TOTAL MAXIMUM DAILY LOAD (TMDL)

For

Siltation & Habitat Alteration

In The

Lower Elk River Watershed (HUC 06030004)

Giles, Lawrence, Marshall and Maury County, Tennessee

Prepared by:

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

September 30, 2003

TABLE OF CONTENTS

APPENDICES

LIST OF FIGURES

LIST OF TABLES

LIST OF TABLES

LIST OF ABBREVIATIONS

ARS	Agricultural Research Station
BMP	Best Management Practices
CFR	Code of Federal Regulations
CFS	Cubic Feet per Second
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
RMCP	Ready Mix Concrete Plant
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

SUMMARY SHEET

LOWER ELK RIVER WATERSHED (HUC 06030004)

Total Maximum Daily Load for Siltation / Habitat Alteration in Waterbodies Identified on the State of Tennessee's 1998 303(d) List or the Proposed Final 2002 303(d) List

Impaired Waterbody Information:

State: Tennessee
Counties: Giles, Lawrence, Marshall & Maury
Watershed: Lower Elk River (HUC 06030004)
Watershed Area: 714 mi^2
Constituent of Concern: Siltation / Habitat Alteration
Impaired Waterbodies:

	Waterbody ID	Waterbody	RM
1998 303(d) List:	06030004017	Richland Creek	19.7
	06030004029	Weakley Creek	16.6
Proposed Final 2002 303(d) List:	06030004017_0300	UT to Richland Creek	3.2
	06030004017_2000	Richland Creek	26.7
	06030004043_0300	Corn Creek	4.0

Designated Uses: Fish & aquatic life, irrigation, livestock watering & wildlife, and recreation. Some waterbodies in watershed are also classified for domestic and/or industrial water supply.

Applicable Water Quality Standard: Most stringent narrative criteria applicable to fish & aquatic life use classification:

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.

TMDL Development

Analysis Methodology:

- Watershed Characterization System Sediment Tool (based on Universal Soil Loss Equation) applied to subwatershed areas corresponding 12-digit hydrologic unit code.

- Target sediment loads (lbs/acre/year) are based on the average annual sediment load from biologically healthy watersheds (Level IV Ecoregion reference sites).

- TMDLs, WLAs, and LAs are expressed as the percent reduction in average annual sediment load required for a subwatershed containing impaired waterbodies relative to the appropriate target load.

Critical Conditions: Methodology takes into account all flow conditions.

Seasonal Variation: Methodology addresses all seasons.

Margin of Safety (MOS): Implicit (conservative modeling assumptions).

TMDL/Allocations

Storm Water Related Discharges:

Subwatershed	Level IV Ecoregion	Target Sediment Load	% Reduction – Avg. Annual. Sediment Load		
			TMDL	WLAs (Construction SW)	LAs (Nonpoint Sources)
		[lbs/acre/yr]	[%]	[%]	[%]
0201	71h	597.6	35.6	35.6	35.6
0205	71f	525.7	62.2	62.2	62.2
0206	71h	597.6	39.6	39.6	39.6

Non-storm Water Related Discharges:

WLAs for NPDES regulated wastewater treatment plants, mining sites, and ready mix concrete plants are equal to existing permit limits for total suspended solids (TSS).

TOTAL MAXIMUM DAILY LOAD (TMDL) FOR SILTATION/HABITAT ALTERATION LOWER ELK RIVER WATERSHED (HUC 06030004)

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

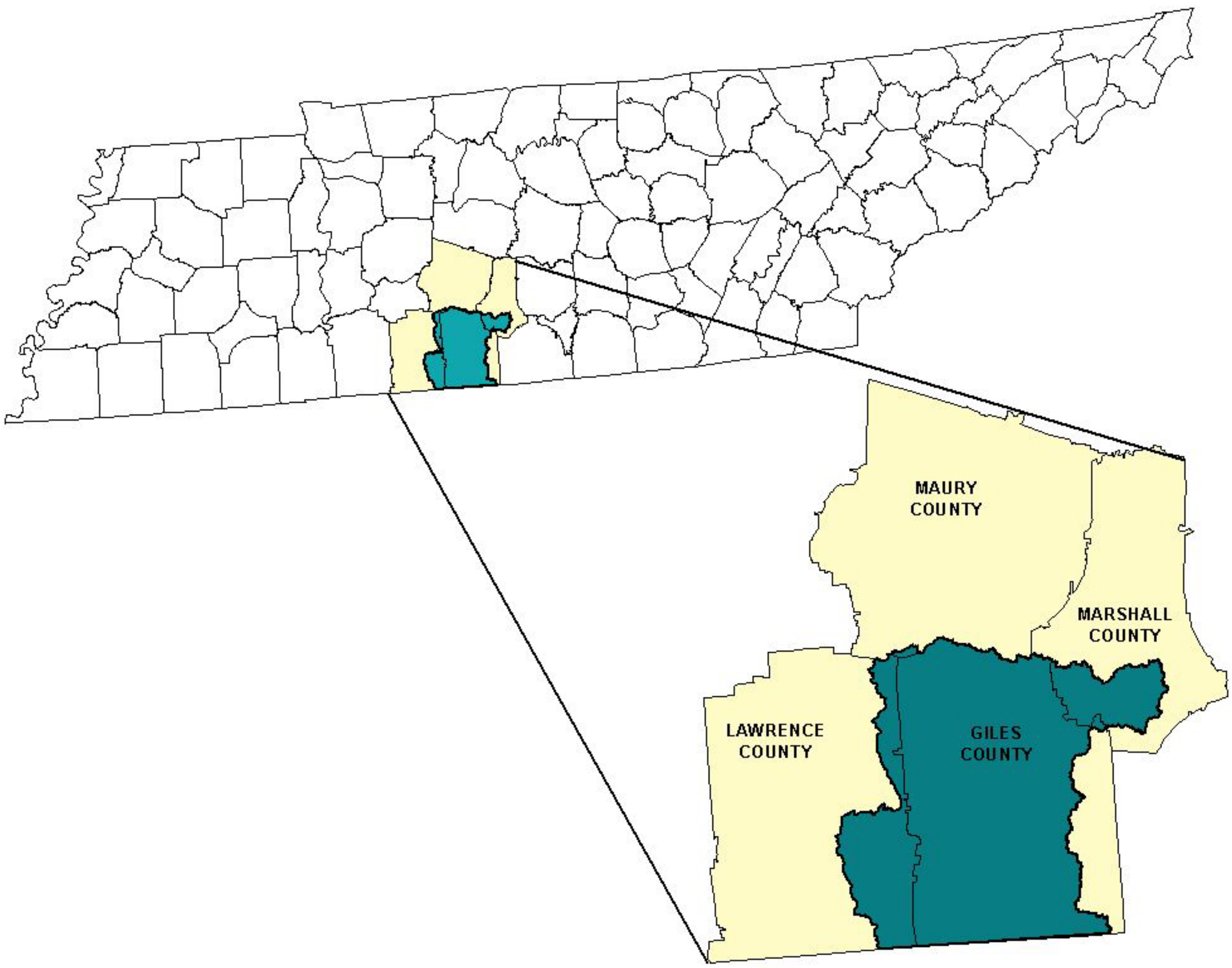
The Lower Elk River Watershed (HUC 06030004) is located in Middle Tennessee (Figure 1), primarily in Giles, Lawrence and Marshall Counties (a small portion of the watershed is in Maury County). The Lower Elk River Watershed lies within 1 level III Ecoregion (Interior Plateau) and contains 3 level IV Ecoregions as shown in Figure 2 (USEPA, 1997):

- Western Highland Rim (71f) is characterized by dissected, rolling terrain of open hills, with elevations of 400 to 1000 feet. The geologic base of Mississippian-age limestone, chert, and shale is covered by soils that tend to be cherty, acidic and low to moderate in fertility. Streams are characterized by coarse chert gravel and sand substrates with areas of bedrock, moderate gradients, and relatively clear water. The oak-hickory natural vegetation was mostly deforested in the mid to late 1800's, in conjunction with the iron ore related mining and smelting of the mineral limonite, but now the region is again heavily forested. Some agriculture occurs on the flatter areas between streams and in the stream and river valleys: mostly hay, pasture, and cattle, with some cultivation of corn and tobacco.

- The Eastern Highland Rim (71g) has level terrain, with landforms characterized as tablelands of moderate relief and irregular plains. Mississippian-age limestone, chert, shale, and dolomite predominate, and karst terrain sinkholes and depressions are especially noticeable between Sparta and McMinnville. Numerous springs and spring-associated fish fauna also typify the region. Natural vegetation for the region is transitional between the oak-hickory type to the west and the mixed mesophytic forests of the Appalachian ecoregions to the east. Bottomland hardwoods forests were once abundant in some areas, although much of the original bottomland forest has been inundated by several large impoundments. Barrens and former prairie areas are now mostly oak thickets or pasture and cropland.

- The Outer Nashville Basin (71h) is a heterogeneous region, with rolling and hilly topography and slightly higher elevations. The region encompasses most all of the outer areas of the generally no-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 forest 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.

Figure 1 Location of the Lower Elk River Watershed



The Tennessee portion of the Lower Elk River Watershed has approximately 1,117.3 miles of streams (Rf3), and drains a total area of 714 square miles. Watershed land use distribution is based on Multi-Resolution Land Characteristic (MRLC) databases derived from Landsat Thematic Mapper digital images from the period 1990-1993. Land use for the Lower Elk River Watershed is summarized in Table 1 and shown in Figure 3.

