

TOTAL MAXIMUM DAILY LOAD (TMDL)

For Sediment

In the Upper Chattahoochee River Basin

**White Creek
And
Hazel Creek**

HUC 03130001

February 2003



In compliance with the provisions of the Federal Clean Water Act, 33 U.S.C §1251 et.seq., as amended by the Water Quality Act of 1987, P.L. 400-4, the U.S Environmental Protection Agency is hereby establishing Total Maximum Daily Loads (TMDLs) for sediment for White and Hazel Creek in the Upper Chattahoochee River Basin. Subsequent actions must be consistent with this TMDL.

Signed February 28, 2003

James D. Giattina, Director

Date

Water Management Division

TOTAL MAXIMUM DAILY LOAD (TMDL)

Sediment

In the Chattahoochee River Basin

Under the authority of Section 303(d) of the Clean Water Act, 33 U.S.C. 1251 *et seq.*, as amended by the Water Quality Act of 1987, P.L. 100-4, the U.S. Environmental Protection Agency is hereby proposing a TMDL for sediment for the protection of aquatic life in the following segments of the Chattahoochee River Basin in Georgia:

White Creek in Southern Upper Piedmont Ecoregion (biota and habitat due to sediment)

Hazel Creek in Southern Upper Piedmont Ecoregion (biota and habitat due to sediment)

The calculated allowable load of sediment that may come into the identified segments of the Upper Piedmont Ecoregion in the Chattahoochee River Basin without exceeding the water quality target is an annual loading of 0.4 tons/acre/year. EPA interpreted the State of Georgia's narrative water quality standard for fish and wildlife to determine the applicable water quality target. Based on the current estimated annual loading for White Creek of 1.0 ton/acre/year, a sixty (60%) percent reduction in the existing sediment loads is needed. Based on the current estimated annual loading for Hazel Creek of 1.25 ton/acre/year a seventy (70%) percent reduction in the existing sediment load is needed. To achieve the watershed sediment load reductions needed for the watersheds, it is recommended that Best Management Practices and continued compliance with the State of Georgia's stormwater construction permit be maintained and enforced to allow the stream to purge itself of the historic sediment loads and maintain standards.

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1. Executive Summary

1. 303(d) Listed Waterbody Information

State: Georgia

Major River Basin: Upper Chattahoochee River Basin

Watershed: Wolf River - HUC03130001

Impaired Waterbodies (2002 303(d) List):

Table 1: Impaired Waterbody List

Watershed ID	Segment Names	County	Ecoregion	Not Support (miles)
GA03130001000050	Hazel Creek.	Habersham	Upper Piedmont Ecoregion	5
GA03130001001056	White Creek	White	Upper Piedmont Ecoregion	10

Constituent(s) Causing Impairment: Sediment causing habitat and biota problems

Designated Uses: Fishing

Applicable Water Quality Standard:

The calculated allowable load of sediment that may come into the identified segments of the Upper Piedmont Ecoregion in the Chattahoochee River Basin without exceeding the water quality target is an annual loading of 0.4 tons/acre/year. EPA interpreted the State of Georgia's narrative water quality standard for fish and wildlife for the protection of aquatic life to determine the applicable water quality target.

2. TMDL Development

Analysis/Modeling:

The link between the habitat alteration due to sediment loads and the identified sources of sediment is the basis for the development of the TMDL. The linkage is defined as the cause and effect relationship between the selected indicators and identified sources. This provides the basis for estimating the total assimilative capacity of the river and any needed load reductions. Watershed-scale loading of sediment in water was simulated using the Watershed Characterization System (WCS) (USEPA, 2001). The complexity of this loading function model 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 variability. The WCS provides a mechanistic, simplified simulation of precipitation-driven runoff and sediment delivery, yet is intended to be applicable without calibration. Solids load from runoff can then be used to estimate pollutant delivery to the receiving waterbody from the watershed. This estimate is based on sediment concentrations in wet and dry deposition, which is processed by soils in the watershed and ultimately delivered to the receiving waterbody by runoff, erosion and direct deposition.

Critical Conditions:

The annual average watershed load represents the long-term processes of accumulation of sediments in the stream habitat areas that are associated with the potential for habitat alteration and aquatic life effects.

Seasonal Variation:

The average annual load addresses seasonal variation.

Watershed Allocation by Stream Reach for Sediment:**Table 2: TMDL Allocation**

Waterbody	WLA Tons/Acre/Year	LA Tons/Acre/Year	MOS	TMDL Tons/Acre/Year	Percent Reduction
Hazel Creek	0.1	0.4	Implicit	0.4	60
White Creek	0.1	0.4	Implicit	0.4	75

Notes: Since the WLA on an arial basis is less than the allowable load allocation, the WLA will have no impact on the overall area weighted TMDL load. For example if total watershed size is 100 acres and 10% or 10 acres are covered by construction stormwater permit and the remaining 90 acres meet the LA of 0.4 tons/acre/year, then the actual loading from the watershed is: $10 \text{ acres} * 0.1 \text{ tons/acre/year} + 90 * 0.4 \text{ tons/acre/year} = 37 \text{ tons/year per } 100 \text{ acres}$ or an area weighted total load of 0.37 tons/acre/year.

2. Background

2.1.1. Creeks Location

White and Hazel Creek are located in extreme northeastern Georgia in Habersham County. The location of the Hazel and White Creek watersheds are shown in Figure 1. The land use characteristics of the Chattahoochee River Basin watersheds were determined using data from Georgia's Multiple Resolution Land Coverage (MRLC). This coverage is based on Landsat Thematic Mapper digital images developed in 1995. The classification is based on a modified Anderson level one and two system. Table 3 below lists the land use distribution of Hazel and White Creeks. White and Hazel Creek were listed on the State of Georgia 1996 303(d) list for habitat modification. The confirmed pollutant found impairing the designated use was sedimentation.

