

# Engineering Codes and Best Management Practices

## **Knox County Stormwater Management Ordinance (adopted 1.30.08)**

### **Ordinance No. O-07-12-101**

### **and Knox County Stormwater Management Manual**

The entirety of the Knox County Stormwater Management Ordinance and Manual can be found at:

<http://www.knoxcounty.org/stormwater/>

## **Stormwater Management Ordinance**

### **Summary**

The ordinance regulates grading, excavation, clearance, and other land alteration activities, erosion prevention, sediment and construction related waste control, the design and construction of storm drainage facilities for purposes of water quality and quantity control, floodplain management, developments in or near sinkholes, and water quality buffers. The ordinance strives to limit the dangers of personal injury, and/or property or environmental damage that may be caused by stormwater runoff.

*Select steep slope related ordinances*

### **Section 2. Definitions**

Community Waters – Any of the following waterbodies located within the unincorporated areas of Knox County are considered community waters:

- a. Streams, as defined herein;
- b. Wetlands, as defined by the any agency with authority to make legal wetland determinations (USACE, USEPA, TDEC, USNRCS);
- c. Ponds that have a direct hydraulic connection to other community waters; and,
- d. Lakes.

### **Section 6. Water Quality Buffers**

#### **6.3 Design Criteria**

##### **6.3.1 Streams**

6.3.1(a)(3) The vegetative target for the inner zone is mature, moderately dense forest (i.e., trees) with woody shrubs and understory vegetation. Where forest vegetation has the potential to impact traffic safety or limit access, areas immediately surrounding approved stream crossings and utility access areas that are located in the inner zone may be vegetated with dense grasses.

(d) Buffer width averaging is prohibited for any portion of developments that have (or will have) the land uses listed below:

(1) 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.

##### **6.3.4 Steep Slopes**

Where slopes greater than 15%, or where Slope Protection Areas as identified by the MPC, are located within 50 feet of the community water, one of the two following conditions shall apply:

- (1) the buffer width in the steep slope area shall be adjusted to include an additional twenty-five (25) feet, giving a total buffer width of seventy-five (75) feet; or,
- (2) the buffer in steep slope areas shall have a minimum width of (50) feet and shall consist of one-zone, comprised of undisturbed, forested vegetation, as described in section 6.3.1(a)(3).

## **Knox County Stormwater Management Manual**

### **Summary**

#### **2.2.6 Reducing the WQv (Water Quality Volume)**

WQv credits. The basic premise of the credit system is to recognize the water quality benefits of certain site design practices by allowing for a reduction in the WQv. Some example BMPs include credits for undisturbed natural area preservation, managed area preservation, stream and vegetated buffers, vegetated channels, impervious area disconnection, and environmentally sensitive large lot neighborhoods.

#### **9.3.3 Stabilization of Disturbed Areas**

Disturbed areas within the project site must be permanently or temporarily stabilized within 15 days after construction activity in that portion of the site has temporarily or permanently ceased unless the soil is frozen, soggy, or otherwise unworkable.

Pre-construction vegetative ground cover must not be destroyed, removed or disturbed more than 10 days prior to grading or earth moving unless the area is seeded and/or mulched or other temporary cover is installed.

Stabilization of disturbed areas refers to measures that protect soil from accelerated erosion. Applicable practices include, but are not limited to, vegetative groundcovers, mulch, or the application of gravel base on areas to be paved. Unpacked gravel containing fines (silt and clay sized particles) or crusher run will not be considered a non-erosive surface. Soil stabilization specifications should be provided for year round seeding and the particular site conditions.

Specifications for establishing a groundcover should include seeding mixtures for permanent and temporary seed establishment, soil amendments, mulch application, and application of a tackifier to hold the mulch in place.

Permanent vegetative cover shall be established on disturbed areas not otherwise permanently stabilized. Areas that were previously disturbed and provided with a permanent vegetative groundcover will not be considered established until a groundcover is achieved which, in the opinion of the Department of Engineering and Public Works, is mature enough to control soil erosion and to survive severe weather conditions. Generally, final stabilization of a site with a vegetative groundcover has been achieved when the following has been provided:

- All cut and fill slopes have a permanent groundcover with at least 70% coverage, and the slopes do not contain evidence of rill or gully erosion.
- All concentrated flow paths have been stabilized against erosion with a permanent measure (groundcover, rip rap, concrete, etc.) at least 70% coverage, and the concentrated flow paths do not contain evidence of erosion.
- All other areas of the site have a permanent groundcover with at least 70% coverage, and the site does not contain evidence of accelerated erosion.