Figure 2 Level IV Ecoregions in the Lower Elk River Watershed

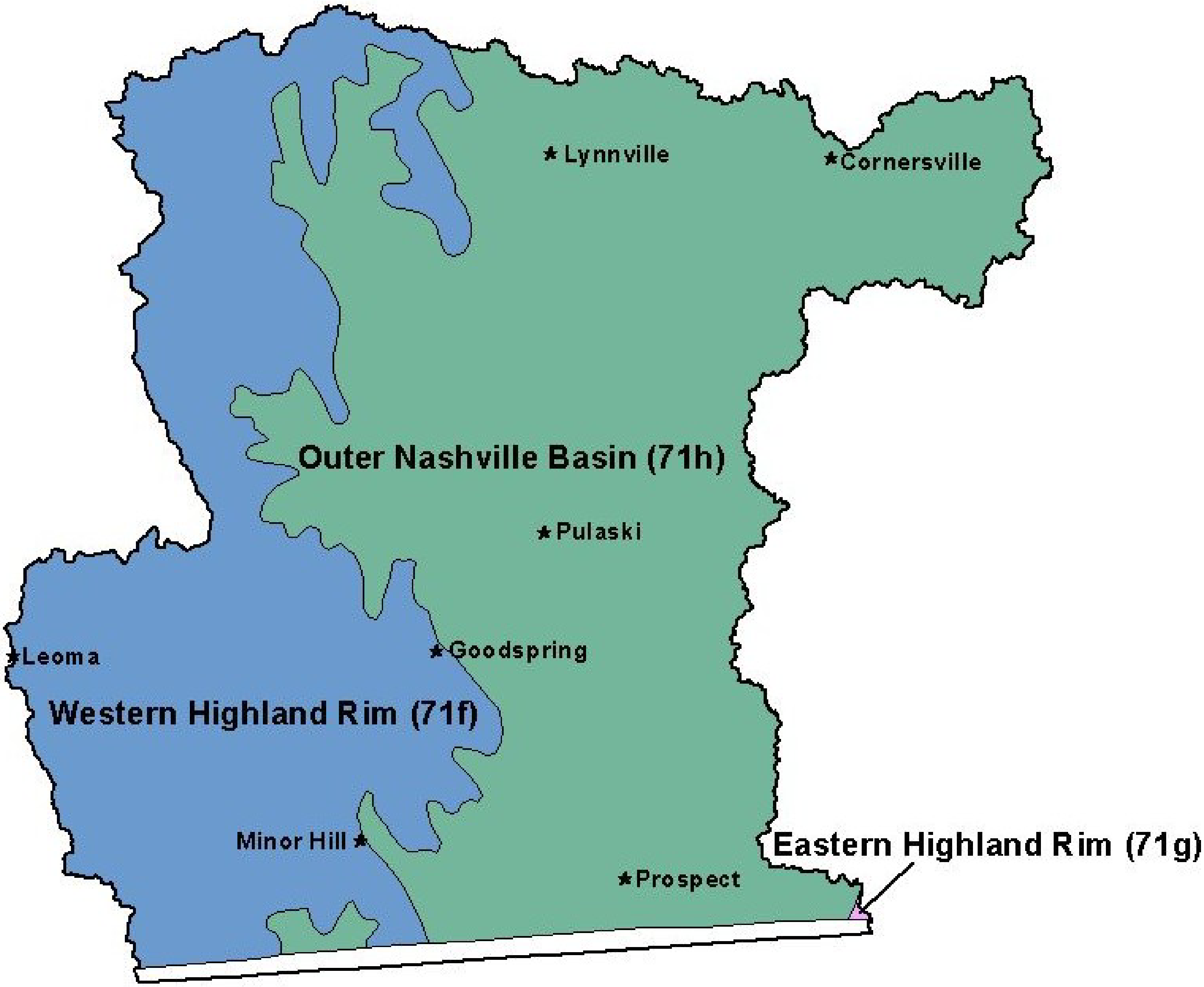


Figure 3 MRLC Land Use in the Lower Elk River Watershed

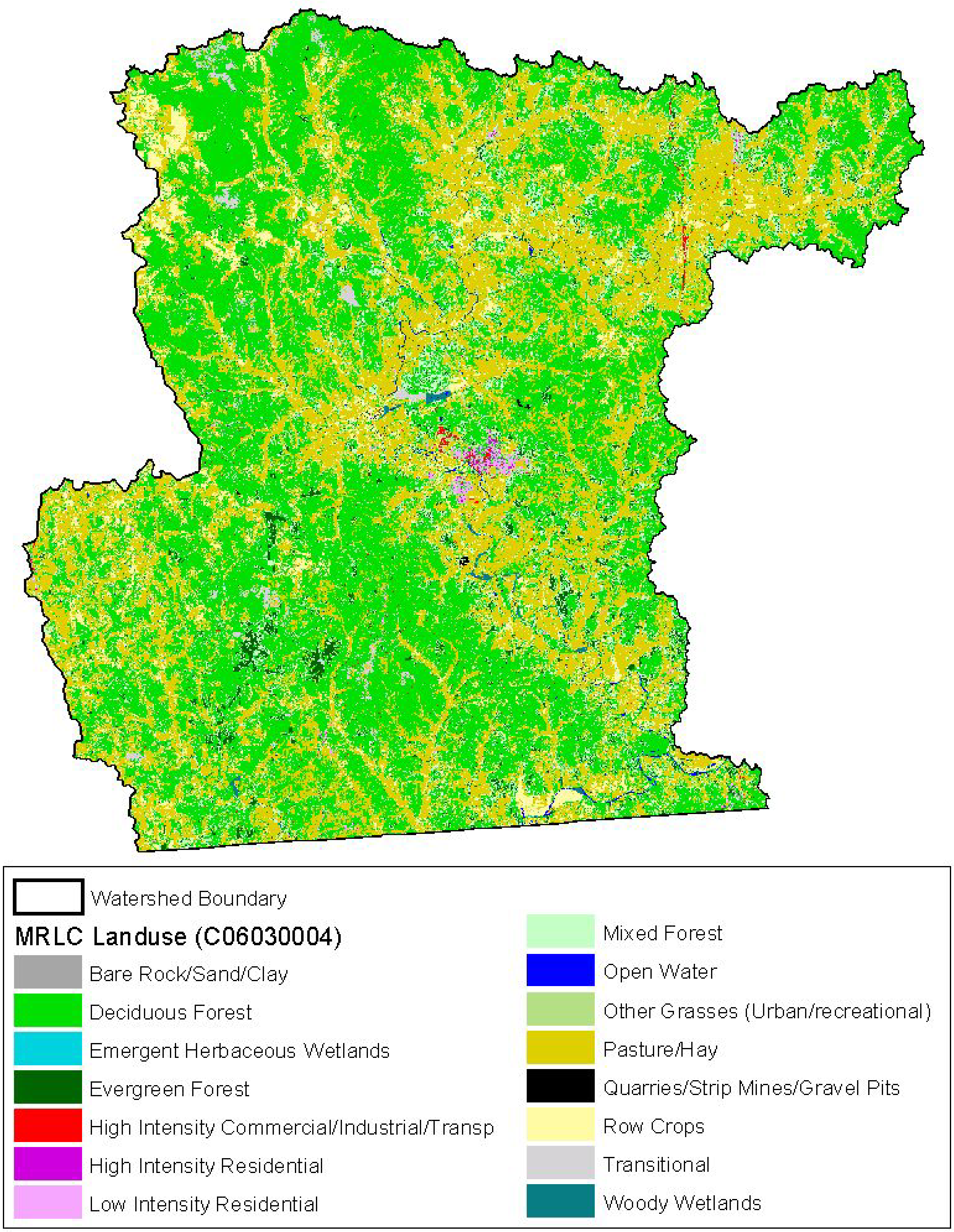


Table 1 Land Use Distribution - Lower Elk River Watershed

Land Use	Area		
	[acres]	[mi^2]	[%]
Open Water	992.08	1.55	0.22
Low Intensity Residential	1801.80	2.82	0.39
High Intensity Residential	246.19	0.38	0.05
High Intensity Commercial / Industrial / Transportation	1115.06	1.74	0.24
Quarries / Strip Mines / Gravel Pits	107.86	0.17	0.02
Transitional	2835.69	4.43	0.62
Deciduous Forest	217883.04	340.45	47.68
Evergreen Forest	10228.61	15.98	2.24
Mixed Forest	41441.26	64.75	9.07
Pasture / Hay	143035.02	223.50	31.30
Row Crops	35317.09	55.18	7.73
Other Grasses (Urban / Recreational)	975.18	1.52	0.21
Bare Rock/Sand	0.00	0.00	0.00
Woody Wetlands	898.90	1.40	0.20
Emergent Herbaceous Wetlands	112.53	0.18	0.02
Total	**456990.32**	**714.06**	**100.00**

3.0 PROBLEM DEFINITION

The most frequently sited pollutant in Tennessee is siltation, impacting over 4,860 miles of streams. Siltation is generally associated with land disturbing activities such as agriculture and construction. Some of the significant economic impacts caused by siltation are increased water treatment costs, filling in of reservoirs, loss of navigation channels, and increased likelihood of flooding (TDEC 2002).

Silt alters the physical properties of waters by:

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

Silt alters the chemical properties of waters by:

- Interfering with photosynthesis
- Decreasing available oxygen due to decomposition of organic matter. Decomposing organic matter in the absence of light causes a deficiency in dissolved oxygen.
- Increasing nutrient levels that accelerate eutrophication in reservoirs
- 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
- Transporting other pollutants, in possibly toxic amounts, or providing a reservoir of substances that may become concentrated in the food chain
- Clogging the gills of fish and other forms of aquatic life
- Interfering with fish ability to see food
- Covering substrate that provides habitat for aquatic insects, a main prey of fish
- Reducing biological diversity by altering habitats to favor burrowing species
- Accelerating growth of submerged aquatic plants and algae

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 two waterbodies in the Lower Elk River watershed as not fully supporting designated use classifications due, in part, to siltation associated with agriculture and land development (see Table 2). The designated use classifications for the Lower Elk 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. These TMDLs are established to attain full support of the designated use of fish and aquatic life. This approach will also protect all other designated uses.

Waterbodies in the Lower Elk River watershed were reassessed by the State in 2000 and in 2002 using more recent data and a revised waterbody identification system. In September 2002, the State of Tennessee submitted to the USEPA, the Proposed Final 2002 303(d) List. This list identified a number of waterbodies in the Lower Elk River watershed as not supporting designated use classifications due, in part, to siltation and/or habitat alteration (see Table 3). These TMDLs address all subwatersheds in the Lower Elk River watershed. All waterbodies listed on both the 1998 303(d) list and the Proposed Final 2002 303(d) List are provided a TMDL for sediment loading. These waterbodies are shown in Figure 4.

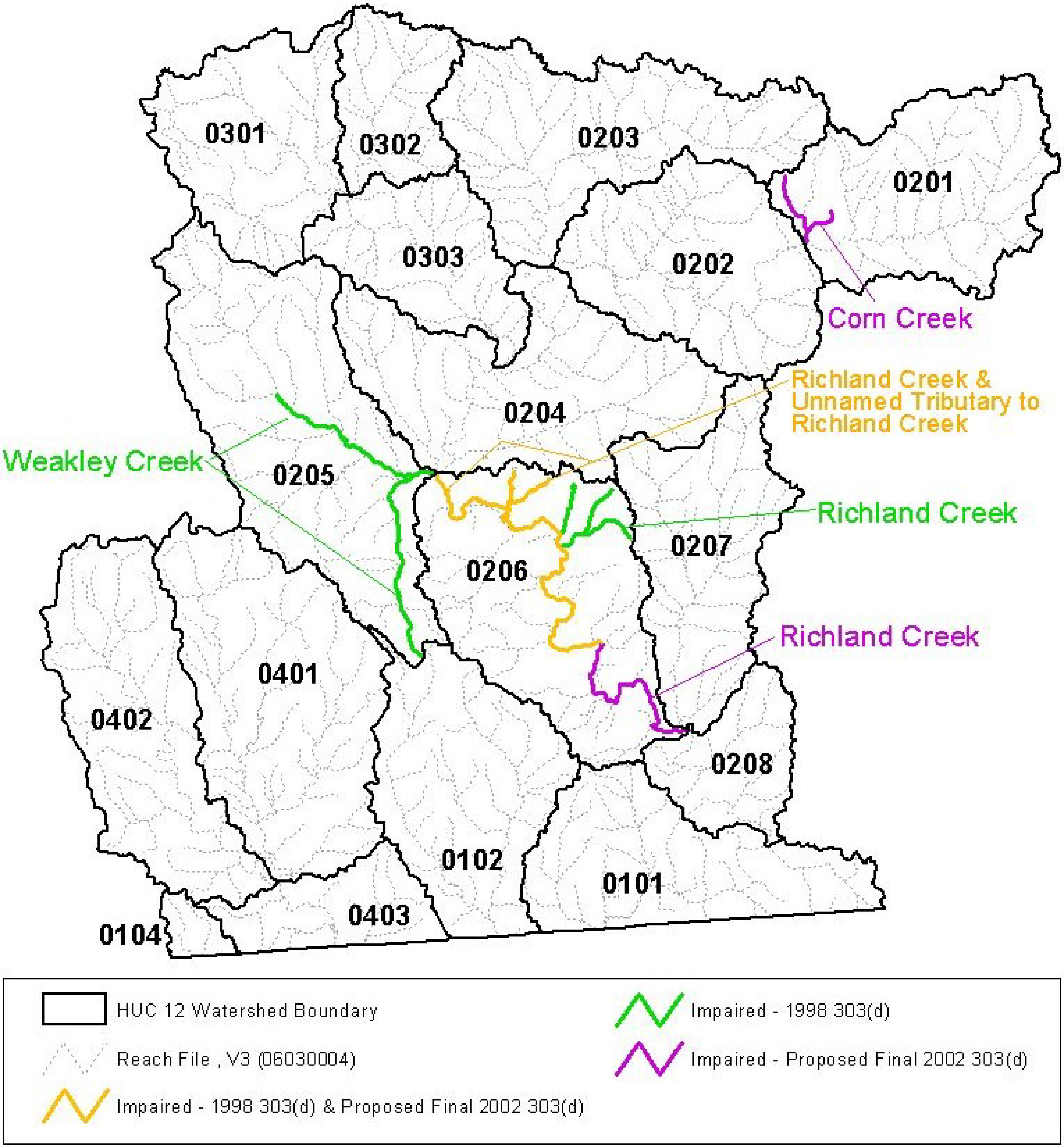
Table 2 1998 303(d) List for Siltation - Lower Elk River Watershed

