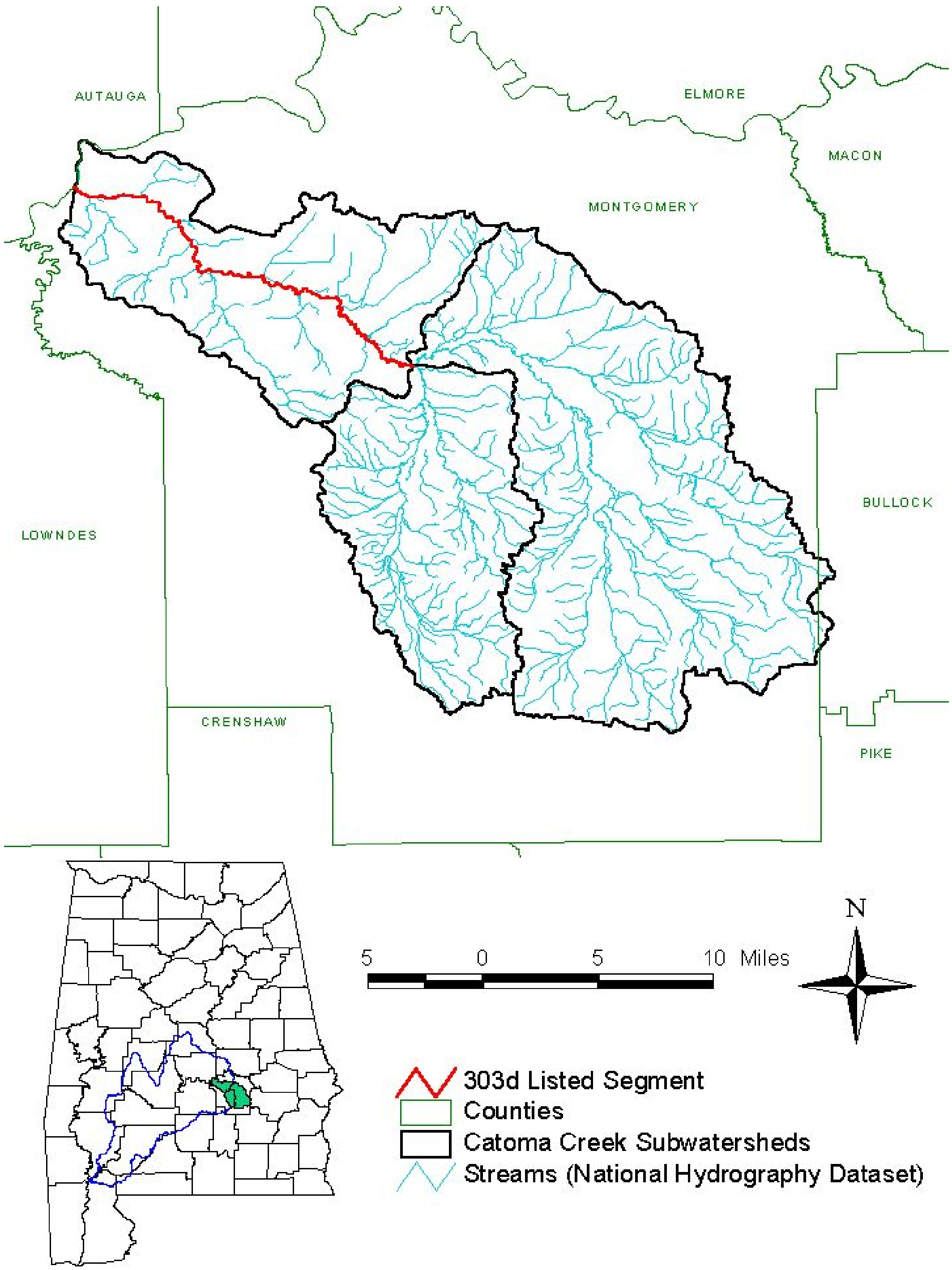
FINAL

Total Maximum Daily Load (TMDL)
for
Catoma Creek AL/03150201-080_01
Organic Enrichment/Low Dissolved Oxygen (OE/DO)