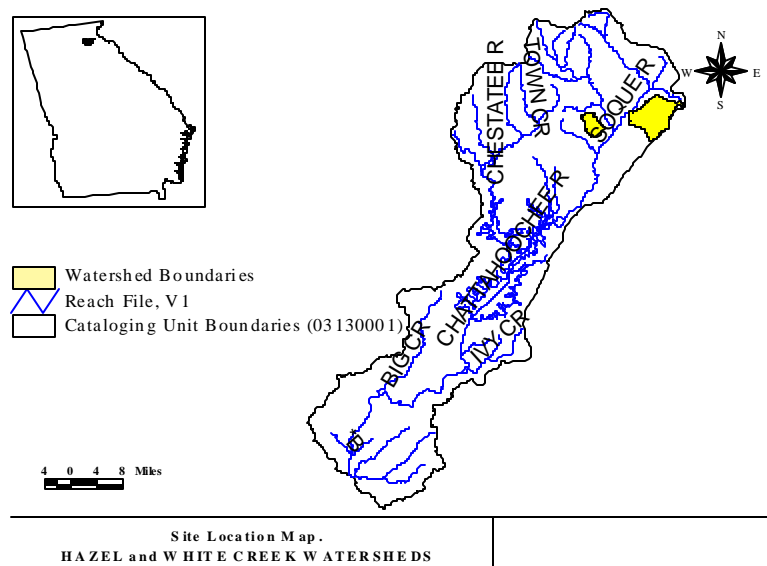


Figure 1: Hazel Creek and White Creek Watershed Location Map

Table 3 - Landuse in the Hazel Creek and White Creek Watershed (acres)

	Deciduous Forest	Pasture/Hay	Mixed Forest	Evergreen Forest	Row Crops	Low Intensity Residential	High Intensity Commercial/Industrial/Transportation	Other Grasses (Urban/recreational; e.g. parks)	Open Water	Quarries/Strip Mines/Gravel Pits	High Intensity Residential	Transitional	Woody Wetlands	Emergent Herbaceous Wetlands	Bare Rock/Sand/Clay
Hazel Creek	7675	4240	4011	2378	998	251	243	174	65	57	35	23	21	3	2
White Creek	1369	1946	1158	349	263	3	7	0	9	0	0	0	0	0	0

EPA developed TMDLs for each of the listed segments in the watersheds. Each watershed contains several different types of land uses. Different land uses collect and distribute sediment at different rates as a function of runoff, slope, soil erosivity and erosion.

2.1.2. Source Assessment

A TMDL evaluation examines the known potential sources of the pollutant in the watershed, including point sources, nonpoint sources, and background levels. For the purpose of this TMDL, facilities permitted under the National Pollutant Discharge Elimination System (NPDES) Program are considered point sources.

2.1.3. Point Sources

One minor continuous NPDES permitted discharge from a municipal wastewater treatment facility is located in the Georgia portion of the 303(d) listed streams. This is a minor contributor of biological reactive solids and is not considered in the WLA.

Table 4: Point Source Loads

Facility	Permit Number	Receiving Waters	County	Flow (mgd)
Demorest WPCP	GA0032506	Hazel Creek	Habersham	Minor

Other potential point sources discharges in the Georgia portion of the listed streams are storm water

discharges associated with construction activities. The State of Georgia Department of Natural Resources, Environmental Protection Division (EPD) has developed a general storm water permit, which covers all existing and new storm water point source discharges. Under this permit, storm water point sources associated with construction activity, are authorized to waters of the State in accordance with the limitations, monitoring requirements and other conditions set forth in Parts I through VII of the Georgia Storm Water General Permit. The permit limitations are established to assure that the storm water runoff from these point source sites do not cause or contribute to the existing sediment impairment. A Comprehensive Monitoring Plan with turbidity monitoring requirements is required to assure any storm water discharge from the site does not cause or contribute to the existing sediment problem.

The Georgia General Storm Water Permit for Construction Activities (Storm Water Permit) was developed to reduce the input of sediment from construction activities. As an example, in the Middle Chattahoochee Watershed, based on the available mid 1990s landuse information, it was estimated that, absent the limitations established by the Storm Water Permit, construction would contribute 450 tons/square-mile/year to the stream sediment load. Implementation of the Storm Water Permit in the Middle Chattahoochee Watershed, which has the highest contribution from construction activities, should reduce the sediment contributed by these construction activities to 0.1 tons/acre/year. This level is below the target of 0.4 tons/acre/year. This reduced load would be less than 25% of the total allowable sediment area weighted load for the Chattahoochee River Basin and will not cause or contribute to the sediment problem if storm water permit levels are met.

The Georgia General Storm Water Permit can be considered to be a water quality-based permit, in that the numeric limits in the permit, if met and enforced, will not cause a water quality problem in a unimpaired stream or contribute to an existing problem in an impaired stream. It is recommended that for impaired watersheds, the cold water (trout stream) turbidity table be used.

2.1.4. Existing Nonpoint Watershed Sediment Loads

The long-term sediment watershed load was calculated using the Universal Soil Loss Equation (USLE) and broken down by land use sediment sources and road erosion sediment sources. Appendix A

contains the estimated loads from roads and various landuses for Hazel and White Creek Watersheds.

2.1.5. Upper Chattahoochee River Basin – HUC 03130001

The current estimated long-term area weighted watershed sediment loads for White and Hazel Creek are shown in Table 5.

Table 5: Upper Chattahoochee Watershed Sediment Loads

Listed Streams – Georgia	Watershed	Area (Acres)	Area Weighted (Tons/Acre/Year)
Hazel Creek	Upper Chattahoochee River Basin	20,490	1.0
White Creek	Upper Chattahoochee River Basin	5,218	1.25

3. EPA Region 4 Biological/Habitat Data and Information

3.1.1. Establishment of Reference Site

In 2001, EPA's Science Ecosystem and Support Division (SESD) conducted field studies to determine appropriate reference sites for White Creek and Hazel Creek. Because White Creek and Hazel Creek are located in the Piedmont Ecoregion¹, Upper Piedmont subecoregion, the goal of the investigation was to find an appropriate reference site within the correct ecoregion for each stream.

