TOTAL MAXIMUM DAILY LOAD (TMDL)

For

Siltation & Habitat Alteration

In The

Stones River Watershed (HUC 05130203)

Cannon, Davidson, Rutherford, & Wilson County, Tennessee

Prepared by:

Tetra Tech, Inc.
2110 Powers Ferry Road, Suite 460
Atlanta, GA 30339

and

U.S. Environmental Protection Agency, Region 4
Atlanta Federal Building
61 Forsyth Street SW
Atlanta, GA 30303-8960

and

Tennessee Department of Environment and Conservation
Division of Water Pollution Control
6th Floor L & C Tower
401 Church Street
Nashville, TN 37243-1534

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ARS	Agricultural Research Station
BMP	Best Management Practices
CFR	Code of Federal Regulations
CFS	Cubic Feet per Second
CRC	Cumberland River Compact
DEM	Digital Elevation Model
DWPC	Division of Water Pollution Control
EPA	Environmental Protection Agency
HUC	Hydrologic Unit Code
LA	Load Allocation
MGD	Million Gallons per Day
MOS	Margin of Safety
MRLC	Multi-Resolution Land Characteristic
MS4	Municipal Separate Storm Sewer System
NED	National Elevation Dataset
NPS	Nonpoint Source
NPDES	National Pollutant Discharge Elimination System
NSL	National Sediment Laboratory
Rf3	Reach File v.3
RM	River Mile
STATSGO	State Soil and Geographic Database
SSURGO	Soil Survey Geographic Database
TDEC	Tennessee Department of Environment & Conservation
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
USGS	United States Geological Survey
USLE	Universal Soil Loss Equation
WCS	Watershed Characterization System
WLA	Waste Load Allocation
WMD	Water Management Division
WWTF	Wastewater Treatment Facility

EXECUTIVE SUMMARY

Total Maximum Daily Load for Sediment in Waterbodies Listed on the State of Tennessee's 1998 Section 303(d) List Stones River Watershed (HUC 05130203)

The Tennessee Department of Conservation and Environment, Division of Water Pollution Control is proposing a Total Maximum Daily Load (TMDL) for sediment for waterbodies identified on the State's 1998 Section 303(d) list of impaired waters located within the Stones River Watershed in middle Tennessee. This TMDL proposes reductions in average annual sediment loading to activities and facilities discharging sediment to these waterbodies. This TMDL, when fully implemented, is expected to achieve the State's narrative water quality standard for protection of fish and aquatic life. TMDLs are expressed as the required percent reduction in the estimated average annual sediment loading for an impaired subwatershed, relative to the estimated average annual sediment loading of a biologically healthy (reference) subwatershed located in the same Level IV ecoregion.

Watershed Description

The Stones River watershed (HUC 05130203) is located in middle Tennessee, primarily in Cannon, Davidson, Rutherford, and Wilson Counties. The watershed lies within the Level III Interior Plateau (71) ecoregion and basically contains two Level IV ecoregions (a very small area in the extreme eastern part of the watershed is in the 71g Level IV ecoregion). The Stones River watershed has approximately 1,461 miles of streams (Rf3) and drains a total area of 936 square miles. The mouth of the Stones River is at Cumberland River (Cheatham Lake) mile 205.8. The Stones River watershed has 14 waterbodies, representing nearly 256 miles, that are listed on the 1998 303(d) list for siltation and/or habitat alteration.

TMDL Approach

There are 15 facilities in the Stones River Watershed with National Pollutant Discharge Elimination System (NPDES) permits that require monitoring of Total Suspended Solids (TSS) or turbidity. The TMDL is providing these NPDES-regulated Wastewater Treatment Facilities (WWTFs) their current NPDES permit limits as individual Waste Load Allocations (WLAs) for each facility. It is considered appropriate to provide these facilities their current discharge levels of TSS since these WWTF sources provide negligible loadings of sediment to impaired receiving waters compared to wet weather sources (e.g., NPDES-regulated construction activities, Municipal Separate Storm Sewer Systems [MS4s], and nonpoint sources). Also, the TSS component of the WWTF discharges is generally composed more of organic material, and therefore, provides less direct impact on the biologic integrity of a stream (through settling and accumulation) than would stream sedimentation due to soil erosion during wet weather events.

This TMDL primarily addresses wet weather sources of sediment which are discharged to a receiving waterbody as a result of the storm events. These wet weather sources can be broadly defined, for the purposes of this TMDL, into two categories: wet weather sources regulated by the NPDES program, and wet weather sources not regulated by NPDES. Wet weather sources regulated by the NPDES program are point sources and include industrial activities (which includes certain construction activities), and discharges from MS4s. The NPDES-regulated sources are provided WLAs in this TMDL, while all other wet weather sources of sediment (those not regulated by NPDES) are considered to be due to nonpoint sources and are provided a Load Allocation (LA).

For a TMDL to be established for the wet weather sources of sediment to the receiving waters, a numeric “target” protective of the uses of the waterbodies must be identified to serve as the basis for the TMDL. Where State regulation provides a numeric water quality criteria for the pollutant, the criteria is the basis for the TMDL. Where state regulation does not provide a numeric water quality criteria, as in the case of sediment, a numeric interpretation of the narrative water quality standard must be determined. The narrative water quality standard for protection of the fish and aquatic life designated use has been identified to serve as the basis for this sediment TMDL. All other designated uses for the waterbodies covered by this TMDL will be protected by attainment of the TMDL to protect fish and aquatic life.

For the purpose of this TMDL, the average annual sediment loading from a biologically healthy watershed located within the same Level IV ecoregion as the impaired watershed has been determined to be the appropriate numeric interpretation of the narrative water quality standard for protection of fish and aquatic life. The biologically healthy watershed was identified from the State’s ecoregion reference sites.

The Watershed Characterization System Sediment Tool was used to calculate the average annual sediment load for the biologically healthy (reference) subwatersheds in Level IV ecoregions 71h and 71i. These were evaluated and the most appropriate reference load in each ecoregion selected as the target for TMDL analysis. Since the impairment of biological integrity due to sediment build-up is generally a long-term process, an average annual load is considered to be the appropriate measure for the TMDL.

The Watershed Characterization System Sediment Tool was also used to calculate the existing average annual sediment load for each impaired subwatershed in the Stones River watershed. Impaired subwatersheds are those in which one or more waterbodies on Tennessee's 1998 Section 303(d) list of impaired waters are located. The estimated existing average annual sediment loads for impaired subwatersheds are compared to the target average annual sediment loads for the biologically healthy subwatersheds to determine the percent reduction in average annual sediment loading required to fully attain the fish and aquatic life designated use.

The sediment TMDLs for waterbodies listed as impaired due to siltation/habitat alteration in the Stones River watershed are summarized in the table below. WLAs for NPDES Wastewater Treatment Facilities are set at current permitted levels. WLAs for NPDES-regulated construction activities, WLAs for MS4 areas, and LAs for nonpoint sources are equal to the specified TMDL (percent reduction in average annual sediment load).

TMDLs for 1998 303(d) Listed Waterbodies in the Stones River Watershed

Waterbody ID	1998 303(d) Listed Waterbody	TMDL (Reduction in Avg. Annual Sediment Loading) [%]
TN05130203001	McCrory Creek	37.7
TN05130203010	Stewarts Creek; Rock Spring Br.; Olive Br.	50.1
TN05130203003T	Finch Branch	41.2
TN05130203015	Overall Creek – Armstrong Branch	25.1
TN05130203022	Lytle Creek	37.2
TN05130203023	Wades Branch	46.7
TN05130203023	Bear Branch; Dry Branch	57.3
TN05130203025	Cripple Creek; McElroy Creek	39.8
TN05130203026	East Fork Stones River	9.7
TN05130203026	East Fork Stones Tributaries - Cavender Branch	9.7
	East Fork Stones Tributaries – McKnight Branch	61.8
TN05130203029	Bradley Creek – Jarman Br.; Unnamed Tributary	48.0
TN05130203032	Fall Creek; Williams Branch; Cedar Branch	46.5
TN05130203035	Stoners Creek; Unnamed tributary	45.0
TN05130203036.78	Hurricane Creek	41.2

Implementation of the TMDL

The WLAs provided to the NPDES Wastewater Treatment Facilities will be implemented through the State's NPDES permit program. The WLAs provided to the NPDES-regulated construction activities and MS4 areas will be incorporated into NPDES permits as Best Management Practices (BMPs) since, at this time, it is not technically feasible to incorporate numeric sediment limits into permits for these activities/facilities. LAs for nonpoint sources will be achieved through the voluntary application of BMPs. Properly designed and well-maintained BMPs are expected to provide attainment of the wet weather WLAs and LAs.

As the science and available data for wet weather discharges of sediment continues to grow, more advanced approaches to sediment TMDLs are expected to be developed. These new approaches will be applied, as appropriate, through the adaptive management process to enhance the effectiveness of TMDLs for providing a sound basis for water quality management decisions. A discussion of U.S. Environmental Protection Agency's (EPA's) proposed future approach to sediment TMDLs is provided in the Appendix C.

Evaluation of the Effectiveness of the TMDL

The effectiveness of the TMDL will be assessed within the context of the State's rotating watershed management approach. Watershed monitoring and assessment activities will provide information by which the effectiveness of sediment loading reduction measures can be evaluated. Monitoring data, ground-truthing, and source identification actions will also enable implementation of particular types of BMPs to be directed to specific areas in the subwatersheds. These TMDLs will be revaluated during subsequent watershed cycles and revised as required to assure attainment of applicable water quality standards.

SEDIMENT TOTAL MAXIMUM DAILY LOAD (TMDL)
STONES RIVER WATERSHED (HUC 05130203)

1.0 INTRODUCTION

Section 303(d) of the Clean Water Act requires each state to list those waters within its boundaries for which technology based effluent limitations are not stringent enough to protect any water quality standard applicable to such waters. Listed waters are prioritized with respect to designated use classifications and the severity of pollution. In accordance with this prioritization, states are required to develop Total Maximum Daily Loads (TMDLs) for those water bodies that are not attaining water quality standards. State water quality standards consist of designated use(s) for individual waterbodies, appropriate numeric and narrative water quality criteria protective of the designated uses, and an antidegradation statement. The TMDL process establishes the maximum allowable loadings of pollutants for a waterbody that will allow the waterbody to maintain water quality standards. The TMDL may then be used to develop controls for reducing pollution from both point and nonpoint sources in order to restore and maintain the quality of water resources (USEPA, 1991).

2.0 WATERSHED DESCRIPTION

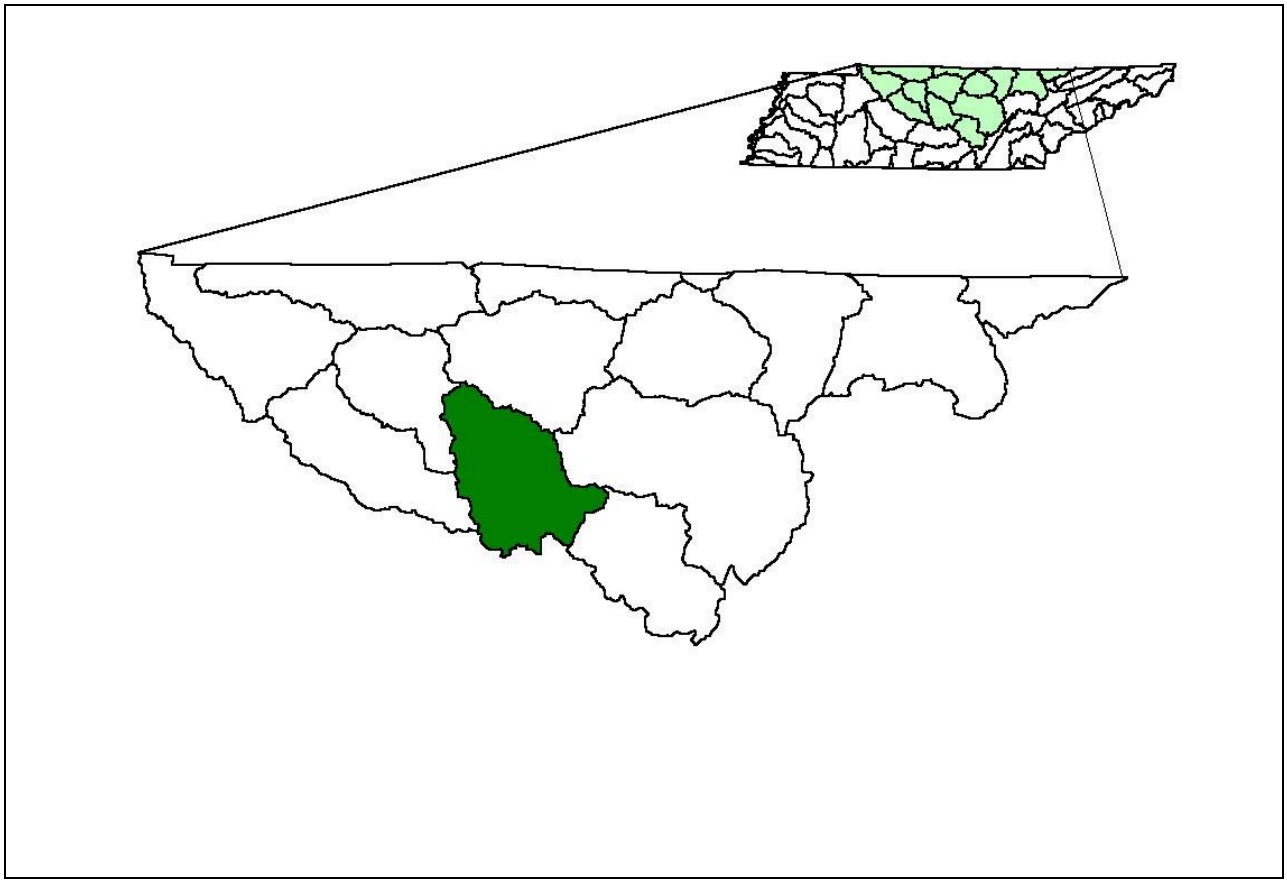
The Stones River watershed (HUC 05130203) is located in Middle Tennessee (Figure 1), primarily in Cannon, Davidson, Rutherford, and Wilson Counties. The watershed lies within the Level III Interior Plateau (71) ecoregion and basically contains two Level IV ecoregions (a very small area in the extreme eastern part of the watershed is in the 71g Level IV ecoregion) as shown in Figure 2 (USEPA, 1997):

- Outer Nashville Basin (71h) is a more heterogeneous region than the Inner Nashville Basin, with more rolling and hilly topography and slightly higher elevations. The region encompasses most all of the outer areas of the generally non-cherty Ordovician limestone bedrock. The higher hills and knobs are capped by the more cherty Mississippian-age formations, and some Devonian-age Chattanooga shale, remnants of the Highland Rim. The region's limestone rocks and soils are high in phosphorus, and commercial phosphate is mined. Deciduous forests with pasture and cropland are the dominant land covers. Streams are low to moderate gradient, with productive nutrient-rich waters, resulting in algae, rooted vegetation, and occasionally high densities of fish. The Nashville Basin as a whole has a distinctive fish fauna, notable for fish that avoid the region, as well as those that are present.

- Inner Nashville Basin (71i) is less hilly and lower than the Outer Nashville Basin. Outcrops of the Ordovician-age limestone are common, and the generally shallow soils are redder and lower in phosphorus than those of the Outer Basin. Streams are lower gradient than surrounding regions, often flowing over large expanses of limestone bedrock. The most characteristic hardwoods within the Inner Basin are a maple-oak-hickory-ash association. The limestone cedar glades of Tennessee, a unique mixed grassland/forest/cedar glades vegetation type with many endemic species, are located primarily on the limestone of the Inner Nashville Basin. The more xeric, open

characteristics and shallow soils of the cedar glades also result in a distinct distribution of amphibian and reptile species.

Figure 1 Location of the Stones River Watershed



The Stones River watershed has approximately 1,461 miles of streams (Rf3) and drains a total area of 936 square miles. The mouth of the Stones River is at Cumberland River (Cheatham Lake) mile 205.8. Watershed land use distribution is based on the Multi-Resolution Land Characteristic (MRLC) databases derived from Landsat Thematic Mapper digital images from the period 1990-1993. Land use for the Stones River watershed is summarized in Table 1 and shown in Figure 3.

Figure 2 Level IV Ecoregions in the Stones River Watershed

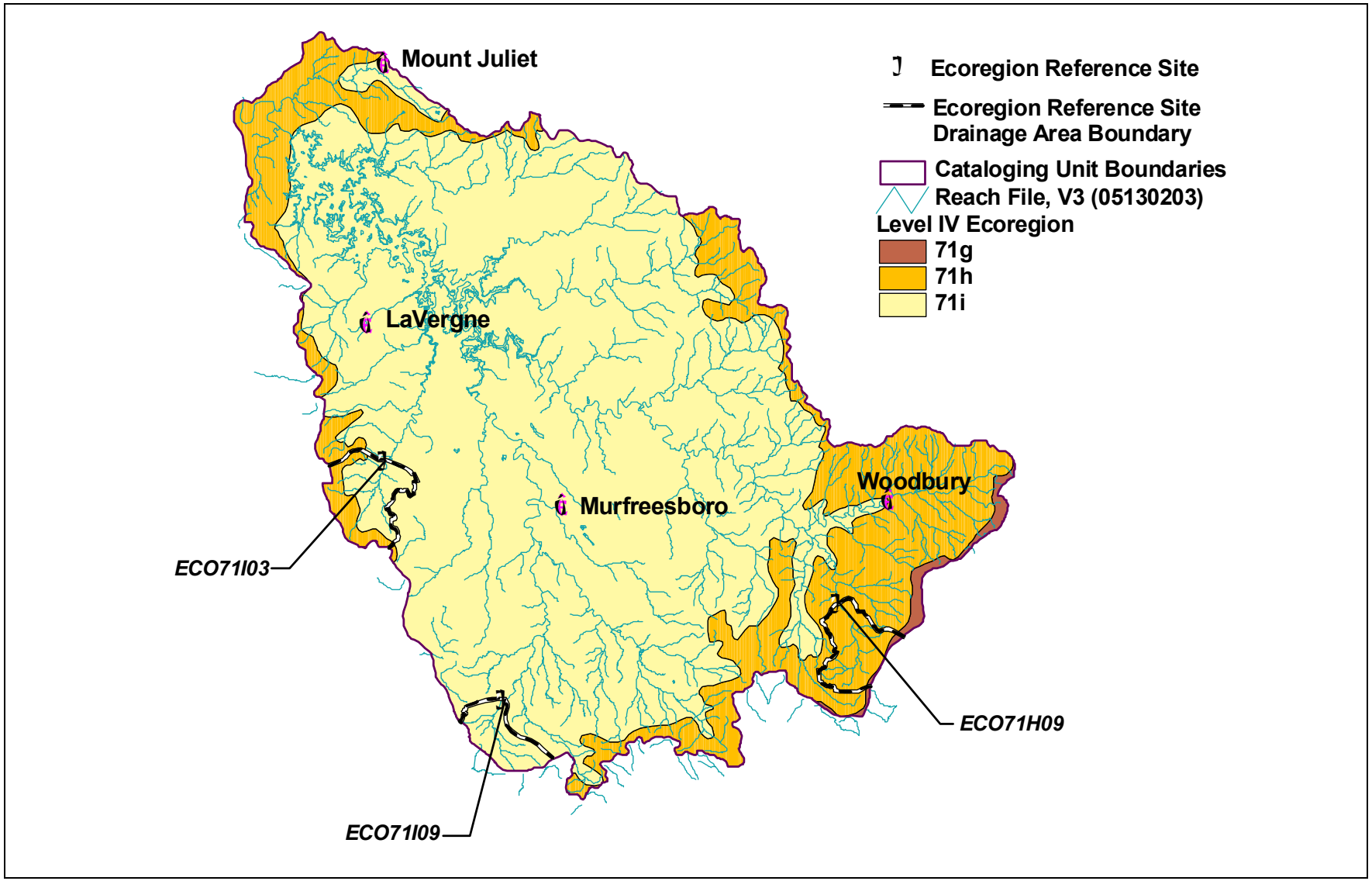


Figure 3 MRLC Land Use in the Stones River Watershed

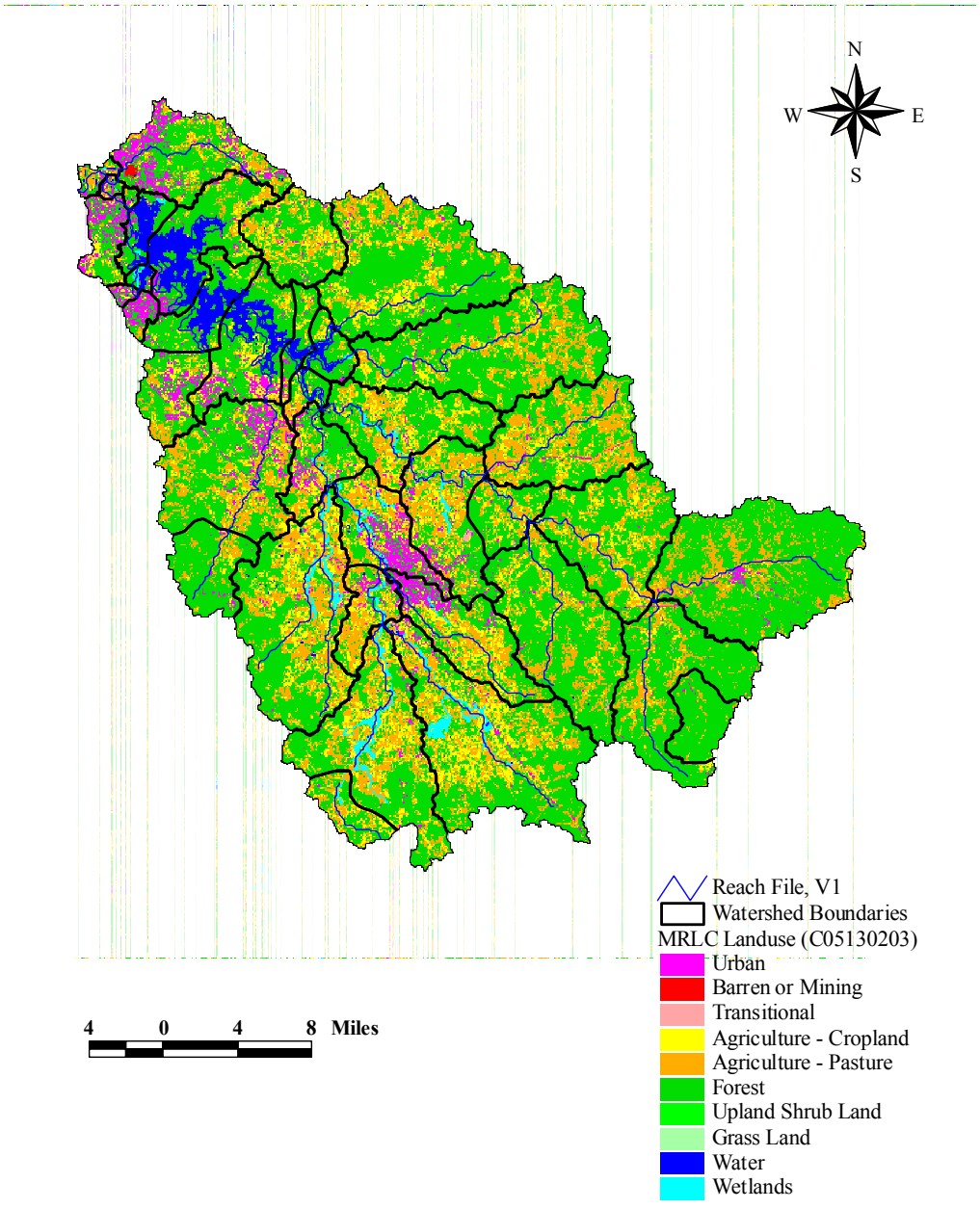


Table 1 Land Use Distribution - Stones River Watershed

LAND COVER/LAND USE	AREA [SQ. MI.]	AREA [%]
Open Water	22.9	2.5
Low Intensity Residential	27.3	2.9
High Intensity Residential	5.5	0.6
High Intensity Commercial/ Industrial/Transportation	13.4	1.4
Bare Rock/Sand/Clay	0.0	0.0
Transitional	1.0	0.1
Deciduous Forest	332.1	35.5
Evergreen Forest	59.9	6.4
Mixed Forest	151.6	16.2
Pasture/Hay	193.7	20.7
Row Crops	101.3	10.8
Other Grasses (Urban/Recreational)	15.1	1.6
Woody Wetlands	10.7	1.2
Emergent Herbaceous Wetlands	1.0	0.1
Quarries/Strip Mines/Gravel Pits	0.3	0.0
Total	**935.8**	**100.0**

3.0 PROBLEM DEFINITION

Siltation effects impact over 4,000 miles of streams in Tennessee and is by far the most frequently cited pollutant for surface waters. Pollution due to siltation has a significant economic impact due to increased water treatment costs, loss of storage capacity in reservoirs, direct impacts to navigation, and the increased possibility of flooding (TDEC, 2000).

