Town of Chapel Hill
Stormwater Management Division
Public Works Department

Vegetated Riparian Buffers

Riparian Buffers

Vegetated riparian buffers are the areas adjacent to streams which are instrumental in reducing impacts to streams and the greater watershed from adjacent land use activities. Riparian buffers protect water quality by:

- filtering out pollutants from adjacent land uses;
- slowing and infiltrating runoff, which reduces peak flows and downstream flooding;
- stabilizing stream banks and stream channels, which helps prevent erosion;
- providing shade, which cools water temperatures, helps maintain dissolved oxygen levels, and reduce algae levels;
- facilitating the exchange of groundwater and surface water; and
- providing organic nutrients to support aquatic food webs.

Riparian buffers also improve air quality, provide important habitat for fish and wildlife, provide recreational opportunities, and have aesthetic value. These functions are well documented across numerous studies. In addition, protecting riparian areas allows ecological systems to be more resilient to natural and human-induced changes, including climate change.

There is an economic as well as environmental value in protecting riparian buffers, not just for property owners and the community, but also for the greater watershed. Jordan Lake supplies drinking water to nearly 700,000 Triangle residents, and offers important regional and statewide recreational opportunities, with a million or more visitors a year. Jordan Lake is also a future drinking water source for OWASA. According to NCDEQ (2016), riparian buffers provide many financial benefits to both the property owner and the community, including: decreasing the need for public investment in stormwater management, flood control and pollution removal; increased property values; and reduced land maintenance costs (compared to formal lawns and other landscaped areas). Protection of water quality by the protection of riparian buffers also lowers costs associated with expensive drinking water treatment plants or upgrades needed to purify water in degraded watersheds—saving money for municipalities and utilities.

In determining an appropriate riparian buffer width, the following four criteria are recommended considerations: the desired functions of the buffer, value of the resource protected, physical characteristics of the riparian area, and intensity of adjacent land use. The following figures provides buffer width ranges associated with the most accepted riparian buffer functions according to USDA (1998).

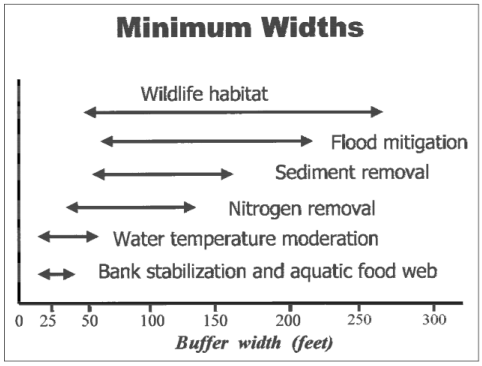


Figure 6 - 3. Range of minimum widths for meeting specific buffer objectives.

In 2002, the NC Wildlife Resources Commission published guidance for local governments regarding generalized mitigation measures for all watersheds within North Carolina to address indirect and cumulative impacts of projects to wildlife and water quality. This guidance recommends 100-foot forested buffers on perennial streams, 50-foot forested buffer on intermittent streams, and encourages the implementation of buffers on ephemeral streams. The guidance also recommends limiting impervious surfaces to less than 10% of the watershed.

Headwater Streams

Headwater streams include ephemeral, intermittent, and perennial streams that are the very beginnings of larger or streams and rivers. In the United States, headwater stream systems represent 79% of the overall river network and drain 70% of the land area. Small but often overlooked, headwater streams are of great importance to the ecosystem and are critical in terms of influencing water quality and quantity in streams and watersheds. Headwater streams, which are the smallest tributaries of streams and rivers in a watershed, serve as an essential hydrological and ecological linkage to downstream waters. Many small headwater streams in the Town of Chapel Hill form the headwaters of Bolin Creek, Booker Creek, Little Creek, and Morgan Creek, all of which drain to Jordan Lake.

Headwater streams are vulnerable to land development since they are relatively easy to fill in, channelize, or relocate due to their smaller flows. Loss of native vegetation, creation of compacted soils, addition of impervious area and associated storm drainage infrastructure from development eliminates the water quality improvement that would occur in a naturally flowing system and results in an increase in both the rate and volume of stormwater flow.

The North Carolina Department of Environment and Natural Resources (now NCDEQ) conducted a multi-year research study to examine the water quality and aquatic life values of headwater streams and wetlands across the state. Researchers determined that headwater streams provide significant reductions in nutrients and sediment across the state and provide a significant source of organic matter for downstream ecosystems. The research findings show that proper protection and management of headwater streams and wetlands is critical to protect downstream water quality and aquatic life in the state. (NCDWQ 2006).