The criteria SESD used in selecting these reference sites included:

- 1) Level of human disturbance – The reference stream selected needed to be within the same ecoregion and have a low level of human disturbance. This site would represent the least impacted

¹ An ecoregion is a region of relative homogeneity in ecological systems. Seven major ecoregions have been identified in Georgia based upon the soil types, potential natural vegetation, land surface form, and predominant land uses. These include the Blue Ridge Mountains, Ridge and Valley, Southwestern Appalachians, Piedmont, Middle Atlantic Coastal Plain, Southeastern Plains, and Southern Coastal Plain. White Creek and Hazel Creek are both located in the Upper Piedmont Ecoregion.

watersheds given the prevalent land use within the ecoregion. Other considerations included lack of permitted discharges, landuse classifications, and good riparian condition.

2) Accessibility - These sites had to be accessible and wadable.

3) Representativeness - The streams selected as reference sites had to be representative of the stream(s) being investigated.

4) Health of the Stream – The stream must have good biology. As further described below, the biotic integrity of the reference streams was determined to be good.

Based on the results of SESD field studies, Davidson Creek was selected as the reference site for White Creek and Hazel Creek.

Once the reference site was selected, SESD used established metrics to assess the biotic integrity of the study stream. Each metric was scored and a comparison of its value to the value of the selected regional reference site are used to determine the condition of the community. SESD collected macroinvertebrates to provide additional information and insight concerning water quality conditions. Macroinvertebrate sampling was conducted using a modified version of EPA's Rapid Bioassessment Protocol III. Macroinvertebrate data results were evaluated using four metrics as a measure of diversity, community composition (e.g., prevalence of tolerant or intolerant organisms), and environmental stress from a variety of possible sources.

In addition, habitat assessments were completed for the reference sites as well as the 303(d) listed stream segments. Habitat scores evaluate stream channel conditions and the physical surroundings of a stream as they affect and influence the quality of the water resource and its resident aquatic community. The habitat assessment evaluates the stream's physical parameters and is broken into three levels. One level describes in-stream characteristics that directly affect biological communities (in-stream cover, epifaunal substrate, embeddedness, and riffle frequency). Another level describes the channel morphology (channel alteration, sediment deposition and channel flow status). A third describes the riparian zone surrounding the stream, which indirectly affects the type of habitat and food resources available in the stream (bank vegetation, bank stability, and riparian zone width). The total habitat scores obtained for each sampling station were compared to the regional reference site. The ratio between the station of interest and the

reference site provides a percent comparability that can be used to classify the stream. These data may also help clarify the results of the biotic indices. These data and metric calculation results for the impaired streams were compared to the appropriate reference stream.

3.1.2. *Hazel Creek*

The aquatic macroinvertebrate community was determined to be impaired when compared to the reference site based on sampling results from December 2001. Based on the qualitative habitat analysis, the habitat quality was determined to be impacted when compared to the reference site. The qualitative analyses of habitat parameters showed that the habitat was adversely impacted by sediment. In addition, storm event samples of sedimentation in both the reference site and Hazel Creek showed that the suspended sediment and turbidity concentrations were much higher in Hazel Creek than in the reference stream (EPA 2003-Data Report).

3.1.3. *White Creek*

The aquatic macroinvertebrate community was determined to be impaired when compared to the reference site based on sampling results from December 2001. Based on the qualitative habitat analysis, the habitat quality was determined to be impacted when compared to the reference site. The qualitative analyses of habitat parameters showed that the habitat was adversely impacted by sediment. In addition, storm event samples of sedimentation in both the reference site and White Creek showed that the suspended sediment and turbidity concentrations were much higher in White Creek than in the reference stream (EPA 2003-Data Report).

4. Model Development

The link between the habitat alteration due to sediment loads and the identified sources of sediment is the basis for the development of the TMDL. The linkage is defined as the cause and effect relationship between the selected indicators and identified sources. This provides the basis for estimating the total assimilative capacity of the river and any needed load reductions. Details of the sediment-loading model used for the Chattahoochee River Basin Sediment TMDL can be found in Appendix A.

5. Numeric Sediment Target Determination

5.1. *Numeric Target*

The working hypothesis for the sediment watershed load is that if the Chattahoochee River Basin has a long-term annual sediment load similar to a relatively biologically unimpacted healthy stream, then the Chattahoochee River Basin will remain stable and not be biologically impaired due to sediment. Biologically unimpacted streams in the Upper Chattahoochee River Basin and part of the Upper Piedmont Ecoregion were used to develop a target sediment watershed load. The streams used to develop the TMDL annual loading of 0.40 tons/acre/year target are Mud Creek and Soque River in Habersham County, Georgia. These target streams have been determined to have habitat of acceptable quality and a macroinvertebrate community that is not adversely impacted by sediment.

The calculated allowable load of sediment that may come into the identified segments of the Upper Piedmont Ecoregion in the Chattahoochee River Basin without exceeding the water quality target is an annual loading of 0.40 tons/acre/year. This is based on average sediment loadings calculated from nearby streams where the biota and habitat was determined to be good. EPA interpreted the State of Georgia's narrative water quality standard for fish and wildlife to determine the applicable water quality target. Based on the current estimated annual loading for the listed segments, White Creek has an existing estimated annual sediment watershed loading of 1.0 tons/acre/year and will need a sixty percent reduction in existing estimated watershed sediment loads and Hazel Creek has an existing estimated annual sediment watershed loading of 1.25 tons/acre/year and will need a seventy percent reduction in existing estimated watershed sediment loads. To achieve the watershed sediment load reductions needed for the watersheds, it is recommended that Best Management Practices and continued compliance with the State of Georgia's stormwater construction permit be maintained and enforced to allow the stream to purge itself of the historic sediment loads and maintain standards.

5.2. *Critical Condition Determination*

The annual average watershed load represents the long-term processes of accumulation of

sediments in the stream habitat areas that are associated with the potential for habitat alteration and aquatic life effects.

5.3. Seasonal Variation

The average annual load addresses seasonal variation.