Waterbody ID	Waterbody	RM Partially Supporting	RM Not Supporting	Cause (Pollutant)	Source (Pollutant)
6030004017	Richland Creek (from Silver Ck to Weakley Ck PS - two small tribs are NS)	16.7	3	Siltation	Industrial Point Source Collection System Failure Land Development Urb Runoff/storm Sewers
6030004029	Weakley Creek incl Agnew Creek (Weakley Ck. from mouth to Dry Weakley is PS)	16.6		Siltation	Agriculture

Table 3 Proposed Final 2002 303(d) List - Stream Impairment Due to Siltation/Other Habitat Alterations in the Lower Elk River Watershed

Waterbody ID	Waterbody	RM Partially Supporting	RM Not Supporting	Cause (Pollutant)	Source (Pollutant)	Reference to 1998 303(d) List
06030004017_0300	Unnamed Trib to Richland Creek		3.2	Siltation Other Habitat Alterations	Industrial Permitted Stormwater Urban Runoff/Stormwater	6030004017
06030004017_2000	Richland Creek	26.7		Siltation	Industrial Point Source Collection System Failure Land Development Urban Runoff/Stormwater	6030004017
06030004043_0300	Corn Creek		4	Siltation	Pasture Grazing Livestock in Stream	NA

Figure 4 Waterbodies Impaired Due to Siltation/Habitat Alteration - 1998 303(d) List & Proposed Final 2002 303(d) List



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).

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

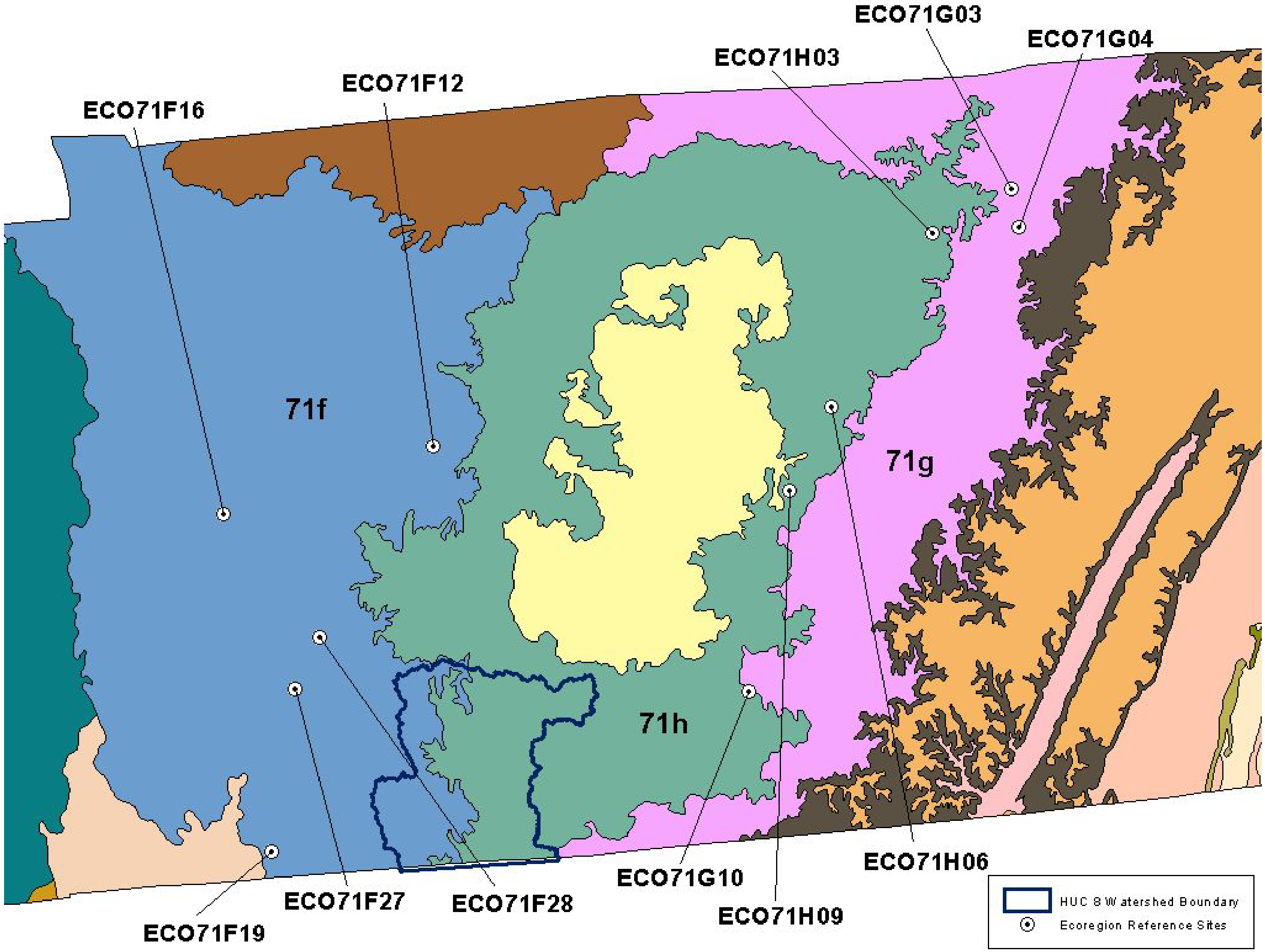
In order for a TMDL to be established, a numeric “target” protective of the uses of the water must be identified to serve as the basis for the TMDL. Where State regulation provides a numeric water quality criteria for the pollutant, the criteria is the basis for the TMDL. Where State regulation does not provide a numeric water quality criteria, as in the case of siltation/habitat alteration, a numeric interpretation of the narrative water quality standard must be determined. For the purpose of these TMDLs, the average annual sediment loading in lbs/acre/yr, 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. Biologically healthy watersheds were identified from the State’s ecoregion reference sites. These ecoregion reference sites have similar characteristics and conditions as the majority of streams within that ecoregion. Detailed information regarding Tennessee ecoregion reference sites can be found in *Tennessee Ecoregion Project, 1994-1999* (TDEC 2000a) and is summarized in Appendix D. In general, land use in ecoregion reference watersheds contain 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 an ecoregion and, as such, sediment loading from these watersheds may serve as an 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) watersheds in Level IV ecoregions71f, 71g, and 71h. The geometric mean of the average annual sediment loads of the reference watersheds in each Level IV ecoregion was selected as the most appropriate target for that ecoregion. Since the impairment of biological integrity due to sediment build-up is generally a long-term process, using an average annual load is considered appropriate. The average annual sediment loads for reference sites and corresponding TMDL target values for Level IV ecoregions 71f, 71g, and 71h are summarized in Table 4. Reference site locations are shown in Figure 5.

Table 4 Average Annual Sediment Loads of Level IV Ecoregion Reference Sites

Level 4 Ecoregion	Reference Site	Stream	Drainage Area (acres)	Average Annual Sediment Load [lbs/acre/year]
71f	ECO71F12	South Harpeth River	6748	1249.3
	ECO71F16	Wolf Creek	9883	249.7
	ECO71F19	Brush Creek	8169	794.0
	ECO71F27	Swanegan Branch	3204	767.5
	ECO71F28	Little Swan Creek	5562	211.3
	Geometric Mean (Target Load)			**525.7**
71g	ECO71G03	Flat Creek	14151	340.0
	ECO71G04	Spring Creek	17100	496.3
	ECO71G10	Hurricane Creek	3563	269.3
	Geometric Mean (Target Load)			**356.9**
71h	ECO71H03	Flynn Creek	8316	735.7
	ECO71H06	Clear Fk. Creek	8782	559.3
	ECO71H09	Carson Fork	7937	518.6
	Geometric Mean (Target Load)			**597.6**

Figure 5 Reference Sites in Level IV Ecoregions 71f, 71g, & 71h



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 Lower Elk River watershed (Figure 6). The estimated existing average annual loads for subwatersheds with waterbodies listed on the 1998 303(d) list or in the Proposed Final 2002 303(d) List as impaired for siltation/habitat alteration are summarized in Table 5.

