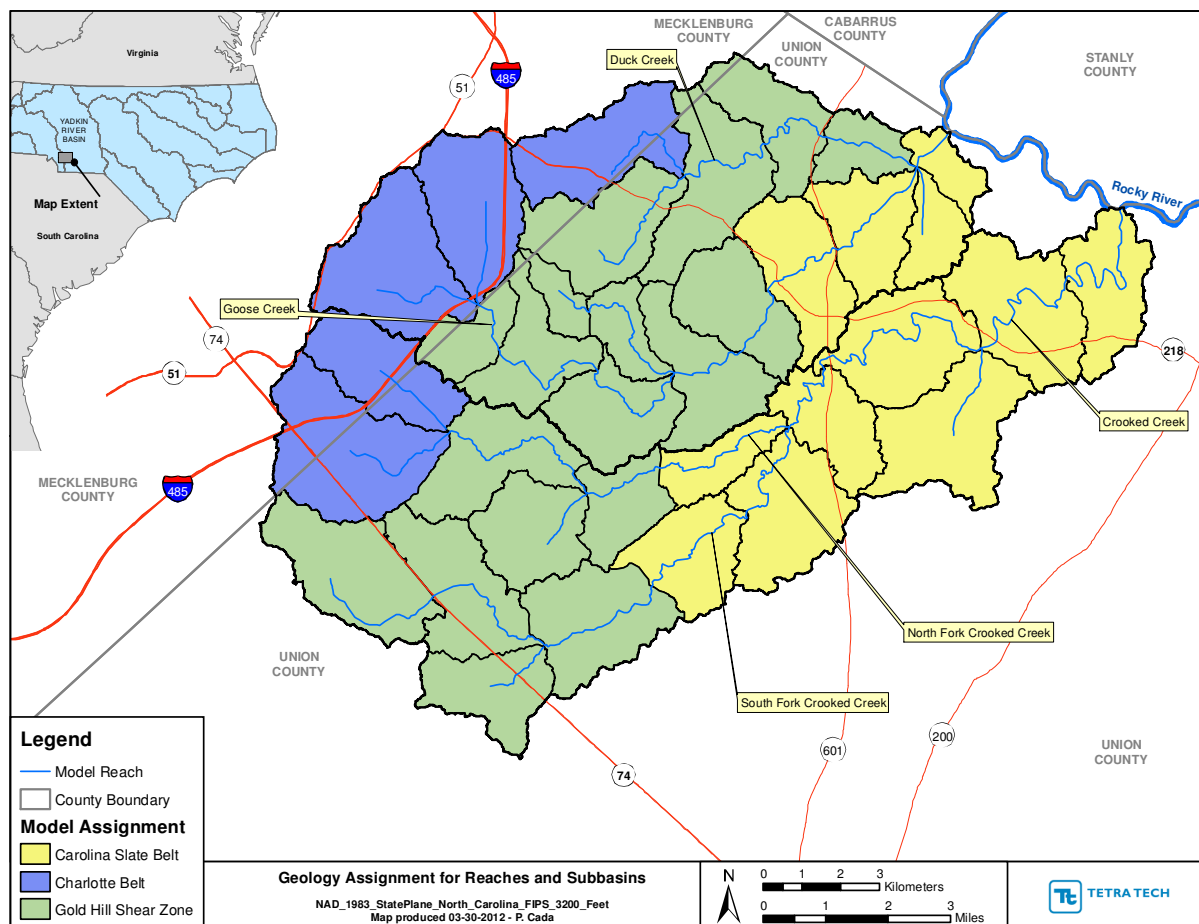


Figure 4. Geology Assignment by Subwatershed for the Goose Creek and Crooked Creek Watersheds

3.3 WATERSHED ASSESSMENT SUMMARY

Three major analyses composed the watershed assessment: (1) collection and analysis of monitoring data, (2) development of a watershed model, and (3) development of a biotic ligand model (BLM). The following brief summary draws from the WAR (NCEEP, 2012a) and its appendix documentation.

3.3.1 Monitoring and Field Assessment Summary

3.3.1.1 Water Quality Monitoring

NCDWQ WAT assessed physical and chemical water quality parameters at 10 stations throughout the Goose Creek and Crooked Creek watersheds and at a site on Barnes Creek, which served as a reference site, between August 2009 and June 2010 (Figure 5). Parameters assessed were dissolved oxygen, pH, specific conductance, temperature, nutrients (nitrite-nitrate, total Kjeldahl nitrogen, total phosphorus [TP], and ammonia), total suspended solids (TSS), turbidity, fecal coliform bacteria, and copper. Both baseflows and stormflows were sampled. Monitoring supported characterization and modeling for the LWP.

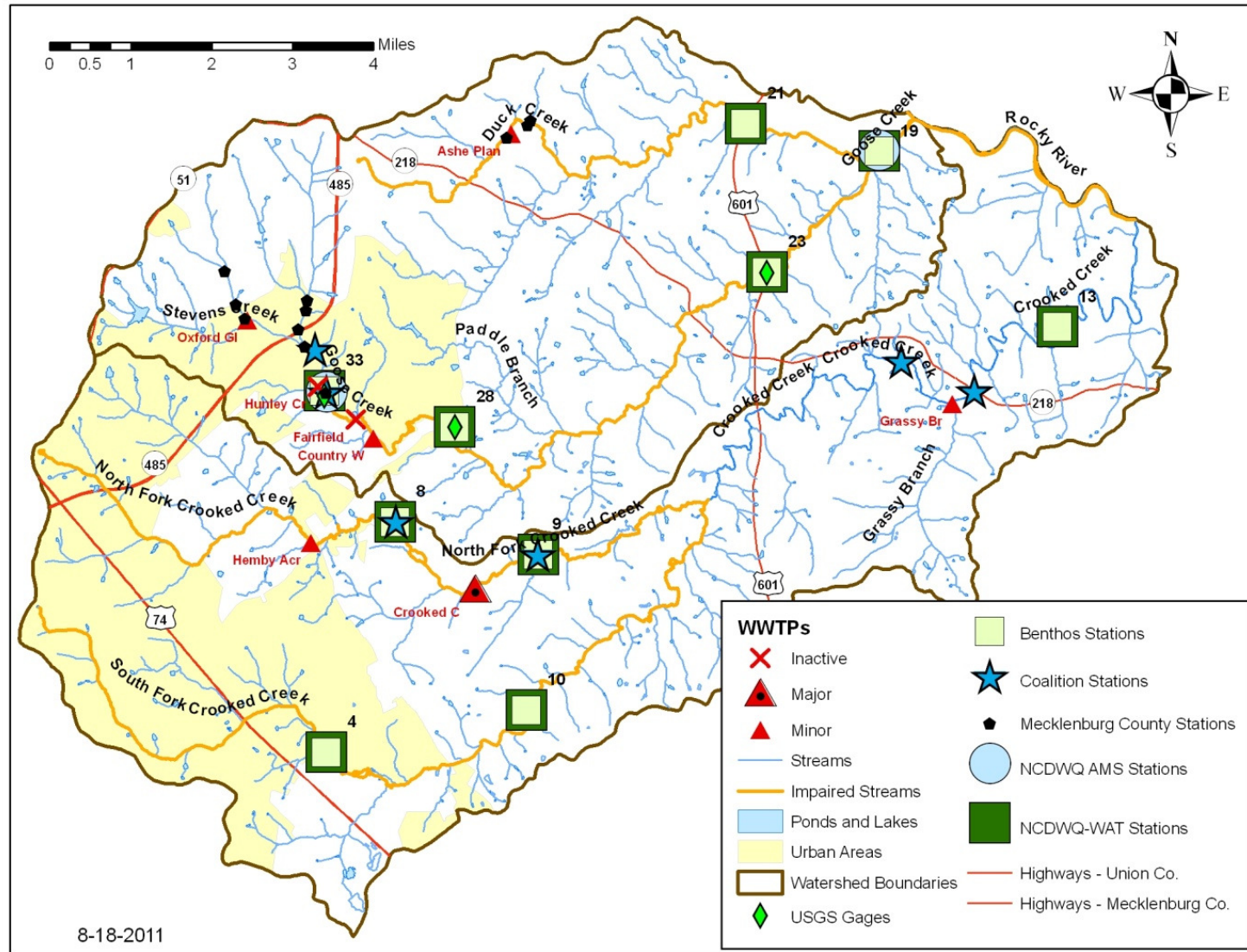


Figure 5. Monitoring Stations and Wastewater Treatment Plants in the Goose Creek and Crooked Creek Watersheds (Map prepared by NCDWQ)

Low dissolved oxygen concentrations were observed and coincided with low flows and warm water temperatures. Most observations (18 of 21) of low dissolved oxygen were in North Fork Crooked Creek and South Fork Crooked Creek.

The highest median nutrient (nitrite-nitrate and TP) concentrations and specific conductance values were found on North Fork Crooked Creek at SR 1514 (#9) and Crooked Creek at SR 1547 (#13), both below the Crooked Creek WWTP #2. Other sites below WWTPs, North Fork Crooked Creek at SR 1520 (#8) and Goose Creek at SR 1525 (#28), also had high nutrient and specific conductance values.

Existing data from the NCDWQ-AMS monitoring station (Q8360000) on SR 1524 near Mint Hill (just below the Hunley WWTP) showed high concentrations of ammonia-nitrogen before the summer of 2006. In the summer of 2006, the Hunley WWTP discharges were rerouted to another facility, and concentrations of ammonia-nitrogen decreased significantly.

Only one baseflow sample collected by NCDWQ WAT exceeded the water quality standard for turbidity (50 nephelometric turbidity units), but most stormflow results exceeded the turbidity standard.

3.3.1.2 Biological Monitoring

In July 2009 NCDWQ biologists sampled benthic macroinvertebrate communities at six sites in the Goose Creek and Crooked Creek watersheds and at a reference site (Barnes Creek) outside the watersheds (Figure 5). All sites in the study watershed were rated Fair or Poor; Barnes Creek was rated good. All sites were sampled earlier (in 1998, 2000, or 2006), and no sites showed improvement in bioclassification ratings (NCDWQ, 2009).

In May 2010 NCDOT, NCDWQ, and NCEEP biologists monitored fish communities at eight sites in the Goose Creek and Crooked Creek watersheds. All four Crooked Creek watershed sites were sampled previously by NCDWQ in 1995 or 2006. In 2006 the Crooked Creek site (#13) was rated Good; in 1995, the lower North Fork Crooked Creek site (#9) was rated Good-Fair, and the upper South Fork Crooked Creek site (#4) was rated Good-Fair. The fish communities found in 2010 at these sites were similar to those monitored in the past (NCDOT, 2011).

3.3.1.3 Habitat and Channel Assessment

NCDWQ performed habitat assessments for each of the 10 fish and benthic macroinvertebrate monitoring sites described above (NCDWQ, 2011). Overall habitat scores ranged from 92 out of 100 points at Barnes Creek to 35 out of 100 at South Fork Crooked Creek at SR 1515. The Goose Creek and Crooked Creek watersheds showed considerable variability in habitat quality, with notable differences in bottom inorganic substrate (proportion of bedrock, boulder, cobble, gravel, sand, and silt), quality of pool and riffle habitats, and in-stream habitat. One common deficiency among many sites was a lack of available root mat and undercut bank habitats; many of these were isolated above water. This isolation could in part be due to the low flows in portions of the watershed affected by Slate Belt geology, but channel incision from stormwater impacts could exacerbate this effect.

Overall habitat scores for Goose Creek and Duck Creek were moderate to high, increasing from upstream to downstream. The lowest overall habitat scores occurred in the upper reaches of North Fork Crooked Creek and South Fork Crooked Creek, with total scores ranging from 35 to 56. The downstream reaches of Crooked Creek had improved habitat.

In addition to the NCDWQ assessments, 70 sites across both watersheds were also assessed for habitat quality for stream assessments during 2008 and 2010 (Tetra Tech 2008, 2010). Stream habitat results also varied widely among the observed reaches and only a small minority of sites scored above 80. Many of these were in the Duck Creek subwatershed of Goose Creek. Habitat scores in the Crooked Creek watershed were generally lower than in the Goose Creek watershed. The features that had the strongest

influence on the lower scoring sites (less than 60) were considered to be deficiencies in the substrate (e.g., great amount of embeddedness) and riffle habitat.

Along with habitat, channel conditions were also evaluated using a geomorphic assessment including Bank Erosion Hazard Index (BEHI) (Rosgen 2001a, 2001b) and classification of reaches using the Channel Evolution Model (CEM) (Schumm et al. 1984; Simon, 1989). The six stages represent different points along a time series where a stream channel's form can be found—often in response to upstream drainage area development or changes in land use and land cover (Figure 6). These processes also occur naturally, but, usually over a much longer time scale when compared to anthropogenically induced changes. Although this conceptual model does not necessarily represent all the forms a stream reach can have in its evolution through time, it can serve as a proxy for the degree of stream ecosystem degradation in affected watersheds.

Of the assessed reaches, 40 percent had a high risk of erosion and instability on the basis of the BEHI. Only 10 percent had a low risk. Reach classification according to the CEM suggested nearly 50 percent of channels were degrading (or incising) under Stages 3 and 4 (Figure 6; Figure 7). About 25 percent were aggrading and widening under Stage 5.

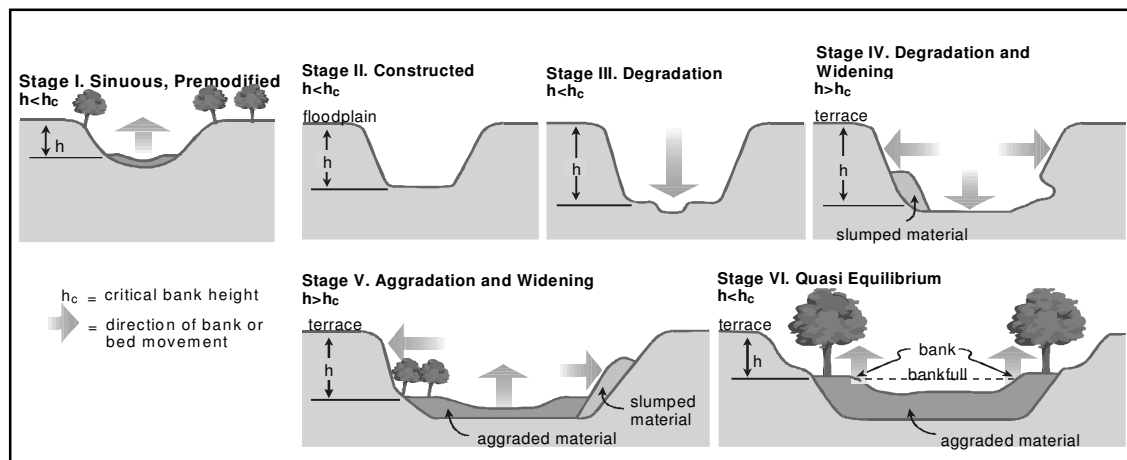


Figure 6. Stages of the CEM

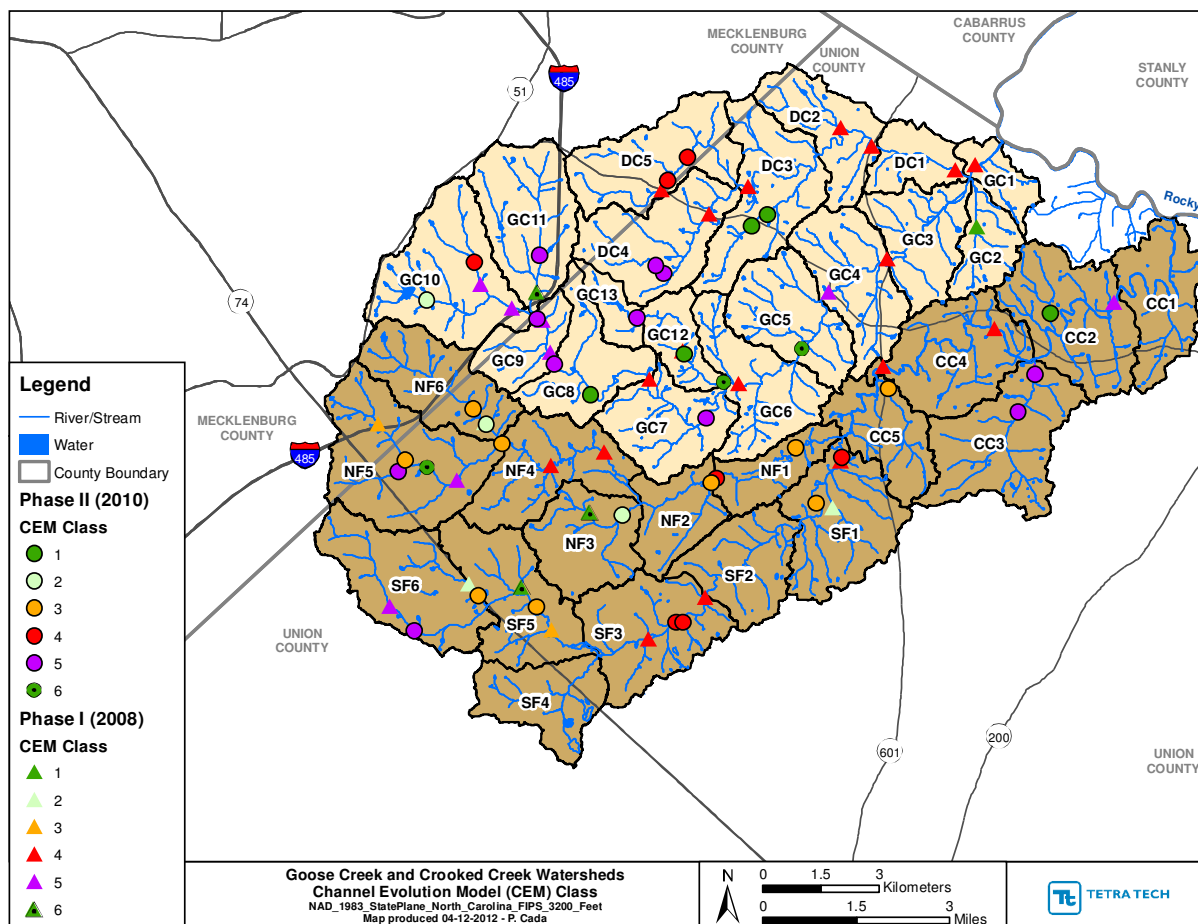


Figure 7. CEM Class for Reaches in the Goose Creek and Crooked Creek Watershed

3.3.2 Watershed Modeling

The EPA-approved Loading Simulation Program C++ (LSPC) model was selected for the Goose Creek and Crooked Creek watersheds (<http://www.epa.gov/athens/wwqtsc/html/lspc.html>). LSPC is a watershed modeling system that includes streamlined Hydrologic Simulation Program–FORTRAN (HSPF) algorithms for simulating hydrology, sediment, and other water quality parameters on land, as well as a stream fate and transport model (Tetra Tech and USEPA, 2009).

Tetra Tech (2012c) provided detailed information on model development and calibration and provided a summary (Tetra Tech 2012a) for the WAR (NCEEP, 2012a). LSPC model configuration for the Goose Creek and Crooked Creek watersheds relied on a variety of local data sources. The data included detailed elevation data, meteorological time series of rainfall and evapotranspiration, point source discharges, land cover/land use, soils, and existing Hydrologic Engineering Center (HEC) models. Calibration data included flow measurements from U.S. Geological Survey gages, water quality monitoring data from several different entities, and field data from stream surveys. The model simulation spanned January 1, 1999, through May 31, 2010.

Existing and future condition land use scenarios were developed and included existing stormwater BMPs and a representation of future treatment requirements according to existing regulation. BMPs were continually simulated. Tetra Tech provided details of scenario assumptions and full modeling results (Tetra Tech 2012d).

Results presented here are summarized by reporting zones shown in Figure 8, using the following measures:

- Hydrology: Percent increase in the time duration of bankfull events compared to undisturbed (forest) conditions based on hourly simulated flow. The bankfull event was defined as the 1.44-year return interval storm event for rural areas in the North Carolina piedmont (Doll et al., 2002). Many researchers have investigated the role of increased duration of near-bankfull events due to urbanization and the risk of increased scour and bank erosion (MacRae, 1992, 1993; Bledsoe and Watson, 2001). An additional model was prepared reflecting forest land cover to provide an undisturbed baseline of the time duration of bankfull events. Any development (including current conditions) would be expected to increase the frequency of bankfull events over the forest baseline.
- Sediment: Upland sediment (tons/acre/year) and streambank and bed sediment (tons/mile/year) based on simulated loading occurring within subwatershed boundaries
- Nutrients: Total nitrogen (TN; lbs/acre/year) and TP (lbs/acre/year) based on simulated loading from within subwatershed boundaries.

The graphical summary results are grouped separately by Goose Creek and Crooked Creek, which are both split further into *Upper* and *Lower* designations. Upper sections of both watersheds tend to correspond to more urbanized/developed areas; the lower sections are more rural and agricultural. For results in terms of percent increase in bankfull time duration, two additional subgroups were added – Upper Goose non-Charlotte Belt, and Upper Crooked non-Charlotte Belt. As shown in Figure 4, the Charlotte Belt geological zone is associated with the westernmost subwatersheds, largely in Mecklenburg County. Charlotte Belt soils are fairly impermeable, but the Slate Belt soils in the remainder of both watersheds are more impermeable even in an undeveloped state. For the largest storm events that contribute to this bankfull measure, undeveloped forested Slate Belt soils react with runoff rates much greater than Charlotte Belt soils; the jump from forested to developed conditions creates a significantly larger increase in the duration of bankfull events.

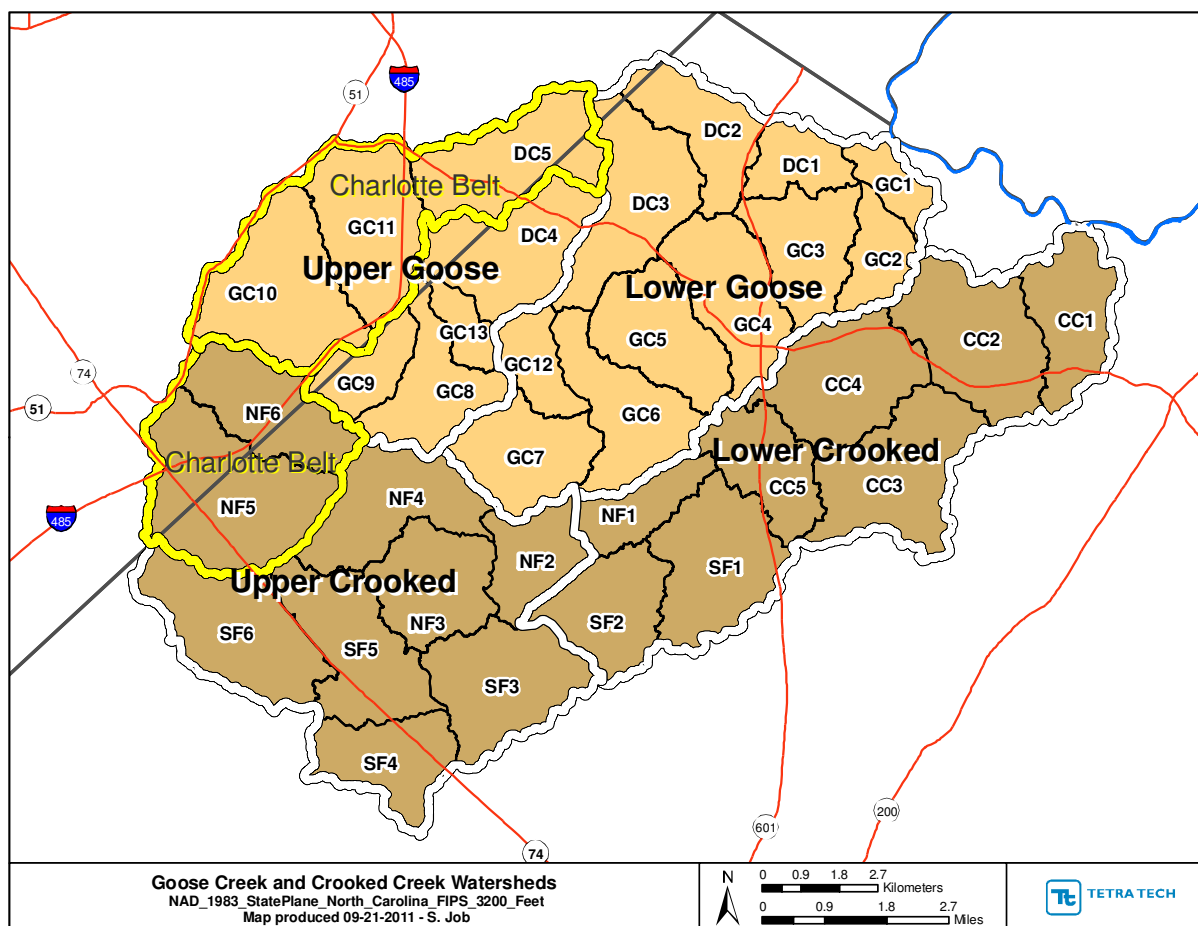


Figure 8. Reporting Zones for Model Results

Figure 9 through Figure 14 show results for several indices. A relative comparison of the results shows that new development in the future condition scenario without stormwater BMPs, increases bankfull event duration across the board, more so in areas with larger increases in impervious surfaces. However, the stormwater management requirements for future development appear to be effective at mitigating the risk and managing increased volume in the future. The Bed+Bank Sediment Erosion measure shows a similar trend; unmitigated runoff from new development increases bed and bank erosion, but stormwater management requirements mitigate the increase by holding back the increase in erosive flows.

Figure 11 presents an alternative measure of the bed and bank erosion shown in Figure 10; whereas Figure 10 has units of stream erosion scaled to miles (which is a good measure of overall load contribution), Figure 11 rescales the rates to account for contributing bed area. All other things being equal, one expects per-mile loading rates to increase as contributing drainage area increases, since the wetted perimeter (combined bed width and bank heights) increases. Figure 11 provides a normalized view of bed and bank erosion that emphasizes erosion risk independent of the size of the upstream drainage area. However, it is important to note that the impacts are cumulative and not necessarily derived entirely from the local subwatershed. Relative to Figure 10, Figure 11 shows that the areal bed rates for Lower Goose remain higher than Upper Goose, but now Upper Crooked is considerably elevated relative to Lower Crooked.

The Annual Upland Loading Rate measures show some trends that might not be expected; new development does not necessarily raise overall loading significantly, even if treatment BMPs are not used. This outcome is chiefly because of relatively high loading rates originating from agricultural land; when development with low or medium housing densities replaces agricultural land, overall rates might decrease. BMPs provide an additional reduction in loading rates.

The existing conditions scenario indicates that about 31,800 and 47,500 tons of sediment are washed from upland areas to streams in Goose Creek and Crooked Creek watersheds, respectively; whereas an additional 43,500 and 56,800 tons are eroded from the banks and the beds of Goose Creek and Crooked Creek watersheds, respectively, over the 11.4-year simulation. Upland sediment does contribute to modeled aggradation in the stream (in a few reaches), so the total load leaving the two watersheds is slightly lower than the sum of the two contributions.

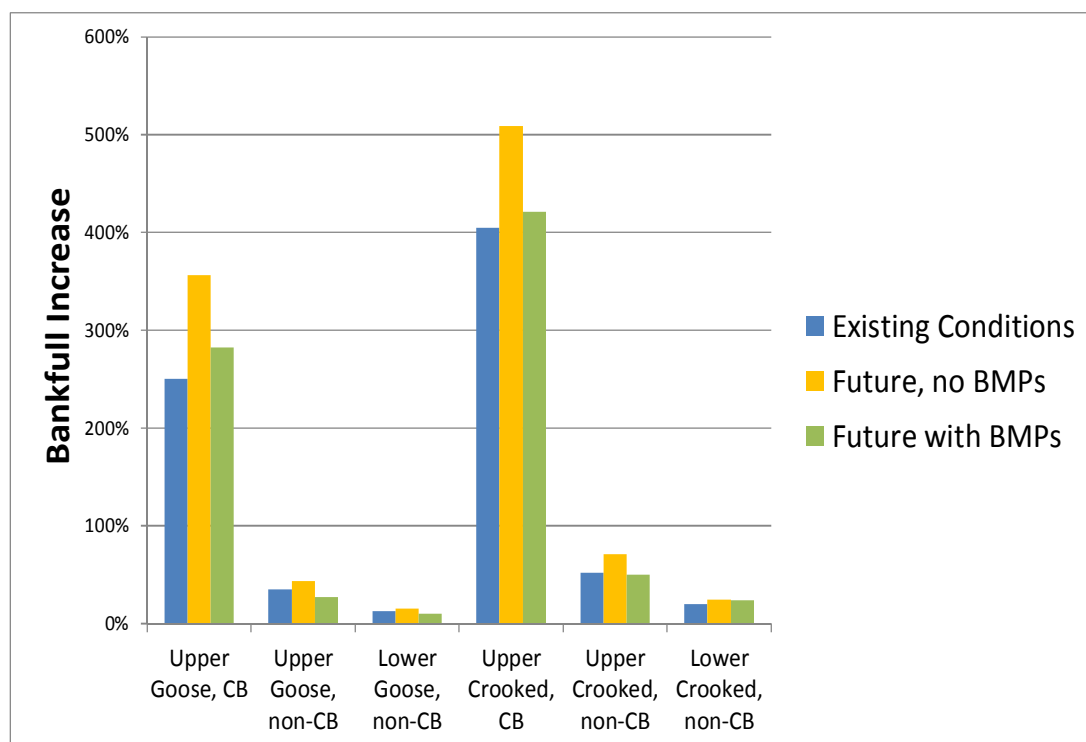


Figure 9. Scenario Results for Percent Increase in Bankfull Time Duration (CB=Charlotte Belt)

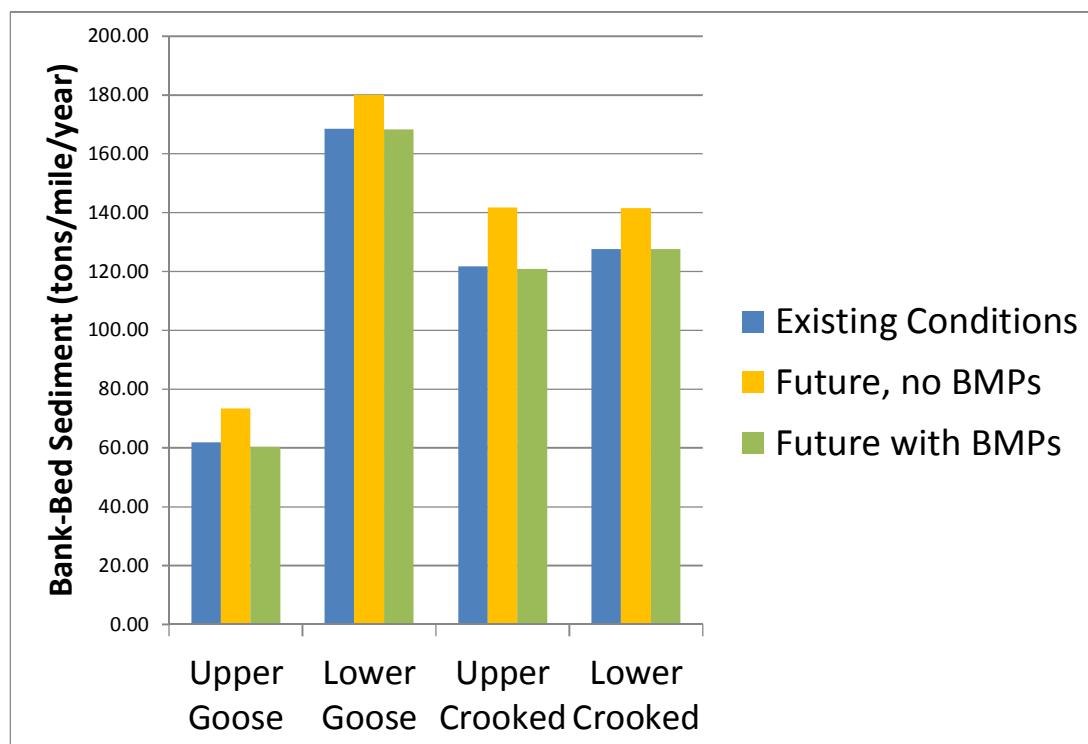


Figure 10. Scenario Results for Bed+Bank Sediment Erosion (Per Mile of Stream)

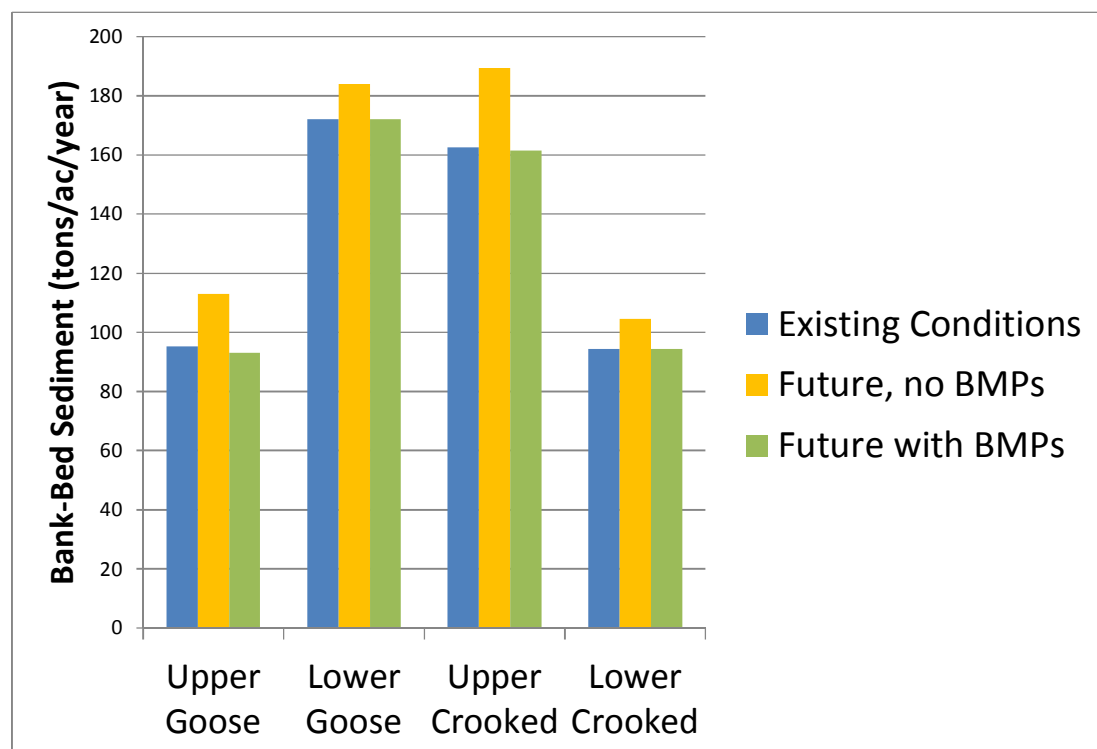


Figure 11. Bed+Bank Erosion, Using Rates Scaled to Stream Bed Area

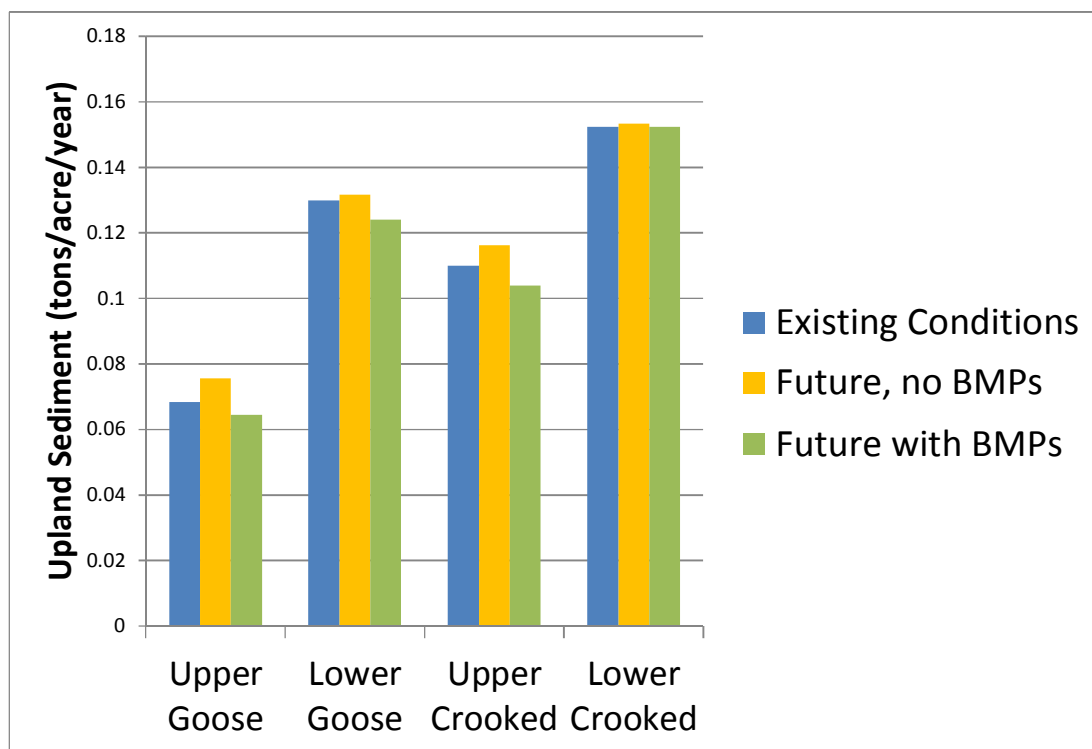


Figure 12. Scenario Results for Annual Upland Sediment Loading Rates

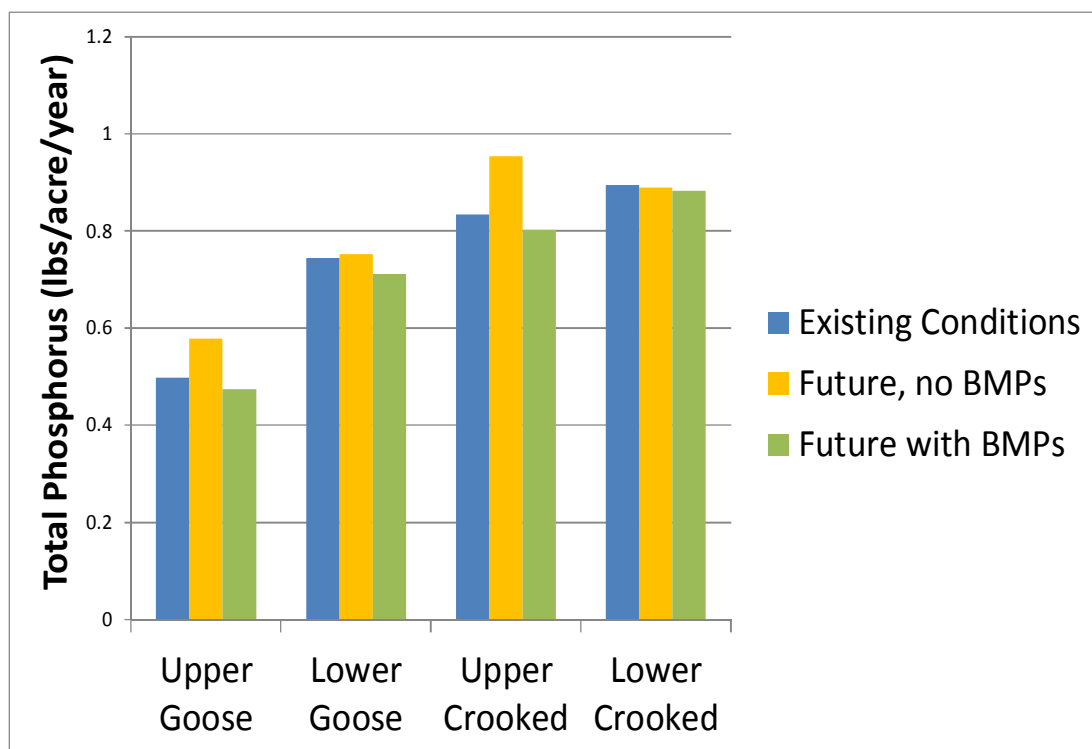


Figure 13. Scenario Results for Annual Upland TP Loading Rates

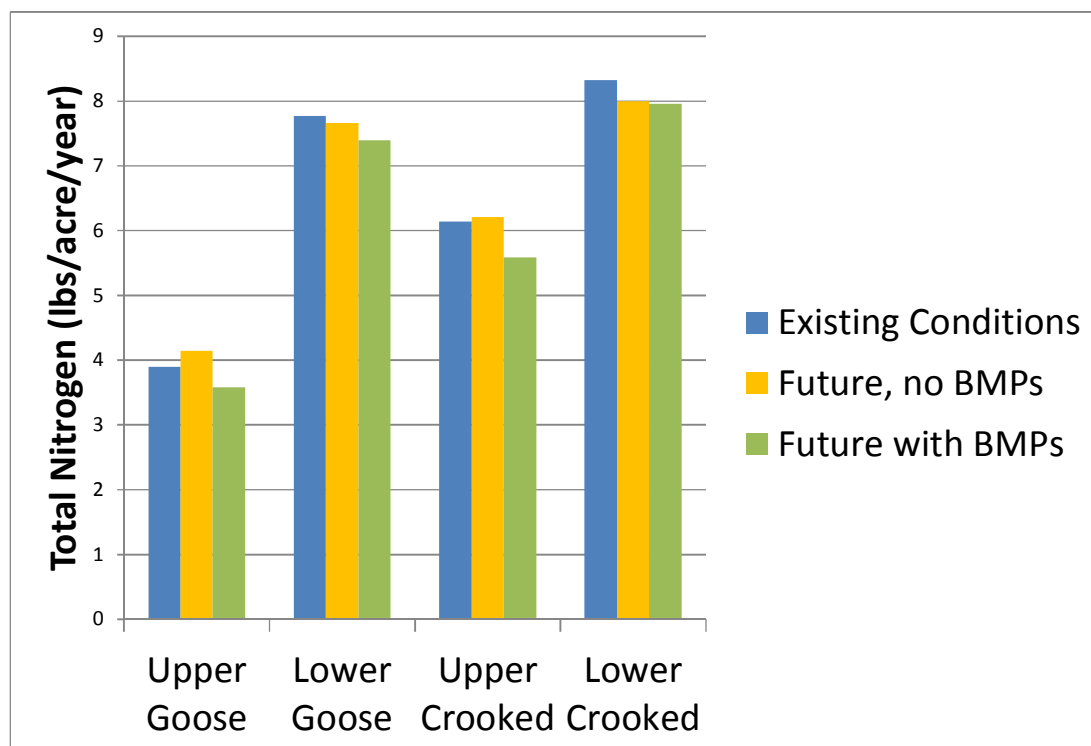


Figure 14. Scenario Results for Annual Upland TN Loading Rates

The scenario result figures above combined with subwatershed loading maps provide information about spatial trends in the nonpoint source loading rates (an example upland subwatershed loading map is provided in Figure 15; remaining maps are located in Appendix B). Upland sediment loading rates are highest in the eastern, lower portions of Goose Creek and Crooked Creek, where pasture tends to dominate the land use; the rates are also elevated in urban areas in the western, upper portions (Figure 15). TP rates are highest in both the eastern subwatersheds where pasture is, and in the most urbanized subwatersheds to the west. TN rates follow a similar pattern as upland sediment, with pasture driving the highest rates and urban areas showing intermediate rates.

Bed and bank erosion rates (normalized to bed area, as discussed on page 20) follow different trends (Figure 16). The rates increase sharply in Goose Creek at GC5 and in Duck Creek at DC3, consistent with field data indicating the downstream portions of these watersheds are not in equilibrium. In Crooked Creek, the most unstable reaches tend to be in the middle of the watershed. The CEM assessment of the lower Crooked Creek reaches identified during field data collection suggest that these lower reaches are beginning to attain a new equilibrium following a period of active erosion in the past.

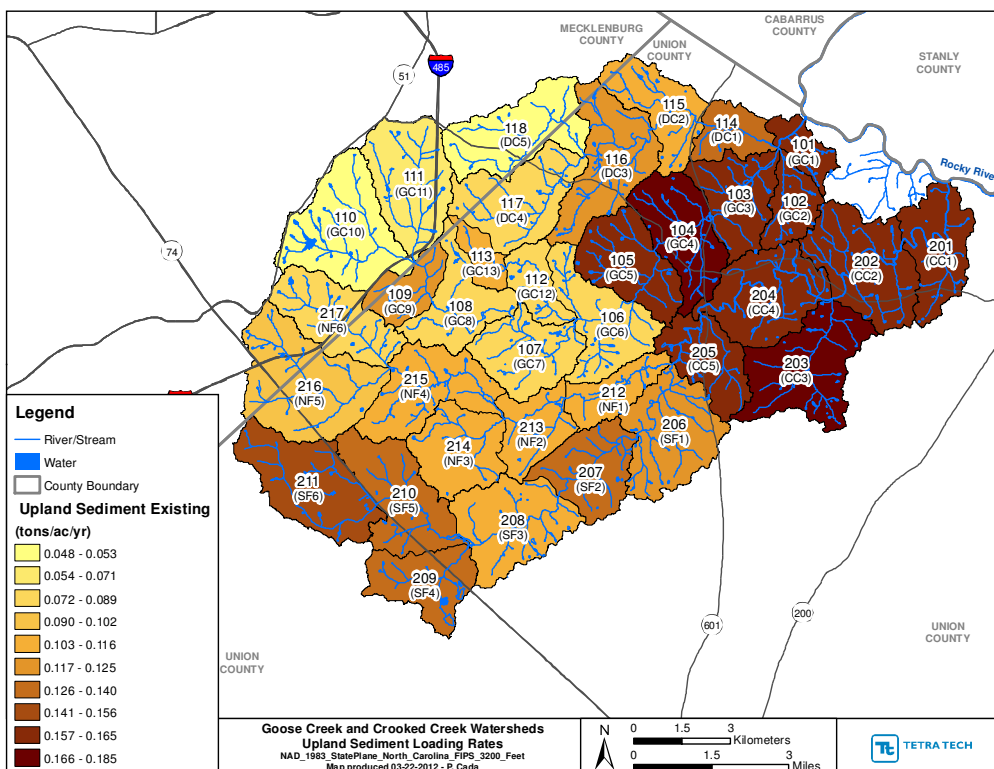


Figure 15. Upland Sediment Loading by Subwatershed (Existing Scenario)

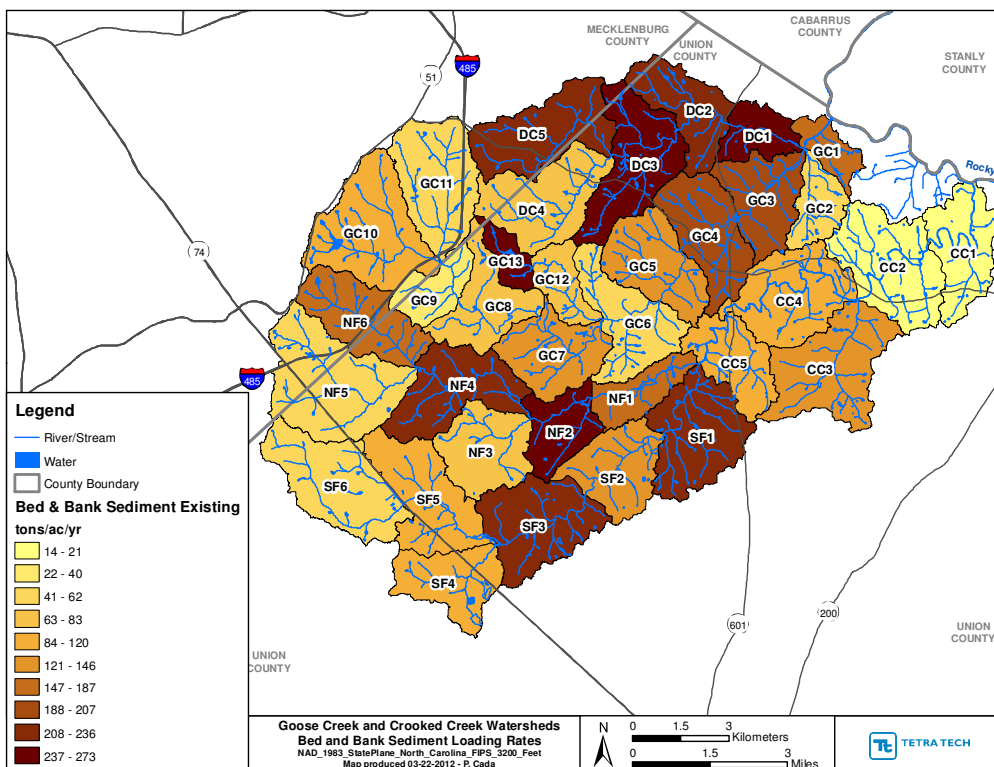


Figure 16. Bank and Bed Sediment Loading per Bed Acre, by Subwatershed (Existing Scenario)

To gain an understanding of the relative contribution of upland, channel, and point sources, model results were summarized for the simulation period (Table 4). The Hunley and Fairfield discharges were omitted from this summary because they were taken offline during the simulation period. Results show that channel sources of sediment are greater than upland sources in both watersheds, and that sediment loading in Crooked Creek is greater than Goose Creek. Loading for nutrients follows the same trend. Point sources contribute an insignificant load of sediment or TSS, however, the nutrient contribution ranges from a quarter (for TN) to a third (for TP) in the Crooked Creek watershed. The point source percentage of nutrients in the Goose Creek watershed is much lower.