5.4. Margin of Safety

A Margin of Safety (MOS) is a required component of a TMDL that accounts for the uncertainty about the relationship between the pollutant loads and the quality of the receiving waterbody. The MOS is typically incorporated into the conservative assumptions used to develop the TMDL. A MOS is incorporated into this TMDL by selection of the average sediment loading numeric target rather than the greatest allowable sediment loading value for streams that have been identified as having good habitat and biology.

5.5. TMDL Formula:

TMDL = WLA + LA + MOS, where:

- TMDL = 0.4 tons/acre/year
- Wasteload Allocation (WLA) = WLA from wet weather discharges subject to the General Storm Water Permit = 0.1 tons/acre/year;
- Load Allocation (LA) from nonpoint source runoff and roads = 0.4 tons/acre/year

5.6. TMDL Determination

The Chattahoochee River Basin existing and TMDL loads are presented in Table 6.

Table 6: Upper Chattahoochee Watershed Sediment Loads

Listed Streams	Watershed	Area (Acres)	Area Weighted Existing Loads (Tons/Acre/Year)	TMDL Percent Reduction	TMDL for Listed Segments (Ton/Year)	Area Weighted TMDL (Tons/Acre/Year)
Hazel Creek	Upper Chattahoochee River Basin	20,490	1.0	60%	8196	0.4
White Creek	Upper Chattahoochee River Basin	5,218	1.25	70%	2087	0.4

5.7. TMDL Assumptions:

The allocations in this TMDL reflect the following assumptions regarding ongoing watershed restoration and/or pollution control activities in the Chattahoochee watershed:

EPA assumes that construction activities in the watershed will be conducted in compliance with Georgia's Storm Water General Permit for construction activities, including discharge limitations and monitoring requirements contained in the General Storm Water Permit. Compliance with these permits will lead to sediment loadings from construction sites at or below applicable targets.

With respect to all land disturbance activities, including road building and maintenance, if the BMPs as outlined above are implemented, then EPA believes that water quality targets for sediment will be achieved throughout the Chattahoochee Watershed.

The wasteload allocation component of this TMDL reflects the following additional assumptions:

- No NPDES point source will be authorized to increase its concentration of sediment above levels reflected in current water quality-based effluent limitations or allowed in the State's General Storm Water Permit.
- The permitting authority will establish the shortest reasonable period of time for compliance with permit limitations and conditions based on this TMDL.

These assumptions provide reasonable assurance that the allocation of loads in this TMDL, described in more detail below, are appropriate. During Phase 1 of this TMDL, EPA and Georgia will gather data and information to determine whether continued reliance on these assumptions is reasonable. The Phase 2 TMDL may revise the allocation of the allowable load, as necessary, should EPA or Georgia be required to change the assumptions underlying that allocation.

6. Allocation of Loads

In a TMDL assessment, the total allowable load is divided and allocated to the various pollutant sources – both point sources and nonpoint sources. Allocations provided to point sources are wasteload allocations (WLAs). Based on the numeric limits of the storm water permit the area loading from point sources will be 0.1 tons/acre/year, which is below the target of 0.4 tons/acre/year, which is based on sediment loadings from streams with healthy biology and good habitat.

Allocations to nonpoint sources are load allocations (LAs). Roads, agriculture and bare ground (non permitted construction type sites, etc.) are the major sediment producing areas in the watershed. If best management practices (BMPs), as outlined in “Georgia’s Best Management Practices for Forestry” (GaEPD 1999), for these practices and other sediment producing activities are implemented at the sites that are near the stream’s drainage network and the stream’s riparian zone or buffer zones are maintained or

restored, then the TMDL targets can be met. Detailed BMP measures are discussed in Georgia Environmental Protection Division's Proposed Chattahoochee River Basin TMDL report (GaEPD 2002).

The calculated allowable load of sediment that can come into the Chattahoochee River Basin without exceeding the applicable narrative water quality standard, as interpreted by EPA, is 0.4 tons/acre/year. For example, in the Chattahoochee River Basin, this assessment indicates that over 99% of the loading of sediment is from nonpoint sources and construction activity prior to issuance of Georgia's Storm Water Permit. Additional sediment reduction activities should target nonpoint sources, including the unpaved roads, to gain the greatest water quality benefit.

6.1.1. Storm Water Point Sources

Compliance with the Georgia General Storm Water Permit will ensure construction sites to meet the TMDL area weighted loading. The Georgia General Storm Water Permit can be considered to be a water quality-based permit, in that the numeric limits in the permit, if met and enforced, will not cause a water quality problem in an unimpaired stream or contribute to an existing problem in an impaired stream. A Comprehensive Monitoring Plan with turbidity monitoring requirements is required to assure any storm water discharge from the site does not cause or contribute to the existing sediment problem. It is recommended that for streams in the impaired watersheds the cold water (trout stream) turbidity table be used. Based on the numeric limits of the storm water permit, the area loading will be 0.086 tons/acre/year, which is below the target of 0.4 tons/acre/year. This will ensure that permitted point source sediment loads in the watersheds will contribute less than 25% of the total allowable area weighted sediment loads.

This TMDL accords the permitting authority a certain amount of discretion in incorporating these wasteload allocations into NPDES permits. The permitting authority can determine the appropriate frequency, duration and location of monitoring associated with the sediment characterization component of the wasteload allocation. The permitting authority also has the discretion to determine the level of oversight in connection with the development of sediment minimization plans and the discharger's choice of appropriate, cost-effective measures to implement such plans. EPA believes that each of these decisions is heavily fact-dependent and that the permitting authority is the appropriate decision maker in this regard.

6.1.2. Allocation to Nonpoint Sources

It is recommended that the Chattahoochee watershed be considered a high priority for restoration of riparian buffer zones and reduction of sediment from road crossings, agricultural activities, and construction activities. Further ongoing monitoring needs to be completed to monitor progress and to assure further degradation does not occur.

For those land disturbing activities related to silviculture that may occur on public lands, it is recommended that practices as outlined for landowners, foresters, timber buyers, loggers, site preparation and reforestation contractors, and others involved with silvicultural operations follow the practices to minimize nonpoint source pollution as outlined in "Georgia's Best Management Practices for Forestry (GaEPD 1999).

