

# WATER QUALITY BUFFERS

## 6.1 Introduction

Water quality buffers are naturally vegetated areas that are located along the edge or perimeter of streams, lakes, ponds, reservoirs, and wetlands that are defined as “community waters” in unincorporated Knox County. Knox County’s stormwater management ordinance requires water quality buffers for all new developments and redevelopments that are bounded by or contain community waters. Community waters are defined in the sections below.

Water quality buffers provide several benefits to water quality in Knox County and are one of a number of best management practices (BMPs) that are available for site developers to incorporate into development plans to meet water quality goals. Buffers provide a tool for the improvement of stream water quality and habitat. A properly designed buffer will slow and spread-out stormwater runoff from upstream impervious areas, and will filter sediment and the chemicals and pollutants that attach to sediment particles via the trees, shrubs, and grasses that comprise the buffer area. Further, the trees and other vegetation in a buffer provide shade for the stream and buffer area, allowing stormwater runoff that has been heated on roofed and paved areas to cool before reaching the stream.

### PURPOSES OF A STREAM BUFFER:

- Reduce erosion and stabilize stream banks.
- Assist with infiltration of stormwater runoff.
- Control sedimentation.
- Reduce the effects of flood and drought.
- Provide shade to streams.
- Provide and protect habitat for aquatic species and other wildlife.
- Offer scenic value and recreational opportunities.
- Restore and maintain the chemical, physical and biological integrity of water resources.
- Minimize public investment in waterway restoration, stormwater management, and other public water resource endeavors.

Shueler, WPT Summer, 1995  
*Vegetated Riparian Buffers and Buffer Ordinances*, SCDEC

Vegetated buffers can also act as a flood and erosion management tool. Buffers slow runoff velocities, counter channelization of runoff inflows, and reduce inflow volumes somewhat through infiltration into the soil and capture in vegetation. These effects can reduce the potential for downstream flooding, and the potential for streambank instability and erosion, both in the buffered area and downstream. Because development in buffered areas is limited, buffers can be helpful for floodplain management, preventing development along the stream edge and, in some cases, out of the floodway.

Knox County must incorporate requirements for water quality buffers into its stormwater management program in order to comply with the National

Pollutant Discharge Elimination System (NPDES) Phase II Permit. The permit requires that Knox County “develop and implement a set of requirements to establish, protect and maintain water quality buffers in areas of new development and redevelopment.” In the permit, water quality buffers are defined as “undisturbed vegetation including trees, shrubs, and herbaceous vegetation; enhanced or restored vegetation; or the re-establishment of vegetation bordering streams, ponds, wetlands, reservoirs, or lakes, which exists or is established to protect those water bodies.”

## 6.2 Applicability

### 6.2.1 Community Waters Definitions

For new developments and redevelopments, water quality buffers must be established, protected and maintained along or around all water bodies that are designated as community waters that are located in the unincorporated areas of Knox County. Community waters include streams, wetlands, ponds, and lakes as defined below.

#### 6.2.1.1 Streams

Streams are defined in the Knox County Stormwater Management Ordinance as linear surface water conveyances that can be characterized as having either perennial or ephemeral base flow and

- a. have published floodplain elevations that have been computed as part of an approved flood study; *or*
- b. are identified as a blue line on a 7.5-minute USGS quadrangle, unless otherwise designated by Tennessee Department of Environmental Conservation (TDEC); *or*
- c. are identified by the property owner as a stream; *or*,
- d. are determined to be streams by Knox County, the United States Army Corps of Engineers (USACE) or Tennessee Department of Environmental Conservation (TDEC).

If the designation of a linear drainage feature as a stream based on the above stated criteria is disputed, and if the feature has an upstream drainage area of one-hundred (100) acres or more, a stream determination can be performed by the property owner. The stream determination must be performed using the stream determination protocol provided by Knox County Engineering. The protocol should be completed by a qualified individual. The determination will be reviewed and approved or denied by Knox County staff.

In the event that the property owner disputes the identification by Knox County or another party of a linear drainage feature as a stream (and therefore community waters), TDEC can be utilized to make the ultimate determination. It is the responsibility of the property owner to contact and coordinate stream determination activities with TDEC. Any determination made by TDEC must be documented in writing and submitted to Knox County with the stormwater management plan prepared for the site. In the event that TDEC determines that a linear drainage feature is not a stream, Knox County will accept TDEC's written determination, and a water quality buffer will not be required.

#### 6.2.1.2 Wetlands

Wetlands are defined in the Knox County Stormwater Management Ordinance as areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and under normal circumstances does support a prevalence of vegetation typically adapted for life in saturated soil conditions.

Knox County staff will not make wetland determinations. Wetland determinations must be performed by one of the following agencies:

- USACE; and/or
- EPA; and/or
- TDEC; and/or
- the Natural Resources Conservation Service (NRCS); and/or
- a qualified professional that has been trained in the identification and delineation of wetland areas.

### 6.2.1.3 Ponds and Lakes

Ponds and lakes are defined as inland bodies of standing water. Water quality buffers are required for ponds and lakes that are directly connected to a stream that is considered community water.

For a pond or lake to be directly connected to a stream, at least one of the following criteria must be met:

- a stream, as defined in section 6.2.1.1, must have a direct discharge into the pond or lake; or,
- the pond or lake discharges directly into a stream, as defined in section 6.2.1.1, or wetland.

Buffers are not required for isolated ponds or lakes that do not have a direct connection to a stream. Further, buffers are not required for ponds that have been constructed solely for the purpose of water quantity and/or quality control.

## 6.3 Buffer Zones and Widths

### 6.3.1 Zones

Knox County has established a two-zoned buffer approach on community waters. The buffer zones and the width of each zone that are required for each type of community water feature are described below. In general, the inner zone of a water quality buffer (i.e., the zone closest to the water) is to remain undisturbed and should consist of forest vegetation and deep-rooted, woody vegetation. The outer zone of a water quality buffer (i.e., the zone farthest from the water) is a transition zone between the inner zone and development. The outer zone can consist of managed vegetation, including grasses. Knox County allows buffer width averaging within the outer zone. Buffer width averaging is discussed in Section 6.5. The outer zone of a buffer may be disturbed, in accordance with Section 6.7, but must be revegetated. Impervious surfaces are not permitted within either zone.

While the goal of the water quality buffer zone is to maintain undisturbed vegetation with no impervious surfaces in either zone, limited disturbances or impacts are permitted. Section 6.7 provides more information on the permitted disturbances or impacts to water quality buffers.

### 6.3.2 Widths

The following sections identify zone widths for each type of community water feature.