Silt alters the physical properties of waters by:

- Restricting or preventing light penetration
- Altering temperature patterns
- Decreasing the depth of pools or lakes
- Changing flow patterns

Silt alters the chemical properties of waters by:

- Interfering with photosynthesis
- Causing an increase in sediment oxygen demand due to decomposition of organic material
- Increasing nutrient levels which can accelerate eutrophication
- Transporting organic chemicals and metals into the water column (especially if the original disturbed site was contaminated)

Silt alters the biological properties of waters by:

- Smothering eggs and nests of fish
- Piggybacking other pollutants in possibly toxic amounts or providing a reservoir of substances that may bioconcentrate in the food chain
- Clogging the gills of fish and other forms of aquatic life
- Interfering with the feeding of fish species that find food by sight
- Covering substrate that provides habitat for benthic organisms that provide food for fish
- Reducing biological integrity by altering habitats to favor burrowing species
- Accelerating the growth of submerged aquatic plants

The State of Tennessee's final 1998 303(d) list (TDEC, 1998) was approved by the U.S. Environmental Protection Agency (EPA), Region IV on September 17, 1998. The list identified a number of waterbodies in the Stones River watershed as not fully supporting designated use classifications due, in part, to siltation and habitat alteration associated with urban runoff, land development, and agriculture (see Table 2). The designated use classifications for the Stones River and its tributaries include fish and aquatic life, irrigation, livestock watering & wildlife, and recreation. Some waterbodies in the watershed are also classified for industrial water supply and/or domestic water supply. This TMDL is established to attain the fish and aquatic life designated use since all other uses will be protected by this approach.

Waterbodies in the Stones River watershed were reassessed by the State in 2000 using more recent data and a revised waterbody identification system (see Table 3). The waterbody listings in Table 3 represent smaller watersheds than those listed in the 1998 303(d) list (Table 2.) All waters listed on the 2000 reassessment (Table 3) fall within one of the larger watersheds on the1998 303(d) list (Table 2). The last column in Table 3 provides the link between the 2000 assessment and the 1998 303(d) list. Waterbodies that were considered to be impaired due to siltation and/or habitat alteration on the 1998 303(d) list that were found to meet water quality standards in the 2000 assessment are tabulated in Table 4. Since this Stones River sediment TMDL addresses all subwatersheds in the Stones River watershed, all waterbodies listed on both the 1998 303(d) list and the 2000 assessment are provided a TMDL for sediment loading.

Table 2 1998 303(d) List for Siltation/Habitat Alteration - Stones River Watershed

Waterbody ID	Impacted Waterbody	RM Partially Supporting	RM Not Supporting	CAUSE (Pollutant)
TN05130203001	MCCRORY CREEK – is not supporting.		12.1	Habitat Alteration
TN05130203010	STEWARTS CREEK – From Harris Br. to Rocky Fork, plus Rock Spring Br. are partial. Olive Br. is not supporting.	25.1	8.2	Habitat Alteration Siltation
TN05130203003T	FINCH BRANCH	3.2		Habitat Alteration
TN05130203015	OVERALL CREEK - Armstrong Branch is not supporting.		5.3	Habitat Alteration
TN05130203022	LYTLE CREEK - Headwaters are partially supporting. Downstream area not supporting	10.1	10.1	Siltation Habitat Alteration
TN05130203023	WADES BRANCH – Downstream part of Wades Branch partially supporting (upper portion not supporting.)	7.2	3.9	Siltation Habitat Alteration
TN05130203023	BEAR BRANCH – is not supporting. Dry Br. is partially supporting.	1.1	3.5	Siltation Habitat Alteration
TN05130203025	CRIPPLE CREEK - Portion of Cripple Cr., as well as McElroy Cr. are partially supporting	31.1		Siltation Habitat Alteration
TN05130203026	EAST FORK STONES – Upper East Fork Stones (headwaters) partially supporting.	9.1		Habitat Alteration
TN05130203026	EAST FORK STONES TRIBUTARIES – McKnight and Cavender Br. partially supporting.	24.2		Habitat Alteration
TN05130203029	BRADLEY CREEK - Jarman Branch is partially supporting. Unnamed trib. is not supporting.	4.4	4.5	Habitat Alteration Siltation
TN05130203032	FALL CREEK – Fall Creek and Williams Branch are partial. Cedar Branch is not supporting.	65.5	4.1	Siltation
TN05130203035	STONERS CREEK – Portion of Stoners Creek and unnamed tributary are partially supporting	3.5		Siltation
TN05130203036.78	HURRICANE CREEK	19.4		Siltation

Table 3 2000 Assessment - Stream Impairment Due to Siltation/Habitat Alteration in the Stones River Watershed

Waterbody ID	Segment Name	Size [mi.]	Use Support	CAUSE (Pollutant)	Reference to 1998 303(d) List Waterbody ID
TN05130203010 – 0200	Olive Branch	8.1	Partial	Other Habitat Alterations	TN05130203010
TN05130203010 – 0300	Rock Spring Branch	10.8	Partial	Siltation Other Habitat Alterations	TN05130203010
TN05130203010 – 1000	Stewarts Creek	16.9	Partial	Siltation Other Habitat Alterations	TN05130203010
TN05130203022 – 0200	Lees Spring Branch	1.0	Not	Siltation Other Habitat Alterations	TN05130203022
TN05130203022 – 1000	Lytle Creek	9.0	Not	Siltation Other Habitat Alterations	TN05130203022
TN05130203022 – 2000	Lytle Creek	10.1	Partial	Siltation Other Habitat Alterations	TN05130203022
TN05130203023 – 0100	Wades Branch	7.2	Partial	Siltation Other Habitat Alterations	TN05130203023
TN05130203023 - 0110	Upper Wades Branch	3.9	Not	Siltation Other Habitat Alterations	TN05130203023
TN05130203023 – 0300	Dry Branch	1.6	Partial	Siltation	TN05130203023
TN05130203023 – 0310	Bear Branch	3.5	Not	Siltation Other Habitat Alterations	TN05130203023
TN05130203026 – 0200	McKnight Branch	18.8	Partial	Other Habitat Alterations	TN05130203026
TN05130203026 – 3000	East Fork Stones River	11.1	Partial	Other Habitat Alterations	TN05130203026
TN05130203029 – 0100	Jarman Branch	4.4	Partial	Siltation	TN05130203029
TN05130203029 – 0200	Unnamed Tributary to Bradley Creek	2.7	Not	Other Habitat Alterations	TN05130203029
TN05130203032 – 0100	Unnamed Tributary to Fall Creek	3.0	Not	Siltation Other Habitat Alterations	TN05130203032
TN05130203032 – 0200	Cedar Creek	1.7	Partial	Other Habitat Alterations	TN05130203032
TN05130203035 – 0400	Unnamed Tributary to Stoners Creek	1.4	Partial	Siltation	TN05130203035

Table 4 1998 303(d) Listed Waterbodies Assessed as Not Impaired

1998 303(d) List - Impaired Waterbody	1998 303(d) List - Waterbody ID	Size [mi.]	1998 303(d) List Cause (Pollutant)	Reason for Non-Impaired Determination in 2000 Assessment
CRIPPLE CREEK Also McElroy Creek	TN05130203025	28.0	Siltation Habitat Alteration	Reason: clarification of narrative criteria. The reference stream database for Level IV ecoregion 71i made it possible to reassess this stream in 2000. The four EPT families found in these streams fall well within the range of conditions documented at the reference streams. Like many other streams in 71i, Cripple Creek and its tributaries go dry from time to time, which may contribute to the lack of intolerant families.
Cavender Branch	TN05130203026	5.5	Habitat Alteration	Reason: clarification of narrative criteria. The reference stream database for Level IV ecoregion 71h made it possible to reassess this stream in 2000. The seven EPT families found in this stream fall within the range of conditions documented at the reference streams.
Fall Creek	TN05130203032	30.7	Siltation	Reason: clarification of narrative criteria. The reference stream database for Level IV ecoregion 71h made it possible to reassess this stream in 2000. The eight EPT families found in this stream fall within the range of conditions documented at the reference streams. (Note: Cedar Branch and unnamed tributary are still listed.)

4.0 TARGET IDENTIFICATION

Several narrative criteria, applicable to siltation/habitat alteration, are established in *State of Tennessee Water Quality Standards, Chapter 1200-4-3 General Water Quality Criteria, October, 1999* (TDEC, 1999):

Applicable to all use classifications (Fish & Aquatic Life shown):

> Solids, Floating Materials, and Deposits – There shall be no distinctly visible solids, scum, foam, oily slick, or the formation of slimes, bottom deposits or sludge banks of such size and character that may be detrimental to fish and aquatic life.
>
> Other Pollutants – The waters shall not contain other pollutants that will be detrimental to fish or aquatic life.

Applicable to the Domestic Water Supply, Industrial Water Supply, Fish & Aquatic Life, and Recreation use classifications (Fish & Aquatic Life shown):

> Turbidity or Color – There shall be no turbidity or color in such amounts or of such character that will materially affect fish and aquatic life.

Applicable to the Fish & Aquatic Life use classification:

> Biological Integrity - The waters shall not be modified through the addition of pollutants or through physical alteration to the extent that the diversity and/or productivity of aquatic biota within the receiving waters are substantially decreased or adversely affected, except as allowed under 1200-4-3-.06. The condition of biological communities will be measured by use of metrices suggested in guidance such as Rapid Bioassessment Protocols for Use in Streams and Rivers (EPA/444/4-89-001) or other scientifically defensible methods. Effects to biological populations will be measured by comparisons to upstream conditions or to appropriately selected reference sites in the same ecoregion (See definition).

This TMDL is being established to attain full support of the fish and aquatic life designated use classification. A TMDL established to protect fish and aquatic life will protect all other use classifications for the identified waterbodies from adverse alteration due to sediment loading.

In order for a TMDL to be established, a numeric “target” protective of the uses of the water must be identified to serve as the basis for the TMDL. Where State regulation provides a numeric water quality criteria for the pollutant, the criteria is the basis for the TMDL. Where state regulation does not provide a numeric water quality criteria, as in the case of sediment, a numeric interpretation of the narrative water quality standard must be determined. For the purpose of this TMDL, the average annual sediment loading from a biologically healthy watershed, located within the same Level IV ecoregion as the impaired watershed, is determined to be the appropriate numeric interpretation of the narrative water quality standard for protection of fish and aquatic life. The biologically healthy watershed was identified from the State’s ecoregion reference sites (see Figure 2). These ecoregion reference sites have similar characteristics and conditions as the majority of streams in the ecoregion. Detailed information regarding Tennessee ecoregion reference sites can be found in *Tennessee Ecoregion Project, 1994-1999* (TDEC, 2000a). In general, land use within

the ecoregion reference watersheds contained less pasture, cropland, and urban areas, and more forested areas compared to the impaired watersheds. The biologically healthy (reference) watersheds are considered the "least impacted" in the ecoregion and, as such, sediment loading from these subwatersheds may serve as the appropriate target for the TMDL.

Using the methodology described in Appendix A, the Watershed Characterization System (WCS) sediment "tool" was used to calculate the average annual sediment load for each of the biologically healthy (reference) subwatersheds. These loads were evaluated and the most appropriate reference load selected as the target for each Level IV ecoregion.

Level IV Ecoregion 71h

There were two reference sites in the 71h Level IV ecoregion that were used in the target identification. The two stations were ECO71H09 (Carson Fork) and ECO71H15 (West Harpeth River). Upon reviewing these two stations, it was noted that station ECO71H15 was dropped from the State of Tennessee's ecoregion reference site list due to massive development in the sub-watershed. A significant portion of this development is that associated with new Highway 840 which cuts directly through the subwatershed. Since ECO71H15 was dropped as an ecoregion site, this station was not used. The average annual unit sediment load was 660 lbs/acre/year from the ECO71H09 subwatershed.

Level IV Ecoregion 71i

There were two reference sites in the 71i Level IV ecoregion that were used in the target identification. The two stations were ECO71I03 (Stewart Creek) and ECO71I09 (West Fork Stones River). The average annual sediment load was 220 lbs/acre/year from the ECO71I03 subwatershed and was 300 lbs/acre/year from ECO71I09 subwatershed. Since an implicit margin of safety was applied to the TMDLs (conservative modeling assumptions), the ECO71I03 station (220 lbs/acre/year) was used for the target.

Since the impairment of biological integrity due to sediment build-up is generally a long-term process, using an average annual is considered appropriate. The average annual sediment load TMDL target values for Level IV ecoregions 71h and 71i are summarized in Table 5.

Table 5 TMDL Target Average Annual Sediment Loads

Level IV Ecoregion	Reference Watershed Monitoring Station	Target Sediment Load [lbs/acre/year]
71h	ECO71H09	660
71i	ECO71I03	220

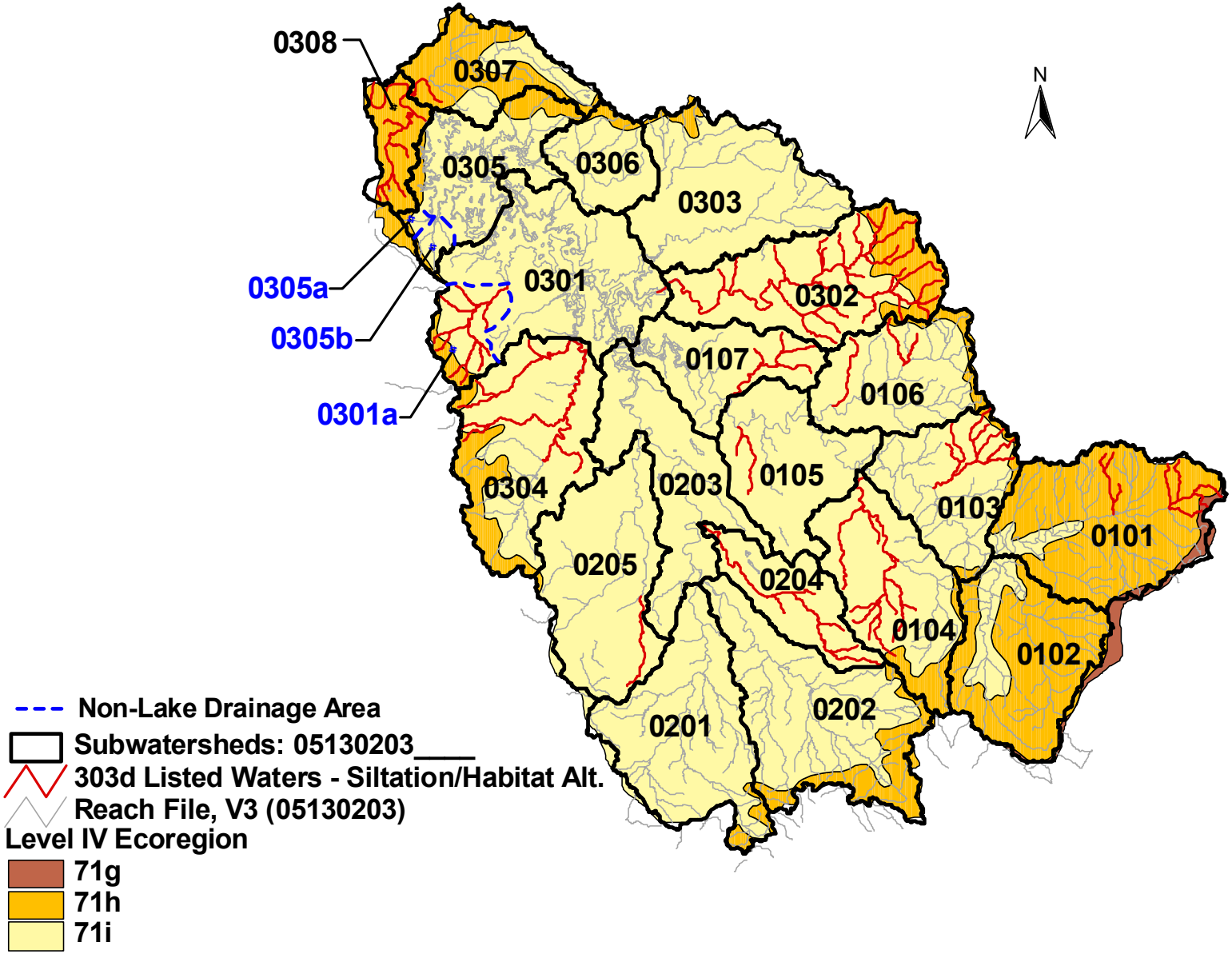
5.0 WATER QUALITY ASSESSMENT AND DEVIATION FROM TARGET

Using the methodology described in Appendix A, the WCS Sediment Tool was used to determine the average annual sediment load for all subwatersheds (corresponding to 12-digit HUCs) in the Stones River watershed (Figure 4). The estimated existing average annual loads for subwatersheds with waterbodies listed as impaired for siltation/habitat alteration are summarized in Table 6.

Table 6 Existing Sediment Loads in Subwatersheds With 303(d) Listed Waterbodies

Subwatershed	Level IV Ecoregion	Existing Sediment Load [lbs/acre/year]
0101	71h	731
0307	71h	1,200
0308	71h	1,059
0106	71i	423
0103	71i	576
0104	71i	366
0105	71i	515
0204	71i	350
0205	71i	294
0203	71i	432
0302	71i	411
0107	71i	413
0304	71i	441
0305b	71i	862
0305a	71i	766
0301a	71i	374

Figure 4 Stones River Watershed – Subwatershed Delineation



6.0 SOURCE ASSESSMENT

An important part of the TMDL analysis is the identification of individual sources, source categories, or source subcategories of siltation in the watershed and the amount of pollutant loading contributed by each of these sources. Under the Clean Water Act, sources are broadly classified as either point or nonpoint sources. Under 40 CFR 122.2, a point source is defined as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. The National Pollutant Discharge Elimination System (NPDES) program regulates point source discharges. Point sources can be described by two broad categories: 1) NPDES-regulated municipal and industrial wastewater treatment facilities (WWTFs) and 2) NPDES-regulated industrial activities (which includes construction activities) and municipal storm water discharges (Municipal Separate Storm Sewer Systems [MS4s]). A TMDL must provide Waste Load Allocations (WLAs) for all NPDES-regulated point sources. For the purposes of this TMDL, all sources of sediment loading not regulated by NPDES are considered nonpoint sources. The TMDL must provide a Load Allocation (LA) for these sources.

6.1 Point Sources

6.1.1 NPDES-Regulated Municipal and Industrial Wastewater Treatment Facilities

Discharges from WWTFs may contribute sediment to receiving waters as Total Suspended Solids (TSS) and/or turbidity. There are 15 facilities with NPDES permits that require monitoring of TSS or turbidity in the Stones River watershed (see Figure 5). These discharges are summarized in Table 7. Sediment loads to the receiving streams from WWTFs are negligible in relation to sediment discharges caused by storm water runoff. The cumulative total of all WWTF discharges to receiving waters in subwatersheds impaired for sediment in the Stones River watershed is calculated to be less than 3% of the total sediment loading. The TSS component of WWTF discharges is generally composed more of organic material and, therefore, provides less direct impact to the biological integrity of the stream (through settling and accumulation) than would stream sedimentation due to soil erosion.

6.1.2 NPDES-Regulated Construction Activities

Sediment loadings from NPDES-regulated construction activities and Municipal Separate Storm Sewer Systems (MS4s) are considered point sources of sediment to surface waters. These discharges occur in response to storm events.

Currently, discharges of storm water from construction activities disturbing an area of five acres or more must be authorized by an NPDES permit. Most of these construction sites obtain coverage under NPDES Permit No. TNR10-0000, *General NPDES Permit for Storm Water Discharges Associated With Construction Activity*. In some cases, for discharges into 303(d) listed waters, sites may be required to obtain coverage under an individual NPDES permit. Beginning in March 2003, discharge of storm water from construction activities disturbing between one and five acres must also be authorized by an NPDES permit. The purpose of these NPDES permits is to eliminate or minimize the discharge of pollutants from construction activities. Since construction activities at a site are of a temporary, relatively short term nature, the number of construction sites covered by the general permit at any instant of time varies. In the Stones River watershed, there were 72 permitted construction sites, disturbing, 1,582 acres on May 2, 2002. The location of these sites is shown in Figure 6.