Table 4. Pollutant Loading Summary – Goose Creek and Crooked Creek Watersheds

Source	Pollutant	Goose Creek Watershed	Crooked Creek Watershed
Watershed/Upland	TN (lb/yr)	164,608	229,666
	TP (lb/yr)	17,228	27,719
	Upland Sed (ton/yr)	2,792	4,162
Channel	Bed/Bank Sed (ton/yr)	3,816	4,975
Point Sources	TN (lb/yr)	10,010	80,671
	TP (lb/yr)	2,712	13,496
	TSS (ton/yr)	0.74	8.39
Percent from Point Sources	TN	5.7%	26.0%
	TP	13.6%	32.7%
	Sediment	0.01%	0.09%

3.3.3 Biotic Ligand Modeling—Copper

Among the water quality concerns identified in Goose Creek over the past 15 years, total copper concentrations in surface waters have exceeded the state's water quality action level of 7 µg/L (parts per billion) (NCDENR, 2007). The Raleigh Field Office of the USFWS contributed to the watershed assessment in Goose Creek by conducting an evaluation of copper as a stressor for the endangered Carolina heelsplitter using a BLM (USFWS, 2012).

BLMs have been developed to enable mechanistic modeling of copper bioavailability and acute toxicity as a function of metal speciation and the protective effects of competing cations. In-stream data collected by NCDWQ were evaluated with BLM Windows Interface, Version 2.2.3 (HydroQual Inc., 2007) in Water Quality Criteria Calculation mode.

Results show that the 2009 and 2010 copper data for Goose Creek do not exceed BLM-derived water quality criteria for the protection of aquatic life. These data, if representative of the system, indicate copper is not of toxicological concern. Estimation of historical dissolved copper concentrations indicated few exceedances of the BLM criteria, and the few that did occur appear to be associated with higher flows when undissolved forms of copper (which are of lesser toxicological concern) would be anticipated. From

a watershed management standpoint, attention to nonpoint source controls of sediment would help to further reduce copper loadings, but no additional management would be needed to address copper.

A sensitivity analyses indicated that measured variations in Goose Creek water temperature, calcium, magnesium, sodium, potassium, sulfate, chloride, and alkalinity do not appreciably affect the BLM's predictions of safe dissolved copper concentrations for this stream. Stream pH and dissolved organic carbon are important drivers of the BLM's predictions in this system. Stream pH is well characterized, and the recent data are consistent with historic data. There are few data for dissolved organic carbon, so this parameter should be added to future monitoring efforts to help determine if the inference that copper is not a limiting factor is accurate.

3.4 STREAM CONDITIONS: FUNCTIONAL STRESSORS AND SOURCES

The Phase I preliminary findings discussed the linkages between the major stressors, sources, impacts, and functional deficits and hypothesized that sediment and increased peak flows/runoff volumes were the most important and pervasive stressors to watershed function in the Goose Creek and Crooked Creek watersheds (Tetra Tech, 2008). Additional candidate stressors included bacteria, oxygen-demanding substances/nutrients, and toxicity-related pollutants (i.e., ammonia, copper, other metals and pesticides).

Table 5 summarizes the hypothesized linkages among the stressors, sources, impacts, and functional deficits in the Goose Creek and Crooked Creek watersheds. These stressors result primarily from agricultural and urban/suburban land use in the watershed. Over the past two decades, development has increasingly replaced forest and agricultural uses. Until recently, few if any stormwater controls were required for new development. Agricultural land still dominates land use in the lower half of each watershed and is expected to remain a concern in the near future. Field reconnaissance suggested that livestock access to streams is contributing to degradation in some locations. Wastewater discharges are also considered a source of stressors (i.e., nutrients and oxygen demanding material) in the watershed, although their importance has declined somewhat with the removal of two of these discharges.

Table 5. Linkage Between Stressors, Sources, Impacts and Functional Deficits in the Goose Creek and Crooked Creek Watersheds

Stressor	Source(s)	Impact(s)	Functional Deficit(s)
Increased Peak Flows and Runoff Volumes	Impervious surface, removal of vegetation, direct stormwater discharges	Decreased groundwater recharge and baseflows, channel modification and increased bed/bank erosion (and potential increases in sediment-attached pollutants), substrate disturbance; increased velocities, scour	Impaired aquatic habitat, loss of wetland hydrology/ habitat, Impaired aquatic organisms
Sediment	Erosion of construction sites, agricultural land, livestock access to streams, streambank and channel erosion, ATV use	Increased deposited sediment in stream channel, increased turbidity/suspended sediment, increases in sediment-associated pollutants (e.g., nutrients, metals)	Impaired aquatic habitat and aquatic organisms
Bacteria	Pets, livestock, wastewater discharges, sewer overflows and leaks, septic tanks, wildlife	Increased count of pathogens in surface and ground water	Increased risk to human health (and aquatic life)

Stressor	Source(s)	Impact(s)	Functional Deficit(s)
Nutrients and Oxygen-Demanding Substances	Nutrient loading from urban and agricultural runoff, temperature increase in runoff from impervious surfaces; natural sources; WWTPs; septic systems; direct loading from livestock; other agricultural sources	Excessive algal growth, depletion of dissolved oxygen	Aquatic organism stress and mortality; shifts in aquatic community composition
Toxicity-Related Pollutants: Ammonia, Copper, Pesticides, Chlorine, Other Metals	Wastewater discharges, runoff from impervious surfaces and lawns, golf courses, and agricultural land (manure and agrochemicals)	Increased concentration of toxic chemicals	Toxic effects on aquatic organisms

The results of the Phase II assessments confirmed the hypothesis regarding the most important watershed stressors. On the basis of data and field observations, sediment and increased peak flows/runoff volumes are the most important and pervasive stressors to watershed function. Figure 17 illustrates a more detailed relationship between stressor sources and functional impacts for the closely linked concerns of sediment and hydromodification. Impervious cover and land disturbance (both urban and agricultural) have resulted in most of the sedimentation and channel instability seen in these watersheds because of increased peak flows and runoff volumes, riparian disturbance, and upland erosion and sedimentation. These impacts have been identified as a concern for mussel species. The findings for these and other stressors are discussed below.

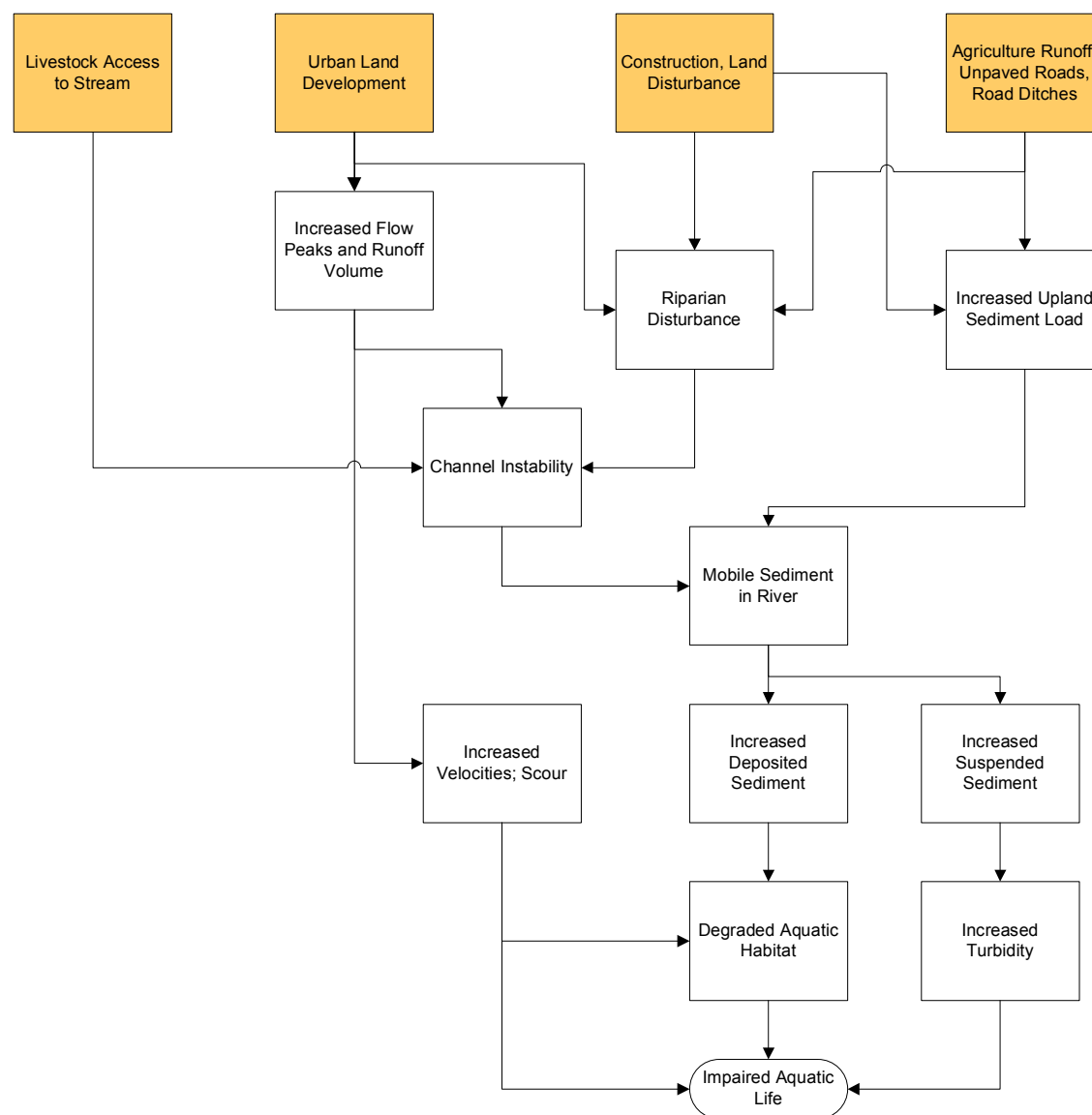


Figure 17. Sediment and Hydromodification Conceptual Model

Increased Peak Flows and Runoff Volumes: Monitoring confirmed evidence of widespread impacts from increased peak flows and runoff volumes. Crooked Creek and Goose Creek macroinvertebrate monitoring shows Poor or Fair bioclassifications, indicating continued impairment. The macroinvertebrate data suggested the most important factor continuing to affect these streams is urban runoff from headwater development.

Habitat assessments further supported the presence of this stressor specifically with the notation that one common deficiency among many sites was a lack of available root mat and undercut bank habitats.

Assessments conducted to evaluate stream geomorphic conditions revealed widespread evidence of undercutting, incision to bed rock, and widening of stream channels. In many reaches, incision had disconnected streams from the floodplain. Mass wasting of streambanks was also observed in both watersheds, which results in streambanks failing and large quantities of sediment entering the stream.

Most reaches evaluated in the current study have a moderate to high risk of bank erosion, with characteristics similar to highly unstable channels.

Sediment: Monitoring and modeling results provide further evidence that significant amounts of sediment are being contributed through both upland sources and from stream channel erosion in both watersheds, resulting from urbanization and imperviousness upstream and agricultural impacts downstream. Field assessment found considerable sand and silt at stream sites, indicating considerable amounts of sediment are being contributed to the system either through runoff or channel erosion.

Oxygen-Demanding Substances/Nutrients: On the basis of the preliminary findings, nutrients and other oxygen-demanding substances appeared to be emerging as a concern throughout the watershed. Low dissolved oxygen concentrations were sampled frequently and typically occurred during low flows and warmer temperatures. Nutrients and other sources of oxygen demand can exert a compounding effect during low flows when dissolved oxygen is already naturally depressed. Algal growth induced by nutrient availability can serve as both source and sink for dissolved oxygen.

Point sources are an important source of nutrients. During periods of low flow, point source effluent dominates in-stream flow. The dominating presence of low dissolved oxygen tolerant macroinvertebrates and high nutrient/organic waste tolerant taxa downstream of the WWTPs indicates they are likely significant sources of this stressor. In addition, at several sites it was noted that quality habitat was available but tolerant species were dominant, indicating that poor water quality was from sources other than sediment and erosive flows.

Bacteria: Historically, fecal coliform bacteria counts in Goose Creek have been high resulting in 303(d) listing and developing a total maximum daily load. NCDWQ WAT sampling revealed continued presence of elevated fecal coliform bacteria. The sources for this stressor are likely varied including urban runoff, livestock with access to streams, wildlife, sewer overflows and leaks, and WWTP discharges to a lesser extent.

Toxic Substances (e.g., Ammonia and Copper): Between 1995 and 2006, the Hunley WWTP in the Goose Creek watershed discharged high concentrations of ammonia nitrogen. In 2006 wastewater from the Hunley WWTP was redirected to a regional WWTP outside the watershed. Recent monitoring downstream of this plant and others suggests that ammonia no longer appears to be an issue in either watershed. In addition, all the plants now use ultraviolet disinfection thereby eliminating chlorine as a potential source of toxicity.

The BLM developed by USFWS with support from NCDWQ WAT specifically evaluated potential impacts from dissolved copper because of concern for the Carolina heelsplitter. The analysis indicated that copper is not of toxicological concern. From a watershed management standpoint, attention to nonpoint source controls of sediment would further reduce copper loadings, but no special measures are recommended to address copper (USFWS, 2012). However, further investigation is being considered.

Data on other toxic substances such as other metals and pesticides are limited, but the available information suggests that these are not significant concerns. However, additional study might be warranted.

3.5 SUBWATERSHED PRIORITIZATION

An analysis of stressors at the subwatershed scale provides a tool for understanding where the greatest magnitude of stressors exist under present conditions or are likely to exist in the future. In addition, an assessment at a scale such as a subwatershed can also help to reveal the level at which these watersheds are functioning. Generally, those watersheds with more assets (i.e., high-quality habitat, forested riparian and floodplain area, stable streambanks, undisturbed uplands) and few stressors can be classified as high-functioning watersheds. These watersheds are likely to be good candidates for preservation opportunities. Watersheds with affected streams, wetlands, and floodplains are under increased stress and might be

unable to sustain functions. These lower functioning systems are more likely to need stream and wetland restoration/enhancement, and additional stormwater management, among other management needs. Watersheds in the moderate range may require a mix of conservation and restoration actions to maintain or improve their functions. The priority for the subwatershed assessment was to identify problem areas that are in the most need of improvement or are likely to be considered lower functioning. The results can identify areas where resources will be most effective in providing benefits.

To this end, a framework for stressor-based prioritization of subwatersheds in the LWP planning area was developed using indicators that serve as linkages between stressors and sources in the watershed and the impacts demonstrated by monitoring and field data. More details on the approach and results are in Tetra Tech (2012b) provided in the WAR appendix (NCEEP, 2012a).

The framework is based directly on the Goose Creek and Crooked Creek LWP goals. Goals 1 and 2 are most relevant to the stressor-based analysis:

- Goal 1: Restore, protect, and enhance watershed functions such as hydrology, water quality, and aquatic and terrestrial habitat.
- Goal 2: To minimize impacts on water quality, aquatic and terrestrial habitat, and hydrology in the watershed by supporting balanced, sustainable, and diverse land use and development, in accordance with existing and future policies.

Goal 1 generally seeks to protect or improve existing watershed functions, and Goal 2 seeks to address future effects on watershed functions. To prioritize subwatersheds where management would best meet each of these goals, two scores were calculated for each subwatershed: one for existing conditions and one for future conditions. As part of the scoring, the subwatersheds with the greatest magnitude of stressors were considered the highest priority because addressing these areas would address the most severe effects on sensitive mussels and other watershed functions.

Indicators were selected that would measure the gaps between existing and future conditions and achievement of these goals. These include:

- Hydrology, upland sediment loading, stream bank and bed sediment, and upland nutrient loading on a subwatershed basis as discussed in Section 3.3.2.
- Bacteria: No direct indicator for subwatershed scoring; considered qualitatively.
- Toxicity-related pollutants: No direct indicator for subwatershed scoring; considered qualitatively.

The watershed modeling results served as the primary source of indicator values and best available measure of stressors across space and time. The watershed model provides output across all subwatersheds throughout an extended continuous period as opposed to monitoring, which is limited to data at sampling locations reflecting only a few discrete points in time and space. However, both water quality monitoring and stream assessment data were used to develop watershed model input and inform the calibration. Because bacteria and toxicity-related pollutants were not simulated, adjustments were made to the subwatershed priorities on the basis of a qualitative assessment of these stressors.

The Goose Creek and Crooked Creek watersheds were scored separately to provide each watershed a similar number of priority subwatersheds and to ensure protection of the Carolina heelsplitter. Figure 18 and Figure 19 display the results of the stressor-based scoring for existing and future conditions, respectively, and the scoring results for each watershed are detailed in Tetra Tech (2012b). The subwatersheds are shaded according to natural breaks in the overall composite scores. Two tiers of priorities are recommended: Tier I represents subwatersheds with a high level of management need, and Tier II represents subwatersheds that have a moderate level of management need. A yellow border indicates the subwatersheds are recommended as Tier II management priorities. The red border indicates

Tier I. These subwatersheds exhibit moderate- to high-level stressors across the indicators or low scores (very high loading) under the TN and TP indicators. The future with BMPs scenario differs from the existing conditions scenario by applying areal changes to the land use and land cover and by adding stormwater BMPs for treating new development according to current regulations. The Tier I and II priority subwatersheds are recommended as tools for targeting the most promising management opportunities.

In general, the priority subwatersheds were clustered in the headwaters of Crooked Creek where more dense development exists and the mid-lower reaches of the Goose Creek and Crooked Creek mainstems where streams have been affected by both upstream development and adjacent agricultural land uses. A few additional priority subwatersheds were identified farther upstream in the Goose Creek watershed. Fewer priority subwatersheds were identified under future conditions because the modeling indicated improvement in pollutant loading and stormwater flow in some portions of the watershed because of stormwater regulations and replacing agriculture with low-density residential development.

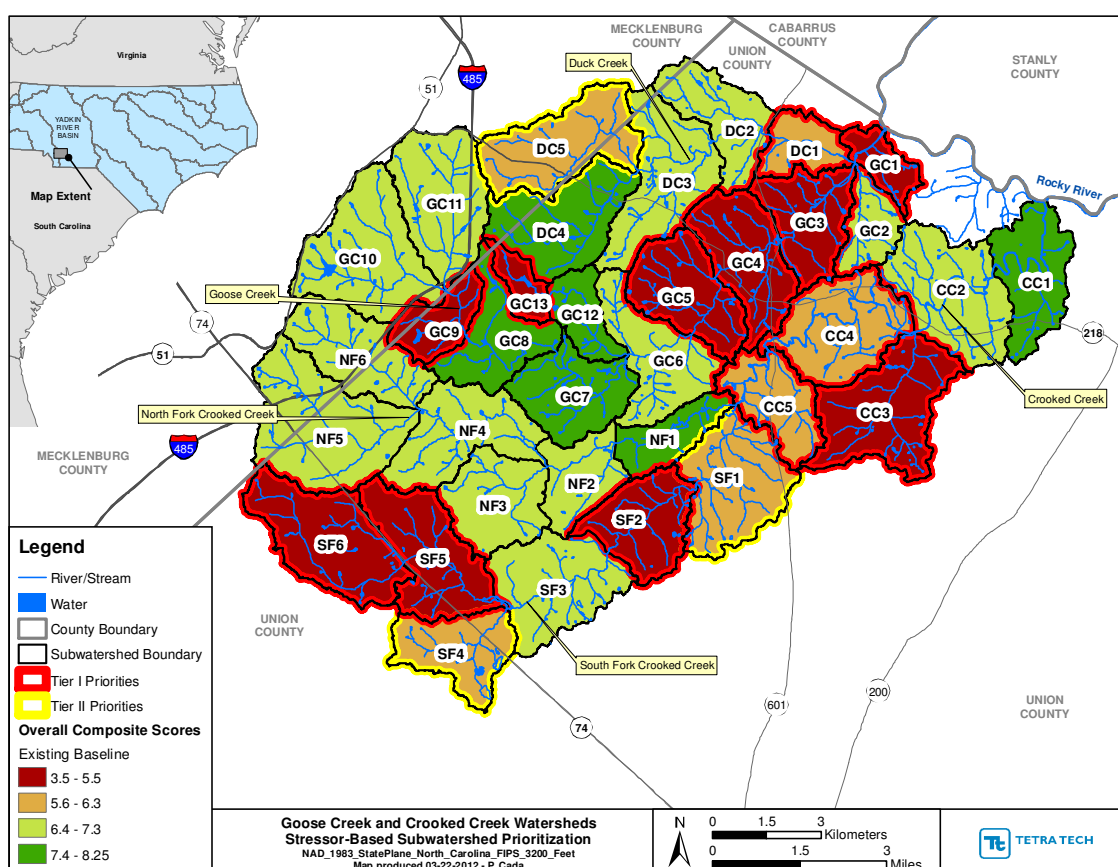


Figure 18. Stressor-Based Subwatershed Prioritization based on Existing Conditions for the Goose Creek and Crooked Creek Watersheds

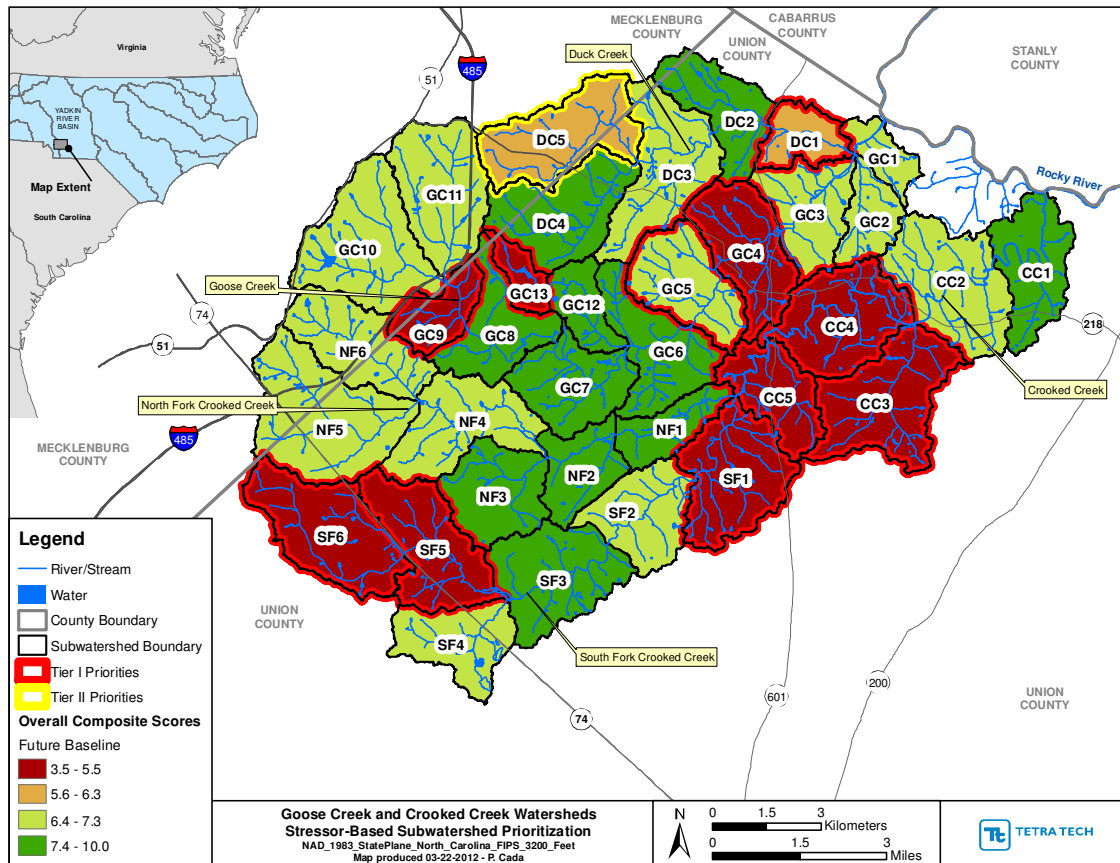


Figure 19. Stressor-Based Subwatershed Prioritization for Future Conditions for the Goose Creek and Crooked Creek Watersheds

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4 Plan Recommendations

As discussed in Section 3, sediment and increased peak flows/runoff volumes are the most important and pervasive stressors to watershed function in the Goose Creek and Crooked Creek watersheds. Other stressors include bacteria, nutrients, oxygen-demanding substances, and toxicity-related pollutants from urban, point, and agricultural sources. The plan recommendations seek to address these stressors, both under existing and future conditions, through a number of targeted management practices and a prioritization of those practices that selects the opportunities that would best address watershed stressors and restore or protect watershed functions.

Under Section 4.1, each management type is discussed individually, including a summary of the identification and prioritization efforts. Individual project scores were produced separately for the following management types: stream restoration and enhancement, wetland restoration and enhancement, and stormwater BMPs. Preservation, agricultural BMPs, point source management, and watershed protection measures are also discussed outside a formal prioritization.

Details on the sites identified for management opportunities are included in the Project Atlas (provided as a companion document), and described in Section 4.2. The individual project scores are then incorporated into a comprehensive project prioritization that takes into account the stressor-based subwatershed analysis in Section 3.5 and the relationship to other opportunities (Section 4.3).

4.1 MANAGEMENT STRATEGIES

Management strategies for the Goose Creek and Crooked Creek watersheds seek to address the stressors of increased peak flows and runoff volumes, sediment, bacteria, oxygen-demanding substances, nutrients, and toxicity-related pollutants. These stressors, resulting primarily from the lack of historical pre- and post-construction stormwater control, have resulted in impairments to biological integrity in both watersheds. The preliminary findings and detailed watershed characterization led to the following conclusions regarding opportunities to address management needs:

- Hydromodification caused by development in the headwaters is a pervasive issue throughout both watersheds. Stream restoration is likely to be most effective in the upper and middle portions of the watersheds, with a few exceptions as noted.
- A number of stormwater BMP retrofit opportunities exist where stormwater controls have not been required in the past. Potential for use of agricultural BMPs also exists, especially in the lower portions of both watersheds.
- Opportunities for riparian buffer restoration exist throughout the watershed. More than a third of subwatersheds had greater than 40 percent deficiency in vegetative cover according to satellite imagery, mostly in the headwaters and along South Fork Crooked Creek.
- Wetlands restoration opportunities can be found throughout both watersheds, but these opportunities are most likely to exist in the lower portions where agricultural land is most prevalent.
- About 93 percent of remaining natural area in the watershed remains unprotected and provides a large opportunity for preservation throughout the watershed.
- Although a number of protection measures are already in place and measures specific to Goose Creek are some of the most stringent in the state, additional watershed protection may be needed.

Following these findings, individual management opportunity identification and prioritization exercises were conducted for the following types of management: stream restoration and enhancement, wetland

restoration and enhancement, preservation of watershed assets, stormwater BMPs, and protection measures. The opportunities address stressors and watershed impacts in a number of ways as described in Table 6.

Table 6. Summary of Stressors, Impacts, and Functional Benefits Addressed by Management Opportunities

Management Opportunity	Targeted Stressor or Impact	Functional Benefit
Stream Enhancement and Restoration	Degraded riparian buffer; nonpoint source runoff, increased temperature, channel instability and aquatic habitat degradation; disconnected floodplains	Improved water quality, enhanced aquatic and terrestrial habitat, shading, reduction of in-stream sediment loading, floodplain connection, nutrient cycling
Wetland Enhancement and Restoration	High flow, nonpoint source runoff, degraded terrestrial habitat, disconnected floodplains	Hydrologic attenuation, nutrient cycling, sediment trapping, connection to floodplains, enhanced terrestrial habitat
Stormwater Retrofit	Increased flow and nonpoint source runoff	Hydrologic attenuation, treatment of nonpoint source runoff
Preservation	Future risk of degradation	Protection of existing hydrologic, water quality, and habitat functions
Protection Measures	Future risk of degradation	Protection of existing hydrologic, water quality, and habitat functions

The following sections summarize the identification and prioritization results for each type of management.

4.1.1 Stream Restoration and Enhancement

Goose Creek and Crooked Creek watersheds have experienced widespread channel impacts, most notably in the upper reaches draining headwater-based development (Tetra Tech, 2008). Potential stream management opportunities were screened for further field assessment on the basis of the results from Phase I, NCEEP minimum criteria for stream restoration, existing HEC River Analysis System (HEC-RAS) models, and available GIS data and aerial imagery. For selected reaches, geomorphic data, in-stream habitat, and other data items were collected in the field to support more in-depth analysis of stream management opportunities. The WAR (NCEEP, 2012a) and Tetra Tech (2010) provide more details on the site identification and prioritization methods, including NCEEP restoration and enhancement criteria.

The stream reaches considered for management opportunities are shown in Figure 20. The stream management opportunities were ranked according to cost-effectiveness (cost per ton of sediment reduction), number of landowners, proximity to utilities, and forested riparian area. This ranking was used as the individual project score, which is incorporated into the project prioritization described in Section 4.3.

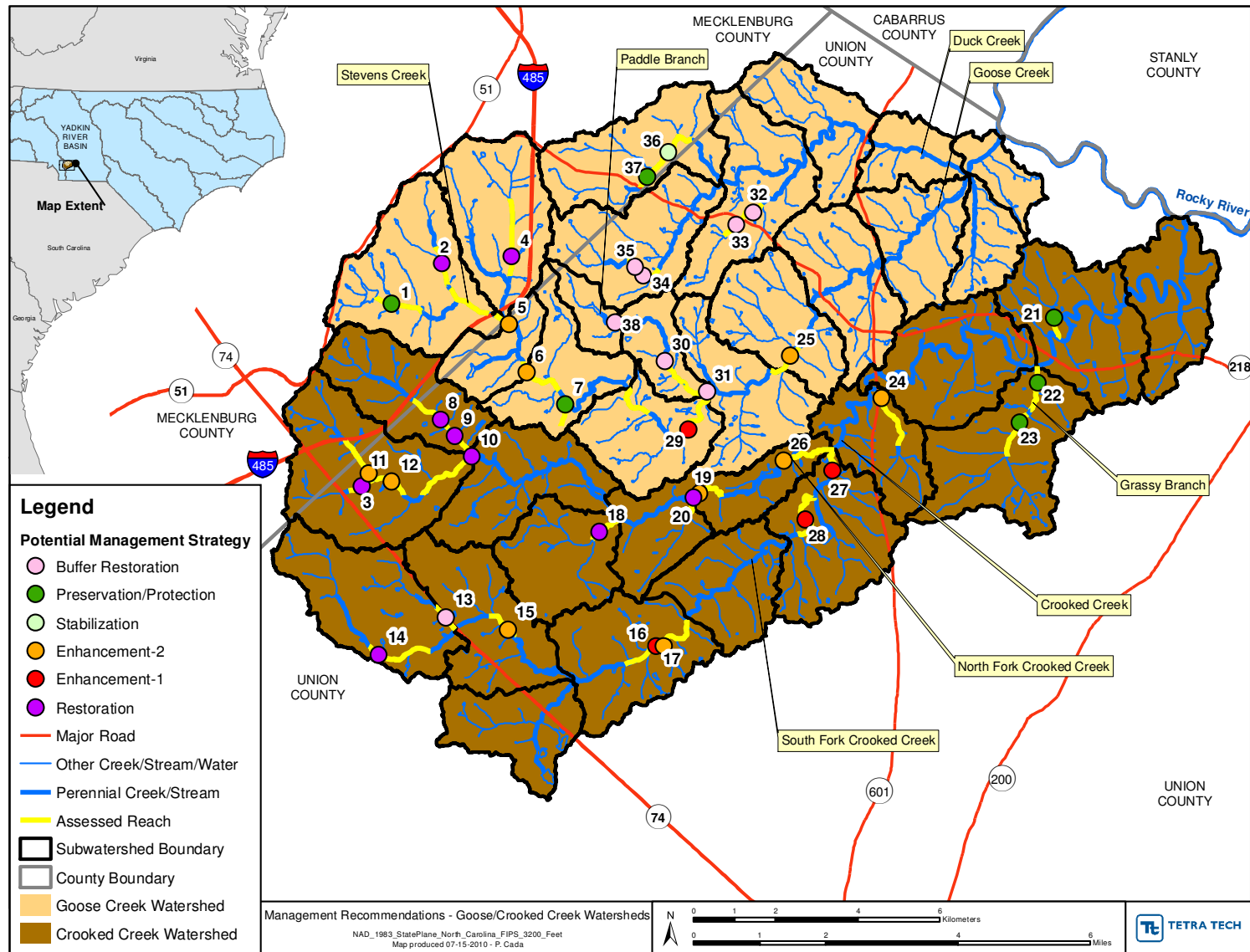


Figure 20. Recommended (Primary) Management Strategies for Selected Reaches in the Goose Creek and Crooked Creek Watersheds

On the basis of the information collected to date, all reaches were considered feasible for some degree of management. During plan implementation, more detailed, site-specific feasibility assessments and contact with landowners will be required.

The analysis of management opportunities in the study area yielded six stream reaches considered as good to excellent condition and that should be protected through some form of preservation or protection. Eight reaches are recommended for riparian buffer restoration, either because that was the only identified need or the constraints of a reach would limit management efforts to the riparian zone. Many of these reaches were classified as CEM stage I, where major stream degradation has not occurred.

The remaining 24 reaches are recommended for some degree of active or higher level management (e.g., Restoration, Enhancement-1, Enhancement-2, or Stabilization). These included two of three reaches in CEM stage II, all nine reaches in CEM stage III, and six of seven reaches in CEM stage IV (for description of CEM stages, see Figure 6). Half of the CEM stage V reaches would benefit from higher levels of management to address widening and aggrading field observations.

Three reaches were observed in the quasi-equilibrium of CEM stage VI, where a new bankfull bench has established in the active channel area. Two of these reaches are recommended for Enhancement-2. The third reach observed in CEM stage VI has a stable active channel area but is in need of riparian buffer restoration.

In seven reaches, the team identified alternative options where further site investigation is needed to determine which, if any, of the management recommendations should be pursued. For example, Site #13 has three possible recommendations ordered *Buffer Restoration*, *Enhancement-2*, and then *Restoration*. Buffer restoration at Site #13 could be accomplished with minimal investigation of infrastructure. However, the stream would benefit from grade-control measures and depending on the location of underground utilities and infrastructure, and the availability of large, undeveloped parcels on the opposite side of East Independence Boulevard, this reach could be rerouted into a newly created stream channel. While any of or all these three recommendations could improve the stream, more information is needed to determine the most appropriate option.

4.1.2 Wetland Restoration and Enhancement

As discussed above, sediment and increased peak flows/runoff volumes are considered the most important and pervasive stressors to watershed function in the Goose Creek and Crooked Creek watersheds. Other notable stressors include pollutant loading from urban and agricultural sources. Riparian wetland restoration or enhancement would address these stressors by reducing the velocity and volume of stormwater runoff and high stream flows that might be intercepted by the restoration site. The type of wetland enhancement provided would determine to what extent these stressors are addressed, but enhancement activities such as planting or minor improvements in hydrologic storage would slow runoff, which would encourage settling in the enhanced wetland, leading to reduced turbidity and TSS in streams. Beyond enhancement, wetlands restoration could provide a much greater increase in these functions. Riparian wetlands enhancement or restoration might help reduce nutrients and other pollutants in these flows as well. In addition, enhancing or restoring wetland habitat would support the protection or restoration of critical aquatic habitat for sensitive mussel species through ecological pathways, like enhanced food web interactions and improved habitat through reduction in sediment loading, controlling storm flows, and regulating temperature through shading, among other benefits. Protecting sensitive mussel species is a key consideration for the LWP. Wetland preservation would protect water quality, hydrology, and habitat functions provided by existing wetlands. Non-riparian wetland mitigation would restore or preserve the unique ecological functions of non-riparian wetlands, including habitat for rare, threatened, and endangered species.

Riparian and non-riparian wetlands were prioritized separately and *major focus indicators* were selected on which to base the prioritization. The following list outlines the major focus indicators related to benefits, feasibility, and mitigation value.

- Benefits
 - Water Quality/Hydrology Benefits
 - Supports a Stream Restoration Opportunity
 - Supports or is Supported by a BMP Opportunity
 - Supports Existing Wildlife Habitat or Endangered/Threatened Species
 - Development Pressure
- Feasibility
 - Constraints – Landowners
 - Constraints – Utilities/Access
- Mitigation Value
 - Potential Wetlands Mitigation Units (WMUs)

A composite score was developed on the basis of these indicators to measure how well each site would achieve the overarching goal for the wetland mitigation prioritization (Tetra Tech, 2012e):

- Prioritize sites that would provide the greatest potential benefit related to watershed stressors and are feasible and cost-effective.

This composite score was used as the individual project score, which is incorporated into the project prioritization described in Section 4.3.

The scoring revealed three riparian and one non-riparian top scoring sites (15, 17, 3, and 2). All four sites appeared to provide promising opportunities, and their unique characteristics are described in more detail below:

- **Site 15** is a high-priority riparian site because of several major focus indicators. Of all sites inspected, this is one of four sites with the third highest score (8.1 out of 10) for its potential to provide local water quality and hydrologic benefits. Site 15 is in an existing municipal boundary, supports a stream restoration opportunity and does not have observable constraints related to utilities or access. Landowner consent at this time is unknown. The landowners have been contacted, and NCEEP is anticipating a response from them. Site 15 consists of 5 acres with the potential for riparian enhancement.
- **Site 17** is a site of high priority because of several major focus indicators. The site is in an existing municipal boundary, consists of both riparian and non-riparian opportunities, and has a high potential for WMUs. The site has no observable constraints, and the landowners have shown interest in establishing a conservation easement for the wetland project. In addition, NCEEP has obtained an option for purchase from the landowners. The site supports wildlife habitat and has the potential to support endangered or threatened species. It could also provide a stream enhancement opportunity in addition to the opportunities identified in Tetra Tech's stream restoration planning report (Tetra Tech, 2010). The site is now under an NCEEP contract (as of 2010) for design including stream enhancement, stream preservation, wetland restoration, and wetland enhancement.
- **Site 3** is a high-priority riparian site because of several major focus indicators. The site is in an existing municipal boundary, has high potential for WMUs, has no record of utility or access constraints, and appears to support wildlife habitat and endangered or threatened species. Site 3 has only one landowner of unknown interest. NCEEP left information regarding participation in

wetland restoration efforts at the landowner's residence during the site identification process and anticipates further communication efforts if the landowner does not respond.

- **Site 2** was the highest scoring non-riparian wetland site. Even though site 2 did not score the highest across all major focus indicators, it consistently scored in the higher range for almost all major focus indicators. Site 2 has highest potential WMUs across all non-riparian opportunities, and one of four non-riparian sites having the highest potential to support endangered or threatened aquatic species. NCEEP reported potential interest for participation from landowners after speaking with the landowners in person on August 4, 2010.

A total of 32 wetland opportunity sites were identified (23 riparian and 9 non-riparian). Figure 21 and Figure 22 provide the location and composite score for the riparian and non-riparian sites, respectively. Tetra Tech (2012e) provides more details on the site identification and prioritization methods.

Following the prioritization, NCEEP modified the list of opportunities with the following changes:

- Site 7 was removed because wetland hydrology indicators, specifically redoximorphic features, were not observed on the site.
- Site 23 and Site 4 were combined into one project under Site 4 because they are on the same parcel.
- Site 28 and Site 19 were combined into one project under Site 19 because they are on the same parcel.
- Site 17 was removed from the list because it is being implemented by NCEEP. The location of this project site is shown in the Project Atlas (Section 4.2) for reference.

These changes resulted in a revised list of 29 wetland opportunities sites (22 riparian and 7 non-riparian). This list is applied to the project prioritization discussed in Section 4.3.

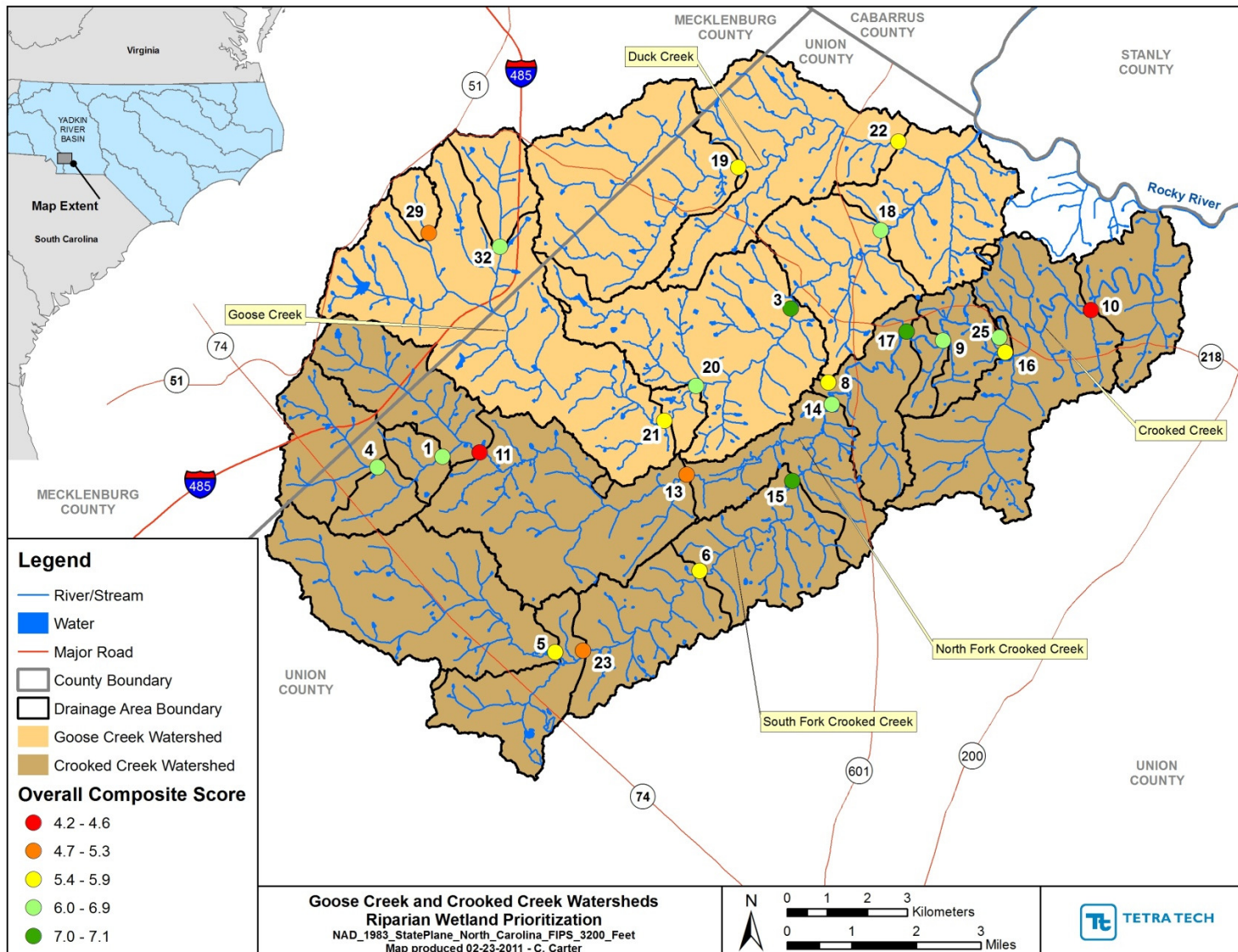


Figure 21. Potential Riparian Wetland Mitigation Sites Varying by Overall Composite Score

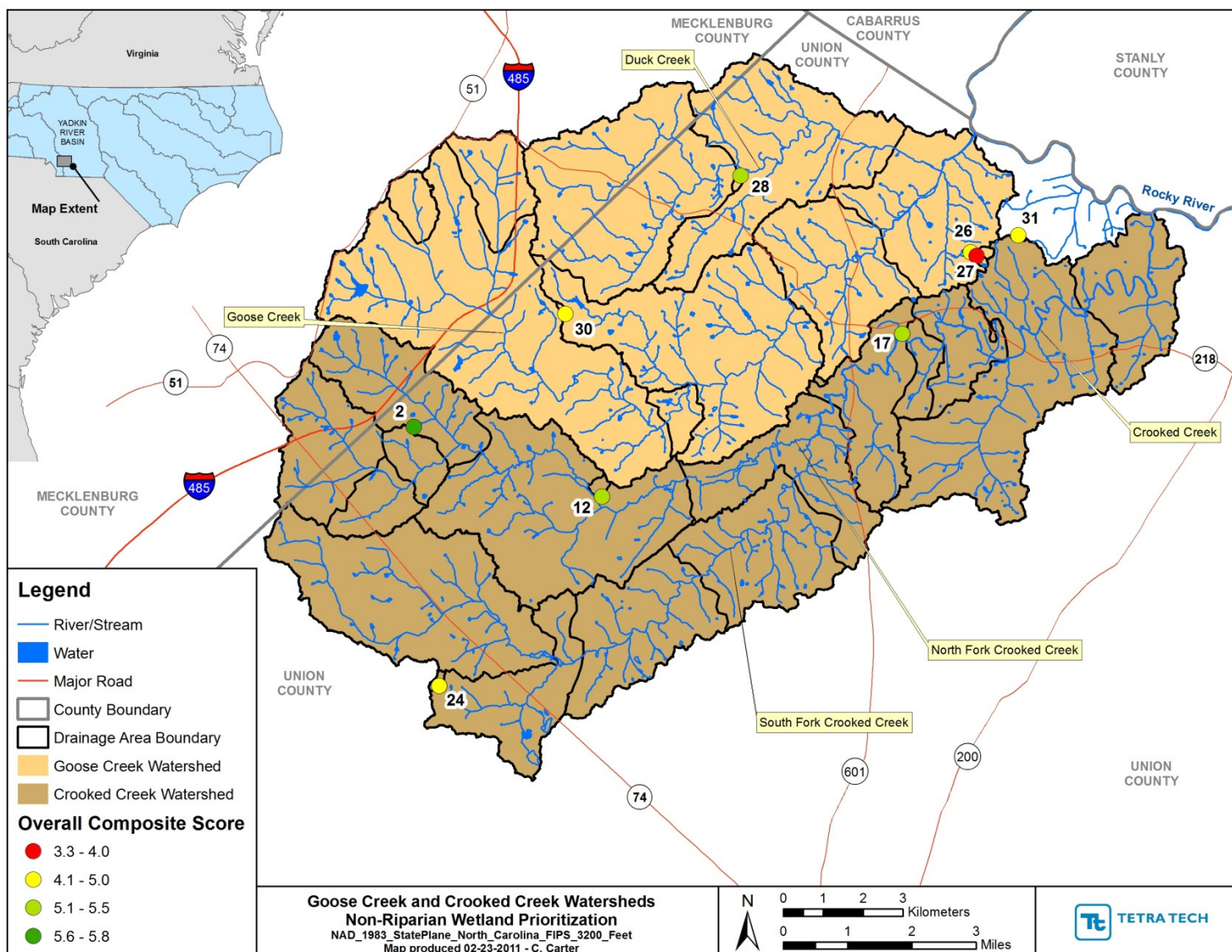


Figure 22. Potential Non-riparian Wetland Mitigation Sites Varying by Overall Composite Score

4.1.3 Preservation

An important component of a watershed assessment is identifying watershed assets that can provide opportunities for preservation. Watershed assets are considered twofold for this assessment: (1) as significant natural resources that exist in the watersheds, and (2) as beneficial natural resources that exist and provide protection for water quality and habitat for significant resources. The value of beneficial natural resources will vary between watersheds, particularly depending on what key stressors are present, however in general intact riparian buffers, undisturbed or undeveloped land, land already under conservation, high quality habitat, and interested landowners and stakeholders are examples of things considered important when evaluating watershed assets. Preservation of these assets, especially in clusters, is an effective way to protect against the impacts of stressors and support long-term watershed health. The preservation of assets is valuable in the Goose Creek and Crooked Creek watersheds for many reasons including the protecting riparian buffers that will help reduce sediment, runoff/peak flow and nutrient impacts, maintaining existing natural areas that will prevent further impacts from additional disturbed land or imperviousness, and ensuring the conservation of habitat that supports the many significant species in these two watersheds including the federally endangered Carolina heelsplitter found in the Goose Creek watershed.

4.1.3.1 Significant Natural Resources

The Natural Heritage Program (NHP) supports conservation of the rarest and the most outstanding elements of the natural diversity of our state. These elements of natural diversity include those plants and animals that are so rare or the natural communities that are so significant that they merit special consideration as land-use decisions are made. According to the NHP a Significant Natural Heritage Area (SNHA) is an area of land or water identified by the NHP as being important for conservation of the State's biodiversity. SNHAs contain one or more Natural Heritage Elements which are high-quality or rare natural communities, rare species, and special animal habitats. There have been several Natural Heritage Element Occurrences (NHEO) in the watersheds (NCEEP, 2012a). In addition to the NHEOs some areas in these watersheds are also identified by the NHP as unique SNHAs. The North Fork Crooked Creek Sunflower site, Goose Creek and Duck Creek Aquatic Habitat, and the Crooked Creek Aquatic Habitat, which support the various sensitive species are all included as SNHAs (Figure 20).

Goose Creek and its major tributary, Duck Creek, also are considered significant by the USFWS because they support the federally endangered Carolina heelsplitter and are designated critical habitat for this species.

4.1.3.2 Prioritization of Watershed Assets for Preservation

Preservation opportunities in the Goose Creek and Crooked Creek watersheds were evaluated separately to identify a similar number of opportunities in each watershed and also to allow for the potentially different nature of preservation projects in these watersheds because of additional regulatory protections in place for the Goose Creek watershed. Subwatersheds for preservation were selected for further evaluation of preservation opportunities according to which subwatersheds have the greatest percentage of total natural area as defined in the preliminary findings (Tetra Tech, 2008). Then, these subwatersheds were further evaluated to ensure that they provided for the focused protection of quality habitat and water quality that supports the sensitive and unique species in them and prevent further degradation from sources such as imperviousness, construction, stormwater, agriculture and other nonpoint sources. Table 7 and Table 8 list the additional characteristics evaluated for the Goose Creek and Crooked Creek watersheds, respectively. Figure 23 illustrates the location of the priority subwatersheds and the large parcels in them that might contain significant preservation opportunities. NCEEP (2012a) provides more details on the site identification and prioritization methods in the WAR.

