1.5 Stormwater Quality Treatment Rationale

This section provides an explanation of Minimum Standard #1, which requires 80% removal of total suspended solids (TSS) from post-construction stormwater runoff for the 85th percentile storm event, as measured on an average annual basis.

1.5.1 Regulatory Overview

The NPDES Phase II regulation requires that Knox County (and other Phase II regulated communities) develop, implement, and enforce a stormwater management program that reduces the discharge of pollutants from the regulated jurisdiction "to the maximum extent practicable (MEP)". MEP is a technology-based discharge standard that was designed for the reduction of pollutant discharges and established in the Clean Water Act. Using guidance provided by the Environmental Protection Agency (EPA), Knox County can achieve the MEP standard by instituting a stormwater management program that implements and requires best management practices (BMPs) that are designed to protect water quality. No further guidance on MEP is provided by EPA or by the Tennessee Department of Environment and Conservation (TDEC).

Control measure 5 of the National Pollutant Discharge Elimination System (NPDES) Phase II Permit presents the requirements for the control of post-construction (i.e., after development) stormwater runoff. Quoting directly from the NPDES Permit for the State of Tennessee, regulated cities and counties (including Knox County) must:

> *"Develop, implement, and enforce a program to address storm water runoff from new development and redevelopment projects that 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 your small MS4. Your program must ensure that controls are in place that would prevent or minimize water quality impacts;*
>
> *Develop and implement strategies which include a combination of structural and/or non-structural best management practices appropriate for your community; and*
>
> *Develop and implement a set of requirements to establish, protect and maintain water quality buffers in areas of new development and redevelopment.*
>
> *Use an ordinance or other regulatory mechanism to address post-construction runoff from new development and redevelopment projects to the extent allowable under State or local law."*

As a result of these requirements, Knox County must implement a requirement for new developments and redevelopments to control stormwater quality using both structural (i.e., constructed) and non-structural (i.e., site planning) best management practices (BMPs). This requirement must be fully implemented no later than 2008.

The NPDES Phase II regulation also requires that Knox County focus stormwater management on controlling discharges of pollutants of concern to local impaired streams. Based on the State of Tennessee's 303(d) list of "impaired" streams, the largest pollutant in Knox County is sedimentation. In 2004, over 225 stream miles were considered impaired due to excessive sedimentation.

1.5.2 Attaining the Water Quality Standard

The basic goal of the NPDES Phase II regulation is to reduce the water quality impacts of development. The preferred approach to meet this goal and comply with the NPDES permit is called the "Water Quality Volume method" or "WQv method". The WQv method is based on a minimum water quality control goal of 80% removal TSS, as measured on an average annual

basis, from post-construction stormwater runoff (i.e., after construction of a site is completed. TSS is a commonly used representative stormwater pollutant for measuring sedimentation.

There are a number of factors that support the use of an 80% TSS removal standard as a minimum level water quality goal in Knox County.

1. The Tennessee 303(d) list indicates that sedimentation (i.e., sediment) is a significant pollutant of concern in local streams. This fact alone requires that Knox County implement a stormwater management program that, at least in part, focuses on the removal of sediment from stormwater discharges in order to achieve compliance with the NPDES Phase II regulations to the maximum extent practicable.
2. The use of TSS as an "indicator" pollutant for sediment is well-established.
3. The control of TSS leads to indirect control of other pollutants of concern that can adhere to suspended solids in stormwater runoff. In fact, some research shows that a large fraction of many other pollutants of concern are either reduced along with TSS, or at rates proportional to the TSS reduction.
4. A treatment standard of 80% is not a numeric standard, but a "best available technology" standard. In other words, the 80% TSS removal level is reasonably attainable using properly designed, constructed and maintained structural stormwater BMPs (for typical ranges of TSS concentration found in stormwater runoff). This standard is supported with research data from numerous research projects and compiled by the International Stormwater Best Management Practices (BMP) Database evaluation project, titled Determining Urban Stormwater Best Management Practices Removal Efficiencies, June, 2000.