Figure 5 Point Source Facilities Discharging TSS in the Stones River Watershed

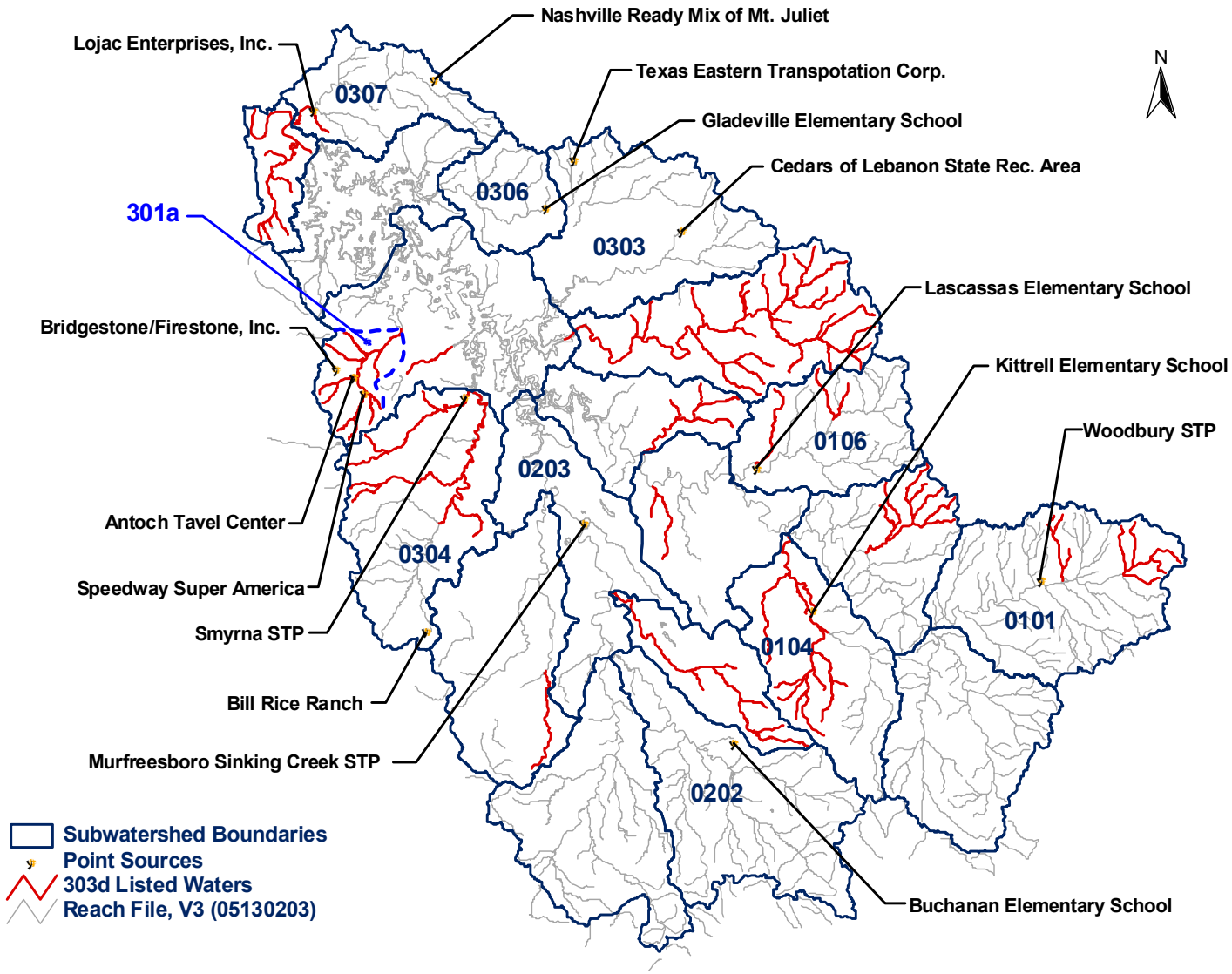


Table 7 NPDES Facilities Permitted to Discharge TSS in the Stones River Watershed

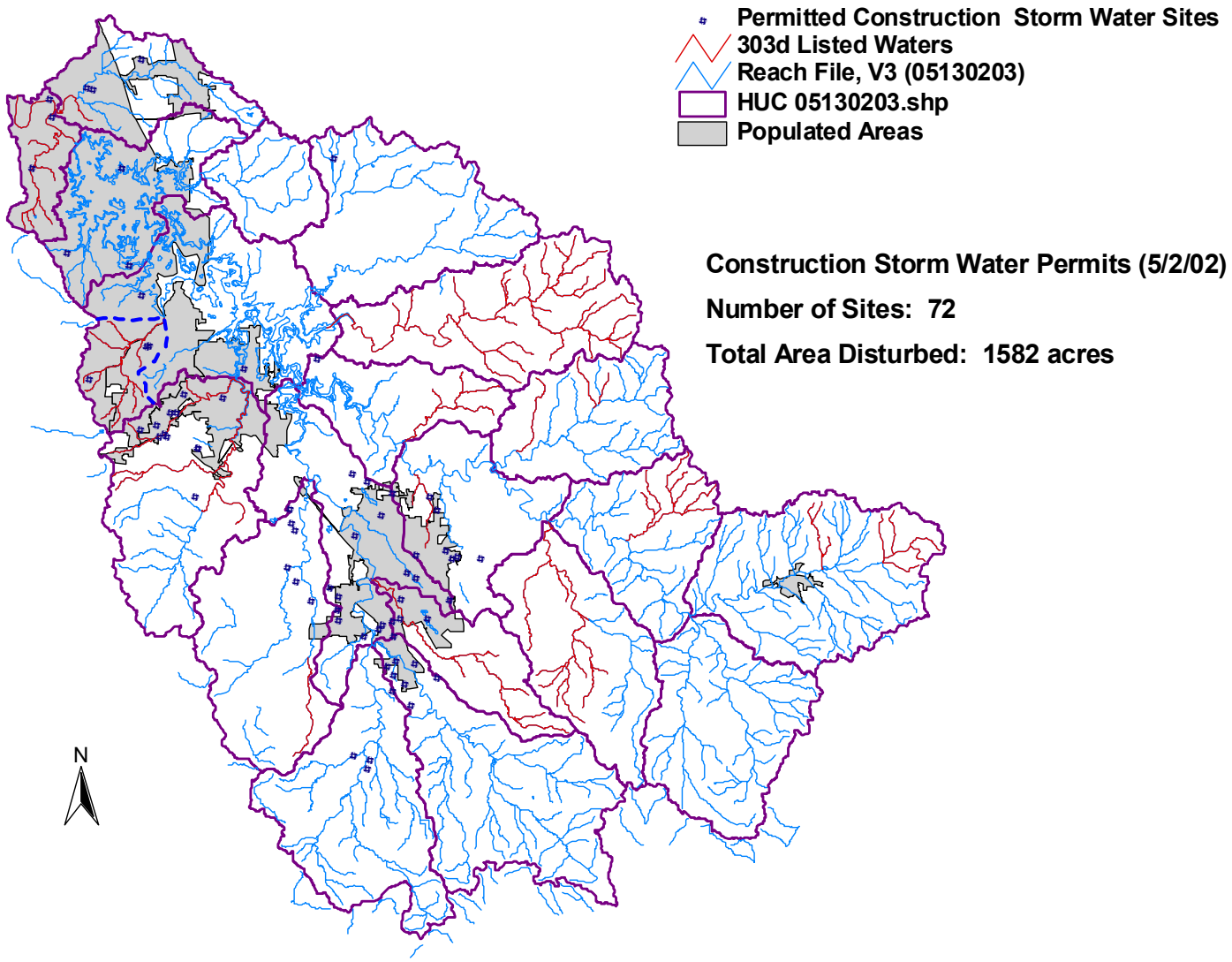
Sub-watershed	Sub-watershed Area	NPDES Permit No.	Facility	Design Flow	NPDES Permit Limit TSS				
					Monthly Average		Weekly Average		Daily Maximum
	[acres]			[MGD]	[mg/l]	[lbs/day]	[mg/l]	[lbs/day]	[mg/l]
0101	41,599.0	TN0025089	Woodbury STP	0.6	30	150	40	200	45
0104	30,807.7	TN0067253	Kittrell Elementary School	0.019	30				40
0106	25,121.1	TN0067245	Lascassas Elementary School	0.0192	30				40
0202	42,357.4	TN0057797	Buchanan Elementary School	0.017	30				40
0203	29,098.0	TN0022586	Murfreesboro Sinking Ck. STP	16.0	30	4003	40	5338	45
0301a	9,069.2	TN0022039	Bridgestone/Firestone, Inc.	0.22				75	113 [b]
0301a	9,069.2	TN0028797	Antioch Travel Center	0.001					40
0301a	9,069.2	TN0061301	Speedway Super America	0.0006					40
0306	37,066.1	TN0057801	Gladeville Elementary School	0.0216	30				45
0303	37,066.1	TN0058149	Cedars of Lebanon State Park	0.024	30				40
0303	37,066.1	TN0067237	Texas Eastern Transport. Corp.	0.0031					40
0304	37,752.2	TN0020541	Smyrna STP	5.2	30	1302	40	1735	45
0304	37,752.2	TN0057975	Bill Rice Ranch [c]	0.3	30				45
0307	18,518.6	TN0060119	Lojac Enterprises, Inc.	0.0025					40
0307	18,518.6	TN0073628	Nashville Ready Mix-Mt. Juliet	0.008					50

a Facilities located in Subwatersheds 0301 & 0305 (see Figure 4) are not listed. These subwatersheds are primarily comprised of J. Percy Priest Lake and could not be analyzed with the Sediment Tool (see Appendix A – Sediment Modeling Methodology, #4).

b pounds/day

c Flow and limit shown is for the period from October through May. Flow and limits for June through September is 0.1 MGD, DMax = 45 mg/l, WAvg = 40 mg/l,& MAvg = 30 mg/l.

Figure 6 Location of NPDES Permitted Construction Sites in the Stones River Watershed (May 1, 2002)



6.1.3 NPDES-Regulated Municipal Separate Storm Sewer Systems

MS4s also discharge sediment to waterbodies in response to storm events through road drainage systems, curb and gutter systems, ditches, and storm drains. These systems convey urban runoff from surfaces such as bare soil and wash-off of accumulated street dust and litter from impervious surfaces during rain events. Large and medium MS4s serving populations greater than 100,000 people are required to obtain an NPDES storm water permit. At present, Metro Nashville/Davidson County is the only MS4 of this size in the Stones River watershed that is regulated by the NPDES program (TNS068047). In March 2003, small MS4s serving urbanized areas will be required to obtain a permit under the Phase II storm water regulations. An urbanized area is defined as an entity with a residential population of at least 50,000 people and an overall population density of 1,000 people per square mile. Lavergne, Mount Juliet, Murfreesboro, Smyrna, Rutherford County, and Wilson County will be covered under Phase II of the NPDES Storm Water Program. The Tennessee Department of Transportation (TDOT) is also being issued MS4 permits for state roads in urban areas.

6.2 Nonpoint Sources

Nonpoint sources account for the vast majority of sediment loading to surface waters. These sources include:

- Natural erosion occurring from the weathering of soils, rocks, and uncultivated land; geological abrasion; and other natural phenomena.

- Erosion from agricultural activities can be a major source of sedimentation due to the large land area involved and the land-disturbing effects of cultivation. Grazing livestock can leave areas of ground with little vegetative cover. Unconfined animals with direct access to streams can cause streambank damage.

- Urban erosion from bare soil areas under construction and washoff of accumulated street dust and litter from impervious surfaces.

- Erosion from unpaved roadways can be a significant source of sediment to rivers and streams. It occurs when soil particles are loosened and carried away from the roadway, ditch, or road bank by water, wind, or traffic. The actual road construction (including erosive road-fill soil types, shape and size of coarse surface aggregate, poor subsurface and/or surface drainage, poor road bed construction, roadway shape, and inadequate runoff discharge outlets or “turn-outs” from the roadway) may aggravate roadway erosion. In addition, external factors such as roadway shading and light exposure, traffic patterns, and road maintenance may also affect roadway erosion. Exposed soils, high runoff velocities and volumes, and poor road compaction all increase the potential for erosion

- Surface mining activities which typically include removal of vegetation, displacement of soils and other significant land disturbing activities.

- Soil erosion from forested land that occurs during timber harvesting and reforestation activities. Timber harvesting includes the layout of access roads, log decks, and skid trails; the construction and stabilization of these areas; and the cutting of trees. Established forest areas produce very little soil erosion.

For the listed waterbodies within the Stones River Basin, the primary sources of nonpoint sediment loads come from agriculture, roadways, and urban sources.

7.0 DEVELOPMENT OF TOTAL MAXIMUM DAILY LOAD

The TMDL is the total amount of a pollutant that can be loaded into a waterbody (the loading capacity) and still attain the applicable water quality standard. A TMDL is expressed as Waste Load Allocations (WLAs) for point source discharges from facilities and activities regulated by the NPDES permit program and Load Allocations (LAs) for all nonpoint sources. The TMDL must also provide an appropriate margin of safety (MOS) which takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

Sediment analysis for watersheds can be conducted using methods ranging from simple, gross estimates to complex dynamic loading and receiving water models. The choice of methodology is dependent on a number of factors that include: watershed size, type of impairment, type and quantity of data available, resources available, time, and cost. In consideration of these factors, the following approach was selected as most the appropriate for first phase sediment TMDLs in the Stones River watershed:

- The Watershed Characterization System (WCS) Sediment Tool was used to determine sediment loading to Level IV ecoregion reference site watersheds. These are considered to be biologically healthy watersheds. The average annual sediment loads of these reference watersheds serve as target values for the Stones River watershed sediment TMDLs.

- The Sediment Tool was also used to determine the existing average annual sediment loads of impaired watersheds located in the same Level IV ecoregion. Impaired watersheds are defined as 12-digit HUCs containing one or more waterbodies identified as impaired due to siltation/habitat alteration on the State's 1998 Section 303(d) list (see Figure 7).

- The average annual sediment load of each impaired watershed was compared to the average annual load of the appropriate reference (biologically healthy) watershed and a required percent reduction in loading calculated. Although the Sediment Tool uses the best road, elevation, and landuse GIS coverages available, the resulting average annual sediment loads should not be interpreted in the absolute sense. The calculated loading reductions, however, are considered to be valid since they are based on the relative comparison of loads calculated using the same methodology.

- TMDLs, WLAs, and LAs are expressed as a percent reduction in average annual sediment loading. It is considered that the reduction of sediment loading as specified by WLAs and LAs in impaired watersheds will result in the attainment of fully supporting status for all designated use classifications, with respect to siltation/habitat alteration. According to 40 CFR §130.2 (i), TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measure.

This approach is recognized as an acceptable alternative to a maximum allowable mass load per day in the *Protocol for Developing Sediment TMDLs* (USEPA, 1999). Target loading and sediment TMDLs for impaired watersheds are summarized in Table 8.

Figure 7 Waterbodies Impaired Due to Siltation/Habitat Alteration - 1998 303(d) List

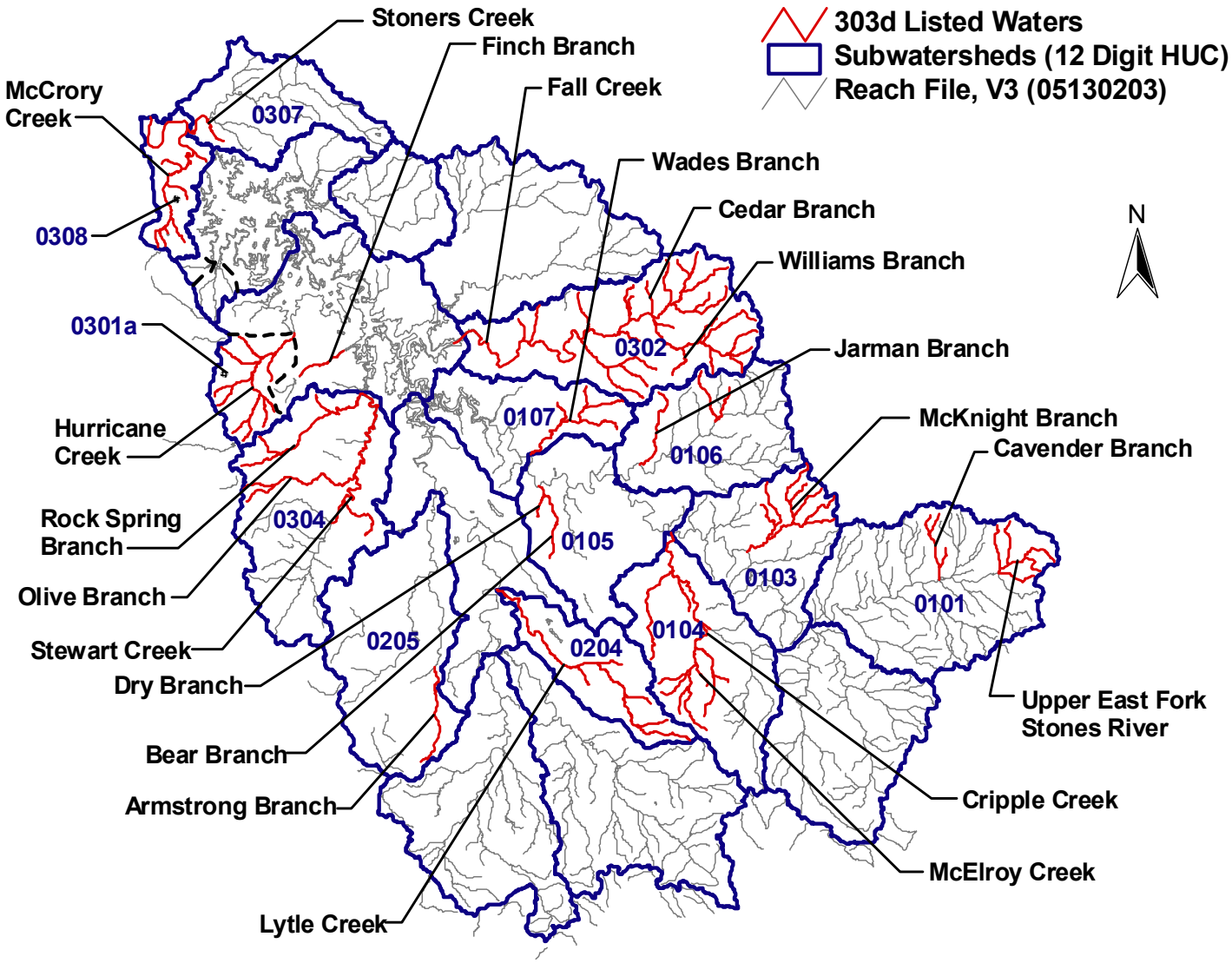


Table 8 Sediment TMDLs for Subwatersheds With 303(d) Listed Waterbodies

Subwatershed	Waterbody ID	1998 303(d) List Waterbody	Level IV Ecoregion	Target Load	TMDL (Required Load Reduction*)
				[lbs/acre/yr]	[%]
0308	TN05130203001	McCrory Creek	71h	660	37.7
0304	TN05130203010	Stewart Creek; Olive Br.; Rock Spring Br.	71i	220	50.1
0301	TN05130203003T	Finch Branch	71i	220	41.2
0205	TN05130203015	Armstrong Branch	71i	220	25.1
0204	TN05130203022	Lytle Creek	71i	220	37.2
0107	TN05130203023	Wades Branch	71i	220	46.7
0105	TN05130203023	Bear Branch; Dry Branch	71i	220	57.3
0104	TN05130203025	Cripple Creek; McElroy Creek	71i	220	39.8
0101	TN05130203026	East Fork Stones River (upper); Cavender Br.	71h	660	9.7
0103	TN05130203026	McKnight Branch	71i	220	61.8
0106	TN05130203029	Jarman Branch	71i	220	48.0
0302	TN05130203032	Fall Creek; Cedar Branch; Williams Branch	71i	220	46.5
0307	TN05130203035	Stoners Creek; Unnamed Tributary	71h	660	45.0
0301a	TN05130203036.78	Hurricane Creek	71i	220	41.2

* Required reduction in existing average annual sediment load to achieve target average annual sediment load.

Note: Finch Branch (TN05130203003T), located in Subwatershed 0301, is identified on the 1998 303(d) List as impaired for habitat alteration due to riparian loss and land development. Subwatershed 0301 is primarily comprised of J. Percy Priest Lake and could not be analyzed using the Sediment Tool (see Appendix A – Sediment Modeling Methodology, #4). For purposes of this TMDL analysis, the TMDL for the Finch Branch drainage area is considered to be equal to those specified for Subwatershed 0301a.

7.1 Waste Load Allocations

7.1.1 Determination of Waste Load Allocations for NPDES-Regulated Municipal and Industrial Wastewater Treatment Facilities

There are 15 facilities in the Stones River Watershed with individual NPDES permits that require monitoring of TSS or turbidity. The TMDL is providing these NPDES-regulated WWTFs their current NPDES permit limits as individual WLAs for each facility (see Table 9). It is considered appropriate to provide these facilities their current discharge levels of TSS since the sediment loading from these facilities is negligible compared to other sources. WWTFs cumulatively contribute less than 3% of the total sediment loading to surface waters in impaired subwatersheds. In addition, sediment loads from WWTFs are generally composed more of organic material and, therefore, provide less direct impact to biological integrity (through settling and accumulation) than would direct soil loss to the streams.

Table 9 WLAs for NPDES-Permitted Municipal and Industrial Wastewater Treatment Facilities

Subwatershed	NPDES Permit No.	Facility	WLA (as TSS)	
			Flow	Monthly Average Permit Limit
			[MGD]	[mg/l]
0101	TN0025089	Woodbury STP	0.6	30
0104	TN0067253	Kittrell Elementary School	0.019	30
0106	TN0067245	Lascassas Elementary School	0.0192	30
0202	TN0057797	Buchanan Elementary School	0.017	30
0203	TN0022586	Murfreesboro Sinking Ck. STP	16.0	30
0301a	TN0022039	Bridgestone/Firestone, Inc.	0.22	75[b]
0301a	TN0028797	Antioch Travel Center	0.001	40[a]
0301a	TN0061301	Speedway Super America #8454	0.0006	40[a]
0306	TN0057801	Gladeville Elementary School	0.0216	30
0303	TN0058149	Cedars of Lebanon State Park	0.024	30
0303	TN0067237	Texas Eastern Transport. Corp.	0.0031	40[a]
0304	TN0020541	Smyrna STP	5.2	30
0304	TN0057975	Bill Rice Ranch [c]	0.3	30
0307	TN0060119	Lojac Enterprises, Inc.	0.0025	40[a]
0307	TN0073628	Nashville Ready Mix-Mt. Juliet	0.008	50[c]

a Daily Maximum limit = 40 mg/l.
b Pounds/day
c Daily Maximum limit = 50 mg/l.

7.1.2 Determination of Waste Load Allocations for NPDES-Regulated Construction Activities

Certain construction activities are currently regulated by the State's NPDES program (see Section 6.1.2). Since these construction activities may discharge sediment to surface waters, WLAs are provided for this category of activities. WLAs are established for each subwatershed containing a waterbody identified on the 1998 303(d) list as impaired due to siltation or habitat alteration (ref. Table 2). WLAs are expressed as the required percent reduction in the estimated average annual sediment loading for the impaired subwatershed, relative to the estimated average annual sediment loading of a biologically healthy (reference) subwatershed located in the same Level IV ecoregion (see Table 10).

The WLAs provided to the NPDES regulated construction activities will be implemented as Best Management Practices (BMPs), as specified in NPDES Permit No. TNR10-0000, *General NPDES Permit for Storm Water Discharges Associated With Construction Activit*y. It is not technically feasible to incorporate numeric sediment limits into construction storm water permits at this time. WLAs should not be construed as numeric permit limits. Ambient monitoring may be required for specific discharges to determine compliance with the TMDL for a particular segment. Properly designed and well-maintained BMPs are expected to provide attainment of WLAs. In some cases, it may be necessary to go beyond standard practices in the application of BMPs to assure compliance with the WLA (see Section 8).

7.1.3 Determination of Waste Load Allocations for NPDES-Regulated Construction Municipal Separate Storm Sewer Systems (MS4s)

Large and medium municipal separate storm sewer systems (MS4s) are currently regulated by the State's NPDES program (see Section 6.1.3). In 2003, small MS4s serving urbanized areas will also be required to obtain an NPDES permit under the Phase II storm water regulations. Since MS4s have the potential to discharge TSS to surface waters, WLAs are specified for these systems. WLAs are established for each subwatershed containing a waterbody identified on the 1998 303(d) list as impaired due to siltation or habitat alteration (ref. Table 2). WLAs are expressed as the required percent reduction in the estimated average annual sediment loading for an impaired subwatershed, relative to the estimated average annual sediment loading of a biologically healthy (reference) subwatershed located in the same Level IV ecoregion (see Table 10).

WLAs provided to NPDES regulated MS4s will be implemented as Best Management Practices (BMPs) as specified in Phase I & II MS4 permits. It is not technically feasible to incorporate numeric sediment limits into MS4 permits at this time. WLAs should not be construed as numeric permit limits. Ambient monitoring may be required for specific discharges to determine compliance with the TMDL for a particular segment. Properly designed and well-maintained BMPs are expected to provide attainment of WLAs. In some cases, it may be necessary to go beyond standard practices in the application of BMPs to assure compliance with the WLA (see Section 8).

7.2 Determination of Load Allocations for Nonpoint Sources

All sources of sediment loading to surface waters not covered by the NPDES program are provided a Load Allocation (LA) in this TMDL. LAs are established for each subwatershed containing a waterbody identified on the 1998 303(d) list as impaired due to siltation or habitat alteration (ref. Table 2). LAs are expressed as the required percent reduction in the estimated

average annual sediment loading for the impaired subwatershed, relative to the estimated average annual sediment loading of a biologically healthy (reference) subwatershed located in the same Level IV ecoregion (see Table 10). Properly designed and well-maintained BMPs will be necessary to assure that LAs are achieved.

7.3 Margin of Safety

There are two methods for incorporating a Margin of Safety (MOS) in the analysis: a) implicitly incorporate the MOS using conservative model assumptions to develop allocations; or b) explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations. In these TMDLs, an implicit MOS was incorporated through the use of conservative modeling assumptions. These include:

- Target values based on Level IV ecoregion reference sites. These sites represent the least impacted streams in the ecoregion.
- The use of appropriate ecoregion reference site average annual sediment load as the target value for the calculation of load reductions.
- The use of the sediment delivery process that results in the most sediment transport to surface waters (Method 2 in Appendix A).

7.4 Seasonal Variation

Sediment loading is expected to fluctuate according to the amount and distribution of rainfall. The determination of sediment loads on an average annual basis accounts for these differences through the rainfall erosivity index in the USLE (See Appendix A). This is a statistic calculated from the annual summation of rainfall energy in every storm and its maximum 30-minute intensity.

7.5 Future Sediment TMDLs

As the science and available data for wet weather discharges of sediment continues to grow, more advanced approaches to sediment TMDLs are expected to be developed. These new approaches will be applied, as appropriate, through the adaptive management process to enhance the effectiveness of TMDLs and to provide a sound basis for water quality management decisions. A discussion of U.S. Environmental Protection Agency's proposed future approach to sediment TMDLs is provided in Appendix C.