Table 7. Goose Creek Priority Subwatersheds for Preservation

Stream Name	SW ID	Total Natural Area (%)	Protected Natural Area (acres)	Average Impervious (%)	Existing Riparian Buffer (%)	NHEO (species count)	SNHA (Intersecting)
Duck Creek	DC2	48.6%	6	3.6%	79.47%	3	1
Duck Creek	DC3	43.6%	1	2.5%	74.43%	3	1
Duck Creek Headwaters	DC4	47.2%	9	4.7%	83.13%	3	1
Unnamed Trib of Duck Creek	DC5	47.8%	14	4.9%	80.3%	3	1
Goose Creek	GC1	50.8%	10	2.9%	75.54%	6	1
Unnamed Trib of Goose Creek	GC2	40.8%	1	1.8%	71.17%	4	1
Goose Creek	GC3	40.1%	27	2.1%	68.33%	4	1
Goose Creek	GC6	43.8%	1	3.5%	66.88%	1	1
Goose Creek	GC7	57.0%	0	3.8%	77.21%	6	2
Goose Creek	GC8	56.7%	0	8.5%	84.85%	1	1
Stevens Creek	GC10	39.3%	243	7.8%	77.95%	1	1
Paddle Branch	GC12	40.8%	0	2.4%	67.62%	1	1

Table 8. Crooked Creek Priority Subwatersheds for Preservation

Stream Name	SW ID	Total Natural Area (%)	Protected Natural Area (acres)	Average Impervious (%)	Existing Riparian Buffer (%)	NHEO (Species Count)	SNHA (Intersecting)
Crooked Creek	CC1	42.6%	0	1.7%	83.19%	3	1
Crooked Creek	CC2	37.3%	0	3.7%	71.55%	3	1
Crooked Creek	CC4	36.4%	0	3.2%	66.54%	2	1
Crooked Creek	CC5	31.9%	0	2.9%	58.63%	3	1
North Fork Crooked Creek	NF1	39.3%	0	3%	65.24%	2	1
North Fork Crooked Creek	NF2	42.4%	0	5.7%	60.94%	0	1
North Fork Crooked Creek	NF4	36.7%	0	13.1%	63.3%	2	1
South Fork Crooked	SF3	32.1%	0	7.9%	57.51%	3	1

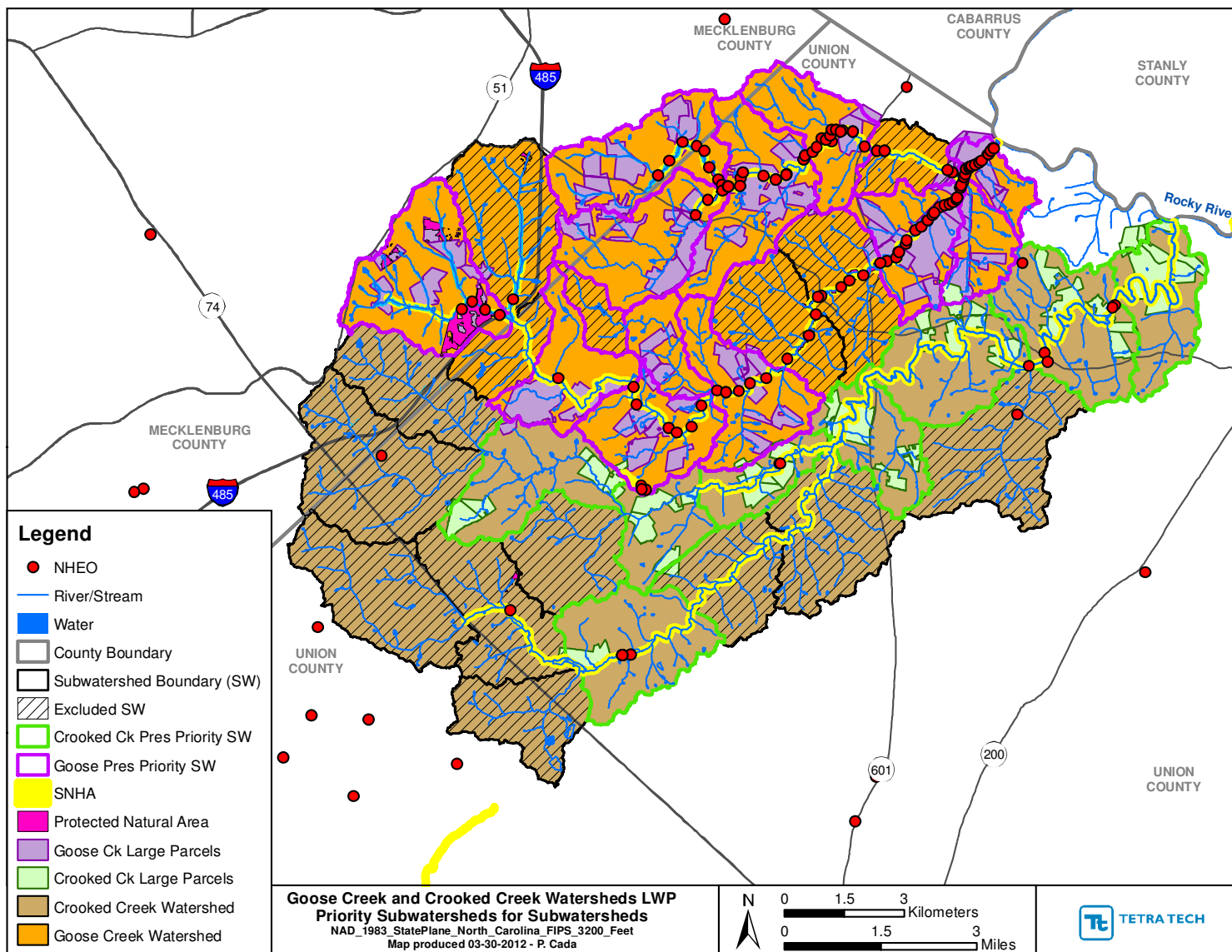


Figure 23. Goose Creek and Crooked Creek Priority Subwatersheds for Preservation

4.1.4 Stormwater BMPs

The watershed characterization indicates that management options should address excessive stormwater runoff volumes and peak flows, degradation of in-stream aquatic habitat, toxicity due to nonpoint source impacts, upland sources of nutrients and sediment, and point source impacts at low flows. While the stream and wetland restoration, and preservation opportunities discussed previously will serve to reduce the impacts of some of these stressors, uplift of the hydrologic, water quality, and aquatic habitat functions in the study area will also require implementing stormwater BMPs or BMP retrofits. Retrofits are structural stormwater management measures added to previously developed areas where little or no prior stormwater controls existed. In the case of the Goose Creek and Crooked Creek watersheds, few stormwater controls were in place for existing development before about 2007. (Note: NCEEP cannot receive mitigation credit for standalone stormwater BMP implementation. Therefore, design, construction and monitoring of stormwater BMP opportunities would likely need to be implemented through other funding sources through stakeholder partnerships.)

NCEEP staff conducted a study to identify stormwater BMP opportunities focused on two types of BMPs: bioretention basins and stormwater wetlands (NCEEP, 2012b; provided in Appendix C). Bioretention basins use plants and soils for pollutant removal from stormwater runoff via adsorption, filtration, sedimentation, volatilization, ion exchange, and biological decomposition. In addition, bioretention provides landscaping and habitat enhancement benefits. Stormwater wetlands are constructed systems that mimic the functions of natural wetlands and use physical, chemical, and biological processes to treat stormwater pollution. For more information on the siting, design, construction, and maintenance of stormwater BMPs, see the NCDWQ *Stormwater Best Management Practices Manual* (NCDWQ, 2007).

Figure 24 provides the location of the stormwater BMP opportunities in the watersheds and Table 9 summarizes the characteristics and priority rankings of the opportunities. The priority ranking was determined with three major steps. First, an “*approximate effectiveness*” was determined for each BMP. This is defined as the percentage of drainage area that can be effectively treated with the available BMP footprint. Undersized BMPs will have approximate effectiveness value less than 100%, whereas the approximate effectiveness values for properly sized BMPs will be 100%. The estimated cost was divided by the effective area treated (equal to drainage area multiplied by approximate effectiveness) to yield the cost per effective area treated, in dollars per acre. Finally, multipliers were applied to the cost per effective area treated values according to the location of each site in relation to the future with BMPs stressor-based subwatershed priorities (Section 3.5). For example, the lowest multipliers applied to BMPs in the Tier I subwatersheds, which served to adjust the cost per effective area treated downward to reflect a higher priority for these projects. Appendix C provides more details on the site identification and prioritization methods. The BMP priority ranking was inverted and used as the individual project score, which is incorporated into the project prioritization described in Section 4.3.

Sites 13 and 15 were not considered in either the individual BMP ranking or the project prioritization (Section 4.3). During field verification, site 13 was deemed unsuitable because on-site drainage conditions are not favorable for BMP placement. Site 15 was not able to be field verified because of property access limitation. When these sites are removed, the number of BMP opportunities is reduced to 15.

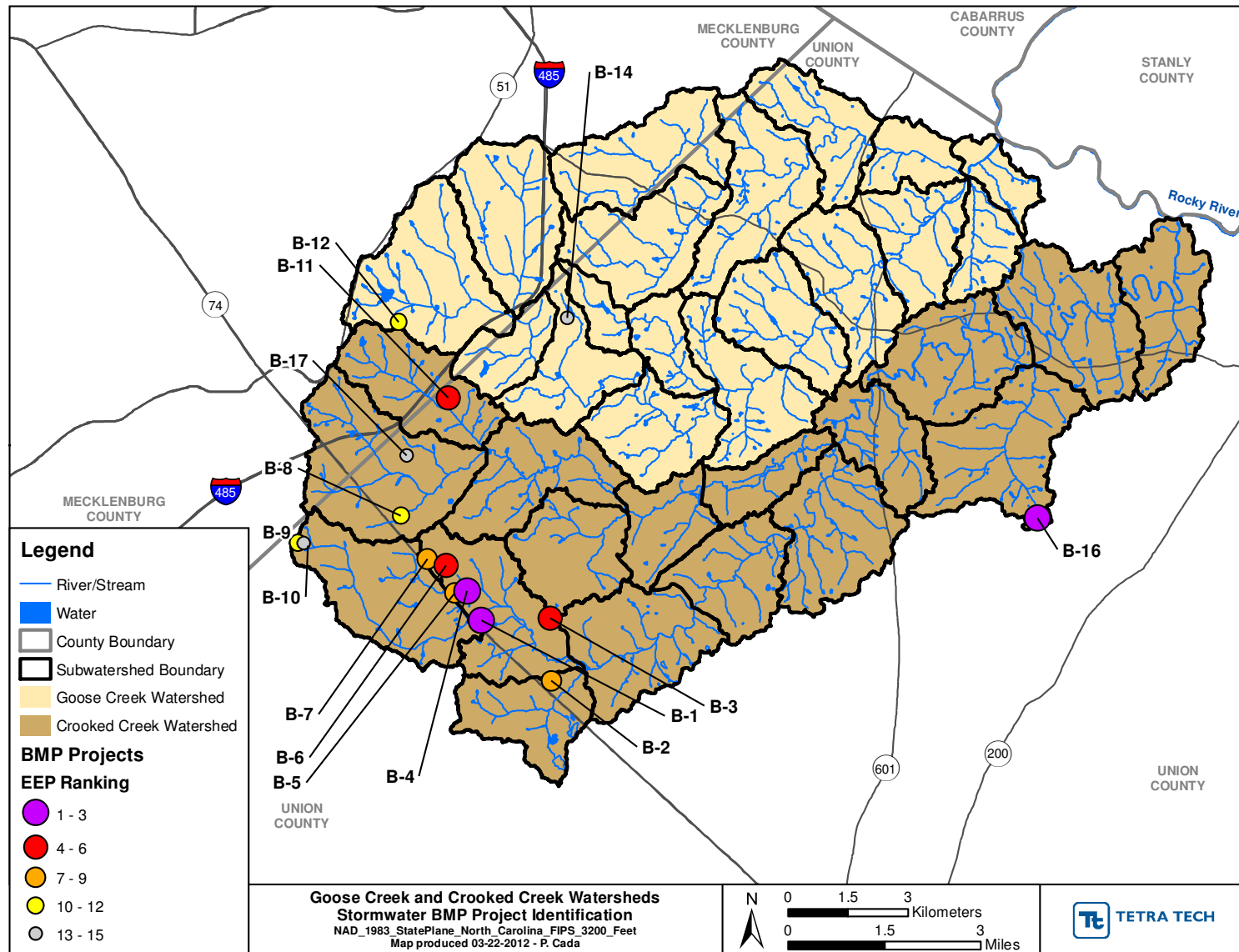


Figure 24. Selected Stormwater BMP Opportunities in the Goose Creek and Crooked Creek Watersheds

Table 9. Stormwater BMP Characteristics and Priority Ranking

Site ID	BMP Type	Site Type	Drainage Area (ac)	Site Footprint (ac)	Impervious Surface (%)	Approximate Effectiveness ¹ (%)	Design & Construction Cost	Rank
1	Stormwater Wetland	New	41.1	1.8	78%	87%	\$220,000	1
2	Stormwater Wetland	Retrofit	5.8	0.7	100%	100%	\$120,000	8
3	Bioretention	Retrofit	9.8	0.1	36%	57%	\$325,000	6
4	Stormwater Wetland	Retrofit	15.4	1.2	100%	100%	\$300,000	3
5	Bioretention	Retrofit	5.7	0.6	100%	100%	\$450,000	9
6	Stormwater Wetland	Retrofit	4.6	0.4	100%	100%	\$100,000	4
7	Bioretention	Retrofit	7.2	0.3	76%	82%	\$350,000	7
8	Stormwater Wetland	Retrofit	3.1	0.5	63%	100%	\$120,000	12
9	Bioretention	Retrofit	1.6	0.1	94%	100%	\$175,000	11
10	Bioretention	Retrofit	0.8	0.05	100%	81%	\$100,000	14
11	Stormwater Wetland	Retrofit	18.7	0.9	100%	85%	\$300,000	5
12	Stormwater Wetland	New	3.7	0.5	62%	100%	\$100,000	10
14	Stormwater Wetland	Retrofit	4.9	0.7	100%	100%	\$150,000	13
16	Stormwater Wetland	Retrofit	9.9	0.2	75%	62%	\$90,000	2
17	Bioretention	Retrofit	3.6	0.3	45%	100%	\$240,000	15

¹ Defined as the percentage of drainage area that can be effectively treated with the available BMP footprint.

4.1.5 Agricultural BMPs

Although not typically referred to as *retrofits*, a similar concept can be applied to agricultural land uses given the large amount of this land use in the lower portions of the watersheds. Agricultural BMPs are used to reduce nonpoint source runoff from pasture, row crops, and confined animal operations. During Phase I, stakeholders emphasized the importance of practices to reduce impacts from poultry operations and restricting livestock from streams. Livestock access to streams was also observed during the stream assessment.

Table 10 presents a comprehensive list of agricultural BMPs for possible implementation in the study area for reducing upland water quality stressors. Each practice is accompanied by the NRCS conservation practice code (<http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/alphabetical/ncps>). While a pasture condition evaluation was not conducted in this study, common pasture management issues include spot grazing, grazing on high slopes, undesirable plant species, sheet and rill erosion, and uncontrolled cattle access to streams. Recommended BMPs to address these issues involve rotational grazing, alternative water sources, stream corridor fencing to exclude livestock, grazing management plans, and nutrient management plans. A smaller percentage of the agricultural land is devoted to crops. BMPs to reduce pollutant loading include residue management practices such as conservation tillage or no-till, nutrient management plans, field borders, riparian buffers. Confined animal operations can benefit from waste management plans if not already in place as a requirement of state regulation.

Table 10. Menu of Agricultural BMPs to Address Watershed Stressors and Impacts

BMPs (NRCS Conservation Practice Code)	Upland Sediment and Nutrient Loading/	Peak Flow and Runoff Volume	Channel Stability	Fecal Coliform Loading
Crop/Land Management				
Conservation Cover (327)	H	H	H	M-L
Conservation Crop Rotation (328)	M-L	M-L	M-L	M-L
Contour Buffer Strips (332)	H	M-L	M-L	M-L
Contour Farming (330)	M-L	M-L	M-L	M-L
Cover and Green Manure Crop (340)	M-L	M-L	M-L	M-L
Cover Crop (340)	H	M-L	M-L	M-L
Field Border (386)	H	M-L	M-L	M-L
Filter Strip (393)	H	H	H	H
Grassed Waterway (412)	M-L	M-L	M-L	M-L
Nutrient Management (590)	H			H
Residue Management, Mulch Till (329B)	H*	H	M-L	M-L
Residue Management, No Till/Strip Till (329A)	H*	H	M-L	M-L
Residue Management, Ridge Till (329C)	H*	H	M-L	M-L
Residue Management, Seasonal (344)	H*	H	M-L	M-L
Stream Buffer	H	H	H	H
Stripcropping, Contour (585)	M-L	H	M-L	M-L
Stripcropping, Field (586)	M-L	M-L	M-L	M-L

BMPs (NRCS Conservation Practice Code)	Upland Sediment and Nutrient Loading/	Peak Flow and Runoff Volume	Channel Stability	Fecal Coliform Loading
Vegetated Filter Strips	H	H	H	M-L
Pasture Management				
Critical Area Planting (342)	M-L	H	H	M-L
Fence (for streamside buffer) (382)	M-L	H	H	M-L
Heavy Use Area Protection (561)	M-L	M-L	H	M-L
Nutrient Management (590)	M-L			M-L
Offstream Watering	M-L	M-L	H	M-L
Pasture and Hay Planting (512)	M-L			
Prescribed Grazing (528A)	M-L	M-L		M-L
Riparian Forest Buffer (391)	M-L	M-L	H	M-L
Rotational grazing (528)	M-L			M-L
Stream Crossing (578)	M-L	M-L	H	H
Tree/Shrub Establishment (612)	M-L	M-L		M-L
Use Exclusion (472)	M-L	M-L		M-L
Wetland Creation (658)	M-L	M-L		M-L
Wetland Enhancement (659)	M-L	M-L		M-L
Wetland Restoration (657)	M-L	M-L		M-L

H = High Effectiveness

M-L = Medium to Low Effectiveness

H* = High Effectiveness for Sediment, Low to Moderate Effectiveness for Nutrients

Local Soil and Water Conservation districts, NRCS, and the North Carolina Cooperative Extension Service will be key participants in implementing these practices in cooperation with local landowners. Sources of funding and technical assistance are discussed further in Section 6.

4.1.6 Point Source Management

Point sources are an important source of nutrients in both watersheds, especially during low-flow conditions when effluent dominates stream flow. Nutrients and other sources of oxygen demand can exert a compounding effect during low flows when dissolved oxygen is already naturally depressed. In addition, low dissolved-oxygen-tolerant macroinvertebrates and high nutrient/organic-waste-tolerant taxa were found downstream of the WWTPs. Recent management to address these issues has included

connecting two smaller WWTPs in the Goose Creek watershed to a regional plant that discharges outside the watershed. In addition, the *Goose Creek Site-Specific Water Quality Management Plan* (Goose Creek SSWQMP; NCDENR, 2009) provides restrictions on the growth of point sources and ammonia limits in the Goose Creek watershed. Going forward, further evaluation of the assimilative capacity of both Goose Creek and Crooked Creek could be warranted.

4.1.7 Watershed Protection

Protection is a general term for the strategy used by NCEP to protect critical watershed functions in three basic categories: water quality, habitat, and hydrologic balance. Multiple stressors have been identified as known or suspected causes of water quality problems and risk to aquatic species including sensitive mussels. Watershed protection involves preventing further degradation to the watersheds from future development. This section discusses the current level of watershed protection provided in the Goose Creek and Crooked Creek watersheds and the opportunities available to provide additional watershed protection.

General Protection Needs

The policies reviewed in the preliminary findings (Tetra Tech, 2008) illustrated the degree of watershed protection now in place or likely to be in place in the future. The degree that stormwater runoff control, riparian buffer protection, and sediment and erosion control was addressed varies by jurisdiction. The Goose Creek SSWQMP (NCDENR, 2009)¹ was found to provide significant watershed protection through stormwater treatment and riparian buffer requirements. A number of jurisdictions have in place tree protection ordinances that outline requirements to protect existing trees and require new tree plantings to prevent erosion, protect water quality, and provide shading and scenic beauty. Both watersheds are experiencing growth, and large amounts of development are expected, particularly planned subdivisions in the headwaters over the near term. It is uncertain whether protection measures will be sufficient to protect the watershed from additional functional losses from future development. Although a number of protection needs exist, the review highlighted two major gaps: (1) the lack of protection in Crooked Creek compared to Goose Creek, and (2) the need for local sediment and erosion control ordinances and enforcement.

A more detailed review in association with the future scenario watershed modeling (Tetra Tech, 2012d) revealed that several recently adopted regulations are providing improved protection in Crooked Creek. Indian Trail and Stallings adopted the Goose Creek SSWQMP water quality volume and treatment requirements within their entire jurisdictional boundaries for development greater than 24 percent impervious area. In addition, there is a requirement to match pre-developed peak flows for the 2-, 10-, 25-, 50-, and 100-year storm events, invoked at 24 percent impervious area in the Crooked Creek watershed and 10 percent impervious area in the Goose Creek watershed. Monroe (in the Crooked Creek watershed) requires peak matching to pre-developed conditions for nonresidential development creating a new impervious footprint exceeding 20,000 square feet, applied to the 2- and 10-year storm events.

While these recent regulations in Indian Trail, Stallings, and Monroe help improve future protection in the Crooked Creek watershed, aquatic habitat in and downstream of municipalities that have less stringent requirements could be at risk for further degradation in the future. Buffer regulations in Crooked Creek remain much less stringent compared to the Goose Creek watershed, which provides an additional opportunity for improved protection. Impacts from lower density development could also be a consideration throughout Crooked Creek watershed as the recent regulations focus on either development greater than 24 percent imperviousness or nonresidential development. The future with BMPs scenario results are tied to projected growth assumptions, which indicate higher growth in the western/downstream portions of the watersheds and little high-density growth in the eastern/downstream portions of the

¹ http://portal.ncdenr.org/c/document_library/get_file?folderId=285750&name=DLFE-8516.pdf

watersheds. If higher density development occurs in the eastern portions of the Crooked Creek watershed where stormwater requirements do not address volume control for larger events, the projected channel impacts could be significant.

Under the projected growth assumptions, the future with BMPs model scenario indicates an overall trend—BMPs treating higher density new development mitigate the increase in loading rates in most cases, and lower density development with little or no stormwater treatment replaces agricultural land with equivalent elevated loading rates, resulting in no increase in most subwatersheds. The future watershed modeling demonstrated that low-density development replacing agriculture is less of a concern than replacing forested or other natural areas because of relatively high pollutant loading from agricultural land use (Tetra Tech, 2012d). Therefore, stormwater control and treatment is most important for low-density development replacing forested or other natural, undisturbed areas, but should not be ignored in other cases.

A major gap in both watersheds is the need for enhanced sediment and erosion controls and more thorough enforcement. The portions of the Goose Creek and Crooked Creek watersheds in Union County are under the state sedimentation and erosion regulations and, therefore, enforcement is limited compared to jurisdictions that operate their own enforcement locally. Additional controls and enforcement beyond the state requirements would provide significant opportunities for increasing protection in both watersheds.

Centralina COG also evaluated institutional and regulatory measures in watershed jurisdictions that would affect water quality and watershed functions in the future. In addition to stormwater management ordinances addressed above, Centralina COG reviewed land use planning in the watersheds. All jurisdictions in the watersheds have land use plans except for Fairview, Hemby Bridge, Lake Park, and Unionville. The land use plans in place in the watershed generally provide considerations for reducing impacts from stormwater runoff, conserving natural open space, and protecting natural resources. Several land use plans establish the use of cluster or conservation development land use categories that can encourage the preservation of natural open space. These considerations provide watershed protection in addition to the quantitative stormwater regulations discussed above. Appendix D provides more details on each jurisdiction's land use plan. Jurisdictions without these uses established should add cluster or conservation development considerations in their land use plans or development ordinances. The jurisdictions without land use plans should develop such plans as a foundation for sound watershed protection strategies.

Better Site Design Opportunities

Another tool used in watershed protection and restoration is better site design. Local codes and ordinances can be used to incorporate BMPs into new and redevelopment sites to minimize a project's environmental footprint, reduce impervious cover or redirect runoff. These techniques are also sometimes referred to as low impact development (LID), which is an innovative stormwater management approach that is modeled after natural hydrologic and biological processes. Its goal is to manage rainfall and runoff at the source using distributed decentralized practices. Many site design methods can be easily incorporated into local codes and ordinances, including:

- Minimizing disturbance to conserve forested or natural areas
- Designing and using smaller parking lots and parking stalls, and shared parking requirements
- Managing and treating stormwater through the use of conditioned planted soil beds and planting materials (e.g., bioretention cells and wetlands)
- Designing narrower streets integrated with open drainage
- Using conservation design with clustered buildings and preserved open space

- Disconnecting impervious surfaces and associated runoff from stormwater sewer systems
- Preserving riparian buffers
- Using swales instead of curb and gutter where appropriate
- Rain barrels or cisterns

To gather information on the degree that best practices are being implemented in the watersheds, Centralina COG asked each jurisdiction to complete the Center for Watershed Protection Code and Ordinance Worksheet (CWP, 1998), which is an in-depth review of local codes and ordinances that shape how development occurs.

The eight jurisdictions that responded

- Require a minimum percentage of parking lots to be landscaped
- Allow cluster type of developments
- Have a stream buffer ordinance
- Prohibit development in the 100-year floodplain

Conditions that varied by jurisdiction were

- All but Union County require a minimum right of way of 45 feet or less (some jurisdictions have a 45-foot minimum right of way requirement; others require less than 45 feet as a minimum).
- Only Union County and Monroe do not require curb and gutter in all residential streets.
- Only Matthews does not allow for shared parking.
- Only Union County does not require at least part of the stream buffer to be maintained with native vegetation.
- Only Mint Hill does not require significant tree strands to be preserved during new construction.
- Only Mecklenburg, Unionville, and Fairview offer incentives to conserve land.

The Centralina COG review indicated that opportunities for enhancing buffer regulations exist throughout the watershed jurisdictions. Recommendations included increasing required undisturbed buffer widths to a minimum of 75 feet on each side of a stream and including additional protection for freshwater wetland, steep slopes, and the 100-year floodplain.

Additional Recommendations

Recommendations for protection needs have been provided by WRC (2005), various members of the LWP WTT, and the public at-large. These have been compiled and summarized below.

Much discussion has already taken place among state and local authorities on protection in Goose Creek. The current rules that address post-construction stormwater, riparian buffer disturbance, ammonia toxicity, and new point sources in the watershed are expected to provide a significant level of protection. However, wildlife experts have noted additional protection measures that may be needed to maintain a viable Carolina heelsplitter population in the watershed. WRC (2005) recommends the following management strategies to protect Carolina heelsplitter habitat:

- Establish site-specific water quality standards for copper, nitrate-nitrite, and phosphorus
- Revise point source permit limits to reflect lack of dilution during low-flow periods
- Convert wastewater facilities to land application, or tie the facilities into a larger regional facility
- Require maintenance of pre-development hydrology (peak flow and volume) for new developments exceeding 6 percent imperviousness
- Encourage the use of LID techniques

- Develop emergency management procedures to prevent contamination from wildfires and hazardous spills
- Strengthen sediment and erosion control requirements
- Expand monitoring to assess the effectiveness of restoration efforts and to investigate pesticide concentrations
- Prohibit water withdrawals from Goose Creek during the summer

Tetra Tech also gathered stakeholder input on protection needs through public and WTT meetings and phone interviews. The following protection needs were noted:

- Implement measures for existing sources of toxicity and existing wastewater dischargers
- Enact regulations specific to fertilizer use (addressed indirectly in ammonia rule in the Goose Creek SSWQMP)
- Expand enforcement of existing and future state regulations regarding toxicity and encourage local governments to help with enforcement
- Require undisturbed buffers throughout the watershed
- Require or encourage development to maximize infiltration on-site

These protection needs exist, for the most part, throughout the entire watershed, especially because sensitive mussel habitat exists in the lower reaches of Goose Creek and Crooked Creek and is affected by activities in both the lower and upper reaches of the watershed.

Summary of Watershed Protection Recommendations

The recommendations above are summarized below in a list by state government, local government, developers, and private citizens. They were compiled from a number of sources as indicated above. Unless otherwise noted, the recommendations apply to both watersheds (Goose Creek and Crooked Creek) and all jurisdictions in the watersheds.

State Government

- Expand enforcement of existing and future state regulations regarding toxicity
- Revise point source permit limits to reflect lack of dilution during low-flow periods
- Require wider undisturbed riparian buffer widths in the Crooked Creek watershed
- Prohibit or manage water withdrawals from Goose Creek during the summer
- Expand monitoring to assess the effectiveness of restoration efforts
- Expand monitoring to investigate pesticide concentrations
- Establish site-specific water quality standards for copper, nitrogen, and phosphorus

Local Government

- Increase required buffer widths in the Crooked Creek watershed. More specifically, increase required undisturbed buffer widths to a minimum of 75 feet on each side of a stream and include additional protection for riparian wetlands, steep slopes, or the 100-year floodplain.
- Provide incentives for LID and similar strategies (both watersheds would benefit, but greater needs exist in the Crooked Creek watershed).
- Strengthen sediment and erosion control requirements and enforcement of these requirements (with more focus on improvements in Union County jurisdictions).
- Develop emergency management procedures to prevent contamination from wildfires and hazardous spills.

- Require maintenance of pre-development hydrology (peak flow and volume) for new developments in the Crooked Creek watershed.
- Evaluate converting existing wastewater facilities to land application or reuse, or connecting these facilities to a larger regional facility.
- Incorporate Better Site Design techniques into ordinances and manuals (see list above in better site design discussion).
- Provide options and incentives for cluster or conservation design development in land use plans and ordinances.
- Require significant tree stands to be preserved during development (focus on Mint Hill).

Developers

- Apply LID and better site design techniques, with a focus on maximizing infiltration on development sites
- Design landscaping to minimize the need for fertilizer application and irrigation
- Comply with sediment and erosion control requirements
- Avoid selecting development sites with large areas of natural, undisturbed vegetation
- When designing development layouts, preserve natural, undisturbed areas as open space

Private Citizens

- Minimize fertilizer use through obtaining soil tests and using landscaping that requires minimal nutrient inputs
- Properly dispose of hazardous substances
- Construct rain gardens to treat roof runoff
- Use rainwater for irrigation by collection with rain barrels and cisterns

4.2 SUMMARY OF PROJECT ATLAS

The Project Atlas, available as a companion document, provides details on each recommended management opportunity to aid in the implementation of this WMP by NCEEP and its partners. The atlas contains an upfront map index showing the page numbers where detailed maps are for groups of subwatersheds. For each group of subwatersheds, a detailed map identifies the locations of the stream, wetland, and BMP management opportunities. Project fact sheets and a project-scale map are provided. The project fact sheet provides a summary of information for the opportunity, including the primary project types and alternative or adjacent opportunities, a project description, primary project recommendation characteristics, parcel information (i.e., PIN), and estimated benefits. The project-scale maps show the extent of the opportunity, outline of parcels, nearby roads, aerial imagery, and other features.

4.3 PROJECT PRIORITIZATION

The identification and prioritization exercises summarized in Section 4.1 were conducted for individual types of management opportunities. The results of these exercises provide useful tools to target the implementation of each type of management opportunity but lack a means for targeting management across all types of opportunities. The project prioritization was developed to bring the individual project ranking and scores for stream management, wetland mitigation, and stormwater BMPs into a comprehensive prioritization that adds consideration of watershed needs and the relationship to other supporting projects. Watershed management needs are incorporated using results from the stressor-based

subwatershed prioritization to provide a clear link between site-scale benefits and watershed-scale needs. The methods and results of this prioritization are described below.

4.3.1 Project Prioritization Methods

The project composite score consisted of six criteria across three main categories.

Individual Project Benefits/Feasibility/Ranking

Criterion 1 is based on the individual project scores and rankings developed for each of the project types and discussed in Section 4.1. Note that for wetland and BMP projects, the individual ranking and scores incorporated subwatershed needs (BMPs) and considered supporting practices (wetlands) to some degree. Therefore, scores for these projects were adjusted slightly to remove these previous weights to prevent double-counting and overlap that would occur as a result of the additional criteria below.

Subwatershed Needs

Criterion 2 is based on the subwatershed score from the stressor-based subwatershed prioritization. The score is converted for use here by subtracting it from 10 because a lower score in the subwatershed prioritization indicates a higher priority for management. Subwatershed scores were based on five indicators as described in Section 3.5. The subwatersheds that were not initially classified as Tier I Priority according to these scores but were classified as priority according to subsequent consideration of supplemental qualitative information were given the median score of the Tier I Priority class (i.e., 4.9) for the purposes of this project prioritization.

Criterion 3. If a proposed project is either in or directly upstream of a subwatershed that has an in-stream score of less than or equal to 10 (determined by summing the *Hydrology* and *Bed and Bank Sediment* indicators from stressor-based subwatershed prioritization), the project is given a score of 2. Otherwise, it is scored as zero. Stream projects are included in this criterion because a stream that has failing banks or downcutting (or head cuts) that can be restored might also improve in-stream conditions in the direct or downstream subwatershed.

Relationship to Other Projects

Criterion 4 applies to all project types. A project receives a score of 1 if it is hydrologically connected and upstream of another project (within a Euclidean distance of 2,500 feet) that could benefit from that project being implemented.

Criterion 5 is the number of projects upstream of the project being scored. The scope is limited to the projects in the same subwatershed as the project being scored unless the proposed project is near the upper portion of the subwatershed's mainstem. In this case, the projects in the directly upstream subwatershed(s) will be included. The points for this criterion are based directly on the number of projects.

Notes for Criterion 4 and 5: Note that all projects have the potential to have a positive effect on a downstream stream reach (or associated project). However, it is assumed that a stream restoration or enhancement project will not have an effect on an upstream BMP or wetland.

Criterion 6 applies to all project types and addresses those projects that are coincident in location and where it would be efficient to consider all proposed projects in a combined design and construction effort.

Scores from all six criteria were then summed to give a final composite score for each project.

4.3.2 Project Prioritization Results

Figure 25 presents the location and composite score for stream, wetland, and BMP projects. Table 11, Table 12, and Table 13 report the individual criterion scores.

For stream reaches, composite scores ranged from 1.5 to 24.7. Of the 38 stream opportunities, 15 were in either Tier I or Tier II priority subwatersheds. Of the 10 highest scoring sites, 3 are recommended for full-scale stream restoration. The remaining high scoring sites include five Enhancement Level 2 and two Enhancement Level 1 projects. Stream buffer restoration and preservation/protection projects (14 of the 38 reaches) were scored separately.

The composite scores for the stormwater BMPs ranged from 5.9 to 18.5. Of the 15 opportunities, 10 are in either Tier I or Tier II subwatersheds.

The wetland mitigation composite scores ranged from 7.9 to 29. Riparian opportunities ranked higher than non-riparian overall, which is expected since scoring methods incorporated proximity of other projects, including hydrologic connectivity. Of the 29 total opportunities, 12 were in high-priority (i.e., Tier 1 or Tier II) subwatersheds.

Overall, the project prioritization provides a planning tool for implementation. NCEEP and its partners could consider the higher scoring stream projects as first priorities for implementation, and then look for wetland mitigation opportunities that support those stream projects and would provide cumulative benefits. Where high scoring stormwater BMP projects are upstream of stream management opportunities, NCEEP could look for partners who can implement the stormwater BMP projects so that additional flow protection is in place before beginning stream restoration activities. The top scoring projects across all management types help pinpoint those opportunities that would provide the greatest benefits when implemented in conjunction with other projects to address the greatest watershed needs.

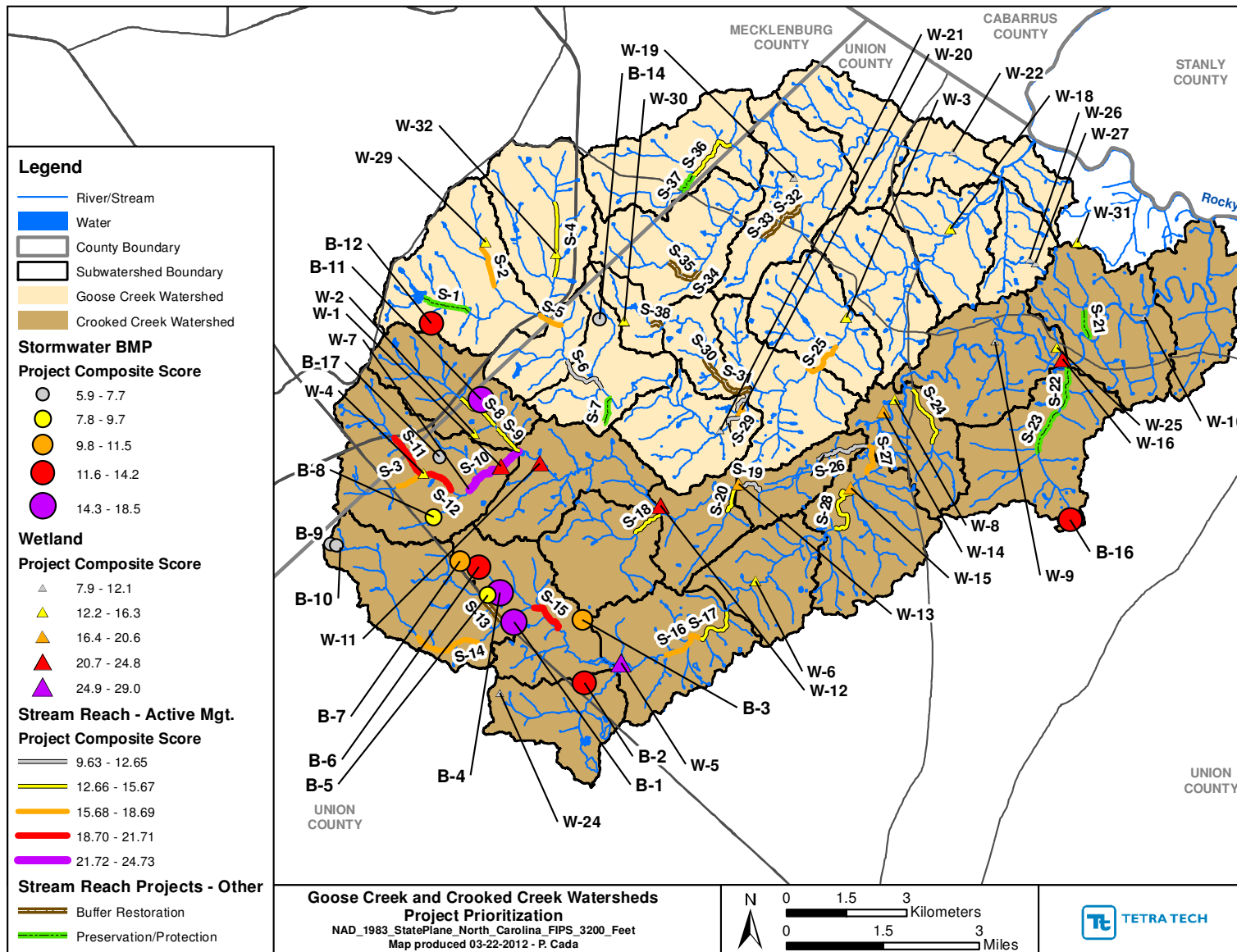


Figure 25. Goose Creek and Crooked Creek Watersheds Project Prioritization Results

Table 11. Scoring for Stream Project Types (Ranked by Final Composite Score)

Project Number	SWS ^a ID	Individual Project Score (0–10)	SWS Composite Score (0–10)	Supports SWS Channel Priority	Supports Proximal Downstream Project	Number of Upstream Supporting Practices	Number of Projects Coincident in Location	Final Composite Score
Stream Restoration/Enhancement/Stabilization Recommendations								
S-10	NF5	7.73	4	2	1	8	2	24.73
S-12	NF5	9.38	4	2	1	4	0	20.38
S-15	SF5	7.30	5.5	2	0	5	0	19.80
S-11	NF5	7.93	4	2	1	2	2	18.92
S-14	SF6	9.38	5.25	2	0	2	0	18.63
S-3	NF5	8.55	4	2	1	0	2	17.55
S-27	SF1	7.50	4.75	2	0	2	0	16.25
S-16	SF3	7.30	4.5	2	1	1	0	15.80
S-5	GC9	7.30	4.5	0	0	4	0	15.80
S-25	GC5	6.68	5.1	2	1	1	0	15.78
S-2	GC10	9.18	3.5	2	0	1	0	15.68
S-28	SF1	6.88	4.75	2	1	0	1	15.63
S-17	SF3	5.85	4.5	2	1	2	0	15.35
S-9	NF6	5.00	3.75	2	1	3	0	14.75
S-8	NF6	6.68	3.75	2	1	1	0	14.43
S-36	DC5	7.30	4	2	0	1	0	14.30
S-20	NF2	7.08	3.5	2	1	0	0	13.58
S-4	GC11	8.13	3	0	1	0	1	13.13
S-18	NF3	7.93	3	2	0	0	0	12.93
S-24	CC5	7.93	5	0	0	0	0	12.93
S-19	NF1	3.53	3.25	0	0	3	1	10.78
S-6	GC8	7.08	1.5	0	0	2	0	10.58
S-29	GC7	5.85	1.25	0	0	2	1	10.10

Project Number	SWS ^a ID	Individual Project Score (0–10)	SWS Composite Score (0–10)	Supports SWS Channel Priority	Supports Proximal Downstream Project	Number of Upstream Supporting Practices	Number of Projects Coincident in Location	Final Composite Score
S-26	NF1	4.38	3.25	0	0	2	0	9.63
Stream Buffer Restoration Recommendations								
S-38	GC13	N/A	4.5	2	0	1	0	7.50
S-13	SF6	N/A	5.25	2	0	0	0	7.25
S-32	DC3	N/A	3.25	0	0	1	0	4.25
S-33	DC3	N/A	3.25	0	1	0	0	4.25
S-34	DC4	N/A	1.5	0	0	1	0	2.50
S-35	DC4	N/A	1.5	0	1	0	0	2.50
S-30	GC12	N/A	1.25	0	1	0	0	2.25
S-31	GC12	N/A	1.25	0	0	1	0	2.25
S-38	GC13	N/A	4.5	2	0	1	0	7.50
S-13	SF6	N/A	5.25	2	0	0	0	7.25
Stream Preservation/Protection Recommendations								
S-22	CC3	N/A	5.1	0	1	2	0	8.10
S-23	CC3	N/A	5.1	0	1	1	0	7.10
S-37 ^b	DC5	N/A	4	2	1	0	0	7.00
S-1 ^b	GC10	N/A	3.5	2	0	1	0	6.50
S-21 ^b	CC2	N/A	3	0	0	0	0	3.00
S-7 ^b	GC8	N/A	1.5	0	0	0	0	1.50

^a SWS = Subwatershed

^b Note: These four stream reaches were also incorporated in the preservation work detailed in Section 4.1.3.2.

Table 12. Scoring for Wetland Project Types (Ranked by Final Composite Score)

Project Number	SWS ^a ID	Individual Project Score (0–10)	SWS Composite Score (0–10)	Supports SWS Channel Priority	Supports Proximal Downstream Project	Number of Upstream Supporting Practices	Number of Projects Coincident in Location	Final Composite Score
W-5	SF3	7.0	10	2	1	9	0	29.0
W-11	NF4	5.3	4	2	0	12	0	23.3
W-16	CC4	7.3	10	0	0	5	0	22.3
W-1	NF5	7.4	4	0	1	8	1	21.4
W-12	NF2	7.0	10	2	0	2	0	21.0
W-13	NF1	4.8	10	0	1	2	1	18.8
W-20	GC6	6.3	10	0	0	1	1	18.3
W-15	SF1	7.7	4.75	2	1	1	1	17.4
W-14	CC5	8.4	5	0	1	2	0	16.4
W-31	CC2	5.8	10	0	0	0	0	15.8
W-8	CC5	7.6	5	0	0	3	0	15.6
W-6	SF2	7.2	4.75	2	0	1	0	15.0
W-4	NF5	6.9	4	0	1	2	1	14.9
W-2	NF6	7.3	3.75	2	1	0	0	14.1
W-30	GC13	6.3	4.5	2	1	0	0	13.8
W-3	GC5	9.0	3.5	0	0	1	0	13.5
W-32	GC11	7.3	3	0	1	1	1	13.3
W-29	GC10	6.5	3.5	2	1	0	0	13.0
W-25	CC4	7.8	4	0	1	0	0	12.8
W-18	GC3	8.0	4.25	0	0	0	0	12.3
W-9	CC4	7.8	4	0	0	0	0	11.8
W-22	DC1	7.2	3.75	0	0	0	0	10.9
W-10	CC2	5.8	3	0	0	2	0	10.8
W-19	DC3	7.4	3.25	0	0	0	0	10.6

Project Number	SWS ^a ID	Individual Project Score (0–10)	SWS Composite Score (0–10)	Supports SWS Channel Priority	Supports Proximal Downstream Project	Number of Upstream Supporting Practices	Number of Projects Coincident in Location	Final Composite Score
W-24	SF4	5.9	4.5	0	0	0	0	10.4
W-21	GC7	6.9	1.25	0	1	0	0	9.1
W-26	GC2	5.1	2.75	0	0	1	0	8.8
W-27	GC2	4.1	2.75	0	1	0	0	7.9

^a SWS = Subwatershed**Table 13. Scoring for BMP Project Types (Ranked by Final Composite Score)**

Project Number	SWS ^a ID	Individual Project Score (0–10)	SWS Composite Score (0–10)	Supports SWS Channel Priority	Supports Proximal Downstream Project	Number of Upstream Supporting Practices	Number of Projects Coincident in Location	Final Composite Score
B-1	SF5	10.00	5.5	2	1	0	0	18.50
B-4	SF5	8.67	5.5	2	0	0	0	16.17
B-11	NF6	7.34	3.75	2	1	0	0	14.09
B-6	SF5	8.00	5.5	2	0	0	0	15.50
B-16	CC3	9.34	4.5	0	0	0	0	13.84
B-2	SF4	5.34	4.5	0	1	0	0	10.84
B-12	GC10	4.00	3.5	2	1	0	0	10.50
B-3	SF5	6.67	5.5	2	0	0	0	14.17
B-7	SF5	6.00	5.5	2	0	0	0	13.50
B-8	NF5	2.67	4	0	1	0	0	7.67
B-5	SF5	4.67	5.5	2	0	0	0	12.17
B-17	NF5	0.67	4	0	1	0	0	5.67
B-14	GC8	2.00	1.5	0	0	0	0	3.50
B-9	SF6	3.34	5.25	0	0	0	0	8.59

^a SWS = Subwatershed

5 Watershed Management Plan Implementation

The effective implementation of the Goose Creek and Crooked Creek watersheds WMP requires a coordinated effort among NCEEP and its partners. A number of promising management opportunities exist, as discussed in Section 4. NCEEP implements stream and wetland mitigation that involves stream and wetland restoration, enhancement, and preservation. Successful implementation of BMP retrofits, agricultural BMPs, point source management, and watershed protection measures will largely rely on partnerships among watershed stakeholders.

Three major actions will serve to provide a successful foundation for implementation:

- **NCEEP Project Implementation:** NCEEP will direct project implementation efforts to the stream and wetlands restoration/enhancement and preservation projects identified in the Project Atlas, giving attention to those projects that received high-priority scores. This process is referred to as Phase IV and will begin immediately. More details about NCEEP's Phase IV implementation process is provided in Appendix E.
- **Adoption or Endorsement of the Watershed Management Plan:** Local jurisdictions that have participated in the stakeholder involvement process will be asked to endorse or adopt the WMP. The plan could be adopted through a number of mechanisms, including as a reference to the WMP and its goals and recommendations in unified development ordinances or land use plans. Because the WMP represents an intensive stakeholder involvement effort and scientifically based decision-making process, the management recommendations are expected to be complementary to the jurisdictions' goals. A number of benefits can be realized by communities through activities that enhance, restore, and protect watershed functions enjoyed by residents and visitors throughout the watersheds.
- **Coordinated Management Strategy:** Because implementation could occur through multiple jurisdictions, agencies, and organizations, it will be important to develop a coordinated effort so that resources can be shared and timing of activities provides the greatest possible success for watershed functions. Establishing a local watershed council can provide this coordination and continue the momentum of the LWP effort. The hiring of a Local Watershed Coordinator has been achieved with Section 319 funding in other high-priority watersheds in North Carolina. [Note: NCDWQ's Section 319 Program prioritizes grant proposals that build on existing Local Watershed Planning efforts.] While these positions are time limited, the funding can be renewed through additional grant proposals, especially if local watershed success stories can be reported within two or three years.

The above actions provide a foundation for implementing the WMP and are expected to provide a starting point for determining additional actions that might be required. Each of these actions is considered essential to achieving the goals and objectives of the WMP and toward implementing the recommended management opportunities.

Furthermore, watershed management is a dynamic process and plan development should be an ongoing commitment. As conditions change in the future, the management framework recommended herein will need to be revisited. By monitoring progress against the established goals and objectives, the plan can be adapted as necessary to enhance performance and support communities to be economically prosperous, represent a high-quality of life, and to support an environment in balance.

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6 Technical Resources and Funding Sources

A number of technical resources and funding sources exist that can support the implementation of the Goose Creek and Crooked Creek WMP. Appendix F provides a comprehensive list of agencies and organizations and their websites that can provide funding, partnering, or technical support and information. It will be important to include Centralina COG and the local governments in implementation efforts to draw on local knowledge, coordinate with development actions and other relevant activities, and leverage available funding resources. A number of university resources exist, including research and publications on stormwater management, LID, and similar techniques through North Carolina State (see affiliated organization and departments in Appendix F). Of particular note, the North Carolina LID Guidebook, published by North Carolina State Cooperative Extension (Perrin et al., 2009), provides detailed guidance on applying LID in North Carolina. Several state agencies have participated in past research and management efforts in the watersheds and should continue to be included in implementation efforts. In addition to NCEEP, these agencies include, for example, NCDWQ, WRC, and NHP.

Appendix F provides a list of funding sources, which include funding through EEP mitigation, section 319 grants, Clean Water Management Trust Fund, and a number of other watershed and water resource related funding opportunities. Wildlife-related funding sources (e.g., USFWS Partners for Wildlife) are also included and could provide important opportunities for protecting and restoring sensitive mussel habitat. A separate list of agricultural funding sources is provided to support implementation of agricultural BMPs in the more rural parts of the watershed.