7. Implementation

EPA has coordinated with the Georgia Environmental Protection Division (EPD) to prepare this Initial Implementation Plan for this TMDL. EPD has also established a plan and schedule for the development of a more comprehensive implementation plan to be completed after this TMDL is established. EPD and EPA have executed a Memorandum of Understanding (MOU) that documents the schedule for developing the more comprehensive plans.

This initial Implementation Plan includes a list of best management practices (BMPs) and provides for an initial implementation of demonstration projects to address one or more of the major sources of pollutants identified in the TMDL, while State and/or local agencies work with local officials to develop a revised TMDL Implementation Plan. The Initial TMDL Implementation Plan also includes a process whereby EPD and/or Regional Development Centers (RDCs), will develop expanded plans (hereinafter, "Revised TMDL Implementation Plans").

This Initial TMDL Implementation Plan, written by EPD and for which EPD and/or the EPD Contractor are responsible, contains the following elements.

1. EPA has identified a number of management strategies for the control of nonpoint sources of pollutants, representing some best management practices. The “Management Measure Selector Table shown below identifies these management strategies by source category and pollutant. Nonpoint sources are the primary cause of excessive pollutant loading in most cases. Any wasteload allocations in this TMDL will be implemented in the form of water-quality based effluent limitations in NPDES permits issued under CWA Section 402. See 40 C.F.R. § 122.44(d)(1)(vii)(B). NPDES permit discharges are a secondary source of excessive pollutant loading.

2. EPD and the EPD Contractor will select and implement one or more best management practice (BMP) demonstration projects for each River Basin. The purpose of the demonstration projects will be to evaluate by River Basin and pollutant parameter the site-specific effectiveness of one or more of the BMPs chosen. EPD intends that the BMP demonstration project be completed before the Revised TMDL Implementation Plan is issued. The BMP demonstration project will address the major category of contribution of the pollutant(s) of concern for the respective River Basin as identified in the TMDLs of the watersheds in the River Basin. The demonstration project need not be of a large scale, and may consist of one or more measures from the Table or equivalent BMP measures proposed by the EPD Contractor and approved by EPD. Other such measures may include those found in EPA’s “Best Management Practices Handbook”, the “NRCS National Handbook of Conservation Practices, or any similar reference, or measures that the volunteers, etc., devise that EPD approves. If for any reason the EPD Contractor does not complete the BMP demonstration project, EPD will take responsibility for doing so.

3. As part of the Initial TMDL Implementation Plan the EPD brochure entitled “Watershed Wisdom -- Georgia’s TMDL Program” will be distributed by EPD to the EPD Contractor for use with appropriate stakeholders for this TMDL, and a copy of the video of that same title will be provided to the EPD Contractor for its use in making presentations to appropriate stakeholders, on TMDL Implementation plan development.

4. If for any reason an EPD Contractor does not complete one or more elements of a Revised TMDL Implementation Plan, EPD will be responsible for getting that (those) element(s) completed, either directly or through another contractor.
5. The deadline for development of a Revised TMDL Implementation Plan, is the end of August, 2003.
6. The EPD Contractor helping to develop the Revised TMDL Implementation Plan, in coordination with EPD, will work on the following tasks involved in converting the Initial TMDL Implementation Plan to a Revised TMDL Implementation Plan:
 - Generally characterize the watershed;
 - Identify stakeholders;
 - Verify the present problem to the extent feasible and appropriate, (e.g, local monitoring);
 - Identify probable sources of pollutant(s);
 - For the purpose of assisting in the implementation of the load allocations of this TMDL, identify potential regulatory or voluntary actions to control pollutant(s) from the relevant nonpoint sources;
 - Determine measurable milestones of progress;
 - Develop monitoring plan, taking into account available resources, to measure effectiveness; and
 - Complete and submit to EPD the Revised TMDL Implementation Plan.
7. The public will be provided an opportunity to participate in the development of the Revised TMDL Implementation Plan and to comment on it before it is finalized.
8. The Revised TMDL Implementation Plan will supersede this Initial TMDL Implementation Plan when the Revised TMDL Implementation Plan is approved by EPD.

Management Measure Selector Table

Land Use	Management Measures	Fecal Coliform	Dissolved Oxygen	PH	Sediment	Temperature	Toxicity	Mercury	Metals (copper, lead, zinc, cadmium)	PCBs, toxaphene
Agriculture	1. Sediment & Erosion Control	-	-		-	-				
	2. Confined Animal Facilities	-	-							
	3. Nutrient Management	-	-							
	4. Pesticide Management		-							
	5. Livestock Grazing	-	-		-	-				

	<i>6. Irrigation</i>		-		-	-				
Forestry	<i>1. Preharvest Planning</i>				-	-				
	<i>2. Streamside Management Areas</i>	-	-		-	-				
	<i>3. Road Construction & Reconstruction</i>		-		-	-				
	<i>4. Road Management</i>		-		-	-				
	<i>5. Timber Harvesting</i>		-		-	-				
	<i>6. Site Preparation & Forest Regeneration</i>		-		-	-				

	<i>7. Fire Management</i>	-	-	-	-	-				
	<i>8. Revegetation of Disturbed Areas</i>	-	-	-	-	-				
	<i>9. Forest Chemical Management</i>		-			-				
	<i>10. Wetlands Forest Management</i>	-	-	-		-		-		
Urban	<i>1. New Development</i>	-	-		-	-			-	
	<i>2. Watershed Protection & Site Development</i>	-	-			-		-	-	
	<i>3. Construction Site Erosion and Sediment Control</i>		-		-	-				

	4. Construction Site Chemical Control		-							
	5. Existing Developments	-	-		-	-			-	
	6. Residential and Commercial Pollution Prevention	-	-							
Onsite Wastewater	1. New Onsite Wastewater Disposal Systems	-	-							
	2. Operating Existing Onsite Wastewater Disposal Systems	-	-							
Roads, Highways and Bridges	1. Siting New Roads, Highways & Bridges	-	-		-	-			-	

	<p>2. Construction Projects for Roads, Highways and Bridges</p>		-		-	-				
	<p>3. Construction Site Chemical Control for Roads, Highways and Bridges</p>		-							
	<p>4. Operation and Maintenance- Roads, Highways and Bridges</p>	-	-			-			-	

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9. Appendix A

An analysis of watershed loading could 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 Chattahoochee River Basin prevented EPA from using a detailed dynamic watershed runoff model, which needs a great deal of data for calibration. Instead, EPA determined the sediment contributions to the Chattahoochee River Basin from the surrounding watershed based on an annual mass balance of sediment in water and sediment loading from the watershed.