Table 10 Percent Reductions in Average Annual Sediment Loading for Impaired Subwatersheds

Subwatershed	Level IV Ecoregion	Target Sediment Load	% Reduction – Avg. Annual Sediment Load		
			TMDL	WLAs (Construction SW & MS4s)	LAs (Nonpoint Sources)
		[lbs/ac/yr]	[%]	[%]	[%]
0101	71h	660	9.7	9.7	9.7
0103	71i	220	61.8	61.8	61.8
0104	71i	220	39.8	39.8	39.8
0105	71i	220	57.3	57.3	57.3
0106	71i	220	48.0	48.0	48.0
0107	71i	220	46.7	46.7	46.7
0204	71i	220	37.2	37.2	37.2
0205	71i	220	25.1	25.1	25.1
0301a	71i	220	41.2	41.2	41.2
0302	71i	220	46.5	46.5	46.5
0304	71i	220	50.1	50.1	50.1
0307	71h	660	45.0	45.0	45.0
0308	71h	660	37.7	37.7	37.7

Note: Finch Branch (TN05130203003T), located in Subwatershed 0301, is identified on the 1998 303(d) List as impaired for habitat alteration due to riparian loss and land development. Subwatershed 0301 is primarily comprised of J. Percy Priest Lake and could not be analyzed using the Sediment Tool (see Appendix A – Sediment Modeling Methodology, #4). For purposes of this TMDL, the LA and required nonpoint source load reduction for the Finch Branch drainage area is considered to be equal to those specified for Subwatershed 0301a.

8.0 IMPLEMENTATION PLAN

8.1 Point Sources

8.1.1 NPDES-Regulated Municipal and Industrial Wastewater Treatment Facilities

Calculations show that TSS discharges from facilities covered under individual NPDES permits account for less than three percent of the total existing average annual sediment loading in impaired subwatersheds in the Stones River watershed. This TMDL requires that all of these facilities comply with their existing permit requirements. The WLA for these facilities will be implemented through each facility's NPDES permit.

8.1.2 NPDES-Regulated Construction Storm Water

The WLAs provided to the NPDES-regulated construction activities and will be implemented through Best Management Practices (BMPs) as specified in NPDES Permit No. TNR10-0000, *General NPDES Permit for Storm Water Discharges Associated With Construction Activity*. It is not technically feasible to incorporate numeric sediment limits into permits for these activities at this time. WLAs should not be construed as numeric permit limits.

Construction sites in Tennessee disturbing five acres or more are currently required to obtain coverage under the *General NPDES Permit for Storm Water Discharges Associated With Construction Activity* (see Appendix E). This permit requires:

- Development and implementation of a site-specific Storm Water Pollution Prevention Plan (SWPPP) that addresses erosion and sediment control.
- Good engineering and best management practices in the design, installation, and maintenance of erosion and sediment controls.
- Erosion and sediment controls must be designed to function properly in a two-year, 24-hour storm event.

In addition, a number of special requirements in the permit apply to discharges entering waterbodies that have been identified on the 1998 303(d) list, or more recent assessments, as being impaired due to siltation. This includes all waterbodies provided a WLA under this TMDL. These additional requirements include:

- More frequent (weekly) inspections of erosion and sediment controls.
- Inspections and the condition of erosion and sediment controls must be reported to the Division of Water Pollution Control (DWPC).
- The SWPPP must be submitted to the DWPC prior to disturbing soil at the construction site.
- In order to assure that the WLA is achieved, the application of BMPs that go beyond the typical minimum elements generally undertaken to comply with the General Permit may be necessary.

Strict compliance with the provisions of the *General NPDES Permit for Storm Water Discharges Associated With Construction Activity* can reasonably be expected to achieve reduced sediment loads to streams. The primary challenge for the reduction of sediment loading from construction sites to meet TMDL WLAs is in the effective compliance monitoring of all requirements specified in the permit and timely enforcement against construction sites not found to be in compliance with the permit.

8.1.3 NPDES-Regulated Municipal Separate Storm Sewer Systems (MS4s)

For regulated discharges from municipal separate storm sewer systems, WLAs will be implemented through Phase I & II MS4 permits. These permits will require the development and implementation of a Storm Water Management Plan (SWMP) that will reduce the discharge of pollutants to the "maximum extent practicable" and not cause or contribute to violations of State water quality standards. The individual permittees will be responsible for identifying the specific BMPs to be applied to attain appropriate reduction in sediment loads. The SWMP will also include a number of programs/activities to identify sources of pollutants in municipal storm water runoff and verify SWMP effectiveness.

8.2 Implementation of Load Allocations for Nonpoint Sources

Reductions of sediment loading from nonpoint sources (NPS) will be achieved using a phased approach. Voluntary, incentive-based mechanisms will be used to implement NPS management measures in order to assure that measurable reductions in sediment loadings can be achieved for the targeted impaired water. Cooperation and active participation by the general public and various industry, business, and environmental groups is critical to successful implementation of TMDLs. Local citizen-led and implemented management measures offer the most efficient and comprehensive avenue for reduction of loading rates from nonpoint sources. TMDL implementation activities will be accomplished within the framework of Tennessee's Watershed Approach (ref: www.state.tn.us/environment/wpc/wshed1.htm).

The Watershed Approach is based on a five-year cycle and encompasses planning, monitoring , assessment, TMDLs, WLAs/LAs, and permit issuance. It relies on participation at the federal, state, local and nongovernmental levels to be successful. The *Stones River Watershed Management Plan* (TDEC, 2002) describes, in general, the partnerships among government agencies and stakeholder groups and the roles that each play in the effort to improve water quality in the Stones River watershed, including the reduction of pollutant loading.

Governmental agencies include :

- Natural Resources Conservation Service
- USGS Water Resource Programs—Tennessee District
- United States Army Corps of Engineers-Nashville District
- U.S. Environmental Protection Agency
- TDEC - Division of Water Supply
- TDEC Division of Community Assistance
- Tennessee Department of Agriculture
- Tennessee Wildlife Resources Agency

Local stakeholder groups include:

- Black Fox Wetland League
- Friends of Murfreesboro Greenway
- The Nature Conservancy

With respect to the reduction of nonpoint source sediment loading and habitat alteration, government agency and stakeholder should, at a minimum, be directed to:

- Implement and maintain conservation farming, including conservation tillage, contour strips and no till farming.
- Install grass buffer strips along streams.
- Reduce activities within riparian areas
- Minimize road and bridge construction impacts on streams

8.3 Aquatic Resource Alteration

There are a number of stream alteration activities that have the potential to effect sediment loading to surface waters in the Stones River watershed. In Tennessee, Aquatic Resource Alteration Permits (ARAPs) are required for any alteration of state waters not requiring a federal permit, including:

- Dredging, widening, straightening, or bank stabilization
- Levee construction (if excavation or fill of stream channel is involved)
- Channel relocation
- Flooding, excavating, draining, and/or filling a wetland
- Bridge construction
- Bridge scour repair
- Construction of road or utility line crossings
- Sand and gravel dredging
- Debris removal
- Emergency road repair

Aquatic Resource Alteration Permits are developed in accordance with Tennessee Rule 1200-4-7, *Aquatic Resource Alteration* (TDEC, 2000b) and contain provisions that minimize impacts to surface waters.

8.4 Evaluation of TMDL Effectiveness

The effectiveness of the TMDL will be assessed within the context of the State's rotating watershed management approach. Watershed monitoring and assessment activities will provide information by which the effectiveness of sediment loading reduction measures can be evaluated. Monitoring data, ground-truthing, and source identification actions will enable implementation of particular types of BMPs to be directed to specific areas in the subwatersheds. These TMDLs will be revaluated during subsequent watershed cycles and revised as required to assure attainment of applicable water quality standards.

9.0 PUBLIC PARTICIPATION

In accordance with 40 CFR §130.7, the proposed sediment TMDLs for the Stones River watershed were placed on Public Notice for a 65-day period and comments solicited. Steps that were taken in this regard include:

1) Notice of the proposed TMDLs was posted on the Tennessee Department of Environment and Conservation website on April 8, 2002 (see Appendix F). The announcement invited public and stakeholder comment until May 13, 2002. The comment period was extended an additional 30 days at the request of several stakeholders. As of May 31, 2002, the Public Notice announcement was accessed 94 times and the TMDL document 545 times.

2) Notice of the availability of the proposed TMDLs (similar to the website announcement) was included in one of the NPDES permit Public Notice mailings which was sent to approximately 90 interested persons or groups who have requested this information.

3) 3) A letter was sent to point source facilities in the Stones River study area that are permitted to discharge treated total suspended solids (TSS) advising them of the proposed sediment TMDLs and their availability on the TDEC website. The letter also stated that a written copy of the draft TMDL document would be provided on request. Letters were sent to the following facilities:

   Woodbury STP (TN0025089)
   Kittrell Elementary School (TN0067253)
   Lascassas Elementary School (TN0067245)
   Buchanan Elementary School (TN0057797)
   Murfreesboro Sinking Creek STP (TN0022586)
   Bridgestone/Firestone, Inc. (TN0022039)
   Antioch Travel Center (TN0028797)
   Speedway Super America #8454 (TN0061301)
   Gladeville Elementary School (TN0057801)
   Cedars of Lebanon State Park (TN0058149)
   Texas Eastern Transport Corp. (TN0067237)
   Smyrna STP (TN0020541)Bill Rice Ranch (TN0057975)
   Lojac Enterprises, Inc. (TN0060119)
   Nashville Ready Mix – Mt. Juliet (TN0073628)

4) A draft copy of the proposed sediment TMDLs was sent to Metro Nashville/Davidson County, Tennessee Department of Transportation, City of Murfreesboro, City of Lavergne, City of Smyrna, City of Mount Juliet, Rutherford County, and Wilson County. Metro Nashville/Davidson County is covered under Municipal Separate Storm Sewer System (MS4) permit TNS068047. The other entities will be issued MS4 permits under the Phase II storm water regulations.

5) A meeting, sponsored by the City of Murfreesboro, was held on June 6,2002. Twenty-two representatives of municipal government, county government, consultants, developers, and contractors were present. In this meeting, the Division of Water Pollution Control made a presentation of the analysis methodology used for the Stones River sediment TMDLs. An opportunity to ask questions and make comments followed.

Written comments were received from several parties during the public comment period. These comments are included in Appendix G and the Division of Water Pollution Control responses are contained in Appendix H. No requests to hold additional public meetings were received regarding the proposed TMDLs as of close of business on June 12, 2002.

10.0 FURTHER INFORMATION

Further information concerning Tennessee's TMDL program can be found on the Internet at the Tennessee Department of Environment and Conservation website:

www.state.tn.us/environment/wpc/tmdl.htm

Technical questions regarding this TMDL should be directed to the following members of the Division of Water Pollution Control staff:

Bruce R. Evans, P.E., Watershed Management Section
e-mail: Bruce.Evans@state.tn.us

Sherry H. Wang, Ph.D., Watershed Management Section
e-mail: Sherry.Wang@state.tn.us

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APPENDIX A

Watershed Sediment Loading Model

WATERSHED SEDIMENT LOADING MODEL

Determination of target average annual sediment loading values for reference watersheds and the sediment loading analysis of 303(d) listed waterbodies was accomplished utilizing the Watershed Characterization System (WCS) Sediment Tool (v.2.1). WCS is an Arcview geographic information system (GIS) based program developed by USEPA Region IV to facilitate watershed characterization and TMDL development. WCS consists of an initial set of spatial and tabular watershed data, stored in a database, and allows the incorporation of additional data when available. It provides a number of reporting tools and data management utilities to allow users to analyze and summarize data. Program extensions, such as the sediment tool, expand the functionality of WCS to include modeling and other more rigorous forms of data analysis (USEPA, 2001).

Sediment Analysis

The Sediment Tool is an extension of WCS that utilizes available GIS coverages (land use, soils, elevations, roads, etc), the Universal Soil Loss Equation (USLE) to calculate potential erosion, and sediment delivery equations to calculate sediment delivery to the stream network. The following tasks can be performed:

- Estimate extent and distribution of potential soil erosion in the watershed.
- Estimate potential sediment delivery to receiving waterbodies.
- Evaluate effects of land use, BMPs, and road network on erosion and sediment delivery.

The Sediment Tool can also be used to evaluate different scenarios, such as the effects of changing land uses and implementation of BMPs, by the adjustment of certain input parameters. Parameters that may be adjusted include:

- Conservation management and erosion control practices
- Changes in land use
- Implementation of Best Management Practices (BMPs)
- Addition/Deletion of roads

Sediment analyses can be performed for single or multiple watersheds.

Universal Soil Loss Equation

Erosion potential is based on the Universal Soil Loss Equation (USLE), developed by Agriculture Research Station (ARS) scientists W. Wischmeier and D. Smith. It has been the most widely accepted and utilized soil loss equation for over 30 years. The USLE is a method to predict the average annual soil loss on a field slope based on rainfall pattern, soil type, topography, crop system, and management practices. The USLE only predicts the amount of soil loss resulting from sheet or rill erosion on a single slope and does not account for soil losses that might occur from gully, wind, or tillage erosion. Designed as a model for use with certain cropping and management systems, it is also applicable to non-agricultural situations (OMAFRA 2000). While the USLE can be

used to estimate long-term average annual soil loss, it cannot be applied to a specific year or a specific storm. Based on its long history of use and wide acceptance by the forestry and agricultural communities, the USLE was considered to be an adequate tool for estimating the relative long-term average annual soil erosion of watersheds and evaluating the effects of land use changes and implementation of BMP measures.

Soil loss from sheet and rill erosion is primarily due to detachment of soil particles during rain events. It is the cause of the majority of soil loss for lands associated with crop production, grazing areas, construction sites, mine sites, logging areas, and unpaved roads. In the USLE, five major factors are used to calculate the soil loss for a given area. Each factor is the numerical estimate of a specific condition that affects the severity of soil erosion in that area. The USLE for estimating average annual soil erosion is expressed as:

$$A = R \times K \times LS \times C \times P$$

where:

A = average annual soil loss in tons per acre
R = rainfall erosivity index
K = soil erodibility factor
LS = topographic factor - L is for slope length and S is for slope
C = crop/vegetation & management factor
P = conservation practice factor

Evaluating the factors in USLE:

R - Rainfall Erosivity Index

The rainfall erosivity index describes the kinetic energy generated by the frequency and intensity of the rainfall. It is statistically calculated from the annual summation of rainfall energy in every storm, which correlates to the raindrop size, times its maximum 30-minute intensity. This index varies with geography.

K - Soil Erodibility Factor

This factor quantifies the cohesive or bonding character of the soil and its ability to resist detachment and transport during a rainfall event. The soil erodibility factor is a function of soil type.

LS - Topographic Factor

The topographic factor represents the effect of slope length and slope steepness on erosion. Steeper slopes produce higher overland flow velocities. Longer slopes accumulate runoff from larger areas and also result in higher flow velocities. For convenience L and S are frequently lumped into a single term.

C – Crop/Vegetation & Management Factor

The crop/vegetation and management factor represents the effect that ground cover

conditions, soil conditions, and general management practices have on soil erosion. It is the most computationally complicated of USLE factors and incorporates the effects of: tillage management, crop type, cropping history (rotation), and crop yield.

P - Conservation Practice Factor

The conservation practice factor represents the effects on erosion of Best Management Practices (BMPs) such as contour farming, strip cropping and terracing.

Estimates of the USLE parameters, and thus the soil erosion as computed from the USLE, are provided by the Natural Resources Conservation Service's (NRCS) National Resources Inventory (NRI) 1994. The NRI database contains information of the status, condition, and trend of soil, water and related resources collected from approximately 800,000 sampling points across the country.

The soil losses from the erosion processes described above are localized losses and not the total amount of sediment that reaches the stream. The fraction of the soil lost in the field that is eventually delivered to the stream depends on several factors. These include, the distance of the source area from the stream, the size of the drainage area, and the intensity and frequency of rainfall. Soil losses along the riparian areas will be delivered into the stream with runoff-producing rainfall.

Sediment Modeling Methodology

Using WCS and the Sediment Tool, average annual sediment loading to surface waters was modeled according to the following procedures:

1. A WCS project was setup for the watershed that is the subject of this TMDL. Additional data layers required for sediment analysis were generated or imported into the project. These included:

   DEM (grid) – The Digital Elevation Model (DEM) layers that come with the basic WCS distribution system are shapefiles of coarse resolution (300x300m). A higher resolution DEM grid layer (30x30m) is required. The National Elevation Dataset (NED) is available from the USGS website and the coverage for the watershed (8-digit HUC) was imported into the project.

   Road – A road layer is needed as a shape file and requires additional attributes such as road type, road practice, and presence of side ditches. If these attributes are not provided, the Sediment Tool automatically assigns default values: road type - secondary paved roads, side ditches present, and no road practices. This data layer was obtained from ESRI for areas in the watershed.

   Soil – The SSURGO (1:24k) soil data may be imported into the WCS project if higher-resolution soil data is required for the estimation of potential erosion. If the SSURGO soil database is not available, the system uses the STATSGO Soil data (1:250k) by default.

MRLC Land Use – The Multi-Resolution Land Characteristic (MRLC) data set for the watershed is provided with the WCS package, but must be imported into the project.

2. Using WCS, the entire watershed was delineated into 20 subwatersheds corresponding to USGS 12-digit Hydrologic Unit Codes (HUCs). Subwatersheds 051302030301 and 051302030305 were further delineated into drainage areas representing J. Percy Priest Lake (0301 & 0305) and non-lake drainage areas (0301a, 0301b, & 0305a) containing waterbodies listed on the 1998 303(d) list as impaired due to siltation/habitat alteration. These delineations are shown in Figure 5. Land use distribution for these delineations is summarized in Appendix B. All of the sediment analyses were performed on the basis of these drainage areas.

The following steps are accomplished using the WCS Sediment Tool:

3. For a selected watershed or subwatershed, a sediment project is set up in a new view that contains the data layers that will be subsequently used to calculate erosion and sediment delivery.

4. The stream grid for each delineated subwatershed, based on DEM grid data, was created so that the stream follows the elevation (i.e., the stream corresponds to the lower elevations in the subwatershed). The system uses a user input threshold to define the drainage area and location, relative to the subwatershed boundary, of stream grid headwater cells. The threshold value can be manipulated to increase or decrease the density of the resulting stream network. Reach File v. 3 (Rf3) or National Hydrology Dataset (NHD) is used as a reference, or basis of comparison, to obtain the desired stream density.

   For the Stones River watershed, a threshold value of 330 produced the best overall correlation with Rf3 with respect to stream network shape and total stream length. The stream grid and Rf3 for one of the delineated subwatersheds (051302040502) is shown in Figure A-1. Other subwatersheds are similar.

   It should be noted that sediment loading analysis was not performed for lake drainage areas 0301 & 0305. Version 2.1 of the Sediment Tool does not have the capability to calculate sediment delivery to large lakes correctly. Sediment loads are conveyed to lower elevations in the DEM grid rather than to the lake boundary. This generally results in lower total sediment loading to surface waters in the drainage area.

5. For each 30 by 30 meter grid cell within the subwatershed, the Sediment Tool calculates the potential erosion using the USLE based on the specific cell characteristics. The model then calculates the potential sediment delivery to the stream grid network. Sediment delivery can be calculated using one of the four available sediment delivery equations:

- Distance-based equation (Sun and McNulty 1998)

  Mad = M * (1-0.97 * D/L)

  where: Mad = mass moved (tons/acre/yr)
  M = sediment mass eroded (ton)
  D = least cost distance from a cell to the nearest stream grid (ft)
  L = maximum distance the sediment may travel (ft)

- Distance Slope-based equation (Yagow et al. 1998)

  DR = exp(-0.4233 * L * So)
  So = exp (-16.1 * r/L+ 0.057)) - 0.6

  where: DR = sediment delivery ration
  L = distance to the stream (m)
  r = relief to the stream (m)

- Area-based equation (USDASCS 1983)

  $DR = 0.417762 * A^{(-0.134958)} - 1.27097, \quad DR <= 1.0$

  where: DR = sediment delivery ratio
  A = area (sq miles)

- WEEP-based regression equation (Swift 2000)

  $Z = 0.9004 - 0.1341 * X^2 + X^3 - 0.0399 * Y + 0.0144 * Y^2 + 0.00308 * Y^3$

  where: Z = percent of source sediment passing to the next grid cell
  X = cumulative distance down slope (X > 0)
  Y = percent slope in the grid cell (Y > 0)

The distance slope based equation (Yagow et al. 1998) was selected to simulate sediment delivery in the Stones River watershed. USLE parameters applied to the Stones River watershed are summarized in Table A-1.

6. The total sediment delivered upstream of each subwatershed "pour point" is calculated. The sediment analysis provides the calculations for six new parameters:

   - Source Erosion – estimated erosion from each grid cell due to the land cover
   - Road Erosion – estimated erosion from each grid cell representing a road
   - Composite Erosion – composite of the source and road erosion layers
   - Source Sediment – estimated fraction of the soil erosion from each grid cell that reaches the stream (sediment delivery)
   - Road Sediment – estimated fraction of the road erosion from each grid cell that reaches the stream
   - Composite Sediment – composite of the source and erosion sediment layers

   The sediment delivery can be calculated based on the composite sediment, road sediment, or source sediment layer. The sources of sediment by each land use type is determined showing the types of land use, the acres of each type of land use, and the tons of sediment estimated to be generated from each land use.

7. For each subwatershed of interest, the resultant sediment load calculation is expressed as a long-term average annual soil loss expressed in pounds per year calculated for the rainfall erosivity index (R). This statistic is calculated from the annual summation of rainfall energy in every storm (correlates with raindrop size) times its maximum 30-minute intensity.

   Calculated erosion, sediment loads delivered to surface waters, and unit loads (per unit area) for subwatersheds that contain 303(d) listed waters are summarized in Tables A-2, A-3, and A-4, respectively. Similar information for subwatersheds that do not contain 303(d) listed waters are summarized in Tables A-5, A-6, and A-7.