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References

- Bledsoe, B.P., and C.C. Watson. 2001. Effects of urbanization on channel instability. *Journal of the American Water Resources Association* 37(2):255–270.
- CWP (Center for Watershed Protection). 1998. *Better Site Design: A Handbook for Changing Development Rules in Your Community*. Center for Watershed Protection, Ellicott City, MD.
- Centralina Council of Governments. 2009. *Goose Creek & Crooked Creeks Local Watershed Plan Phase I Summary Report*. Prepared for North Carolina Ecosystem Enhancement Program, by Jason Wager, Centralina Council of Governments.
- Daniel, C.C. III, and P.R. Dahlen. 2002. *Preliminary hydrogeologic assessment and study plan for a regional ground-water resource investigation of the Blue Ridge and Piedmont Provinces of North Carolina*. U.S. Geological Survey Water-Resources Investigations 02-4105.
- Doll, B.A., D.E. Wise-Frederick, C.M. Buckner, S.D. Wilkerson, W.A. Harman, R.E. Smith, and J. Spooner. 2002. Hydraulic Geometry Relationships for Urban Streams throughout the Piedmont of North Carolina. *Journal of the American Water Resources Association* 38:641–651.
- EMC (Environmental Management Commission). 2007. *Final Agency Decision: North Carolina Wildlife Federation, Central Piedmont Group of the North Carolina Sierra Club v. North Carolina Department of Environment and Natural Resources, Division of Water Quality*. North Carolina Environmental Management Commission. 05 HER 2055 and 06 HER 0164. March, 2007.
- Federal Register. 2002. Designation of Critical Habitat for the Carolina Heelsplitter. Final Rule. July 2, 2002. Federal Register, 67:44501-44522.
- Giese, G.L., and R.R. Mason Jr. 1993. *Low-flow characteristics of streams in North Carolina*. U.S. Geological Survey Water-Supply Paper 2403. U.S. Geological Survey, Raleigh, NC.
- HydroQual, Inc. 2007. *The Biotic Ligand Model Windows Interface, Version 2.2.3: User's Guide and Reference Manual*. HydroQual, Inc., Mahwah, NJ.
- Johnson, J. 2001. Atlantic Slope Mussels and Fish. Pages 2–26 In *Annual Performance Report –Nongame and Endangered Wildlife Program, July 1999–June 2000*. Volume IX. North Carolina Wildlife Resources Commission, Division of Wildlife Management, Raleigh, NC.
- Keferl, E.P. 1991. *A Status Survey for the Carolina Heelsplitter (Lasmigona decorata), a Freshwater Mussel Endemic to the Carolinas*. Unpublished report. U.S. Department of the Interior, Fish and Wildlife Service, City, ST.
- MacRae, C.R. 1992. The Role of Moderate Flow Events and Bank Structure in the Determination of Channel Response to Urbanization. Resolving conflicts and uncertainty in water management. In *Proceedings of the 45th Annual Conference of the Canadian Water Resources Association*. Shrubsole, D., ed. 1992, pp. 12.1-12.21.
- MacRae, C.R. 1993. An Alternate Design Approach for the Control of Instream Erosion Potential in Urbanizing Watersheds. In *Proceedings of the Sixth International Conference on Urban Storm Drainage*, September 12–17, 1993. Torno, H.C., vol. 2, pp. 1086–1098.
- NCDENR (North Carolina Department of Environment and Natural Resources). 2007. “Redbook” 280 *Classifications and Water Quality Standards Applicable to Surface Waters and Wetlands of North Carolina* (15A NCAC 2B .0100 and .0200). North Carolina Department of Environment and Natural Resources, Division of Water Quality, Raleigh, NC.

- NCDENR (North Carolina Department of Environment and Natural Resources). 2009. *Site-Specific Water Quality Management Plan for the Goose Creek Watershed*.
http://portal.ncdenr.org/c/document_library/get_file?folderId=285750&name=DLFE-8516.pdf.
- NCDOT (North Carolina Department of Transportation). 2011. *Summary of May 2010 Fish Collections in the Goose and Crooked Creek Watersheds, Union County*. North Carolina Department of Transportation, Biological Surveys Group Natural Environment Unit/PDEA. September.
- NCDWQ (North Carolina Department of Water Quality). 2007. *Stormwater Best Management Practices Manual*. North Carolina Division of Water Quality.
- NCDWQ (North Carolina Department of Water Quality). 2009. *Ecosystem Enhancement Program (EEP) Baseline Macroinvertebrate Monitoring in the Goose and Crooked Creek Drainages (Yadkin Subbasin 12), Union County, July 2009*. North Carolina Division of Water Quality, Biological Assessment Unit.
- NCDWQ (North Carolina Department of Water Quality). 2010. *North Carolina 2010 Integrated Report Categories 4 and 5 Impaired Waters*. North Carolina Department of Environment and Natural Resources, Division of Water Quality. Accessed March 2012.
http://portal.ncdenr.org/c/document_library/get_file?uuid=8ff0bb29-62c2-4b33-810c-2eee5afa75e9&groupId=38364
- NCDWQ (North Carolina Department of Water Quality). 2011. *Water Quality Integrated Analysis Report for the Goose and Crooked Creek Local Watershed Plan*. North Carolina Division of Water Quality, Watershed Assessment Team.
- NCDWQ (North Carolina Department of Water Quality). 2012. *2012 Draft North Carolina Impaired Waters Category 4 and 5- by County*. North Carolina Department of Environment and Natural Resources, Division of Water Quality. Accessed March 2012.
http://portal.ncdenr.org/c/document_library/get_file?uuid=df57f2f4-7d1f-4444-8090-d4891062aa9e&groupId=38364
- NCEEP (North Carolina Ecosystem Enhancement Program). 2012a. *Goose and Crooked Creeks Local Watershed Plan: Watershed Assessment Report – Phase II. Draft*. February 2012.
- NCEEP (North Carolina Ecosystem Enhancement Program). 2012b. *Goose and Crooked Creeks BMP Assessment*. Final.
- Perrin, C., L. Milburn, L. Szpir, W. Hunt, S. Bruce, R. McLendon, S. Job, D. Line, D. Lindbo, S. Smutko, H. Fisher, R. Tucker, J. Calabria, K. Debusk, C. Cone, G.M. Smith, T. Blue, J. Spooner, N. Deal, J. Lynn, D. Rashash, R. Rubin, N. White, D. Jones, M. Senior, and W. Eaker. 2009. *Low Impact Development: A Guidebook for North Carolina* (AG-716). Cooperative Extension, North Carolina State University, Raleigh. <http://www.ncsu.edu/WECO/LID/>.
- Rosgen, D.L. 2001a. *A Practical Method of Computing Streambank Erosion Rate*. Wildland Hydrology, Pagosa Springs, CO.
- Rosgen, D.L. 2001b. *A Stream Channel Stability Assessment Methodology*. Wildland Hydrology, Pagosa Springs, CO.
- Schumm, S.A., M.D. Harvey, and C.C. Watson. 1984. *Incised Channels: Morphology Dynamics and Control*. Water Resources Publishing, Littleton, CO.
- Simon, A. 1989. A model of channel response in disturbed alluvial channels. *Earth Surface Processes and Landforms* 14:11–26.

- Tetra Tech. 2008. *Technical Memorandum – Goose Creek and Crooked Creek LWP Phase I Preliminary Findings*. Prepared for North Carolina Department of Environment and Natural Resources, North Carolina Ecosystem Enhancement Program, by Tetra Tech. Inc.
- Tetra Tech. 2010. *Technical Memorandum – Goose Creek and Crooked Creek LWP Phase II-III Stream Restoration Planning*. Prepared for North Carolina Department of Environment and Natural Resources, North Carolina Ecosystem Enhancement Program. December. Prepared by Tetra Tech.
- Tetra Tech. 2012a. *Technical Memorandum – Revised Goose Creek and Crooked Creek LWP Model Scenario Summary*. Prepared for North Carolina Department of Environment and Natural Resources, North Carolina Ecosystem Enhancement Program, by Tetra Tech, Inc.
- Tetra Tech. 2012b. *Technical Memorandum – Goose Creek and Crooked Creek LWP Phase II-III Stressor-Based Subwatershed Prioritization*. Revised January 20, 2012. Prepared for North Carolina Department of Environment and Natural Resources, North Carolina Ecosystem Enhancement Program, by Tetra Tech, Inc.
- Tetra Tech. 2012c. *Goose Creek and Crooked Creek Watersheds: Model Development and Calibration (Revised)*. Prepared for Centralina Council of Governments and North Carolina Division of Water Quality, by Tetra Tech, Inc.
- Tetra Tech. 2012d. *Goose Creek and Crooked Creek Watersheds: Model Scenarios*. Prepared for Centralina Council of Governments and North Carolina Division of Water Quality, by Tetra Tech, Inc.
- Tetra Tech. 2012e. *Technical Memorandum – Goose Creek and Crooked Creek LWP Phase II-III Wetland Mitigation Planning*. Revised February 16, 2012. Prepared for North Carolina Department of Environment and Natural Resources, North Carolina Ecosystem Enhancement Program, by Tetra Tech, Inc.
- Tetra Tech and USEPA (U.S. Environmental Protection Agency). 2009. *Loading Simulation Program in C++ (LSPC) Version 3.1 User's Manual*. Tetra Tech, Inc., Fairfax, VA and U.S. Environmental Protection Agency, Washington, DC.
- USFWS (U.S. Fish and Wildlife Service). 2012. *Evaluation of Copper Concentrations in Goose Creek with regard to Conservation of Freshwater Mussels*. Revised. U.S. Fish and Wildlife Service.
- WRC (North Carolina Wildlife Resources Commission). 2005. *Technical Support Document for Consideration of Federally listed Threatened or Endangered Aquatic Species in Water Quality Management Planning for the Goose Creek Watershed: July 2005 Review Draft*. North Carolina Wildlife Resources Commission.

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Appendix A Watershed Technical Team (WTT) Participants

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Appendix B Subwatershed Loading Maps

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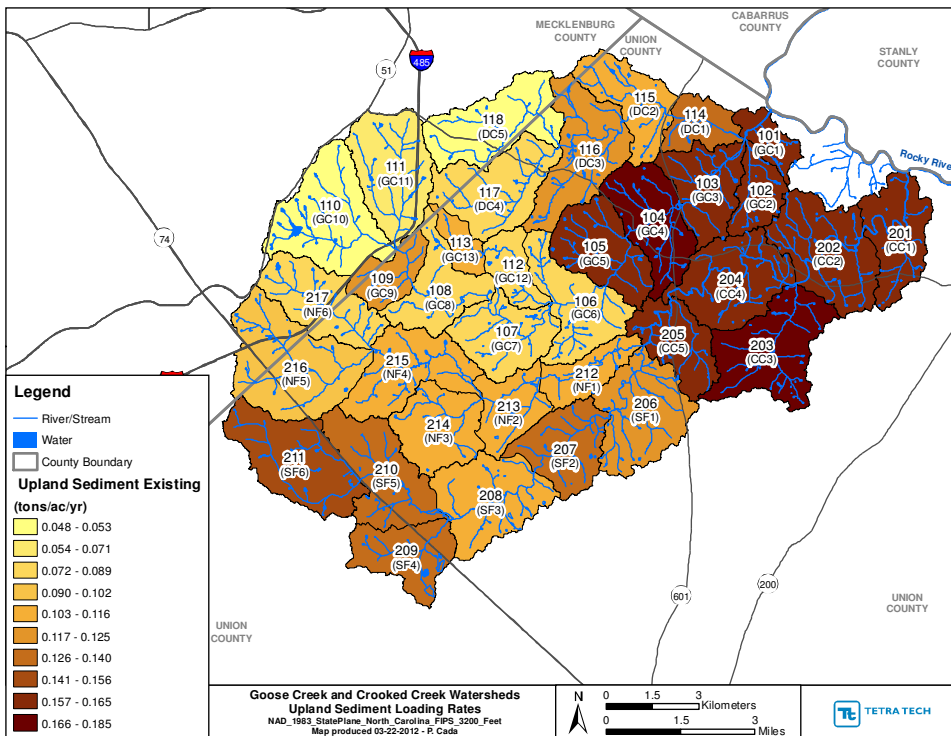


Figure B-1 Existing Baseline Upland Sediment Loading Rates

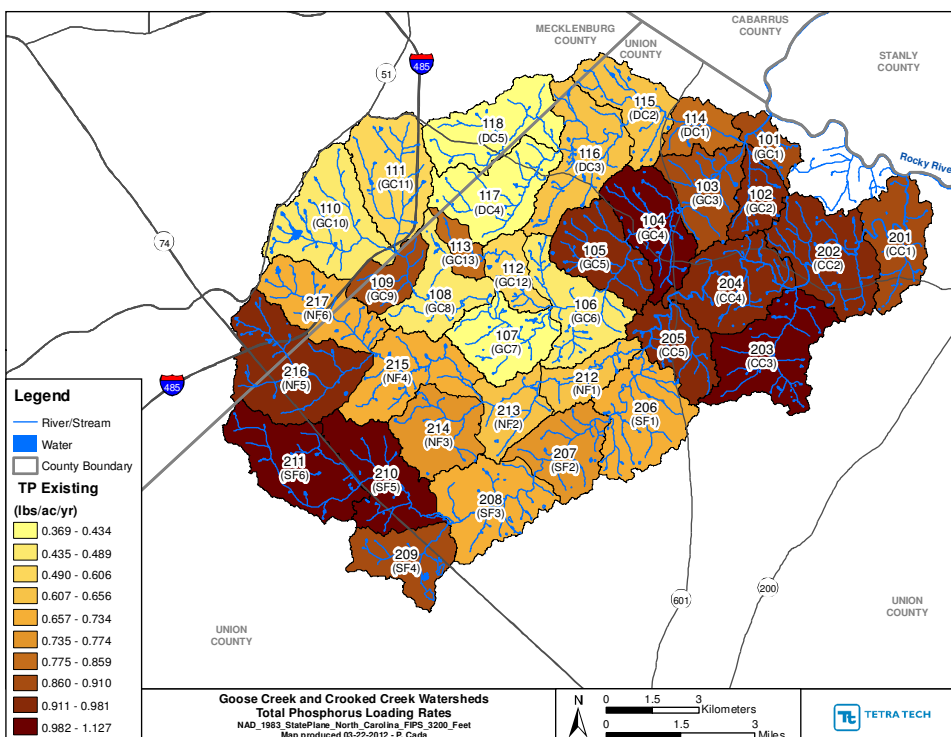


Figure B-2 Existing Baseline Total Phosphorus Loading Rates

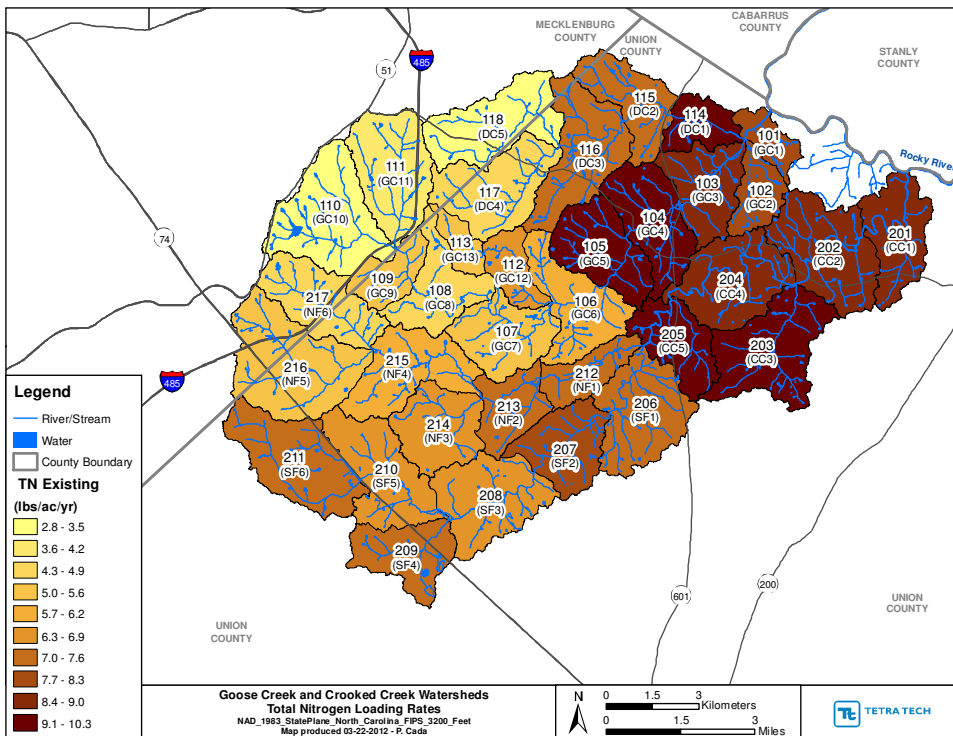


Figure B-3 Existing Baseline Total Nitrogen Loading Rates

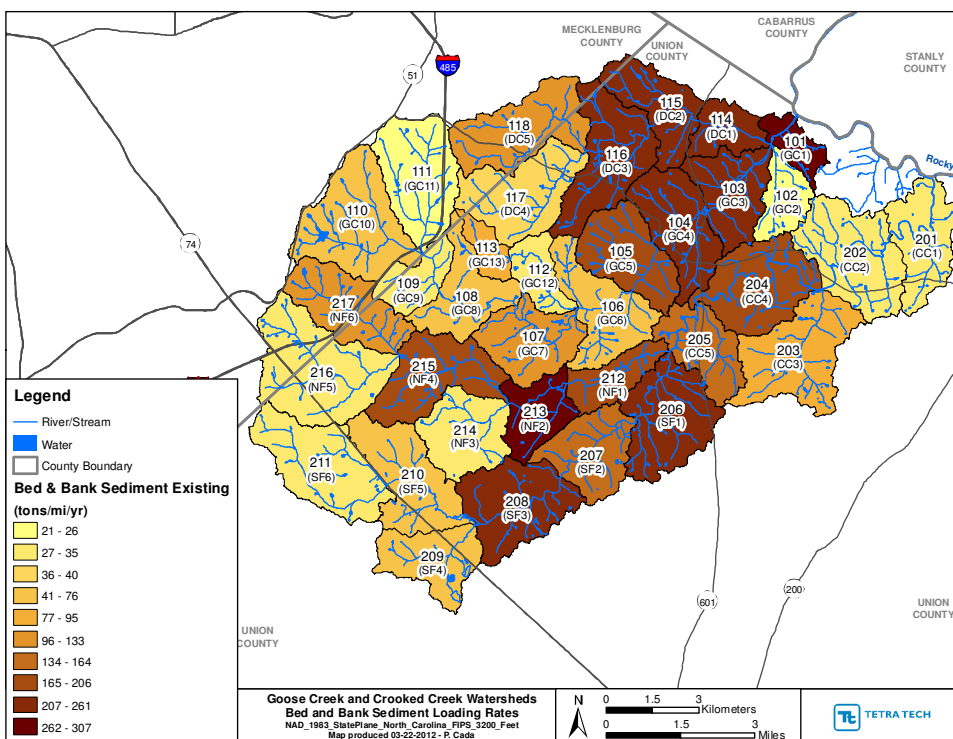


Figure B-4 Existing Baseline Bed and Bank Sediment Loading Rates, per Mile of Stream

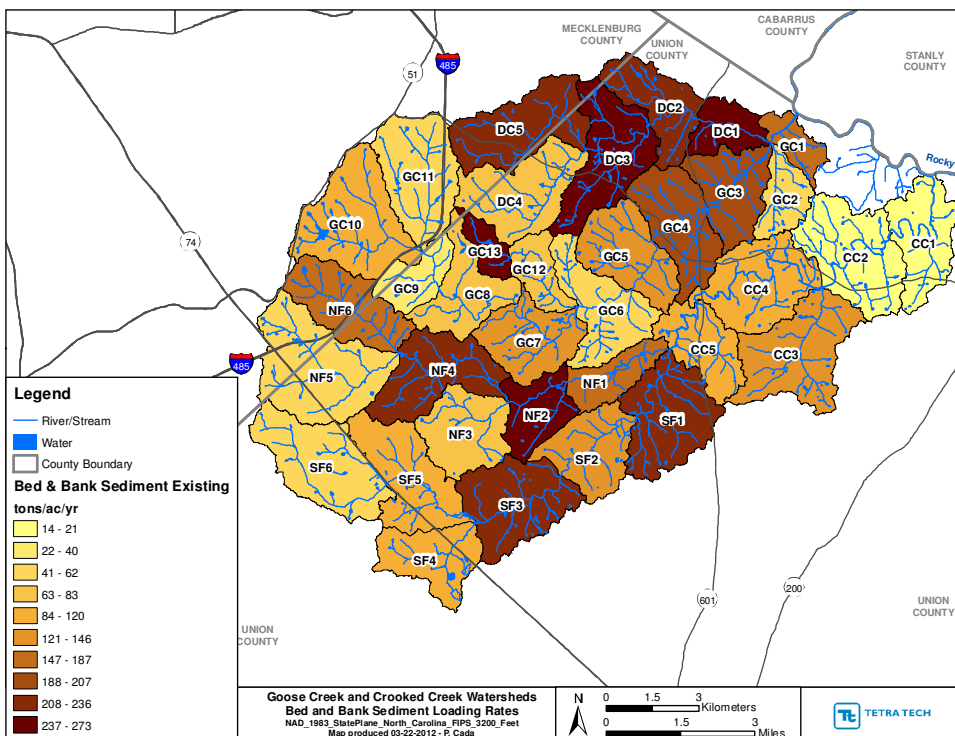


Figure B-5 Existing Baseline Bed and Bank Sediment Loading Rates, per Acre of Stream Bed

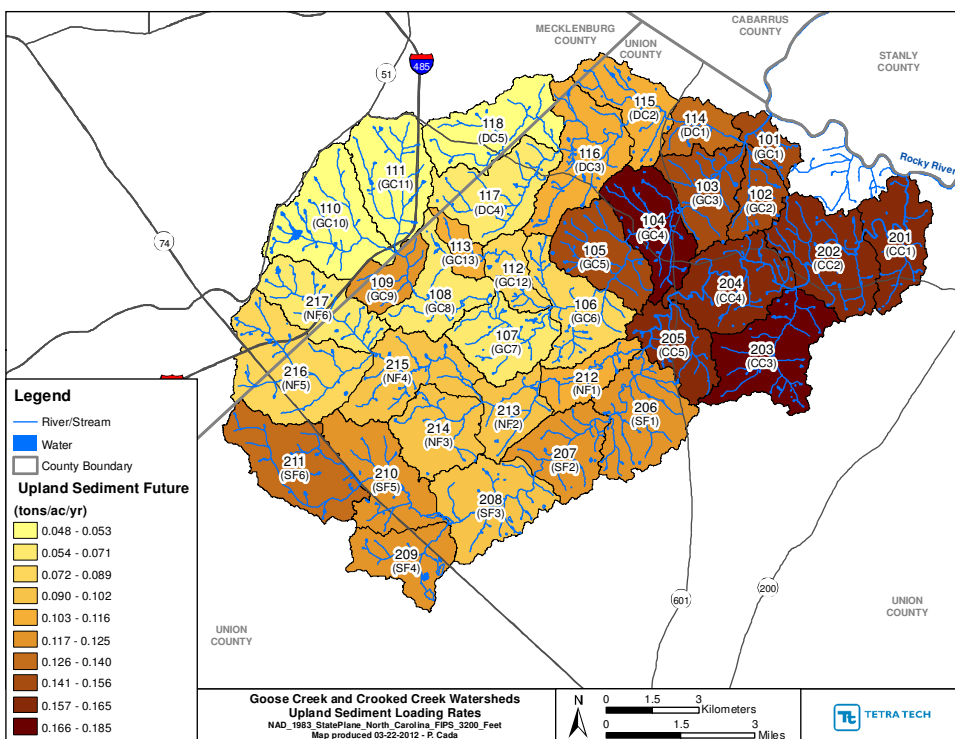


Figure B-6 Future Baseline Upland Sediment Loading Rates

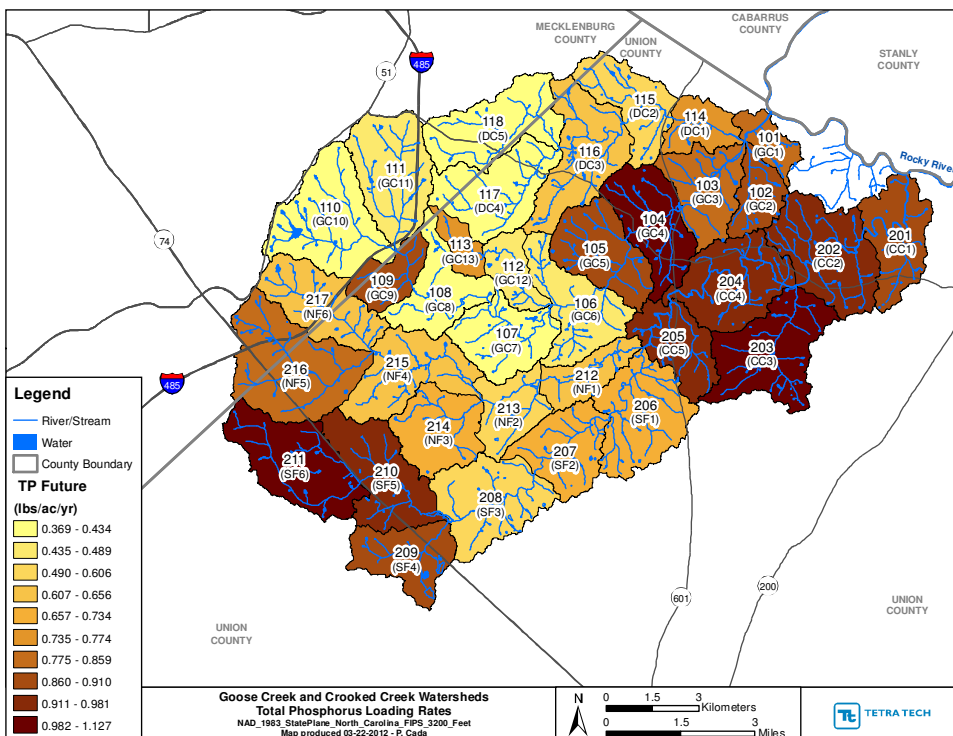


Figure B-7 Future Baseline Total Phosphorus Loading Rates

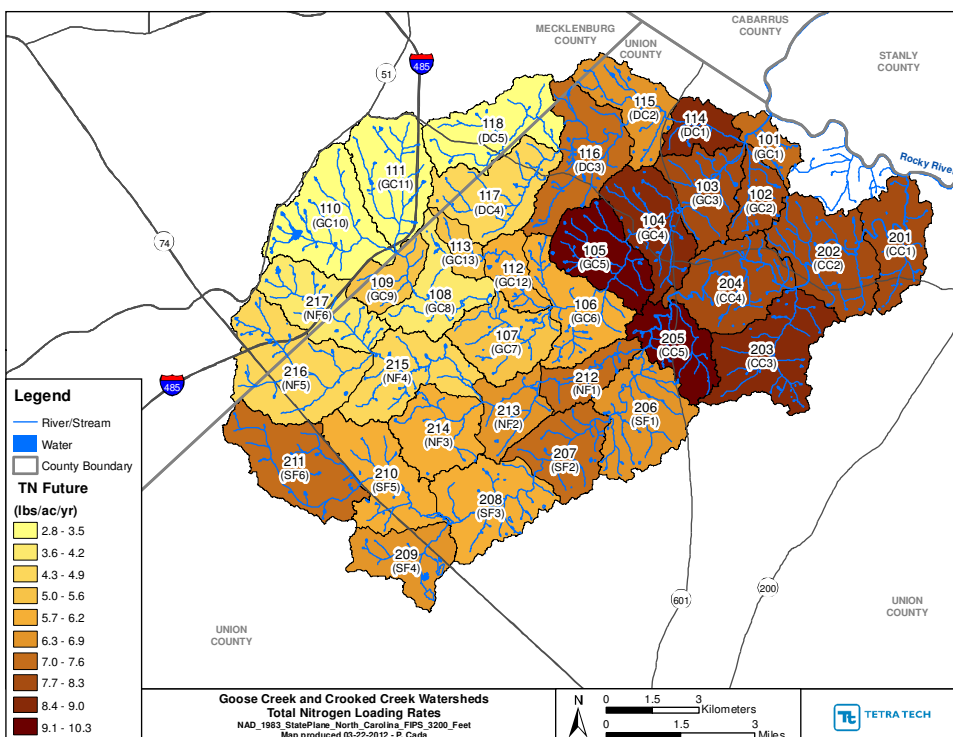


Figure B-8 Future Baseline Total Nitrogen Loading Rates

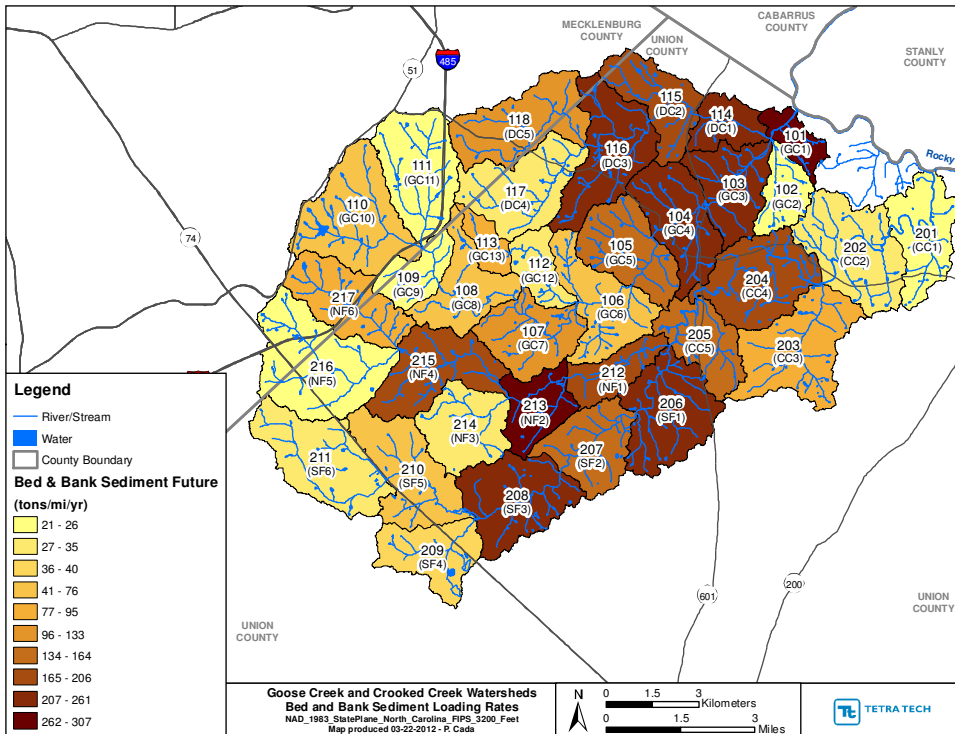


Figure B-9 Future Baseline Bed and Bank Sediment Loading Rates, per Mile of Stream

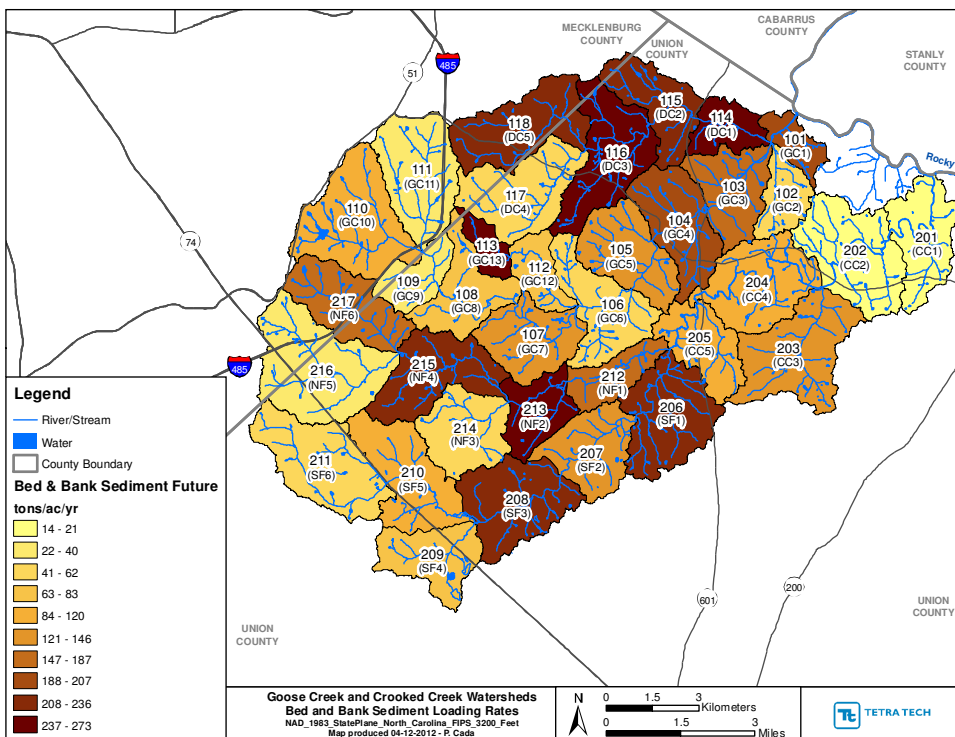


Figure B-10 Future Baseline Bed and Bank Sediment Loading Rates, per Acre of Stream Bed

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Appendix C BMP Assessment

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Goose Creek and Crooked Creek LWP Stormwater BMP Assessment

Prepared by NCEEP

The NC Ecosystem Enhancement Program (NCEEP) has initiated development of a local watershed plan (LWP) for Goose Creek and Crooked Creek, 14-digit hydrologic units 03040105030020 and 03040105040010. The two watersheds, encompassing parts of northern Union County and southeastern Mecklenburg County, drain to the Rocky River which in turn drains to the Yadkin-Pee Dee River Basin.

Studies within the LWP indicate that sediment and increased stormwater runoff peak flows and volumes are among the primary watershed stressors. A component of the LWP is an assessment of potential locations for stormwater best management practices (BMPs), such as stormwater wetlands and bioretention areas, which most effectively mitigate those primary watershed stressors. This document details the data sources, tools, methods, and results of the BMP assessment for the Goose and Crooked Creek watersheds.

Geospatial Data Sources

The data layers used in the identification of candidate BMP sites are as follows:

- 2010 Aerial Imagery (NC Center for Geographic Information & Analysis)
- 2-foot Interval Contour Lines (NCDOT GIS Branch)
- NC 14-digit Hydrologic Units (USDA-NRCS, NC CGIA, NC DENR-DWQ)
- Primary and Secondary Road Coverages (NCDOT GIS Branch)
- Major Hydrography (1:24000) for the Yadkin River Basin (NC CGIA)
- Union County Parcel Data (Union County GIS service and online mapping)
- Mecklenburg County Parcel Data (Mecklenburg County GIS service and online mapping)

Assessment Tools and Methods

The software tools used in this assessment were ESRI ArcMap 9.3.1 and Google Earth.

The assessment was begun using the 14-digit HUC watershed boundaries for the Goose and Crooked Creek watersheds. These boundaries served as the limits for the BMP search.

Within these boundaries, a visual search was initiated using the 2010 aerial imagery, as well as the aerial imagery (originating over a variety of dates) within Google Earth. Potential sites were chosen based on a visual determination of the suitability of a site with respect to its landscape position and on the land use in the surrounding area. Emphasis was placed on developed areas, where greater potential for concentrated stormwater runoff exists, although the entire watershed was scanned. As potential locations were found, the 2-foot interval contour lines and major hydrography datasets were utilized to further evaluate each potential site. Specifically, site drainage was checked, a rough estimate of watershed area was calculated, and proximity to existing stream features was determined. Sites that were in a suitable landscape position to receive runoff, had sufficient space upon which to place a BMP sized appropriately for the BMP watershed, and that were not in immediate proximity to existing perennial or intermittent stream features, were marked on a master map for field investigation.

Field investigation involved physically visiting each site and examining the immediate surroundings. This included noting any existing stormwater treatment devices, examining the topography and drainage characteristics of the surrounding landscape, and noting any difference in land use as compared to the aerial

imagery. Potential constraints and apparent utility conflicts were also noted where applicable. Where applicable and possible, storm sewer drainage inlets and culverts were examined to get a sense of the storm drainage network that might influence watershed drainage and ultimately drain to a potential BMP. More often than not, though, thorough examination of the storm sewer connectivity was not extensively possible. In a few cases, property access issues prevented complete examination of the respective sites. Several photos were also taken of each site.

The field investigation yielded sites that were categorized as infeasible, unknown, feasible, or retrofit. Retrofit sites are those in which some form of stormwater or sediment BMP is in place, and the site is a candidate for being retrofitted with a more effective means of stormwater treatment.

Sites that were categorized as either feasible or retrofit were then analyzed in detail to determine the approximate BMP footprint area available, drainage area, impervious surface, potential landowner issues (*i.e.* more than 2 landowners), as well as assessing the approximate effectiveness of the BMP (which is described in more detail in the following paragraph) and developing an initial design and construction cost estimate (not including land cost). The NC Division of Water Quality (DWQ) Stormwater BMP Manual (2007), and specifically the Simple Method contained therein, served as the guide for sizing the BMP according to runoff volume treated. Cost estimates were made using information from Hunt and Wossink (2003) as a starting point, and adjusting upwards for inflation and increased fuel and material costs. Upward cost adjustments were also made based on study of the cost of more recent BMP projects. Exact cost estimation is difficult, especially without a design, but it is believed that by adjusting for these various factors, a more reasonable cost estimate is possible.

Annual pollutant removal cost per ton of pollutant was also evaluated, using sediment as the pollutant. Annual sediment loading was calculated using the Simple Method as mentioned above, although in this case the inputs were annual rainfall, percent imperviousness, watershed area, and an estimate of typical sediment influent concentration of 80 mg/L. Once the annual sediment load was computed, the annual rate of removal of sediment was calculated assuming an 85% total suspended solids (TSS) removal rate for both BMP practices. This removal rate, in tons per year, was divided into the cost for each BMP to compute the annual cost of sediment removal for each BMP.

Table 2 below summarizes the watershed characteristics, effectiveness, and cost of each BMP.

The approximate effectiveness is a means of estimating the effective area treated and the effective efficiency for undersized BMPs. An undersized BMP will not remove pollutants as efficiently as a properly sized BMP. This reduced efficiency is the multiplicative product of the expected BMP efficiency and the approximate effectiveness. Likewise, the effective area treated is the multiplicative product of the drainage area to the BMP and the approximate effectiveness. The approximate effectiveness of the BMP is determined by computing the amount of rainfall the BMP could fully treat, based on footprint. This amount of rainfall is then compared to a statistical analysis of rainfall for the region to determine the percent of storms of less than one inch of runoff that would be fully captured by the BMP. This percentage of captured storms is the approximate effectiveness. Undersized BMPs will have approximate effectiveness value less than 100%, whereas the approximate effectiveness values for properly sized BMPs will be 100%.

Table 3 summarizes the priority rank for each BMP. Priority rank is determined first by multiplying the approximate effectiveness by the drainage area which yields the effective area treated, in acres. The estimated cost is then divided by the effective area treated to yield the cost per effective area treated, in dollars per acre.

For each site, the tier is determined based on the location of each site in relation to the stressor-based subwatersheds. Tier 1 indicates highest stressor-based priority, while tier 4 indicated lowest stressor-based priority. Each tier was assigned a tier multiplier, which is essentially a scaled discount depending on the tier. A tier 1 project gets the highest discount of 0.25, while a tier 4 gets no discount (*i.e.* a multiplier of 1.0). When the tier multiplier is multiplied by the cost per effective area treated, it serves to adjust the cost per effective area treated downward to reflect a higher priority for each project.

The stressor-based subwatersheds were ranked according to both existing conditions and future conditions. The future conditions assumed various development regulations were in place to help improve water quality in some places, and also assumed degradation of the watershed in other places due to land use conversion. The tier rankings used in this study were based on the future conditions subwatershed ranking.

The two BMP types analyzed in this assessment are bioretention basins and stormwater wetlands. These BMPs are described in detail below, with the information taken from the NC Division of Water Quality (DWQ) Stormwater BMP Manual (2007).

Bioretention basins use plants and soils for pollutant removal from stormwater runoff via adsorption, filtration, sedimentation, volatilization, ion exchange, and biological decomposition. In addition, bioretention provides landscaping and habitat enhancement benefits.

Advantages of bioretention basins include:

- Efficient removal method for suspended solids, heavy metals, adsorbed pollutants, nitrogen, phosphorus, pathogens, and temperature.
- In appropriate soil conditions, can effectively reduce peak runoff rates for relatively frequent storms, reduce runoff volumes, and recharge groundwater.
- Flexible adaptation to urban retrofits and natural integration into landscaping for urban landscape enhancement.

Disadvantages of bioretention basins include:

- Surface soil layer may clog over time (though it can be restored).
- Frequent trash removal may be required, especially in high traffic areas.
- Require frequent maintenance of plant material and mulch layer.

Stormwater wetlands are constructed systems that mimic the functions of natural wetlands and use physical, chemical, and biological processes to treat stormwater pollution.

Advantages of stormwater wetlands include:

- Create a shallow matrix of sediment, plants, water, and detritus that collectively removes multiple pollutants through a series of complementary physical, chemical, and biological processes.
- Best BMP design for maximum TSS, nitrogen, and phosphorus removal while also providing stormwater volume control.
- Aesthetically pleasing when properly maintained and can be sited in both low- and high-visibility areas.

Disadvantages of stormwater wetlands include:

- Occupy more land than other stormwater BMPs such as detention basins.
- Need to meet critical water balance requirements to stay healthy and properly functioning.
- Without proper maintenance, can be colonized by invasive species that out-compete native wetlands plants.

Function and feasibility considerations for each practice are listed below.

Table 1. Function and feasibility considerations

BMP Type	Nutrient Removal Rate (%)			Runoff Attenuation		Other Considerations	
	TSS	TN	TP	Peak	Volume	Land Requirement	Maintenance Burden
Bioretention	85	40*	45	Yes	Possible	High	Med-High
Stormwater Wetland	85	40	40	Yes	Yes	High	Med

TSS = Total Suspended Solids, TN = Total Nitrogen, TP = Total Phosphorous

*TN removal possible assuming the bioretention cell utilizes an internal water storage (IWS) device. Without an IWS, TN removal is 35%.

References

NC DENR, DWQ. *Stormwater Best Management Practices Manual*. Raleigh, North Carolina. 2007.

Wossink, Ada and Bill Hunt. *An Evaluation of Cost and Benefits of Structural Stormwater Best Management Practices in North Carolina*. NC Cooperative Extension Service. Raleigh, North Carolina. 2003. Also available at http://www.neuse.ncsu.edu/Stormwater_BMP_Factsheet.pdf

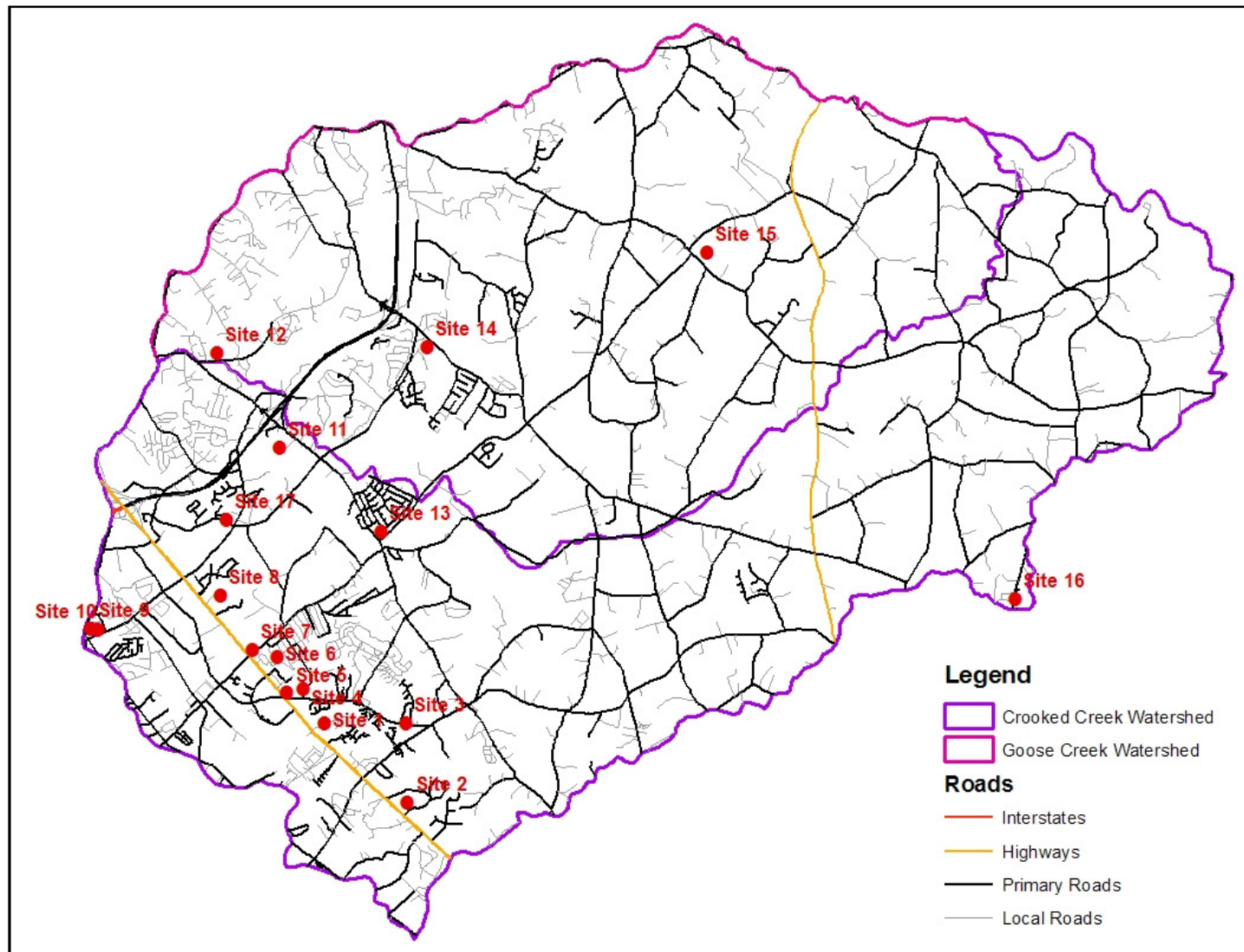


Figure 1. Goose and Crooked Creek Watershed Map with potential BMP Site locations

Table 2. Summary of BMP Site Characteristics

Site ID	BMP Type	Site Type	Drainage Area (ac)	Site Footprint (ac)	Impervious Surface (%)	Approximate Effectiveness (%)	D & C Cost	Sediment Removal Cost (\$/ton/yr)	Priority Rank
1	Stormwater Wetland	New	41.1	1.8	78	87%	\$220,000	\$20,700	1
2	Stormwater Wetland	Retrofit	5.8	0.7	100	100%	\$120,000	\$64,300	8
3	Bioretention	Retrofit	9.8	0.1	36	57%	\$325,000	\$239,100	6
4	Stormwater Wetland	Retrofit	15.4	1.2	100	100%	\$300,000	\$60,800	3
5	Bioretention	Retrofit	5.7	0.6	100	100%	\$450,000	\$245,800	9
6	Stormwater Wetland	Retrofit	4.6	0.4	100	100%	\$100,000	\$67,500	4
7	Bioretention	Retrofit	7.2	0.3	76	82%	\$350,000	\$187,500	7
8	Stormwater Wetland	Retrofit	3.1	0.5	63	100%	\$120,000	\$191,900	12
9	Bioretention	Retrofit	1.6	0.1	94	100%	\$175,000	\$373,200	11
10	Bioretention	Retrofit	0.8	0.05	100	81%	\$100,000	\$404,000	14
11	Stormwater Wetland	Retrofit	18.7	0.9	100	85%	\$300,000	\$50,100	5
12	Stormwater Wetland	New	3.7	0.5	62	100%	\$100,000	\$136,900	10
14	Stormwater Wetland	Retrofit	4.9	0.7	100	100%	\$150,000	\$96,200	13
16	Stormwater Wetland	Retrofit	9.9	0.2	75	62%	\$90,000	\$35,000	2
17	Bioretention	Retrofit	3.6	0.3	45	100%	\$240,000	\$486,700	15

Table 3. BMP Site Prioritization

Priority Rank	Site ID	BMP Type	Site Type	Drainage Area (ac)	Approx Eff (%)	D&C Cost	Eff Ac Treated	Cost/Ac Treated	Tier	Tier Mult	Adjusted Cost/Acre
1	1	Stormwater Wetland	New	41.1	87%	\$220,000	35.8	\$6,153	1	0.25	\$1,538
2	16	Stormwater Wetland	Retrofit	9.9	62%	\$90,000	6.1	\$14,663	1	0.25	\$3,665
3	4	Stormwater Wetland	Retrofit	15.4	100%	\$300,000	15.4	\$19,481	1	0.25	\$4,870
4	6	Stormwater Wetland	Retrofit	4.6	100%	\$100,000	4.6	\$21,739	1	0.25	\$5,434
5	11	Stormwater Wetland	Retrofit	18.7	85%	\$300,000	15.9	\$18,874	3	0.75	\$14,155
6	3	Bioretention	Retrofit	9.8	57%	\$325,000	5.6	\$58,181	1	0.25	\$14,545
7	7	Bioretention	Retrofit	7.2	82%	\$350,000	5.9	\$59,282	1	0.25	\$14,820
8	2	Stormwater Wetland	Retrofit	5.8	100%	\$120,000	5.8	\$20,690	3	0.75	\$15,517
9	5	Bioretention	Retrofit	5.7	100%	\$450,000	5.7	\$78,947	1	0.25	\$19,736
10	12	Stormwater Wetland	New	3.7	100%	\$100,000	3.7	\$27,027	3	0.75	\$20,270
11	9	Bioretention	Retrofit	1.6	100%	\$175,000	1.6	\$109,375	1	0.25	\$27,343
12	8	Stormwater Wetland	Retrofit	3.1	100%	\$120,000	3.1	\$38,710	3	0.75	\$29,032
13	14	Stormwater Wetland	Retrofit	4.9	100%	\$150,000	4.9	\$30,612	4	1	\$30,612
14	10	Bioretention	Retrofit	0.8	81%	\$100,000	0.6	\$154,321	1	0.25	\$38,580
15	17	Bioretention	Retrofit	3.6	100%	\$240,000	3.6	\$66,667	3	0.75	\$50,000
NA	13	NA	NA	NA	NA	NA	NA	NA	3	0.75	NA
NA	15	NA	NA	NA	NA	NA	NA	NA	1	0.25	NA



Site 1 Location Map



Site 1, standing approx midway looking downslope

Site Number	1
Location (Lat/Long in DD)	35.0718, -80.6437
BMP Type	Stormwater Wetland
Site Type	New BMP
Drainage Area (ac)	41.1
Approx BMP Footprint (ac)	1.77
Impervious Surface (%)	80%
Constraints	Minimal
Utility Conflicts	Minimal
Approx Effectiveness	87%
Estimated Cost	\$220,000

Site 1 is situated in a low area, possibly an existing drainage swale or poor quality wetland that drains a large commercial park. The most feasible BMP option in this space, given the linear nature of the proposed site, is a new stormwater wetland. Accessibility at present should not be an issue, unless the park is built out near the site. The risk of utility conflicts is minimal, although that risk increases near the road. Constraints at present are minimal, again dependent on how the site is built out into the future. There are 2-3 landowners currently holding the land on which the site is located.