When conditions are not conducive to establishing a permanent vegetative cover, a temporary cover can be established, provided that a permanent cover is provided when conditions have improved. Temporary covers can include annual grains or mulch anchored with netting, crimping or other appropriate anchor.

### 9.3.8 Cut and Fill Slopes

Cut and fill slopes must be designed and constructed in a manner which will minimize erosion and potential slope failure. Consideration must be given to the length and steepness of the slope, the soil type, upslope tributary area, groundwater conditions, and other applicable factors. To promote proper maintenance, all cut and fill slopes should be graded no steeper than 3 feet horizontal to 1 foot vertical (3:1). Cut and fill slopes must be stabilized once the final slope has been established.

### **City of Knoxville Code of Ordinances**

#### **Chapter 22.5: Stormwater**

#### **Stormwater and Street Ordinance, May 2005**

#### **Best Management Practices (BMP) Manual, October 2007**

The entirety of the Stormwater and Street Ordinance can be found at:

<http://www.cityofknoxville.org/engineering/ldmanual/LD-ORD22-5.pdf>

The entirety of the BMP Manual can be found at:

[http://www.cityofknoxville.org/engineering/bmp\\_manual/](http://www.cityofknoxville.org/engineering/bmp_manual/)

### **Stormwater and Street Ordinance**

*Select steep slope related ordinances*

### 4.2 Identify Objectives

The objectives in pollution prevention for each property can vary widely. Therefore, a specific understanding of pollution risks for each activity is essential for selecting and implementing BMPs. Defining these risks requires review of the characteristics of the site and the nature of the construction process or industrial activity. This information should be carefully assembled and reviewed early in the design process. Once these pollution risks are defined, then BMP objectives are developed and specific BMPs can be selected. The BMP objectives for a typical construction project (that pertain to steep slopes) are as follows:

**Minimize Disturbed Areas:** Only clear land that will be actively under construction in the near term (within the next 3 months). Minimize new land disturbance, and do not clear or disturb sensitive areas (e.g., steep slopes, buffers and natural watercourses).

**Protect Slopes and Channels:** Avoid disturbing steep or unstable slopes. Safely convey runoff from the top of the slope and stabilize disturbed slopes as quickly as possible. Avoid disturbing natural channels. Stabilize temporary and permanent channel crossings as quickly as possible and ensure that increases in runoff velocity caused by the project do not erode the channel.

### 4.3 Select BMPs

Once the BMP objectives are defined, it is necessary to identify the BMPs that are best suited to meet each objective. To determine where to place BMPs, a map of the project site can be prepared with sufficient topographic detail to show existing and proposed drainage patterns and existing and proposed permanent stormwater control structures. The project site map should identify the following:

- Identify locations subject to high rates of erosion such as steep slopes and unlined channels. Long, steep slopes over 100 feet in length are considered as areas of moderate to high erosion potential.

- Categorize slopes as: low erosion potential (0 to 5 percent slope), moderate erosion potential (5 to 10 percent slope), or high erosion potential (slope greater than 10 percent).

### 5.3 Site Perimeter Controls

When grading has been completed, the areas should be protected with vegetative measures such as mulching, seeding, planting, emulsifiers, or a combination of these methods. The combination of erosion protection measures and sediment control devices should remain in place until the area is permanently stabilized.

### 5.4 Internal Erosion and Drainage Design

When perimeter controls and outfall devices have been installed, internal erosion and drainage design can be addressed. Internal design elements are generally more time-intensive. The middle of a project site is where construction phasing and sequencing becomes important. Until the permanent facilities are constructed, temporary stormwater facilities will be subjected to erosion from concentrated flows.

Long or steep slopes should be terraced at regular intervals. Terraces will slow down the runoff and provide a place for small amounts of sediment to settle out.

Slope benches may be constructed with either ditches along them or back-sloped at a gentle angle toward the hill. These benches and ditches intercept runoff before it can reach an erosive velocity and divert it to a stable outlet.

#### ACTIVITY: Preservation of Existing Vegetation AM – 03

Carefully planned preservation of existing vegetation minimizes the potential of removing or injuring existing trees, vines, shrubs and grasses that serve as erosion controls or otherwise stabilize soil or slopes. This practice will create a significant reduction in sediment, nutrients, floatable materials and oxygen demanding substances.