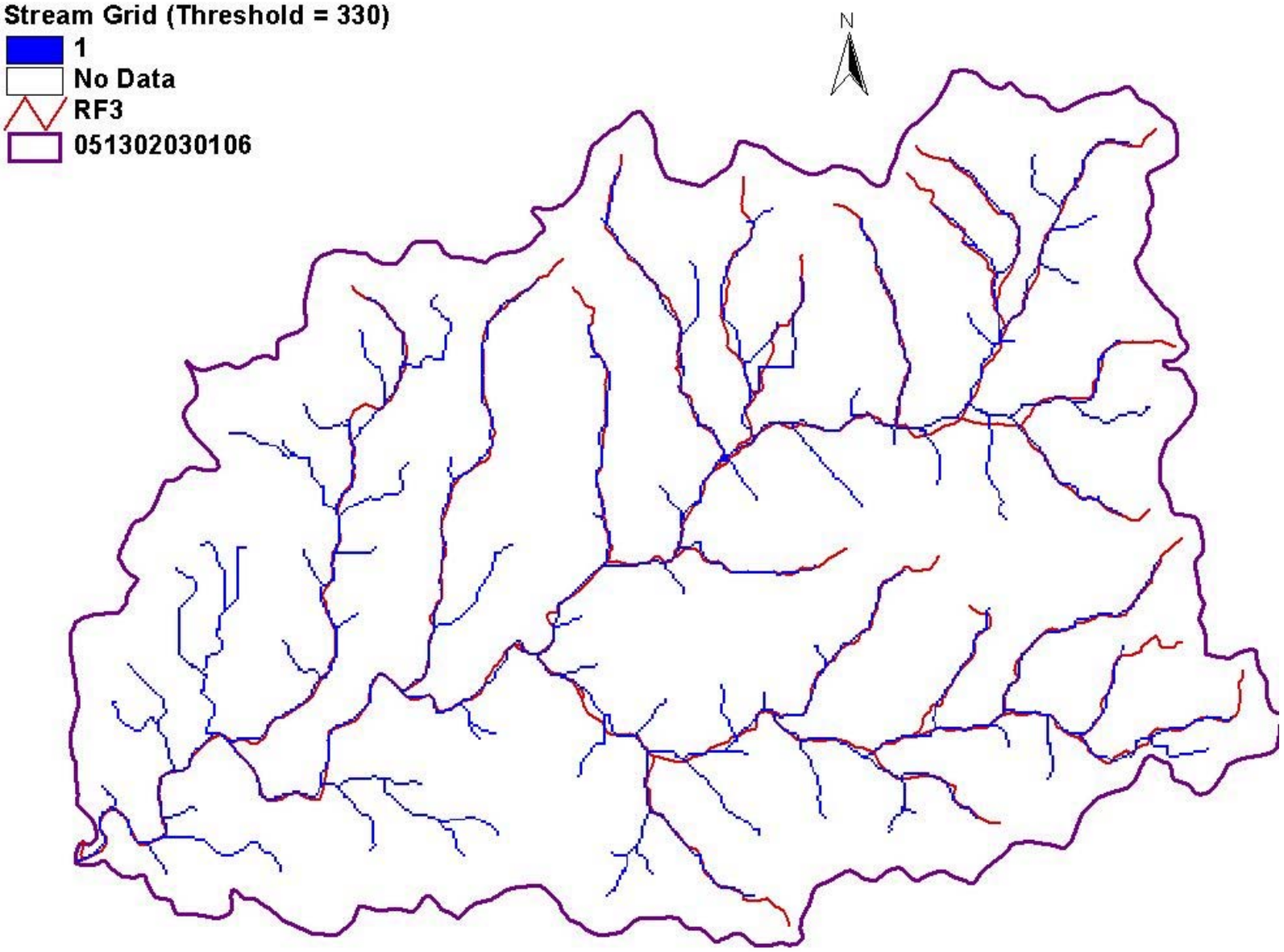

Figure A-1 Stream Grid and Reach File v.3 for Subwatershed 051302030106

Table A-1 USLE Parameters - Stones River Watershed

County	Crop Code	Crop	IRR	R	K	C	P	SL	SLP	Vintage	ERO
Cannon	013	Soybeans (Row Crops)	0	230	0.43	0.25	1	50	2	1992	0.92
Cannon	141	Grass (Hayland)	0	230	0.37	0.01	1	150	6	1992	0.18
Cannon	143	Legume Grass (Hayland)	0	230	0.34	0.02	1	111.38	7.07	1992	0.52
Cannon	211	Grass (Pastureland)	0	230	0.28	0.01	1	110	11	1992	0.17
Cannon	213	Grass Forbs Legumes Mixed (Pastureland)	0	230	0.30	0.01	1	83.31	13	1992	0.0
Cannon	400	Farmsteads & Ranch HQ (Other Farmland)	0	230	0.38	0.02	1	65.38	7.69	1992	0.0
Davidson	141	Grass (Hayland)	0	210	0.37	0	1	100	1	1992	0.04
Davidson	211	Grass (Pastureland)	0	210	0.36	0.01	1	84.45	9.36	1992	0.75
Davidson	400	Farmsteads & Ranch HQ (Other Farmland)	0	210	0.35	0	1	79.12	9.29	1992	0.3
Davidson	613		0	210	0.32	1	1	100	1	1992	8.7
Rutherford	005	Berry (Horticultural)	1	230	0.43	0.01	1	150	4	1992	0.47
Rutherford	011	Corn (Row Crops)	0	230	0.36	0.2	0.96	179.01	2.26	1992	4.77
Rutherford	013	Soybeans (Row Crops)	0	230	0.41	0.16	1	180.61	2.16	1992	4.02
Rutherford	014	Cotton (Row Crops)	0	230	0.43	0.26	0.95	191.67	1.5	1992	4.79
Rutherford	141	Grass (Hayland)	0	230	0.35	0.01	1	156.85	3.49	1992	0.2
Rutherford	142	Legume (Hayland)	0	230	0.39	0.01	1	151.59	4.13	1992	0.32
Rutherford	143	Legume Grass (Hayland)	0	230	0.37	0.01	0.97	167.36	3.12	1992	0.49
Rutherford	211	Grass (Pastureland)	0	230	0.35	0.01	1	151.07	4.96	1992	0.41
Rutherford	212	Legume (Pastureland)	0	230	0.36	0	1	175	2.5	1992	0.12

Table A-1 USLE Parameters - Stones River Watershed (Continued)

County	Crop Code	Crop	IRR	R	K	C	P	SL	SLP	Vintage	ERO
Rutherford	213	Grass Forbs Legumes Mixed (Pastureland)	0	230	0.34	0.01	1	156.68	3.55	1992	0.22
Rutherford	400	Farmsteads & Ranch HQ (Other Farmland)	0	230	0.34	0.01	1	137.27	4.95	1992	0.31
Rutherford	410	Conservation Reserve Program Land (Other Farmland)	0	230	0.43	0.01	1	150	4	1992	0.28
Wilson	011	Corn (Row Crops)	0	210	0.43	0.3	1	130	1	1992	3.79
Wilson	016	Tobacco (Row Crops)	0	210	0.32	0.33	1	60	10	1992	25.53
Wilson	111	Wheat (Close Grown Cropland)	0	210	0.43	0.1	1	130	3	1992	2.75
Wilson	116	All Other Close Grown Cropland	0	210	0.32	0.3	1	90	1	1992	2.49
Wilson	141	Grass (Hayland)	0	210	0.41	0.01	1	154.03	2.77	1992	0.36
Wilson	143	Legume Grass (Hayland)	0	210	0.37	0.02	1	90.79	2.97	1992	0.51
Wilson	211	Grass (Pastureland)	0	210	0.31	0.01	1	85.38	7.14	1992	0.29
Wilson	213	Grass Forbs Legumes Mixed (Pastureland)	0	210	0.32	0	1	40	1	1992	0.02
Wilson	400	Farmsteads & Ranch HQ (Other Farmland)	0	210	0.31	0.01	1	50	5	1992	0.25

Table A-2 Calculated Erosion - Subwatersheds With 303(d) Listed Waterbodies

	Erosion (us ton/yr)				
SUBWATERSHEDS	SOURCE	ROAD	TOTAL	% SOURCE	% ROAD
0101	11318.80	13171.85	24490.65	46.22	53.78
0307	17740.80	6794.42	24535.22	72.31	27.69
0308	6543.39	3702.65	10246.04	63.86	36.14
0106	9404.24	2461.19	11865.43	79.26	20.74
0103	12062.50	2971.55	15034.05	80.23	19.77
0104	6952.29	4427.49	11379.78	61.09	38.91
0105	12441.60	3439.00	15880.60	78.34	21.66
0204	5011.69	2633.63	7645.32	65.55	34.45
0205	12038.30	2573.24	14611.54	82.39	17.61
0302	12085.60	4486.83	16572.43	72.93	27.07
0107	8002.43	1816.74	9819.17	81.50	18.50
0304	10951.10	6412.55	17363.65	63.07	36.93
0301a	2765.01	1432.81	4197.82	65.87	34.13

Table A-3 Calculated Sediment Delivery to Surface Waters - Subwatersheds With 303(d) Listed Waterbodies

	Sediment (us ton/yr)				
SUBWATERSHEDS	SOURCE	ROAD	TOTAL	% SOURCE	% ROAD
0101	5813.55	9534.05	15347.60	37.88	62.12
0307	7331.25	4134.33	11465.58	63.94	36.06
0308	2909.32	1995.08	4904.40	59.32	40.68
0106	3915.49	1456.63	5372.12	72.89	27.11
0103	5387.46	1830.28	7217.74	74.64	25.36
0104	3114.66	2585.36	5700.02	54.64	45.36
0105	5182.11	1628.77	6810.88	76.09	23.91
0204	1620.51	1250.79	2871.30	56.44	43.56
0205	4245.70	1179.49	5425.19	78.26	21.74
0302	5447.02	2560.50	8007.52	68.02	31.98
0107	3147.46	940.99	4088.45	76.98	23.02
0304	4809.40	3831.77	8641.17	55.66	44.34
0301a	923.62	798.96	1722.58	53.62	46.38

Table A-4 Unit Loads - Subwatersheds With 303(d) Listed Waterbodies

	Unit Loads		
	Erosion	Sediment	
SUBWATERSHEDS	[tons/acre/year]	[tons/acre/year]	[lbs/acre/year]
0101	0.583	0.365	731
0307	1.284	0.600	1200
0308	1.106	0.529	1059
0106	0.468	0.212	423
0103	0.600	0.288	576
0104	0.365	0.183	366
0105	0.600	0.257	515
0204	0.466	0.175	350
0205	0.395	0.147	294
0302	0.425	0.206	411
0107	0.496	0.207	413
0304	0.443	0.220	441
0301a	0.456	0.187	374

Table A-5 Calculated Erosion - Subwatersheds Without 303(d) Listed Waterbodies

	Erosion (us ton/yr)				
SUBWATERSHEDS	SOURCE	ROAD	TOTAL	% SOURCE	% ROAD
0102	12470.90	7661.72	20132.62	61.94	38.06
0202	16225.70	5450.30	21676.00	74.86	25.14
0201	12975.60	2902.55	15878.15	81.72	18.28
0203	9380.87	6180.21	15561.08	60.28	39.72
0305b	687.35	1011.78	1699.13	40.45	59.55
0305a	465.68	585.47	1051.15	44.30	55.70
0303	11392.50	3593.10	14985.60	76.02	23.98
0306	5009.58	1155.59	6165.17	81.26	18.74

Table A-6 Calculated Sediment Delivery to Surface Waters - Subwatersheds Without 303(d) Listed Waterbodies

	Sediment (us ton/yr)				
SUBWATERSHEDS	SOURCE	ROAD	TOTAL	% SOURCE	% ROAD
0102	5705.43	5061.97	10767.40	52.99	47.01
0202	6362.93	3232.66	9595.59	66.31	33.69
0201	4746.21	1373.49	6119.70	77.56	22.44
0203	3513.40	3049.14	6562.54	53.54	46.46
0305b	316.64	627.11	943.75	33.55	66.45
0305a	135.09	207.00	342.09	39.49	60.51
0303	4393.67	1753.65	6147.32	71.47	28.53
0306	1822.31	507.79	2330.10	78.21	21.79

Table A-7 Unit Loads - Subwatersheds Without 303(d) Listed Waterbodies

	Unit Loads		
	Erosion	Sediment	
SUBWATERSHEDS	[tons/acre/year]	[tons/acre/year]	[lbs/acre/year]
0102	0.597	0.319	638
0202	0.504	0.223	446
0201	0.418	0.161	322
0203	0.512	0.216	432
0305b	0.776	0.431	862
0305a	1.177	0.383	766
0303	0.399	0.164	327
0306	0.465	0.176	351

APPENDIX B

Subwatershed Land Use

Table B-1 Stones River Watershed – Subwatershed Land Use Distribution

Land Use	Subwatershed											
	0101		0102		0103		0104		0105		0106	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Open Water	11.6	0.0	4.0	0.0	6.672	0.0	4.225	0.0	80.504	0.3	4.893	0.0
Low Intensity Residential	346.9	0.8	112.1	0.3	35.582	0.1	186.138	0.6	835.953	3.3	76.946	0.3
High Intensity Residential	72.3	0.2					0.445	0.0	174.796	0.7	2.002	0.0
High Intensity Commercial /Industrial/Transportation	190.8	0.5	92.3	0.3	72.943	0.3	75.167	0.2	283.321	1.1	281.987	1.1
Bare Rock/Sand/Clay												
Transitional	33.6	0.1	23.8	0.1			69.607	0.2	240.623	0.9		
Deciduous Forest	26001.0	62.5	20716.7	61.9	7843.588	31.6	13411.268	43.5	6553.299	25.6	7364.566	29.3
Evergreen Forest	1636.3	3.9	1818.9	5.4	2754.040	11.1	2445.367	7.9	1547.368	6.0	1461.749	5.8
Mixed Forest	4909.2	11.8	4467.1	13.3	5143.143	20.7	6217.272	20.2	3911.564	15.3	3791.030	15.1
Pasture/Hay	7712.8	18.5	4833.4	14.4	5918.384	23.9	5897.702	19.1	7338.770	28.6	9187.027	36.6
Row Crops	497.9	1.2	1391.9	4.2	2966.642	12.0	2461.156	8.0	3587.324	14.0	2876.575	11.5
Other Grasses (Urban/Recreational)	186.6	0.4	18.5	0.1	4.670	0.0	38.251	0.1	570.645	2.2	74.277	0.3
Woody Wetlands			3.3	0.0	65.827	0.3	1.112	0.0	442.550	1.7		
Emergent Herbaceous Wetlands									62.491	0.2		
Quarries/Strip Mines /Gravel Pits												
Total	**41599.0**	**100.0**	**33481.9**	**100.0**	**24811.5**	**100.0**	**30807.7**	**100.0**	**25629.2**	**100.0**	**25121.1**	**100.0**

Table B-1 Stones River Watershed – Subwatershed Land Use Distribution (Continued)

Land Use	Subwatershed											
	0107		0201		0202		0203		0204		0205	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Open Water	171.0	0.9	24.685	0.1	66.494	0.2	266.2	0.9	22.906	0.1	110.304	0.3
Low Intensity Residential	155.4	0.8	256.857	0.7	248.184	0.6	2863.9	9.8	965.159	6.1	349.370	1.0
High Intensity Residential	4.7	0.0	4.003	0.0	47.591	0.1	844.4	2.9	365.382	2.3	46.034	0.1
High Intensity Commercial /Industrial/Transportation	97.6	0.5	103.188	0.3	566.864	1.3	1161.5	4.0	617.346	3.9	219.718	0.6
Bare Rock/Sand/Clay												
Transitional			28.021	0.1	16.457	0.0	10.5	0.0			12.009	0.0
Deciduous Forest	5490.3	28.5	12147.665	32.5	14557.672	34.4	6189.3	21.3	4135.730	26.1	12798.814	35.8
Evergreen Forest	1701.7	8.8	1668.792	4.5	2192.735	5.2	996.3	3.4	541.512	3.4	1082.135	3.0
Mixed Forest	3461.5	18.0	4948.555	13.2	5456.042	12.9	2897.9	10.0	1721.053	10.9	3544.626	9.9
Pasture/Hay	4333.2	22.5	9619.792	25.7	9945.145	23.5	7379.5	25.4	4197.331	26.5	10095.701	28.2
Row Crops	3168.3	16.5	6689.844	17.9	7094.589	16.7	3805.3	13.1	2757.376	17.4	6363.603	17.8
Other Grasses (Urban/Recreational)	260.6	1.4	125.204	0.3	434.544	1.0	1481.1	5.1	394.515	2.5	55.819	0.2
Woody Wetlands	378.9	2.0	1717.494	4.6	1600.964	3.8	1067.5	3.7	94.292	0.6	951.149	2.7
Emergent Herbaceous Wetlands	28.2	0.1	94.292	0.3	130.096	0.3	134.8	0.5	14.233	0.1	134.989	0.4
Quarries/Strip Mines /Gravel Pits												
Total	**19251.6**	**100.0**	**37428.4**	**100.0**	**42357.4**	**100.0**	**29098.0**	**100.0**	**15826.8**	**100.0**	**35764.3**	**100.0**

Table B-1 Stones River Watershed – Subwatershed Land Use Distribution (Continued)

Land Use	Subwatershed											
	0301a		0301		0302		0303		0304		0305a	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Open Water	4.003	0.0	1033.4	2.7	4.7	0.0	14.5	0.0	25.8	0.1	4.2	0.6
Low Intensity Residential	349.592	3.9	1397.0	3.6	130.8	0.3	260.4	0.7	1666.6	4.4	251.5	35.5
High Intensity Residential	12.898	0.1	175.5	0.5	2.7	0.0	0.9	0.0	536.4	1.4	60.5	8.5
High Intensity Commercial /Industrial/Transportation	962.491	10.6	2005.3	5.2	80.5	0.2	91.8	0.2	558.4	1.5	2.0	0.3
Bare Rock/Sand/Clay												
Transitional	5.337	0.1	101.0	0.3	55.8	0.1			8.7	0.0	0.9	0.1
Deciduous Forest	1980.356	21.8	13197.3	34.2	14579.2	37.8	12596.0	34.0	14583.5	38.6	84.5	11.9
Evergreen Forest	581.320	6.4	3225.3	8.4	3956.0	10.3	4332.3	11.7	1233.4	3.3	59.4	8.4
Mixed Forest	2086.212	23.0	8360.4	21.7	8143.8	21.1	8530.8	23.0	6850.4	18.1	94.7	13.4
Pasture/Hay	1685.026	18.6	4009.4	10.4	7917.4	20.5	6192.6	16.7	8191.4	21.7	25.8	3.6
Row Crops	568.199	6.3	3032.0	7.9	3546.6	9.2	4838.5	13.1	3270.6	8.7	11.3	1.6
Other Grasses (Urban/Recreational)	833.729	9.2	2032.8	5.3	13.6	0.0	208.4	0.6	827.1	2.2	112.8	15.9
Woody Wetlands			20.7	0.1	140.8	0.4						
Emergent Herbaceous Wetlands			3.781	0.0							0.2	0.0
Quarries/Strip Mines /Gravel Pits												
Total	**9069.2**	**100.0**	**38593.9**	**100.0**	**38571.9**	**100.0**	**37066.1**	**100.0**	**37752.2**	**100.0**	**707.9**	**100.0**

Table B-1 Stones River Watershed – Subwatershed Land Use Distribution (Continued)

Land Use	Subwatershed									
	0305b		0305		0306		0307		0308	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Open Water			749.2	4.2	8.228	0.1	19.348	0.1	139.881	1.6
Low Intensity Residential	883.1	43.0	2156.5	12.0	248.406	1.9	3030.245	16.4	1506.004	17.3
High Intensity Residential	105.9	5.2	242.0	1.3	3.336	0.0	466.123	2.5	263.751	3.0
High Intensity Commercial /Industrial/Transportation	111.0	5.4	346.3	1.9	43.366	0.3	628.021	3.4	597.776	6.9
Bare Rock/Sand/Clay			0.2	0.0	0.890	0.0				
Transitional			7.6	0.0			10.230	0.1	34.025	0.4
Deciduous Forest	335.1	16.3	6036.2	33.5	4204.448	32.3	3788.584	20.5	1162.417	13.4
Evergreen Forest	80.5	3.9	1303.9	7.2	803.262	6.2	1168.421	6.3	783.914	9.0
Mixed Forest	299.1	14.6	3894.2	21.6	2328.391	17.9	4369.237	23.6	1853.595	21.3
Pasture/Hay	161.7	7.9	1750.4	9.7	3063.825	23.5	2586.360	14.0	1055.449	12.1
Row Crops	35.4	1.7	958.7	5.3	2044.656	15.7	1343.440	7.3	456.116	5.2
Other Grasses (Urban/Recreational)	40.5	2.0	313.1	1.7	287.769	2.2	1108.599	6.0	796.813	9.2
Woody Wetlands			220.2	1.2					33.358	0.4
Emergent Herbaceous Wetlands			30.022	0.2					9.563	0.1
Quarries/Strip Mines /Gravel Pits										
Total	**2052.2**	**100.0**	**18008.5**	**100.0**	**13036.6**	**100.0**	**18518.6**	**100.0**	**8692.7**	**100.0**

Table B-2 Level IV Ecoregion Reference Site Drainage Area Land Use Distribution

Land Use	Ecoregion Reference Site Drainage Area					
	ECO71H09		ECO71I03		ECO71I09	
	[acres]	[%]	[acres]	[%]	[acres]	[%]
Open Water	35.6	0.5	1.1	0.0	1.334	0.0
Low Intensity Residential			105.4	1.0	15.345	0.3
High Intensity Residential			6.2	0.1		
High Intensity Commercial /Industrial/Transportation	4.9	0.1	21.8	0.2	4.670	0.1
Bare Rock/Sand/Clay						
Transitional			6.9	0.1		
Deciduous Forest	6135.2	79.9	5572.8	52.7	1847.368	31.6
Evergreen Forest	233.1	3.0	854.0	8.1	321.349	5.5
Mixed Forest	697.2	9.1	2352.0	22.3	733.210	12.5
Pasture/Hay	452.6	5.9	1227.8	11.6	1590.289	27.2
Row Crops	122.1	1.6	375.2	3.5	1215.122	20.8
Other Grasses (Urban/Recreational)	0.2	0.0	45.4	0.4	3.558	0.1
Woody Wetlands					104.744	1.8
Emergent Herbaceous Wetlands					10.007	0.2
Quarries/Strip Mines /Gravel Pits						
Total	**7680.8**	**100.0**	**10568.5**	**100.0**	**5847.0**	**100.0**

APPENDIX C

Future Sediment TMDL Related Work in EPA Region IV

1.0 Existing Approach

TMDLs are established at levels necessary to attain and maintain the applicable narrative and numerical water quality standards. (See 40 CFR Section 130.7(c)(1).) Most State Water Quality Standards do not include a numerical water quality standard for aquatic life protection due to sediment. The narrative standard is to maintain the biological integrity of the waters of the State.

The TMDL sediment linkage is defined as the cause and effect relationship between the biological integrity, habitat alteration and identified sediment sources.

An analysis of watershed sediment loading can be conducted at various levels of complexity, ranging from a simplistic gross estimate to a dynamic model that captures the detailed runoff from the watershed to the receiving waterbody. The limited amount of data available for the most regional watersheds prevented EPA from presently using a detailed dynamic watershed runoff model. Instead, EPA determined the sediment contributions to the impaired segments based on an average annual load of sediment from the upstream watershed. Comparing this impaired segment's watershed sediment load to an average annual sediment load from a biologically and habitat unimpaired watershed provides the basis for estimating any needed load reductions for the impaired segments.

Watershed-scale loading of sediment in water and sediment are estimated using the Watershed Characterization System (WCS) Sediment Tool. The Arcview based WCS Sediment Tool loading function model, based on the Universal Soil Loss Equation, falls between that of a detailed simulation model, which attempts a mechanistic, time-dependent representation of pollutant load generation and transport, and simple export coefficient models, which do not represent temporal or spatial variability. The WCS Sediment Tool provides a mechanistic, simplified simulation of precipitation-driven runoff and sediment delivery, yet is intended to be applicable without calibration. Sediment load from runoff can be used to estimate pollutant delivery to the receiving waterbody from the watershed. This estimate is based on sediment concentrations in storm water and an estimate of the average annual sediment load ultimately delivered to the receiving waterbody by runoff and erosion.

2.0 Future Work

Region IV is working with the Region IV States, Federal and State agencies and a Technical Advisory Group, to develop better and more technically sound TMDLs procedures for sediment. This ongoing work includes:

2.1 Development of ecoregion sediment loading curves for unimpaired streams

Development of allowable instream ecoregion based sediment concentrations (for various flow conditions;

Given that a major source of sediment in the impaired unstable streams are from eroding channel banks, in-stream loadings will be simulated using the channel-evolution model; and

Develop a more effective and transferable monitoring strategy for evaluating sediment impacts in streams.

2.2 Development of Ecoregion Sediment Loading Curves

Development of ecoregion sediment loading curves in EPA Region IV will require the establishment of the link between geomorphic, sediment and biologic characteristics of streams in the Southeast USA. Ongoing work, with the USDA - Agricultural Research Service, National Sedimentation Laboratory entails the review of 282 stream sites in seven Level III ecoregions in EPA Region IV. The tasks involve evaluating those streams that have existing records of flow and sediment transport as measured by other Federal agencies (U.S. Geological Survey and U.S. Department of Agriculture). Field and analytic work will be performed on this existing data to determine "reference" sediment-transport conditions and the likelihood that streams are impacted and/or impaired due to excess sediment.

The output of this work will be the results of the analysis of "reference" sediment-transport conditions and describe a rapid approach that TMDL practitioners can use to determine impairment in streams due to excess sediment.

USDA - Agricultural Research Service, National Sedimentation Laboratory will:

- Conduct rapid geomorphic assessments (RGA's) and determine stage of channel evolution at the 282 sites in seven Level III ecoregions in EPA Region IV. From the total number of 282 sites, select a minimum of two "reference" and two impacted sites in each ecoregion to perform detailed analysis of flow, sediment transport and aquatic community structure. Sites will be used to evaluate links between stage of channel evolution, sediment indices, and biologic integrity. All sites will be located within the states of EPA Region IV.

- Acquire from USDA and USGS existing historical flow and sediment-transport data for all sites selected in Task A. Evaluate sediment yields at the effective discharge and determine from detailed gage records, the channel stability conditions at the time of historical sediment sampling. Characterize the sediment-transport rate at the effective discharge at all sites.

- Acquire 15-minute discharge data and combine with sediment-transport data to determine the frequency, and duration of sediment transport at the four selected sites in each ecoregion. Develop frequency and duration relations for "reference" and impacted sites and compare with available biologic data to assess potential threshold levels of concentration.

- Acquire all existing historical data that may be available on the stream/reach and collect information on bank-material shear strength, bed-material size and erodibility, channel cross-sections and profiles.

- Assemble all sediment-transport results into data tables and histograms for each ecoregion and compare these values with stage VI "reference conditions."