Resource Conservation District (RCD)

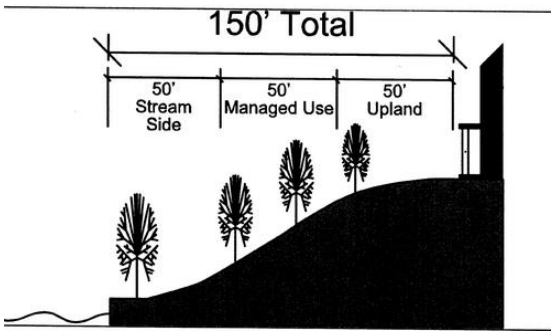
Riparian buffer protection in Chapel Hill dates to 1984 when the initial Resource Conservation District (RCD) was approved and implemented along watercourses within the Town's planning jurisdiction. The RCD is intended to be applied to the areas within and along watercourses in order to:

- preserve the water quality of the Town's actual or potential water supply sources

- minimize danger to lives and properties from flooding in and near the watercourses
- preserve the water-carrying capacity of the watercourses and protect them from erosion and sedimentation
- retain open spaces and greenways and to protect their environmentally sensitive character
- preserve urban wildlife and plant life habitats from the intrusions of urbanization
- provide air and noise buffers to ameliorate the effects of development, and
- preserve and maintain the aesthetic qualities and appearance of the town. [LUMO Section 3.6.3].

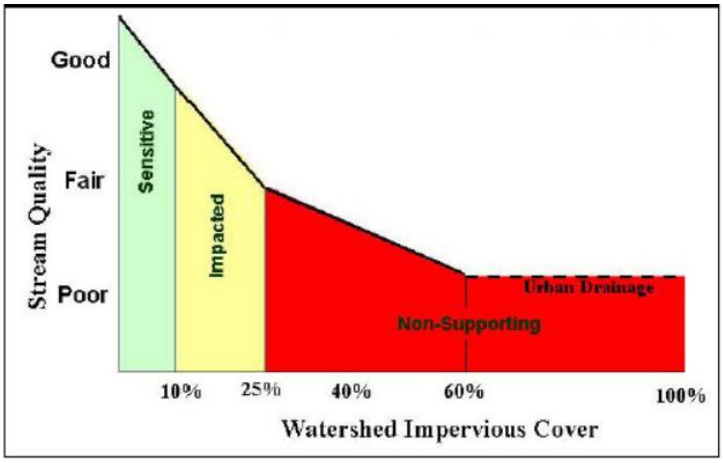
The RCD ordinance establishes allowable uses and activities within the RCD buffer, and dimensional regulations for disturbed area and impervious area allowed on a property.

The resource conservation district riparian buffer for a perennial stream is 150 feet consisting of a 50 foot stream side area, 50 foot managed use area, and 50 foot upland area. The riparian width for an intermittent stream is 50 feet.



Stream and Watershed Impacts from Impervious Surfaces
According to research from the Center for Watershed Protection and many other sources, streams become impaired when impervious surfaces cover just 10% of a watershed. Streams in watersheds where impervious surfaces cover 25% of the watershed area typically cannot support aquatic life or attain water quality standards and are severely degraded from a physical and biological standpoint (CWP 2003).

Figure 1. Relationship between stream quality and imperviousness (CWP 2003).



Stormwater Control Measures (SCM)

The Town's stormwater ordinances require development projects to meet certain standards regarding water quality treatment, peak flow rates, and volume detention. These ordinances are typically addressed by the construction of a designed stormwater control measure (SCM) such as a wet pond, bioretention, permeable pavement. A meta-analysis of 52 modelling studies globally to relate stormwater control measures and hydrologic changes indicates that impervious surface mitigated by stormwater control measures does indicate reduction in runoff and peak flows (Bell 2000). Even with the runoff reduction, studies by Bell 2000 and Hopkins 2019 note that streamflow magnitude and timing were altered by urbanization even with SCMs treating 100% of the impervious area (Hopkins 2019). The prominent driver for streamflow response in these studies was the impervious coverage not the number or density of stormwater control measures.

Stream Restoration

Stream restoration or enhancement activities can achieve many objectives:

- Control severe stream bank erosion and instability
- Repair damage from floods
- Improve aquatic habitat or riparian forest conditions
- Compensate for impacts that result from highway projects or other site development

Stream restoration re-creates meanders, stabilizes soil, and installs gently sloping stream banks. Stream restoration is not always possible due to constraints such as utility crossings, structures, and roadways. A modest approach to restoration is to stabilize eroding stream banks and add native vegetation but does not address the natural flow of the stream. A basic restoration project consists of replanting stream banks and riparian areas. Restoration is a difficult and expensive project which takes time with respect to construction and maturation of the trees. Due to past degradation, stream restoration is an important aspect of watershed management in concert with preserving riparian buffers.

Citations

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Stream classification for the Columbia Street Annex Property

The Town of Chapel Hill uses the North Carolina Division of Water Resources (NCDWR) methodology to determine stream classifications. The three categories of classification are perennial, intermittent, and ephemeral as defined below according to NCDWG methodology. Citation of the appropriate section of the North Carolina Administrative Code (NCAC) is shown in the parentheses following each definition.