Approach: Preservation of vegetation on a site must be planned before any site disturbance begins and must be done in accordance with the City of Knoxville Tree Protection Ordinance (included in Table AM-03-1). Preservation requires good site management to minimize the impact of construction activities on existing vegetation, which may adversely affect tree respiration, food processing, and growth. It is very inexpensive to preserve existing vegetation if properly planned during the project design, and it will yield aesthetic benefits that enhance property values.

### **Best Management Practices (BMP) Manual**

*Select steep slope related BMP guidelines*

#### Section 3 - BMPs for Erosion and Sediment (ES)

**ACTIVITY: Gradient Terraces ES – 04**

Recommended for slopes steeper than 3:1 and greater than five (5') feet in height. Terraces prevent or reduce the discharge of pollutants to the storm drain system or to watercourses as a result of construction activity by decreasing runoff velocities, trapping sediment, increasing infiltration, and supporting the establishment of vegetative cover. This management practice is likely to create a significant reduction in sediment.

**ACTIVITY: Seeding ES – 08**

Temporary or permanent stabilization of soil, with rapidly growing annual or perennial grasses, is used to prevent erosion on disturbed areas. Temporary seeding is performed for graded areas that are

not ready to receive permanent vegetation. Permanent seeding is performed for finished construction areas and for eroded areas that need a permanent vegetation cover.

Steep slope areas require either mulching and a tackifier or jute nets or excelsior mats (see ES-11, Erosion Control Matting).

**ACTIVITY: Sodding ES – 09**

On steep slopes The placement of sod allows the rapid establishment of grass vegetation, along with a layer of good topsoil. This can be beneficial in critical erosion areas, adjacent to natural streams and ditches, and as a filter strip to slow stormwater runoff and trap sediment.

On slopes steeper than 4:1, sod with pegs and staples. If the sod is to be mowed do not place it on slopes greater than 3:1 if it is to be mowed.

**ACTIVITY: Trees, Shrubs and Vines ES – 10**

Planting trees, shrubs, vines and other ground covers will provide long-term stabilization of soil. The primary functions of permanent vegetation is to improve aesthetics, reduce erosion by slowing runoff velocities, enhance infiltration and transpiration, trap sediment and other particulates, protect soil from raindrop impact, and provide habitat for wildlife. This management practice is likely to create a significant reduction in sediment.

Approach: See AM-03, Preservation of Existing Vegetation, in order to plan removal of existing vegetation during construction projects. Existing vegetation should be preserved whenever possible, particularly native species which are aesthetically pleasing and provide wildlife habitats.

**ACTIVITY: Erosion Control Matting ES – 11**

Placing jute mesh, excelsior matting, or other lightweight erosion control mat will reduce erosion on previously graded and seeded swales, channels, slopes, or critical areas. Firmly anchor erosion control matting by means of trenching, anchor slots, stakes or staples. This practice will create a significant reduction in sediment.

**ACTIVITY: Geotextiles ES – 12**

Prevent or reduce the discharge of sediment as a result of construction activity by stabilizing soil, using a wide variety of geotextile materials and applications. Areas with current and potential erosion problems may also benefit from the installation of geotextiles. Geotextiles may also be used in conjunction with other construction methods or as part of a landscaped terrain to prevent potential erosion problems. This practice will create a significant reduction in sediment.

**ACTIVITY: Sediment Basin ES – 19**

A sediment basin is an impoundment for the purpose of detaining runoff to allow excessive sediment to settle. A temporary sediment basin can be an impoundment (using natural divides and favorable topography where possible) to remove sediment during a construction project or other land-disturbing activity. A detention basin can also be refitted to temporarily perform as a sediment basin for handling large amounts of silt and eroded soil if good practices such as frequent inspection and maintenance are performed. A sediment basin will significantly reduce sediment.

Application: At locations with very steep slopes, sloughing or severely eroded soils, or industrial activities that generate sediment and soil particles.

**ACTIVITY: Bank Stabilization and Soil Bioengineering ES – 20**

Provide slope stabilization, protection, vegetative cover and erosion reduction through the use of woody vegetation structures alone or in combination with simple retaining structures. This practice is likely to create a significant reduction in sediment.

Application: Protection of steep slopes against surface erosion and shallow mass wasting. Wherever trees, shrubs and dense non-landscaped vegetation may be desired.

Approach: At some locations it is very difficult to establish vegetation. Steep slopes that are subject to weather from prevailing storm patterns are a primary example. It is difficult to plant trees and shrubs on a steep slope in order to establish a stable ground cover. Streambanks are also subject to erosion and severe stresses, for which grass and other vegetation may not be sturdy enough. The techniques in this BMP are generally for slope stabilization; design of stream habitats and vegetation is a lengthy subject for which expert advice and extensive regulatory review is needed.