Watershed-scale loading of sediment in water and sediment was simulated using the Watershed Characterization System (WCS) (USEPA, 2001). The complexity of this loading function model 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 variability. The WCS provides a mechanistic, simplified simulation of precipitation-driven runoff and sediment delivery, yet is intended to be applicable without calibration. Solids load from runoff can then be used to estimate pollutant delivery to the receiving waterbody from the watershed. This estimate is based on sediment concentrations in wet and dry deposition, which is processed by soils in the watershed and ultimately delivered to the receiving waterbody by runoff, erosion and direct deposition.

9.1.1. *Universal Soil Loss Equation*

The Universal Soil Loss Equation (USLE), developed by Agriculture Research Station (ARS) scientists W. Wischmeier and D. Smith, has been the most widely accepted and utilized soil loss equation for over 30 years. Designed as a method to predict average annual soil loss caused by sheet and rill erosion, the USLE is often criticized for its lack of applications. While it can estimate long-term annual soil loss and guide conservationists on proper cropping, management, and conservation practices, it cannot be applied to a specific year or a specific storm. The USLE is mature technology and enhancements to it are limited by the simple equation structure. However based on its long history of use and wide acceptance by the forestry and agriculture communities, it was selected as an adequate tool for estimating long-term annual

soil erosion, for evaluating the impacts of land use changes and evaluating the benefits of various Best Management Practices (BMPs).

The Sediment Tool, which incorporates the USLE equation, is an extension of the Watershed Characterization System (WCS). For more detailed information on WCS, refer to the WCS User's Manual. The Sediment Tool can be used to perform the following tasks:

- 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.

Soil loss from sheet and rill erosion is mainly due to detachment of soil particles during rainfall. It is the major soil loss from crop production and grazing areas, construction sites, mine sites, logging areas, and unpaved roads. The magnitude of soil erosion is normally estimated through the use of the Universal Soil Loss Equation (USLE). The USLE equation is a multiplicative function of crop and site specific factors that represent rainfall erosivity (R), soil erodibility (K), soil slope (S), slope length (L), cropping or conservation management practices (C), and erosion control practices (P). The R factor describes the kinetic energy generated by the frequency and intensity of rainfall. The K factor represents the susceptibility of soil to erosion (i.e. soil detachment). The L and S factors represent the effect of slope length and slope steepness on erosion, respectively. The C factor represents the effect of plants, soil cover, soil biomass and soil disturbing activities on erosion including crop rotations, tillage and residue practices. Finally, the P factor represents the effects of conservation practices such as contour farming, strip cropping and terraces.

The USLE equation for estimating average annual soil erosion is:

$$A = RKLSCP$$

- A = average annual soil loss in t/a (tons per acre)
- R = rainfall erosivity index

- **K** = soil erodibility factor
- **LS** = topographic factor - L is for slope length & S is for slope
- **C** = cropping factor
- **P** = conservation practice factor

Evaluating the factors in USLE:

R - the rainfall erosivity index

Most appropriately called the erosivity index, it is a statistic calculated from the annual summation of rainfall energy in every storm (correlates with raindrop size) times its maximum 30 - minute intensity. As expected, it varies geographically.

K - the soil erodibility factor

This factor quantifies the cohesive or bonding character of a soil type and its resistance to dislodging and transport due to raindrop impact and overland flow.

LS - the topographic factor

Steeper slopes produce higher overland flow velocities. Longer slopes accumulate runoff from larger areas and also result in higher flow velocities. Thus, both result in increased erosion potential, but in a non - linear manner. For convenience L and S are frequently lumped into a single term.

C - the crop management factor

This factor is the ratio of soil loss from land cropped under specified conditions to corresponding loss under tilled, continuous fallow conditions. The most computationally complicated of USLE factors, it incorporates effects of: tillage management (dates and types), crops, seasonal erosivity index distribution, cropping history (rotation), and crop yield level (organic matter production potential).

P - the conservation practice factor

Practices included in this term are contouring, strip cropping (alternate crops on a given slope established on the contour), and terracing.

Appropriate values for the USLE parameters should be provided for each of the management activities. Literature values are available, but site-specific values should be used when available. Estimates of the USLE parameters and thus the soil erosion as computed from the USLE equation are provided by the Natural Resources Conservation Service's 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.

Soil loss from gully erosion occurs in sloping areas mainly as a result of natural processes. Farming practices such as livestock grazing exacerbates it. The deepening of rill erosion causes gullies. The amount of sediment yield from gully erosion is generally less than that caused by sheet and rill erosion. There are no exact methods or equations to quantify gully erosion, but Dunne and Leopold (1978) provide percent sediment yield estimates for various regions of the country. In a small grazed catchment near Santa Fe, New Mexico, gully erosion was found to contribute only 1.4 percent of the total sediment load as compared to sheet erosion and rain splash, which contributed 97.8 percent of the sediment load. Dunne and Leopold report that in most cases (nationally and internationally) gully erosion contributes less than 30 percent of the total sediment load, although the percentages have ranged from 0 percent to 89 percent contribution (Dunne and Leopold, 1978).

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 losses in the field that is eventually delivered to the stream depends on several factors, which 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 are expected to be delivered into the stream with runoff-producing rainfall.