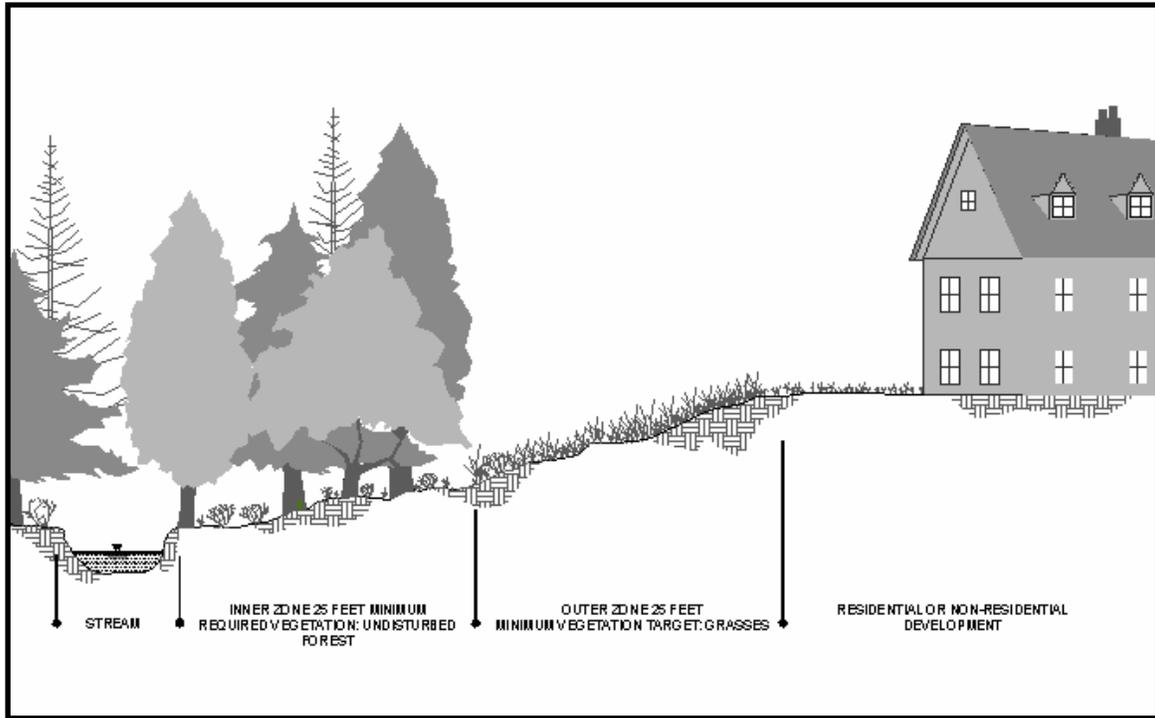
#### 6.3.2.1 Streams

A fifty (50) foot minimum width buffer shall be provided along each side of a stream, unless a narrower width is permitted through buffer width averaging, presented in Section 6.5. The water quality buffer is divided into two zones and shall be maintained as stated below. A graphical depiction of a two-zone buffer is presented in Figure 6-1.

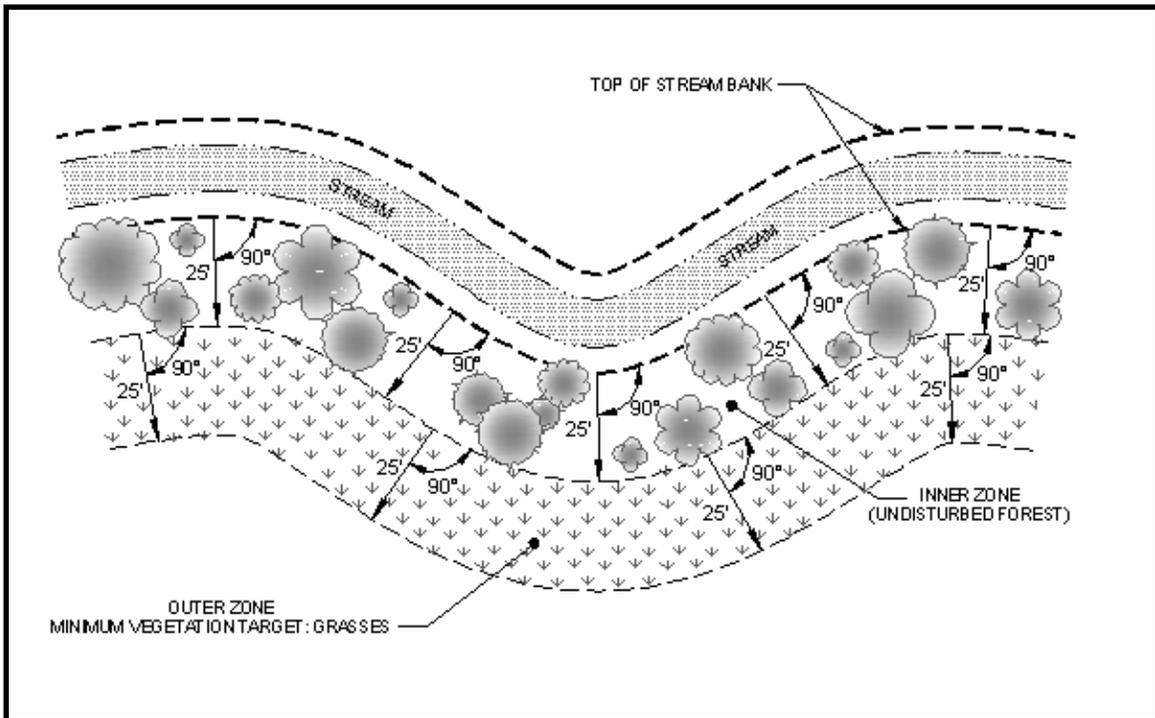
1. The **inner zone** shall have a minimum width of twenty-five (25) feet measured landward, perpendicular from the top-of-bank of the active channel. For streams that do not have a defined top-of-bank, the buffer shall be measured perpendicular from the centerline of the stream. The inner zone must remain undisturbed except for the allowable disturbances listed in Section 6.7.
2. The **outer zone** shall be measured from the outer edge of the inner zone and shall extend the perpendicular distance required to fulfill the required minimum total, two-zoned buffer width of fifty (50) feet. The outer zone can be disturbed, graded and revegetated according to the specifications in Section 6.7.2.

Examples of buffer width measurement, as referenced from the top-of-bank and stream centerline, are shown in Figures 6-2a and 6-2b, respectively.