An appropriately sized stormwater wetland for this watershed would be approximately 2.6 acres in surface area. Given the available footprint, a stormwater BMP at this location would be approximately 87% effective at flow attenuation and nutrient removal. Estimated design and construction cost is approximately \$220,000.



Site 2 Location Map



Site 2, standing upslope looking toward outlet

Site Number	2
Location (Lat/Long in DD)	35.0579, -80.6251
BMP Type	Stormwater Wetland
Site Type	Retrofit
Drainage Area (ac)	5.8
Approx BMP Footprint (ac)	0.7
Impervious Surface (%)	100%
Constraints	Minimal
Utility Conflicts	Minimal
Approx Effectiveness	100%
Estimated Cost	\$120,000

Site 2 is an existing stormwater detention pond situated at the edge of and receiving drainage from a large vehicle dealership park. This location is an excellent candidate to be retrofit with a stormwater wetland. Accessibility at present should not be difficult, and there are no apparent utility conflicts other than the existing stormwater infrastructure that drains into the detention pond. The existing site is constrained by the auto dealership, but there appears to be adequate space to construct a retrofit in the existing BMP footprint.

An appropriately sized stormwater wetland for this watershed would be approximately 0.5 acres in surface area. Given the available footprint, a stormwater BMP at this location could be fully sized for the watershed and be fully effective at flow attenuation and nutrient removal. The estimated design and construction cost is \$120,000.



Site 3 Location Map

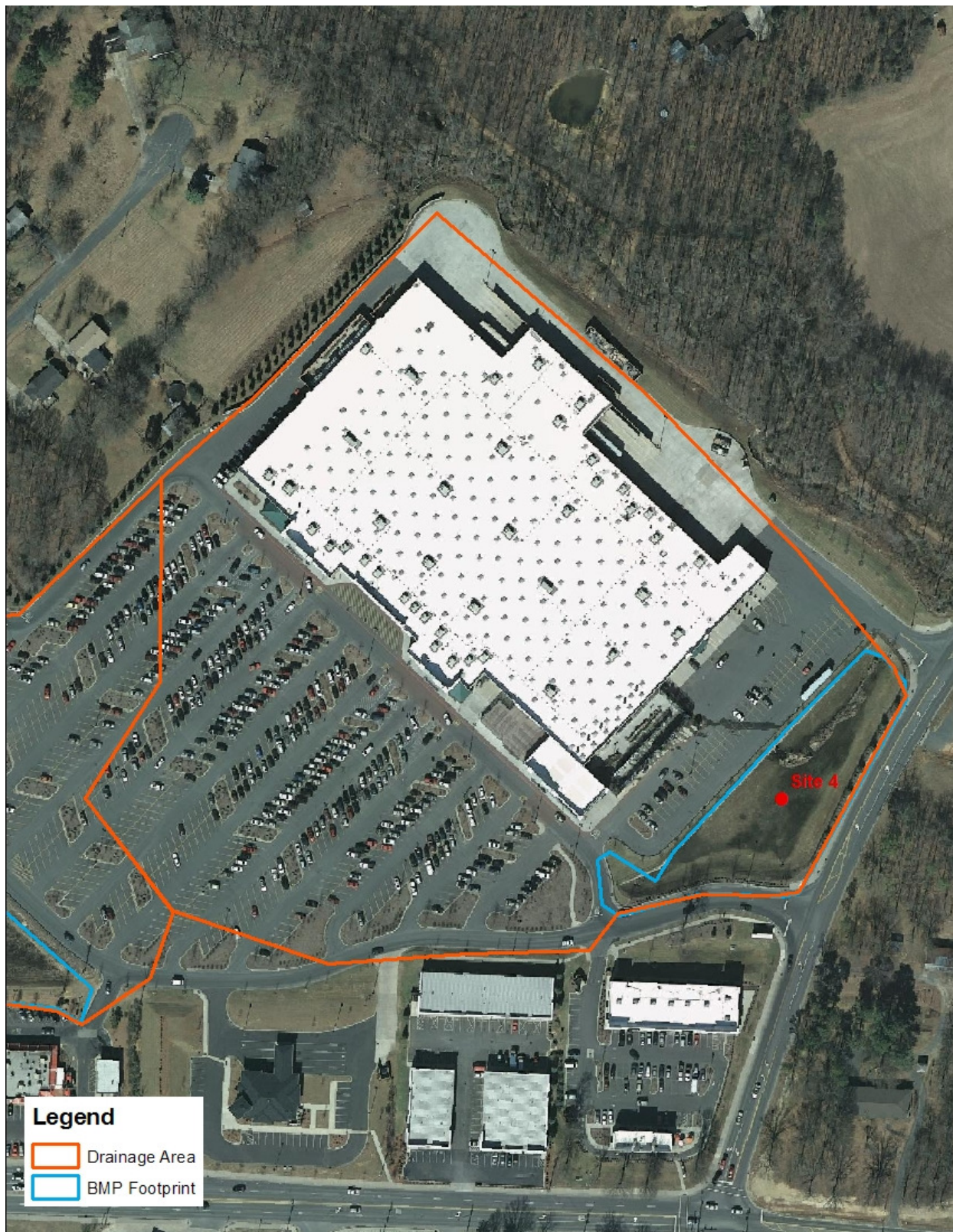


Site 3, standing at outlet looking upslope

Site Number	3
Location (Lat/Long in DD)	35.0721, -80.6257
BMP Type	Bioretention
Site Type	Retrofit
Drainage Area (ac)	9.8
Approx BMP Footprint (ac)	0.1
Impervious Surface (%)	40%
Constraints	Moderate
Utility Conflicts	Moderate
Approx Effectiveness	57%
Estimated Cost	\$325,000

Site 3 is a small existing and partially eroding rock swale situated at the downstream end of a residential area. This is a fair candidate to be retrofit with a bioretention area. The proximity of the site to nearby residences and roadways means that accessibility may be somewhat limited, that there is moderate risk of utility conflicts, and that the site is moderately constrained. The site does currently occupy an undeveloped lot, so there is the potential of expanding the footprint and mitigating some of the access and constraint issues.

An appropriately sized bioretention area for this watershed would be approximately 0.3 acres in surface area. Given the available footprint, a stormwater BMP at this location would be approximately 57% effective at nutrient removal and minimally effective at flow attenuation, although the effectiveness could increase if a flow splitter is used to divert a portion of the incoming flow. The estimated design and construction cost is \$325,000.



Site 4 Location Map



Site 4, standing at outlet looking upslope

Site Number	4
Location (Lat/Long in DD)	35.0779, -80.6486
BMP Type	Stormwater Wetland
Site Type	Retrofit
Drainage Area (ac)	15.4
Approx BMP Footprint (ac)	1.2
Impervious Surface (%)	100%
Constraints	High
Utility Conflicts	Moderate
Approx Effectiveness	100%
Estimated Cost	\$300,000

Site 4 is an existing dry detention pond that is situated adjacent to and receives drainage from a medium sized retail area. This site is a good candidate to be retrofit with a stormwater wetland. The site is highly constrained due to the proximity of existing roads and parking areas, which will pose problems with accessibility. The risk of utility conflicts is moderate within the existing BMP footprint, but is likely to increase outside of the BMP footprint.

An appropriately sized stormwater wetland for this watershed would be approximately 1.2 acres in surface area. Given the available footprint, a stormwater BMP at this location could be fully sized for the watershed and be fully effective at flow attenuation and nutrient removal. The estimated design and construction cost is \$300,000.



Site 5 Location Map



Site 5, looking across toward outlet

Site Number	5
Location (Lat/Long in DD)	35.0773, -80.652
BMP Type	Bioretention
Site Type	Retrofit
Drainage Area (ac)	5.7
Approx BMP Footprint (ac)	0.6
Impervious Surface (%)	100%
Constraints	High
Utility Conflicts	Moderate
Approx Effectiveness	100%
Estimated Cost	\$450,000

Site 5 is an existing dry detention pond that is situated adjacent to and receives drainage from a medium sized retail area. This site is a fair candidate to be retrofit with a bioretention area. The site is highly constrained due to the proximity of existing roads and parking areas, which will pose problems with accessibility. The risk of utility conflicts is moderate within the existing BMP footprint, but is likely to increase outside of the BMP footprint.

An appropriately sized bioretention area for this watershed would be approximately 0.5 acres in surface area. Given the available footprint, a stormwater BMP at this location could be fully sized for the watershed and be fully effective at nutrient removal and moderately effective at flow attenuation. The estimated design and construction cost is \$450,000.



Site 6 Location Map



Site 6, standing upslope looking toward outlet

Site Number	6
Location (Lat/Long in DD)	35.0837, -80.6544
BMP Type	Stormwater Wetland
Site Type	Retrofit
Drainage Area (ac)	4.6
Approx BMP Footprint (ac)	0.4
Impervious Surface (%)	100%
Constraints	Minimal
Utility Conflicts	Minimal
Approx Effectiveness	100%
Estimated Cost	\$100,000

Site 6 is an existing dry detention pond, or perhaps an old sediment basin, that is adjacent to and receives drainage from a church campus. This site is an excellent candidate to be retrofit with a stormwater wetland. The site is minimally constrained by an existing parking lot. Accessibility is good and the risk of utility conflicts is minimal.

An appropriately sized stormwater wetland for this watershed would be approximately 0.4 acres in surface area. Given the available footprint, a stormwater BMP at this location could be fully sized for the watershed and be fully effective at flow attenuation and nutrient removal. The estimated design and construction cost is \$100,000.



Site 7 Location Map



Site 7, standing upslope looking toward outlet

Site Number	7
Location (Lat/Long in DD)	35.0849, -80.6597
BMP Type	Bioretention
Site Type	Retrofit
Drainage Area (ac)	7.2
Approx BMP Footprint (ac)	0.3
Impervious Surface (%)	80%
Constraints	High
Utility Conflicts	Moderate
Approx Effectiveness	82%
Estimated Cost	\$350,000

Site 7 is perched partway up a slope between a road and a retail area. It is an existing detention pond that receives drainage from the retail area. This site is a fair candidate to be retrofit with a bioretention area. The site is highly constrained given the slope of the surrounding landscape, and the proximity of the roads and retail area, and accessibility could pose problems. The risk of utility conflicts is moderate within the existing BMP footprint, but is likely to increase outside of the BMP footprint.

An appropriately sized bioretention area for this watershed would be approximately 0.4 acres in surface area. Given the available footprint, a stormwater BMP at this location would be approximately 82% effective at nutrient removal and minimally effective at flow attenuation. The estimated design and construction cost is \$350,000.



Site 8 Location Map



Site 8, looking across towards inlet

Site Number	8
Location (Lat/Long in DD)	35.0946, -80.6671
BMP Type	Stormwater Wetland
Site Type	Retrofit
Drainage Area (ac)	3.1
Approx BMP Footprint (ac)	0.5
Impervious Surface (%)	65%
Constraints	Minimal
Utility Conflicts	Minimal
Approx Effectiveness	100%
Estimated Cost	\$120,000

Site 8 is an existing detention pond situated in an open area that is adjacent to and receives drainage from a small commercial area. A long drainage swale leads from the commercial area to the pond. This site is an excellent candidate to be retrofit with a stormwater wetland. The site is minimally constrained and accessibility should be reasonably easy. The risk of utility conflicts is low.

An appropriately sized stormwater wetland for this watershed would be approximately 0.2 acres in surface area. Given the available footprint, a stormwater BMP at this location could be fully sized for the watershed and be fully effective at flow attenuation and nutrient removal. The estimated design and construction cost is \$120,000.



Site 9 Location Map



Site 9, standing upslope looking towards outlet

Site Number	9
Location (Lat/Long in DD)	35.0882, -80.6953
BMP Type	Bioretention
Site Type	Retrofit
Drainage Area (ac)	1.6
Approx BMP Footprint (ac)	0.1
Impervious Surface (%)	95%
Constraints	Minimal
Utility Conflicts	Minimal
Approx Effectiveness	100%
Estimated Cost	\$175,000

Site 9 is an existing remnant sediment basin situated behind and receiving drainage from a medical office. This location is an excellent candidate to be retrofit with a bioretention area. The site is moderately constrained by the parking lot, and accessibility should be good. The risk of utility conflicts is moderate given the proximity to the parking lot and a nearby water tower.

An appropriately sized bioretention area for this watershed would be approximately 0.1 acres in surface area. Given the available footprint, a stormwater BMP at this location could be fully sized for the watershed and be fully effective at nutrient removal and moderately effective at flow attenuation. The estimated design and construction cost is \$175,000.



Site 10 Location Map



Site 10, looking across at outlet

Site Number	10
Location (Lat/Long in DD)	35.088, -80.6937
BMP Type	Bioretention
Site Type	Retrofit
Drainage Area (ac)	0.8
Approx BMP Footprint (ac)	0.05
Impervious Surface (%)	100%
Constraints	High
Utility Conflicts	Moderate
Approx Effectiveness	81%
Estimated Cost	\$100,000

Site 10 is a small existing dry detention basin in the parking lot of a police station, from which it receives drainage. This site is a fair candidate to be retrofit with a bioretention area. The site is highly constrained by surrounding buildings and parking areas and accessibility is limited. The risk of utility conflicts is moderate, and increases outside of the existing BMP footprint.

An appropriately sized bioretention area for this watershed would be approximately 0.1 acres in surface area. Given the available footprint, a stormwater BMP at this location would be approximately 81% effective at nutrient removal and minimally effective at flow attenuation, although this could be improved with the use of a flow splitter. The estimated design and construction cost is \$100,000.



Site 11 Location Map



Site 11, standing downslope looking upslope

Site Number	11
Location (Lat/Long in DD)	35.1214, -80.6546
BMP Type	Stormwater Wetland
Site Type	Retrofit
Drainage Area (ac)	18.7
Approx BMP Footprint (ac)	0.9
Impervious Surface (%)	100%
Constraints	High
Utility Conflicts	Moderate
Approx Effectiveness	85%
Estimated Cost	\$300,000

Site 11 is an existing swale or possibly a remnant sediment basin situated behind and receiving drainage from a large retail park. This site is a fair candidate to be retrofit with a stormwater wetland. This site is highly constrained, not only by the adjacent parking lot, but also by steeply sloping surrounding landscape which leaves minimal room to work. Accessibility could be problematic given the side slopes, and the risk of utility conflicts is moderate.

An appropriately sized stormwater wetland for this watershed would be approximately 1.5 acres in surface area. Given the available footprint, a stormwater BMP at this location would be approximately 85% effective at flow attenuation and nutrient removal. The estimated design and construction cost is \$300,000.



Site 12 Location Map

No site photo available for site 12

Site Number	12
Location (Lat/Long in DD)	35.1383, -80.6687
BMP Type	Stormwater Wetland
Site Type	New BMP
Drainage Area (ac)	3.7
Approx BMP Footprint (ac)	0.5
Impervious Surface (%)	65%
Constraints	Minimal
Utility Conflicts	Minimal
Approx Effectiveness	100%
Estimated Cost	\$100,000

Site 12 is situated in a low area behind and receiving drainage from a church campus. The potential location of the BMP was not accessible during the time of this assessment. The most feasible BMP option in this space, given the space available, is a new stormwater wetland. The site is minimally constrained although access may be limited if the site cannot be accessed directly from the back of the church parking lot. The risk of utility conflicts is minimal.

An appropriately sized stormwater wetland for this watershed would be approximately 0.2 acres in surface area. Given the available footprint, a stormwater BMP at this location could be fully sized for the watershed and be fully effective at nutrient removal and flow attenuation. The estimated design and construction cost is \$100,000.



Site 13 Location Map

No site photo available for site 13

Site Number	13
Location (Lat/Long in DD)	35.1065, -80.632
BMP Type	NA
Site Type	Unsuitable
Drainage Area (ac)	NA
Approx BMP Footprint (ac)	NA
Impervious Surface (%)	NA
Constraints	NA
Utility Conflicts	NA
Approx Effectiveness	NA
Estimated Cost	NA

Site 13 was deemed unsuitable following the field verification. The site appears to have open space for BMP placement when viewed on the aerial photos. However, onsite drainage conditions are not favorable for BMP placement and this site is not recommended at this time. It is included, though, should conditions in the future change.



Site 14 Location Map



Site 14, standing near outlet looking toward inlet

Site Number	14
Location (Lat/Long in DD)	35.1400, -80.6224
BMP Type	Stormwater Wetland
Site Type	Retrofit
Drainage Area (ac)	4.9
Approx BMP Footprint (ac)	0.7
Impervious Surface (%)	100%
Constraints	Moderate
Utility Conflicts	Moderate
Approx Effectiveness	100%
Estimated Cost	\$150,000

Site 14 is an existing wet detention pond situated behind and receiving drainage from a large retail park. This site is a good candidate to be retrofit with a stormwater wetland. The site is moderately constrained by adjacent property and existing parking lots, but there is ample space within the existing BMP footprint. Accessibility is generally good, and the risk of utility conflicts is moderate, increasing outside the existing BMP footprint.

An appropriately sized stormwater wetland for this watershed would be approximately 0.4 acres in surface area. Given the available footprint, a stormwater BMP at this location could be fully sized for the watershed and be fully effective at nutrient removal and flow attenuation. The estimated design and construction cost is \$150,000.



Site 15 Location Map

No site photo available for site 15

Site Number	15
Location (Lat/Long in DD)	35.1578, -80.5614
BMP Type	Swale or Wetland
Site Type	New BMP
Drainage Area (ac)	NA
Approx BMP Footprint (ac)	NA
Impervious Surface (%)	NA
Constraints	NA
Utility Conflicts	NA
Approx Effectiveness	NA
Estimated Cost	NA

Site 15 was not able to be field verified due to property access limitation. It appears to be a ditch draining an industrial area. Feasible BMPs for this area would include grassed swales and constructed wetlands. Further speculation is not possible at this time without proper field verification.



Site 16 Location Map

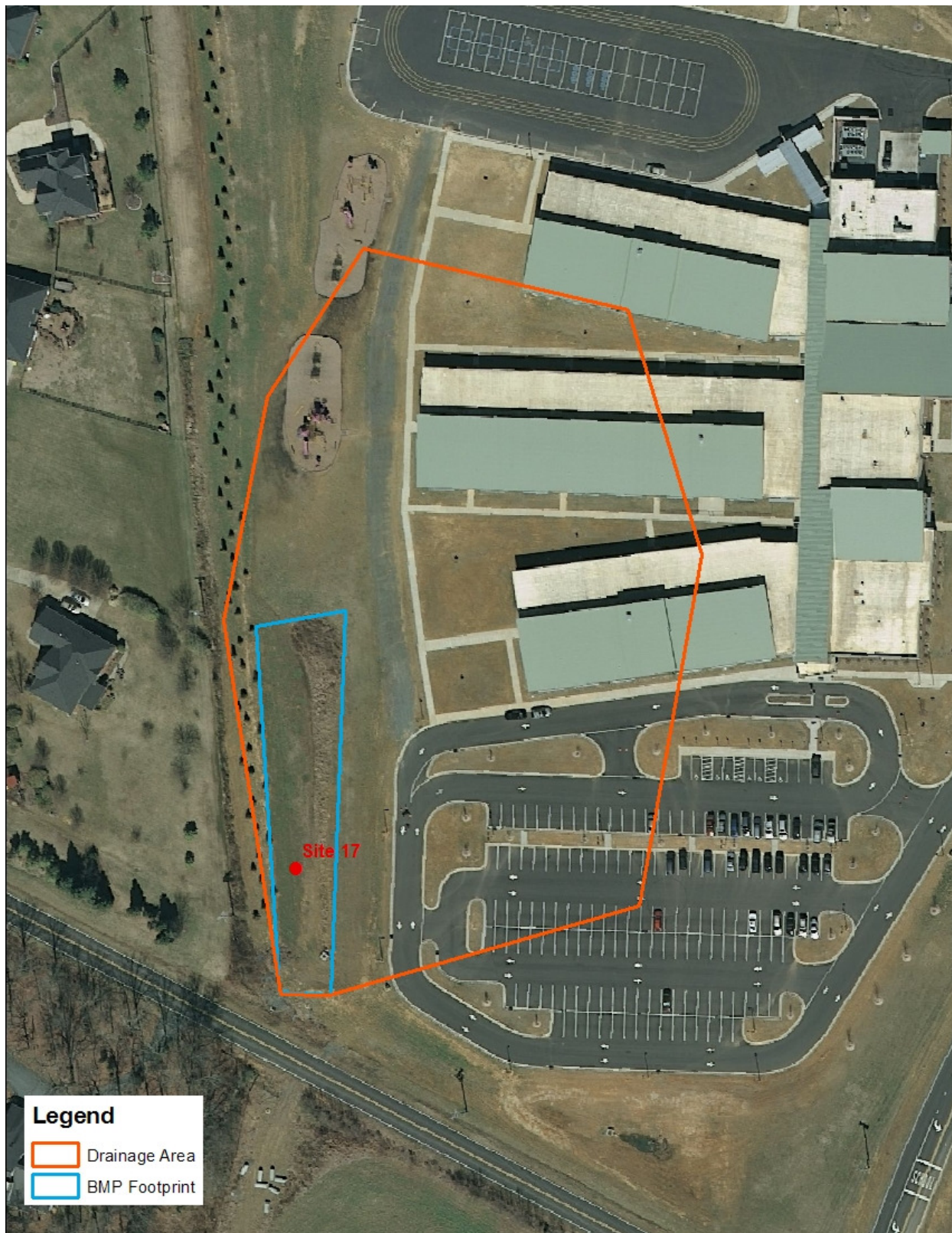


Site 16, standing upslope looking downslope

Site Number	16
Location (Lat/Long in DD)	35.0962, -80.4924
BMP Type	Stormwater Wetland
Site Type	Retrofit
Drainage Area (ac)	9.9
Approx BMP Footprint (ac)	0.4
Impervious Surface (%)	75%
Constraints	Moderate
Utility Conflicts	Moderate
Approx Effectiveness	62%
Estimated Cost	\$90,000

Site 16 is an existing swale situated on and receiving drainage from a high school campus. This site is a good candidate to be retrofit with a stormwater wetland. This site does present potential educational benefit to the school. The site is moderately constrained by a road and a ball field, although access should be good. The risk of utility conflicts is moderate considering the proximity to the road, school, and ball field.

An appropriately sized stormwater wetland for this watershed would be approximately 0.6 acres in surface area. Given the available footprint, a stormwater BMP at this location would be approximately 62% effective at flow attenuation and nutrient removal. The estimated design and construction cost for this site is \$90,000.



Site 17 Location Map



Site 17, standing upslope looking toward outlet

Site Number	17
Location (Lat/Long in DD)	35.1082, -80.6659
BMP Type	Bioretention
Site Type	Retrofit
Drainage Area (ac)	3.6
Approx BMP Footprint (ac)	0.3
Impervious Surface (%)	45%
Constraints	High
Utility Conflicts	Moderate
Approx Effectiveness	100%
Estimated Cost	\$240,000

Site 17 is an existing swale situated on and receiving drainage from an elementary school campus. This site is a good candidate to be retrofit with a bioretention area, particularly considering the safety hazards of open water near young children. This site does present potential educational benefit to the school. The site is highly constrained by a road, a parking lot, and a residential area, although access should be good. The risk of utility conflicts is moderate considering the proximity to the road, school, and residential area.

An appropriately sized bioretention area for this watershed would be approximately 0.1 acres in surface area. Given the available footprint, a stormwater BMP at this location could be fully sized for the watershed and be fully effective at nutrient removal and moderately effective at flow attenuation. The estimated design and construction cost is \$240,000.

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Appendix D Institutional and Regulatory Measures Review

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Goose Creek and Crooked Creek LWP Institutional and Regulatory Measures

Prepared by Centralina Council of Governments

Watershed management is framed by a network of ordinances, rules, and programs that ultimately impact the function of the watershed and the quality of the waters. Watershed management policies can be found in many sources. Communities can have plans that deal explicitly with water issues such as watershed protection plans or stormwater management plans. Guidelines or rules that affect watershed management can also be found in more general documents such as comprehensive plans, zoning ordinances, growth strategies, and even transportation plans.

As stated in Section 1.2 of the Goose Creek and Crooked Creek LWP Watershed Assessment Report, LWP Goal 2 is to *minimize impacts on water quality, aquatic and terrestrial habitat, and hydrology in the watershed by supporting balanced, sustainable, and diverse land use and development, in accordance with existing and future policies*. In order to understand and recommend areas for improvement, a comprehensive analysis of current institutional and regulatory measures is required. This appendix reviews the regulatory codes, practices and programs of the jurisdictions located within the Goose and Crooked Creek watersheds and their ability to protect the watershed as well as help to restore an area that may have already been degraded by agriculture or urbanization. It will review these documents and how they relate to the following watershed protection tools and techniques:

- I. Land Use Planning
- II. Land Conservation
- III. Stormwater Management
- IV. Better Site Design

I. Land Use Planning

Land use planning is perhaps the single most important watershed protection tool available. Land use planning is used to balance growth with conservation by identifying, protecting and enhancing natural resources, and by encouraging land use patterns to protect those resources. Land use planning techniques can be used to strategically direct site selection for new development, mitigate the impacts of development, preserve sensitive areas, and maintain or reduce the impervious cover within a given watershed. One source to understand a community's desire to achieve these goals is the comprehensive plan. The land use plan of each of the jurisdictions within the two watersheds is reviewed in the next session. The municipalities of Fairview, Hemby Bridge, Lake Park and Unionville do not have a Land Use Plan. Mecklenburg County does not have any land use authority as the watersheds are located either within the town limits or the Extra Territorial Jurisdiction (ETJ) of either Mint Hill or Matthews. A large portion of the Goose Creek watershed is located within the Town of Fairview, which is an agricultural community with large undeveloped tracts of land. The Crooked Creek basin is the larger of the two and is located in some of the fastest developing areas of Union and Mecklenburg Counties. The Town of Indian Trail has the largest portion of land with this watershed.

Union County

Union County adopted an updated comprehensive plan in October 2010. This plan's 15-year time horizon is meant to balance the demand for new development that accompanies a county experiencing one of the fastest growing populations in the country with the need to protect its natural resources. The plan examines a multitude of topics, including growth, economic development, transportation and housing. It

has many goals which will benefit the watershed. One such goal is to “direct development away from rural areas.” The following strategies are outlined:

- Encourage the development of large lot subdivisions that reflect the rural character of Union County.
- Encourage developers to use stormwater best management practices, respect the natural topography and drainage patterns of the land, and protect groves of trees when designing new subdivisions.
- Consider providing incentives for subdivision designs that incorporate these types of low-impact design principles.

The plan’s policy to coordinate the planning and development of new school facilities with plans for county recreation facilities helps to reduce new impervious surfaces by using shared parking spaces.

Another land use planning goal is to “consider impacts of new development on environmental features and endangered/threatened habitats.” The policy aims to direct development away from environmentally sensitive areas including wetlands, waterways, slopes, protected species habitats, and other areas.

Finally, the County’s comprehensive plan includes an implementation plan with action steps geared toward making their vision successful. The action steps include making amendments to both the zoning code and the subdivision ordinance that both requires and incentivizes new development to conserve and protect open space, cluster developments, locate away from environmentally sensitive or significant locations, and reduce storm runoff in parking areas. The plan identifies a one year timeline to initiate the code updates within one year of the plan’s adoption.

City of Monroe

The City of Monroe’s Land Development Plan was adopted in 2000 and amended in 2008 to include several new provisions. It is currently being revised again. Some of the new provisions in the 2008 update include allowing cluster developments that contain large areas of open space to direct development away from environmentally sensitive areas. The plan identified environmental benefits of cluster developments such as the protection of streams, floodplain areas and significant existing tree cover. The plan update also included the addition of a “Natural Resource and Recreation Areas” section. The objectives of the section are to: protect the City’s drinking water supply, maintain and expand open space access and recreational resources throughout the City, and support floodplain protection and management. Strategies used to achieve these include, establish minimum buffer requirements depending on the type of use for development which abuts perennial streams and other bodies of water, limit disturbances to floodplain areas including filling and clearing whenever feasible, develop post construction stormwater management standards for all new developments, develop a stormwater master plan, adopt and enforce local sedimentation erosion control and stormwater regulations.

Town of Indian Trail

The Town of Indian Trail adopted its first comprehensive plan in 2005. The plan recognizes the issue of *existing inadequate stormwater management along Goose Creek, as well as the likelihood of development pressure because of the proximity to I-485*. The plan established the Conservation Development Village to preserve the environmentally sensitive areas within the Goose Creek Watershed. This village type development preserves open space for environmental protection and to reflect a rural setting. This development district was created as a specific effort to protect the environmentally sensitive areas within the Goose Creek Watershed.

Town of Stallings

The Town of Stallings adopted its land use plan in 2006. It contains policies similar to other Union County municipalities that encourage the protection of the watershed. The Stallings plan recommended changes in the zoning ordinance that would reduce stormwater runoff by increasing the amount of landscaping in parking lots and to reduce impervious services by mandating the shared use of parking facilities between neighbouring commercial developments. The Stallings plan also recommends establishing an ordinance to prevent land clearing, retaining significant tree stands and developing a local soil erosion and sedimentation program.

Town of Mint Hill

The Town of Mint Hill is currently developing a new land use plan. The existing plan was adopted in 2000. At that time the recommendation was to continue its large lot single family development pattern while considering ordinance changes to allow cluster style development. The land use plan stated that, “clustering is a smart way for the town to grow and yet retain those natural elements that make a town desirable.”

Town of Matthews

The Town of Matthews adopted their land use plan in 2002 and is also in the process of developing a revised plan. There was no discussion of policies or strategies that would directly benefit the watershed or improve stormwater management. The plan encourages the Town to continue its established large lot single family development pattern. Little information was available about the recommendations in the updated land use plan.

The municipalities of Fairview, Hemby Bridge, Lake Park and Unionville do not have a Land Use Plan.

II. Land Conservation

Another watershed protection tool is land conservation. This includes programs or efforts to conserve undeveloped, ecologically-sensitive areas and/or areas of historical, recreational, or cultural value. All of the jurisdictions that have a land use plan mention the importance of protecting sensitive lands.

The Union County Comprehensive Plan specifically includes the goal, “promote protection of open spaces and environmentally sensitive land.” Its strategies include:

- Encourage landowners to place private conservation easements on important open lands and environmentally sensitive areas. Direct landowners to land trust organizations that can assist with these efforts.
- Consider developing a dedicated public funding source for protecting critical open space lands.
- Identify existing large parcels in the County that are located in the rural area on the Future Land Use Plan map that have good soil and draining conditions for agricultural production. Work with landowners to encourage permanent protection of these lands.
- Work with the Catawba Lands Conservancy to identify priority open space lands and promote private land conservation efforts in these areas. This could include private conservation easements or acquisition of land funded through grants and other funding sources

III. Stormwater Management

It has been well established that stormwater runoff is a source of stream impact and impairment in the Goose Creek and Crooked Creek watersheds. As development continues within these watersheds, stormwater impacts will continue to affect stream stability, water quality, aquatic habitat and species diversity. Incorporating stormwater management practices into new or re-development sites to mitigate

stormwater runoff impacts on catchment waters helps minimize further degradation of the watersheds. Different communities have different goals and objectives depending on local circumstances and requirements. Federal and state Phase II Stormwater Regulations cover post-construction impacts from development in medium-sized communities. Municipalities located, in whole or in part, within an urbanized area as designated by the most recent census are required to submit Phase II National Pollutant Discharge Elimination System (NPDES) permit applications for stormwater management. Some communities choose to only meet Phase II requirements while others may set higher goals than state minimum requirements due to local concerns such as drinking water supply or habitat protection. Within the Goose Creek and Crooked Creek watersheds, all jurisdictions except the towns of Fairview, Hemby Bridge, and Unionville are currently designated Phase II communities. Both Fairview and Unionville have been identified as possible designation in 2011 because of potential stormwater discharges to impaired waters. Union County was “tipped in” because it had a 10 year growth rate equal or greater than the average state growth rate.

Background NPDES Information

In 1990 the U.S. Environmental Protection Agency’s (EPA) Phase I stormwater program was promulgated under the Clean Water Act. Phase I relies on National Pollutant Discharge Elimination System (NPDES) permit coverage to address stormwater runoff from: (1) “medium” and “large” municipal separate storm sewer systems (MS4s) generally serving populations of 100,000 or greater, (2) construction activity disturbing 5 acres of land or greater, and (3) ten categories of industrial activity.

The NPDES Stormwater Phase II Final Rule was promulgated in December 1999, and is the next step in EPA’s effort to preserve, protect, and improve the Nation’s water resources from polluted stormwater runoff. The Phase II program expands the Phase I program by requiring additional operators of MS4s in urbanized areas and operators of small construction sites, through the use of NPDES permits, to implement programs and practices to control stormwater runoff. Phase II is intended to further reduce adverse impacts to water quality and aquatic habitat by instituting the use of controls on the unregulated sources of stormwater discharges that have the greatest likelihood of causing continued environmental degradation. North Carolina is an EPA delegated state for the federal NPDES program and implements this program through the Division of Water Quality (DWQ). A small MS4 becomes part of the Phase II program in one of four ways:

1. Automatic designation,
2. Petitioning,
3. TMDL designation or
4. State designation

All Regulated Public Entities (RPEs) shall develop, implement and enforce a stormwater management plan approved by the DWQ. The plan shall be designed to reduce discharge of pollutants to the maximum extent practicable and, except as otherwise provided, shall include but not be limited to the following minimum measures:

1. A public education and outreach program on the impacts of stormwater discharges on water-bodies to inform citizens of how to reduce pollutants in stormwater runoff.
2. A public involvement and participation program consistent with all applicable state and local requirements.
3. A program to detect and eliminate illicit discharges within the RPE jurisdictional area.
4. A program to reduce pollutants in any stormwater runoff to the MS4 or waters of the State from construction activities resulting from a land disturbance of greater than or equal to one acre.
5. A program to address post-construction stormwater runoff from new development and redevelopment projects that cumulatively disturb greater than or equal to one acre, including

projects less than one acre that are part of a larger common plan of development or sale, that discharge into the MS4 or into an interconnected MS4 or waters of the State; and

6. A pollution prevention/good housekeeping program for municipal operations that addresses operation and maintenance, including a training component, to prevent or reduce pollutant runoff from those operations. RPEs may use qualified existing state and local programs to meet the required permit minimum measures either in whole or in part.

Union County

The Union County Comprehensive Plan encourages the protection and improvements of local water quality and recommends the adoption and implementation of stormwater best management practices (BMPs) in development regulations and programs to reduce runoff and protect water quality. It also recommends the long-term management of these facilities as a component of stormwater planning efforts.

City of Monroe

The City of Monroe's Land Development Plan includes a Special Planning Area for Natural Resources and Recreation. Strategies within this area include developing post construction stormwater management standards for all new developments and to continue to explore innovative stormwater management/treatment alternatives to standard wet detention.

In 2007 the City of Monroe passed a Stormwater Management Ordinance. The purpose of this ordinance is to "protect, maintain and enhance the public health, safety, environment and general welfare by establishing minimum requirements and procedures to control the adverse effects of increased post-development stormwater runoff and non-point and point source pollution associated with new development and redevelopment as well as illicit discharges into municipal stormwater systems." The proper management of construction-related and post-development stormwater runoff will minimize damage to public and private property and infrastructure; safeguard the public health, safety, and general welfare; and protect water and aquatic resources.

This Ordinance seeks to meet its general purpose through the following specific objectives and means:

1. Establishing decision-making processes for *development* that protect the integrity of watersheds and preserve the health of water resources;
2. Requiring that new *development* and *redevelopment* maintain the *pre-development* hydrologic response in their post-*development* state as nearly as practicable for the applicable design storm to reduce flooding, stream bank erosion, non-point and point source pollution and increases in stream temperature, and to maintain the integrity of stream channels and aquatic habitats;
3. Establishing minimum post-*development* stormwater management standards and design criteria for the regulation and control of stormwater runoff quantity and quality;
4. Establishing design and review criteria for the construction, function, and use of structural stormwater BMPs that may be used to meet the minimum post-*development* stormwater management standards;
5. Encouraging the use of better management and site design practices, such as the use of vegetated conveyances for stormwater and the preservation of green space, riparian buffers and other conservation areas to the maximum extent practicable;

6. Establishing provisions for the long-term responsibility for and maintenance of *structural and nonstructural stormwater BMPs* to ensure that they continue to function as designed, are maintained appropriately, and pose no threat to public safety;
7. Establishing administrative procedures for the submission, review, approval and disapproval of *stormwater management plans*, for the inspection of approved projects, and to assure appropriate long-term maintenance.
8. Coordinating site design plans that include open space and natural areas with the Unified Development Ordinance.
9. Controlling illicit discharges into the municipal separate stormwater system.
10. Controlling erosion and sedimentation from construction activities in conjunction with the Erosion and Sedimentation Control Ordinance

The jurisdictions of Matthews, Mint Hill, Stallings, Indian Trail, Lake Park and Union County also have adopted Post Construction Stormwater Ordinances with purpose statements and objectives almost identical to the City of Monroe's. Only the City of Monroe includes objectives eight and nine as listed above.

For the unincorporated portions of Union County, Fairview, Hemby Bridge, and Unionville, the North Carolina Division of Water Quality implements the Post-Construction requirements (within Crooked Creek watershed). The Site Specific Water Quality Management Plan for the Goose Creek Watershed is also implemented by the NCDWQ in the Goose Creek Watershed. The purpose of the actions required by the site-specific management strategy is for the maintenance and recovery of the water quality conditions required to sustain and recover the federally endangered Carolina heelsplitter (*Lasmigona decorata*) species. If new development disturbs one acre or more of land within the Goose Creek Watershed and adds impervious surface (e.g., roads, parking lots, buildings), then stormwater runoff must be controlled and treated with structural controls. Structural controls normally require engineering design and engineered construction. Examples include wet ponds, stormwater wetlands or permeable pavement.

IV. Better Site Design

Another tool used in watershed protection and restoration is better site design. Local codes and ordinances can be used to incorporate best management practices into new and redevelopment sites to minimize a project's environmental footprint, reduce impervious cover or redirect runoff. These techniques are normally referred to as Low Impact Development (LID) which is an innovative stormwater management approach that is modeled after nature. Its goal is to manage rainfall at the source using uniformly distributed decentralized micro-scale controls. There are many site design methods that can easily be incorporated into local codes and ordinances, including:

- Minimizing disturbance to conserve forested or natural areas
- Designing and using smaller parking lots and parking stalls and shared parking requirements
- Managing and treating stormwater through the use of conditioned planted soil beds and planting materials (e.g., bioretention cells and wetlands).
- Designing narrower streets integrated with open drainage
- Using conservation design with clustered buildings and preserved open space
- Disconnecting impervious surfaces and associated runoff from stormwater sewer system
- Preserving riparian buffers

- Using swales instead of curb and gutter
- Rain barrels or cisterns

For many communities the big difference is to what degree the community commits to these practices. Many may encourage the practice, while very few actually require it. This section reviews how each community uses these tools and techniques to protect the watersheds and improve water quality. To gather information of the best practices, each jurisdiction completed the Code and Ordinance Worksheet, which is an in-depth review of local codes and ordinances which shape how development occurs. The worksheet presents 77 site planning benchmarks which focus on a specific site design practice, such as a minimum diameter of cul-de-sacs, the minimum street width and a minimum parking ratio. The worksheet also helps to identify areas where the codes and ordinances can be strengthened. The worksheet has a scoring/point system which helps evaluate how well local practices meet better site design principles.

The worksheet breaks the design techniques into three major categories: new impervious surfaces, neighborhood design, and protection of natural areas. The new impervious surface section focuses on the codes, ordinances and standards that determine the size, shape and construction of parking lots, roadways and driveways in the suburban landscape. The neighborhood design section focuses on the regulations which determine the lot size, lot shape, housing density and the overall design appearance of the neighborhoods. The protection of natural areas section addresses the codes and ordinances that promote (or impede) the protection of existing natural areas and incorporation of open spaces into new development.

Eight of the eleven communities within the two basins submitted a completed worksheet. Only the Village of Lake Park, Hemby Bridge and the Town of Stallings did not. A few of the 77 benchmarks have been extracted to see the level of better design principles each of the communities currently maintain. These findings are included in the following:

All jurisdictions that responded

- Require a minimum percentage of parking lots to be landscaped
- Allow cluster type of developments
- Have a stream buffer ordinance
- Prohibit development in the 100-year floodplain.

Various levels

- All but Union County require a minimum right of way of less than 45 feet.
- Only Union County and Monroe do not require curb and gutter in all residential streets
- Only Matthews does not allow for shared parking
- Only Union County does not require at least part of the stream buffer be maintained with native vegetation
- Only Mint Hill does not require significant tree strands to be preserved during new construction
- Only Mecklenburg, Unionville and Fairview offer incentives to conserve land.

Conclusion

Regulatory and programmatic changes are made in response to a review of local codes, ordinances, and programs related to watershed protection. When local regulations are found lacking, specific changes may be needed to protect watershed resources from future development impacts. A community can first look to their adopted land use plan to provide

The Code of Ordinances Worksheet is a simple and straight forward tool that will highlight what regulatory changes can directly influence watershed management. There are various levels of better practices within each category. For instance, having a stream buffer ordinance is the first step. If a community wants to improve it even more the minimum width would be expanded to 75' or more stream buffer. Expanding the buffer to include freshwater wetland, steep slopes or the 100 year floodplain will take regulation to an even higher level. Each level of regulation or best practice will provide additional protection of the watershed. Within the eight communities that responded all eight have a stream buffer, however none go beyond 70' and none include any additional types of areas.

Code of Ordinances Worksheets

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CODE AND ORDINANCE WORKSHEET

About the Adobe Acrobat Form

Note: Acrobat Reader will not save the information entered into a form. Saving changes is only possible with a full version of Acrobat.

- The blue fields indicate that an answer is required.
- The gray fields are for notes and are not required, but highly recommended.
- The green fields will automatically summarize the points – no input is needed here.

To fill out a form:

1. Select the hand tool .
2. Position the pointer inside a form field, and click. The I-beam pointer allows you to type text. If your pointer appears as a pointing finger, you can select an item from a list (i.e., YES or NO).
3. After entering text or making a selection, press Tab to accept the form field change and go to the next or previous field.
4. Once you have filled in the appropriate form fields, do both of the following:
 - Choose File > Export > Form Data to save the form data in a separate FDF file. Type a filename and click save.
 - Print the form so that you have a hard copy for your records.

And Most Importantly...

Send CWP a copy! Let us know how you did!

The Code and Ordinance Worksheet allows an in-depth review of the standards, ordinances, and codes (i.e., the development rules) that shape how development occurs in your community. You are guided through a systematic comparison of your local development rules against the model development principles. Institutional frameworks, regulatory structures and incentive programs are included in this review. The worksheet consists of a series of questions that correspond to each of the model development principles. Points are assigned based on how well the current development rules agree with the site planning benchmarks derived from the model development principles.

The worksheet is intended to guide you through the first two steps of a local site planning roundtable.

Step 1: Find out what the Development Rules are in your community.

Step 2: See how your rules stack up to the Model Development Principles.

The homework done in these first two steps helps to identify which development rules are potential candidates for change.

PREPARING TO COMPLETE THE CODE AND ORDINANCE WORKSHEET

Two tasks need to be performed before you begin in the worksheet. First, you must identify all the development rules that apply in your community. Second, you must identify the local, state, and federal authorities that actually administer or enforce the development rules within your community. Both tasks require a large investment of time. The development process is usually shaped by a complex labyrinth of regulations, criteria, and authorities. A team approach may be helpful. You may wish to enlist the help of a local plan reviewer, land planner, land use attorney, or civil engineer. Their real-world experience with the development process is often very useful in completing the worksheet.

Identify the Development Rules

Gather the key documents that contain the development rules in your community. A list of potential documents to look for is provided in Table 1. Keep in mind that the information you may want on a particular development rule is not always found in code or regulation, and maybe hidden in supporting design manuals, review checklists, guidance document or construction specifications. In most cases, this will require an extensive search. Few communities include all of their rules in a single document. Be prepared to contact state and federal, as well as local agencies to obtain copies of the needed documents.

Table 1: Key Local Documents that will be Needed to Complete the COW

Zoning Ordinance
Subdivision Codes
Street Standards or Road Design Manual
Parking Requirements
Building and Fire Regulations/Standards
Stormwater Management or Drainage Criteria
Buffer or Floodplain Regulations
Environmental Regulations
Tree Protection or Landscaping Ordinance
Erosion and Sediment Control Ordinances
Public Fire Defense Masterplans
Grading Ordinance

Identify Development Authorities

Once the development rules are located, it is relatively easy to determine which local agencies or authorities are actually responsible for administering and enforcing the rules. Completing this step will provide you with a better understanding of the intricacies of the development review process and helps identify key members of a future local roundtable. Table 2 provides a simple framework for identifying the agencies that influence development in your community. As you will see, space is provided not only for local agencies, but for state and federal agencies as well. In some cases, state and federal agencies may also exercise some authority over the local development process (e.g., wetlands, some road design, and stormwater).

USING THE WORKSHEET: HOW DO YOUR RULES STACK UP TO THE MODEL DEVELOPMENT PRINCIPLES?

Completing the Worksheet

Once you have located the documents that outline your development rules and identified the authorities responsible for development in your community, you are ready for the next step. You can now use the worksheet to compare your development rules to the model development principles. The worksheet is presented at the end of this chapter. The worksheet presents seventy-seven site planning benchmarks. The benchmarks are posed as questions. Each benchmark focuses on a specific site design practice, such as the minimum diameter of cul-de-sacs, the minimum width of streets, or the minimum parking ratio for a certain land use. You should refer to the codes, ordinances, and plans identified in the first step to determine the appropriate development rule. The questions require either a yes or no response or specific numeric criteria. If your development rule agrees with the site planning benchmark, you are awarded points.

Calculating Your Score

A place is provided on each page of the worksheet to keep track of your running score. In addition, the worksheet is subdivided into three categories:

- Residential Streets and Parking Lots (Principles No. 1 - 10)
- Lot Development (Principles No. 11 - 16)
- Conservation of Natural Areas (Principles No. 17 - 22).

For each category, you are asked to subtotal your score. This **"Time to Assess"** allows you to consider which development rules are most in line with the site planning benchmarks and what rules are potential candidates for change.

The total number of points possible for all of the site planning benchmarks is 100. Your overall score provides a general indication of your community's ability to support environmentally sensitive development. As a general rule, if your overall score is lower than 80, then it may be advisable to systematically reform your local development rules. A score sheet is provided at end of the Code and Ordinance Worksheet to assist you in determining where your community's score places in respect to the Model Development Principles. Once you have completed the worksheet, go back and review your responses. Determine if there are specific areas that need improvement (e.g., development rules that govern road design) or if your development rules are generally pretty good. This review is key to implementation of better development: assessment of your current development rules and identification of impediments to innovative site design. This review also directly leads into the next step: a site planning roundtable process conducted at the local government level. The primary tasks of a local roundtable are to systematically review existing development rules and then determine if changes can or should be made. By providing a much-needed framework for overcoming barriers to better development, the site planning roundtable can serve as an important tool for local change.

Table 2: Local, State, and Federal Authorities Responsible for Development in Your Community

Development Responsibility		State/Federal	County	Town
Sets road standards	Agency:			
	Contact Name:			
	Phone No.:			
Review/approves subdivision plans	Agency:			
	Contact Name:			
	Phone No.:			
Establishes zoning ordinances	Agency:			
	Contact Name:			
	Phone No.:			
Establishes subdivision ordinances	Agency:			
	Contact Name:			
	Phone No.:			
Reviews/establishes stormwater management or drainage criteria	Agency:			
	Contact Name:			
	Phone No.:			
Provides fire protection and fire protection code enforcement	Agency:			
	Contact Name:			
	Phone No.:			
Oversees buffer ordinance	Agency:			
	Contact Name:			
	Phone No.:			
Oversees wetland protection	Agency:			
	Contact Name:			
	Phone No.:			
Establishes grading requirements or oversees erosion and sediment control program	Agency:			
	Contact Name:			
	Phone No.:			
Reviews/approves septic systems	Agency:			
	Contact Name:			
	Phone No.:			
Review/approves utility plans (e.g., water and sewer)	Agency:			
	Contact Name:			
	Phone No.:			
Reviews/approves forest conservation/ tree protection plans	Agency:			
	Contact Name:			
	Phone No.:			

1. Street Width

What is the minimum pavement width allowed for streets in low density residential developments that have less than 500 daily trips (ADT)?

 feet

If your answer is between **18-22 feet**, give yourself **4 points**

At higher densities are parking lanes allowed to also serve as traffic lanes (i.e., queuing streets)?