9.1.2. *Sediment Analysis*

The watershed sediment loads for selected watersheds are determined using the USLE and available GIS coverage. The sediment analysis produces the following outputs:

- Source Erosion and Sediment
- Stream Grid
- Sediment Delivery on Stream

The sediment analysis is also able to evaluate default scenarios by, for example, changing land uses and BMPs. The following are some of the parameters that may be altered:

- C and P Lookup values
- Land Use Change Layer
- BMP Layers
- Add/Delete Roads
- Create Road Control Structure Layer

The sediment analysis can be run for a single watershed or multiple watersheds. For TMDL development purposes the basic sediment analysis was used for developing relative impacts. Other applications used in developing the TMDL include the evaluation of the effectiveness of BMPs and development of implementation plans.

9.1.3. *Sediment Modeling Methodology*

The watersheds of interest are first delineated. The stream grid for each delineated watershed, based on the Digital Elevation Maps (DEM) data, is created so that the stream matches the elevation (i.e., the stream corresponds to the lower elevations in the watershed). The system uses this threshold to determine whether a particular grid cell corresponds to a stream. Grid cells having flow accumulation values higher than the threshold will be considered as part of the stream network. The RF3 stream network is used as a reference or basis of comparison to obtain the desired stream density. A stream grid corresponding to the stream network that has fifty 30 by 30 meter headwater cells is the default.

For each 30 by 30 meter grid cell the potential erosion based on USLE and potential sediment delivery to the stream network is estimated. The potential erosion from each cell is calculated using the USLE and the sediment delivery to the stream network can be calculated using one of four available sediment delivery equations.

(1) Distance-based equation 1 (Sun and McNulty 1988)

$$M_d = M * (1 - 0.97 * D / L),$$

$$L = 5.1 + 1.79 * M,$$

Where M_d is the mass moved from each cell to the closest stream network (US tons/acre/yr);

D (feet) is the least cost distance from a cell to the nearest stream network; and

L (feet) is the maximum distance that sediment with mass M (US ton) may travel.

(2) Distance-based equation 2 (Yagow et al. 1998)

$$DR = \exp(-1.033 * L * Sf),$$

$$Sf = \exp(-16.1 * (r / L + 0.057)) - 0.6,$$

Where DR is the sediment delivery ration;

L is the distance to stream in meters and

r is the relief to stream in meters.

(3) Area-based equation (converted from a curve from National Engineering Handbook by Soil

Conservation Service 1983

$$DR = 0.417762 * A ^ (-0.134958) - 0.127097,$$

$$DR \leq 1.0,$$

Where DR is the sediment delivery ratio and

A is area in square miles;

(4) WEPP-based regression equation (L.W.Swift, Jr.,2000)

$$Z=0.9004-0.1341*X-0.0465*X^2+0.00749*X^3-0.0399*Y+0.0144*Y^2+0.00308*Y^3,$$

$$X>0,Y>0,$$

Where Z is percent of source sediment passing to next grid cell,

X is cumulative distance downslope,

Y is percent slope in grid cell.

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. The information and estimates developed using this methodology were summarized in Sections 8.1.7 and 8.1.8.

9.1.4. Sediment Analysis Inputs

Before conducting a sediment analysis, a number of data layers must be available. These include the following:

- DEM (grid) – The DEM layers that come with the WCS distribution system are shape files and are of coarse resolution (300 m x 300 m). The user needs to import a DEM grid layer. A higher resolution DEM grid layer (30m x 30 m) was downloaded from USGS web site or from a state's GIS data clearinghouse
- Road – The road layer is needed as a shape file and requires additional attributes such as C (road type), P (road practice) and ditch (value of either 3 or 4, indicating presence or absence of side ditch, respectively). If these attributes are not provided, the Sediment Tool automatically assigns default values of road type 2 (secondary paved roads) ditch 3 (with ditch) and road practice 1 (no practices).
- 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 not available, the system uses the STATSGO Soil data (1:250k) by default.

- The Multi-Resolution Land use Classification (MRLC) data are also used.
- Rainfall erosivity index is either provides based on a rainfall index of the USA or can be calculated based on precipitation data.

The Universal Soil Loss Equation (USLE) R, K, LS, C, and P factors are calculated from the above data as follows:

$$A = RKLSCP$$

- **A** = average annual soil loss in t/a (tons per acre) is calculated.
- **R** = rainfall erosivity index is provide based on a rainfall index of the USA.
- **K** = soil erodibility factor calculated based on soil types.
- **LS** = topographic factor - L is for slope length set at 30 meters and S is for slope calculated based on the 30 meter DEM data. Presently a watershed average LS term is used.
- **C** = cropping factor or land use factor.
- **P** = conservation practice factor or BMP implementation.

9.1.5. *Sediment Load Development Methodology*

For each watershed of interest, the “existing” long-term sediment loading is estimated via the USLE sediment analysis, using default parameters and estimated C and P values. The USLE is designed as a method to predict average annual soil loss caused by sheet and rill erosion. While it can estimate long - term annual soil loss and guide on proper cropping, management, and conservation practices, it cannot be applied to a specific year or a specific storm.

The resultant sediment load calculation for each watershed is therefore expressed as a long-term annual soil loss expressed in tons per year calculated for the R - the rainfall erosivity index, a statistic

calculated from the annual summation of rainfall energy in every storm (correlates with raindrop size) times its maximum 30 - minute intensity.

The watershed sediment load target is based on the long - term annual soil loss expressed in tons per year calculated for relatively unimpacted watershed with demonstrated healthy biology and habitat. For the initial sediment load development consistent default parameters and inputs are used for each watershed. These include the MRLC land use data, the USGS DEM data, STASTGO soil information and watershed average C and P values for each land use type.

9.1.6. *Estimated Contributors to Sediment Load*

Soil type, land slope and distance the sediment source is from the stream determine the amount of sediment that reaches the streams from the various parts of the watershed. Figure 2 shows the landuses in White and Hazel Watersheds. Road types and road nearness to the streams determine how much sediment is caused by road or roadside erosion. Estimated sediment loads by landuse are presented in Appendix A.