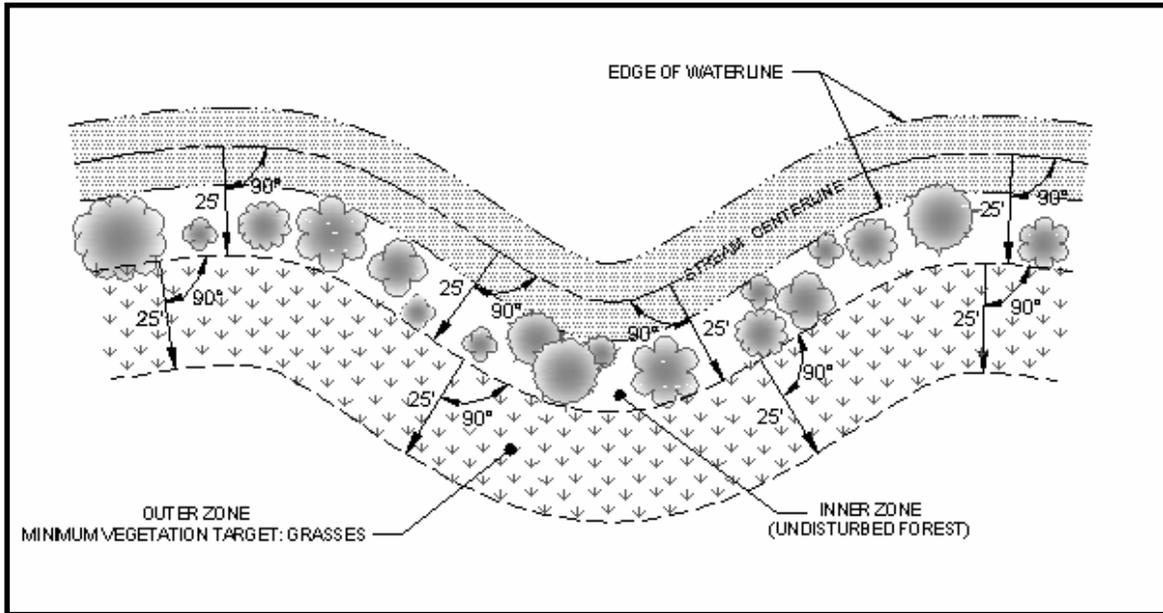
**Figure 6-1. Streamside Water Quality Buffers: Zones and Widths**



**Figure 6-2a. Example Buffer Width Measurement – Top-of-Bank**



**Figure 6-2b. Example Buffer Width Measurement – Stream Centerline**



### 6.3.2.2 Wetlands

A minimum twenty-five (25) foot water quality buffer shall be provided around the perimeter of a wetland, measured perpendicular from the outermost edge of the wetland, as determined by USACE, NRCS, TDEC, or other qualified professional. The water quality buffer on a wetland will consist of one zone, which shall remain undisturbed except for the allowable disturbances listed in Section 6.7.

### 6.3.2.3 Ponds and Lakes

A minimum twenty-five (25) foot water quality buffer shall be provided around the perimeter of ponds and lakes that are directly connected to other community waters. The water quality buffer width shall be measured perpendicular landward from the topographic contour that defines the normal pool elevation, as shown in Figure 6-3. The water quality buffer shall consist of one zone, which can be disturbed, graded, and revegetated according to the specifications in Section 6.7.

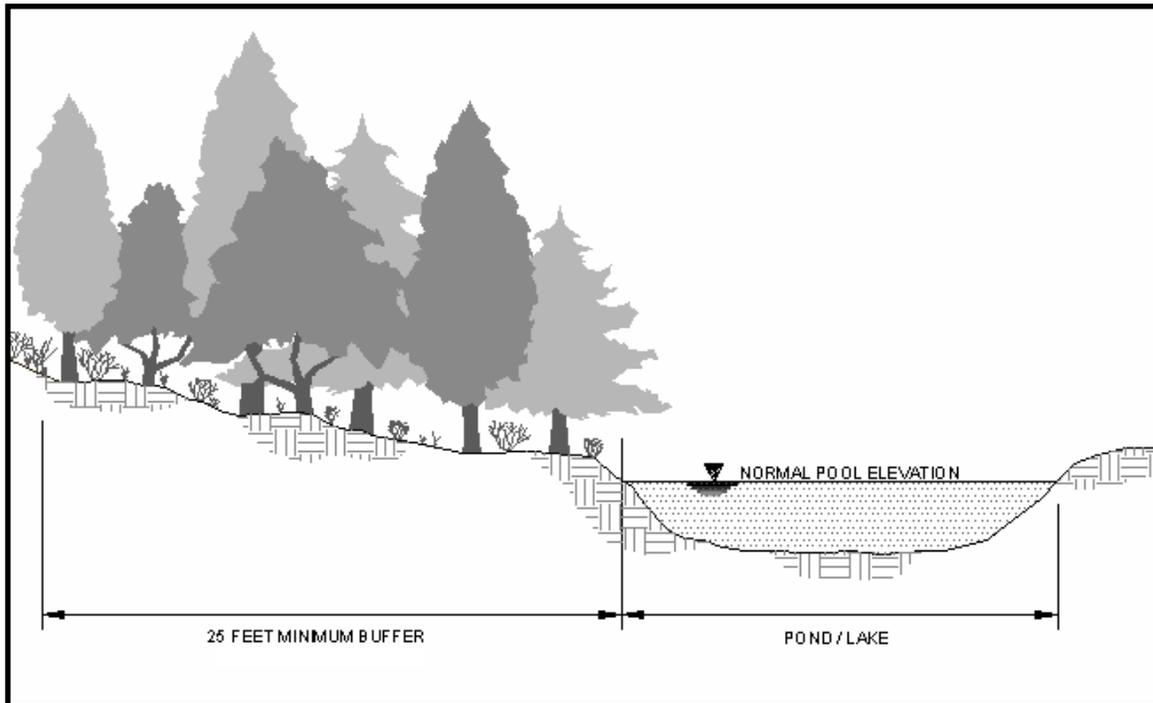
## 6.3.3 Width Requirements for Steep Slopes

A physical parameter that impacts a buffer's ability to slow stormwater runoff and filter pollutants is the slope of the buffer. A steeper slope will reduce the effectiveness of buffer areas because the runoff moves too quickly through the buffer to allow proper filtration of sediment and infiltration of smaller storm events. This issue can be overcome by requiring buffer width increases when steep slopes are present.

Where steep slopes greater than 15% or where Slope Protection Areas, as identified by the Metropolitan Planning Commission, are located within 50 feet of the community water, one of the two following conditions shall apply to the water quality buffer:

- the buffer width in the steep slope areas shall be adjusted to include an additional 25 feet, giving a total buffer width of 75 feet; or,
- the 50-foot buffer in the steep slope areas shall consist of one-zone, comprised of undisturbed, forested vegetation, as described in section 6.4.1.

Buffer width adjustments using buffer averaging, which is discussed in Section 6.5, are prohibited where steep slopes are present.

**Figure 6-3. Example Buffer Width Measurement – Normal Pool Elevation**


## 6.4 Vegetation and Enhancement Requirements

This section provides requirements and guidance on buffer vegetation and buffer enhancement, and describes the contents of Buffer Enhancement Plans. Within the requirements set forth by Knox County, detailed information on streambank and buffer restoration techniques, planting guidelines and native plant species can be found from the following sources:

- Tennessee Valley Authority's Riparian Restoration webpage, located at [www.tva.com/river/landandshore/stabilization/index.htm](http://www.tva.com/river/landandshore/stabilization/index.htm)
- Tennessee Valley Authority's Native Plant Finder webpage, located at [www.tva.com/river/landandshore/stabilization/plantsearch.htm](http://www.tva.com/river/landandshore/stabilization/plantsearch.htm);
- Banks and Buffers: A guide to selecting native plants for streambanks and shorelines. Contact information to obtain this publication is provided at [www.tva.com/river/landandshore/stabilization/websites.htm](http://www.tva.com/river/landandshore/stabilization/websites.htm);
- Knoxville-Knox County Tree Conservation & Planting Plan, published by MPC and available at [www.knoxmpc.org](http://www.knoxmpc.org)
- the Tennessee Exotic Plant Pest Council website, located at [www.tneppc.org](http://www.tneppc.org); and
- the Natural Resource Conservation Service (NRCS).