2.3 Development of allowable instream ecoregion based sediment concentrations

EPA Region IV is participating on Sediment TMDL Technical Advisory Group sponsored by the Georgia Nature Conservancy and the University of Georgia in Athens. A preliminary recommendation from the group is that a TMDL should be expressed as an annual sediment load and a daily sediment load and concentration. The daily load will depend on flow. If an average flow is used for daily load, then this would represent an upper limit for base-flow or chronic conditions. If sediment rating curve slope is available, a flow and sediment concentration for storm flow conditions can be used to calculate a daily-load upper limit that would represent acute condition. Work is ongoing to refine the proposal and to test the proposal in various ecoregions in Georgia.

2.4 Instream loadings simulated using the channel-evolution model

Given that a major source of sediment in the region's stream is from eroding channel banks, in-stream sediment loads will be simulated using other more complex, process-based models like GSTARS or CONCEPTS. These models require a more robust sediment and flow database in the individual watershed. One useful exercise will be to compare the model outputs from some of the preliminary Phase I TMDLs produced by Region IV via BASINS within the South Fork Broad Watershed (noted above) to other more complex, process-based models.

The EPA ORD work on the Broad River sediment data collection project will be useful to compare with other efforts within the Region to develop sediment TMDLs in the Piedmont, Coastal Plain and Interior Plateau. It will also be useful to compare the results of the ORD project to some of the work currently underway between EPA Region IV and the USDA-ARS, National Sedimentation Laboratory in Oxford, Mississippi.

2.5 Develop a more effective and transferable monitoring strategy for evaluating sediment impacts in streams

Monitoring is a key component of the TMDL process and should be particularly emphasized in the Phased TMDLs because of the uncertainty surrounding their establishment. At a minimum, the monitoring program will have to address the issues of discharge, sediment concentrations and loads, and very importantly, temporal resolution (daily, weekly, monthly, seasonally, yearly). The monitoring plan must incorporate the use of consistent and accurate sampling and analytical procedures.

In EPA Region IV's Science and Ecosystem Support Division (SESD) and Water Management Division (WMD) and EPA's Office of Research and Development (ORD) are working on the refinement and implementation of both habitat and biological assessments and sediment storm water monitoring strategies to gather the data and information necessary to develop the more complex TMDLs. These strategies include the measurement of sediment reaching the stream and instream sediment sources.

APPENDIX D

Tennessee Ecoregion Project

Tennessee Ecoregion Project

Note: Major portions of the following narrative, as well as the data in Table D-1, are excerpted or summarized from *Tennessee Ecoregion Project, 1994-1999* (TDEC, 2000a). Detailed information regarding the Tennessee Ecoregion Project can be found in this reference

Several narrative criteria, applicable to siltation/habitat alteration, are established in *State of Tennessee Water Quality Standards, Chapter 1200-4-3 General Water Quality Criteria, October 1999* (TDEC, 1999):

Applicable to all use classifications (Fish & Aquatic Life shown):

> Solids, Floating Materials, and Deposits – There shall be no distinctly visible solids, scum, foam, oily slick, or the formation of slimes, bottom deposits or sludge banks of such size and character that may be detrimental to fish and aquatic life.
>
> Other Pollutants – The waters shall not contain other pollutants that will be detrimental to fish or aquatic life.

Applicable to the Domestic Water Supply, Industrial Water Supply, Fish & Aquatic Life, and Recreation use classifications (Fish & Aquatic Life shown):

> Turbidity or Color – There shall be no turbidity or color in such amounts or of such character that will materially affect fish and aquatic life.

Applicable to the Fish & Aquatic Life use classification:

> Biological Integrity - The waters shall not be modified through the addition of pollutants or through physical alteration to the extent that the diversity and/or productivity of aquatic biota within the receiving waters are substantially decreased or adversely affected, except as allowed under 1200-4-3-.06. The condition of biological communities will be measured by use of metrices suggested in guidance such as Rapid Bioassessment Protocols for Use in Streams and Rivers (EPA/444/4-89-001) or other scientifically defensible methods. Effects to biological populations will be measured by comparisons to upstream conditions or to appropriately selected reference sites in the same ecoregion····.

Terms such as "detrimental to fish & aquatic life" and "materially affect fish & aquatic life" are not defined. A method was needed for comparing the existing conditions found in streams to the "natural" or reference condition in healthy, relatively unimpaired streams. The reference data needed to be from similar geographic areas to avoid inappropriate comparisons. It was important that the chosen approach provide scientific, practical, and defensible background data for the different parts of the state.

In the 1980's, EPA developed a geographical framework called the ecoregion approach. In this approach, the United States is delineated into 76 different Level III ecoregions based on a similarity in climate, landform, soil, natural vegetation, hydrology and other ecologically relevant variables. Tennessee is divided into eight of these regions. The ecoregion approach was

considered to be a reasonable way to determine regionally specific information for use in narrative criteria interpretation and application.

The Tennessee Ecoregion Project was initiated in 1993 and had several long-term objectives:

- Refine Level III ecoregions and delineate Level IV ecoregions (subregions) in Tennessee.
- Locate least impacted and minimally disturbed reference streams in each subregion.
- Determine baseline physical, chemical, and biological conditions in reference streams.
- Explore the use of reference data to assist in the interpretation of existing narrative criteria.

Delineation of Subregion Boundaries

The eight Level III ecoregions comprising Tennessee were too large and diverse to be useful for the establishment of water quality goals. It was therefore necessary to refine and subdivide the ecoregions into smaller, more homogeneous units. Beginning in 1993, the Division of Water Pollution Control (DWPC) arranged for James Omernik and Glenn Griffith of EPA's Corvalis Laboratory to subregionalize and update Tennessee's ecoregions (USEPA, 1997). Experts in many disciplines from 27 state and federal agencies, as well as universities and private organizations, were involved in this process. Maps containing information on bedrock and surface geology, soils, hydrology, physiography, topography, precipitation, land use and vegetation were reviewed. The result was the sub-delineation of Tennessee's eight (Level III) ecoregions into 25 (Level IV) ecological subregions.

Reference Stream Selection

Reference sites were chosen to represent the best attainable conditions for all streams with similar characteristics in each of the 25 subregions. An initial candidate list of 241 streams were evaluated as potential reference sites. A set of guidelines developed by Alabama and Mississippi (1994) were used as the basis for field reconnaissance. Potential sites were rated as to how well they met the following criteria:

- The entire watershed was contained within the subregion.
- The watershed was mostly or completely forested (if forest was the natural vegetation type) or has a typical land use for the subregion The watershed may be contained within a National Forest, State Refuge or other protected area.
- The geologic structure and soil pattern was typical of the region.
- The watershed did not contain a municipality, mining area, permitted discharger or any other obvious potential sources of pollutants, including non-regulated sources.
- The watershed was not heavily impacted by nonpoint source pollution.
- The stream flowed in its natural channel and had not been recently channelized. There were no flow or water level modification structures such as dams, irrigation canals or field drains.

- No power or pipelines crossed upstream of the site.
- The watershed contained few roads.

Initial site evaluations were conducted by experienced field biologists. Abbreviated screenings of the benthic community, focusing on clean water indicator species, were conducted at each potential site. Measurements of dissolved oxygen, pH, conductivity and water temperature were obtained, habitat assessments were conducted, and upstream watershed areas were investigated for potential impacts. During field reconnaissance, an additional 122 sites were added to the original candidate list and 139 sites were dropped due to observable impacts during the initial field reconnaissance, leaving 214 sites left for consideration.

The original goal was to select three final reference sites per subregion. This was determined as the minimal number necessary to generate a statistically valid database. Three streams could not always be located in smaller subregions. A total of 70 candidate reference sites were selected by August 1996 for intensive monitoring.

Intensive Monitoring of Reference Streams

From 1996 to 1999, the reference sites were monitored quarterly for chemicals and bacteria. Chemical sampling generally included the parameters historically sampled by the DWPC in its long-term ambient monitoring network. Macroinvertebrate samples and habitat assessments were conducted biannually in spring and fall. Since 1999, the reference streams have been monitored in accordance with the watershed cycle (each stream is visited every five years). Macroinvertebrate biometric and index scores for the ecoregion reference sites used as targets for the Stones River watershed sediment TMDL (ECO71H09 and ECO71I09) are summarized in Table D-1.

Table D-1 Biometric & Index Scores of Target Ecoregion Reference Sites

Reference Stream Identification Code *	Collection Method **	Sample Date	Total Number of Individuals	Taxa Richness	EPT Taxa Richness	EPT Abundance	% Chironomidae	North Carolina Biotic Index	% Clingers	% Tolerant Organisms	Tennessee Stream Condition Index
ECO71H09	SQKICK	4/30/97	183	21	10	63.9	14.2	3.68	33.9	0.6	32
ECO71H09	SQKICK	4/13/98	172	15	8	34.3	1.2	5.71	32.6	1.2	24
ECO71H09	SQKICK	6/11/99	199	28	10	45.2	20.6	5.22	37.2	14.4	29
ECO71H09	SQKICK	10/16/96	200	26	10	61.6	14.5	5.19	46.2	8.0	34
ECO71H09	SQKICK	8/19/97	210	33	15	54.3	12.4	5.11	40.5	6.2	34
ECO71H09	SQKICK	8/31/98	199	21	10	58.8	9.0	5.53	34.7	20.1	29
ECO71I03	SQKICK	4/23/97	200	28	9	56.0	19.5	4.19	37.5	18.1	32
ECO71I03	SQKICK	9/26/96	200	24	5	12.6	74.0	5.49	19.8	11.7	20
ECO71I03	SQKICK	10/1/97	174	27	3	5.7	43.7	6.05	24.7	23.8	20

* SQKICK = Semiquantitative Kick

APPENDIX E

NPDES Permit No. TNR10-0000
General NPDES Permit for Storm Water Discharges Associated With Construction Activity

NPDES Permit No. TNR10-0000
General NPDES Permit for Storm Water Discharges Associated With Construction Activity

Information regarding permitting requirements for construction storm water may be downloaded from the TDEC website at:

http://www.state.tn.us/environment/permits/conststrm.htm

NPDES Permit No. TNR10-0000, *General NPDES Permit for Storm Water Discharges Associated With Construction Activity* may also be downloaded from the TDEC website at:

http://www.state.tn.us/environment/permits/conststrmrul.pdf

The following is a summary of key provisions of NPDES Permit No. TNR10-0000, *General NPDES Permit for Storm Water Discharges Associated With Construction Activity*, that relate directly to implementation of Waste Load Allocations (WLAs) for sediment in impaired waterbodies in the Stones River watershed.

Tennessee General Permit No. TNR10-0000, *General NPDES Permit for Storm Water Discharges Associated With Construction Activity* became effective on July 1, 2000 and is required for construction sites that disturb five acres or more. The permit authorizes storm water discharges from construction activities, storm water discharges from construction support activities, and certain non-storm water discharges associated with construction activities. The permit also covers discharges from construction sites that disturb less than five acres if the Director of the Division of Water Pollution Control has determined that the discharge from the site contributes to, or is likely to contribute to, a violation of a State water quality standard, or is likely to be a significant contributor of pollutants to the waters of the State. Discharges that result in violations of State water quality standards are prohibited. Construction activities are required to be carried out in such a manner to prevent violations of State water quality standards.

The permitted construction activity is required to develop, maintain, and implement a site-specific Storm Water Pollution Prevention Plan (SWPPP) to minimize erosion of soil and the discharge of pollutants to waters of the State. At a minimum, the SWPPP must include:

- Description of the site, description of the intended sequence of major activities which disturb soil, estimates of total area of the site and area disturbed, any data describing the soil or the quality of any site discharge, site location, identification of storm water outfalls, identification of receiving waters.

- Description of appropriate control measures and the general timing during the construction process that measures will be implemented. (The permit describes in some detail minimum requirements for: 1) erosion and sediment controls designed to retain sediment on site; 2) stabilization practices for disturbed portions of the site; 3) structural practices to divert flows from exposed soils, store flows, or otherwise limit runoff and pollutant discharge resulting from a 2 year, 24 storm (approximately 3.5 inches/24 hours for the Stones River watershed); and 4) storm water management measures that will be installed after construction operations have been completed).

- Maintenance procedures to ensure that vegetation, erosion, and sediment control measures are kept in good and effective operating condition.

- A schedule of inspections by qualified personnel of disturbed areas of the construction site that are not fully stabilized, storage areas exposed to precipitation, structural control measures, outfall points, and locations where vehicles enter and exit the site. These inspections must be performed before certain anticipated storm events, within 24 hours after storm events of 0.5 inches , or greater, and at least once every two weeks (once per week for receiving streams listed on the 303(d) list for siltation). Based on the results of inspections, inadequate or damaged control measures must be modified or repaired as necessary before the next anticipated storm event (within seven days maximum). Also based on the results of inspections, pollution prevention measures must be revised as necessary within a specified time frame. Inspections must be documented.

- Sources of authorized non-storm water that are combined with storm water discharges associated with construction activity must be identified in the plan and appropriate pollution prevention measures for the non-storm water component of the discharge identified and implemented.

Additional requirements are specified for discharges into waters listed on the Tennessee 303(d) list for siltation. These additional requirements include:

- The SWPPP must be submitted to the local Environmental Assistance Center (EAC) prior to the start of construction.

- More frequent (weekly) inspections of erosion and sediment controls. Inspections and the condition of erosion and sediment controls must be certified to TDEC on a weekly basis.

- If TDEC learns that a discharge is causing a violation of water quality standards or contributing to the impairment of a 303(d) listed water, the discharger will be notified that the discharge is no longer eligible for coverage under the general permit and that additional discharges must be covered under an individual permit.

APPENDIX F

Public Notice Announcement

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF WATER POLLUTION CONTROL

PUBLIC NOTICE OF AVAILABILITY OF PROPOSED TOTAL MAXIMUM DAILY LOADS (TMDLs) FOR SILTATION & HABITAT ALTERATION IN THE STONES RIVER WATERSHED (HUC 05130203), TENNESSEE

Announcement is hereby given of the availability of Tennessee's proposed Total Maximum Daily Loads (TMDLs) for siltation and habitat alteration in the Stones River watershed located in middle Tennessee. Section 303(d) of the Clean Water Act requires states to develop TMDLs for waters on their impaired waters list. TMDLs must determine the allowable pollutant load that the water can assimilate, allocate that load among the various point and nonpoint sources, include a margin of safety, and address seasonality.

A number of waterbodies in the Stones River watershed are listed on Tennessee's final 1998 303(d) list as not supporting designated use classifications due, in part, to siltation and habitat alteration associated with land development, riparian loss, urban runoff, and agricultural sources. The TMDLs utilize Tennessee's general water quality criteria, ecoregion reference site data, land use data, digital elevation data, a sediment loading and delivery model, and an appropriate Margin of Safety (MOS) to establish allowable loadings of sediment which will result in reduced in-stream concentrations and the attainment of water quality standards. The TMDLs require reductions in sediment loading of approximately 10% to 62% in the listed waterbodies.

The proposed siltation/habitat alteration TMDLs may be downloaded from the Department of Environment and Conservation website:

http://www.state.tn.us/environment/wpc/tmdl.htm

Technical questions regarding this TMDL should be directed to the following members of the Division of Water Pollution Control staff:

Bruce R. Evans, P.E., Watershed Management Section
Telephone: 615-532-0668

Sherry H. Wang, Ph.D., Watershed Management Section
Telephone: 615-532-0656

Persons wishing to comment on the TMDLs are invited to submit their comments in writing no later than May 13, 2002 to:

Division of Water Pollution Control
Watershed Management Section
6th Floor, L & C Annex
401 Church Street
Nashville, TN 37243-1534

All comments received prior to that date will be considered when revising the TMDL for final submittal to the U.S. Environmental Protection Agency.

The TMDL and supporting information are on file at the Division of Water Pollution Control, 6th Floor, L & C Annex, 401 Church Street, Nashville, Tennessee. They may be inspected during normal office hours. Copies of the information on file are available on request.

Note: The comment period was extended 30 days to June 12, 2002.

APPENDIX G

Public Comments Received

Letter from the City of Murfreesboro

June 12, 2002

Mr. Bruce Evans, P.E.
Division of Water Pollution Control
Watershed Management Section
6th Floor, L & C Annex
401 Church Street
Nashville, TN 37243-1534

RE: Comments on the Proposed Total Maximum Daily Load for Siltation and Habitat Alteration – Stones River Watershed

Dear Mr. Evans:

The City of Murfreesboro has reviewed the proposed Total Maximum Daily Load (TMDL) for Siltation and Habitat Alteration for the Stones River Watershed. We and other interested stakeholders have already made some comments on this proposal and anticipate that the Division of Water Pollution Control will consider those comments previously submitted. In addition to comments and concerns expressed in our May 13, 2002 correspondence, we offer these additional comments and concerns on the proposed TMDL. Our comments are divided into the general areas of Overall, Modeling/Implementation, NPDES Phase II Storm water, and Wastewater NPDES Permits.

Overall

1. The Division is imposing requirements based on the 1998 303(d) list of impaired streams. In doing so, the list should have been promulgated as a rule in accordance with the Uniform Administrative Procedures Act. Also the Division is imposing requirements for "siltation/habitat alteration" which are not formal water quality criteria pursuant to required rule making procedures.
2. It appears that the implementation of the TMDL through the NPDES regulated community requires implementation activities only in impaired stream segments and their watersheds. Please confirm and clarify this requirement.

Modeling/Implementation

1. The cause of impairment in the targeted streams is listed as siltation/habitat alteration without information on the specific mechanisms of sedimentation and habitat alteration. However, the TMDL model appears to assume that siltation and habitat alteration result from specific mechanisms as described by the Universal Soil Loss Equation and does not consider other mechanisms. Without specific information on the mechanisms of impairment, can an appropriate implementation strategy be designed? Can an appropriate evaluation of the implementation be developed and conducted without considering the mechanisms?
2. TMDLs are proposed as numeric values while the Division has placed emphasis on BMPs and percent reductions as the implementation strategy and goals for correcting the listed impairment. An appropriate level of concern exists that these numeric values derived from the model may become "regulatory limits" or "discharge limits" in the future. Would a more appropriate approach be listing the impaired streams and targeting BMP implementation for sediment reductions as the TMDL?
3. The information presented in Table 9 does not appear to correspond to the text reference to Table 9 in sections 7.1.2 and 7.2.
4. There are 14 subwatersheds with 303(d) listed waterbodies in the Stones River Basin. The estimated average annual sediment loadings in the impacted segments averaged about 576 lbs/ac/yr with a range from 274 to 1,200 lbs/ac/yr. TDEC reported 8 subwatersheds without 303(d) listed waterbodies in the Stones River Basin. This group does not include all of the subwatersheds in the Stones River Basin that are not impaired; rather these are the unimpaired subwatersheds with data available from which to calculate an average annual sediment loading. For these unimpaired subwatersheds, the estimated average annual sediment loading was 518 lbs/ac/yr with a range of 327 to 862 lbs/ac/yr. Without a specific statistical analysis, the similarity of the ranges and averages of the impaired data set and the unimpaired data set suggest no significant difference between the two data sets.
5. The reference basins used to establish a baseload of sediment delivered to the reference two ecoregions segments, both in the Stones River watershed, ranged from 220 to 660 lbs/ac/yr. These loadings do not represent a total maximum daily load that will not impair the stream; rather they represent modeling output of what two subwatersheds that are not impaired are presently calculated to deliver to their corresponding stream segments.
6. The Stones River Basin results can be compared with similar calculated values for the Harpeth River Basin results. For the Harpeth River, the same Stones River ecoregions were used to establish the TMDLs for the impacted segments. Estimated sediment loads in the 303(d) impacted Harpeth River Basin stream segments averaged 1,137 lbs/ac/yr with a range from 351 to 2,012 lbs/ac/yr. There were 9 subwatersheds without 303(d) listed waterbodies with data sufficient to calculate an annual sediment loading. These watersheds had an average estimated sediment loading of 929 lbs/ac/yr with a range of 530 to 1,566 lbs/ac/yr. These results, although numerically higher, are similar to the small differences seen between the impaired and unimpaired subwatersheds in the Stones River Basin.
7. The recommended sediment delivery TMDLs for the Stones River 303(d) subwatersheds were presented as either 220 lbs/ac/yr or 660 lbs/ac/yr. These numbers represent a soil loss of about 0.0008 to 0.0023 in of soil loss per year from each acre in the subwatershed basin. As a comparison, the soil loss from the unimpaired subwatersheds ranged from 0.0011 to 0.0030 in of soil loss per year from each acre in the subwatershed basin. These are only measurable in geologic time (1,000 years or more).
8. There were no sediment delivery rates collected from any of the basins from which to

calculate the actual sediment delivery versus the calculated delivery using accepted soil loss equations.

9. The sediment transport in the streams themselves has not been modeled. This means, no attempt has been made to actually determine where the sediment actually comes from that is deposited in the impaired sections of streams in the Basin.
10. The sediment delivery rates of 220 and 660 lbs/ac/yr are relative numbers that do not represent a maximum load that the stream segments can receive and still be unimpaired.
11. It may be more appropriate to use the sediment delivery rates calculated for the unimpaired subwatersheds within the Stones River Basin (versus the ecoregion methodology) as a goal for the TMDLs and to measure progress towards sediment reduction due to BMPs implementation in the 303(d) impaired subwatersheds.
12. The selected ecoregions may or may not be indicative of what sediment loading results in stream impaired subwatersheds. The ecoregions are in the headwaters of the Stones River Basin where sediment transport and hydrologic/land use patterns have not been as greatly impacted as other areas of the Basin. Again, the sediment delivery rates are not truly total maximum daily loads that the stream can handle without causing impairment, which is the traditional method of calculating a maximum daily load. In this case, the Division does not have a readily identifiable physical or chemical water quality parameter from which to model sediment delivery rates that can cause impairment.
13. Sediment impairment in a stream is caused by sediment deposit zones in the stream itself (e.g., pools). Sediment delivery from the land is only one part of this equation with the flow volume and the stream bathymetry and morphology being as significant impacts to this cause and effect analysis. We agree with the Division's analysis that the sediment delivery rates of 220 and 660 lbs/ac/yr are relative numbers and should not be used as absolute numbers for determining compliance with permits.
14. Sediment transport has not been modeled in the Stones River and it is unclear if the listed 303(d) subwatersheds are impaired due to sediment delivery in the subwatershed land area or from transport from an upstream subwatershed.
15. As the Stones River Basin undergoes further development, the sediment analysis will be required to be updated. The change in flow due to further development will have an impact on both the morphology of the streams and subsequent additional erosion of the streambed and banks to meet the increased flows. The TMDL loadings presented must be considered dynamic in nature and future changes in these loadings are expected due to changes in basin land use and development.
16. Is it logical to think that all subwatersheds/stream segments within any river basin will not be impaired by sediments or habitat alterations, even under natural conditions? Flood events alone can alter the basic stream channels, habitat, and sediment scouring and deposition characteristics of a stream. The goals of the sediment TMDLs should be geared towards decreasing the impact of controllable activities, such as, land clearing and development, that can effectively deliver large sediment loadings, if not controlled, over those loadings that would normally occur. Implementation of structural and non-structural BMPs should effectively decrease sediment delivery to the steams. There is no current readily obtainable method to measure the complex measurement of stream sedimentation and its either negative or positive effects. Sediment delivery is only one aspect of this equation and decreasing sediment delivery rates alone may not ensure that this type of impairment will not continue.
17. We would strongly urge the Division and the stakeholders to make this initial TMDL analysis as a starting point to addressing sediment and habitat alterations in the Stones River Basin. We suggest that the sediment loadings of 220 to 660 lbs/ac/yr not be published as TMDLs,

but rather as loadings that may not cause impairment. TDEC and the stakeholders should form a partnership to further refine BMPs and also the reasons behind why certain subwatersheds become impaired or undergo habitat alteration. This should be a dynamic process where goals are set and further refinement of the cause and effect of both sediment delivery and watershed changes on stream health be assessed.

18. Based on the sediment delivery rates calculated for the unimpaired subwatersheds in the Stones River watershed, it appears that there is additional capacity in most stream segments to handle both current point source loadings of suspended solids as well as foreseeable growth. The addition of storm water discharge points also appears to be obtainable, especially if effective BMPs are implemented in the jurisdictional area for the permitted MS4 entities.