The WQv method can meet the goal of 80% TSS removal using a two-pronged approach. First, it encourages the reduction of imperviousness (and therefore pollution) from developed sites through incentives for non-structural BMPs, such as natural conservation areas and water quality buffers. Second, it requires treatment of any remaining stormwater runoff with structural controls. This method allows Knox County to meet its water quality goals and regulatory requirements, yet still allows developers flexibility in their site designs.

There are a number of advantages with the WQv method when compared to the County's current requirement for first flush treatment. These advantages are as follows:

- The WQv method provides a measure of flexibility in site design. The new development or redevelopment site will be required to meet the 80% reduction goal using one or more of a number of locally-acceptable structural BMPs.
- If desired, the developer can also utilize non-structural controls to reduce imperviousness. The WQv method will provide incentives for the reduction of impervious surfaces and the use of non-structural BMPs, such as buffers, natural space preservation, and impervious area disconnection. When utilized, these practices will reduce the amount of stormwater runoff that will require treatment by structural practices, thereby reducing the structural BMP maintenance burden.
- WQv is not a prescriptive approach in that it mandates the use of one specific treatment BMP, such as a first flush pond. Instead, the developer can choose from a menu of BMPs, each of which is assigned a % TSS removal efficiency. When constructed alone, or in combination with other structural and/or non-structural BMPs, the minimum percent TSS removal standard can be attained.
- Research shows that extended release "first flush" ponds, which are often called dry extended detention (ED) ponds and are commonly used in East Tennessee, cannot attain a TSS removal standard of 80%. Such ponds have a high propensity for sediment resuspension and subsequent discharges, especially during large storm events. Recent studies of the BMP give it

an average TSS reduction somewhere between 50% and 70% (Schueler and Holland, 2000). Of course, pollutant removal ability does depend upon geographic location, overall sediment characteristics, hydrology, and storm event size.

- WQv is a performance based approach. If the BMP(s) are designed, constructed and maintained in accordance with guidance and requirements set by Knox County, then the BMP(s) will be considered "in compliance" with the minimum 80% water quality standard.
- The WQv method allows a consistent, "apples-to-apples" application of water quality treatment practices on every development site. Each site will be required to design, construct and maintain in accordance with the 80% TSS removal goal.

The WQv is calculated for the 85th percentile storm event using a value of 1.1 inches of rainfall. Thus, a stormwater management system designed for the WQv will treat the runoff from all storm events of 1.1 inches or less, as well as the first 1.1 inches of runoff for all larger storm events. The 85th percentile was chosen because it represents the "knee in the curve" volume that captures a significant number of storms (normally in the 80-90% of all storms range) without attempting to treat the small percentage of much larger storms that result in large volumes of runoff. Such storms would be expensive to treat, are rare in occurrence, and typically diluted in pollution concentration. Figure 1-4 presents a graphical representation of how the 85th percentile rainfall depth was determined, using a "knee-in-the-curve" approach. The value of 1.1 inches for the 85th percentile storm was determined for Knox County based on analysis of rainfall data collected in south Knox County and in Oak Ridge dating back to 1943.

Detailed information on the calculation of the WQv and % TSS removal for a development or redevelopment site are presented in Volume 2, Chapter 2 of this manual.

It is important to note that Knox County is not alone in implementing an 80% TSS removal standard, or the WQv method. Many states, including Maryland, Massachusetts, North Carolina, Georgia, and Florida have set similar statewide TSS goals and have research data to support BMPs meeting this reduction goal. Further, a number of communities in Tennessee, the State of Georgia and the Commonwealth of Virginia have implemented a WQv type of method as the statewide water quality control approach. The BMP design and maintenance guidance from these states can be used and modeled as appropriate to implement a water quality control program that is appropriate to meet Knox County's needs.

Figure 1-4: Knox County 85th Percentile Rainfall Analysis