### 6.4.1 Inner Zone (Streams and Wetlands)

The vegetative target for the inner zone of stream buffers and for buffers around wetlands is undisturbed, mature, moderately dense forest (i.e., trees) with woody shrubs and understory vegetation that provides a stable forest floor. Native, non-invasive vegetation is preferable, although existing buffer areas that are stable with limited populations of undesirable plant species are acceptable. Native trees, shrubs and grasses that are appropriate for use in a water quality buffer are better-suited for local, long-term hydrologic conditions than non-native vegetation. As such, native vegetation will likely have lower mortality rates and few maintenance requirements, making them ideal for an area that must remain undisturbed.

The Director of Knox County Department of Engineering and Public Works (the Director) may require (or allow if requested by the property owner) limited disturbances of an existing buffer to remove unhealthy, damaged, diseased, dead, and/or non-native or invasive vegetation in order to improve the vegetative condition of the buffer. Such disturbances must be performed in accordance with the provisions of the Knox County Stormwater Management Ordinance and the policies set forth in Section 6.7 of this manual.

The Director may require (or allow if requested by the property owner) enhancement of inner zone areas that do not conform to the vegetative target of a mature forest at the time of development, in accordance with the provisions and guidance presented in this manual. Areas that can be characterized as an early successional forest, consisting of a combination of grasses, vines, shrubs, tree saplings and possibly even a few mature trees, may not require enhancement, provided that the vegetation appears healthy, provides adequate ground coverage, and consists largely of native and non-invasive species.

#### **6.4.2 Outer Zone (Streams and Ponds/Lakes)**

The outer zone of the water quality buffer for streams and around ponds and lakes is a transition zone between the inner zone and the developed property. The minimum vegetative target for the outer zone is mowed, dense grass that covers the entire zone. Vegetation in the outer zone can be managed within the allowable uses, activities and disturbances stated in this manual and in the Knox County Stormwater Management Ordinance.

Although native plant species are not required in the outer zone, undisturbed native, shrubs, trees and other woody vegetation are strongly encouraged. Invasive species, such as honeysuckle, privet, ivy, and kudzu are not permitted in the outer zone. Note that leaving the entire buffer area, including the outer zone, as an undisturbed natural area could provide additional water quality treatment benefits and credits against the required water quality treatment volume. Volume II Chapter 5 of this manual provides more information on water quality treatment credits using buffers.

#### **6.4.3 Non-native and Invasive Vegetation**

Knox County discourages the introduction or propagation of plants considered as nuisance, non-native (also termed "exotic") and/or invasive plant species, such as honeysuckle, privet, ivys and kudzu. When a Buffer Enhancement Plan is required by the County, non-native and/or invasive plant species will not be permitted. Guidance on non-native species in Tennessee can be found at the Tennessee Exotic Plant Pest Council website, located at [www.tnepcc.org](http://www.tnepcc.org).

Non-native and/or invasive plant species found in existing buffer areas can be removed. Limited disturbances for vegetation removal and/or maintenance must be performed in accordance with Section 6.7. Large populations of non-native and/or invasive plants may require extensive measures to eliminate the vegetation and will require the submittal of a Buffer Enhancement Plan to Knox County for review and approval.

#### **6.4.4 Buffer Enhancement Requirements**

Buffer enhancement can only be performed with prior approval of the Director. The Director has the authority to require enhancement of the water quality buffer when a buffer area:

- does not conform to the vegetative target for the area, or in its existing state does not have the potential to meet the vegetative target through natural vegetative succession;
- has significant populations of non-native and/or invasive plant species; or
- has significant areas of unhealthy, damaged, diseased or dead vegetation.

Property owners can request buffer enhancement if desired. Buffer enhancement activities located on water quality buffers in existing developments may require submittal of a stormwater

management plan. Consult the Knox County Stormwater Management Ordinance for guidance. When enhancement of the vegetation within a buffer is desired or required, the Director may approve, or require, a Buffer Enhancement Plan. The plan must be submitted and approved by the Director prior to restoring or enhancing a buffer. Required contents of buffer restoration and/or enhancement plans are presented in Volume I Chapter 4 of this manual.

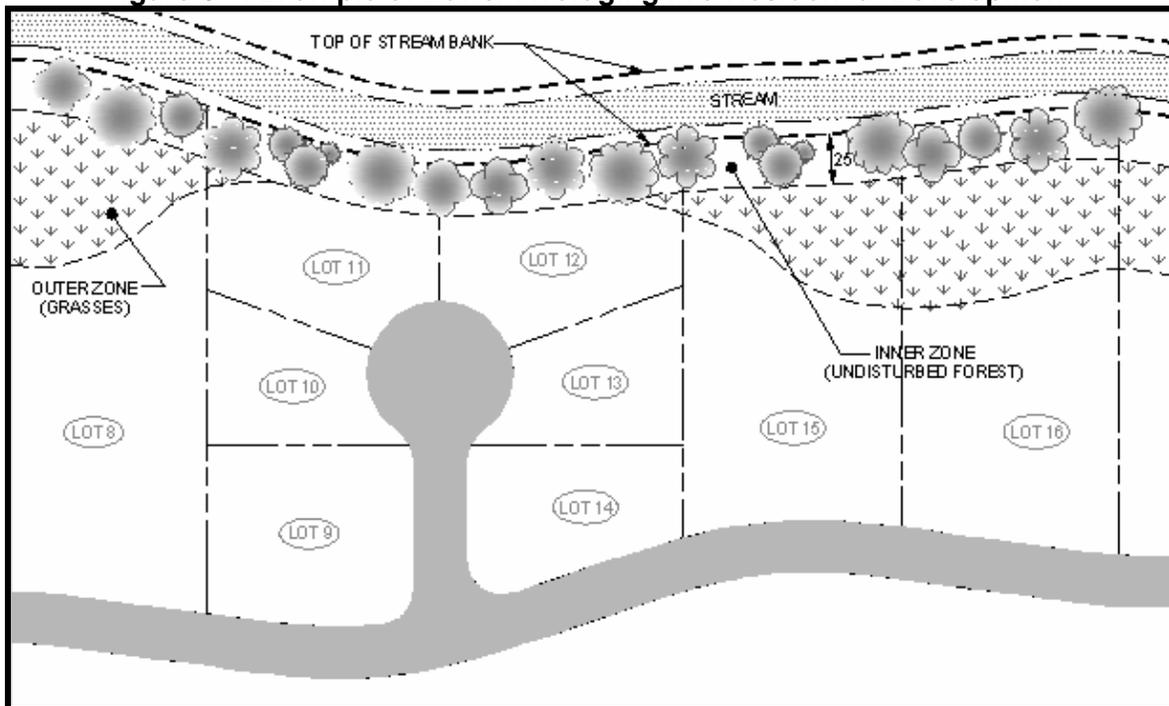
Enhancement of water quality buffers must be performed in accordance with the requirements of the Knox County Stormwater Management Ordinance and the guidance provided below.