 YES

If your answer is **YES**, give yourself **3 points**

Notes on Street Width (include source documentation such as name of document, section and page #):

2. Street Length

Do street standards promote the most efficient street layouts that reduce overall street length?

 YES

If your answer is **YES**, give yourself **1 point**

Notes on Street Length (include source documentation such as name of document, section and page #):

3. Right-of-Way Width

What is the minimum right of way (ROW) width for a residential street?

 feet

If your answer is **less than 45 feet**, give yourself **3 points**

Does the code allow utilities to be placed under the paved section of the ROW?

 YES

If your answer is **YES**, give yourself **1 point**

Notes on ROW Width (include source documentation such as name of document, section and page #):

4. Cul-de-Sacs

What is the minimum radius allowed for cul-de-sacs?

 feet

If your answer is **less than 35 feet**, give yourself **3 points**

If your answer is **36 feet to 45 feet**, give yourself **1 point**

Can a landscaped island be created within the cul-de-sac?

 YES

If your answer is **YES**, give yourself **1 point**

Are alternative turnarounds such as "hammerheads" allowed on short streets in low density residential developments?

 YES

If your answer is **YES**, give yourself **1 point**

Notes on Cul-de-Sacs (include source documentation such as name of document, section and page #):

5. Vegetated Open Channels

Are curb and gutters required for most residential street sections?

YES

If your answer is **NO**, give yourself **2 points**

Are there established design criteria for swales that can provide stormwater quality treatment (i.e., dry swales, biofilters, or grass swales)?

YES

If your answer is **YES**, give yourself **2 points**

Notes on Vegetated Open Channel (include source documentation such as name of document, section and page #):

6. Parking Ratios

What is the minimum parking ratio for a professional office building (per 1000 ft² of gross floor area)?

 spaces

If your answer is **less than 3.0 spaces**, give yourself **1 point**

What is the minimum required parking ratio for shopping centers (per 1,000 ft² gross floor area)?

 spaces

If your answer is **4.5 spaces or less**, give yourself **1 point**

What is the minimum required parking ratio for single family homes (per home)?

 spaces

If your answer is **less than or equal to 2.0 spaces**, give yourself **1 point**

Are your parking requirements set as maximum or median (rather than minimum) requirements?

YES

If your answer is **YES**, give yourself **2 points**

Notes on Parking Ratios (include source documentation such as name of document, section and page #):

7. Parking Codes

Is the use of shared parking arrangements promoted?

YES

If your answer is **YES**, give yourself **1 point**

Are model shared parking agreements provided?

YES

If your answer is **YES**, give yourself **1 point**

Are parking ratios reduced if shared parking arrangements are in place?

YES

If your answer is **YES**, give yourself **1 point**

If mass transit is provided nearby, is the parking ratio reduced?

YES

If your answer is **YES**, give yourself **1 point**

Notes on Parking Codes (include source documentation such as name of document, section and page #):

8. Parking Lots

What is the minimum stall width for a standard parking space?

 feet

If your answer is **9 feet or less**, give yourself **1 point**

What is the minimum stall length for a standard parking space?

 feet

If your answer is **18 feet or less**, give yourself **1 point**

Are at least 30% of the spaces at larger commercial parking lots required to have smaller dimensions for compact cars?

 YES

If your answer is **YES**, give yourself **1 point**

Can pervious materials be used for spillover parking areas?

 YES

If your answer is **YES**, give yourself **2 points**

Notes on Parking Lots (include source documentation such as name of document, section and page #):

9. Structured Parking

Are there any incentives to developers to provide parking within garages rather than surface parking lots?

 YES

If your answer is **YES**, give yourself **1 point**

Notes on Structured Parking (include source documentation such as name of document, section and page #):

10. Parking Lot Runoff

Is a minimum percentage of a parking lot required to be landscaped?

 YES

If your answer is **YES**, give yourself **2 points**

Is the use of bioretention islands and other stormwater practices within landscaped areas or setbacks allowed?

 YES

If your answer is **YES**, give yourself **2 points**

Notes on Parking Lot Runoff (include source documentation such as name of document, section and page #):

@ Time to Assess: Principles 1 - 10 focused on the codes, ordinances, and standards that determine the size, shape, and construction of parking lots, roadways, and driveways in the suburban landscape. There were a total of **40** points available for Principles 1 - 10. What was your total score?

Subtotal Page 5 + Subtotal Page 6 + Subtotal Page 7 =

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

11. Open Space Design

Are open space or cluster development designs allowed in the community?

*If your answer is **YES**, give yourself **3** points*

*If your answer is **NO**, skip to question No. 12*

Is land conservation or impervious cover reduction a major goal or objective of the open space design ordinance?

*If your answer is **YES**, give yourself **1** point*

Are the submittal or review requirements for open space design greater than those for conventional development?

*If your answer is **NO**, give yourself **1** point*

Is open space or cluster design a by-right form of development?

*If your answer is **YES**, give yourself **1** point*

Are flexible site design criteria available for developers that utilize open space or cluster design options (e.g., setbacks, road widths, lot sizes)?

*If your answer is **YES**, give yourself **2** points*

Notes on Open Space Design (include source documentation such as name of document, section and page #):

12. Setbacks and Frontages

Are irregular lot shapes (e.g., pie-shaped, flag lots) allowed in the community?

If your answer is **YES**, give yourself **1 point**

What is the minimum requirement for front setbacks for a one half (½) acre residential lot?

 feet

If your answer is **20 feet or less**, give yourself **1 point**

What is the minimum requirement for rear setbacks for a one half (½) acre residential lot?

 feet

If your answer is **25 feet or less**, give yourself **1 point**

What is the minimum requirement for side setbacks for a one half (½) acre residential lot?

 feet

If your answer is **8 feet or less**, give yourself **1 points**

What is the minimum frontage distance for a one half (½) acre residential lot?

 feet

If your answer is **less than 80 feet**, give yourself **2 points**

Notes on Setback and Frontages (include source documentation such as name of document, section and page #):

13. Sidewalks

What is the minimum sidewalk width allowed in the community?

 feet

If your answer is **4 feet or less**, give yourself **2 points**

Are sidewalks always required on both sides of residential streets?

If your answer is **NO**, give yourself **2 points**

Are sidewalks generally sloped so they drain to the front yard rather than the street?

If your answer is **YES**, give yourself **1 point**

Can alternate pedestrian networks be substituted for sidewalks (e.g., trails through common areas)?

If your answer is **YES**, give yourself **1 point**

Notes on Sidewalks (include source documentation such as name of document, section and page #):

14. Driveways

What is the minimum driveway width specified in the community?

 feet

If your answer is **9 feet or less (one lane) or 18 feet (two lanes)**, give yourself **2 points**

Can pervious materials be used for single family home driveways (e.g., grass, gravel, porous pavers, etc)?

YES

If your answer is **YES**, give yourself **2 points**

Can a "two track" design be used at single family driveways?

YES

If your answer is **YES**, give yourself **1 point**

Are shared driveways permitted in residential developments?

YES

If your answer is **YES**, give yourself **1 point**

Notes on Driveways (include source documentation such as name of document, section and page #):

15. Open Space Management

Skip to question 16 if open space, cluster, or conservation developments are not allowed in your community.

Does the community have enforceable requirements to establish associations that can effectively manage open space?

YES

If your answer is **YES**, give yourself **2 points**

Are open space areas required to be consolidated into larger units?

YES

If your answer is **YES**, give yourself **1 point**

Does a minimum percentage of open space have to be managed in a natural condition?

YES

If your answer is **YES**, give yourself **1 point**

Are allowable and unallowable uses for open space in residential developments defined?

YES

If your answer is **YES**, give yourself **1 point**

Can open space be managed by a third party using land trusts or conservation easements?

YES

If your answer is **YES**, give yourself **1 point**

Notes on Open Space Management (include source documentation such as name of document, section and page #):

16. Rooftop Runoff

Can rooftop runoff be discharged to yard areas?

YES

If your answer is **YES**, give yourself **2 points**

Do current grading or drainage requirements allow for temporary ponding of stormwater on front yards or rooftops?

YES

If your answer is **YES**, give yourself **2 points**

Notes on Rooftop Runoff (include source documentation such as name of document, section and page #):

@ Time to Assess: Principles 11 through 16 focused on the regulations which determine lot size, lot shape, housing density, and the overall design and appearance of our neighborhoods. There were a total of **36** points available for Principles 11 - 16. What was your total score?

Subtotal Page 8 + Subtotal Page 9 + Subtotal Page 10 =

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

17. Buffer Systems

Is there a stream buffer ordinance in the community?

YES

If your answer is **YES**, give yourself **2** points

If so, what is the minimum buffer width?

feet

If your answer is **75 feet or more**, give yourself **1** point

Is expansion of the buffer to include freshwater wetlands, steep slopes or the 100-year floodplain required?

YES

If your answer is **YES**, give yourself **1** point

Notes on Buffer Systems (include source documentation such as name of document, section and page #):

18. Buffer Maintenance

If you do not have stream buffer requirements in your community, skip to question No. 19

Does the stream buffer ordinance specify that at least part of the stream buffer be maintained with native vegetation?

YES

If your answer is **YES**, give yourself **2** points

Does the stream buffer ordinance outline allowable uses?

YES

If your answer is **YES**, give yourself **1** point

Does the ordinance specify enforcement and education mechanisms?

YES

If your answer is **YES**, give yourself **1 point**

Notes on Buffer Systems (include source documentation such as name of document, section and page #):

19. Clearing and Grading

Is there any ordinance that requires or encourages the preservation of natural vegetation at residential development sites?

YES

If your answer is **YES**, give yourself **2 points**

Do reserve septic field areas need to be cleared of trees at the time of development?

YES

If your answer is **NO**, give yourself **1 point**

Notes on Buffer Maintenance (include source documentation such as name of document, section and page #):

20. Tree Conservation

If forests or specimen trees are present at residential development sites, does some of the stand have to be preserved?

YES

If your answer is **YES**, give yourself **2 points**

Are the limits of disturbance shown on construction plans adequate for preventing clearing of natural vegetative cover during construction?

YES

If your answer is **YES**, give yourself **1 point**

Notes on Tree Conservation (include source documentation such as name of document, section and page #):

21. Land Conservation Incentives

Are there any incentives to developers or landowners to conserve non-regulated land (open space design, density bonuses, stormwater credits or lower property tax rates)?

YES

If your answer is **YES**, give yourself **2 points**

Is flexibility to meet regulatory or conservation restrictions (density compensation, buffer averaging, transferable development rights, off-site mitigation) offered to developers?

YES

If your answer is **YES**, give yourself **2 points**

Notes on Land Cons. Incentives (include source documentation such as name of document, section and page #):

22. Stormwater Outfalls

Is stormwater required to be treated for quality before it is discharged?

YES

If your answer is **YES**, give yourself **2 points**

Are there effective design criteria for stormwater best management practices (BMPs)?

YES

If your answer is **YES**, give yourself **1 point**

Can stormwater be directly discharges into a jurisdictional wetland without pretreatment?

YES

If your answer is **NO**, give yourself **1 point**

Does a floodplain management ordinance that restricts or prohibits development within the 100-year floodplain exist?

YES

If your answer is **YES**, give yourself **2 points**

Notes on Stormwater Outfalls (include source documentation such as name of document, section and page #):

Code and Ordinance Worksheet

Subtotal Page 13

0

@ Time to Assess: Principles 17 through 22 addressed the codes and ordinances that promote (or impede) protection of existing natural areas and incorporation of open spaces into new development. There were a total of 24 points available for Principles 17 - 22. What was your total score?

Subtotal Page 11 + Subtotal Page 12 + Subtotal Page 13 =

0

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

To determine final score, add up subtotal from each **@ Time to Assess**

Principles 1 - 10 (Page 8)

0

Principles 11 - 16 (Page 11)

0

Principles 17 - 22 (Page 13)

0

TOTAL

0

SCORING (A total of **100** points are available):

Your Community's Score

90- 100	L	Congratulations! Your community is a real leader in protecting streams, lakes, and estuaries. Keep up the good work.
80 - 89	L	Your local development rules are pretty good, but could use some tweaking in some areas.
79 - 70	L	Significant opportunities exist to improve your development rules. Consider creating a site planning roundtable.
60 - 69	L	Development rules are inadequate to protect your local aquatic resources. A site planning roundtable would be very useful.
less than 60	L	Your development rules definitely are not environmentally friendly. Serious reform of the development rules is needed.

Code and Ordinance Worksheet

Table 2: Local, State, and Federal Authorities Responsible for Development in Your Community

Development Responsibility		State/Federal	County	Town
Sets road standards	Agency:			
	Contact Name:			
	Phone No.:			
Review/approves subdivision plans	Agency:			City of Monroe
	Contact Name:			
	Phone No.:			
Establishes zoning ordinances	Agency:			City of Monroe
	Contact Name:			Planning Department
	Phone No.:			
Establishes subdivision ordinances	Agency:			City of Monroe
	Contact Name:			
	Phone No.:			
Reviews/establishes stormwater management or drainage criteria	Agency:			City of Monroe
	Contact Name:			Engineering Department
	Phone No.:			
Provides fire protection and fire protection code enforcement	Agency:			City of Monroe
	Contact Name:			Fire Department
	Phone No.:			
Oversees buffer ordinance	Agency:			City of Monroe
	Contact Name:			Planning Department
	Phone No.:			
Oversees wetland protection	Agency:	USA COE		
	Contact Name:			
	Phone No.:			
Establishes grading requirements or oversees erosion and sediment control program	Agency:			City of Monroe
	Contact Name:			Engineering Department
	Phone No.:			
Reviews/approves septic systems	Agency:		Union County	
	Contact Name:		Health Department	
	Phone No.:			
Review/approves utility plans (e.g., water and sewer)	Agency:			City of Monroe
	Contact Name:			Water Resources Dept.
	Phone No.:			
Reviews/approves forest conservation/ tree protection plans	Agency:			
	Contact Name:			
	Phone No.:			

Development Feature**Your Local
Criteria****1. Street Width**

What is the minimum pavement width allowed for streets in low density residential developments that have less than 500 daily trips (ADT)?

 feet

If your answer is between 18-22 feet, give yourself 4 points • •

At higher densities are parking lanes allowed to also serve as traffic lanes (i.e., queuing streets)?

If your answer is YES, give yourself 3 points • •

Notes on Street Width (include source documentation such as name of document, section and page #):

City Std. Specification & Detail Manual - Detail 02.01.04A

2. Street Length

Do street standards promote the most efficient street layouts that reduce overall street length?

If your answer is YES, give yourself 1 point • •

Notes on Street Length (include source documentation such as name of document, section and page #):

City Std. Specification & Detail Manual

3. Right-of-Way Width

What is the minimum right of way (ROW) width for a residential street?

 feet

If your answer is less than 45 feet, give yourself 3 points • •

Does the code allow utilities to be placed under the paved section of the ROW?

If your answer is YES, give yourself 1 point • •

Notes on ROW Width (include source documentation such as name of document, section and page #):

City Std. Specification & Detail Manual

4. Cul-de-Sacs

What is the minimum radius allowed for cul-de-sacs?

 feet

If your answer is less than 35 feet, give yourself 3 points • •

If your answer is 36 feet to 45 feet, give yourself 1 point • •

Can a landscaped island be created within the cul-de-sac?

If your answer is YES, give yourself 1 point • •

Are alternative turnarounds such as "hammerheads" allowed on short streets in low density residential developments?

If your answer is YES, give yourself 1 point • •

Notes on Cul-de-Sacs (include source documentation such as name of document, section and page #):

City Std. Specification & Detail Manual - Detail 02.01.09

Development Feature**Your Local
Criteria****5. Vegetated Open Channels**

Are curb and gutters required for most residential street sections?

If your answer is **NO**, give yourself 2 points • •

Are there established design criteria for swales that can provide stormwater quality treatment (i.e., dry swales, biofilters, or grass swales)?

If your answer is **YES**, give yourself 2 points • •

NO

2

YES

2

Notes on Vegetated Open Channel (include source documentation such as name of document, section and page #):

City Std. Specification & Detail Manual and Stormwater Management Ordinance

6. Parking Ratios

What is the minimum parking ratio for a professional office building (per 1000 ft² of gross floor area)?

If your answer is **less than 3.0 spaces**, give yourself 1 point • •

What is the minimum required parking ratio for shopping centers (per 1,000 ft² gross floor area)?

If your answer is **4.5 spaces or less**, give yourself 1 point • •

What is the minimum required parking ratio for single family homes (per home)?

If your answer is **less than or equal to 2.0 spaces**, give yourself 1 point • •

Are your parking requirements set as maximum or median (rather than minimum) requirements?

If your answer is **YES**, give yourself 2 points • •

No REQUIREMENTS

spaces

1

spaces

1

4.0

spaces

0

YES

2

Notes on Parking Ratios (include source documentation such as name of document, section and page #):

Unified Development Ordinance - Section 156.187 (page 158)

7. Parking Codes

Is the use of shared parking arrangements promoted?

If your answer is **YES**, give yourself 1 point • •

Are model shared parking agreements provided?

If your answer is **YES**, give yourself 1 point • •

Are parking ratios reduced if shared parking arrangements are in place?

If your answer is **YES**, give yourself 1 point • •

If mass transit is provided nearby, is the parking ratio reduced?

If your answer is **YES**, give yourself 1 point • •

YES

1

NO

0

YES

1

NO

0

Notes on Parking Codes (include source documentation such as name of document, section and page #):

Unified Development Ordinance - Section 156.189 (page 159)

8. Parking Lots

What is the minimum stall width for a standard parking space?

If your answer is **9 feet or less**, give yourself **1 point** • •

9.0 feet

1

What is the minimum stall length for a standard parking space?

If your answer is **18 feet or less**, give yourself **1 point** • •

20.0 feet

0

Are at least 30% of the spaces at larger commercial parking lots required to have smaller dimensions for compact cars?

If your answer is **YES**, give yourself **1 point** • •

NO

0

Can pervious materials be used for spillover parking areas?

If your answer is **YES**, give yourself **2 points** • •

YES

0

Notes on Parking Lots (include source documentation such as name of document, section and page #):

City Std. Specification & Detail Manual - Section 02.02.05, Table 02-01

9. Structured Parking

Are there any incentives to developers to provide parking within garages rather than surface parking lots?

If your answer is **YES**, give yourself **1 point** • •

NO

0

Notes on Structured Parking (include source documentation such as name of document, section and page #):

10. Parking Lot Runoff

Is a minimum percentage of a parking lot required to be landscaped?

If your answer is **YES**, give yourself **2 points** • •

YES

2

Is the use of bioretention islands and other stormwater practices within landscaped areas or setbacks allowed?

If your answer is **YES**, give yourself **2 points** • •

YES

2

Notes on Parking Lot Runoff (include source documentation such as name of document, section and page #):

NC DENR BMP Manual/chapter 156.220 Zoning Ordinance

- • **Time to Assess:** Principles 1 - 10 focused on the codes, ordinances, and standards that determine the size, shape, and construction of parking lots, roadways, and driveways in the suburban landscape. There were a total of 40 points available for Principles 1 - 10. What was your total score?

Subtotal Page 5 + Subtotal Page 6 + Subtotal Page 7 =

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

11. Open Space Design

Are open space or cluster development designs allowed in the community?

If your answer is **YES**, give yourself 3 points • •

If your answer is **NO**, skip to question No. 12

Is land conservation or impervious cover reduction a major goal or objective of the open space design ordinance?

If your answer is **YES**, give yourself 1 point • •

Are the submittal or review requirements for open space design greater than those for conventional development?

If your answer is **NO**, give yourself 1 point • •

Is open space or cluster design a by-right form of development?

If your answer is **YES**, give yourself 1 point • •

Are flexible site design criteria available for developers that utilize open space or cluster design options (e.g., setbacks, road widths, lot sizes)

If your answer is **YES**, give yourself 2 points • •

Notes on Open Space Design (include source documentation such as name of document, section and page #):

Land Development Plan - Residential Uses (b) page 5

Development Feature

Your Local Criteria

12. Setbacks and Frontages

Are irregular lot shapes (e.g., pie-shaped, flag lots) allowed in the community?

If your answer is **YES**, give yourself 1 point • •

YES

1

What is the minimum requirement for front setbacks for a one half (½) acre residential lot?

10.0

feet

If your answer is **20 feet or less**, give yourself 1 point • •

1

What is the minimum requirement for rear setbacks for a one half (½) acre residential lot?

10.0

feet

If your answer is **25 feet or less**, give yourself 1 point • •

1

What is the minimum requirement for side setbacks for a one half (½) acre residential lot?

10.0

feet

If your answer is **8 feet or less**, give yourself 1 points • •

0

What is the minimum frontage distance for a one half (½) acre residential lot?

100.0

feet

If your answer is **less than 80 feet**, give yourself 2 points • •

0

Notes on Setback and Frontages (include source documentation such as name of document, section and page #):

Unified Development Ordinance - Section 156.139 and 156.140

13. Sidewalks

What is the minimum sidewalk width allowed in the community?

5.0

feet

If your answer is **4 feet or less**, give yourself 2 points • •

0

Are sidewalks always required on both sides of residential streets?

NO

If your answer is **NO**, give yourself 2 points • •

2

Are sidewalks generally sloped so they drain to the front yard rather than the street?

NO

If your answer is **YES**, give yourself 1 point • •

0

Can alternate pedestrian networks be substituted for sidewalks (e.g., trails through common areas)?

YES

If your answer is **YES**, give yourself 1 point • •

1

Notes on Sidewalks (include source documentation such as name of document, section and page #):

Std. Specification & Detail Manual - Detail 02.03.01

14. Driveways

What is the minimum driveway width specified in the community?

12.0

feet

If your answer is **9 feet or less (one lane) or 18 feet (two lanes)**, give yourself 2 points • •

0

Development Feature**Your Local
Criteria**

Can pervious materials be used for single family home driveways (e.g., grass, gravel, porous pavers, etc)?

If your answer is YES, give yourself 2 points • •

NO

0

Can a "two track" design be used at single family driveways?

If your answer is YES, give yourself 1 point • •

NO

0

Are shared driveways permitted in residential developments?

If your answer is YES, give yourself 1 point • •

NO

0

Notes on Driveways (include source documentation such as name of document, section and page #):

15. Open Space Management

Skip to question 16 if open space, cluster, or conservation developments are not allowed in your community.

Does the community have enforceable requirements to establish associations that can effectively manage open space?

If your answer is YES, give yourself 2 points • •

YES

2

Are open space areas required to be consolidated into larger units?

If your answer is YES, give yourself 1 point • •

NO

0

Does a minimum percentage of open space have to be managed in a natural condition?

If your answer is YES, give yourself 1 point • •

NO

0

Are allowable and unallowable uses for open space in residential developments defined?

If your answer is YES, give yourself 1 point • •

NO

0

Can open space be managed by a third party using land trusts or conservation easements?

If your answer is YES, give yourself 1 point • •

NO

0

Notes on Open Space Management (include source documentation such as name of document, section and page #):

Land Development Plan Residential Uses C(6) Page 3, Unified Development Ordinance - Section 156.148 - 149 page 142-143

16. Rooftop Runoff

Can rooftop runoff be discharged to yard areas?

If your answer is YES, give yourself 2 points • •

YES

2

Do current grading or drainage requirements allow for temporary ponding of stormwater on front yards or rooftops?

If your answer is YES, give yourself 2 points • •

NO

0

Notes on Rooftop Runoff (include source documentation such as name of document, section and page #):

• • **Time to Assess:** Principles 11 through 16 focused on the regulations which determine lot size, lot shape, housing density, and the overall design and appearance of our neighborhoods. There were a total of **36** points available for Principles 11 - 16. What was your total score?

Subtotal Page 8 + Subtotal Page 9 + Subtotal Page 10 =

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

17. Buffer Systems

Is there a stream buffer ordinance in the community?

If your answer is **YES**, give yourself 2 points • •

If so, what is the minimum buffer width?

If your answer is **75 feet or more**, give yourself 1 point • •

Is expansion of the buffer to include freshwater wetlands, steep slopes or the 100-year floodplain required?

If your answer is **YES**, give yourself 1 point • •

 feet

Notes on Buffer Systems (include source documentation such as name of document, section and page #):

18. Buffer Maintenance

If you do not have stream buffer requirements in your community, skip to question No. 19

Does the stream buffer ordinance specify that at least part of the stream buffer be maintained with native vegetation?

If your answer is **YES**, give yourself 2 points • •

Does the stream buffer ordinance outline allowable uses?

If your answer is **YES**, give yourself 1 point

Development Feature**Your Local
Criteria**

Does the ordinance specify enforcement and education mechanisms?

YES

If your answer is **YES**, give yourself **1 point** • •

1

Notes on Buffer Systems (include source documentation such as name of document, section and page #):

Unified Development Ordinance - Section 156.180

19. Clearing and Grading

Is there any ordinance that requires or encourages the preservation of natural vegetation at residential development sites?

YES

If your answer is **YES**, give yourself **2 points** • •

2

Do reserve septic field areas need to be cleared of trees at the time of development?

N/A

NO

If your answer is **NO**, give yourself **1 point** • •

0

Notes on Buffer Maintenance (include source documentation such as name of document, section and page #):

Unified Development Ordinance - Section 156.221 (page 173)

20. Tree Conservation

If forests or specimen trees are present at residential development sites, does some of the stand have to be preserved?

YES

If your answer is **YES**, give yourself **2 points** • •

2

Are the limits of disturbance shown on construction plans adequate for preventing clearing of natural vegetative cover during construction?

YES

If your answer is **YES**, give yourself **1 point** • •

1

Notes on Tree Conservation (include source documentation such as name of document, section and page #):

Unified Development Ordinance - Section 156.221 and 156.222 (page 173 - 174)

21. Land Conservation Incentives

Are there any incentives to developers or landowners to conserve non-regulated land (open space design, density bonuses, stormwater credits or lower property tax rates)?

NO

If your answer is **YES**, give yourself **2 points** • •

0

Is flexibility to meet regulatory or conservation restrictions (density compensation, buffer averaging, transferable development rights, off-site mitigation) offered to developers?

NO

If your answer is **YES**, give yourself **2 points** • •

0

Notes on Land Cons. Incentives (include source documentation such as name of document, section and page #):

22. Stormwater Outfalls

Is stormwater required to be treated for quality before it is discharged?

YES

If your answer is **YES**, give yourself 2 points • •

2

Are there effective design criteria for stormwater best management practices (BMPs)?

YES

If your answer is **YES**, give yourself 1 point • •

2

Can stormwater be directly discharges into a jurisdictional wetland without pretreatment?

NO

If your answer is **NO**, give yourself 1 point • •

1

Does a floodplain management ordinance that restricts or prohibits development within the 100-year floodplain exist?

YES

If your answer is **YES**, give yourself 2 points • •

2

Notes on Stormwater Outfalls (include source documentation such as name of document, section and page #):

Stormwater Management Ordinance and NC DENR BMP Manual

Code and Ordinance Worksheet

Subtotal Page 13

7

• • **Time to Assess:** Principles 17 through 22 addressed the codes and ordinances that promote (or impede) protection of existing natural areas and incorporation of open spaces into new development. There were a total of 24 points available for Principles 17 - 22. What was your total score?

Subtotal Page 11 5 + Subtotal Page 12 6 + Subtotal Page 13 7 = **18**

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

To determine final score, add up subtotal from each • **Time to Assess**

Principles 1 - 10 (Page 8)

22

Principles 11 - 16 (Page 11)

16

Principles 17 - 22 (Page 13)

18

TOTAL**56**

Development Feature

Your Local Criteria

1. Street Width

What is the minimum pavement width allowed for streets in low density residential developments that have less than 500 daily trips (ADT)?

18 feet

If your answer is between 18-22 feet, give yourself 4 points • •

4

At higher densities are parking lanes allowed to also serve as traffic lanes (i.e., queuing streets)?

NO

If your answer is YES, give yourself 3 points • •

0

Notes on Street Width (include source documentation such as name of document, section and page #):

Indian Trail Land Development Standards (ITLDS)

2. Street Length

Do street standards promote the most efficient street layouts that reduce overall street length?

YES

If your answer is YES, give yourself 1 point • •

1

Notes on Street Length (include source documentation such as name of document, section and page #):

Unified Development Ordinance (UDO)

3. Right-of-Way Width

What is the minimum right of way (ROW) width for a residential street?

40 feet

If your answer is less than 45 feet, give yourself 3 points • •

3

Does the code allow utilities to be placed under the paved section of the ROW?

YES

If your answer is YES, give yourself 1 point • •

1

Notes on ROW Width (include source documentation such as name of document, section and page #):

ITLDS

4. Cul-de-Sacs

What is the minimum radius allowed for cul-de-sacs?

35 feet

If your answer is less than 35 feet, give yourself 3 points • •

If your answer is 36 feet to 45 feet, give yourself 1 point • •

3

Can a landscaped island be created within the cul-de-sac?

NO

If your answer is YES, give yourself 1 point • •

0

Are alternative turnarounds such as "hammerheads" allowed on short streets in low density residential developments?

NO

If your answer is YES, give yourself 1 point • •

0

Notes on Cul-de-Sacs (include source documentation such as name of document, section and page #):

ITLDS

Development Feature

**Your Local
Criteria**

5. Vegetated Open Channels

Are curb and gutters required for most residential street sections?

YES

If your answer is **NO**, give yourself 2 points . .

0

Are there established design criteria for swales that can provide stormwater quality treatment (i.e., dry swales, biofilters, or grass swales)?

YES

If your answer is **YES**, give yourself 2 points . .

0

Notes on Vegetated Open Channel (include source documentation such as name of document, section and page #):

ITLDS & UDO

6. Parking Ratios

What is the minimum parking ratio for a professional office building (per 1000 ft² of gross floor area)?

3.5 spaces

If your answer is **less than 3.0 spaces**, give yourself 1 point . .

0

What is the minimum required parking ratio for shopping centers (per 1,000 ft² gross floor area)?

4.0 spaces

If your answer is **4.5 spaces or less**, give yourself 1 point . .

1

What is the minimum required parking ratio for single family homes (per home)?

2.0 spaces

If your answer is **less than or equal to 2.0 spaces**, give yourself 1 point . .

1

Are your parking requirements set as maximum or median (rather than minimum) requirements?

NO

If your answer is **YES**, give yourself 2 points . .

0

Notes on Parking Ratios (include source documentation such as name of document, section and page #):

UDO

7. Parking Codes

Is the use of shared parking arrangements promoted?

YES

If your answer is **YES**, give yourself 1 point . .

1

Are model shared parking agreements provided?

NO

If your answer is **YES**, give yourself 1 point . .

0

Are parking ratios reduced if shared parking arrangements are in place?

YES

If your answer is **YES**, give yourself 1 point . .

1

If mass transit is provided nearby, is the parking ratio reduced?

NO

If your answer is **YES**, give yourself 1 point . .

0

Notes on Parking Codes (include source documentation such as name of document, section and page #):

UDO

Code and Ordinance Worksheet

Subtotal Page 6

4

Development Feature

**Your Local
Criteria**

8. Parking Lots

What is the minimum stall width for a standard parking space?

If your answer is **9 feet or less**, give yourself **1 point** . .

9.0 feet

1

What is the minimum stall length for a standard parking space?

If your answer is **18 feet or less**, give yourself **1 point** . .

18.0 feet

1

Are at least 30% of the spaces at larger commercial parking lots required to have smaller dimensions for compact cars?

If your answer is **YES**, give yourself **1 point** . .

NO

0

Can pervious materials be used for spillover parking areas?

If your answer is **YES**, give yourself **2 points** . .

YES

2

Notes on Parking Lots (include source documentation such as name of document, section and page #):

ITLDS & UDO

9. Structured Parking

Are there any incentives to developers to provide parking within garages rather than surface parking lots?

If your answer is **YES**, give yourself **1 point** . .

NO

0

Notes on Structured Parking (include source documentation such as name of document, section and page #):

10. Parking Lot Runoff

Is a minimum percentage of a parking lot required to be landscaped?

If your answer is **YES**, give yourself **2 points** . .

YES

2

Is the use of bioretention islands and other stormwater practices within landscaped areas or setbacks allowed?

If your answer is **YES**, give yourself **2 points** . .

YES

2

Notes on Parking Lot Runoff (include source documentation such as name of document, section and page #):

UDO

Development Feature

Your Local Criteria

• • **Time to Assess:** Principles 1 - 10 focused on the codes, ordinances, and standards that determine the size, shape, and construction of parking lots, roadways, and driveways in the suburban landscape. There were a total of 40 points available for Principles 1 - 10. What was your total score?

Subtotal Page 5 + Subtotal Page 6 + Subtotal Page 7 =

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

11. Open Space Design

Are open space or cluster development designs allowed in the community?

If your answer is **YES**, give yourself 3 points • •

If your answer is **NO**, skip to question No. 12

YES

3

Is land conservation or impervious cover reduction a major goal or objective of the open space design ordinance?

If your answer is **YES**, give yourself 1 point • •

YES

1

Are the submittal or review requirements for open space design greater than those for conventional development?

If your answer is **NO**, give yourself 1 point • •

NO

0

Is open space or cluster design a by-right form of development?

If your answer is **YES**, give yourself 1 point • •

YES

1

Are flexible site design criteria available for developers that utilize open space or cluster design options (e.g., setbacks, road widths, lot sizes)?

If your answer is **YES**, give yourself 2 points • •

YES

2

Notes on Open Space Design (include source documentation such as name of document, section and page #):

UDO

Development Feature

Your Local Criteria

12. Setbacks and Frontages

Are irregular lot shapes (e.g., pie-shaped, flag lots) allowed in the community?

If your answer is **YES**, give yourself 1 point • •

YES

1

What is the minimum requirement for front setbacks for a one half (½) acre residential lot?

If your answer is **20 feet or less**, give yourself 1 point • •

25.0 feet

0

What is the minimum requirement for rear setbacks for a one half (½) acre residential lot?

If your answer is **25 feet or less**, give yourself 1 point • •

30.0 feet

0

What is the minimum requirement for side setbacks for a one half (½) acre residential lot?

If your answer is **8 feet or less**, give yourself 1 points • •

10.0 feet

0

What is the minimum frontage distance for a one half (½) acre residential lot?

If your answer is **less than 80 feet**, give yourself 2 points • •

60.0 feet

2

Notes on Setback and Frontages (include source documentation such as name of document, section and page #):

UDO

13. Sidewalks

What is the minimum sidewalk width allowed in the community?

If your answer is **4 feet or less**, give yourself 2 points • •

5.0 feet

0

Are sidewalks always required on both sides of residential streets?

If your answer is **NO**, give yourself 2 points • •

YES

0

Are sidewalks generally sloped so they drain to the front yard rather than the street?

If your answer is **YES**, give yourself 1 point • •

NO

0

Can alternate pedestrian networks be substituted for sidewalks (e.g., trails through common areas)?

If your answer is **YES**, give yourself 1 point • •

NO

0

Notes on Sidewalks (include source documentation such as name of document, section and page #):

UDO

14. Driveways

What is the minimum driveway width specified in the community?

If your answer is **9 feet or less (one lane) or 18 feet (two lanes)**, give yourself 2 points • •

15.0 feet

2

Development Feature**Your Local Criteria**

Can pervious materials be used for single family home driveways (e.g., grass, gravel, porous pavers, etc)?

NO

0

If your answer is **YES**, give yourself 2 points • •

Can a "two track" design be used at single family driveways?

NO

0

If your answer is **YES**, give yourself 1 point • •

Are shared driveways permitted in residential developments?

NO

0

If your answer is **YES**, give yourself 1 point • •

Notes on Driveways (include source documentation such as name of document, section and page #):

ITLDS

15. Open Space Management

Skip to question 16 if open space, cluster, or conservation developments are not allowed in your community.

Does the community have enforceable requirements to establish associations that can effectively manage open space?

YES

2

If your answer is **YES**, give yourself 2 points • •

Are open space areas required to be consolidated into larger units?

YES

1

If your answer is **YES**, give yourself 1 point • •

Does a minimum percentage of open space have to be managed in a natural condition?

YES

1

If your answer is **YES**, give yourself 1 point • •

Are allowable and unallowable uses for open space in residential developments defined?

YES

1

If your answer is **YES**, give yourself 1 point • •

Can open space be managed by a third party using land trusts or conservation easements?

YES

1

If your answer is **YES**, give yourself 1 point • •

Notes on Open Space Management (include source documentation such as name of document, section and page #):

UDO

16. Rooftop Runoff

Can rooftop runoff be discharged to yard areas?

YES

2

If your answer is **YES**, give yourself 2 points • •

Do current grading or drainage requirements allow for temporary ponding of stormwater on front yards or rooftops?

NO

0

If your answer is **YES**, give yourself 2 points • •

Notes on Rooftop Runoff (include source documentation such as name of document, section and page #):

UDO

Code and Ordinance Worksheet

Subtotal Page 10

8

• • **Time to Assess:** Principles 11 through 16 focused on the regulations which determine lot size, lot shape, housing density, and the overall design and appearance of our neighborhoods. There were a total of **36** points available for Principles 11 - 16. What was your total score?

Subtotal Page 8 + Subtotal Page 9 + Subtotal Page 10 =

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

17. Buffer Systems

Is there a stream buffer ordinance in the community?

If your answer is **YES**, give yourself **2** points • •

If so, what is the minimum buffer width?

If your answer is **75 feet or more**, give yourself **1** point • •

Is expansion of the buffer to include freshwater wetlands, steep slopes or the 100-year floodplain required?

If your answer is **YES**, give yourself **1** point • •

 feet

Notes on Buffer Systems (include source documentation such as name of document, section and page #):

UDO

18. Buffer Maintenance

If you do not have stream buffer requirements in your community, skip to question No. 19

Does the stream buffer ordinance specify that at least part of the stream buffer be maintained with native vegetation?

If your answer is **YES**, give yourself **2** points • •

Does the stream buffer ordinance outline allowable uses?

If your answer is **YES**, give yourself **1** point

Development Feature

**Your Local
Criteria**

Does the ordinance specify enforcement and education mechanisms?

YES

If your answer is YES, give yourself 1 point • •

Notes on Buffer Systems (include source documentation such as name of document, section and page #):

15A NCAC 02B.0607 - .0608

19. Clearing and Grading

Is there any ordinance that requires or encourages the preservation of natural vegetation at residential development sites?

YES

If your answer is YES, give yourself 2 points • •

2

Do reserve septic field areas need to be cleared of trees at the time of development?

YES

If your answer is NO, give yourself 1 point • •

0

Notes on Buffer Maintenance (include source documentation such as name of document, section and page #):

UDO & 15A NCAC 02B.0607 - .0608

20. Tree Conservation

If forests or specimen trees are present at residential development sites, does some of the stand have to be preserved?

YES

If your answer is YES, give yourself 2 points • •

2

Are the limits of disturbance shown on construction plans adequate for preventing clearing of natural vegetative cover during construction?

YES

If your answer is YES, give yourself 1 point • •

1

Notes on Tree Conservation (include source documentation such as name of document, section and page #):

UDO

21. Land Conservation Incentives

Are there any incentives to developers or landowners to conserve non-regulated land (open space design, density bonuses, stormwater credits or lower property tax rates)?

NO

If your answer is YES, give yourself 2 points • •

0

Is flexibility to meet regulatory or conservation restrictions (density compensation, buffer averaging, transferable development rights, off-site mitigation) offered to developers?

NO

If your answer is YES, give yourself 2 points • •

0

Notes on Land Cons. Incentiv es (include source documentation such as name of document, section and page #):

UDO

Development Feature

Your Local Criteria

22. Stormwater Outfalls

Is stormwater required to be treated for quality before it is discharged?

If your answer is **YES**, give yourself 2 points • •

Are there effective design criteria for stormwater best management practices (BMPs)?

If your answer is **YES**, give yourself 1 point • •

Can stormwater be directly discharges into a jurisdictional wetland without pretreatment?

If your answer is **NO**, give yourself 1 point • •

Does a floodplain management ordinance that restricts or prohibits development within the 100-year floodplain exist?

If your answer is **YES**, give yourself 2 points • •

YES

2

YES

1

NO

1

YES

2

Notes on Stormwater Outfalls (Include source documentation such as name of document, section and page #):

Code and Ordinance Worksheet

Subtotal Page 13

6

• • **Time to Assess:** Principles 17 through 22 addressed the codes and ordinances that promote (or impede) protection of existing natural areas and incorporation of open spaces into new development. There were a total of 24 points available for Principles 17 - 22. What was your total score?

Subtotal Page 11 + Subtotal Page 12 + Subtotal Page 13 =

17

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

To determine final score, add up subtotal from each • **Time to Assess**

Principles 1 - 10 (Page 8)

24

Principles 11 - 16 (Page 11)

20

Principles 17 - 22 (Page 13)

17

TOTAL

61

Development Feature

Your Local
Criteria

1. Street Width

What is the minimum pavement width allowed for streets in low density residential developments that have less than 500 daily trips (ADT)?

 feet

If your answer is between **18-22 feet**, give yourself **4 points** • •

At higher densities are parking lanes allowed to also serve as traffic lanes (i.e., queuing streets)?

If your answer is **YES**, give yourself **3 points** • •

Notes on Street Width (include source documentation such as name of document, section and page #):

2. Street Length

Do street standards promote the most efficient street layouts that reduce overall street length?

If your answer is **YES**, give yourself **1 point** • •

Notes on Street Length (include source documentation such as name of document, section and page #):

3. Right-of-Way Width

What is the minimum right of way (ROW) width for a residential street?

 feet

If your answer is **less than 45 feet**, give yourself **3 points** • •

Does the code allow utilities to be placed under the paved section of the ROW?

If your answer is **YES**, give yourself **1 point** • •

Notes on ROW Width (include source documentation such as name of document, section and page #):

4. Cul-de-Sacs

What is the minimum radius allowed for cul-de-sacs?

 feet

If your answer is **less than 35 feet**, give yourself **3 points** • •

If your answer is **36 feet to 45 feet**, give yourself **1 point** • •

Can a landscaped island be created within the cul-de-sac?

If your answer is **YES**, give yourself **1 point** • •

Are alternative turnarounds such as "hammerheads" allowed on short streets in low density residential developments?

If your answer is **YES**, give yourself **1 point** • •

Notes on Cul-de-Sacs (include source documentation such as name of document, section and page #):

5. Vegetated Open Channels

Are curb and gutters required for most residential street sections?

YES

If your answer is **NO**, give yourself 2 points • •

Are there established design criteria for swales that can provide storm water quality treatment (i.e., dry swales, biofilters, or grass swales)?

YES

If your answer is **YES**, give yourself 2 points • •

2

Notes on Vegetated Open Channel (include source documentation such as name of document, section and page #):

6. Parking Ratios

What is the minimum parking ratio for a professional office building (per 1000 ft² of gross floor area)?

3.3 spaces

If your answer is **less than 3.0 spaces**, give yourself 1 point • •

What is the minimum required parking ratio for shopping centers (per 1,000 ft² gross floor area)?

5.0 spaces

If your answer is **4.5 spaces or less**, give yourself 1 point • •

What is the minimum required parking ratio for single family homes (per home)?

2.0 spaces

If your answer is **less than or equal to 2.0 spaces**, give yourself 1 point • •

1

Are your parking requirements set as maximum or median (rather than minimum) requirements?

NO

If your answer is **YES**, give yourself 2 points • •

Notes on Parking Ratios (include source documentation such as name of document, section and page #):

7. Parking Codes

Is the use of shared parking arrangements promoted?

NO

If your answer is **YES**, give yourself 1 point • •

Are model shared parking agreements provided?

NO

If your answer is **YES**, give yourself 1 point • •

Are parking ratios reduced if shared parking arrangements are in place?

NO

If your answer is **YES**, give yourself 1 point • •

If mass transit is provided nearby, is the parking ratio reduced?

NO

If your answer is **YES**, give yourself 1 point • •

Notes on Parking Codes (include source documentation such as name of document, section and page #):

8. Parking Lots

What is the minimum stall width for a standard parking space?

8.5 feet

If your answer is **9 feet or less**, give yourself **1 point** • •

1

What is the minimum stall length for a standard parking space?

17.0 feet

If your answer is **18 feet or less**, give yourself **1 point** • •

1

Are at least 30% of the spaces at larger commercial parking lots required to have smaller dimensions for compact cars?

NO

If your answer is **YES**, give yourself **1 point** • •

Can pervious materials be used for spillover parking areas?

NO

If your answer is **YES**, give yourself **2 points** • •

Notes on Parking Lots (include source documentation such as name of document, section and page #):

9. Structured Parking

Are there any incentives to developers to provide parking within garages rather than surface parking lots?

NO

If your answer is **YES**, give yourself **1 point** • •

Notes on Structured Parking (include source documentation such as name of document, section and page #):

10. Parking Lot Runoff

Is a minimum percentage of a parking lot required to be landscaped?

YES

If your answer is **YES**, give yourself **2 points** • •

2

Is the use of bioretention islands and other stormwater practices within landscaped areas or setbacks allowed?

YES

If your answer is **YES**, give yourself **2 points** • •

2

Notes on Parking Lot Runoff (include source documentation such as name of document, section and page #):

- • **Time to Assess:** Principles 1 - 10 focused on the codes, ordinances, and standards that determine the size, shape, and construction of parking lots, roadways, and driveways in the suburban landscape. There were a total of 40 points available for Principles 1 - 10. What was your total score?

Subtotal Page 5 + Subtotal Page 6 + Subtotal Page 7 =

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

11. Open Space Design

Are open space or cluster development designs allowed in the community?

If your answer is **YES**, give yourself 3 points • •

If your answer is **NO**, skip to question No. 12

Is land conservation or impervious cover reduction a major goal or objective of the open space design ordinance?

If your answer is **YES**, give yourself 1 point • •

Are the submittal or review requirements for open space design greater than those for conventional development?

If your answer is **NO**, give yourself 1 point • •

Is open space or cluster design a by-right form of development?

If your answer is **YES**, give yourself 1 point • •

Are flexible site design criteria available for developers that utilize open space or cluster design options (e.g., setbacks, road widths, lot sizes)

If your answer is **YES**, give yourself 2 points • •

Notes on Open Space Design (include source documentation such as name of document, section and page #):

12. Setbacks and Frontages

Are irregular lot shapes (e.g., pie-shaped, flag lots) allowed in the community?

If your answer is **YES**, give yourself **1 point** • •

What is the minimum requirement for front setbacks for a one half (½) acre residential lot?

If your answer is **20 feet or less**, give yourself **1 point** • •

What is the minimum requirement for rear setbacks for a one half (½) acre residential lot?

If your answer is **25 feet or less**, give yourself **1 point** • •

What is the minimum requirement for side setbacks for a one half (½) acre residential lot?

If your answer is **8 feet or less**, give yourself **1 points** • •

What is the minimum frontage distance for a one half (½) acre residential lot?

If your answer is **less than 80 feet**, give yourself **2 points** • •

YES

1

50.0 feet

60.0 feet

12.0 feet

90.0 feet

Notes on Setback and Frontages (include source documentation such as name of document, section and page #):

13. Sidewalks

What is the minimum sidewalk width allowed in the community?

If your answer is **4 feet or less**, give yourself **2 points** • •

Are sidewalks always required on both sides of residential streets?

If your answer is **NO**, give yourself **2 points** • •

Are sidewalks generally sloped so they drain to the front yard rather than the street?

If your answer is **YES**, give yourself **1 point** • •

Can alternate pedestrian networks be substituted for sidewalks (e.g., trails through common areas)?

If your answer is **YES**, give yourself **1 point** • •

5.0 feet

YES

NO

NO

Notes on Sidewalks (include source documentation such as name of document, section and page #):

14. Driveways

What is the minimum driveway width specified in the community?

If your answer is **9 feet or less (one lane) or 18 feet (two lanes)**, give yourself **2 points** • •

0.0 feet

2

Development Feature**Your Local
Criteria**

Can pervious materials be used for single family home driveways (e.g., grass, gravel, porous pavers, etc)?

YES

If your answer is **YES**, give yourself **2 points** • •

2

Can a "two track" design be used at single family driveways?

YES

If your answer is **YES**, give yourself **1 point** • •

1

Are shared driveways permitted in residential developments?

YES

If your answer is **YES**, give yourself **1 point** • •

1

Notes on Driveways (include source documentation such as name of document, section and page #):

15. Open Space Management

Skip to question 16 if open space, cluster, or conservation developments are not allowed in your community.

Does the community have enforceable requirements to establish associations that can effectively manage open space?

NO

If your answer is **YES**, give yourself **2 points** • •

Are open space areas required to be consolidated into larger units?

NO

If your answer is **YES**, give yourself **1 point** • •

Does a minimum percentage of open space have to be managed in a natural condition?

NO

If your answer is **YES**, give yourself **1 point** • •

Are allowable and unallowable uses for open space in residential developments defined?

NO

If your answer is **YES**, give yourself **1 point** • •

Can open space be managed by a third party using land trusts or conservation easements?

YES

If your answer is **YES**, give yourself **1 point** • •

1

Notes on Open Space Management (include source documentation such as name of document, section and page #):

16. Rooftop Runoff

Can rooftop runoff be discharged to yard areas?

YES

If your answer is **YES**, give yourself **2 points** • •

2

Do current grading or drainage requirements allow for temporary ponding of stormwater on front yards or rooftops?

NO

If your answer is **YES**, give yourself **2 points** • •

Notes on Rooftop Runoff (include source documentation such as name of document, section and page #):

Code and Ordinance Worksheet

Subtotal Page 10

7

• • **Time to Assess:** Principles 11 through 16 focused on the regulations which determine lot size, lot shape, housing density, and the overall design and appearance of our neighborhoods. There were a total of **36** points available for Principles 11 - 16. What was your total score?

Subtotal Page 8 + Subtotal Page 9 + Subtotal Page 10 =

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

17. Buffer Systems

Is there a stream buffer ordinance in the community?

If your answer is **YES**, give yourself **2** points • •

If so, what is the minimum buffer width?

If your answer is **75 feet or more**, give yourself **1** point • •

Is expansion of the buffer to include freshwater wetlands, steep slopes or the 100-year floodplain required?

If your answer is **YES**, give yourself **1** point • •

 feet

Notes on Buffer Systems (include source documentation such as name of document, section and page #):

18. Buffer Maintenance

If you do not have stream buffer requirements in your community, skip to question No. 19

Does the stream buffer ordinance specify that at least part of the stream buffer be maintained with native vegetation?