NPDES Phase II Storm water

Based on the recent Phase II Storm water Program Workshop sponsored by the EPA, they are strongly encouraging the use of general permits for the Phase II NPDES program. After review of the Draft Small MS4 General Permit, the following excerpted sections (listed as a, b, and c) of the draft permit appear to obligate future Phase II Storm water Permits to the TMDLs and consistency of the NPDES Permit with TMDLs established within their watershed.

a. A portion of Section 1.3 states that the Phase II permit does not authorize: "*1.3.9 Discharges of any pollutant into any water for which a Total Maximum Daily Load (TMDL) has been either established or approved by the EPA unless your discharge is consistent with that TMDL. This eligibility condition applies at the time you submit a Notice of Intent for coverage. If conditions change after you have permit coverage, you may remain covered by the permit provided you comply with the applicable requirements of Part 3.* ***You must incorporate any limitations, conditions and requirements applicable to your discharges, including monitoring frequency and reporting required, into your Storm Water Management Program in order to be eligible for permit coverage.*** *For discharges not eligible for coverage under this permit, you must apply for and receive an individual or other applicable general NPDES permit prior to discharging."*

b. A portion of section 5.1 states: *"5.1.1 You must evaluate program compliance, the appropriateness of identified best management practices, and progress toward achieving identified measurable goals.* ***If you discharge to a water for which a TMDL has been approved, you will have additional monitoring requirements under Part 3.1.3.6."***

c. Section 3.1.3 is as follows:

"3.1.3 *Consistency with Total Maximum Daily Load (TMDL) Allocations*. If a TMDL has been approved for any waterbody into which you discharge, you must:

3.1.3.1 Determine whether the approved TMDL is for a pollutant likely to be found in storm water discharges from your MS4.

3.1.3.2 Determine whether the TMDL includes a pollutant wasteload allocation (WLA) or other performance requirements specifically for storm water discharge from your MS4.

3.1.3.3 Determine whether the TMDL address a flow regime likely to occur during periods of storm water discharge.

3.1.3.4 After the determinations above have been made and if it is found that your MS4 must implement specific WLA provisions of the TMDL, assess whether the WLAs are being met through implementation of existing storm water control measures or if additional control measures are necessary.

3.1.3.5 Document all control measures currently being implemented or planned to be implemented. Also include a schedule of implementation for all planned controls. Document the calculations or other evidence that shows that the WLA will be met.

3.1.3.6 Describe a monitoring program to determine whether the storm water controls are adequate to meet the WLA.

3.1.3.7 If the evaluation shows that additional or modified controls are necessary, describe the type and schedule for the control additions/revisions. Continue Parts 3.1.3.4-7 until two continuous monitoring cycles show that the WLAs are being met or that WQ standards are being met."

1. The Division has stated that the TMDL for sediment was run based on **relative scenarios** to establish percent reductions recommended for the impaired waterbodies and that the numerical limits published in the TMDL are neither enforceable nor measurable. Based on the NPDES Phase II draft permit's attention to TMDLs as referenced above and the Divisions interpretation of the proposed TMDL for sediment as relative goals, please provide information on the Division's plan on integrating the above described draft small MS4 general permit sections with the TMDL for Siltation and Habitat Alteration in the Stones River Watershed.
2. Can the TMDL set for siltation and habitat alteration be based on implementation of BMPs as they pertain to erosion and sediment control for construction and post-construction activities?
3. Should the Division consider dropping the numerical limits (in favor of non-numeric or narrative goals) published in the TMDL for Siltation and Habitat Alteration in the Stones River Watershed as it has vast impacts with regard to the draft small MS4 general permit? Waste Load Allocation (WLA) and monitoring will be required for compliance as the draft general permit currently reads. At the minimum, should the Division publish the fact that the model is using **relative comparisons** to establish the percent reductions recommended?
4. Should the Division provide a mechanism for the City of Murfreesboro or other stakeholder to establish independent data that can be used to better define the actual in-stream impacts of siltation and habitat alteration in the Stones River Watershed?

Wastewater NPDES Permits

1. In the Executive Summary (page vi, paragraph three), the Division states that existing NPDES permit holders will retain "their current discharge levels of TSS." The study is silent on future WLAs for permit holders. If any of the NPDES permit holders for wastewater are required to increase their discharge to meet service area demands, will additional TSS levels be granted? If so, on what basis?
2. On page 27 of 29, the report discusses non-point source implementation and indicates that efforts should be made to "reduce activities within riparian areas" as a minimum requirement. How will this requirement interface with wastewater system needs to

extend or replace existing gravity sewers since the most economical way to sewer an area is by gravity and gravity sewers tend to follow streams?

Again, thanks for your recent accommodations regarding the staff conference and extending the public comment period. If any of the City of Murfreesboro staff or consulting team can provide any follow up or clarification to our comments, please do not hesitate to contact me. We would appreciate a final copy of the proposed TMDL package including the Division's response to comments that will be forwarded to EPA for their consideration.

Sincerely,

City of Murfreesboro

Kenneth N. Hays, PE
City Engineer

Copy: Mr. Roger Haley – City of Murfreesboro
Ms. Susan McGannon – City of Murfreesboro
Mr. Rob Lyons – City of Murfreesboro
Mr. Joe Kirchner – Murfreesboro Water and Sewer
Mr. Bobby Worthington – Murfreesboro Water and Sewer
Mr. Sam Huddleston –City of Murfreesboro
Mr. Darren Gore – The Wiser Company
Mr. Mark Lee – SEC
Mr. Bill Huddleston – Huddleston-Steele
Mr. Kenny Diehl – SSR
Mr. Michael Corn – AquAeTer

CITY of MURFREESBORO
Planning and Engineering Department
111 WEST VINE STREET
POST OFFICE BOX 1139
MURFREESBORO, TN 37133-1139
AREA CODE 615 893-6441
FAX 615 849-2606
WWW.CI.MURFREESBORO.TN.US

May 13, 2002

Mr. Bruce Evans, P.E.
Division of Water Pollution Control
Watershed Management Section
6th Floor, L & C Annex
401 Church Street
Nashville, TN 37243-1534

RE: Proposed Total Maximum Daily Load for Sediment and Habitat Alteration Stones River Watershed

Dear Mr. Evans:

We are in receipt of the proposed TMDL referenced above and, as discussed with you by phone with Mr. Sam Huddleston of my office, we have some comments and concerns about the proposal. Our comments and concerns fall into two categories. First, we are concerned about the potential limited awareness and distribution of the proposed TMDL along with limited time for responses. Second, we have comments and concerns about some of the technical aspects of the TMDL.

Regarding the limited awareness and distribution, we have checked with City of Murfreesboro staff as well as other local government and engineering community representatives and found limited to nonexistent awareness of the current proposal. We are sure that you have made attempts to solicit public input as is evidenced by our receipt of the proposal; however, we believe that some stakeholders will miss a critical opportunity to participate in the TMDL process including the City of Murfreesboro with the currently scheduled close of the public comment period. During your phone conversation with Mr. Huddleston, you seemed willing to extend the public comment period to May 28, 2002. We appreciate that gesture but respectfully request that the period be extended to June 12, 2002 (30 days). We have identified several potential stakeholders that we believe should be involved and are willing to assist your Department in soliciting their input.

So that we may gain additional understanding and more fully evaluate our concerns, we also request that your Department schedule and conduct a public hearing as well. As an alternate, we request that a staff conference be conducted with selected representatives of the stakeholders group. We would be willing to host either the public hearing or staff conference at City of Murfreesboro facilities. Please advise us of the status of these

requests at your earliest opportunity so that we may schedule our efforts to comment on the proposal.

The City of Murfreesboro appears to be impacted in at least four areas by the TMDL proposal. First, City construction projects will be impacted by the requirements proposed for NPDES permits for construction activities. Second, operation and maintenance activities for the City's storm sewer system will be impacted by requirements proposed for NPDES MS4 permits for Phase II cities. Third, City review and oversight of subdivision and site development will be impacted by both MS4 and construction permits. Fourth, the Sinking Creek Wastewater Treatment Plant will be required to meet existing NPDES wastewater discharge permit conditions.

During our review of the proposal, we noted several areas of concern within the proposal. These are briefly summarized in the following bulleted items.

- The TMDLs were established equivalent to and based on conditions observed in relatively undeveloped watersheds meaning that implementation methods must be more protective than natural processes in relatively undisturbed watersheds to meet the intended targets.
- The TMDLs established for streams in the Murfreesboro area may not be achievable with current technology leading to additional regulation and enforcement in the future.
- The TMDLs were not based on levels of an observed impact but on observed levels of non-impact. Some adjustment of the TMDL may be appropriate based on this consideration.
- The economic impact to the City may be substantial due to increased construction costs and increased administrative and operation costs.
- The economic impact to the community may be substantial due to a potential competitive advantage granted to other communities by the implementation of the TMDL.
- The implementation requirements and costs for operation and maintenance of the City's storm sewer system cannot be accurately predicted based on the details in this proposal and is tied to the anticipated Phase II NPDES permit.
- The implementation of the TMDL appears to rely on the regulation of and implementation through local government activities with a limited level of State and EPA action.
- The implementation of the TMDL appears to rely on restrictions to activities regulated by the NPDES process (point sources) while lacking equivalent regulatory mechanisms for non-NPDES activities (nonpoint sources). This lack of regulatory mechanism may unduly shift the burden of TMDL compliance to the NPDES regulated community.
- Failure to meet the goals within the watershed will likely result in additional implementation requirements and potential enforcement during future reviews of the TMDL program.

We plan to expand on these observations and to provide additional comments on the proposal based on your Department's response to the request for additional public comment period and/or public hearing or staff conference. Thank you for your consideration of our comments and concerns in the matter. Please do not hesitate to contact Mr. Sam Huddleston or me regarding this matter.

Sincerely,

City of Murfreesboro Engineering Department

Ken Hays

Kenneth N. Hays, PE
City Engineer

c: Mayor Tommy Bragg – City of Murfreesboro
Mr. Roger Haley – City of Murfreesboro
Mr. Joe Kirchner – City of Murfreesboro Water and Sewer Department
Ms. Susan McGannon - City of Murfreesboro Legal Department
Mr. Paul Estill Davis – Director Division of Water Pollution Control
Ms. Sherry Wang – Watershed Management Section

Murfreesboro Water and Sewer Department

POST OFFICE BOX 1477
MURFREESBORO, TENNESSEE 37133-1477
TELEPHONE 615/890-0862
FAX 615/896-4259

May 13, 2002

Sherry H. Wang, Ph.D., Manager
Watershed Management Section
Department of Environment & Conservation
Division of Water Pollution Control
7th Floor L & C Annex
401 Church Street
Nashville, TN 37243-1534

RE: Draft of Proposed TMDL Load for Sediment
Stones River Watershed, Tennessee

Dear Ms. Wang:

This is in response to your request for comments dated April 8, 2002 on the subject draft report. The Murfreesboro Water and Sewer Department was not contacted directly and requested to comment on the subject report. As a permit holder in the Stones River watershed we are interested in all aspects of the TMDL study. Please add me to your list of contacts for future request for comments or distribution of information.

By no fault on your part, I have had only two days to review this document. I ask an extension of two weeks for review by our consultants and staff. I offer the following comments at this time:

1. It does not appear the report gives due consideration to seasonal loadings. Are seasonal loadings possible for silt and erosion?

2. The document calls for best management practices (BMT) and encourages public watchdog activities. The elaborate and impossible sampling regimes required to monitor BMT efficiencies are conspicuous by their absence. Who will pay for the testing, monitoring and reporting? What is the rotation of watershed management referred to in Section 8.3?

3. Upstream of Murfreesboro the watersheds are unregulated under Phase 2. It will be difficult for Murfreesboro to comply with the standards in the report given the upstream conditions. Intergovernmental cooperation, or the lack thereof, from agencies in unregulated upper reaches of the watershed may impede attaining the desired reductions in Murfreesboro.

4. The basins in the Murfreesboro city limits area are held to the 220 lbs. per acre per year of Stewarts Creek. Could the safety factor considered be 300 lbs. per acre pear year of the West Fork in lieu of the 220 lbs. per acre per year of Stewarts Creek?

5. The stakeholders should include homebuilders, developers and contractors since they are the main contingent responsible for implementing erosion control for projects that disturb larger areas. I recommend contacting the Rutherford County Homebuilders Association and the Rutherford County Chamber of Commerce at a minimum.

To give all stakeholders opportunity to review and comment on the report I suggest a 30-day extension of the comment period and/or a public hearing in Murfreesboro. I would be happy to help you facilitate a meeting in Murfreesboro by offering our facilities for the meeting.

Respectfully submitted,

Joe Kirchner
Director

JK:mp

SSR Smith Seckman Reid, Inc.

2995 Sidco Drive
Nashville, TN 37204
(615) 383-1113
FAX (615) 386-8469
www.ssr-inc.com

May 13, 2002

Nashville
Houston
Deerfield Beach
Sarasota
Memphis
Pine Bluff
Phoenix
New Orleans

Division of Water Pollution Control
Watershed Management Division
6th Floor, L & C Annex
401 Church Street
Nashville, TN 37243-1534

RE: **Draft TMDL Study for**
Siltation & Habitat Alteration in the
Stones River Watershed (HUC 05130203)

Dear Watershed Management:

I am writing in regard to the referenced study. I have reviewed the draft via download from your web site. My comments and questions to date are as follows:

1. The review period for the draft appears to be inadequate. This study is one of the first of its kind in the State (and certainly the first for this watershed). The 35 day review period will not allow the effected cities and counties adequate time to digest the impact of the proposed TMDL's for siltation. This is a complex issue. Therefore, I respectfully request that the review period be extended another 60 days.
2. In the Executive Summary (page vi, paragraph three) you indicate that existing NPDES permit holders will retain "their current discharge levels of TSS." The study is silent on future WLA's for permit holders. If any of the NPDES permit holders are required to increase their discharge to meet service area demands, will additional TSS levels be granted? If so, on what basis?
3. The State is conducting a TMDL study for mass/organic loading on this watershed in parallel to the siltation study. How will the two be interfaced?
4. If the TSS WLA for an NPDES permit holder is unchanged by the siltation study, does this imply that the mass/organic study will abide by this limit without regard to the results of that study?
5. In the Executive Summary (page vii, paragraph 2) you indicate that this TMDL study was modeled on another Level IV ecoregion watershed. What is the name and location of that watershed? Are copies of the siltation TMDL study for that watershed available for review?

6. Since Lavergne, Mount Juliet, Murfreesboro, Smyrna, Rutherford County, and Wilson County will not be covered under the EPA Phase II storm water regulations until 2003 and their jurisdiction may overlap several subwatersheds, how will their individual permit limits be determined?
7. On page 25of 29 in paragraph two you list special requirements. How are the effected government agencies going to pay for these mandates?
8. On page 26 of 29 in paragraph three you mention stakeholder groups for the *Stones River Watershed Management Plan.* Why are the local cities and county governmental agencies absent from this list?
9. On page 27 of 29 you discuss non-point source implementation you say that efforts should be made to "reduce activities within riparian areas" as a minimum requirement. How will this requirement interface with wastewater system needs to extend or replace existing sewers since the most economical way to sewer an area is by gravity and gravity sewers tend to follow streams?

These comments and questions are not meant to be comprehensive due to the short review period. Nonetheless your attention to these matters and an extension of the review period would be appreciated.

Sincerely,

SMITH SECKMAN REID, INC.

Kenneth Diehl

Kenneth G. Diehl, Jr., P.E.
Senior Vice President

cc: Joe Kirchner, Gene Casto, Bobby Worthington – MWSD
Roger Haley, Rob Lyons – City of Murfreesboro

M:\2002\Misc\stonesrivertmdlcomments.doc

Jun-18-02 05:08pm From-EPA Standards, Monitoring & TMDL Branch +404 5629224 T-365 P.002/003 F-738

United States Department of the Interior

FISH AND WILDLIFE SERVICE
446 Neal Street
Cookeville, TN 38501

May 14, 2002

Ms. Stephanie Fulton
TN State TMDL Coordinator
U.S. Environmental Protection Agency
Atlanta Federal Center
61 Forsyth Street
Atlanta, Georgia 30303-8960

Dear Ms. Fulton:

Thank you for your letter and enclosures of May 22, 2002, regarding the establishment and approval of Total Maximum Daily Loads (TMDL) in the State of Tennessee. A siltation and habitat alteration TMDL for various waterbodies in the Stones River watershed was submitted for review and a determination of compliance with Section 7 of the Endangered Species Act. U.S. Fish and Wildlife Service (Service) personnel have reviewed the information submitted and offer the following comments for consideration.

Historic records exist for the Federally endangered tan riffleshell (*Epioblasma florentina walkeri*), yellow-blossom (*Epioblasma florentina florentina*), and the little-wing pearly mussel (*Pegias fabula*) within the Stones River watershed. These species have likely been extirpated from the watershed due to habitat alterations and water quality degradation. Current endangered species collection records available to the Service do not indicate that federally listed or proposed endangered or threatened aquatic species occur within the Stones River watershed. We note, however, that collection records available to the Service may not be all-inclusive. Our data base is a compilation of collection records made available by various individuals and resource agencies. This information is seldom based on comprehensive surveys of all potential habitat and thus does not necessarily provide conclusive evidence that protected species are present or absent at a specific locality.

Endangered species collection records available to the Service indicate that the Federally endangered Braun's rockcress (*Arabis perstellata*), leafy prairie clover (*Dalea foliosa*), Tennessee coneflower (*Echinacea tennesseensis*), and Pyne's ground plum (*Astragalus bibullatus*) occur within the Stones River watershed. Short's bladderpod (*Lesquerella globosa*), a Federal Candidate species, also occurs in the watershed. While not considered obligate aquatic plant species, these plants occur in areas potentially subject to development, resource extraction, and other disturbances that are regulated through National Pollutant Discharge Elimination System (NPDES) permitting programs. Although these species would not be directly affected by EPA approval of this specific TMDL, they

could be indirectly affected by the implementation of the TMDL through the issuance of individual NPDES permits and stormwater general permits. The only regulatory oversight associated with non-coal resource extraction and non-agricultural related surface disturbance activities in the watershed is the review and issuance of individual NPDES and stormwater general permits by the State of Tennessee. We remain concerned that, currently, there are no implemented or enforceable protections for these species through existing State permitting programs. Forestry and agricultural activities are generally exempted from regulatory oversight by the State.

The narrative for the siltation and habitat alteration TMDL states that voluntary, incentive-based mechanisms will be used to implement nonpoint source management measures in order to assure that measurable reductions in pollutant loadings can be achieved for the targeted impaired waterbody. It is also stated that local, citizen-led and implemented management measures offer the most efficient and comprehensive avenue for reduction of loading rates from nonpoint sources. We agree that this type of approach has been partially successful in agricultural areas through the implementation of various incentive-based programs administered by Federal and State agencies. This TMDL, however, does not address regulatory measures such as Tennessee's stormwater and aquatic resource alteration permitting programs. Effective enforcement of these programs is vital in controlling erosion and aquatic habitat loss, especially in urban areas experiencing rapid development such as Rutherford, Davidson, and Wilson Counties, Tennessee. We are concerned that a comprehensive review of these program areas, including current inspection and enforcement statistics, was not included in the narrative for this siltation and habitat alteration TMDL and, ultimately, raises questions regarding the eventual effectiveness of its implementation in the Stones River watershed.

These constitute the comments of the U.S. Department of the Interior in accordance with provisions of the Endangered Species Act (87 Stat. 884, as amended: 16 U.S.C. 1531 et seq.) and the Memorandum of Agreement between the U.S. Fish and Wildlife Service, Environmental Protection Agency, and National Marine Fisheries Service. Thank you for the opportunity to comment on this action. If you have any questions, please contact Steve Alexander of my staff at 931/528-6481 (ext. 210) or via e-mail at *steven_alexander@fws.gov*.

Sincerely,

Lee A. Barclay, Ph.D.
Field Supervisor

xc: Paul Davis, TDEC, Nashville
Dave McKinney, TWRA, Nashville

Other Letters Received During the Public Comment Period

Letters were also received from the Town of Smyrna, Huddleston-Steele Engineering, Inc., Wiser company, Site Engineering Consultants, and the Rutherford County Regional Planning Commission requesting an extension of the public comment period. The public comment period was extended 30 days until June 12, 2002.

APPENDIX H

Response to Public Comments

A. Response to City of Murfreesboro Comments (June 12, 2002)

Overall

1. **Comment:**
The Division is imposing requirements based on the 1998 303(d) list of impaired streams. In doing so, the list should have been promulgated as a rule in accordance with the Uniform Administrative Procedures Act. Also the Division is imposing requirements for "siltation/habitat alteration" which are not formal water quality criteria pursuant to required rule making procedures.

Response:
The federal Clean Water Act (CWA) requires States to identify those waters within its boundaries for which required technology based effluent limitations are not stringent enough to implement any water quality standard applicable to such waters. The 303(d) list is prepared by the State to comply with this requirement. The 303(d) list is not a State regulation and, therefore, the rulemaking provisions of the Uniform Administrative Procedures Act are not applicable. The 1998 303(d) list did, however, undergo an extensive public participation process that is documented in the document.

2. **Comment:**
It appears that the implementation of the TMDL through the NPDES regulated community requires implementation activities only in impaired stream segments and their watersheds. Please confirm and clarify this requirement.

Response:
TMDLs, WLAs, & LAs are provided for 12-digit HUCs that contain one or more waterbodies identified on the 1998 303(d) list as impaired due to siltation/habitat alteration. As stated in Section 8 of the TMDL document, WLAs for regulated point sources discharging to impaired subwatersheds will be implemented through NPDES permits. Activities for regulated point sources that do not discharge into impaired watersheds may be specified in an NPDES permit, but are not required by these TMDLs.

Modeling/Implementation

1. **Comment:**
The cause of impairment in the targeted streams is listed as siltation/habitat alteration without information on the specific mechanisms of sedimentation and habitat alteration. However, the TMDL model appears to assume that siltation and habitat alteration result from specific mechanisms as described by the Universal Soil Loss Equation and does not consider other mechanisms. Without specific information on the mechanisms of impairment, can an appropriate implementation strategy be designed? Can an appropriate evaluation of the implementation be developed and conducted without considering the mechanisms?

Response:
Sediment analysis for watersheds can be conducted using methods ranging from simple, gross estimates to complex dynamic loading and receiving water models. The choice of methodology is dependent on a number of factors that include: watershed size, type of impairment, type and quantity of data available, resources available, time, and cost. In

consideration of these factors, the Sediment Tool/reference watershed methodology was selected as the most appropriate for first phase sediment TMDLs in the Stones River watershed. The TMDL document has been clarified to express TMDLs, WLAs, and LAs as required reductions in average annual sediment loading. The implementation recommendations give latitude to MS4 permittees to implement BMPs that are appropriate to address erosion and sediment loading mechanisms in specific areas. The effectiveness of BMPs can be evaluated by monitoring the biological health and condition of the relevant waterbodies

2. **Comment:**
TMDLs are proposed as numeric values while the Division has placed emphasis on BMPs and percent reductions as the implementation strategy and goals for correcting the listed impairment. An appropriate level of concern exists that these numeric values derived from the model may become "regulatory limits" or "discharge limits" in the future. Would a more appropriate approach be listing the impaired streams and targeting BMP implementation for sediment reductions as the TMDL?

Response:
The TMDL document has been clarified to express TMDLs, WLAs, and LAs as required reductions in average annual sediment loading rather than the average annual sediment load in an ecoregion reference watershed. As stated in the TMDL document, the required reduction for a subwatershed (corresponding to a 12-digit HUC that contains one or more waterbodies identified as impaired due to siltation/habitat alteration) is calculated by comparison of the existing average annual sediment load for that subwatershed to the average annual sediment load for the appropriate ecoregion reference watershed. This modification results in TMDLs, WLAs, and LAs that are more compatible with the relative nature of sediment analysis using the Sediment Tool as described in Section 7 and Appendix A.

3. **Comment:**
The information presented in Table 9 does not appear to correspond to the text reference to Table 9 in sections 7.1.2 and 7.2.

Response:
The table referred to in Section 7.1.1 should be Table 9 and the table referred to in Section 7.1.2 should be Table 10. These typographical errors have been corrected in the final version of the TMDL.

4. **Comment:**
There are 14 subwatersheds with 303(d) listed waterbodies in the Stones River Basin. The estimated average annual sediment loadings in the impacted segments averaged about 576 lbs/ac/yr with a range from 274 to 1,200 lbs/ac/yr. TDEC reported 8 subwatersheds without 303(d) listed waterbodies in the Stones River Basin. This group does not include all of the subwatersheds in the Stones River Basin that are not impaired; rather these are the unimpaired subwatersheds with data available from which to calculate an average annual sediment loading. For these unimpaired subwatersheds, the estimated average annual sediment loading was 518 lbs/ac/yr with a range of 327 to 862 lbs/ac/yr. Without a specific statistical analysis, the similarity of the ranges and averages of the impaired data set and the unimpaired data set suggest no significant difference between the two data sets.