1. All areas/zones of the buffer being enhanced must be planted with vegetation that is appropriate to achieve the vegetative targets stated in Section 6.4 of this manual.
2. All areas/zones of the buffer being enhanced must be stabilized against erosion.
3. If the outer zone of a stream buffer and the buffer around a pond or a lake will consist largely of grasses after enhancement, seeding must be performed at a rate sufficient to provide healthy, dense, permanent vegetative cover for 100% of the buffer area within one growing season. Mulch, pebbles, wood chips and other non-vegetative ground cover is not acceptable for buffer enhancement.
4. Where the removal of such vegetation would cause a reduction in the amount of stream canopy by 50% or more, revegetation with native plants is required to provide the cover of the previous canopy at a minimum. For areas where such vegetation removal would cause a reduction in the amount of streambank vegetation, revegetation specifications with native plants is required to return the amount of vegetative cover to its previous state, at a minimum. To reduce the potential for streambank erosion, revegetation measures along streambanks must include sufficient erosion control measures, such as turf reinforcement mats, erosion control blankets, straw wattles, etc., to stabilize the area in the short- and long-term.
5. To increase the chances for the success and health of the buffer area, the plant species, density, placement, and diversity proposed in Buffer Enhancement Plans must be appropriate for stream, wetland, and pond/lake buffers to achieve the vegetative target that is defined for the buffer through natural succession. Proposed planting and long-term maintenance practices must also be appropriate and properly performed.
6. Vegetation mortality must be accounted for all planting densities that are proposed in Buffer Enhancement Plans.

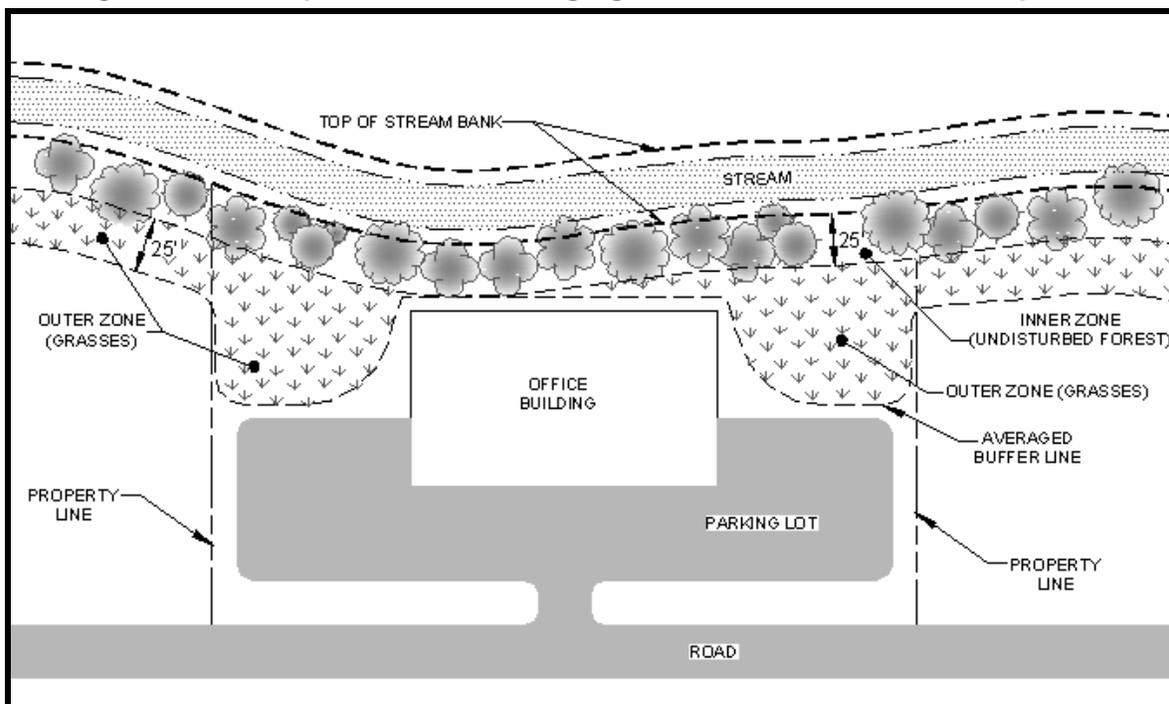
## 6.5 Water Quality Buffer Averaging

This section outlines the criteria for buffer averaging on new and redevelopment sites. Buffer averaging can be utilized to adjust the required buffer width, allowing some flexibility for site development. Using buffer averaging, the width of the buffer can be varied with the criteria stated in the Knox County Stormwater Management Ordinance and in this manual, so long as a minimum average width of fifty (50) feet is maintained. Figures 6-4 and 6-5 illustrate the use of buffer averaging for a residential and commercial development.

**Figure 6-4. Example of Buffer Averaging in a Residential Development**



**Figure 6-5. Example of Buffer Averaging in a Non-Residential Development**



### 6.5.1 Requirements and Policies

The following criteria must be met in order to utilize buffer averaging on a development site:

1. Buffer averaging is required for water quality buffers that have stream crossings.

2. An overall average buffer width of at least fifty (50) feet must be achieved within the boundaries of the property to be developed. Stream buffer corridors on adjoining properties cannot be included with buffer averaging on a separate property, even if owned by the same property owner.
3. The average width must be calculated based upon the entire length of streambank that is located within the boundaries of the property to be developed. When calculating the buffer length, the natural stream channel should be followed.
4. Stream buffer averaging shall be applied to each side of a stream independently. If the property being developed encompasses both sides of a stream, buffer averaging can be applied to both sides of the stream, but must be applied to both sides of the stream independently.
5. The total width of the buffer shall not be less than twenty-five (25) feet at any location, except at approved stream crossings. Those areas of the buffer having a minimum width of twenty-five (25) feet (or less at approved stream crossings) can comprise no more than fifty (50) percent of the buffer length.
6. The entire length of the buffer shall consist of an inner zone, as defined in Section 6.3.1, that has a minimum width of twenty-five (25) feet, and an outer zone, that has a variable width along its length to achieve the minimum average width of at least fifty (50) feet.

### **6.5.2 Areas Where Buffer Averaging is Prohibited**

Buffer width averaging is prohibited in developments that have, or will have after development, the land uses listed below:

- a. Slope protection areas (as identified by MPC), and areas that have slopes greater than 15% that are located within 50 feet of the stream to be buffered;
- b. Developments or facilities that include on-site sewage disposal and treatment systems (i.e., septic systems), raised septic systems, subsurface discharges from a wastewater treatment plant, or land application of bio-solids or animal waste;
- c. Landfills (demolition landfills, permitted landfills, closed-in-place landfills);
- d. Junkyards;
- e. Commercial or industrial facilities that store and/or service motor vehicles;
- f. Commercial greenhouses or landscape supply facilities;
- g. Developments or facilities that have commercial or public pools;
- h. Agricultural facilities, farms, feedlots, and confined animal feed operations;
- i. Animal care facilities, kennels, and commercial/business developments or facilities that provide short-term or long-term care of animals; or
- j. Other land uses deemed by the Director to have the potential to generate higher than normal pollutant loadings.