Perennial stream means a well-defined channel that contains water year-round during a year of normal rainfall with the aquatic bed located below the water table for most of the year. Groundwater is the primary source of water for a perennial stream, but it also carries stormwater runoff. A perennial stream exhibits the typical biological, hydrological, and physical characteristics commonly associated with the continuous conveyance of water. [15A NCAC 02B .0233(2)(i)]

Intermittent stream means a well-defined channel that contains water for only part of the year, typically during winter and spring when the aquatic bed is below the water table. The flow may be heavily supplemented by stormwater runoff. An intermittent stream often lacks the biological and hydrological characteristics commonly associated with the conveyance of water. [15A NCAC 02B .0233(2)(g)]

Ephemeral stream means a feature that carries only stormwater in direct response to precipitation with water flowing only during and shortly after large precipitation events. An ephemeral stream may or may not have a well-defined channel, the aquatic bed is always above the water table, and stormwater runoff is the primary source of water. An ephemeral stream typically lacks the biological, hydrological, and physical characteristics commonly associated with the continuous or intermittent conveyance of water. [15A NCAC 02B .0233(2)(d)]

Due to the broad variability in the natural characteristics of small streams and the impacts of urbanization that may result, some stream segments will not precisely fit the stream definitions and verification criteria. Such channels and/or channel segments shall be classified based on all available evidence including field investigation and map resources upstream of, within, and downstream of the segment in question.

Columbia Street Annex – Proposed Modifications to RCD Regulations

The proposed project entitled Columbia St Annex is requesting modifications to the RCD regulations which include

- Land disturbance beyond regulatory allowance in the managed use zone and upland use zones
- Imperviousness area beyond regulatory allowance in the upland zone
- Proposed parking and building are not allowable uses in the managed or upland zones
- Disturbing all steep slopes exceeding 25% on site which exceeds the allowable limit

Table Summarizing RCD Zone Disturbed and Impervious Areas

RCD Zone	Total Area	Proposed Disturbance	Maximum Disturbance by Code (LUMO)	Proposed Impervious	Maximum Impervious by Code (LUMO)
Streamside	35,935 sf	2,210 sf 6.15%	7,187 sf 20%	0	3,594 sf 10%
Managed	38,618 sf	23,100 sf 59.8%	15,447 sf 40%	5,380 sf 13.9%	7,724 sf 20%
Upland	34,668 sf	18,300 sf 52.8%	13,867 sf 40%	13,650 sf 39.4%	6,934 sf 20%

Over various stream determinations, the stream has consistently been considered “variant” for most of its length across the property meaning that natural stream environmental has been disturbed and is characterized by sediment deposition and diffuse flow. Excessive sedimentation from past land uses have buried natural stream features (and in some areas, the whole channel), and hydrology (baseflow) has been altered in these “variant” stream reaches as a result.

A stream classification is valid for 5 years, which was formalized by a council resolution on October 22, 2003. Over time, there can be changes in hydrology or watershed characteristics that impact a stream and thus its classification. Since 2011, hydrology has changed at this site and other sites in Chapel Hill. According to USGS stream gage data, streamflow (based on monthly mean flow) in the Chapel Hill area was below-average in 2011. The stream classification from the June 7, 2004 determination was perennial and was reclassified as intermittent on May 25, 2011. During the site visit on October 5, 2017, for the current stream determination, strong baseflow as observed for the upstream feature after several weeks of no rainfall and several aquatic organisms (larval salamander, damselfly nymph, and phantom cranefly larvae) were documented. These aquatic organisms are strong biological indicators that the stream reach is perennial (based on NCDWR research and guidance). In accordance with Town stream classification procedures, “variant” stream segments are classified the same as the stream segment immediately upstream for other than headwater segments. Since the upstream segment of this stream was determined to be perennial, the downstream “variant” segment located on this property is also classified as perennial.

The applicant appealed the Town’s stream determination to the NC Division of Water Resources on March 28, 2018. The state conducted an on-site determination to review the feature on June 6, 2018. In an excerpt from their report shared below, Site C refers to a location north of the property and Site B is on the property.

> “The DWR has determined that the stream at the locations labeled Site A and Site B on the attached map are " perennial" and subject to the Jordan Lake Buffer Rule.
>
> The portion of the stream including Site C, though impacted, has been determined to carry the perennial" designation and is subject to the Jordan Lake Buffer Rule.
>
> The feature, between Site C and Site B (labeled " Impacted Variant Section" on the attached map), has been heavily impacted by offsite sedimentation and buried under fill and debris from historic development activities. For regulatory purposes, this portion of the feature is

designated as " not subject" to the Jordan Lake Buffer Rule.”

The state confirmed that the stream classification is perennial. This area is impacted by years of sedimentation and burial by fill and debris from historic development activities and invasive vegetation has colonized near Site C. A copy of NC DWR stream classification has been attached for reference.