**ACTIVITY: Riprap ES – 23**

Riprap is the controlled placement of large rock material that will resist movement and erosion. Riprap is used to protect culvert inlets and outlets, streambanks, drainage channels, slopes, or other areas subject to erosion by stormwater erosion. This practice will significantly reduce erosion and sediment movement.

**ACTIVITY: Gabions ES – 28**

Gabions are large rectangular wire mesh boxes that are filled with large stone or riprap. Gabions can be used as drainage channels, low retaining walls, bridge abutments and approaches, culvert headwalls, flow aprons, drop structures or as general landscaping elements. Thin gabions, typically called revet mattresses or reno mattresses, are used for drainage channels and slopes. The wire mesh is typically galvanized to resist corrosion, and may also receive a PVC coating if intended for use in water.

Applications: On slopes and areas where conditions may not allow vegetation to grow.

**ACTIVITY: TDEC Erosion & Sediment Control BMPs ES – 30**

Statewide BMPs are available in the Tennessee Erosion and Sediment Control Handbook (reference 196). This reference is available from the Tennessee Department of Environment and Conservation (TDEC) at the following website:

[http://www.state.tn.us/environment/wpc/sed\\_ero\\_controlhandbook/index.html](http://www.state.tn.us/environment/wpc/sed_ero_controlhandbook/index.html)

There are three basic categories for the statewide erosion control BMPs: Vegetative Practices, Structural Practices, and Stream Alteration Practices.

Approach: There are many differences between the TDEC statewide BMPs and the various details in the Knoxville BMP Manual. In most cases, the differences are relatively minor. Use the more stringent standard whenever possible to ensure adequate erosion and sediment control. In cases where dimensions or methods conflict, use the Knoxville BMP Manual.

**Section 5 - BMPs for Residential and Homeowners (RH)**

**ACTIVITY: Slope and Streambank Stabilization RH – 09**

Stabilize eroding slopes and streambanks in order to protect ditches, swales, storm drains, creeks, lakes and natural waterways. Slope stabilization improves the appearance of private property and will substantially reduce sedimentation and flood damage. Streambank stabilization may require a permit from the Tennessee Department of Environment and Conservation (TDEC) prior to grading; see the TDEC website for more information.

Approach: Homeowners and private property owners can make a big difference in controlling erosion and sediment. The benefits of controlling erosion substantially outweigh the costs involved. Contrary to popular opinion, vegetation does not just grow by itself on disturbed areas and steep slopes. There is a large potential for eroding slopes wherever land is developed or landscaped in Knoxville, due to hilly topography and native clay soils.

## **City of Knoxville**

### **Land Development Manual, February 2008, revised April 2008**

#### **Summary**

The entirety of the Land Development Manual can be found at:

<http://www.cityofknoxville.org/engineering/ldmanual/>

#### *Select steep slope related guidelines*

### **Chapter 13 – Construction Administration**

#### **13.3 Erosion and Sediment Control**

A final as-built inspection and review will be performed at the project site prior to release or reduction of a construction bond. See Appendix A for the Final Site Inspection Checklist and for the Development Certification Checklist. All disturbed areas must support a thick and healthy stand of vegetation, with no evidence of erosion or slope instability.

Throughout the construction phase of a project, erosion and sediment control measures are required to be inspected at least weekly and also after any significant rainfall event. During periods of prolonged rainfall, the erosion and sediment control measures should be inspected daily.

#### **13.5 Bond Release**

##### **Minimum Requirements...**

3. Good Cover of Vegetation -- All areas disturbed by construction activity must be stabilized for the purpose of erosion control. Due to the difficulty in establishing vegetation on sloped surfaces, it is highly recommended that detention basins should have grass sod or turf reinforcement mats on all slopes.

## **Appendix C**

### **Policy–04–1 Drainage Easements**

In some cases where a trenching box can be used, a drainage easement 20 feet wide is generally adequate. Sandy soils, steep slopes and difficult access approaches will require wider drainage easements.

## **Appendix C**

### **Policy–10–1 Retaining Walls**

Retaining walls located on private property are the responsibility of the property owner. Retaining walls 4 feet or taller require a Site Development Permit.