### **6.5.3 Example Calculation**

This section provides an example calculation of water quality buffer averaging. Consider a development site that is bounded by 500 linear feet of stream, measured following the stream channel. Only one side of the stream is located within the boundaries of the site to be developed. The example site before and after buffer averaging is applied is presented in Figures 6-6a and 6-6b. The example calculation is below.

Constants: Total linear length of buffer = 500 ft

Required width of buffer = 50 ft

**Step 1. Calculate the total required area of buffer.**

The total linear length of the buffer is 500 feet (ft).

The required width of the buffer (without averaging) is 50 ft.

$$\begin{aligned}
 \text{Total required area of buffer} &= \text{length of buffer} \times \text{width of buffer} \\
 &= 500 \text{ ft} \times 50 \text{ ft} \\
 &= 25,000 \text{ ft}^2
 \end{aligned}$$

**Step 2. Calculate maximum allowed length of buffer that has the minimum allowed buffer width:**

Knox County allows a maximum of 50% of the total length of the buffer to have a width of 25 feet (i.e., comprised only of inner zone). Step 2 will determine the maximum length of buffer that can have the minimum allowed buffer width of 25 feet.

$$\begin{aligned}
 \text{Maximum length of 25 ft buffer} &= \text{length of buffer} \times 50\% \\
 &= 500 \text{ ft} \times 50\% \\
 &= 250 \text{ linear feet}
 \end{aligned}$$

Therefore, 250 linear feet of the buffer can have a minimum width of 25 feet.

**Step 3. Calculate total area of buffer that has the minimum allowed buffer width and determine remaining buffer area required.**

$$\begin{aligned}
 \text{Total buffer area provided} &= \text{Length of buffer @ 25 ft} \times 25 \text{ ft width} \\
 &= 250 \text{ ft} \times 25 \text{ ft} \\
 &= 6250 \text{ ft}^2
 \end{aligned}$$

$$\begin{aligned}
 \text{Available buffer area remaining} &= \text{Total required area of buffer} - 6250 \text{ ft}^2 \\
 &= 25,000 \text{ ft}^2 - 6250 \text{ ft}^2 \\
 &= 18,750 \text{ ft}^2
 \end{aligned}$$

**Step 4. Determine the width of remaining buffer.**

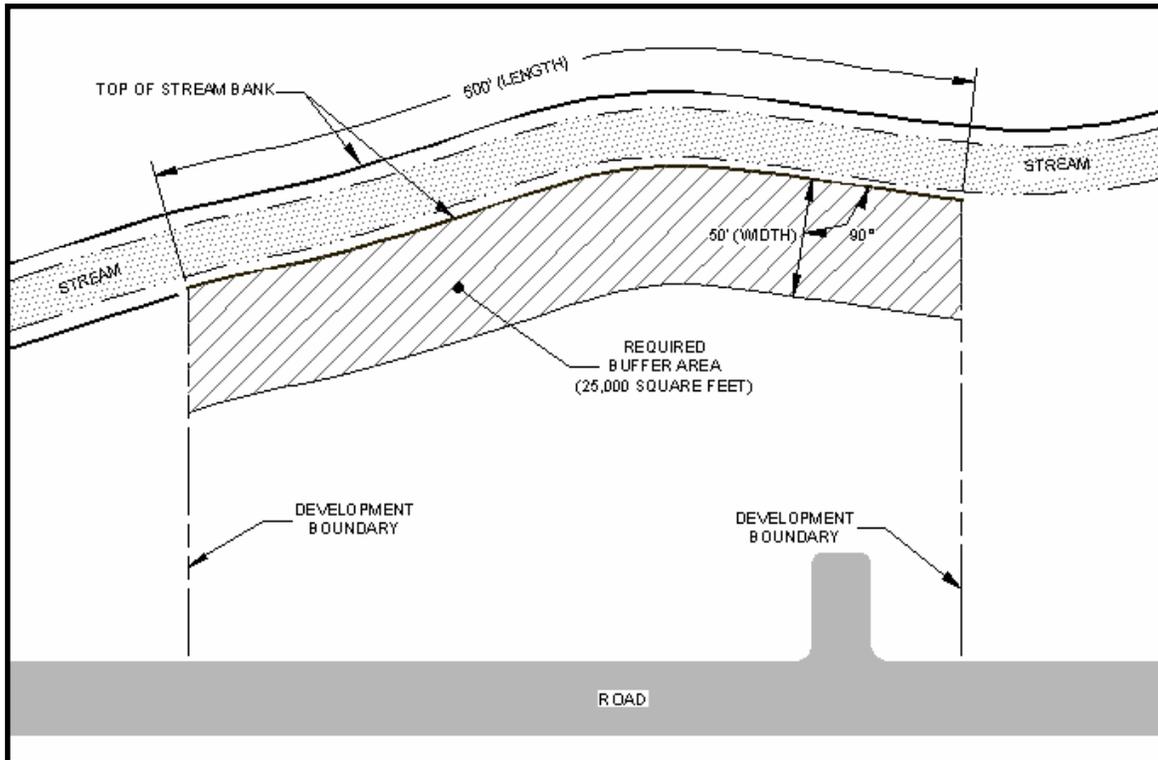
$$\begin{aligned}
 \text{Length of Remaining buffer} &= \text{Total width} - \text{Length of buffer @ 25 ft width} \\
 &= 500 \text{ ft} - 250 \text{ ft} \\
 &= 250 \text{ ft}
 \end{aligned}$$

$$\begin{aligned}
 \text{Width of remaining buffer} &= 18,750 \text{ ft}^2 / 250 \text{ ft} \\
 &= 75 \text{ ft}
 \end{aligned}$$