If your answer is **YES**, give yourself **2** points • •

Does the stream buffer ordinance outline allowable uses?

If your answer is **YES**, give yourself **1** point

Development Feature**Your Local
Criteria**

Does the ordinance specify enforcement and education mechanisms?

YES

If your answer is **YES**, give yourself **1 point** • •

1

Notes on Buffer Systems (include source documentation such as name of document, section and page #):

19. Clearing and Grading

Is there any ordinance that requires or encourages the preservation of natural vegetation at residential development sites?

YES

If your answer is **YES**, give yourself **2 points** • •

2

Do reserve septic field areas need to be cleared of trees at the time of development?

YES

If your answer is **NO**, give yourself **1 point** • •

Notes on Buffer Maintenance (include source documentation such as name of document, section and page #):

20. Tree Conservation

If forests or specimen trees are present at residential development sites, does some of the stand have to be preserved?

YES

If your answer is **YES**, give yourself **2 points** • •

2

Are the limits of disturbance shown on construction plans adequate for preventing clearing of natural vegetative cover during construction?

YES

If your answer is **YES**, give yourself **1 point** • •

1

Notes on Tree Conservation (include source documentation such as name of document, section and page #):

21. Land Conservation Incentives

Are there any incentives to developers or landowners to conserve non-regulated land (open space design, density bonuses, stormwater credits or lower property tax rates)?

NO

If your answer is **YES**, give yourself **2 points** • •

Is flexibility to meet regulatory or conservation restrictions (density compensation, buffer averaging, transferable development rights, off-site mitigation) offered to developers?

NO

If your answer is **YES**, give yourself **2 points** • •

Notes on Land Cons. Incentives (include source documentation such as name of document, section and page #):

22. Stormwater Outfalls

Is stormwater required to be treated for quality before it is discharged?

YES

If your answer is **YES**, give yourself 2 points • •

2

Are there effective design criteria for stormwater best management practices (BMPs)?

YES

If your answer is **YES**, give yourself 1 point • •

1

Can stormwater be directly discharges into a jurisdictional wetland without pretreatment?

NO

If your answer is **NO**, give yourself 1 point • •

1

Does a floodplain management ordinance that restricts or prohibits development within the 100-year floodplain exist?

YES

If your answer is **YES**, give yourself 2 points • •

2

Notes on Stormwater Outfalls (include source documentation such as name of document, section and page #):

Code and Ordinance Worksheet

Subtotal Page 13

6

• • **Time to Assess:** Principles 17 through 22 addressed the codes and ordinances that promote (or impede) protection of existing natural areas and incorporation of open spaces into new development. There were a total of 24 points available for Principles 17 - 22. What was your total score?

Subtotal Page 11 + Subtotal Page 12 + Subtotal Page 13 =

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

We are exploring shared parking agreements within a new UDO in progress.

To determine final score, add up subtotal from each • **Time to Assess**

Principles 1 - 10 (Page 8)

16

Principles 11 - 16 (Page 11)

17

Principles 17 - 22 (Page 13)

18

TOTAL

51

Mecklenburg County

Code and Ordinance Worksheet

Table 2: Local, State, and Federal Authorities Responsible for Development in Your Community				
Development Responsibility		State/Federal	County	Town
Sets road standards	Agency:			Towns of Cornelius, Davi
	Contact Name:			
	Phone No.:			
Review/approves subdivision plans	Agency:		Mecklenburg County Wa	
	Contact Name:		Dave Canaan	
	Phone No.:		704-336-3736	
Establishes zoning ordinances	Agency:			Towns of Cornelius, Davi
	Contact Name:			
	Phone No.:			
Establishes subdivision ordinances	Agency:			Towns of Cornelius, Davi
	Contact Name:			
	Phone No.:			
Reviews/establishes stormwater management or drainage criteria	Agency:		Mecklenburg County Wa	
	Contact Name:			
	Phone No.:			
Provides fire protection and fire protection code enforcement	Agency:			
	Contact Name:			
	Phone No.:			
Oversees buffer ordinance	Agency:		Mecklenburg County Wa	
	Contact Name:			
	Phone No.:			
Oversees wetland protection	Agency:			
	Contact Name:			
	Phone No.:			
Establishes grading requirements or oversees erosion and sediment control program	Agency:		Mecklenburg County Wa	
	Contact Name:			
	Phone No.:			
Reviews/approves septic systems	Agency:		Mecklenburg County He	
	Contact Name:		Lisa Corbitt	
	Phone No.:		704-336-5789	
Review/approves utility plans (e.g., water and sewer)	Agency:			
	Contact Name:			
	Phone No.:			
Reviews/approves forest conservation/ tree protection plans	Agency:			Towns of Cornelius, Davi
	Contact Name:			
	Phone No.:			

Development Feature

Your Local Criteria

1. Street Width

What is the minimum pavement width allowed for streets in low density residential developments that have less than 500 daily trips (ADT)?

feet

If your answer is between **18-22 feet**, give yourself **4 points** • •

At higher densities are parking lanes allowed to also serve as traffic lanes (i.e., queuing streets)?

YES

If your answer is **YES**, give yourself **3 points** • •

Notes on Street Width (include source documentation such as name of document, section and page #):

2. Street Length

Do street standards promote the most efficient street layouts that reduce overall street length?

YES

If your answer is **YES**, give yourself **1 point** • •

Notes on Street Length (include source documentation such as name of document, section and page #):

3. Right-of-Way Width

What is the minimum right of way (ROW) width for a residential street?

feet

If your answer is **less than 45 feet**, give yourself **3 points** • •

Does the code allow utilities to be placed under the paved section of the ROW?

YES

If your answer is **YES**, give yourself **1 point** • •

Notes on ROW Width (include source documentation such as name of document, section and page #):

4. Cul-de-Sacs

What is the minimum radius allowed for cul-de-sacs?

feet

If your answer is **less than 35 feet**, give yourself **3 points** • •

If your answer is **36 feet to 45 feet**, give yourself **1 point** • •

Can a landscaped island be created within the cul-de-sac?

YES

If your answer is **YES**, give yourself **1 point** • •

Are alternative turnarounds such as "hammerheads" allowed on short streets in low density residential developments?

YES

If your answer is **YES**, give yourself **1 point** • •

Notes on Cul-de-Sacs (include source documentation such as name of document, section and page #):

Development Feature

Your Local Criteria

5. Vegetated Open Channels

Are curb and gutters required for most residential street sections?

YES

If your answer is **NO**, give yourself **2 points** • •

Are there established design criteria for swales that can provide stormwater quality treatment (i.e., dry swales, biofilters, or grass swales)?

YES

If your answer is **YES**, give yourself **2 points** • •

2

Notes on Vegetated Open Channel (include source documentation such as name of document, section and page #):

6. Parking Ratios

What is the minimum parking ratio for a professional office building (per 1000 ft² of gross floor area)?

spaces

If your answer is **less than 3.0 spaces**, give yourself **1 point** • •

What is the minimum required parking ratio for shopping centers (per 1,000 ft² gross floor area)?

spaces

If your answer is **4.5 spaces or less**, give yourself **1 point** • •

What is the minimum required parking ratio for single family homes (per home)?

spaces

If your answer is **less than or equal to 2.0 spaces**, give yourself **1 point** • •

Are your parking requirements set as maximum or median (rather than minimum) requirements?

YES

If your answer is **YES**, give yourself **2 points** • •

Notes on Parking Ratios (include source documentation such as name of document, section and page #):

7. Parking Codes

Is the use of shared parking arrangements promoted?

YES

If your answer is **YES**, give yourself **1 point** • •

Are model shared parking agreements provided?

YES

If your answer is **YES**, give yourself **1 point** • •

Are parking ratios reduced if shared parking arrangements are in place?

YES

If your answer is **YES**, give yourself **1 point** • •

If mass transit is provided nearby, is the parking ratio reduced?

YES

If your answer is **YES**, give yourself **1 point** • •

Notes on Parking Codes (include source documentation such as name of document, section and page #):

Development Feature

**Your Local
Criteria**

8. Parking Lots

What is the minimum stall width for a standard parking space?

If your answer is **9 feet or less**, give yourself **1 point** • •

What is the minimum stall length for a standard parking space?

If your answer is **18 feet or less**, give yourself **1 point** • •

Are at least 30% of the spaces at larger commercial parking lots required to have smaller dimensions for compact cars?

If your answer is **YES**, give yourself **1 point** • •

Can pervious materials be used for spillover parking areas?

If your answer is **YES**, give yourself **2 points** • •

Notes on Parking Lots (include source documentation such as name of document, section and page #):

9. Structured Parking

Are there any incentives to developers to provide parking within garages rather than surface parking lots?

If your answer is **YES**, give yourself **1 point** • •

Notes on Structured Parking (include source documentation such as name of document, section and page #):

10. Parking Lot Runoff

Is a minimum percentage of a parking lot required to be landscaped?

If your answer is **YES**, give yourself **2 points** • •

Is the use of bioretention islands and other stormwater practices within landscaped areas or setbacks allowed?

If your answer is **YES**, give yourself **2 points** • •

Notes on Parking Lot Runoff (include source documentation such as name of document, section and page #):

Development Feature

**Your Local
Criteria**

• • **Time to Assess:** Principles 1 - 10 focused on the codes, ordinances, and standards that determine the size, shape, and construction of parking lots, roadways, and driveways in the suburban landscape. There were a total of 40 points available for Principles 1 - 10. What was your total score?

Subtotal Page 5 + Subtotal Page 6 + Subtotal Page 7 =

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

11. Open Space Design

Are open space or cluster development designs allowed in the community?

If your answer is **YES**, give yourself 3 points • •

If your answer is **NO**, skip to question No. 12

YES

3

Is land conservation or impervious cover reduction a major goal or objective of the open space design ordinance?

If your answer is **YES**, give yourself 1 point • •

YES

1

Are the submittal or review requirements for open space design greater than those for conventional development?

If your answer is **NO**, give yourself 1 point • •

YES

Is open space or cluster design a by-right form of development?

If your answer is **YES**, give yourself 1 point • •

YES

Are flexible site design criteria available for developers that utilize open space or cluster design options (e.g., setbacks, road widths, lot sizes)

If your answer is **YES**, give yourself 2 points • •

YES

Notes on Open Space Design (include source documentation such as name of document, section and page #):

Development Feature

Your Local Criteria

12. Setbacks and Frontages

Are irregular lot shapes (e.g., pie-shaped, flag lots) allowed in the community?

If your answer is **YES**, give yourself 1 point • •

What is the minimum requirement for front setbacks for a one half (½) acre residential lot?

If your answer is **20 feet or less**, give yourself 1 point • •

What is the minimum requirement for rear setbacks for a one half (½) acre residential lot?

If your answer is **25 feet or less**, give yourself 1 point • •

What is the minimum requirement for side setbacks for a one half (½) acre residential lot?

If your answer is **8 feet or less**, give yourself 1 points • •

What is the minimum frontage distance for a one half (½) acre residential lot?

If your answer is **less than 80 feet**, give yourself 2 points • •

Notes on Setback and Frontages (include source documentation such as name of document, section and page #):

13. Sidewalks

What is the minimum sidewalk width allowed in the community?

If your answer is **4 feet or less**, give yourself 2 points • •

Are sidewalks always required on both sides of residential streets?

If your answer is **NO**, give yourself 2 points • •

Are sidewalks generally sloped so they drain to the front yard rather than the street?

If your answer is **YES**, give yourself 1 point • •

Can alternate pedestrian networks be substituted for sidewalks (e.g., trails through common areas)?

If your answer is **YES**, give yourself 1 point • •

Notes on Sidewalks (include source documentation such as name of document, section and page #):

14. Driveways

What is the minimum driveway width specified in the community?

If your answer is **9 feet or less (one lane) or 18 feet (two lanes)**, give yourself 2 points • •

Code and Ordinance Worksheet

Subtotal Page 9

0

Development Feature

**Your Local
Criteria**

Can pervious materials be used for single family home driveways
(e.g., grass, gravel, porous pavers, etc)?

If your answer is **YES**, give yourself **2 points** • •

YES

Can a "two track" design be used at single family driveways?

If your answer is **YES**, give yourself **1 point** • •

YES

Are shared driveways permitted in residential developments?

If your answer is **YES**, give yourself **1 point** • •

YES

Notes on Driveways (include source documentation such as name of document, section and page #):

15. Open Space Management

Skip to question 16 if open space, cluster, or conservation developments are not allowed in your community.

Does the community have enforceable requirements to establish associations that
can effectively manage open space?

If your answer is **YES**, give yourself **2 points** • •

YES

Are open space areas required to be consolidated into larger units?

If your answer is **YES**, give yourself **1 point** • •

YES

Does a minimum percentage of open space have to be managed in a natural
condition?

If your answer is **YES**, give yourself **1 point** • •

YES

Are allowable and unallowable uses for open space in residential developments
defined?

If your answer is **YES**, give yourself **1 point** • •

YES

Can open space be managed by a third party using land trusts or conservation
easements?

If your answer is **YES**, give yourself **1 point** • •

YES

Notes on Open Space Management (include source documentation such as name of document, section and page #):

16. Rooftop Runoff

Can rooftop runoff be discharged to yard areas?

If your answer is **YES**, give yourself **2 points** • •

YES

Do current grading or drainage requirements allow for temporary ponding of
stormwater on front yards or rooftops?

If your answer is **YES**, give yourself **2 points** • •

NO

Notes on Rooftop Runoff (include source documentation such as name of document, section and page #):

• • **Time to Assess:** Principles 11 through 16 focused on the regulations which determine lot size, lot shape, housing density, and the overall design and appearance of our neighborhoods. There were a total of 36 points available for Principles 11 - 16. What was your total score?

Subtotal Page 8 + Subtotal Page 9 + Subtotal Page 10 =

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

17. Buffer Systems

Is there a stream buffer ordinance in the community?

If your answer is **YES**, give yourself 2 points • •

If so, what is the minimum buffer width?

If your answer is **75 feet or more**, give yourself 1 point • •

Is expansion of the buffer to include freshwater wetlands, steep slopes or the 100-year floodplain required?

If your answer is **YES**, give yourself 1 point • •

Notes on Buffer Systems (include source documentation such as name of document, section and page #):

18. Buffer Maintenance

If you do not have stream buffer requirements in your community, skip to question No. 19

Does the stream buffer ordinance specify that at least part of the stream buffer be maintained with native vegetation?

If your answer is **YES**, give yourself 2 points • •

Does the stream buffer ordinance outline allowable uses?

If your answer is **YES**, give yourself 1 point

Development Feature

**Your Local
Criteria**

Does the ordinance specify enforcement and education mechanisms?

YES

If your answer is YES, give yourself 1 point • •

1

Notes on Buffer Systems (include source documentation such as name of document, section and page #):

19. Clearing and Grading

Is there any ordinance that requires or encourages the preservation of natural vegetation at residential development sites?

YES

If your answer is YES, give yourself 2 points • •

2

Do reserve septic field areas need to be cleared of trees at the time of development?

NO

If your answer is NO, give yourself 1 point • •

1

Notes on Buffer Maintenance (include source documentation such as name of document, section and page #):

20. Tree Conservation

If forests or specimen trees are present at residential development sites, does some of the stand have to be preserved?

YES

If your answer is YES, give yourself 2 points • •

Are the limits of disturbance shown on construction plans adequate for preventing clearing of natural vegetative cover during construction?

YES

If your answer is YES, give yourself 1 point • •

1

Notes on Tree Conservation (include source documentation such as name of document, section and page #):

21. Land Conservation Incentives

Are there any incentives to developers or landowners to conserve non-regulated land (open space design, density bonuses, stormwater credits or lower property tax rates)?

YES

If your answer is YES, give yourself 2 points • •

2

Is flexibility to meet regulatory or conservation restrictions (density compensation, buffer averaging, transferable development rights, off-site mitigation) offered to developers?

YES

If your answer is YES, give yourself 2 points • •

2

Notes on Land Cons. Incentives (include source documentation such as name of document, section and page #):

Development Feature

Your Local Criteria

22. Stormwater Outfalls

Is stormwater required to be treated for quality before it is discharged?

If your answer is **YES**, give yourself 2 points • •

Are there effective design criteria for stormwater best management practices (BMPs)?

If your answer is **YES**, give yourself 1 point • •

Can stormwater be directly discharged into a jurisdictional wetland without pretreatment?

If your answer is **NO**, give yourself 1 point • •

Does a floodplain management ordinance that restricts or prohibits development within the 100-year floodplain exist?

If your answer is **YES**, give yourself 2 points • •

YES

2

YES

1

YES

YES

2

Notes on Stormwater Outfalls (include source documentation such as name of document, section and page #):

Code and Ordinance Worksheet

Subtotal Page 13

5

• • **Time to Assess:** Principles 17 through 22 addressed the codes and ordinances that promote (or impede) protection of existing natural areas and incorporation of open spaces into new development. There were a total of 24 points available for Principles 17 - 22. What was your total score?

Subtotal Page 11 + Subtotal Page 12 + Subtotal Page 13 =

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

To determine final score, add up subtotal from each • **Time to Assess**

Principles 1 - 10 (Page 8)

6

Principles 11 - 16 (Page 11)

9

Principles 17 - 22 (Page 13)

20

TOTAL

35

Development Feature

Your Local
Criteria

1. Street Width

What is the minimum pavement width allowed for streets in low density residential developments that have less than 500 daily trips (ADT)?

24 feet

If your answer is between **18-22 feet**, give yourself **4 points** • •

At higher densities are parking lanes allowed to also serve as traffic lanes (i.e., queuing streets)?

YES

If your answer is **YES**, give yourself **3 points** • •

3

Notes on Street Width (include source documentation such as name of document, section and page #):

2. Street Length

Do street standards promote the most efficient street layouts that reduce overall street length?

NO

If your answer is **YES**, give yourself **1 point** • •

Notes on Street Length (include source documentation such as name of document, section and page #):

3. Right-of-Way Width

What is the minimum right of way (ROW) width for a residential street?

45 feet

If your answer is **less than 45 feet**, give yourself **3 points** • •

3

Does the code allow utilities to be placed under the paved section of the ROW?

NO

If your answer is **YES**, give yourself **1 point** • •

Notes on ROW Width (include source documentation such as name of document, section and page #):

4. Cul-de-Sacs

What is the minimum radius allowed for cul-de-sacs?

45 feet

If your answer is **less than 35 feet**, give yourself **3 points** • •

If your answer is **36 feet to 45 feet**, give yourself **1 point** • •

1

Can a landscaped island be created within the cul-de-sac?

YES

If your answer is **YES**, give yourself **1 point** • •

1

Are alternative turnarounds such as "hammerheads" allowed on short streets in low density residential developments?

NO

If your answer is **YES**, give yourself **1 point** • •

Notes on Cul-de-Sacs (include source documentation such as name of document, section and page #):

5. Vegetated Open Channels

Are curb and gutters required for most residential street sections?

YES

If your answer is **NO**, give yourself 2 points • •

Are there established design criteria for swales that can provide stormwater quality treatment (i.e., dry swales, biofilters, or grass swales)?

NO

If your answer is **YES**, give yourself 2 points • •

Notes on Vegetated Open Channel (include source documentation such as name of document, section and page #):

6. Parking Ratios

What is the minimum parking ratio for a professional office building (per 1000 ft² of gross floor area)?

3.0 spaces

If your answer is **less than 3.0 spaces**, give yourself 1 point • •

1

What is the minimum required parking ratio for shopping centers (per 1,000 ft² gross floor area)?

4.0 spaces

If your answer is **4.5 spaces or less**, give yourself 1 point • •

1

What is the minimum required parking ratio for single family homes (per home)?

2.0 spaces

If your answer is **less than or equal to 2.0 spaces**, give yourself 1 point • •

1

Are your parking requirements set as maximum or median (rather than minimum) requirements?

NO

If your answer is **YES**, give yourself 2 points • •

Notes on Parking Ratios (include source documentation such as name of document, section and page #):

7. Parking Codes

Is the use of shared parking arrangements promoted?

YES

If your answer is **YES**, give yourself 1 point • •

1

Are model shared parking agreements provided?

NO

If your answer is **YES**, give yourself 1 point • •

Are parking ratios reduced if shared parking arrangements are in place?

YES

If your answer is **YES**, give yourself 1 point • •

1

If mass transit is provided nearby, is the parking ratio reduced?

NO

If your answer is **YES**, give yourself 1 point • •

Notes on Parking Codes (include source documentation such as name of document, section and page #):

8. Parking Lots

What is the minimum stall width for a standard parking space?

If your answer is **9 feet or less**, give yourself **1 point** • •

9.0 feet

1

What is the minimum stall length for a standard parking space?

If your answer is **18 feet or less**, give yourself **1 point** • •

19.0 feet

Are at least 30% of the spaces at larger commercial parking lots required to have smaller dimensions for compact cars?

If your answer is **YES**, give yourself **1 point** • •

NO

Can pervious materials be used for spillover parking areas?

If your answer is **YES**, give yourself **2 points** • •

NO

Notes on Parking Lots (include source documentation such as name of document, section and page #):

9. Structured Parking

Are there any incentives to developers to provide parking within garages rather than surface parking lots?

If your answer is **YES**, give yourself **1 point** • •

NO

Notes on Structured Parking (include source documentation such as name of document, section and page #):

10. Parking Lot Runoff

Is a minimum percentage of a parking lot required to be landscaped?

If your answer is **YES**, give yourself **2 points** • •

YES

2

Is the use of bioretention islands and other stormwater practices within landscaped areas or setbacks allowed?

If your answer is **YES**, give yourself **2 points** • •

YES

2

Notes on Parking Lot Runoff (include source documentation such as name of document, section and page #):

- • **Time to Assess:** Principles 1 - 10 focused on the codes, ordinances, and standards that determine the size, shape, and construction of parking lots, roadways, and driveways in the suburban landscape. There were a total of 40 points available for Principles 1 - 10. What was your total score?

Subtotal Page 5 + Subtotal Page 6 + Subtotal Page 7 =

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

11. Open Space Design

Are open space or cluster development designs allowed in the community?

If your answer is **YES**, give yourself 3 points • •

If your answer is **NO**, skip to question No. 12

Is land conservation or impervious cover reduction a major goal or objective of the open space design ordinance?

If your answer is **YES**, give yourself 1 point • •

Are the submittal or review requirements for open space design greater than those for conventional development?

If your answer is **NO**, give yourself 1 point • •

Is open space or cluster design a by-right form of development?

If your answer is **YES**, give yourself 1 point • •

Are flexible site design criteria available for developers that utilize open space or cluster design options (e.g., setbacks, road widths, lot sizes)

If your answer is **YES**, give yourself 2 points • •

Notes on Open Space Design (include source documentation such as name of document, section and page #):

12. Setbacks and Frontages

Are irregular lot shapes (e.g., pie-shaped, flag lots) allowed in the community?

If your answer is **YES**, give yourself 1 point • •

What is the minimum requirement for front setbacks for a one half (½) acre residential lot?

If your answer is **20 feet or less**, give yourself 1 point • •

What is the minimum requirement for rear setbacks for a one half (½) acre residential lot?

If your answer is **25 feet or less**, give yourself 1 point • •

What is the minimum requirement for side setbacks for a one half (½) acre residential lot?

If your answer is **8 feet or less**, give yourself 1 points • •

What is the minimum frontage distance for a one half (½) acre residential lot?

If your answer is **less than 80 feet**, give yourself 2 points • •

YES

1

50.0 feet

50.0 feet

15.0 feet

75.0 feet

Notes on Setback and Frontages (include source documentation such as name of document, section and page #):

13. Sidewalks

What is the minimum sidewalk width allowed in the community?

If your answer is **4 feet or less**, give yourself 2 points • •

Are sidewalks always required on both sides of residential streets?

If your answer is **NO**, give yourself 2 points • •

Are sidewalks generally sloped so they drain to the front yard rather than the street?

If your answer is **YES**, give yourself 1 point • •

Can alternate pedestrian networks be substituted for sidewalks (e.g., trails through common areas)?

If your answer is **YES**, give yourself 1 point • •

5.0 feet

NO

2

NO

NO

Notes on Sidewalks (include source documentation such as name of document, section and page #):

14. Driveways

What is the minimum driveway width specified in the community?

If your answer is **9 feet or less (one lane) or 18 feet (two lanes)**, give yourself 2 points • •

feet

2

Development Feature**Your Local
Criteria**

Can pervious materials be used for single family home driveways (e.g., grass, gravel, porous pavers, etc)?

YES

If your answer is **YES**, give yourself **2 points** • •

2

Can a "two track" design be used at single family driveways?

YES

If your answer is **YES**, give yourself **1 point** • •

1

Are shared driveways permitted in residential developments?

YES

If your answer is **YES**, give yourself **1 point** • •

1

Notes on Driveways (include source documentation such as name of document, section and page #):

15. Open Space Management

Skip to question 16 if open space, cluster, or conservation developments are not allowed in your community.

Does the community have enforceable requirements to establish associations that can effectively manage open space?

NO

If your answer is **YES**, give yourself **2 points** • •

Are open space areas required to be consolidated into larger units?

NO

If your answer is **YES**, give yourself **1 point** • •

Does a minimum percentage of open space have to be managed in a natural condition?

YES

If your answer is **YES**, give yourself **1 point** • •

1

Are allowable and unallowable uses for open space in residential developments defined?

YES

If your answer is **YES**, give yourself **1 point** • •

1

Can open space be managed by a third party using land trusts or conservation easements?

YES

If your answer is **YES**, give yourself **1 point** • •

1

Notes on Open Space Management (include source documentation such as name of document, section and page #):

16. Rooftop Runoff

Can rooftop runoff be discharged to yard areas?

YES

If your answer is **YES**, give yourself **2 points** • •

2

Do current grading or drainage requirements allow for temporary ponding of stormwater on front yards or rooftops?

NO

If your answer is **YES**, give yourself **2 points** • •

Notes on Rooftop Runoff (include source documentation such as name of document, section and page #):

• • **Time to Assess:** Principles 11 through 16 focused on the regulations which determine lot size, lot shape, housing density, and the overall design and appearance of our neighborhoods. There were a total of **36** points available for Principles 11 - 16. What was your total score?

Subtotal Page 8 + Subtotal Page 9 + Subtotal Page 10 =

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

17. Buffer Systems

Is there a stream buffer ordinance in the community?

If your answer is **YES**, give yourself **2** points • •

If so, what is the minimum buffer width?

If your answer is **75 feet or more**, give yourself **1** point • •

Is expansion of the buffer to include freshwater wetlands, steep slopes or the 100-year floodplain required?

If your answer is **YES**, give yourself **1** point • •

 feet

Notes on Buffer Systems (include source documentation such as name of document, section and page #):

18. Buffer Maintenance

If you do not have stream buffer requirements in your community, skip to question No. 19

Does the stream buffer ordinance specify that at least part of the stream buffer be maintained with native vegetation?

If your answer is **YES**, give yourself **2** points • •

Does the stream buffer ordinance outline allowable uses?

If your answer is **YES**, give yourself **1** point

Development Feature**Your Local
Criteria**

Does the ordinance specify enforcement and education mechanisms?

YES

If your answer is **YES**, give yourself 1 point • •

1

Notes on Buffer Systems (include source documentation such as name of document, section and page #):

19. Clearing and Grading

Is there any ordinance that requires or encourages the preservation of natural vegetation at residential development sites?

YES

If your answer is **YES**, give yourself 2 points • •

2

Do reserve septic field areas need to be cleared of trees at the time of development?

YES

If your answer is **NO**, give yourself 1 point • •

Notes on Buffer Maintenance (include source documentation such as name of document, section and page #):

20. Tree Conservation

If forests or specimen trees are present at residential development sites, does some of the stand have to be preserved?

NO

If your answer is **YES**, give yourself 2 points • •

Are the limits of disturbance shown on construction plans adequate for preventing clearing of natural vegetative cover during construction?

YES

If your answer is **YES**, give yourself 1 point • •

1

Notes on Tree Conservation (include source documentation such as name of document, section and page #):

21. Land Conservation Incentives

Are there any incentives to developers or landowners to conserve non-regulated land (open space design, density bonuses, stormwater credits or lower property tax rates)?

NO

If your answer is **YES**, give yourself 2 points • •

Is flexibility to meet regulatory or conservation restrictions (density compensation, buffer averaging, transferable development rights, off-site mitigation) offered to developers?

NO

If your answer is **YES**, give yourself 2 points • •

Notes on Land Cons. Incentives (include source documentation such as name of document, section and page #):

22. Stormwater Outfalls

Is stormwater required to be treated for quality before it is discharged?

If your answer is **YES**, give yourself **2 points** • •

Are there effective design criteria for stormwater best management practices (BMPs)?

If your answer is **YES**, give yourself **1 point** • •

Can stormwater be directly discharges into a jurisdictional wetland without pretreatment?

If your answer is **NO**, give yourself **1 point** • •

Does a floodplain management ordinance that restricts or prohibits development within the 100-year floodplain exist?

If your answer is **YES**, give yourself **2 points** • •

YES

2

YES

1

NO

YES

2

Notes on Stormwater Outfalls (include source documentation such as name of document, section and page #):

Code and Ordinance Worksheet

Subtotal Page 13

5

• • **Time to Assess:** Principles 17 through 22 addressed the codes and ordinances that promote (or impede) protection of existing natural areas and incorporation of open spaces into new development. There were a total of 24 points available for Principles 17 - 22. What was your total score?

Subtotal Page 11 + Subtotal Page 12 + Subtotal Page 13 =

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

To determine final score, add up subtotal from each • **Time to Assess**

Principles 1 - 10 (Page 8)

18

Principles 11 - 16 (Page 11)

20

Principles 17 - 22 (Page 13)

14

TOTAL**52**

FAIR VIEW

Identify the Development Rules

Gather the key documents that contain the development rules in your community. A list of potential documents to look for is provided in Table 1. Keep in mind that the information you may want on a particular development rule is not always found in code or regulation, and maybe hidden in supporting design manuals, review checklists, guidance document or construction specifications. In most cases, this will require an extensive search. Few communities include all of their rules in a single document. Be prepared to contact state and federal, as well as local agencies to obtain copies of the needed documents.

Table 1: Key Local Documents that will be Needed to Complete the COW

Zoning Ordinance
Subdivision Codes
Street Standards or Road Design Manual
Parking Requirements
Building and Fire Regulations/Standards
Stormwater Management or Drainage Criteria
Buffer or Floodplain Regulations
Environmental Regulations
Tree Protection or Landscaping Ordinance
Erosion and Sediment Control Ordinances
Public Fire Defense Masterplans
Grading Ordinance

Identify Development Authorities

Once the development rules are located, it is relatively easy to determine which local agencies or authorities are actually responsible for administering and enforcing the rules. Completing this step will provide you with a better understanding of the intricacies of the development review process and helps identify key members of a future local roundtable. Table 2 provides a simple framework for identifying the agencies that influence development in your community. As you will see, space is provided not only for local agencies, but for state and federal agencies as well. In some cases, state and federal agencies may also exercise some authority over the local development process (e.g., wetlands, some road design, and stormwater).

USING THE WORKSHEET: HOW DO YOUR RULES STACK UP TO THE MODEL DEVELOPMENT PRINCIPLES?

Completing the Worksheet

Once you have located the documents that outline your development rules and identified the authorities responsible for development in your community, you are ready for the next step. You can now use the worksheet to compare your development rules to the model development principles. The worksheet is presented at the end of this chapter. The worksheet presents seventy-seven site planning benchmarks. The benchmarks are posed as questions. Each benchmark focuses on a specific site design practice, such as the minimum diameter of cul-de-sacs, the minimum width of streets, or the minimum parking ratio for a certain land use. You should refer to the codes, ordinances, and plans identified in the first step to determine the appropriate development rule. The questions require either a yes or no response or specific numeric criteria. If your development rule agrees with the site planning benchmark, you are awarded points.

Table 2: Local, State, and Federal Authorities Responsible for Development in Your Community

Development Responsibility		State/Federal	County	Town
Sets road standards	Agency:	NC DOT		
	Contact Name:			
	Phone No.:			
Review/approves subdivision plans	Agency:			Fairview
	Contact Name:			
	Phone No.:			
Establishes zoning ordinances	Agency:			Fairview
	Contact Name:			
	Phone No.:			
Establishes subdivision ordinances	Agency:			Fairview
	Contact Name:			
	Phone No.:			
Reviews/establishes stormwater management or drainage criteria	Agency:	NC DENR		
	Contact Name:			
	Phone No.:			
Provides fire protection and fire protection code enforcement	Agency:		Union Co	Fairview
	Contact Name:		Fire Marshall	VFD
	Phone No.:			
Oversees buffer ordinance	Agency:			Fairview
	Contact Name:			
	Phone No.:			
Oversees wetland protection	Agency:	NC DENR		Fairview
	Contact Name:			
	Phone No.:			
Establishes grading requirements or oversees erosion and sediment control program	Agency:	NC DENR		
	Contact Name:			
	Phone No.:			
Reviews/approves septic systems	Agency:	NC DENR	Union Co	
	Contact Name:		Environment	
	Phone No.:			
Review/approves utility plans (e.g., water and sewer)	Agency:		Union Co	
	Contact Name:		Public Works	
	Phone No.:			Fairview
Reviews/approves forest conservation/tree protection plans	Agency:			
	Contact Name:			
	Phone No.:			

1. Street Width

What is the minimum pavement width allowed for streets in low density residential developments that have less than 500 daily trips (ADT)?

19 feet

If your answer is between 18-22 feet, give yourself 4 points • •

S/B 4

0

At higher densities are parking lanes allowed to also serve as traffic lanes (i.e., queuing streets)?

YES NO

If your answer is YES, give yourself 3 points • •

0

Notes on Street Width (include source documentation such as name of document, section and page #):

FOLLOW NCDOT STANDARDS

2. Street Length

Do street standards promote the most efficient street layouts that reduce overall street length?

YES NO

If your answer is YES, give yourself 1 point • •

0

Notes on Street Length (include source documentation such as name of document, section and page #):

FOLLOW NCDOT STANDARDS

3. Right-of-Way Width

What is the minimum right of way (ROW) width for a residential street?

30 feet

If your answer is less than 45 feet, give yourself 3 points • •

S/B 3

0

Does the code allow utilities to be placed under the paved section of the ROW?

YES

If your answer is YES, give yourself 1 point • •

1

Notes on ROW Width (include source documentation such as name of document, section and page #):

FOLLOW NCDOT STANDARDS

4. Cul-de-Sacs

What is the minimum radius allowed for cul-de-sacs?

35 feet

If your answer is less than 35 feet, give yourself 3 points • •

If your answer is 36 feet to 45 feet, give yourself 1 point • •

3

Can a landscaped island be created within the cul-de-sac?

YES NO

If your answer is YES, give yourself 1 point • •

0

Are alternative turnarounds such as "hammerheads" allowed on short streets in low density residential developments?

YES NO

If your answer is YES, give yourself 1 point • •

0

Notes on Cul-de-Sacs (include source documentation such as name of document, section and page #):

FOLLOW NCDOT STANDARDS

LANDSCAPED ISLAND — ORDINANCE DOES NOT ADDRESS

5. Vegetated Open Channels

Are curb and gutters required for most residential street sections?

If your answer is **NO**, give yourself 2 points • •

YES

Are there established design criteria for swales that can provide stormwater quality treatment (i.e., dry swales, biofilters, or grass swales)?

If your answer is **YES**, give yourself 2 points • • IF NC DENR permits

YES

Notes on Vegetated Open Channel (include source documentation such as name of document, section and page #):

Section 216 page 191

6. Parking Ratios

What is the minimum parking ratio for a professional office building (per 1000 ft² of gross floor area)? 3.12 1 per 400 sq ft. Page 262If your answer is **less than 3.0 spaces**, give yourself 1 point • •What is the minimum required parking ratio for shopping centers (per 1,000 ft² gross floor area)? 1 space / 400 sq ft. Page 262If your answer is **4.5 spaces or less**, give yourself 1 point • •

What is the minimum required parking ratio for single family homes (per home)? 2 per unit

If your answer is **less than or equal to 2.0 spaces**, give yourself 1 point • •

Are your parking requirements set as maximum or median (rather than minimum) requirements? MINIMUM Section 291

If your answer is **YES**, give yourself 2 points • •

Notes on Parking Ratios (include source documentation such as name of document, section and page #):

Flexibility (Required) Section 292 page 266

7. Parking Codes

Is the use of shared parking arrangements promoted?

If your answer is **YES**, give yourself 1 point • • Section 297 page 268

Are model shared parking agreements provided? Section 297 NO

If your answer is **YES**, give yourself 1 point • •

Are parking ratios reduced if shared parking arrangements are in place? Section 292

If your answer is **YES**, give yourself 1 point • • Could be p. 266

If mass transit is provided nearby, is the parking ratio reduced?

If your answer is **YES**, give yourself 1 point • • Could be Section

Notes on Parking Codes (include source documentation such as name of document, section and page #):

Flexibility - Section 292 page 266

8. Parking Lots

What is the minimum stall width for a standard parking space?

If your answer is **9 feet or less**, give yourself 1 point . . .

9 ft. S/B

9 feet

0

What is the minimum stall length for a standard parking space?

If your answer is **18 feet or less**, give yourself 1 point . . .

19

19 feet

0

Are at least 30% of the spaces at larger commercial parking lots required to have smaller dimensions for compact cars?

Sect 293 p 206

If your answer is **YES**, give yourself 1 point . . .

YES

1

Can pervious materials be used for spillover parking areas?

If your answer is **YES**, give yourself 2 points . . . Appendix D page 295

YES

2

Notes on Parking Lots (include source documentation such as name of document, section and page #):

9. Structured Parking

Are there any incentives to developers to provide parking within garages rather than surface parking lots?

If your answer is **YES**, give yourself 1 point . . .

NO

~~YES~~

0

Notes on Structured Parking (include source documentation such as name of document, section and page #):

Ordinance does not address

10. Parking Lot Runoff

Is a minimum percentage of a parking lot required to be landscaped?

25%

If your answer is **YES**, give yourself 2 points . . .

page 7 under Shopping Center

YES

2

Is the use of bioretention islands and other stormwater practices within landscaped areas or setbacks allowed?

According to STATE Requirements

If your answer is **YES**, give yourself 2 points . . .

YES

0

Notes on Parking Lot Runoff (include source documentation such as name of document, section and page #):

• • **Time to Assess:** Principles 1 - 10 focused on the codes, ordinances, and standards that determine the size, shape, and construction of parking lots, roadways, and driveways in the suburban landscape. There were a total of 40 points available for Principles 1 - 10. What was your total score?

Subtotal Page 5 + Subtotal Page 6 + Subtotal Page 7 =

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

11. Open Space Design

Are open space or cluster development designs allowed in the community?

If your answer is **YES**, give yourself 3 points • •

If your answer is **NO**, skip to question No. 12

YES

3

Is land conservation or impervious cover reduction a major goal or objective of the open space design ordinance?

If your answer is **YES**, give yourself 1 point • •

YES

1

Are the submittal or review requirements for open space design greater than those for conventional development?

If your answer is **NO**, give yourself 1 point • •

~~YES~~ NO

YES

1

Is open space or cluster design a by-right form of development?

If your answer is **YES**, give yourself 1 point • •

YES

2

Are flexible site design criteria available for developers that utilize open space or cluster design options (e.g., setbacks, road widths, lot sizes)

If your answer is **YES**, give yourself 2 points • •

Notes on Open Space Design (include source documentation such as name of document, section and page #):

12. Setbacks and Frontages

Are irregular lot shapes (e.g., pie-shaped, flag lots) allowed in the community?

If your answer is **YES**, give yourself **1 point** • •

YES

1

What is the minimum requirement for front setbacks for a one half (½) acre residential lot?

If your answer is **20 feet or less**, give yourself **1 point** • •40 ~~170~~ feet

0

What is the minimum requirement for rear setbacks for a one half (½) acre residential lot?

If your answer is **25 feet or less**, give yourself **1 point** • •

40 feet

0

What is the minimum requirement for side setbacks for a one half (½) acre residential lot?

If your answer is **8 feet or less**, give yourself **1 point** • •

15 feet

0

What is the minimum frontage distance for a one half (½) acre residential lot?

If your answer is **less than 80 feet**, give yourself **2 points** • •

40 feet

0

Notes on Setback and Frontages (include source documentation such as name of document, section and page #):

13. Sidewalks

Changed to 4 feet - mentioned in many sections of the ordinance

What is the minimum sidewalk width allowed in the community?

If your answer is **4 feet or less**, give yourself **2 points** • •

Not Addressed — feet

0

Are sidewalks always required on both sides of residential streets?

If your answer is **NO**, give yourself **2 points** • •

YES NO

2

Are sidewalks generally sloped so they drain to the front yard rather than the street?

If your answer is **YES**, give yourself **1 point** • •

YES

1

Can alternate pedestrian networks be substituted for sidewalks (e.g., trails through common areas)?

If your answer is **YES**, give yourself **1 point** • •

YES

1

Notes on Sidewalks (include source documentation such as name of document, section and page #):

14. Driveways

What is the minimum driveway width specified in the community?

If your answer is **9 feet or less (one lane) or 18 feet (two lanes)**, give yourself **2 points** • •

9' feet

2

Can pervious materials be used for single family home driveways (e.g., grass, gravel, porous pavers, etc)?

DO NOT address

~~YES~~ ~~NO~~

If your answer is YES, give yourself 2 points • •

0

Can a "two track" design be used at single family driveways?

DO NOT address

~~YES~~ ~~NO~~

If your answer is YES, give yourself 1 point • •

0

Are shared driveways permitted in residential developments?

~~YES~~ ~~NO~~

If your answer is YES, give yourself 1 point • •

0

Notes on Driveways (include source documentation such as name of document, section and page #):

15. Open Space Management

Skip to question 16 if open space, cluster, or conservation developments are not allowed in your community.

Does the community have enforceable requirements to establish associations that can effectively manage open space?

NO

~~YES~~ ~~NO~~

If your answer is YES, give yourself 2 points • •

0

Are open space areas required to be consolidated into larger units?

NO

~~YES~~ ~~NO~~

If your answer is YES, give yourself 1 point • •

0

Does a minimum percentage of open space have to be managed in a natural condition?

~~YES~~ ~~NO~~

If your answer is YES, give yourself 1 point • •

0

Are allowable and unallowable uses for open space in residential developments defined?

~~YES~~ ~~NO~~

If your answer is YES, give yourself 1 point • •

0

Can open space be managed by a third party using land trusts or conservation easements?

YES

If your answer is YES, give yourself 1 point • •

1

Notes on Open Space Management (include source documentation such as name of document, section and page #):

16. Rooftop Runoff

Can rooftop runoff be discharged to yard areas?

~~YES~~ ~~NO~~

If your answer is YES, give yourself 2 points • •

0

Do current grading or drainage requirements allow for temporary ponding of stormwater on front yards or rooftops?

~~YES~~ ~~NO~~

If your answer is YES, give yourself 2 points • •

0

Notes on Rooftop Runoff (include source documentation such as name of document, section and page #):

Ordinance does not address

• • **Time to Assess:** Principles 11 through 16 focused on the regulations which determine lot size, lot shape, housing density, and the overall design and appearance of our neighborhoods. There were a total of **36** points available for Principles 11 - 16. What was your total score?

Subtotal Page 8 + Subtotal Page 9 + Subtotal Page 10 =

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

17. Buffer Systems

Is there a stream buffer ordinance in the community?

If your answer is **YES**, give yourself 2 points • •

If so, what is the minimum buffer width?

If your answer is **75 feet or more**, give yourself 1 point • •

Is expansion of the buffer to include freshwater wetlands, steep slopes or the 100-year floodplain required?

If your answer is **YES**, give yourself 1 point • •

Notes on Buffer Systems (include source documentation such as name of document, section and page #):

NCDENR AND ARTICLE XVI FARMWATER ORDINANCE

18. Buffer Maintenance

If you do not have stream buffer requirements in your community, skip to question No. 19

Does the stream buffer ordinance specify that at least part of the stream buffer be maintained with native vegetation?

If your answer is **YES**, give yourself 2 points • •

Does the stream buffer ordinance outline allowable uses?

If your answer is **YES**, give yourself 1 point

(NCDENR)

Development Feature

Your Local Criteria

Does the ordinance specify enforcement and education mechanisms?

~~YES~~ NO

If your answer is **YES**, give yourself 1 point • •

0

Notes on Buffer Systems (include source documentation such as name of document, section and page #):

NCDEUR Requirements

19. Clearing and Grading

Is there any ordinance that requires or encourages the preservation of natural vegetation at residential development sites?

YES

If your answer is **YES**, give yourself 2 points • •

2

Do reserve septic field areas need to be cleared of trees at the time of development?

YES

If your answer is **NO**, give yourself 1 point • •

1

Notes on Buffer Maintenance (include source documentation such as name of document, section and page #):

NCDEUR Requirements

20. Tree Conservation

If forests or specimen trees are present at residential development sites, does some of the stand have to be preserved?

YES

If your answer is **YES**, give yourself 2 points • •

2

Are the limits of disturbance shown on construction plans adequate for preventing clearing of natural vegetative cover during construction?

YES

If your answer is **YES**, give yourself 1 point • •

1

Notes on Tree Conservation (include source documentation such as name of document, section and page #):

Section 315 page 277

21. Land Conservation Incentives

Are there any incentives to developers or landowners to conserve non-regulated land (open space design, density bonuses, stormwater credits or lower property tax rates)?

~~YES~~ NO

If your answer is **YES**, give yourself 2 points • •

2

Is flexibility to meet regulatory or conservation restrictions (density compensation, buffer averaging, transferable development rights, off-site mitigation) offered to developers?

~~YES~~ NO

If your answer is **YES**, give yourself 2 points • •

0

Notes on Land Cons. Incentives (include source documentation such as name of document, section and page #):

*Section 187 Cluster Subdivision
Section 190 Incentives*

22. Stormwater Outfalls

Is stormwater required to be treated for quality before it is discharged?

If your answer is **YES**, give yourself **2 points** • •

Are there effective design criteria for stormwater best management practices (BMPs)?

If your answer is **YES**, give yourself **1 point** • •

Can stormwater be directly discharges into a jurisdictional wetland without pretreatment?

If your answer is **NO**, give yourself **1 point** • •

Does a floodplain management ordinance that restricts or prohibits development within the 100-year floodplain exist?

If your answer is **YES**, give yourself **2 points** • •

YES

2

YES

1

YES NO

1

YES

2

Notes on Stormwater Outfalls (include source documentation such as name of document, section and page #):

Article XVI Flood Plains, Drainage, SW Management
NC DEVE Requirements page 213

Code and Ordinance Worksheet

Subtotal Page 13

6

• • **Time to Assess:** Principles 17 through 22 addressed the codes and ordinances that promote (or impede) protection of existing natural areas and incorporation of open spaces into new development. There were a total of 24 points available for Principles 17 - 22. What was your total score?

Subtotal Page 11 + Subtotal Page 12 + Subtotal Page 13 =

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

To determine final score, add up subtotal from each • **Time to Assess**

Principles 1 - 10 (Page 8)

0

Principles 11 - 16 (Page 11)

0

Principles 17 - 22 (Page 13)

0

TOTAL

0

CODE AND ORDINANCE WORKSHEET

About the Adobe Acrobat Form

Note: Acrobat Reader will not save the information entered into a form. Saving changes is only possible with a full version of Acrobat.

- The blue fields indicate that an answer is required.
- The gray fields are for notes and are not required, but highly recommended.
- The green fields will automatically summarize the points – no input is needed here.

To fill out a form:

1. Select the hand tool .
2. Position the pointer inside a form field, and click. The I-beam pointer allows you to type text. If your pointer appears as a pointing finger, you can select an item from a list (i.e., YES or NO).
3. After entering text or making a selection, press Tab to accept the form field change and go to the next or previous field.
4. Once you have filled in the appropriate form fields, do both of the following:
 - Choose File > Export > Form Data to save the form data in a separate FDF file. Type a filename and click save.
 - Print the form so that you have a hard copy for your records.

And Most Importantly...

Send CWP a copy! Let us know how you did!

The Code and Ordinance Worksheet allows an in-depth review of the standards, ordinances, and codes (i.e., the development rules) that shape how development occurs in your community. You are guided through a systematic comparison of your local development rules against the model development principles. Institutional frameworks, regulatory structures and incentive programs are included in this review. The worksheet consists of a series of questions that correspond to each of the model development principles. Points are assigned based on how well the current development rules agree with the site planning benchmarks derived from the model development principles.

The worksheet is intended to guide you through the first two steps of a local site planning roundtable.

Step 1: Find out what the Development Rules are in your community.

Step 2: See how your rules stack up to the Model Development Principles.

The homework done in these first two steps helps to identify which development rules are potential candidates for change.

PREPARING TO COMPLETE THE CODE AND ORDINANCE WORKSHEET

Two tasks need to be performed before you begin in the worksheet. First, you must identify all the development rules that apply in your community. Second, you must identify the local, state, and federal authorities that actually administer or enforce the development rules within your community. Both tasks require a large investment of time. The development process is usually shaped by a complex labyrinth of regulations, criteria, and authorities. A team approach may be helpful. You may wish to enlist the help of a local plan reviewer, land planner, land use attorney, or civil engineer. Their real-world experience with the development process is often very useful in completing the worksheet.