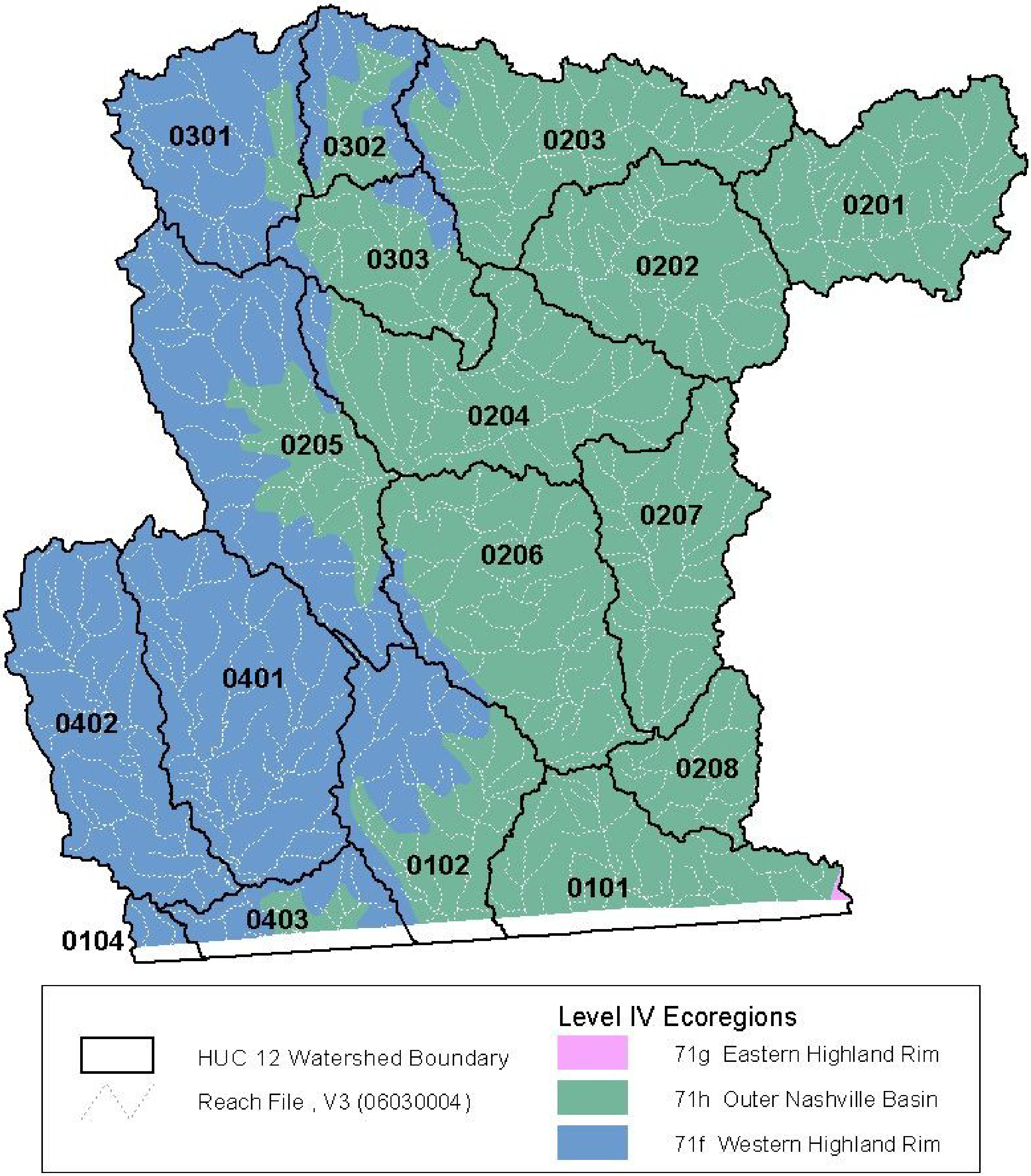
Table 5 Existing Sediment Loads in Subwatersheds With Impaired Waterbodies

Subwatershed	Level IV Ecoregion	Existing Sediment Load [lbs/acre/year]
060300040201	71h	882
060300040205	71f	1321
060300040206	71h	940

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. Regulated point sources include: 1) municipal and industrial wastewater treatment facilities (WWTFs); 2) storm water discharges associated with industrial activity (which includes construction activities); and 3) certain discharges from Municipal Separate Storm Sewer Systems (MS4s). A TMDL must provide Waste Load Allocations (WLAs) for all NPDES-regulated point sources. For the purposes of these TMDLs, all sources of sediment loading not regulated by NPDES are considered nonpoint sources. The TMDL must provide a Load Allocation (LA) for these sources.

Figure 6 Lower Elk River Watershed – Subwatershed Delineation



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 5 facilities with NPDES permits that require monitoring of TSS or turbidity in the Lower Elk River watershed (see Figure 7). These discharges are summarized in Table 6. Sediment loads to the receiving streams from WWTFs are negligible in relation to sediment discharges caused by storm water runoff. The annual total of WWTF discharges in each subwatershed impaired for sediment in the Lower Elk River watershed is calculated to be less than 2% of the total sediment loading in those subwatersheds (see Appendix E). 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 Ready Mixed Concrete Plants

Discharges from regulated Ready Mixed Concrete Plants (RCMPs) may contribute sediment to surface waters as TSS. Most of these facilities obtain coverage under NPDES Permit No. TNG110000, *General NPDES Permit for Discharges of Storm Water Runoff and Process Wastewater Associated With Ready Mixed Concrete Facilities*. The permit sets forth effluent limits on discharges of process wastewater. The effluent Limitation for TSS is 50.0 mg/L as a daily maximum concentration. Discharges from these facilities are generally intermittent, and contribute a minimal amount of the total sediment loading in the watershed. In some cases, for discharges into 303(d) listed waters, sites may be required to obtain coverage under an individual NPDES permit. In the Lower Elk River watershed, there are 2 permitted Ready Mixed Concrete Facilities as listed in Table 8 and shown in Figure 7.

6.1.3 NPDES Regulated Mining Sites

Discharges from regulated mining activities may also contribute sediment to surface waters as TSS. Discharges from active mines may result from dewatering operations and/or in response to storm events. Discharges from permitted inactive mines are only in response to storm events. Inactive sites with successful surface reclamation contribute relatively little solids loading. Permitted mining sites in the Lower Elk River Watershed are shown in Figure 7 and summarized in Table 7. Sediment loads (as TSS) to waterbodies from mining site discharges are negligible in relation to total sediment loading. The estimated sediment load from active or reclaimed mining site discharges in subwatersheds impaired for siltation/habitat alteration in the Lower Elk River watershed is calculated to be less than 2% of the total sediment loading in those subwatersheds (see Appendix E).

6.1.4 NPDES-Regulated Construction Activities

Sediment loadings from NPDES-regulated construction activities 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 one acre 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. 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 Lower Elk River watershed, there were 9 permitted active construction sites on June 9, 2003 (See Figure 8).

Figure 7 NPDES Facilities Permitted to Discharge TSS in the Lower Elk River Watershed

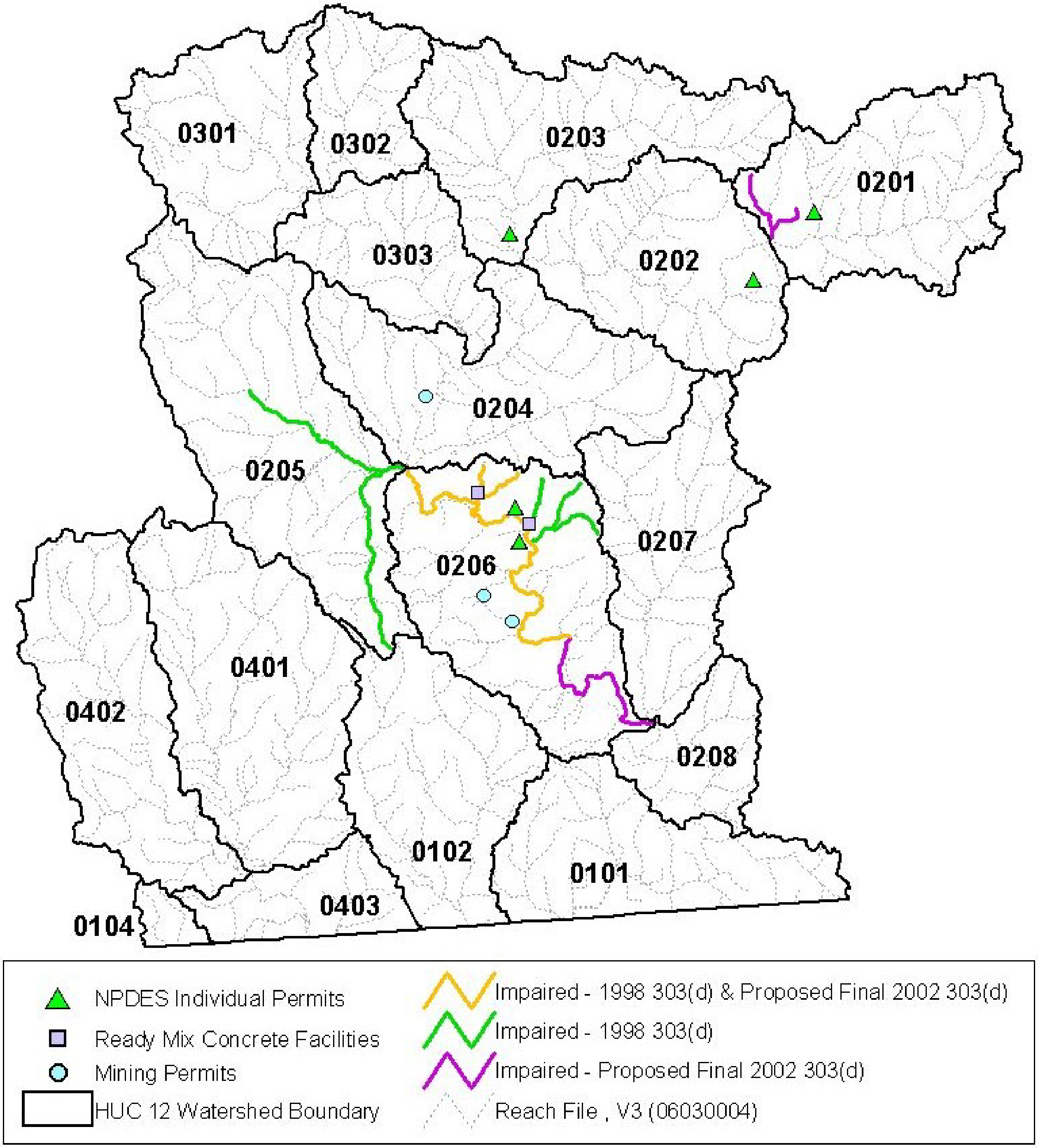


Table 6 NPDES Facilities Permitted to Discharge TSS in the Lower Elk River Watershed

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]
0206	39255	TN0021687	Pulaski STP	4.0	30	1001	40	1334	45
0206	39255	TN0054640	Tennessee Valley Recycling, LLC	0.2	------	------	------	------	40
0203	34338	TN0054810	Richland School	0.016	30	------	------	------	45
0201	30621	TN0061841	Cornersville STP	0.1	30	25	40	33	45
0202	29835	TN0067954	Pilot Travel Centers LLC #406	0.000232	------	------	------	------	40