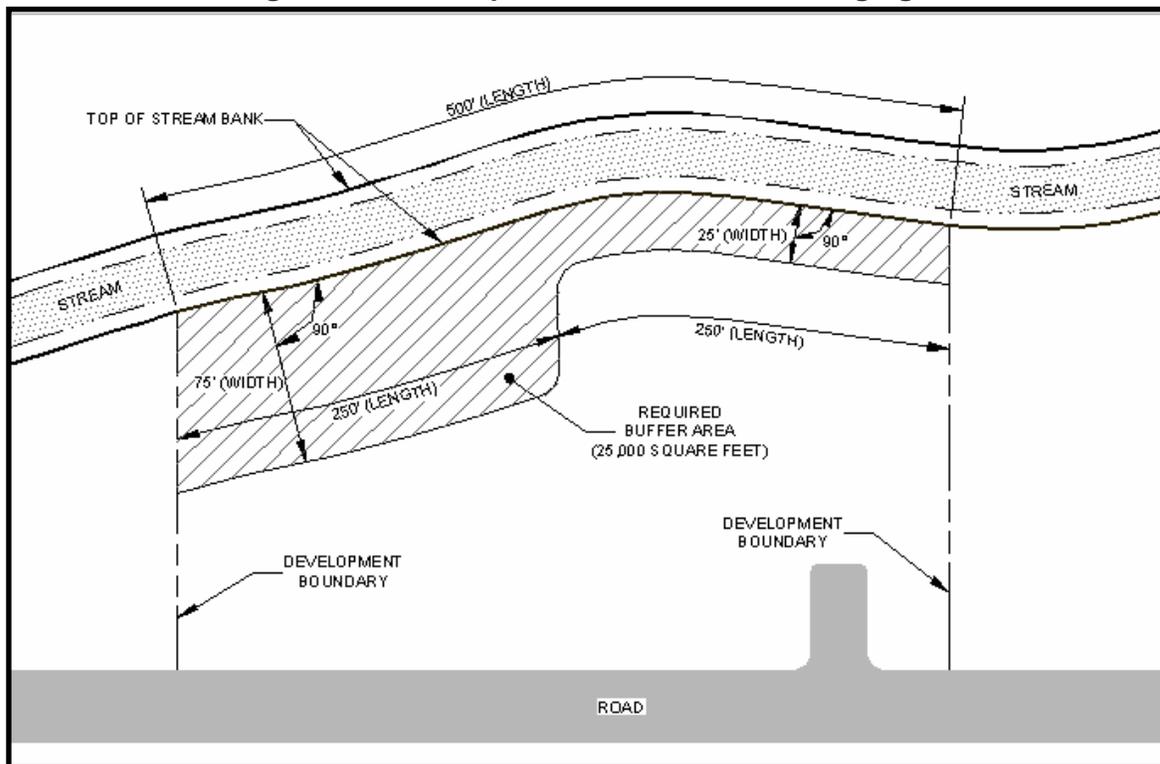
Therefore, 250 linear feet of buffer will have a minimum 25 ft width and an additional 250 ft of buffer will have a minimum width of 75 ft, with an overall buffer width average of 50 ft.

If more variation in the buffer width is desired, steps 3 and 4 can be repeated using variable buffer widths until an average standard width of 50 feet is achieved keeping the total required area of the buffer constant.

**Figure 6-6a. Example Site Before Buffer Averaging**



**Figure 6-6b. Example Site After Buffer Averaging**



## 6.6 Use of Buffer Areas

As described in previous sections, water quality buffers are use-restricted zones of vegetation that are located along community waters. The intention of the Knox County buffer requirements is to implement buffers that can not only provide stream corridor protection, but serve as water quality best management practices as well. Limiting the use and disturbances within the buffer area serves to protect these intended functions of the buffer. The restrictions on uses of and activities in the buffer address both ongoing activities (“uses”) and temporary encroachments (“disturbances”). This section addresses allowed and prohibited uses.

### 6.6.1 Prohibited Uses

The activities listed below are prohibited within water quality buffers because of their detrimental effects on the water quality buffer functions. These activities may only be performed within the water quality buffer with the express written permission of the Director of Engineering and Public Works.

- a. Spraying, filling, dumping, and animal grazing;
- b. Use, storage, or application of pesticides, herbicides, fertilizers, or household or commercially-generated wastes;
- c. Concentrated animal lots or kennels;
- d. Use or storage of motorized vehicles, except for maintenance approved by the Director, or emergency use;
- e. Creation of impervious surfaces except for those included in approved stream crossings and other allowed uses;
- f. Other uses as deemed by the Director to have the potential to generate higher than normal pollutant loadings.

### 6.6.2 Allowable Uses in the Inner Zone

The following uses are permitted in the inner zone of stream buffers and the wetland buffer:

- a. Conservation uses, wildlife sanctuaries, nature preserves, forest preserves, fishing areas, and passive areas of parklands, provided that no impervious surfaces are created;
- b. Recreational trails and greenways that are either unpaved or paved with pervious materials;
- c. Education/scientific research that does not require any of the prohibited activities named in Section 6.6.1;
- d. Stream restoration projects, facilities and activities, with prior approval of the Director;
- e. Infrastructure features such as roads, bridges, storm drainage, stormwater management facilities, utilities, and boat launch ramps, provided that they adhere to the following standards:
  - 1) The width of the disturbance for the feature is the minimum required to allow for maintenance and access;
  - 2) The angle of the buffer crossing shall be perpendicular (with up to 15% deviation off perpendicular) to the stream in order to minimize clearing requirements; and,
  - 3) The number of buffer crossings is minimized, with no more than one crossing every one-thousand (1,000) linear feet. The Director has the authority to approve additional crossings if justified by traffic, safety, or access issues.
  - 4) Multiple driveway or private roadway crossings of a stream or a wetland within one development shall be prohibited, unless approved by the Director after the property owner has demonstrated that the development has been planned in such a manner that driveway and private roadway crossings have been minimized to the maximum extent possible;

Access areas for utilities (e.g., manholes) that are located in the buffer area are allowed. Access areas must be minimized to the maximum extent possible, and shall be located no less than every 300 feet unless warranted by valid safety, access or service issues. At a minimum, utility access areas shall be vegetated in accordance with the vegetative target defined for the outer zone of a stream buffer in Section 6.4.

### **6.6.3 Allowable Uses in the Outer Zone**

The following uses are allowed in the outer zone of stream buffers and in buffers surrounding lakes and ponds:

- a. All activities that are allowable in the inner zone (see above).
- b. Yards, trails, greenways, picnic areas, and passive recreation areas as long as they do not have impervious surfaces. Passive recreation areas are defined as recreational activities that do not require hardened, impervious surfaces to be constructed, such as soccer fields without parking and other facilities, walking trails that are either unpaved or paved with permeable materials; bird watching; or hiking. Passive recreation areas do not include golf courses, ball fields that require the construction of impervious surfaces or the maintenance of open soil areas (such as baseball infields), picnic shelters or parking.

## **6.7 Allowable Disturbances**

Disturbances are temporary actions in or encroachments into water quality buffers. From a practical standpoint, it is not always possible to maintain an undisturbed buffer. Disturbances are often necessary for the construction of infrastructure. Roadways, utilities, and other linear forms of development must cross streams, and water dependant structures such as marinas and docks must be built on water features. Allowances for these necessary uses of buffer areas exist (as presented in Section 6.6) as an approval that can be gained from the Department of Engineering and Public Works, rather than through the variance and appeals process. Knox County regulates disturbances for the inner and outer zones of water quality buffers as follows:

### **6.7.1 Inner Zone**

The following disturbances are permitted in the inner zone of stream buffers and the wetland buffer:

- a. Limited disturbances to remove and/or plant trees or vegetation, as required to maintain the overall health of vegetation in the buffer area. The pruning of native vegetation is allowed provided that the health and function of the vegetation is not compromised. However, only the individual removal of under-story nuisance vegetation (i.e. honeysuckle, kudzu, privet) and/or non-native vegetation which causes minimal soil disturbance is permitted. On land where the removal of such vegetation would cause a reduction in the amount of stream canopy by 50% or more, revegetation with native plants is required to the cover of the previous canopy at a minimum. For areas where such vegetation removal would cause a reduction in the amount of streambank vegetation, revegetation with native plants is required to return the amount of vegetative cover to its previous state, at a minimum.
- b. Removal of individual trees that are in danger of falling, causing damage to dwellings or other structures, are dead or diseased, or have been heavily damaged by storms. The root wad or stump should be left in place, where feasible, to maintain soil stability.
- c. Disturbances necessary for the construction of utility access areas and approved stream crossings.
- d. Disturbances as required to establish and/or restore buffer areas in accordance with an approved Buffer Enhancement Plan. Section 6.8 provides detailed information on buffer enhancement.