Response:
The subwatersheds that were not listed may not have sufficient biological or habitat data collected to make an impairment decision. Since waterbodies in these subwatersheds were not identified as impaired due to sediment on either the 1998 303(d) List or the 2000 assessment, the TMDL does not address these waterbodies. However, the information developed for these watersheds will be used to target future monitoring efforts.

5. **Comment:**
The reference basins used to establish a baseload of sediment delivered to the reference two ecoregions segments, both in the Stones River watershed, ranged from 220 to 660 lbs/ac/yr. These loadings do not represent a total maximum daily load that will not impair the stream; rather they represent modeling output of what two subwatersheds that are not impaired are presently calculated to deliver to their corresponding stream segments.

Response:
It is true that target loads for reference watersheds represent the modeled sediment load delivery to ecoregion reference streams. However, these reference streams are considered to be the least impaired streams in the Level IV ecoregion and to be biologically healthy. Comparison of conditions in impaired watersheds to conditions in reference watersheds is a recognized and appropriate method for the interpretation of applicable narrative water quality standards and determination of the pollutant loading reductions required to attain full support of designated use classifications with respect to that pollutant. This methodology is in accordance with the guidance in *Protocols for Developing Sediment TMDLs* (USEPA, 1999).

6. **Comment:**
The Stones River Basin results can be compared with similar calculated values for the Harpeth River Basin results. For the Harpeth River, the same Stones River ecoregions were used to establish the TMDLs for the impacted segments. Estimated sediment loads in the 303(d) impacted Harpeth River Basin stream segments averaged 1,137 lbs/ac/yr with a range from 351 to 2,012 lbs/ac/yr. There were 9 subwatersheds without 303(d) listed waterbodies with data sufficient to calculate an annual sediment loading. These watersheds had an average estimated sediment loading of 929 lbs/ac/yr with a range of 530 to 1,566 lbs/ac/yr. These results, although numerically higher, are similar to the small differences seen between the impaired and unimpaired subwatersheds in the Stones River Basin.

Response:
This comment is noted. See the response to Modeling/Implementation Comment 4.

7. **Comment:**
The recommended sediment delivery TMDLs for the Stones River 303(d) subwatersheds were presented as either 220 lbs/ac/yr or 660 lbs/ac/yr. These numbers represent a soil loss of about 0.0008 to 0.0023 in of soil loss per year from each acre in the subwatershed basin. As a comparison, the soil loss from the unimpaired subwatersheds ranged from 0.0011 to 0.0030 in of soil loss per year from each acre in the subwatershed basin. These are only measurable in geologic time (1,000 years or more).

Response:
See the response to Modeling/Implementation Comments 2 & 4.

8. Comment:

There were no sediment delivery rates collected from any of the basins from which to calculate the actual sediment delivery versus the calculated delivery using accepted soil loss equations.

Response:

As stated in Appendix A, the Sediment Tool is a watershed loading model that estimates soil loss due to sheet and rill erosion and the sediment load delivered to streams. The Sediment Tool is based on the USLE and only predicts the amount of soil loss resulting from sheet or rill erosion on a single slope. It does not account for soil losses that might occur from gully, wind, or tillage erosion. While the USLE can be used to estimate long-term average annual soil loss, it cannot be applied to a specific year or a specific storm. Based on its long history of use and wide acceptance by the forestry and agricultural communities, the USLE was considered to be an adequate tool for estimating the relative long-term average annual soil erosion of watersheds and evaluating the effects of land use changes and implementation of BMP measures. This type of model is not suitable for calibration to instream parameters or to loading from a single storm event.

9. Comment:

The sediment transport in the streams themselves has not been modeled. This means, no attempt has been made to actually determine where the sediment actually comes from that is deposited in the impaired sections of streams in the Basin.

Response:

Sufficient data and information were not available to factor instream sources of sediment into this TMDL. Flow alteration as a result of urbanization is one likely cause of eroding channel banks. TDEC and EPA are investigating a variety of tools for assessing the sediment loading to the stream from eroding channel banks. It may be possible to simulate in-stream sediment loads using other more complex, process-based models like GSTARS or CONCEPTS. These models require a more robust sediment and flow database in the individual watershed. EPA is examining and testing the use of these models for application in the next phase of the sediment TMDLs.

10. Comment:

The sediment delivery rates of 220 and 660 lbs/ac/yr are relative numbers that do not represent a maximum load that the stream segments can receive and still be unimpaired.

Response:

See the response to Modeling/Implementation Comment 5.

11. Comment:

It may be more appropriate to use the sediment delivery rates calculated for the unimpaired subwatersheds within the Stones River Basin (versus the ecoregion methodology) as a goal for the TMDLs and to measure progress towards sediment reduction due to BMPs implementation in the 303(d) impaired subwatersheds.

Response:

The ecoregion reference site data is the best data available at this time to develop a TMDL

that will protect fish and aquatic life. The subwatersheds listed in Table A-7 may not have sufficient biological or habitat data collected to make an impairment decision. It would be premature to develop TMDLs based on sediment loadings and delivery to those watersheds. TDEC encourages the collection of additional data, including biocriteria, habitat assessments, TSS, turbidity, and other sediment related criteria in subwatersheds with a full spectrum of land uses. Further, this may allow TDEC to determine whether watersheds undergoing development and potentially receiving higher sediment loads than "minimally impacted" watersheds can maintain biological integrity. This would allow TDEC to document and substantiate a higher TMDL loading target that is still protective of the uses of the watershed in future TMDLs for sediment.

12. Comment:

The selected ecoregions may or may not be indicative of what sediment loading results in stream impaired subwatersheds. The ecoregions are in the headwaters of the Stones River Basin where sediment transport and hydrologic/land use patterns have not been as greatly impacted as other areas of the Basin. Again, the sediment delivery rates are not truly total maximum daily loads that the stream can handle without causing impairment, which is the traditional method of calculating a maximum daily load. In this case, the Division does not have a readily identifiable physical or chemical water quality parameter from which to model sediment delivery rates that can cause impairment.

Response:

See the response to Modeling/Implementation Comments 1, 2, 5, & 8.

13. Comment:

Sediment impairment in a stream is caused by sediment deposit zones in the stream itself (e.g., pools). Sediment delivery from the land is only one part of this equation with the flow volume and the stream bathymetry and morphology being as significant impacts to this cause and effect analysis. We agree with the Division's analysis that the sediment delivery rates of 220 and 660 lbs/ac/yr are relative numbers and should not be used as absolute numbers for determining compliance with permits.

Response:

See the response to Modeling/Implementation Comments 1, 2, 5, & 8.

14. Comment:

Sediment transport has not been modeled in the Stones River and it is unclear if the listed 303(d) subwatersheds are impaired due to sediment delivery in the subwatershed land area or from transport from an upstream subwatershed.

Response:

See the response to Modeling/Implementation Comments 1, 8, & 9.

15. Comment:

As the Stones River Basin undergoes further development, the sediment analysis will be required to be updated. The change in flow due to further development will have an impact on both the morphology of the streams and subsequent additional erosion of the streambed and banks to meet the increased flows. The TMDL loadings presented must be considered dynamic in nature and future changes in these loadings are expected due to changes in basin land use and development.

Response:

These TMDLs represent the first phase in a long-term project to restore waterbodies in the Stones River watershed to full use support with respect to sediment. As stated in Section 8.4 (previously 8.3):

> The effectiveness of the TMDL will be assessed within the context of the State's rotating watershed management approach. Watershed monitoring and assessment activities will provide information by which the effectiveness of sediment loading reduction measures can be evaluated. Monitoring data, ground-truthing, and source identification actions will enable implementation of particular types of BMPs to be directed to specific areas in the subwatersheds. These TMDLs will be revaluated during subsequent watershed cycles and revised as required to assure attainment of applicable water quality standards.

All available data and analysis methods will be considered and the most appropriate selected if TMDL revision is required.

16. Comment:

Is it logical to think that all subwatersheds/stream segments within any river basin will not be impaired by sediments or habitat alterations, even under natural conditions? Flood events alone can alter the basic stream channels, habitat, and sediment scouring and deposition characteristics of a stream. The goals of the sediment TMDLs should be geared towards decreasing the impact of controllable activities, such as, land clearing and development, that can effectively deliver large sediment loadings, if not controlled, over those loadings that would normally occur. Implementation of structural and non-structural BMPs should effectively decrease sediment delivery to the steams. There is no current readily obtainable method to measure the complex measurement of stream sedimentation and its either negative or positive effects. Sediment delivery is only one aspect of this equation and decreasing sediment delivery rates alone may not ensure that this type of impairment will not continue.

Response:

The goal of these TMDLs is to reduce the amount of sediment loading to impaired waterbodies in the Stones River watershed to a degree sufficient to fully support all designated use classifications. The approach selected to accomplish this goal is the reduction of sediment loading in impaired subwatersheds as to a degree determined by analysis of these subwatersheds with the Sediment Tool and comparison with the loading to biologically healthy reference watersheds. WLAs and LAs will be primarily implemented through BMPs in accordance with Sections 8.1, 8.2, & 8.3. As stated in Section 8.4, the effectiveness of BMPs will be evaluated within the context of the State's rotating watershed

management approach. The methodology used to assess the water quality and habitat quality of waterbodies includes both site characterization and waterbody assessment. Site characterization involves field observation of the land use patterns and cursory site habitat characterization with photographic documentation. Some of the parameters examined include siltation, riparian vegetation status, channel alterations, and streamside activities such as the presence of livestock or fertilizer application. Visual water quality impacts, such as metal staining of rocks or algal mats enriched by nutrients, are also recorded on an assessment sheet. Waterbody assessment involves cursory examination of instream biota using benthic macroinvertebrates. Typically, a full BioRecon was performed near the mouth of a waterbody, whereas quick screening techniques are used along minor tributaries and in upper portions of the watershed for comparison of benthic communities and support status of designated uses. Waterbodies will be identified as fully supporting designated uses, with respect to sediment, when assessment activities indicate a certain level of biological health.

17. Comment:

We would strongly urge the Division and the stakeholders to make this initial TMDL analysis as a starting point to addressing sediment and habitat alterations in the Stones River Basin. We suggest that the sediment loadings of 220 to 660 lbs/ac/yr not be published as TMDLs, but rather as loadings that may not cause impairment. TDEC and the stakeholders should form a partnership to further refine BMPs and also the reasons behind why certain subwatersheds become impaired or undergo habitat alteration. This should be a dynamic process where goals are set and further refinement of the cause and effect of both sediment delivery and watershed changes on stream health be assessed.

Response:

As previously stated, TDEC regards these TMDLs as the first phase in a long-term project to restore impaired waterbodies in the Stones River watershed to full use support with respect to sediment. As stated in the response to Modeling/Implementation Comment 2, Section 7 of the TMDL document has been clarified to express TMDLs, WLAs, and LAs as required reductions in average annual sediment loading rather than the average annual sediment load in an ecoregion reference watershed. TDEC encourages and welcomes stakeholder participation and active involvement in watershed protection activities.

18. Comment:

Based on the sediment delivery rates calculated for the unimpaired subwatersheds in the Stones River watershed, it appears that there is additional capacity in most stream segments to handle both current point source loadings of suspended solids as well as foreseeable growth. The addition of storm water discharge points also appears to be obtainable, especially if effective BMPs are implemented in the jurisdictional area for the permitted MS4 entities.

Response:

This comment has been noted.

NPDES Phase II Storm Water

1. **Comment:**
   The Division has stated that the TMDL for sediment was run based on relative scenarios to establish percent reductions recommended for the impaired waterbodies and that the numerical limits published in the TMDL are neither enforceable nor measurable. Based on the NPDES Phase II draft permit's attention to TMDLs as referenced above and the Division's interpretation of the proposed TMDL for sediment as relative goals, please provide information on the Division's plan on integrating the above described draft small MS4 general permit sections with the TMDL for Siltation and Habitat Alteration in the Stones River Watershed.

   Response:
   See response to Modeling/Implementation Comment 2. It is expected that the Phase II MS4s will specify the development and implementation of a Storm Water Management Plan (SWMP) that will require the reduction of pollutants to the "Maximum Extent Practicable" and specifically address sediment loading to impaired waterbodies. The initial goal for load reductions will be the WLAs, expressed as percent reductions, specified in Section 8 of this TMDL document. The effectiveness of the SWMP will be evaluated within the context of the State's rotating watershed management approach according to the monitoring and assessment activities described in the response to Modeling/Implementation Comment 16. Permitted entities can also conduct their own monitoring to evaluate SWMP effectiveness.

2. **Comment:**
   Can the TMDL set for siltation and habitat alteration be based on implementation of BMPs as they pertain to erosion and sediment control for construction and post-construction activities?

   Response:
   Implementation of WLAs for regulated construction sites are based on BMPs as specified in Tennessee General Permit No. TNR10-0000, *General NPDES Permit for Storm Water Discharges Associated With Construction Activity* (see Appendix E).

3. **Comment:**
   Should the Division consider dropping the numerical limits (in favor of non-numeric or narrative goals) published in the TMDL for Siltation and Habitat Alteration in the Stones River Watershed as it has vast impacts with regard to the draft small MS4 general permit? Waste Load Allocation (WLA) and monitoring will be required for compliance as the draft general permit currently reads. At the minimum, should the Division publish the fact that the model is using relative comparisons to establish the percent reductions recommended?

   Response:
   See response to Modeling/Implementation Comment 2.

4. **Comment:**
Should the Division provide a mechanism for the City of Murfreesboro or other stakeholder to establish independent data that can be used to better define the actual in-stream impacts of siltation and habitat alteration in the Stones River Watershed?

Response:
It is anticipated that Phase II MS4 permits will specify some monitoring activities. Permitees can also conduct additional monitoring in waterbodies. TDEC will consider any additional data in future assessments and TMDL analyses.

Wastewater NPDES Permits

1. **Comment:**
In the Executive Summary (page vi, paragraph three), the Division states that existing NPDES permit holders will retain "their current discharge levels of TSS." The study is silent on future WLAs for permit holders. If any of the NPDES permit holders for wastewater are required to increase their discharge to meet service area demands, will additional TSS levels be granted? If so, on what basis?

Response:
Requests for increased WLAs due to proposed STP plant expansion will be evaluated on a case by case basis in consideration of proposed discharge quantity, status of receiving waters, State water quality standards, and other relevant factors. Based on current permitted discharges of TSS from wastewater treatment plants, foreseeable future discharges from these facilities may be considered de minimis with respect to total subwatershed sediment loading.

2. **Comment:**
On page 27 of 29, the report discusses non-point source implementation and indicates that efforts should be made to "reduce activities within riparian areas" as a minimum requirement. How will this requirement interface with wastewater system needs to extend or replace existing gravity sewers since the most economical way to sewer an area is by gravity and gravity sewers tend to follow streams?

Response:
The statement referred to is part of a general discussion of methods to reduce nonpoint source sediment loading to waterbodies. It is anticipated that these principles would be applied in "common sense" manner. The recommendation does not preclude all activities in riparian areas. Any activity proposed, however, should be evaluated with respect to necessity and practicable alternatives and, if approved, be conducted in a manner to minimize impact to waterbodies.

B. Response to City of Murfreesboro Comments (May 13, 2002)

In addition to a request for a meeting and an extension to the comment period, the letter enumerated a number of areas of concern with respect to the TMDLs. The City submitted a second comment letter at the end of the comment period extension. The general areas of concern included in the May 13 letter were restated in greater detail in the June 12 letter (in addition to other comments). See the responses to City of Murfreesboro Comments (June 12, 2002).

C. Response to Murfreesboro Water and Sewer Department Comments (May 13, 2002)

1. **Comment:**
It does not appear the report gives due consideration to seasonal loadings. Are seasonal loadings possible for silt and erosion?

Response:
As stated in Section 7.4 of the TMDL document, the analysis of sediment loading on an annual basis accounts for seasonal variations in loading.

2. **Comment:**
The document calls for best management practices (BMT) and encourages public watchdog activities. The elaborate and impossible sampling regimes required to monitor BMT efficiencies are conspicuous by their absence. Who will pay for the testing, monitoring and reporting? What is the rotation of watershed management referred to in Section 8.3?

Response:
As stated in Section 8.4 (previously 8.3) the effectiveness of BMPs will be evaluated within the context of the State's rotating watershed management approach according to the monitoring and assessment activities described in the response to Modeling/Implementation Comment 16.

The State's rotating watershed management approach was developed in 1996 to synchronize all activities in a watershed, including permit issuance, on a five year cycle. Watersheds, corresponding to USGS 8-digit Hydrologic Unit Codes (HUCs), in Tennessee were divided into five groups according to the year of implementation. Each year during 1996-2000, the planning phase for one of the five groups began. Activities that occur for each group during the cycle include: planning and data collection, monitoring, assessment, TMDLs and wasteload allocation, permit issuance, and watershed management plan development. The Stones River is in watershed group 1. Two public watershed meetings have been held in Murfreesboro to date and a third is scheduled for August, 2002. Additional information on the State's watershed management approach may be found on the TDEC website at: http://www.state.tn.us/environment/wpc/wshed1.htm .

3. **Comment:**
Upstream of Murfreesboro, the watersheds are unregulated under Phase 2. It will be difficult for Murfreesboro to comply with the standards in the report given upstream conditions. Intergovernmental cooperation, or the lack thereof, from agencies in unregulated upper reaches of the watershed may impede attaining the desired reductions in Murfreesboro.

Response:
The TMDL provides WLAs and LAs for all subwatersheds, including those upstream of Murfreesboro,, that were identified as impaired due to siltation or siltation related habitat alteration.

4. **Comment:**
The basins in the Murfreesboro city limits area are held to the 220 lbs per acre per year of Stewarts Creek. Could the safety factor considered be 300 lbs. per acre per year of the West Fork in lieu of the 220 lbs. per acre per year of Stewarts Creek?

Response:
Increasing the target load for a subwatershed to an amount higher than the load associated with the appropriate reference site would have the effect of reducing or eliminating MOS altogether. An implicit or explicit MOS is required for TMDLs. As stated in Section 7.3, an implicit MOS was incorporated through the use of conservative modeling assumptions. Also, TMDLs, WLAs, and LAs have been restated as percent sediment load reductions. See response to City of Murfreesboro (June 12, 2002) Modeling/Implementation Comment 2.

5. **Comment:**
The stakeholders should include homebuilders, developers and contractors since they are the main contingent responsible for implementing erosion control for projects that disturb larger areas. I recommend contacting the Rutherford County Homebuilders Association and the Rutherford County Chamber of Commerce at a minimum.

Response:
A meeting was held on June 6, 2002 in Murfreesboro to discuss the Stones River Sediment TMDL. Representatives of the development and construction community were invited to this meeting.

D. Response to SSR Comments (May 13, 2002)

1. **Comment:**
The review period for the draft appears to be inadequate. This study is one of the first of its kind in the State (and certainly the first for this watershed). The 35 day review period will not allow the effected cities and counties adequate time to digest the impact of the proposed TMDLs for siltation. This is a complex issue. Therefore, I respectfully request that the review period be extended another 60 days.

Response:
At the request of several stakeholders, the comment period was extended 30 days to June 12, 2002. In addition, a meeting was held on June 6, 2002 in Murfreesboro to discuss the

Stones River Sediment TMDL. Representatives of the Division of Water Pollution Control, effected city and county government, consultants (including the commenter), developers, and contractors were invited to this meeting.

2. **Comment:**
In the Executive Summary (page iv, paragraph three) you indicate that existing NPDES permit holders will retain "their current discharge levels of TSS." The study is silent on future WLAs for permit holders. If any of the NPDES permit holders are required to increase their discharge to meet service area demands, will additional TSS levels be granted? If so, on what basis?

Response:
See the response to City of Murfreesboro (June 12, 2002) Wastewater NPDES Permits Comment 1.

3. **Comment:**
The State is conducting a TMDL study for mass/organic loading on this watershed in parallel to the siltation study. How will the two be interfaced?

Response:
In addition to habitat alteration, sediment also serves a mechanism for organic loading to streams. Successful implementation of BMPs to reduce sediment loads can also be expected to result in corresponding reductions in organic loading.

4. **Comment:**
If the TSS WLA for an NPDES permit holder is unchanged by the siltation study, does this imply that the mass/organic study will abide by this limit without regard to the results of that study?

Response:
It is not expected that organic enrichment TMDLs will require additional reductions in TSS discharges for NPDES permitted facilities. These TMDLs may, however, require reductions in the discharge of nutrients.

5. **Comment:**
In the Executive Summary (page vii, paragraph 2) you indicate that this TMDL study was modeled on another Level IV ecoregion watershed. What is the name and location of that watershed? Are copies of the siltation TMDL study for that watershed available for review?

Response:
The paragraph cited states that

> …..the average annual sediment loading from a biologically healthy watershed located within the same Level IV ecoregion as the impaired watershed has been determined to be the appropriate numeric interpretation of the narrative water quality standard for protection of fish and aquatic life. The biologically healthy watershed was identified from the State's ecoregion reference sites.

As stated in Section 4.0, the target loads for ecoregion reference subwatersheds were calculated using the methodology described in Appendix A. Information concerning the Tennessee Ecoregion Project, as well as biometric and index scores for the target reference sites, has been added to the TMDL document as Appendix D. The location of the target reference sites is stated in Section 4.0. More detailed information regarding these sites may be found in *Tennessee Ecoregion Project, 1994-1999* (TDEC, 2000).

6. **Comment:**
Since Lavergne, Mount Juliet, Murfreesboro, Smyrna, Rutherford County, and Wilson County will not be covered under the EPA Phase II storm water regulations until 2003 and their jurisdiction may overlap several subwatersheds, how will their individual permit limits be determined?

Response:
WLAs will apply to subwatershed as listed in Table 10. See response to City of Murfreesboro (June 12, 2002) NPDES Phase II Storm Water Comment 1.

7. **Comment:**
On page 25 of 29 in paragraph two you list special requirements. How are the effected government agencies going to pay for these mandates?

Response:
The special requirements cited refer to language in the existing *General NPDES Permit for Storm Water Discharges Associated With Construction Activity* (TNR10-0000) for discharges to waterbodies identified on the 1998 303(d) list, or more recent assessments, as being impaired due to siltation. In order to eliminate confusion, discussion of implementation for regulated construction storm water and Phase II MS4s have been divided into separate sections.

8. **Comment:**
On page 26 of 29 in paragraph three you mention stakeholder groups for the *Stones River Management Plan*. Why are the local cities and county governmental agencies absent from this list?

Response:
The stakeholder groups mentioned in the *Stones River Watershed Management Plan* are groups that have participated in TDEC sponsored watershed meetings or are otherwise actively involved in known watershed restoration or education activities. NPDES permit holders are assumed to be stakeholders.

9. **Comment:**
On page 27 of 29 you discuss non-point source implementation you say that efforts should be made to "reduce activities within riparian areas" as a minimum requirement. How will this requirement interface with wastewater system needs to extend or replace existing sewers since the most economical way to sewer an area is by gravity and gravity sewers tend to follow streams?

Response:
See the response to City of Murfreesboro (June 12, 2002) Wastewater NPDES Permits Comment 2.

E. Response to U.S. Fish and Wildlife Service Comments (May 14, 2002)

1. **Comment:**
The commenter states that effective enforcement of Tennessee's storm water and aquatic resource alteration permitting programs is vital in controlling erosion and habitat loss, especially in urban areas experiencing rapid development, such as Davidson, Rutherford, and Wilson Counties. The commenter expresses concern that a comprehensive review of these program areas, including current inspection and enforcement statistics, was not included in the TMDL narrative and raises questions regarding the eventual effectiveness of the TMDL implementation.

Response:
TDEC agrees that the storm water and Aquatic Resource Alteration Permit (ARAP) programs are important elements of effective reduction of sediment loading in the Stones River watershed. Both of these programs are well established in Tennessee. The Construction Storm Water Permit is discussed in Sections 6.1.2, 7.1.2, & 8.1.2 and described in Appendix E. The Phase II MS4 permit is discussed in Sections 6.1.3, 7.1.3, & 8.1.3. Section 8.3, describing the ARAP program, has been added to the TMDL (the Evaluation of TMDL Effectiveness section has been renumbered as Section 8.4). TDEC has procedures in place for inspection and enforcement of permit programs.