### **Policy–10–2 Geotextile-Reinforced Walls**

There have been several instances of geotextile-reinforced walls that have failed in the last few years on private property and public rights-of-way. It is suspected that insufficient soil compaction, poor backfill, and inadequate soil preparation are the chief culprits. The Engineering Department is very reluctant to allow these types of retaining walls on private property over 4' tall with the potential to

affect public right-of-way or permanent residences. Geotextile-reinforced walls in these instances will be reviewed on a case-by-case basis. Performance bonds or other types of guarantees may be needed to ensure adequate maintenance and repair.

**State of Tennessee**  
**Department of Environment and Conservation (TDEC)**  
**Tennessee Construction General Permit**  
**Summary**

The State of Tennessee General NPDES Permit for Discharges of Stormwater Associated with Construction Activities is henceforth referred to as the “Construction General Permit” (CGP). Applicable to all areas of the State of Tennessee, the CGP is intended to regulate the pollution prevention and the control of wastes during construction activities. Specific to site developments, the CGP emphasizes the application of best management practices for purposes of erosion prevention and sediment control and the control of other construction related materials and wastes.

In general, the CGP authorizes point source discharges of stormwater from construction activities that result in the disturbance of one acre or more of total land area. Projects or developments of less than one acre of land disturbance are required to obtain authorization under the CGP if the construction activities at the site are part of a larger common plan of development or sale. Further, there are permit provisions for development less than one acre of land disturbance, and for construction support activities.

The CGP is administered by the Tennessee Department of Environment and Conservation (TDEC). Development owners or operators can obtain CGP coverage by filing a Notice of Intent (NOI) with TDEC prior to initiating construction activities. A Stormwater Pollution Prevention Plan (SWPPP) and applicable permit fees must be submitted with the NOI. Both the CGP and the Knox County Stormwater Management Ordinance require that development owners or operators obtain coverage under the CGP and provide proof of such coverage (in the form of a Notice of Coverage) prior to obtaining a grading permit from Knox County. Further, the CGP requires that the owner or operator also submit the CGP Notice of Termination (NOT) to TDEC and a copy to Knox County after construction activities are completed.

The CGP, along with the NOI, NOT and inspection documentation forms can be obtained from the local TDEC office, or on-line at: <http://www.state.tn.us/environment>.

**Tennessee Department of Environment and Conservation (TDEC)**  
**Erosion and Sediment Control Handbook: A Guide for Protection of State Waters through the use of Best Management Practices during Land Disturbing Activities, 2<sup>nd</sup> Edition, March 2002**

The entirety of the TDEC Erosion and Sediment Control BMP Handbook can be found at: [http://www.tennessee.gov/environment/wpc/sed\\_ero\\_controlhandbook/eschandbook.pdf](http://www.tennessee.gov/environment/wpc/sed_ero_controlhandbook/eschandbook.pdf)

*Select steep slope related best management practices*

***Vegetative Practices***

Design Specifications  
Buffer Zone requirements:

Stream bank stabilization techniques may be required if steep slopes and/or hydrologic patterns deem it necessary. Refer to specification Bioengineered Stream Bank Stabilization - SBS. Vegetated stream buffers on steep slopes may need to be wider to effectively filter overland flow. Corridors subject to intense flooding may require additional stream bank stabilization measures.

#### Disturbed Area Stabilization (With Mulch)

Applying hay, straw, mulch, plant residues, or other suitable materials, produced on the site if possible to the soil surface.

#### Disturbed Area Stabilization (With Permanent Vegetation)

The planting of perennial vegetation such as trees, shrubs, vines, grasses, or legumes on exposed areas for final permanent stabilization. Permanent perennial vegetation shall be used to achieve final stabilization.

#### Erosion Control Blanket/Matting

Matting and blankets can be applied to steep slopes where erosion hazards are high and conventional seeding is likely to be too slow in providing adequate protective cover. Concentrated flow areas, all slopes steeper than 2.5:1, with a height of ten feet or greater, and cuts and fills within stream buffers, should be stabilized with the appropriate erosion control matting or blanket. Maintenance of the final vegetative cover must be considered when choosing blankets versus matting.

#### Gabions (rock filled wire baskets)

Recommended for areas where slope steepness or erosion potential exceeds the management capacity of less complicated applications. Geotextiles are recommended for use in conjunction with gabions. Used in retaining wall construction, channel revetments, abutments, and check dams, etc.

#### Geotextiles

A geosynthetic fabric, either woven or nonwoven, applied to either the soil surface or between materials, often used in conjunction with another BMP.

#### Gradient Treatment

Step or terrace features created along the contour of steep or long slopes.