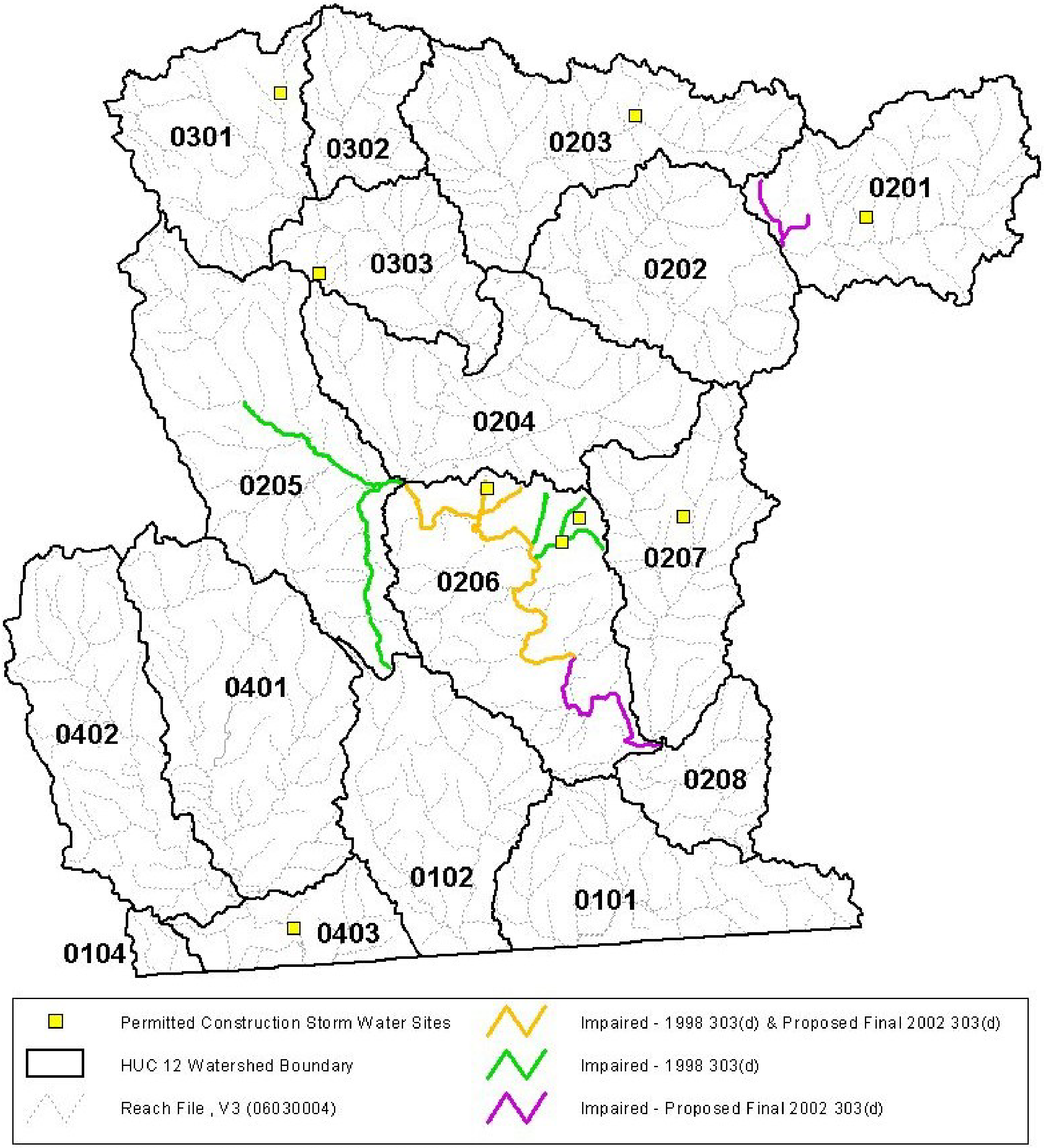
Table 7 NPDES Regulated Mining Sites in the Lower Elk River Watershed

Subwatershed	NPDES Permit No.	Name	Area	TSS Daily Maximum Limit	Status
			[acres]	[mg/l]	
0206	TN0056421	ROGERS GROUP, INC. - PULASKI QUARRY	99.31	40	Active
0206	TN0072907	HMA CONTRACTORS, LLC - PULASKI QUARRY	77.05	40	Active
0204	TN0076244	VULCAN CONSTRUCTION MATERIALS, LP - GILES COUNTY QUARRY	116.25	40	Active

Table 8 NPDES Regulated Ready Mixed Concrete Facilities in the Lower Elk River Watershed

Subwatershed	NPDES Permit No.	Name	Area	TSS Daily Maximum Limit
			[acres]	[mg/l]
0206	TNG110118	Abernathy Concrete Co., Inc.	4.0	50
0206	TNG110119	Mid - South Concrete, Inc.	2.8	50

Figure 8 Location of NPDES Permitted Construction Sites in the Lower Elk River Watershed



*Construction Storm Water Permits as of 06/09/03
(9 sites, 102.77 acres disturbed)

6.1.5 NPDES-Regulated Municipal Separate Storm Sewer Systems

At present, there are no MS4s in the Lower Elk River Watershed.

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

- Runoff from abandoned mines may be significant sources of solids loading. Mining activities typically involve 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 Lower Elk River Watershed, 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 the most appropriate for first phase sediment TMDLs in the Lower Elk 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 in lbs/acre/yr of these reference watersheds serve as target values for the Lower Elk 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 303(d) list and/or Proposed Final 2002 303(d) List (ref: Figure 4).

- Five percent of the ecoregion-based target load was reserved to account for WLAs for NPDES permitted WWTFs, mining sites, and RMCPs. Since the existing loads from these facilities are less than the five percent reserved in each impaired HUC-12 subwatershed, the difference provides for future growth and additional MOS (see Appendix E).

- The average annual sediment load of each impaired watershed was compared to the average annual load of the appropriate reference (biologically healthy) watershed, minus five percent, and a required percent reduction in loading calculated. Although the Sediment Tool uses the best road, elevation, and land use GIS coverages available, the resulting average annual sediment loads should not be interpreted as an absolute value. 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 for construction storm water sites and MS4s, and LAs are expressed as a percent reduction in average annual sediment loading. WLAs for WWTFs, mining sites, and RMCPs are equal to loads authorized by their existing permits. 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 subwatersheds containing waterbodies identified as impaired for siltation/habitat alteration are summarized in Table 9.

7.1 Waste Load Allocations

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

There are a total of 5 facilities in the Lower Elk River Watershed with individual NPDES permits that require monitoring of TSS or turbidity. Three of these facilities are located in subwatersheds with waterbodies identified as impaired due to siltation/habitat alteration on either the 1998 303(d) or Proposed Final 2002 303(d) List. WLAs, at a level equal to their permit limits for TSS, are provided for each of these facilities (see Table 10). 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 (see Appendix E). 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.

7.1.2 Waste Load Allocations for NPDES Regulated Ready Mixed Concrete Facilities

Both of the Ready Mixed Concrete Facilities in the Lower Elk River Watershed with NPDES permits, are located in impaired subwatersheds (ref: Table 8). Since loading from these facilities is negligible compared to other sources (see Appendix E), WLAs for RMCPs are specified to be equal to existing permitted discharge levels of TSS.

7.1.3 Waste Load Allocations for NPDES-Regulated Mining Activities

Of the 3 mines in the Lower Elk River Watershed with NPDES permits, two are located in impaired subwatersheds (ref: Table 7). All of these are limestone quarries. Since sediment loading from mine sites is small (see Appendix E) compared to total loading for Subwatershed 060300040206, WLAs are considered to be equal to the existing permit requirements for these sites.

Table 9 Sediment TMDLs for Subwatersheds with Waterbodies Impaired for Siltation/Habitat Alteration

HUC-12 SubWS	Waterbody ID	Waterbody Impaired by Siltation/ Habitat Alteration	Listing	Level IV Ecoregion	Existing Sediment Load	Target Load	Target Load Minus 5% WLA *	TMDL (required load reduction)
					[lbs/ac/yr]	[lbs/ac/yr]	[lbs/ac/yr]	[%]
0206	6030004017_0300	Unnamed Trib to Richland Creek	1998 303(d) & Proposed Final 2002 303(d)	71h	940	597.6	567.7	39.6
	06030004017_2000	Richland Creek	1998 303(d) & Proposed Final 2002 303(d)	71h	940	597.6	567.7	39.6
0205	6030004029	Weakley Creek	1998 303(d)	71f	1321	525.7	499.4	62.2
0201	06030004043_0300	Corn Creek	Proposed Final 2002 303(d)	71h	882	597.6	567.7	35.6

* 5% reserved for WLAs for WWTFs, mining sites, & RMCPs and additional MOS.

Table 10 WLAs for NPDES Permitted Wastewater Treatment Facilities

HUC-12 SubWS	NPDES Permit No.	Facility	WLA (as TSS)	
			Flow	Monthly Average Permit Limit
			[MGD]	[mg/L]
0206	TN0021687	Pulaski STP	4.0	30
0206	TN0054640	Tennessee Valley Recycling, LLC	0.2	40 *
0201	TN0061841	Cornersville STP	0.1	30

* Daily maximum limit.

7.1.4 Waste Load Allocations for NPDES-Regulated Construction Activities

Certain construction activities are regulated by the State's NPDES program (see Section 6.1.4). 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 or Proposed Final 2002 303(d) List as impaired due to siltation or habitat alteration (ref. Tables 2 & 3). 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 (minus 5%) of a biologically healthy (reference) subwatershed located in the same Level IV ecoregion (see Table 11).

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).

7.2 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 these TMDLs. LAs are established for each subwatershed containing a waterbody identified on the 1998 303(d) list or Proposed Final 2002 303(d) List as impaired due to siltation or habitat alteration (ref. Tables 2 & 3). 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 (minus 5%) of a biologically healthy (reference) subwatershed located in the same Level IV ecoregion (see Table 11). Properly designed and well-maintained BMPs will be necessary to assure that LAs are achieved.

Table 11 Summary of WLAs for Construction Storm Water Sites & LAs for Nonpoint Sources

Subwatershed	Level IV Ecoregion	% Reduction – Avg. Annual. Sediment Load		
		TMDL	WLAs (Construction SW)	LAs (Nonpoint Sources)
		[%]	[%]	[%]
0201	71h	35.6	35.6	35.6
0205	71f	62.2	62.2	62.2
0206	71h	39.6	39.6	39.6

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 Region IV's proposed future approach to sediment TMDLs is provided in Appendix C.

8.0 IMPLEMENTATION PLAN

8.1 Point Sources

8.1.1 NPDES-Regulated Municipal and Industrial Wastewater Treatment Facilities

WLAs for WWTFs located in impaired subwatersheds will be implemented through each facility's NPDES permit. Since TSS discharges from these facilities are small compared to the total existing average annual sediment loading in impaired subwatersheds, WLAs are equal to existing permit requirements.

8.1.2 NPDES Regulated Ready Mixed Concrete Facilities

WLAs for RMCPs will be implemented through NPDES Permit No. TNG110000, *General NPDES Permit for Discharges of Storm Water Runoff and Process Wastewater Associated With Ready Mixed Concrete Facilities*. Since discharges from these facilities are small compared to the total existing average annual sediment loading in impaired subwatersheds, WLAs are equal to existing permit requirements.

8.1.3 NPDES Regulated Mine Sites

WLAs for mining sites located in impaired subwatersheds will be implemented through each site's NPDES permit. Since TSS discharges from these facilities are small compared to the total existing average annual sediment loading in impaired subwatersheds, WLAs are equal to existing permit requirements.

8.1.4 NPDES-Regulated Construction Storm Water

The WLAs provided to future NPDES-regulated construction activities 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 Activit*y. It is not technically feasible to incorporate numeric sediment limits into permits for these activities at this time. WLAs should <u>not</u> be construed as numeric permit limits.

Construction sites in Tennessee disturbing one acre or more are currently required to obtain coverage under the *General NPDES Permit for Storm Water Discharges Associated With Construction Activit*y (see Appendix F). 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 these TMDLs. 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 Activit*y 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.

8.2 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: http://www.state.tn.us/environment/wpc/watershed).

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 *Lower Elk River Watershed Management Plan* will be developed in 2003 and will describe, 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 Lower Elk River Watershed, including the reduction of pollutant loading.