Code and Ordinance Worksheet

Table 2: Local, State, and Federal Authorities Responsible for Development in Your Community

Development Responsibility		State/Federal	County	Town
Sets road standards	Agency:	NC DOT		
	Contact Name:	Barry Moese		
	Phone No.:	704-932-0101		
Review/approves subdivision plans	Agency:		Union County Planning	
	Contact Name:		Richard Horton	
	Phone No.:		704-243-3366	
Establishes zoning ordinances	Agency:		Union County Planning	
	Contact Name:		Richard Black	
	Phone No.:		704-243-3366	
Establishes subdivision ordinances	Agency:		Union County Planning	
	Contact Name:		Richard Black	
	Phone No.:		704-243-3366	
Reviews/establishes stormwater management or drainage criteria	Agency:	NC WQ	Union County Public Wt	
	Contact Name:	Mike Randall	Andy Holmes	
	Phone No.:	704-243-3366	704-243-3366	
Provides fire protection and fire protection code enforcement	Agency:		Union County Fire/Ar	
	Contact Name:		Cliff Spear	
	Phone No.:		704-243-3366	
Oversees buffer ordinance	Agency:	NC DNR		
	Contact Name:	Mike Randall		
	Phone No.:	704-243-3366		
Oversees wetland protection	Agency:	NC DNR		
	Contact Name:	Cynthia Kelly		
	Phone No.:	704-243-3366		
Establishes grading requirements or oversees erosion and sediment control program	Agency:	NC DNR		
	Contact Name:			
	Phone No.:	704-623-1699		
Reviews/approves septic systems	Agency:	NC DENR	Union County Environm	
	Contact Name:	10: Lynn	John Kersh	
	Phone No.:	704-243-3366	704-243-3366	
Review/approves utility plans (e.g., water and sewer)	Agency:		Union County Public Wt	
	Contact Name:		Mike Randall	
	Phone No.:		704-243-3366	
Reviews/approves forest conservation/ tree protection plans	Agency:		Union County Urban For	
	Contact Name:		Dave Gam	
	Phone No.:		704-243-3366	

Development Feature

Your Local
Criteria

1. Street Width

What is the minimum pavement width allowed for streets in low density residential developments that have less than 500 daily trips (ADT)?

 feet

If your answer is between 18-22 feet, give yourself 4 points . . .

At higher densities are parking lanes allowed to also serve as traffic lanes (i.e., queuing streets)?

If your answer is YES, give yourself 3 points . . .

Notes on Street Width (include source documentation such as name of document, section and page #):

2. Street Length

Do street standards promote the most efficient street layouts that reduce overall street length?

If your answer is YES, give yourself 1 point . . .

Notes on Street Length (include source documentation such as name of document, section and page #):

3. Right-of-Way Width

What is the minimum right of way (ROW) width for a residential street?

 feet

If your answer is less than 45 feet, give yourself 3 points . . .

Does the code allow utilities to be placed under the paved section of the ROW?

If your answer is YES, give yourself 1 point . . .

Notes on ROW Width (include source documentation such as name of document, section and page #):

4. Cul-de-Sacs

What is the minimum radius allowed for cul-de-sacs?

 feet

If your answer is less than 35 feet, give yourself 3 points . . .

If your answer is 36 feet to 45 feet, give yourself 1 point . . .

Can a landscaped island be created within the cul-de-sac?

If your answer is YES, give yourself 1 point . . .

Are alternative turnarounds such as "hammerheads" allowed on short streets in low density residential developments?

If your answer is YES, give yourself 1 point . . .

Notes on Cul-de-Sacs (include source documentation such as name of document, section and page #):

Development Feature

Your Local
Criteria

5. Vegetated Open Channels

Are curb and gutters required for most residential street sections?

If your answer is **NO**, give yourself 2 points • •

Are there established design criteria for swales that can provide stormwater quality treatment (i.e., dry swales, biofilters, or grass swales)?

If your answer is **YES**, give yourself 2 points • •

Notes on Vegetated Open Channel (include source documentation such as name of document, section and page #):

6. Parking Ratios

What is the minimum parking ratio for a professional office building (per 1000 ft² of gross floor area)?

If your answer is **less than 3.0 spaces**, give yourself 1 point • •

What is the minimum required parking ratio for shopping centers (per 1,000 ft² gross floor area)?

If your answer is **4.5 spaces or less**, give yourself 1 point • •

What is the minimum required parking ratio for single family homes (per home)?

If your answer is **less than or equal to 2.0 spaces**, give yourself 1 point • •

Are your parking requirements set as maximum or median (rather than minimum) requirements?

If your answer is **YES**, give yourself 2 points • •

Notes on Parking Ratios (include source documentation such as name of document, section and page #):

7. Parking Codes

Is the use of shared parking arrangements promoted?

If your answer is **YES**, give yourself 1 point • •

Are model shared parking agreements provided?

If your answer is **YES**, give yourself 1 point • •

Are parking ratios reduced if shared parking arrangements are in place?

If your answer is **YES**, give yourself 1 point • •

If mass transit is provided nearby, is the parking ratio reduced?

If your answer is **YES**, give yourself 1 point • •

Notes on Parking Codes (include source documentation such as name of document, section and page #):

Development Feature

Your Local
Criteria

8. Parking Lots

What is the minimum stall width for a standard parking space?

If your answer is **9 feet or less**, give yourself **1 point** • •

9.0 feet

What is the minimum stall length for a standard parking space?

If your answer is **18 feet or less**, give yourself **1 point** • •

18.0 feet

Are at least 30% of the spaces at larger commercial parking lots required to have smaller dimensions for compact cars?

If your answer is **YES**, give yourself **1 point** • •

NO

Can pervious materials be used for spillover parking areas?

If your answer is **YES**, give yourself **2 points** • •

YES

Notes on Parking Lots (include source documentation such as name of document, section and page #):

9. Structured Parking

Are there any incentives to developers to provide parking within garages rather than surface parking lots?

If your answer is **YES**, give yourself **1 point** • •

NO

Notes on Structured Parking (include source documentation such as name of document, section and page #):

10. Parking Lot Runoff

Is a minimum percentage of a parking lot required to be landscaped?

If your answer is **YES**, give yourself **2 points** • •

YES

Is the use of bioretention islands and other stormwater practices within landscaped areas or setbacks allowed?

If your answer is **YES**, give yourself **2 points** • •

YES

Notes on Parking Lot Runoff (include source documentation such as name of document, section and page #):

Development Feature

Your Local
Criteria

• • **Time to Assess:** Principles 1 - 10 focused on the codes, ordinances, and standards that determine the size, shape, and construction of parking lots, roadways, and driveways in the suburban landscape. There were a total of **40** points available for Principles 1 - 10. What was your total score?

Subtotal Page 5 + Subtotal Page 6 + Subtotal Page 7 =

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

11. Open Space Design

Are open space or cluster development designs allowed in the community?

If your answer is **YES**, give yourself 3 points • •

If your answer is **NO**, skip to question No. 12

Is land conservation or impervious cover reduction a major goal or objective of the open space design ordinance?

If your answer is **YES**, give yourself 1 point • •

Are the submittal or review requirements for open space design greater than those for conventional development?

If your answer is **NO**, give yourself 1 point • •

Is open space or cluster design a by-right form of development?

If your answer is **YES**, give yourself 1 point • •

Are flexible site design criteria available for developers that utilize open space or cluster design options (e.g., setbacks, road widths, lot sizes)?

If your answer is **YES**, give yourself 2 points • •

YES

YES

NO

YES

YES

2

Notes on Open Space Design (include source documentation such as name of document, section and page #):

Code and Ordinance Worksheet

Subtotal Page 8

8

Development Feature

Your Local Criteria

12. Setbacks and Frontages

Are irregular lot shapes (e.g., pie-shaped, flag lots) allowed in the community?

If your answer is **YES**, give yourself 1 point . .

What is the minimum requirement for front setbacks for a one half (½) acre residential lot?

If your answer is **20 feet or less**, give yourself 1 point . .

What is the minimum requirement for rear setbacks for a one half (½) acre residential lot?

If your answer is **25 feet or less**, give yourself 1 point . .

What is the minimum requirement for side setbacks for a one half (½) acre residential lot?

If your answer is **8 feet or less**, give yourself 1 points . .

What is the minimum frontage distance for a one half (½) acre residential lot?

If your answer is **less than 80 feet**, give yourself 2 points . .

Notes on Setback and Frontages (include source documentation such as name of document, section and page #):

13. Sidewalks

What is the minimum sidewalk width allowed in the community?

If your answer is **4 feet or less**, give yourself 2 points . .

Are sidewalks always required on both sides of residential streets?

If your answer is **NO**, give yourself 2 points . .

Are sidewalks generally sloped so they drain to the front yard rather than the street?

If your answer is **YES**, give yourself 1 point . .

Can alternate pedestrian networks be substituted for sidewalks (e.g., trails through common areas)?

If your answer is **YES**, give yourself 1 point . .

Notes on Sidewalks (include source documentation such as name of document, section and page #):

Sidewalks are only required in Cluster Developments

14. Driveways

What is the minimum driveway width specified in the community?

If your answer is **9 feet or less (one lane) or 18 feet (two lanes)**, give yourself 2 points . .

Development Feature**Your Local Criteria**

Can pervious materials be used for single family home driveways (e.g., grass, gravel, porous pavers, etc)?

If your answer is **YES**, give yourself **2 points** • •

Can a "two track" design be used at single family driveways?

If your answer is **YES**, give yourself **1 point** • •

Are shared driveways permitted in residential developments?

If your answer is **YES**, give yourself **1 point** • •

Notes on Driveways (include source documentation such as name of document, section and page #):

Driveway widths are only regulated for commercial developments

15. Open Space Management

Skip to question 16 if open space, cluster, or conservation developments are not allowed in your community.

Does the community have enforceable requirements to establish associations that can effectively manage open space?

If your answer is **YES**, give yourself **2 points** • •

Are open space areas required to be consolidated into larger units?

If your answer is **YES**, give yourself **1 point** • •

Does a minimum percentage of open space have to be managed in a natural condition?

If your answer is **YES**, give yourself **1 point** • •

Are allowable and unallowable uses for open space in residential developments defined?

If your answer is **YES**, give yourself **1 point** • •

Can open space be managed by a third party using land trusts or conservation easements?

If your answer is **YES**, give yourself **1 point** • •

Notes on Open Space Management (include source documentation such as name of document, section and page #):

16. Rooftop Runoff

Can rooftop runoff be discharged to yard areas?

If your answer is **YES**, give yourself **2 points** • •

Do current grading or drainage requirements allow for temporary ponding of stormwater on front yards or rooftops?

If your answer is **YES**, give yourself **2 points** • •

Notes on Rooftop Runoff (include source documentation such as name of document, section and page #):

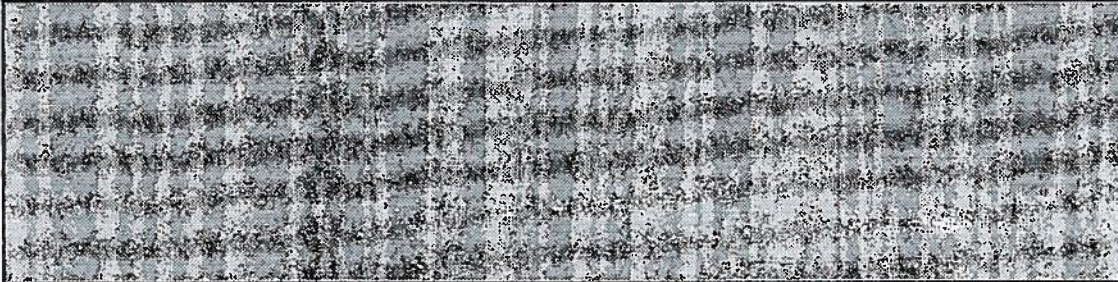
Development Feature

Your Local
Criteria

• • **Time to Assess:** Principles 11 through 16 focused on the regulations which determine lot size, lot shape, housing density, and the overall design and appearance of our neighborhoods. There were a total of **36** points available for Principles 11 - 16. What was your total score?

Subtotal Page 8 + Subtotal Page 9 + Subtotal Page 10 =

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?



17. Buffer Systems

Is there a stream buffer ordinance in the community?

If your answer is **YES**, give yourself 2 points • •

If so, what is the minimum buffer width?

If your answer is **75 feet or more**, give yourself 1 point • •

Is expansion of the buffer to include freshwater wetlands, steep slopes or the 100-year floodplain required?

If your answer is **YES**, give yourself 1 point • •

Notes on Buffer Systems (include source documentation such as name of document, section and page #):

18. Buffer Maintenance

If you do not have stream buffer requirements in your community, skip to question No. 19

Does the stream buffer ordinance specify that at least part of the stream buffer be maintained with native vegetation?

If your answer is **YES**, give yourself 2 points • •

Does the stream buffer ordinance outline allowable uses?

If your answer is **YES**, give yourself 1 point

Code and Ordinance Worksheet

Subtotal Page 11



Union County
Department of Inspections
500 North Main St.
Suite 28
Monroe, NC 28112

FAX TRANSMITTAL

Phone (704) 283-3816
FAX (704) 292-2513

TO: Diane Dils

FAX #: 704-377-4710

FROM: Lee Jensen

DATE: 12/6/10

Number of page including cover: 15

MESSAGE:

CODE AND ORDINANCE WORKSHEET

About the Adobe Acrobat Form

Note: Acrobat Reader will not save the information entered into a form. Saving changes is only possible with a full version of Acrobat.

- The blue fields indicate that an answer is required.
- The gray fields are for notes and are not required, but highly recommended.
- The green fields will automatically summarize the points—no inputs needed here.

To fill out a form:

1. Select the hand tool.
2. Position the pointer inside a form field, and click. The I-beam pointer allows you to type text. If your pointer appears as a pointing finger, you can select an item from a list (i.e., Y/N or NO).
3. After clicking (or making a selection), press **Tab** to accept the form field change and go to the next or previous field.
4. Once you have filled in the appropriate form fields, do both of the following:
 - Choose **File > Export > Form Data** to save the form data in a separate PDF file. Type a filename and click **Save**.
 - Print the form so that you have a hard copy for your records.

And Most Importantly...

Send CWP a copy! Let us know how you did!

The Code and Ordinance Worksheet allows an in-depth review of the standards, ordinances, and codes (i.e., the development rules) that shape how development occurs in your community. You are guided through a systematic comparison of your local development rules against the model development principles. Institutional frameworks, regulatory structures and incentive programs are included in this review. The worksheet consists of a series of questions that correspond to each of the model development principles. Points are assigned based on how well the current development rules agree with the site planning benchmarks derived from the model development principles.

The worksheet is intended to guide you through the first two steps of a local site planning roundtable.

Step 1: Find out what the Development Rules are in your community.

Step 2: See how your rules stack up to the Model Development Principles.

The homework done in these first two steps helps to identify which development rules are potential candidates for change.

PREPARING TO COMPLETE THE CODE AND ORDINANCE WORKSHEET

Two tasks need to be performed before you begin in the worksheet. First, you must identify all the development rules that apply in your community. Second, you must identify the local, state, and federal authorities that actually administer or enforce the development rules within your community. Both tasks require a large investment of time. The development process is usually shaped by a complex labyrinth of regulations, criteria, and authorities. A team approach may be helpful. You may wish to enlist the help of a local plan reviewer, land planner, land use attorney, or civil engineer. Their real-world experience with the development process is often very useful in completing the worksheet.

*Code and Ordinance Worksheet***Identify the Development Rules**

Gather the key documents that contain the development rules in your community. A list of potential documents to look for is provided in Table 1. Keep in mind that the information you may want on a particular development rule is not always found in code or regulation, and maybe hidden in supporting design manuals, review checklists, guidance document or construction specifications. In most cases, this will require an extensive search. Few communities include all of their rules in a single document. Be prepared to contact state and federal, as well as local agencies to obtain copies of the needed documents.

Table 1: Key Local Documents that will be Needed to Complete the COW

Zoning Ordinance
Subdivision Codes
Street Standards or Road Design Manual
Parking Requirements
Building and Fire Regulations/Standards
Stormwater Management or Drainage Criteria
Buffer or Floodplain Regulations
Environmental Regulations
Tree Protection or Landscaping Ordinance
Erosion and Sediment Control Ordinances
Public Fire Defense Masterplans
Grading Ordinance

Identify Development Authorities

Once the development rules are located, it is relatively easy to determine which local agencies or authorities are actually responsible for administering and enforcing the rules. Completing this step will provide you with a better understanding of the intricacies of the development review process and helps identify key members of a future local roundtable. Table 2 provides a simple framework for identifying the agencies that influence development in your community. As you will see, space is provided not only for local agencies, but for state and federal agencies as well. In some cases, state and federal agencies may also exercise some authority over the local development process (e.g., wetlands, some road design, and stormwater).

USING THE WORKSHEET: HOW DO YOUR RULES STACK UP TO THE MODEL DEVELOPMENT PRINCIPLES?**Completing the Worksheet**

Once you have located the documents that outline your development rules and identified the authorities responsible for development in your community, you are ready for the next step. You can now use the worksheet to compare your development rules to the model development principles. The worksheet is presented at the end of this chapter. The worksheet presents seventy-seven site planning benchmarks. The benchmarks are posed as questions. Each benchmark focuses on a specific site design practice, such as the minimum diameter of cul-de-sacs, the minimum width of streets, or the minimum parking ratio for a certain land use. You should refer to the codes, ordinances, and plans identified in the first step to determine the appropriate development rule. The questions require either a yes or no response or specific numeric criteria. If your development rule agrees with the site planning benchmark, you are awarded points.

*Code and Ordinance Worksheet***Calculating Your Score**

A place is provided on each page of the worksheet to keep track of your running score. In addition, the worksheet is subdivided into three categories:

- Residential Streets and Parking Lots (Principles No. 1 - 10)
- Lot Development (Principles No. 11 - 16)
- Conservation of Natural Areas (Principles No. 17 - 22).

For each category, you are asked to subtotal your score. This **"Time to Assess"** allows you to consider which development rules are most in line with the site planning benchmarks and what rules are potential candidates for change.

The total number of points possible for all of the site planning benchmarks is 100. Your overall score provides a general indication of your community's ability to support environmentally sensitive development. As a general rule, if your overall score is lower than 80, then it may be advisable to systematically reform your local development rules. A score sheet is provided at end of the Code and Ordinance Worksheet to assist you in determining where your community's score places in respect to the Model Development Principles. Once you have completed the worksheet, go back and review your responses. Determine if there are specific areas that need improvement (e.g., development rules that govern road design) or if your development rules are generally pretty good. This review is key to implementation of better development: assessment of your current development rules and identification of impediments to innovative site design. This review also directly leads into the next step: a site planning roundtable process conducted at the local government level. The primary tasks of a local roundtable are to systematically review existing development rules and then determine if changes can or should be made. By providing a much-needed framework for overcoming barriers to better development, the site planning roundtable can serve as an important tool for local change.

Code and Ordinance Worksheet

Table 2: Local, State, and Federal Authorities Responsible for Development in Your Community

Development Responsibility		State/Federal	County	Town
Sets road standards	Agency:	NCDOT		
	Contact Name:			
	Phone No.:			
Review/approves subdivision plans	Agency:			Unionville
	Contact Name:			
	Phone No.:			
Establishes zoning ordinances	Agency:			Unionville
	Contact Name:			
	Phone No.:			
Establishes subdivision ordinances	Agency:			Unionville
	Contact Name:			
	Phone No.:			
Reviews/establishes stormwater management or drainage criteria	Agency:	NC DENR		
	Contact Name:			
	Phone No.:			
Provides fire protection and fire protection code enforcement	Agency:		Union County	
	Contact Name:		Fire Marshall	
	Phone No.:			
Oversees buffer ordinance	Agency:			Unionville
	Contact Name:			
	Phone No.:			
Oversees wetland protection	Agency:	NC DENR ACOE		
	Contact Name:			
	Phone No.:			
Establishes grading requirements or oversees erosion and sediment control program	Agency:	NC DENR		
	Contact Name:			
	Phone No.:			
Reviews/approves septic systems	Agency:	NC DENR	Union County	
	Contact Name:		Environmental	
	Phone No.:			
Review/approves utility plans (e.g., water and sewer)	Agency:		Union County	
	Contact Name:		Public Works	
	Phone No.:			
Reviews/approves forest conservation/tree protection plans	Agency:			Unionville
	Contact Name:			
	Phone No.:			

Development Feature

Your Local
Criteria

1. Street Width

What is the minimum pavement width allowed for streets in low density residential developments that have less than 500 daily trips (ADT)?

19 feet

If your answer is between **18-22 feet**, give yourself **4 points** • •

4

At higher densities are parking lanes allowed to also serve as traffic lanes (i.e., queuing streets)?

NO

If your answer is **YES**, give yourself **3 points** • •

0

Notes on Street Width (include source documentation such as name of document, section and page #):

Follow NCDOT Standards

2. Street Length

Do street standards promote the most efficient street layouts that reduce overall street length?

NO

If your answer is **YES**, give yourself **1 point** • •

0

Notes on Street Length (include source documentation such as name of document, section and page #):

Follow NCDOT Standards

3. Right-of-Way Width

What is the minimum right of way (ROW) width for a residential street?

30 feet

If your answer is **less than 45 feet**, give yourself **3 points** • •

3

Does the code allow utilities to be placed under the paved section of the ROW?

YES

If your answer is **YES**, give yourself **1 point** • •

1

Notes on ROW Width (include source documentation such as name of document, section and page #):

Follow NCDOT Standards

4. Cul-de-Sacs

What is the minimum radius allowed for cul-de-sacs?

35 feet

If your answer is **less than 35 feet**, give yourself **3 points** • •

If your answer is **36 feet to 45 feet**, give yourself **1 point** • •

3

Can a landscaped island be created within the cul-de-sac?

NO

If your answer is **YES**, give yourself **1 point** • •

0

Are alternative turnarounds such as "hammerheads" allowed on short streets in low density residential developments?

NO

If your answer is **YES**, give yourself **1 point** • •

1

Notes on Cul-de-Sacs (include source documentation such as name of document, section and page #):

Follow NCDOT Standards. Ordinance does not address landscaped islands.

5. Vegetated Open Channels

Are curb and gutters required for most residential street sections?

YES

If your answer is **NO**, give yourself 2 points • •

0

Are there established design criteria for swales that can provide storm water quality treatment (i.e., dry swales, biofilters, or grass swales)?

NO

If your answer is **YES**, give yourself 2 points • •

0

Notes on Vegetated Open Channel (include source documentation such as name of document, section and page #):

Land Use Ordinance, Section 216, page 187

6. Parking Ratios

What is the minimum parking ratio for a professional office building (per 1000 ft² of gross floor area)?

5.0 spaces

If your answer is **less than 3.0 spaces**, give yourself 1 point • •

0

What is the minimum required parking ratio for shopping centers (per 1,000 ft² gross floor area)?

2.5 spaces

If your answer is **4.5 spaces or less**, give yourself 1 point • •

1

What is the minimum required parking ratio for single family homes (per home)?

2.0 spaces

If your answer is **less than or equal to 2.0 spaces**, give yourself 1 point • •

1

Are your parking requirements set as maximum or median (rather than minimum) requirements?

NO

If your answer is **YES**, give yourself 2 points • •

0

Notes on Parking Ratios (include source documentation such as name of document, section and page #):

Land Use Ordinance, Section 291, page 253

7. Parking Codes

Is the use of shared parking arrangements promoted?

YES

If your answer is **YES**, give yourself 1 point • •

1

Are model shared parking agreements provided?

YES

If your answer is **YES**, give yourself 1 point • •

1

Are parking ratios reduced if shared parking arrangements are in place?

YES

If your answer is **YES**, give yourself 1 point • •

1

If mass transit is provided nearby, is the parking ratio reduced?

NO

If your answer is **YES**, give yourself 1 point • •

0

Notes on Parking Codes (include source documentation such as name of document, section and page #):

Land Use Ordinance, Section 297, page 260

8. Parking Lots

What is the minimum stall width for a standard parking space?

If your answer is **9 feet or less**, give yourself **1 point** • •

9.0 feet

1

What is the minimum stall length for a standard parking space?

If your answer is **18 feet or less**, give yourself **1 point** • •

19.0 feet

0

Are at least 30% of the spaces at larger commercial parking lots required to have smaller dimensions for compact cars?

If your answer is **YES**, give yourself **1 point** • •

NO

0

Can pervious materials be used for spillover parking areas?

If your answer is **YES**, give yourself **2 points** • •

YES

2

Notes on Parking Lots (include source documentation such as name of document, section and page #):

Land Use Ordinance, Section 293 page 258 and Appendix D page 297

9. Structured Parking

Are there any incentives to developers to provide parking within garages rather than surface parking lots?

If your answer is **YES**, give yourself **1 point** • •

NO

0

Notes on Structured Parking (include source documentation such as name of document, section and page #):

Land use ordinance does not address

10. Parking Lot Runoff

Is a minimum percentage of a parking lot required to be landscaped?

If your answer is **YES**, give yourself **2 points** • •

YES

2

Is the use of bioretention islands and other stormwater practices within landscaped areas or setbacks allowed?

If your answer is **YES**, give yourself **2 points** • •

NO

0

Notes on Parking Lot Runoff (include source documentation such as name of document, section and page #):

Land Use Ordinance, Appendix E page 299

• • **Time to Assess:** Principles 1 - 10 focused on the codes, ordinances, and standards that determine the size, shape, and construction of parking lots, roadways, and driveways in the suburban landscape. There were a total of 40 points available for Principles 1 - 10. What was your total score?

Subtotal Page 5 + Subtotal Page 6 + Subtotal Page 7 =

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

11. Open Space Design

Are open space or cluster development designs allowed in the community?

If your answer is **YES**, give yourself 3 points • •

If your answer is **NO**, skip to question No. 12

Is land conservation or impervious cover reduction a major goal or objective of the open space design ordinance?

If your answer is **YES**, give yourself 1 point • •

Are the submittal or review requirements for open space design greater than those for conventional development?

If your answer is **NO**, give yourself 1 point • •

Is open space or cluster design a by-right form of development?

If your answer is **YES**, give yourself 1 point • •

Are flexible site design criteria available for developers that utilize open space or cluster design options (e.g., setbacks, road widths, lot sizes)

If your answer is **YES**, give yourself 2 points • •

Notes on Open Space Design (include source documentation such as name of document, section and page #):

Land Use Ordinance, Section 190 page 176

12. Setbacks and Frontages

Are irregular lot shapes (e.g., pie-shaped, flag lots) allowed in the community?

If your answer is **YES**, give yourself **1 point** • •

YES

1

What is the minimum requirement for front setbacks for a one half (½) acre residential lot?

If your answer is **20 feet or less**, give yourself **1 point** • •

40.0

feet

0

What is the minimum requirement for rear setbacks for a one half (½) acre residential lot?

If your answer is **25 feet or less**, give yourself **1 point** • •

40.0

feet

0

What is the minimum requirement for side setbacks for a one half (½) acre residential lot?

If your answer is **8 feet or less**, give yourself **1 points** • •

12.0

feet

0

What is the minimum frontage distance for a one half (½) acre residential lot?

If your answer is **less than 80 feet**, give yourself **2 points** • •

80.0

feet

2

Notes on Setback and Frontages (include source documentation such as name of document, section and page #):

Land Use Ordinance, Sections 183 and 184, pages 169 and 170.

13. Sidewalks

What is the minimum sidewalk width allowed in the community?

If your answer is **4 feet or less**, give yourself **2 points** • •

4.0

feet

2

Are sidewalks always required on both sides of residential streets?

If your answer is **NO**, give yourself **2 points** • •

NO

2

Are sidewalks generally sloped so they drain to the front yard rather than the street?

If your answer is **YES**, give yourself **1 point** • •

YES

1

Can alternate pedestrian networks be substituted for sidewalks (e.g., trails through common areas)?

If your answer is **YES**, give yourself **1 point** • •

NO

0

Notes on Sidewalks (include source documentation such as name of document, section and page #):

Land Use Ordinance, Section 216 page 188

14. Driveways

What is the minimum driveway width specified in the community?

If your answer is **9 feet or less (one lane) or 18 feet (two lanes)**, give yourself **2 points** • •

10.0

feet

2

Development Feature**Your Local
Criteria**

Can pervious materials be used for single family home driveways (e.g., grass, gravel, porous pavers, etc)?

If your answer is **YES**, give yourself **2 points** • •

Can a "two track" design be used at single family driveways?

If your answer is **YES**, give yourself **1 point** • •

Are shared driveways permitted in residential developments?

If your answer is **YES**, give yourself **1 point** • •

Notes on Driveways (include source documentation such as name of document, section and page #):

Land Use Ordinance, Article XVIII page 253

15. Open Space Management

Skip to question 16 if open space, cluster, or conservation developments are not allowed in your community.

Does the community have enforceable requirements to establish associations that can effectively manage open space?

If your answer is **YES**, give yourself **2 points** • •

Are open space areas required to be consolidated into larger units?

If your answer is **YES**, give yourself **1 point** • •

Does a minimum percentage of open space have to be managed in a natural condition?

If your answer is **YES**, give yourself **1 point** • •

Are allowable and unallowable uses for open space in residential developments defined?

If your answer is **YES**, give yourself **1 point** • •

Can open space be managed by a third party using land trusts or conservation easements?

If your answer is **YES**, give yourself **1 point** • •

Notes on Open Space Management (include source documentation such as name of document, section and page #):

Third party management of open space is not addressed in ordinance. Therefore, it is not prohibited.

16. Rooftop Runoff

Can rooftop runoff be discharged to yard areas?

If your answer is **YES**, give yourself **2 points** • •

Do current grading or drainage requirements allow for temporary ponding of stormwater on front yards or rooftops?

If your answer is **YES**, give yourself **2 points** • •

Notes on Rooftop Runoff (include source documentation such as name of document, section and page #):

Not specifically addressed in the ordinance

• • **Time to Assess:** Principles 11 through 16 focused on the regulations which determine lot size, lot shape, housing density, and the overall design and appearance of our neighborhoods. There were a total of 36 points available for Principles 11 - 16. What was your total score?

Subtotal Page 8 + Subtotal Page 9 + Subtotal Page 10 =

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

17. Buffer Systems

Is there a stream buffer ordinance in the community?

If your answer is **YES**, give yourself 2 points • •

If so, what is the minimum buffer width?

If your answer is **75 feet or more**, give yourself 1 point • •

Is expansion of the buffer to include freshwater wetlands, steep slopes or the 100-year floodplain required?

If your answer is **YES**, give yourself 1 point • •

 feet

Notes on Buffer Systems (include source documentation such as name of document, section and page #):

18. Buffer Maintenance

If you do not have stream buffer requirements in your community, skip to question No. 19

Does the stream buffer ordinance specify that at least part of the stream buffer be maintained with native vegetation?

If your answer is **YES**, give yourself 2 points • •

Does the stream buffer ordinance outline allowable uses?

If your answer is **YES**, give yourself 1 point

Development Feature**Your Local
Criteria**

Does the ordinance specify enforcement and education mechanisms?

YES

If your answer is **YES**, give yourself **1 point** • •

Notes on Buffer Systems (include source documentation such as name of document, section and page #):

19. Clearing and Grading

Is there any ordinance that requires or encourages the preservation of natural vegetation at residential development sites?

NO

If your answer is **YES**, give yourself **2 points** • •

Do reserve septic field areas need to be cleared of trees at the time of development?

YES

If your answer is **NO**, give yourself **1 point** • •

Notes on Buffer Maintenance (include source documentation such as name of document, section and page #):

20. Tree Conservation

If forests or specimen trees are present at residential development sites, does some of the stand have to be preserved?

NO

If your answer is **YES**, give yourself **2 points** • •

Are the limits of disturbance shown on construction plans adequate for preventing clearing of natural vegetative cover during construction?

NO

If your answer is **YES**, give yourself **1 point** • •

Notes on Tree Conservation (include source documentation such as name of document, section and page #):

Land Use Ordinance encourages, but does not require tree conservation

21. Land Conservation Incentives

Are there any incentives to developers or landowners to conserve non-regulated land (open space design, density bonuses, stormwater credits or lower property tax rates)?

YES

If your answer is **YES**, give yourself **2 points** • •

Is flexibility to meet regulatory or conservation restrictions (density compensation, buffer averaging, transferable development rights, off-site mitigation) offered to developers?

NO

If your answer is **YES**, give yourself **2 points** • •

Notes on Land Cons. Incentives (include source documentation such as name of document, section and page #):

Land Use Ordinance, Section 190 page 176

22. Stormwater Outfalls

Is stormwater required to be treated for quality before it is discharged?

YES

If your answer is **YES**, give yourself **2 points** • •

Are there effective design criteria for stormwater best management practices (BMPs)?

YES

If your answer is **YES**, give yourself **1 point** • •

Can stormwater be directly discharges into a jurisdictional wetland without pretreatment?

YES

If your answer is **NO**, give yourself **1 point** • •

Does a floodplain management ordinance that restricts or prohibits development within the 100-year floodplain exist?

YES

If your answer is **YES**, give yourself **2 points** • •

2

Notes on Stormwater Outfalls (include source documentation such as name of document, section and page #):

Land Use Ordinance, Article XVI

Code and Ordinance Worksheet

Subtotal Page 13

2

• • **Time to Assess:** Principles 17 through 22 addressed the codes and ordinances that promote (or impede) protection of existing natural areas and incorporation of open spaces into new development. There were a total of 24 points available for Principles 17 - 22. What was your total score?

Subtotal Page 11 + Subtotal Page 12 + Subtotal Page 13 =

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

To determine final score, add up subtotal from each • • **Time to Assess**

Principles 1 - 10 (Page 8)

22

Principles 11 - 16 (Page 11)

19

Principles 17 - 22 (Page 13)

7

TOTAL**48**

• • **Time to Assess:** Principles 11 through 16 focused on the regulations which determine lot size, lot shape, housing density, and the overall design and appearance of our neighborhoods. There were a total of **36** points available for Principles 11 - 16. What was your total score?

Subtotal Page 8 + Subtotal Page 9 + Subtotal Page 10 =

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

17. Buffer Systems

Is there a stream buffer ordinance in the community?

If your answer is **YES**, give yourself **2** points • •

If so, what is the minimum buffer width?

If your answer is **75 feet or more**, give yourself **1** point • •

Is expansion of the buffer to include freshwater wetlands, steep slopes or the 100-year floodplain required?

If your answer is **YES**, give yourself **1** point • •

 feet

Notes on Buffer Systems (include source documentation such as name of document, section and page #):

Unionville LHO Sec. 335

18. Buffer Maintenance

Ed says DENR requires this

If you do not have stream buffer requirements in your community, skip to question No. 19

Does the stream buffer ordinance specify that at least part of the stream buffer be maintained with native vegetation?

If your answer is **YES**, give yourself **2** points • •

Does the stream buffer ordinance outline allowable uses?

If your answer is **YES**, give yourself **1** point

Development Feature

Your Local Criteria

Does the ordinance specify enforcement and education mechanisms?

YES

If your answer is **YES**, give yourself 1 point • •

Notes on Buffer Systems (include source documentation such as name of document, section and page #):

19. Clearing and Grading

(Ed says DENR prohibits this) (?)

Is there any ordinance that requires or encourages the preservation of natural vegetation at residential development sites?

NO

If your answer is **YES**, give yourself 2 points • •

Do reserve septic field areas need to be cleared of trees at the time of development?

YES ?

If your answer is **NO**, give yourself 1 point • •

Notes on Buffer Maintenance (include source documentation such as name of document, section and page #):

20. Tree Conservation

If forests or specimen trees are present at residential development sites, does some of the stand have to be preserved?

NO

If your answer is **YES**, give yourself 2 points • •

Are the limits of disturbance shown on construction plans adequate for preventing clearing of natural vegetative cover during construction?

NO

If your answer is **YES**, give yourself 1 point • •

Notes on Tree Conservation (include source documentation such as name of document, section and page #):

Land Use Ordinance encourages, but does not require tree conservation

21. Land Conservation Incentives

Are there any incentives to developers or landowners to conserve non-regulated land (open space design, density bonuses, stormwater credits or lower property tax rates)?

YES

If your answer is **YES**, give yourself 2 points • •

Is flexibility to meet regulatory or conservation restrictions (density compensation, buffer averaging, transferable development rights, off-site mitigation) offered to developers?

NO

If your answer is **YES**, give yourself 2 points • •

Notes on Land Cons. Incentives (include source documentation such as name of document, section and page #):

Land Use Ordinance, Section 190 page 176

Development Feature

Your Local Criteria

22. Stormwater Outfalls

According to the requirements of Town's LUO

Is stormwater required to be treated for quality before it is discharged?

If your answer is **YES**, give yourself 2 points • •

☒ YES ☐ NO

Are there effective design criteria for stormwater best management practices (BMPs)?

If your answer is **YES**, give yourself 1 point • •

☒ YES ☐ NO

Can stormwater be directly discharged into a jurisdictional wetland without pretreatment?

If your answer is **NO**, give yourself 1 point • •

Yes ☒ YES ☐ NO *according to E&C #1*

Does a floodplain management ordinance that restricts or prohibits development within the 100-year floodplain exist?

If your answer is **YES**, give yourself 2 points • •

☒ YES

✓ 2

Notes on Stormwater Outfalls (include source documentation such as name of document, section and page #):

Land Use Ordinance, Article XVI *Floodplain Part I; Article XVI Drainage, Erosion Control, + Stormwater Management Part II*

Code and Ordinance Worksheet

Subtotal Page 13

2

• • **Time to Assess:** Principles 17 through 22 addressed the codes and ordinances that promote (or impede) protection of existing natural areas and incorporation of open spaces into new development. There were a total of 24 points available for Principles 17 - 22. What was your total score?

Subtotal Page 11 + Subtotal Page 12 + Subtotal Page 13 =

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

To determine final score, add up subtotal from each • **Time to Assess**

Principles 1 - 10 (Page 8)

22

Principles 11 - 16 (Page 11)

19

Principles 17 - 22 (Page 13)

7

TOTAL

48

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Appendix E NCEEP LWP Phase IV Implementation Guidance

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NCEEP LWP Phase IV Implementation Guidance

Recent legislation has resulted in changes to the process by which NCEEP implements mitigation projects. Session Law 2011-343, approved in June 2011, broadened the applicability of SL 2009-337 to require most local government entities seeking mitigation credits to purchase bank credits when they are available. Through a collaborative effort by NCEEP and the NCDWQ, NCDENR updated policies effective July 1, 2011 to implement the modifications. The following describes how NCEEP will proceed with project implementation.

1. When NCEEP seeks to procure new mitigation credits, NCEEP will first seek to acquire mitigation credits through Full Delivery or the purchase of credits from private mitigation banks. In cases where NCEEP is unsure that either of these approaches are viable (for example, NCEEP is unaware of the existence of a bank, or historical Full Delivery Requests For Proposals submitted prior to June 27, 2011 have been unsuccessful), NCEEP will issue a Request for Information to evaluate the private sector's ability to deliver the needed mitigation. Depending upon the responses received, NCEEP will either issue a Full Delivery RFP, an RFP for private bank credits or move down the hierarchy.
2. If Step 1 is unsuccessful or unviable, and if the impacts are within the service area of an existing local compensatory mitigation bank, NCEEP will seek to procure mitigation from such a bank. There are three in the state that meet the definition included in the session law (the City of Charlotte Umbrella Stream and Wetland Bank, the City of Raleigh Umbrella Stream and Wetland Mitigation Bank and the City of Greensboro Umbrella Wetland, Stream and Watershed Mitigation Bank). The N.C. Interagency Review Team currently does not allow them to sell mitigation credits to third parties. Consequently, this procurement option is not currently available to NCEEP. NCEEP will monitor changes in this situation, but at this time will proceed down the hierarchy.
3. If steps 1 or 2 are not successful or viable, NCEEP will seek to outsource mitigation work through a Design/Build program. Step 3 is also intended for implementation of projects associated with donation of property. In order to apply this approach the program is working to establish the procedural mechanisms called for in the law and required for all state procurement activities. NCEEP is aggressively developing various Design/Build contracting tools and methods and expects to submit a draft to NCDENR management in the coming months. Until NCEEP develops Design/Build contracting methods that have been approved by the Department of Administration, the program will utilize Step 4, Design-Bid-Build (DBB) procurement procedures. The departments of Administration and Justice are actively working with NCEEP to resolve these procurement issues.
4. If steps 1, 2 or 3 are not successful or viable, NCEEP will seek to develop mitigation credits through DBB. S.L. 2011- 343 also allows NCEEP to complete projects currently programmed through the DBB contracting procedures. This applies to all projects under contract for designer services as of June 27, 2011. NCEEP will continue with these projects as scheduled.

Additional Clarifications for Application of the Hierarchy

Best interest of the state: All steps in the procurement process shall be applied in consideration of making decisions that are in the best interest of the state. Factors affecting such decisions include associated

procurement costs, timing of regulatory compliance, project partners, whether a procurement approach can be accomplished within required timeframes, the amount of mitigation available for procurement and whether available mitigation is sufficient to satisfy existing and/or projected requirements.

NCEEP is approached (unsolicited) with a project site: It is common for private landowners, public entities or other interested parties approach NCEEP with a project site. In such situations, NCEEP project managers will respond to the inquiry by gathering pertinent information on the project, and the watershed within which it is located, without committing to its implementation. In cases where NCEEP has sought to meet mitigation needs according to the prescribed hierarchy and found steps 1 and 2 to be unsuccessful or unviable, NCEEP may pursue the project site starting with Step 3, Design/Build.

To ensure that watershed planning continues to be closely tied to project implementation through these procurement methods additional measures have been added to the request for and evaluation of proposed project sites submitted by Full Delivery providers (step 1). Advertisements from NCEEP for mitigation credits will include specific functional objectives (such as controlling and reducing sediment inputs) for each Request for Proposal (RFP) developed. These functional objectives will be determined based on available watershed planning documents, such as Local Watershed Plans and River Basin Restoration Priority plans.

The projects submitted by Full Delivery providers will be scored on how well they address the functional objectives emphasized in a particular RFP. The technical evaluation score sheet will be developed to objectively evaluate potential projects in the context of the functional goals that are emphasized. This is done by including technical components most relevant to a particular RFP's objectives such as including a criteria to score how the proposed project will reduce bank erosion, or to what level it will reestablish the riparian buffer. Scoring weights are then assigned for each criterion to reinforce their relative importance for advancing the specified functional objectives of the RFP. Scores are assigned for each criterion based on relative importance to the plan goals. Proposed projects will receive additional points for being located within an LWP area and also for being identified in an LWP Project Atlas.

Appendix F Technical Resources and Funding Sources

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Technical Resources and Funding Sources

The following list of technical resources and funding is organized by the following major headings:

- Local Resources
- General Funding Resources
- Agricultural Watershed Funding Resources
- Urban Watershed Resources
- Other Watershed Resources
- Publications

Local Resources

Centralina Council of Governments

www.centralina.org

Mecklenburg County Soil and Water Conservation District

Phone Numbers: (704) 336-2455

Email: Anganette.Bryd@MecklenburgCountyNC.gov

Address: 700 North Tryon Street, Charlotte, NC 28202

Mecklenburg County Cooperative Extension

<http://mecklenburg.ces.ncsu.edu/>

Union County Soil and Water Conservation District

Phone Numbers: (704) 233-1621 Ext. 3

Address: 3230-B Presson Road, Monroe, NC 28112

Union County Cooperative Extension

<http://union.ces.ncsu.edu/>

Mecklenburg County Planning

<http://charmeck.org/city/charlotte/planning/Pages/Home.aspx>

Charlotte Mecklenburg Stormwater Services

<http://charmeck.org/stormwater/Pages/default.aspx>

Union County Planning

<http://www.co.union.nc.us/PropertyServices/PlanningDepartment.aspx>

Union County Stormwater

<http://www.co.union.nc.us/PropertyServices/PublicWorks/InfrastructureEnvironment/Stormwater.aspx>

Surface Water Protection / DWQ Mooresville Office, NC DENR

<http://portal.ncdenr.org/web/wq/home/ro/mro>

Catawba Lands Conservancy

<http://www.catawbalands.org/>

Carolina Thread Trail

<http://www.carolinathreadtrail.org/>

Yadkin Riverkeeper

<http://www.yadkinriverkeeper.org/>

Fairview Land Use/Planning Board

<http://fairviewnc.gov/land%20use.htm>

Hemby Bridge Main Website

<http://hembybridgenc.govoffice2.com/>

Indian Trail Planning Board

<http://www.indiantrail.org/boardsandcommittees.php?cat=8>

Indian Trail Planning and NBHD Services

<http://www.indiantrail.org/planning.php>

Indian Trail Engineering and Public Works

<http://www.indiantrail.org/departments.php?cat=35>

Indian Trail Stormwater Services

<http://www.indiantrail.org/requestlist.php>

Indian Trail Parks, Trees and Greenway Committee

<http://www.indiantrail.org/boardsandcommittees.php?cat=26>

Indian Trail Stormwater Advisory Committee

<http://www.indiantrail.org/boardsandcommittees.php?cat=27>

Mint Hill Planning and Zoning

<http://www.minthill.com/index.aspx?nid=85>

Mint Hill Stormwater (refers to Mecklenburg Co. website)

<http://charmeck.org/stormwater/Pages/default.aspx>

Mint Hill Land and Water Resources (refers to Meck. Co. website)

<http://charmeck.org/mecklenburg/county/WaterandLandResources/Pages/default.aspx>

Monroe Stormwater Services

<http://www.monroenc.org/services.php?cat=188>

Monroe Water Resources Dept.

<http://www.monroenc.org/services.php?cat=80>

Monroe Planning and Development

<http://www.monroenc.org/services.php?cat=89>

Unionville Land Use

<http://www.unionvillenc.com/page6.html>

Stallings Stormwater Dept.

http://www.stallingsnc.org/index.asp?Type=B_BASIC&SEC={8592B5C9-35DD-42AC-917E-54C745383356}

Stallings Planning and Zoning

http://www.stallingsnc.org/index.asp?Type=B_BASIC&SEC={4E1EAD4B-561A-4AF3-A12A-6B4BCF6BAF8B}

Matthews Planning and Development

<http://www.matthewsnc.com/Departments/PlanningandDevelopment.aspx>

Matthews Stormwater

<http://www.matthewsnc.com/Departments/PublicWorks/Stormwater.aspx>

General Funding Resources

NC Ecosystem Enhancement Program/ NC DENR

<http://portal.ncdenr.org/web/eep/home>

Clean Water Management Trust Fund

<http://www.cwmtf.net/>

Non-point Source Section 319 Grants / DWQ, NC DENR

<http://portal.ncdenr.org/web/wq/ps/nps/319program>

Planning Grant 205j –DWQ, NC DENR

<http://h2o.enr.state.nc.us/pb/205jPlanningGrantHomePage.htm>

Z. Smith Reynolds Foundation

<http://www.zsr.org/>

Clean Water State Revolving Fund / Construction Grants and Loans, NC DENR

<http://portal.ncdenr.org/web/wq/cgls/iup>

The Cooperative Water Program/ USGS

<http://water.usgs.gov/coop/>

Water Resources Development Project Grant Program/ Division of Water Resources, NC DENR

http://www.ncwater.org/Financial_Assistance/

Planning Assistance To States Program (Section 22) US Army Corps of Engineers

<http://www.saw.usace.army.mil/Floodplain/Section%2022.htm>

Partners for Fish and Wildlife / USFWS

<http://www.fws.gov/raleigh/pfw.html>

EPA List of Watershed Funding Opportunities

<http://www.epa.gov/owow/funding.html>

Community Conservation Assistance Program/ DSWC, NCDENR

http://www.enr.state.nc.us/DSWC/pages/ccap_program.html

Agricultural Watershed Funding Resources

Agriculture Cost Share Program/ DSWC, NC DENR

<http://www.enr.state.nc.us/dswc/pages/agcostshareprogram.html>

Conservation Reserve Program / USDA

<http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=crp>

Conservation Reserve Enhancement Program/ Division of Soil and Water Conservation (DSWC), NC DENR

<http://www.enr.state.nc.us/dswc/pages/crep.html>

Environmental Quality Incentives Program/ NRCS, USDA

<http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/equip>

Wildlife Habitat Incentive Program, NRCS, USDA

<http://www.nrcs.usda.gov/programs/whip>

Farm and Ranch Land Protection Program/ NRCS, USDA

<http://www.nrcs.usda.gov/programs/frpp/>

NC Agricultural Development and Farmland Preservation Trust Fund

<http://www.ncadfp.org/index.htm>

Other USDA Programs

<http://www.nrcs.usda.gov/programs/>

Urban Watershed Resources

NCSU LID Portal

<http://www.ces.ncsu.edu/depts/agecon/WECO/ncsulid/>

NC DENR Division of Land Resources, Erosion and Sediment Control

<http://portal.ncdenr.org/web/lr/erosion>

Green Growth Toolbox/ Wildlife Resource Commission, NC DENR

<http://www.ncwildlife.org/GreenGrowth/>

Community Conservation Assistance Program/ DSWC, NCDENR

http://www.enr.state.nc.us/DSWC/pages/ccap_program.html

Center for Watershed Protection

<http://www.cwp.org/>

NC State University Bio & Ag Engineering, Stormwater Engineering Group

<http://www.bae.ncsu.edu/stormwater/>

Other Watershed Resources

Use Restoration Watershed Funding Resources/ DWQ NC DENR

<http://portal.ncdenr.org/web/wq/ps/bpu/urw/funding>

Environmental Finance Center Network

<http://efc.boisestate.edu/watershed/index.asp>

NC Cooperative Extension

<http://www.ces.ncsu.edu/>

NC DENR Office of Environmental Education

<http://www.eenorthcarolina.org/>

NC DENR – Public

<http://swap.deh.enr.state.nc.us/swap/pages/swplinks.htm>

NC Natural Heritage Trust Fund

<http://www.ncnhtf.org/>

N.C. Parks and Recreation Trust Fund, NC DENR

http://www.ncparks.gov/About/grants/partf_main.php

NC State University Water Quality Group

<http://www.bae.ncsu.edu/programs/extension/wqg/>

NC State University Watershed Education for Communities and Officials (WECO)

<http://www.ces.ncsu.edu/depts/agecon/WECO/index.html>

EPA Watersheds

<http://www.epa.gov/owow/watershed/>

Publications

Center for Watershed Protection, 1998. Better Site Design: A handbook for changing development rules in your community. Center for Watershed Protection, Ellicott City Maryland. August 1998.

N.C. State University, 2009. Low Impact Development: a guidebook for North Carolina. NCSU – NC Cooperative Extension Service. June 2009.

NC Cooperative Extension. 2009. NC LID Guidebook and Model Spreadsheet. NC State Cooperative Extension. <http://www.ces.ncsu.edu/depts/agecon/WECO/lidguidebook/>

NC Wildlife Resources Commission, 2009. Green Growth Toolbox (Nature-friendly planning). NC WRC, Wildlife Diversity Program. January 2009.

US EPA, 2009. Managing Wet Weather and Green Infrastructure. Municipal Handbook. Water Quality Scorecard. EPA-833-B-09-004. August

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