### **6.7.2 Outer Zone**

The following disturbances are allowed in the outer zone of stream buffers and in buffers surrounding lakes and ponds:

- a. Clearing, grubbing, grading, and revegetation in accordance with an approved stormwater management plan.
- b. Disturbances necessary for the construction of utility access areas and approved stream crossings.
- c. Ongoing vegetation maintenance activities such as mowing, bush-hogging, and weed-eating. No chemical applications are allowed in the outer zone.

## **6.8 Protection of Water Quality Buffers**

In order to establish and protect the infiltration, filtration, and stream corridor protection functions of water quality buffers, buffers must be protected prior to, during, and perpetually after construction. Water quality buffer areas must remain protected from land disturbance, vegetation removal, construction of impervious surfaces, and discharges of sediment and other construction-related wastes during development activities. This section discusses methods of buffer protection during construction and after construction activities have been completed.

### **6.8.1 During Construction**

Knox County requires that the following steps be taken during the site plan development and site construction process to protect water quality buffers during construction:

- a. Water quality buffers must be clearly identified on all stormwater management plans and construction drawings and marked with the statement "Water Quality Buffer. Do Not Disturb".
- b. Water quality buffers cannot be encroached upon or disturbed during project construction, unless they are being established, restored, or enhanced in accordance with an approved Buffer Enhancement Plan.
- c. Water quality buffers must be clearly marked or staked at frequent intervals on the property at the time of the pre-construction conference and the marking maintained until completion of construction activities. All contractors and others working on the construction site must be made aware of the existence of the buffer(s) and the restrictions on disturbing the buffer(s).
- d. All areas of the water quality buffer, including streambanks, must be left in a stabilized condition upon completion of construction activities. No actively eroding bare or unstable stream banks shall remain, unless approved by the Director. Placement of riprap and other hard armor is only allowed when bioengineering alternatives are not feasible.

### **6.8.2 After Construction**

Once construction has ceased on a project, water quality buffers must still be maintained in accordance with the recorded Covenants for Maintenance of Stormwater Facilities and Best Management Practices. In order to provide for long-term protection and maintenance, Knox County requires that the water quality buffer be protected in perpetuity by placing the buffer in a permanent water quality or other easement that is recorded with the property's deed. If the area is not publicly owned, the easement should be held by one of the following non-governmental entities:

1. A viable third party such as a land trust, land management company or utility. The purpose of the third party is to provide monitoring and oversight to ensure the perpetual protection of the area in accordance with the requirements of a buffer area. The organization shall:
  - a) have the legal authority to accept and maintain such easements;
  - b) be bona fide and in perpetual existence;

- c) have conveyance instruments that contain an appropriate provision for re-transfer in the event the organization becomes unable to carry-out its functions.
2. A homeowners association (HOA), provided that the following criteria are met:
    - a) Membership in the HOA is mandatory and automatic for all homeowners of the subdivision and their successors.
    - b) The HOA shall have lien authority to ensure the collection of dues from all members.
    - c) The HOA assumes the responsibility for protecting, monitoring and maintaining the area as a conservation easement, in perpetuity.

If neither of the above-stated non-governmental entities is able to provide perpetual protection of the buffer area, then the property owner must assume responsibility for the maintenance and protection for the buffer area.

### 6.8.3 Signage

Permanent boundary marker signs may be required prior to recording the final plat or issuance of a Certificate of Occupancy to ensure that adjacent property owners are aware of the buffer. Further, the Director has the authority to require replacement of such boundary markers that have been removed or destroyed. The following general policies shall apply to buffer boundary markers:

1. Generally, buffer boundary markers must be located on the lot lines at the intersection of the landward edge of the buffer, and at other locations which will approximately delineate the buffer boundary. For single lot site developments, markers, if required, shall be posted every 100 feet along the buffer boundary. For subdivisions where multiple lots are located along the buffer, it is recommended that a buffer boundary marker be located at the intersection of every other lot line with the landward edge of the buffer.
2. Buffer boundary markers shall include the statement "Water Quality Buffer – Do Not Disturb".
3. Where possible, the markers should be mounted to a tree larger than three (3) inches in diameter. Where it is not possible to mount the marker to a tree, a treated wood, metal, or plastic signpost must be used. The post must extend below the ground surface at least twenty-four (24) inches.
4. The boundary markers must be mounted between four (4) and six (6) feet above the ground surface.

The Knox County Engineering can provide guidance on obtaining the appropriate signage.

## 6.9 Level Spreaders

Level spreaders are structures that are designed to dissipate energy of concentrated flow and distribute it as sheet flow over a large surface area. For water quality buffers, they are used to maintain the function of buffers by transitioning concentrated flows of stormwater runoff into sheet flow. Water quality buffers are most effective when shallow sheet flow is discharged to them. This creates a shallow flow that has a high surface contact area, increasing infiltration and the effectiveness of filtration. In contrast, concentrated flow can cause erosion in the buffer area, and limits the effectiveness of plants to filter-out pollutants.

Design instructions and schematics for level spreaders are found in Chapter 7 of this manual.

Level spreaders are required where concentrated flows would discharge overland through the buffer. Sheet flow must be ensured through the buffer for the stream and vegetated buffer credit to be granted. Flows encountered for storms greater than the 1-yr can be piped beneath the buffer to the stream, so long as proper outfall protection is employed and channel protection and peak flow

control criteria have been met. Level spreaders are simple structures that consist of the following elements:

- A pipe, ditch, or swale through which concentrated flow enters the spreader;
- An energy dissipater that slows the water;
- A level lip provided by the construction of a berm, concrete chute, or other permanent material or a shallow linear trench. The purpose of this component is to distribute runoff perpendicularly over the lip at the same depth for the entire length of the structure.

## 6.10 Conflicts with State Requirements

The State of Tennessee may require water quality buffers during construction activities via provisions contained in the Tennessee Construction General Permit (CGP) or other regulatory permits and processes. The State's requirements may, or may not, align with Knox County's requirements and policies for water quality buffers. It is the responsibility of the site developer to be informed and educated on any State-level buffer requirements. If a site developer intends to apply Knox County's buffer requirements in lieu of any requirements of the State of Tennessee, the developer must first obtain approval from TDEC and provide Knox County with written documentation of such approval.

## References

Shueler, T. *Vegetated Riparian Buffers and Buffer Ordinances*. SCDEC, Summer, 1995.



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