Governmental agencies include :

- Natural Resources Conservation Service
- USGS Water Resource Programs—Tennessee District
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service
- Tennessee Valley Authority
- TDEC - Division of Water Supply
- TDEC Division of Community Assistance
- Tennessee Department of Agriculture
- Alabama Department of Environmental Management

Local stakeholder groups include:

- Friends of the Elk River

With respect to the reduction of nonpoint source sediment loading and habitat alteration, government agency and stakeholders 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 large number of stream alteration activities that have the potential to effect sediment loading to surface waters in the Lower Elk River Watershed. In Tennessee, Aquatic Resource Alteration Permits (ARAPs) are required for <u>any</u> 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 Lower Elk River Watershed will be placed on Public Notice for a 35-day period and comments solicited. Steps that will be taken in this regard include:

1) Notice of the proposed TMDLs was posted on the Tennessee Department of Environment and Conservation website (see Appendix G). The notice invited public and stakeholder comments and provided a link to a downloadable version of the TMDL document.

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 on July 21, 2003.

3) A letter was sent to point source facilities in the Lower Elk River Watershed 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 stated that a written copy of the draft TMDL document would be provided on request.

No public comments were received during the Public Notice Period.

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:

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

Technical questions regarding these TMDLs 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

REFERENCES

OMAFRA. 2000. *Factsheet: Universal Soil Loss Equation (USLE*). Ontario Ministry of Agriculture, Food and Rural Affairs website: www.gov.on.ca/OMARFA/english/engineer/facts/00-001.htm.

Plafkin, J.L., Barbour, M.T., Porter, K.D., Gross, S.K., and R.M. Hughes. 1989. *Rapid Bioassessment Protocols for Use in Streams and Rivers*. U.S. Environmental Protection Agency, Office of Water, Washington D.C. EPA/440/4-89/001, May, 1989.

Sun, G. and S.G. McNulty. 1998. *Modeling Soil Erosion and Transport on Forest Landscape*. Proceedings of Conference 29, International Erosion Control Association. pp.187-198.

Swift, Lloyd W. 2000. *Equation to Dissipate Sediment from a Gridcell Downslope*. U.S. Forest Service.

TDEC. 1998. *Final 1998 303(d) List, June 1998 (Revised July and September 1998).* State of Tennessee, Department of Environment and Conservation, Division of Water Pollution Control.

TDEC. 1999. *State of Tennessee Water Quality Standards, Chapter 1200-4-3 General Water Quality Criteria, October 1999.* State of Tennessee, Department of Environment and Conservation, Division of Water Pollution Control.

TDEC. 2002. *The Status of Water Quality in Tennessee, Year 2002 305(b) Report.* State of Tennessee, Department of Environment and Conservation, Division of Water Pollution Control.

TDEC. 2000a. *Tennessee Ecoregion Project 1994 - 1999.* State of Tennessee, Department of Environment and Conservation, Division of Water Pollution Control, December, 2000.

TDEC. 2000b. *Aquatic Resource Alteration, Chapter 1220-4-7, November, 2000 (Revised).* State of Tennessee, Department of Environment and Conservation, Division of Water Pollution Control.

TDEC. 2002 *Proposed Final Version Year 2002 303(d) List, September 2002.* State of Tennessee, Department of Environment and Conservation, Division of Water Pollution Control.

USDASCS. 1983. *Sedimentation*. National Engineering Handbook, Section 3, Chapter 6. U.S. Department of Agriculture Soil Conservation Service.

USEPA, 1991. *Guidance for Water Quality –based Decisions: The TMDL Process.* U.S. Environmental Protection Agency, Office of Water, Washington, DC. EPA-440/4-91-001, April 1991.

USEPA. 1997. *Ecoregions of Tennessee*. U.S. Environmental Protection Agency, National Health and Environmental Effects Research Laboratory, Corvallis, Oregon. EPA/600/R-97/022.

USEPA, 1999. *Protocol for Developing Sediment TMDLs*. U.S. Environmental Protection Agency, Office of Water, Washington, DC. EPA 841-B-99-004, October 1999.

USEPA. 2001. *Watershed Characterization System – User's Manual*. U.S. Environmental Protection Agency, Region 4, Atlanta, Georgia.

Yagow, E.R., V.O. Schanholtz, B.A. Julian, and J.M. Flagg. 1998. *A Water Quality Module for CAMPS*. American Society of Agricultural Engineers Meeting Presentation Paper No. 88-2653.

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 waterbodies impaired for siltation/habitat alteration was accomplished utilizing the Watershed Characterization System (WCS) Sediment Tool (v.2.6). 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:

<u>R - Rainfall Erosivity Index</u>
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.

<u>K - Soil Erodibility Factor</u>
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.

<u>LS - Topographic Factor</u>
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.

<u>C – Crop/Vegetation & Management Factor</u>
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 these TMDLs. 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 17 subwatersheds corresponding to USGS 12-digit Hydrologic Unit Codes (HUCs). These delineations are shown in Figure 6. 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. A stream grid for each delineated subwatershed was created by etching a stream coverage, based on Reach File v. 3 (Rf3) or National Hydrology Dataset (NHD), to the DEM grid.

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)
     $DR = 0.417762 * A^{(-0.134958)} - 1.27097$, 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 Lower Elk River Watershed.

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-1, A-2, and A-3, respectively. Similar information for subwatersheds that do not contain 303(d) listed waters are summarized in Tables A-4, A-5, and A-6.

Table A-1 Calculated Erosion - Subwatersheds With Waterbodies on the 1998 303(d) List and/or Proposed Final 2002 303(d) List

Subwatershed	EROSION				
	Source [tons/yr]	Road [tons/yr]	Total [tons/yr]	%Source	%Road
60300040201	22607	6436	29042	77.8%	22.2%
60300040205	56162	13841	70003	80.2%	19.8%
60300040206	31220	16871	48091	64.9%	35.1%

Table A-2 Calculated Sediment Delivery to Surface Waters - Subwatersheds With Waterbodies on the 1998 303(d) List and/or Proposed Final 2002 303(d) List

Subwatershed	SEDIMENT				
	Source [tons/yr]	Road [tons/yr]	Total [tons/yr]	%Source	%Road
60300040201	9098	4398	13496	67.4%	32.6%
60300040205	22040	8411	30451	72.4%	27.6%
60300040206	10690	7753	18443	58.0%	42.0%

Table A-3 Unit Loads - Subwatersheds With Waterbodies on the 1998 303(d) List and/or Proposed Final 2002 303(d) List

Subwatershed	UNIT LOADS		
	Erosion	Sediment	
	[tons/ac/yr]	[tons/ac/yr]	[lbs/ac/yr]
60300040201	0.948	0.441	882
60300040205	1.518	0.660	1321
60300040206	1.225	0.470	940

Table A-4 Calculated Erosion - Subwatersheds Without Waterbodies on the 1998 303(d) List or Proposed Final 2002 303(d) List

Subwatershed	EROSION				
	Source [tons/yr]	Road [tons/yr]	Total [tons/yr]	%Source	%Road
60300040101	22286	8185	30471	73.1%	26.9%
60300040102	21618	8598	30216	71.5%	28.5%
60300040104	2331	310	2641	88.3%	11.7%
60300040202	27010	6833	33843	79.8%	20.2%
60300040203	33717	6975	40692	82.9%	17.1%
60300040204	29823	8999	38822	76.8%	23.2%
60300040207	7230	9749	16979	42.6%	57.4%
60300040208	8234	1905	10140	81.2%	18.8%
60300040301	39663	4785	44448	89.2%	10.8%
60300040302	16007	2761	18768	85.3%	14.7%
60300040303	13816	4655	18471	74.8%	25.2%
60300040401	37589	13390	50979	73.7%	26.3%
60300040402	35930	7087	43017	83.5%	16.5%
60300040403	6507	3526	10033	64.9%	35.1%

Table A-5 Calculated Sediment Delivery to Surface Waters- Subwatersheds Without Waterbodies on the 1998 303(d) List or Proposed Final 2002 303(d) List

Subwatershed	SEDIMENT				
	Source [tons/yr]	Road [tons/yr]	Total [tons/yr]	%Source	%Road
60300040101	9023	4548	13571	66.5%	33.5%
60300040102	8601	5067	13669	62.9%	37.1%
60300040104	936	115	1051	89.0%	11.0%
60300040202	10582	3668	14250	74.3%	25.7%
60300040203	13242	4520	17762	74.6%	25.4%
60300040204	11487	5144	16630	69.1%	30.9%
60300040207	2361	5828	8189	28.8%	71.2%
60300040208	2658	907	3565	74.6%	25.4%
60300040301	16675	2985	19660	84.8%	15.2%
60300040302	6083	1806	7889	77.1%	22.9%
60300040303	5766	3221	8988	64.2%	35.8%
60300040401	12948	8159	21107	61.3%	38.7%
60300040402	14417	3515	17931	80.4%	19.6%
60300040403	1938	1863	3800	51.0%	49.0%

Table A-6 Unit Loads - Subwatersheds Without Waterbodies on the 1998 303(d) List or Proposed Final 2002 303(d) List

Subwatershed	*UNIT LOADS*		
	Erosion	Sediment	
	[tons/ac/yr]	[tons/ac/yr]	[lbs/ac/yr]
60300040101	1.124	0.501	1001
60300040102	1.002	0.453	907
60300040104	1.117	0.445	889
60300040202	1.134	0.478	955
60300040203	1.185	0.517	1035
60300040204	1.039	0.445	890
60300040207	0.629	0.303	606
60300040208	0.847	0.298	596
60300040301	1.797	0.795	1590
60300040302	1.440	0.605	1211
60300040303	1.020	0.496	992
60300040401	1.226	0.508	1015
60300040402	1.335	0.556	1113
60300040403	0.882	0.334	668

APPENDIX B

Subwatershed Land Use

Table B-1 Lower Elk River Watershed – Subwatershed Land Use Distribution

Land Use	Subwatershed											
	0101		0102		0104		0201		0202		0203	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%
Deciduous Forest	12773.0	47.1%	19981.0	66.3%	529.0	17.4%	12335.0	40.3%	9312.0	31.2%	14460.0	42.1%
Emergent Herbaceous Wetlands	26.0	0.1%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%
Evergreen Forest	874.0	3.2%	621.0	2.1%	62.0	2.0%	653.0	2.1%	625.0	2.1%	448.0	1.3%
High Intensity Commercial / Industrial / Transportation	41.0	0.2%	68.0	0.2%	1.0	0.0%	83.0	0.3%	132.0	0.4%	48.0	0.1%
High Intensity Residential	9.0	0.0%	0.0	0.0%	0.0	0.0%	4.0	0.0%	1.0	0.0%	7.0	0.0%
Low Intensity Residential	98.0	0.4%	78.0	0.3%	4.0	0.1%	91.0	0.3%	19.0	0.1%	66.0	0.2%
Mixed Forest	3128.0	11.5%	1954.0	6.5%	241.0	7.9%	3551.0	11.6%	3706.0	12.4%	3501.0	10.2%
Open Water	359.0	1.3%	14.0	0.0%	1.0	0.0%	2.0	0.0%	35.0	0.1%	5.0	0.0%
Other Grasses (Urban / Recreational)	78.0	0.3%	0.0	0.0%	0.0	0.0%	141.0	0.5%	21.0	0.1%	29.0	0.1%
Pasture / Hay	6816.0	25.1%	5849.0	19.4%	1070.0	35.2%	12269.0	40.1%	13696.0	45.9%	13447.0	39.2%
Quarries / Strip Mines / Gravel Pits	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%
Row Crops	2858.0	10.5%	1140.0	3.8%	456.0	15.0%	1458.0	4.8%	2224.0	7.5%	2276.0	6.6%
Transitional	2.0	0.0%	437.0	1.4%	0.0	0.0%	0.0	0.0%	1.0	0.0%	0.0	0.0%
Woody Wetlands	41.0	0.2%	0.0	0.0%	672.0	22.1%	22.0	0.1%	49.0	0.2%	38.0	0.1%
Total	27103.0	100.0%	30142.0	100.0%	3036.0	100.0%	30609.0	100.0%	29821.0	100.0%	34325.0	100.0%