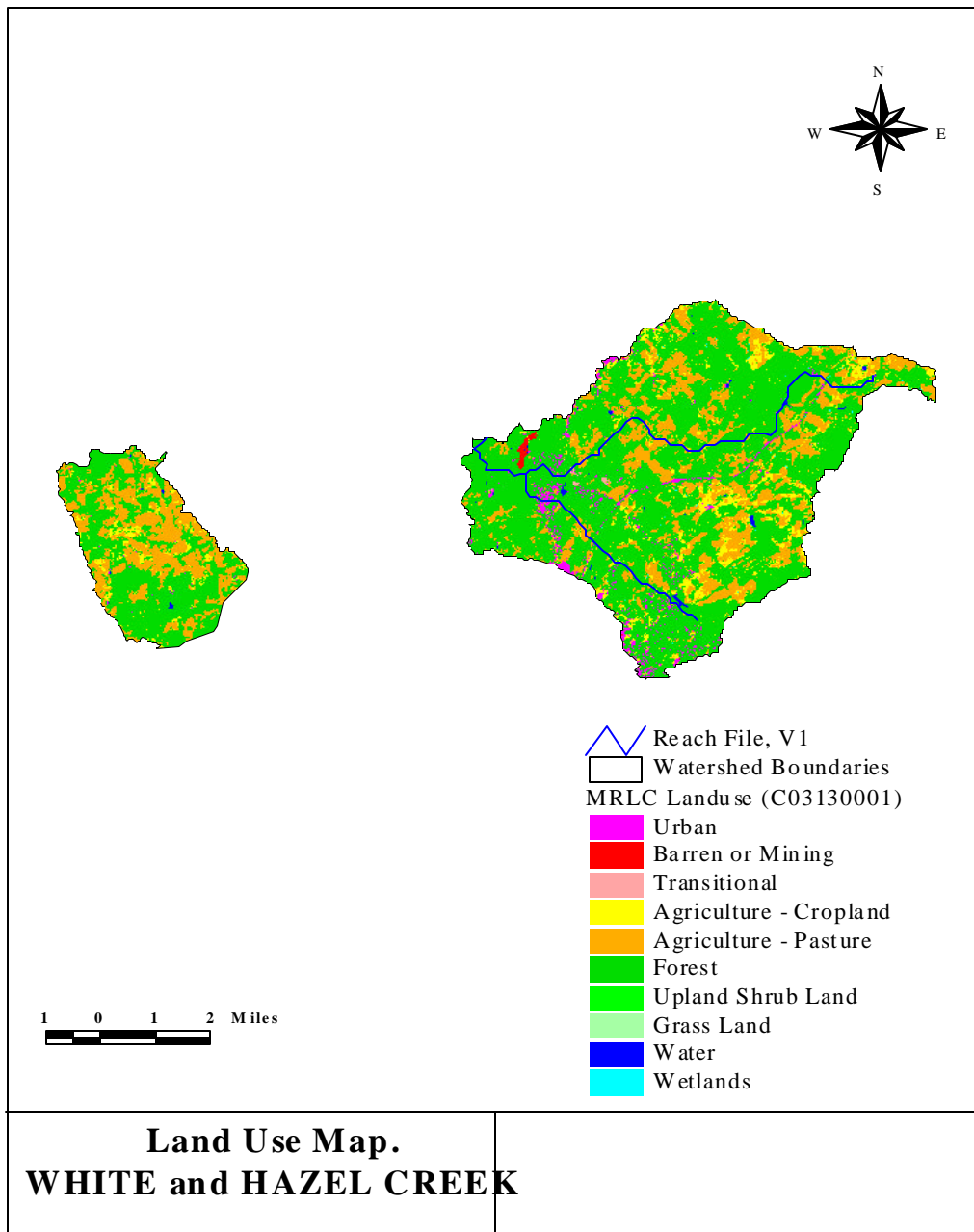


Figure 2: Landuse for White and Hazel Creek Watersheds

Hazel Creek USLE Parameters

Hazel Creek USLE Parameters			
Factors	Min	Max	Mean
LS Factor	0.08	7.53	0.98
K Factor	0.25	0.27	0.26
P Factor	1.00	1.00	1.00
C Factor	0.00	0.75	0.02
R Factor	300.00	300.00	300.00
Weighted R Factor	300.00	300.00	300.00
Composite Erosion	0.00	94.20	0.35
Composite Sediment	0.00	71.10	0.28
White Creek USLE Parameters			
Factors	Min	Max	Mean
LS Factor	0.08	7.06	0.74
K Factor	0.25	0.27	0.25
P Factor	1.00	1.00	1.00
C Factor	0.00	0.30	0.02
R Factor	300.00	300.00	300.00
Weighted R Factor	300.00	300.00	300.00
Composite Erosion	0.00	14.83	0.28

Composite Sediment	0.00	11.74	0.23
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9.1.7. Hazel Creek Watershed Sediment Sources

Roads are estimated to contribute a sediment load of 10,100 tons per year and runoff from the watershed contributes 16,780 tons per year.

	Deciduous Forest	Pasture/Hay	Mixed Forest	Evergreen Forest	Row Crops	Low Intensity Residential	High Intensity Commercial/Industrial/Transportation	Other Grasses (Urban/recreational; e.g. parks)	Open Water	Quarries/Strip Mines/Gravel Pits	High Intensity Residential	Transitional	Woody Wetlands	Emergent Herbaceous Wetlands	Bare Rock/Sand/Clay
Hazel Creek	51.99	2434.02	24.71	14.29	10517.40	38.02	33.76	20.17	0.0	3614.14	7.88	17.30	9.55	0.32	0.0

9.1.8. White Creek Watershed Sediment Sources

Roads are estimated to contribute a sediment load of 1620 tons per year and runoff from the watershed contributes 3820 tons per year.

	Deciduous Forest	Pasture/Hay	Mixed Forest	Evergreen Forest	Row Crops	Low Intensity Residential	High Intensity Commercial/Industrial/Transportation	Other Grasses (Urban/recreational; e.g. parks)	Open Water	Quarries/Strip Mines/Gravel Pits	High Intensity Residential	Transitional	Woody Wetlands	Emergent Herbaceous Wetlands	Bare Rock/Sand/Clay
White Creek	14.51	1236.79	11.07	3.23	2536.72	0.33	0.88	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00