Table B-1 (cont.) Lower Elk River Watershed – Subwatershed Land Use Distribution

Land Use	Subwatershed											
	0204		0205		0206		0207		0208		0301	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%
Deciduous Forest	14638.0	39.2%	27356.0	59.3%	14905.0	38.0%	12818.0	47.5%	3897.0	32.6%	14976.0	60.6%
Emergent Herbaceous Wetlands	12.0	0.0%	0.0	0.0%	40.0	0.1%	0.0	0.0%	34.0	0.3%	0.0	0.0%
Evergreen Forest	605.0	1.6%	655.0	1.4%	1353.0	3.4%	959.0	3.6%	581.0	4.9%	105.0	0.4%
High Intensity Commercial / Industrial / Transportation	39.0	0.1%	71.0	0.2%	392.0	1.0%	45.0	0.2%	17.0	0.1%	11.0	0.0%
High Intensity Residential	3.0	0.0%	0.0	0.0%	210.0	0.5%	0.0	0.0%	0.0	0.0%	0.0	0.0%
Low Intensity Residential	52.0	0.1%	59.0	0.1%	943.0	2.4%	39.0	0.1%	41.0	0.3%	13.0	0.1%
Mixed Forest	4366.0	11.7%	2646.0	5.7%	4568.0	11.6%	3280.0	12.2%	1639.0	13.7%	493.0	2.0%
Open Water	137.0	0.4%	16.0	0.0%	193.0	0.5%	9.0	0.0%	109.0	0.9%	5.0	0.0%
Other Grasses (Urban / Recreational)	85.0	0.2%	16.0	0.0%	579.0	1.5%	0.0	0.0%	8.0	0.1%	1.0	0.0%
Pasture / Hay	14158.0	37.9%	10816.0	23.5%	13242.0	33.7%	9577.0	35.5%	4579.0	38.3%	4230.0	17.1%
Quarries / Strip Mines / Gravel Pits	23.0	0.1%	10.0	0.0%	51.0	0.1%	10.0	0.0%	0.0	0.0%	0.0	0.0%
Row Crops	2446.0	6.5%	4167.0	9.0%	2411.0	6.1%	238.0	0.9%	1049.0	8.8%	4063.0	16.4%
Transitional	518.0	1.4%	282.0	0.6%	5.0	0.0%	0.0	0.0%	2.0	0.0%	830.0	3.4%
Woody Wetlands	267.0	0.7%	0.0	0.0%	346.0	0.9%	19.0	0.1%	2.0	0.0%	0.0	0.0%
Total	37349.0	100.0%	46094.0	100.0%	39238.0	100.0%	26994.0	100.0%	11958.0	100.0%	24727.0	100.0%

Table B-1 (cont.) Lower Elk River Watershed – Subwatershed Land Use Distribution

Land Use	Subwatershed									
	0302		0303		0401		0402		0403	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%
Deciduous Forest	9391.0	72.1%	9424.0	52.1%	23168.0	55.8%	12659.0	39.3%	5265.0	46.3%
Emergent Herbaceous Wetlands	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%
Evergreen Forest	67.0	0.5%	215.0	1.2%	1913.0	4.6%	249.0	0.8%	243.0	2.1%
High Intensity Commercial / Industrial / Transportation	1.0	0.0%	3.0	0.0%	70.0	0.2%	69.0	0.2%	23.0	0.2%
High Intensity Residential	0.0	0.0%	0.0	0.0%	2.0	0.0%	2.0	0.0%	7.0	0.1%
Low Intensity Residential	12.0	0.1%	13.0	0.1%	71.0	0.2%	127.0	0.4%	76.0	0.7%
Mixed Forest	270.0	2.1%	1721.0	9.5%	3394.0	8.2%	2020.0	6.3%	964.0	8.5%
Open Water	0.0	0.0%	54.0	0.3%	20.0	0.0%	24.0	0.1%	10.0	0.1%
Other Grasses (Urban / Recreational)	7.0	0.1%	0.0	0.0%	0.0	0.0%	10.0	0.0%	0.0	0.0%
Pasture / Hay	2219.0	17.0%	5312.0	29.3%	9222.0	22.2%	12425.0	38.6%	4112.0	36.2%
Quarries / Strip Mines / Gravel Pits	14.0	0.1%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%
Row Crops	851.0	6.5%	1363.0	7.5%	3204.0	7.7%	4520.0	14.0%	596.0	5.2%
Transitional	197.0	1.5%	0.0	0.0%	458.0	1.1%	102.0	0.3%	0.0	0.0%
Woody Wetlands	0.0	0.0%	0.0	0.0%	34.0	0.1%	12.0	0.0%	70.0	0.6%
Total	13029.0	100.0%	18105.0	100.0%	41556.0	100.0%	32219.0	100.0%	11366.0	100.0%

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

Land Use	Ecosite Subwatershed											
	ECO71F12		ECO71F16		ECO71F19		ECO71F27		ECO71F28		ECO71G3	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%
Deciduous Forest	4839.0	71.7%	9655.0	97.7%	6610.0	81.0%	1888.0	59.0%	4920.0	88.5%	6703.0	47.4%
Emergent Herbaceous Wetlands	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%
Evergreen Forest	39.0	0.6%	21.0	0.2%	163.0	2.0%	909.0	28.4%	157.0	2.8%	1206.0	8.5%
High Intensity Commercial / Industrial / Transportation	1.0	0.0%	7.0	0.0%	2.0	0.0%	10.0	0.3%	6.0	0.1%	13.0	0.1%
High Intensity Residential	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%
Low Intensity Residential	5.0	0.1%	0.0	0.0%	2.0	0.0%	0.0	0.0%	1.0	0.0%	90.0	0.6%
Mixed Forest	155.0	2.3%	68.0	0.7%	159.0	1.9%	233.0	7.3%	108.0	1.9%	2635.0	18.6%
Open Water	2.0	0.0%	0.0	0.0%	1.0	0.0%	0.0	0.0%	1.0	0.0%	2.0	0.0%
Other Grasses (Urban / Recreational)	0.0	0.0%	0.0	0.0%	1.0	0.0%	0.0	0.0%	4.0	0.1%	175.0	1.2%
Pasture / Hay	1242.0	18.4%	94.0	1.0%	341.0	4.2%	6.0	0.2%	199.0	3.6%	3138.0	22.2%
Quarries / Strip Mines / Gravel Pits	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%
Row Crops	461.0	6.8%	0.0	0.0%	668.0	8.2%	48.0	1.5%	139.0	2.5%	184.0	1.3%
Transitional	1.0	0.0%	33.0	0.3%	177.0	2.2%	108.0	3.4%	23.0	0.4%	0.0	0.0%
Woody Wetlands	0.0	0.0%	0.0	0.0%	36.0	0.4%	0.0	0.0%	0.0	0.0%	0.0	0.0%
Total	6745.0	100.0%	9878.0	99.9%	8160.0	100.0%	3202.0	100.0%	5558.0	100.0%	14146.0	100.0%

Table B-2 (Cont.) Level IV Ecoregion Reference Site Drainage Area Land Use Distribution

Land Use	Ecosite Subwatershed									
	ECO71G4		ECO71G10		ECO71H3		ECO71H6		ECO71H9	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%
Deciduous Forest	9087.0	53.2%	2726.0	76.5%	6784.0	81.6%	7788.0	88.7%	6264.0	79.0%
Emergent Herbaceous Wetlands	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%
Evergreen Forest	384.0	2.2%	80.0	2.2%	137.0	1.6%	137.0	1.6%	245.0	3.1%
High Intensity Commercial / Industrial / Transportation	143.0	0.8%	23.0	0.6%	20.0	0.0%	2.0	0.0%	6.0	0.1%
High Intensity Residential	4.0	0.0%	0.0	0.0%	14.0	0.2%	0.0	0.0%	0.0	0.0%
Low Intensity Residential	132.0	0.8%	3.0	0.1%	136.0	1.6%	2.0	0.0%	36.0	0.5%
Mixed Forest	1612.0	9.4%	169.0	4.7%	757.0	9.1%	604.0	6.9%	722.0	9.1%
Open Water	3.0	0.0%	0.0	0.0%	0.0	0.0%	1.0	0.0%	0.0	0.0%
Other Grasses (Urban / Recreational)	33.0	0.2%	54.0	1.5%	52.0	0.6%	0.0	0.0%	0.0	0.0%
Pasture / Hay	4331.0	25.3%	335.0	9.4%	395.0	4.7%	193.0	2.2%	494.0	6.2%
Quarries / Strip Mines / Gravel Pits	42.0	0.2%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%
Row Crops	1319.0	7.7%	170.0	4.8%	23.0	0.3%	50.0	0.6%	167.0	2.1%
Transitional	0.0	0.0%	5.0	0.1%	0.0	0.0%	1.0	0.0%	0.0	0.0%
Woody Wetlands	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%
Total	17090.0	100.0%	3565.0	100.0%	8318.0	99.8%	8778.0	100.0%	7934.0	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, 2000). 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 Corvallis 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 Lower Elk River Watershed sediment TMDL are summarized in Table D-1.

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

Reference Stream ID Code	Collection Method*	Sample Date	Total # of Individuals	Taxa Richness	EPT Taxa Richness	EPT Abundance	% Chironomidae	North Carolina Biotic Index	% Clingers % Cling	% Tolerant Organisms % Tol	Tennessee Stream Condition Index
ECO71F12	SQKICK	4/22/97	177	31	10	41.2	48.6	3.82	32.2	6.0	30
ECO71F12	SQKICK	4/22/98	192	30	8	22.4	37.5	5.27	28.1	33.3	22
ECO71F12	SQKICK	5/10/99	179	30	12	31.3	12.3	4.85	69.3	14.7	32
ECO71F12	SQKICK	9/25/96	200	28	11	54.6	11.9	4.62	65.4	15.9	36
ECO71F12	SQKICK	8/25/97	187	31	11	51.9	5.9	4.91	47.6	16.3	32
ECO71F12	SQKICK	8/5/98	188	31	11	65.4	9.6	4.68	53.2	17.9	34
ECO71F16	SQKICK	5/29/98	189	30	13	37.6	3.2	4.25	58.2	4.5	36
ECO71F16	SQKICK	5/10/99	203	30	10	30.5	42.9	3.93	40.4	8.9	29
ECO71F16	SQKICK	9/9/98	190	27	10	41.6	16.3	4.85	43.7	7.7	32
ECO71F19	SQKICK	5/14/97	185	28	10	58.4	25.9	3.25	48.1	14.2	36
ECO71F19	SQKICK	5/19/98	187	33	11	54.5	18.7	3.24	61.0	21.9	38
ECO71F19	SQKICK	6/7/99	176	31	10	35.8	31.3	3.69	58.5	8.1	32
ECO71F19	SQKICK	10/4/96	200	33	11	50.2	6.5	3.89	53.6	12.7	34
ECO71F19	SQKICK	9/3/97	178	32	11	68.0	14.0	3.64	53.4	14.3	36
ECO71F19	SQKICK	9/21/98	197	31	13	58.9	16.8	4.22	38.6	14.4	36
ECO71F27	SQKICK	4/21/97	194	38	17	44.3	13.4	3.78	45.9	18.9	38
ECO71F27	SQKICK	5/5/98	208	43	16	52.9	10.6	2.96	56.7	18.2	40
ECO71F27	SQKICK	6/7/99	170	32	11	47.6	14.7	3.72	59.4	13.2	36
ECO71F27	SQKICK	10/9/96	227	38	13	45.8	7.0	4.61	30.0	27.3	30
ECO71F27	SQKICK	9/11/97	190	38	13	22.1	16.8	4.09	48.4	22.0	34
ECO71F27	SQKICK	9/21/98	182	39	12	33.5	23.6	4.12	43.4	17.2	34
ECO71F28	SQKICK	5/14/97	184	25	9	32.6	20.1	3.36	65.2	7.8	32
ECO71F28	SQKICK	5/5/98	184	24	8	43.5	13.0	2.58	76.6	6.6	34
ECO71F28	SQKICK	6/7/99	228	22	10	62.7	27.6	5.73	39.9	31.1	28
ECO71F28	SQKICK	10/4/96	200	25	10	53.0	3.8	3.24	75.4	4.1	36

* semiquanitative kick

Table D-1 (Cont.) Biometric & Index Scores of Target Ecoregion Reference Sites

Reference Stream ID Code	Collection Method*	Sample Date	Total # of Individuals	Taxa Richness	EPT Taxa Richness	EPT Abundance	% Chironomidae	North Carolina Biotic Index	% Clingers % Cling	% Tolerant Organisms % Tol	Tennessee Stream Condition Index
ECO71F28	SQKICK	9/3/97	208	29	13	66.8	1.9	4.10	46.6	18.0	36
ECO71F28	SQKICK	9/21/98	239	26	10	63.2	24.7	4.37	55.6	2.6	36
ECO71G03	SQKICK	4/28/98	226	41	18	41.2	13.7	3.88	57.1	14	40
ECO71G03	SQKICK	6/16/99	213	35	15	35.7	14.1	4.06	58.2	8.3	36
ECO71G03	SQKICK	9/14/98	188	29	12	56.9	7.4	4.11	69.1	5.4	38
ECO71G04	SQKICK	4/28/98	237	36	11	65.8	9.3	3.66	44.7	16	38
ECO71G04	SQKICK	6/16/99	175	26	9	48.6	9.1	4.28	54.9	9.9	32
ECO71G04	SQKICK	9/14/98	201	33	7	55.7	26.4	4.28	44.3	9.5	32
ECO71G10	SQKICK	5/1/97	223	36	14	74.9	15.7	3.01	43.5	2.8	36
ECO71G10	SQKICK	4/23/98	231	32	13	77.5	6.5	2.6	51.9	5.4	36
ECO71G10	SQKICK	6/8/99	188	29	13	50.5	12.8	4.28	75	31.1	34
ECO71G10	SQKICK	9/30/96	200	24	9	75.2	3.2	3.7	49.8	4.2	34
ECO71G10	SQKICK	10/10/97	164	24	9	85.4	4.3	4.53	67.7	1.9	34
ECO71G10	SQKICK	9/8/98	190	25	11	80.5	6.3	4.07	67.4	3.7	38
ECO71H03	SQKICK	5/6/97	231	30	12	61.9	6.9	2.43	70.1	3.5	38
ECO71H03	SQKICK	5/4/98	215	31	14	49.3	1.9	2.15	84.2	5.3	38
ECO71H03	SQKICK	6/2/99	182	30	11	52.2	22.5	4.35	36.3	13.3	34
ECO71H03	SQKICK	10/14/96	200	25	12	39.7	2	3.22	75.3	9.9	36
ECO71H03	SQKICK	8/20/97	186	36	11	43	15.6	4.77	38.7	30.2	34
ECO71H03	SQKICK	9/17/98	186	29	11	55.9	21.5	4.3	60.8	12.8	38
ECO71H06	SQKICK	5/12/97	169	29	8	62.7	18.3	3.07	43.2	10.1	34
ECO71H06	SQKICK	4/13/98	188	20	8	70.7	2.1	2.59	62.2	3.8	34
ECO71H06	SQKICK	6/11/99	196	33	10	43.4	43.9	5.29	21.4	33.5	26
ECO71H06	SQKICK	10/16/96	200	30	11	38.5	6.9	3.33	61.5	6.8	36
ECO71H06	SQKICK	8/21/97	176	27	14	72.2	13.1	3.44	50.6	5.7	38

* semiquanitative kick

Table D-1 (Cont.) Biometric & Index Scores of Target Ecoregion Reference Sites

Reference Stream ID Code	Collection Method*	Sample Date	Total # of Individuals	Taxa Richness	EPT Taxa Richness	EPT Abundance	% Chironomidae	North Carolina Biotic Index	% Clingers % Cling	% Tolerant Organisms % Tol	Tennessee Stream Condition Index
ECO71H06	SQKICK	8/31/98	191	22	9	58.1	19.4	4.35	40.8	10.1	32
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	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	5.53	34.7	20.1	29

* semiquanitative kick

APPENDIX E

Estimate of Existing Point Source Loads for NPDES Permitted Wastewater Treatment Facilities, Mining Sites, & Ready Mix Concrete Plants

Determination of Existing Point Source Sediment Loads

Existing point source sediment loads for several classes of permitted facilities located in impaired HUC-12 subwatersheds were estimated using the methodologies described below.

Wastewater Treatment Facilities (WWTFs)

Existing loads for WWTFs are based on facility design flow, the monthly average permit limit for TSS, and the area of the HUC-12 subwatershed in which the facility is located. Loads are expressed as average annual loads per unit area and are summarized in Table E-1.

$$AAL_{WWTF} = \frac{(Q_d) \times (MAvg)\ (8.34\ \text{lb-l/gal-mg})\ (365\ \text{days/yr})}{(A_{HUC\text{-}12})}$$

where: AAL = Average annual load [lb/ac/yr]
Q_d = Facility design flow [MGD]
MAvg = Monthly average concentration limit for TSS [mg/l]
$A_{HUC\text{-}12}$ = Area of impaired HUC-12 subwatershed [acres]

Table E-1 Estimate of Existing Load – Wastewater Treatment Facilities

HUC-12 Subwatershed (06030004___)	Subwatershed Area [acres]	NPDES Permit No.	Design Flow [MGD]	Monthly Average TSS Limit [mg/l]	Annual Average Load [lb/ac/yr]
0201	30,609	TN0061841	0.1	30	0.30
0206	39,238	TN0021687	4.0	30	9.31
		TN0065640	0.2	40 *	0.62

* Daily maximum limit.

Mining Sites

Existing loads for permitted mining sites are based on an assumed runoff from the site drainage area, the daily maximum permit limit for TSS, and the area of the HUC-12 subwatershed in which the mining site is located (see Table E-2). Site runoff was estimated by assuming that one half of the annual precipitation falling on the site area results in runoff. Annual precipitation for the Lower Elk watershed is approximately 52 in/yr.

$$AAL_{Mining} = \frac{(A_d)\ (DMax)\ (Precip)\ (0.2266\ lb\text{-}l/ac\text{-}in\text{-}mg)\ (0.5)}{(A_{HUC\text{-}12})}$$

where: AAL = Average annual load [lb/yr]
A_d = Facility drainage area [acres]
DMax = Daily maximum concentration limit for TSS [mg/l]
Precip = Average annual precipitation for watershed [in/yr]
$A_{HUC\text{-}12}$ = Area of impaired HUC-12 subwatershed [acres]

Table E-2 Estimate of Existing Load – NPDES Permitted Mining Sites

HUC-12 Subwatershed (06030004___)	Subwatershed Area	Precip.	NPDES Permit No.	Site Drainage Area	Daily Maximum TSS Limit	Annual Average Load
	[acres]	[in/yr]		[acres]	[mg/l]	[lb/ac/yr]
0206	39,238	52	TN0056421	99.31	40	0.60
		52	TN0072907	77.05	40	0.46

Ready Mix Concrete Plants (RMCPs)

Total loading from RMCPs is the sum of loading from process wastewater discharges and storm water runoff. Estimates of loading (see Table E-3) from these two sources were determined using methods similar to those used to determine WWTF and mining site loads.

Table E-3 Estimate of Existing Loads – Ready Mix Concrete Plants

HUC-12 SubWS (06030004__)	SubWS Area	NPDES Permit No.	Process Wastewater		Storm Water Runoff		Total Annual Average Load
			Est. Flow	Daily Maximum TSS Limit	Site Drainage Area	TSS Cut-off Concen.	
	[acres]		[MGD]	[mg/l]	[acres]	[mg/l]	[lb/ac/yr]
0206	39,238	TNG110118	0.0001	50	4.0	200	0.12
		TNG110119	0.0001	50	2.8	200	0.08

Total Existing Point Source Loads for Impaired HUC-12 Subwatersheds

Estimated point source loads were summed for each impaired HUC-12 subwatershed and then compared to both existing and target subwatershed sediment loads (see Table E-4).

Table E-4 Estimate of Existing Point Source Loads in Impaired HUC-12 Subwatersheds

HUC-12 SubWS (06030004__)	NPDES Permit No.	Facility Type	Avg. Annual. Point Source Load	Total Existing Subwatershed Load	Point Source Percentage of Total Existing Load	Subwatershed Target Load	Point Source Percentage of Target Load
			[lb/ac/yr]	[lb/ac/yr]	[%]	[lb/ac/yr]	[%]
0201	TN0061841	WWTF	0.30	882	0.03	597.6	0.05
0205	NA	NA	NA	1,321	NA	525.7	NA
0206	TN0021687	WWTF	9.31				
	TN0054640	WWTF	0.62				
	TN0056421	Mining	0.60				
	TN0072907	Mining	0.46				
	TNG110118	RMCP	0.12				
	TNG110119	RMCP	0.08				
	Subwatershed Total		11.19	940	1.19	597.6	1.87

APPENDIX F

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 Lower Elk 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 one acre or more and activities that result in the disturbance of less than one acre if it is part of a larger common plan of development or sale. 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. 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 3.7 inches/24 hours for the Lower Elk 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.

<u>Additional requirements are specified for discharges into waters listed on the Tennessee 303(d) list for siltation</u>. 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 G

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 LOWER ELK RIVER WATERSHED (HUC 06030004), TENNESSEE

Announcement is hereby given of the availability of Tennessee's proposed Total Maximum Daily Loads (TMDLs) for siltation and habitat alteration in the Lower Elk 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 Lower Elk River watershed are listed on Tennessee's final 1998 303(d) list and/or Proposed Final 2002 303(d) list as not supporting designated use classifications due, in part, to siltation and habitat alteration associated with resource extraction, land development, riparian loss, 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 reductions in sediment loading which will result in reduced in-stream concentrations and the attainment of water quality standards. The TMDLs require reductions in sediment loading of approximately 32 to 60% 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

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

Regan W. McGahen, Watershed Management Section
Telephone: 615-532-0644

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 August 25, 2003 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.