Alabama Department of Environmental Management
Water Quality Branch
Water Division
July 2005

Catoma Creek Watershed in the Alabama River Basin



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1.0 Executive Summary

Section 303(d) of the Clean Water Act and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to identify waterbodies which do not meet their designated use. Upon being identified as impaired, these listed waters are prioritized with respect to designated use classification and severity of pollution. In accordance with this prioritization, states are required to develop Total Maximum Daily Loads (TMDLs) for these impaired waters. A TMDL represents the total amount of pollutant loading that can enter a given waterbody while still attaining the applicable water quality standards assigned to that waterbody. This TMDL proposes reductions in pollutant loading from activities and facilities which discharge to the identified waterbody. Results of this TMDL are to be used toward the development of pollutant reduction controls which will both restore and maintain the necessary water quality standards. TMDLs are the sum of individual wasteload allocations (WLAs) for point sources, load allocations (LAs) for non-point sources including natural background levels, and a margin of safety (MOS). This TMDL, when fully implemented, is expected to achieve water quality standards established for Catoma Creek.

Catoma Creek is part of the Alabama River basin, is located almost entirely within Montgomery County, and holds a current stream use classification of Fish & Wildlife. Catoma Creek was added to the State of Alabama's 1996 §303(d) use impairment list for organic enrichment/low dissolved oxygen (OE/DO), based upon a 50% noncompliance of DO measurements recorded in 1989 and subsequent 40% noncompliance of recorded measurements from 1991 as referenced from ADEM's December 1992 *Alabama Clean Water Strategy Water Quality Assessment Report*.

Water quality data collected over the five year interval from 1998 through the present by state and local agencies (ADEM and Montgomery Waterworks and Sanitary Sewer Board), as well as, from citizen-volunteer monitoring (Alabama Water Watch and Montgomery Water Watch) further identified and confirmed dissolved oxygen impairments to Catoma Creek. Stream flows occurring during periods of impairment were typically near established $7Q_{10}$ (the minimum 7-day average flow over a 10-year recurrence interval) levels. Dissolved oxygen impairments in Catoma Creek were attributable to low flows and high temperatures as evidenced during summer sampling events. Based on ADEM's data analysis, a steady state modeling approach was deemed appropriate for TMDL development. In examining all available water quality data covering the most recent five year period, water quality measurements recorded on September 19, 2001, provided the most thorough and inclusive representation of critical conditions for TMDL development.

In accordance with ADEM's water quality standards, the minimum required instream dissolved oxygen concentration for waters classified as Fish and Wildlife is 5.0 mg/l. A DO criterion of 5.0 mg/l is herein used as the target for establishing load reductions necessary to bring Catoma Creek into compliance with the applicable DO criterion for Fish and Wildlife stream use classification.

Impairment to Catoma Creek is derived exclusively from non-point source (NPS) and Municipal Separate Storm Sewer Systems (MS4) pollutant loadings, for which needed reductions will be sought under TMDL implementation. Based on TMDL analysis, Table 1-1 summarizes the pollutant source reductions required to achieve an instream dissolved oxygen concentration of 5.0 mg/l in terms of Ultimate Carbonaceous Biochemical Oxygen Demand ($CBOD_u$) and Nitrogenous Biochemical Oxygen Demand (NBOD) components.

Table 1-1 Reductions Necessary to Meet the TMDL at the Time of this Report, in the Catoma Creek Watershed HUC AL/03150201-080_01

Loading Parameter	Existing Loads		Allowable Loads		Reductions	
	WLA(1)	LA	WLA(1)	LA	% WLA	% LA
CBODu	9.4 lbs/day	61.8 lbs/day	5.3 lbs/day	35.0 lbs/day	43.6	43.4
NBOD	8.5 lbs/day	56.1 lbs/day	8.5 lbs/day	56.1 lbs/day	0.0	0.0

(1) NOTE: MS4 Stormwater Phase I contributions are represented in terms of WLA.

2.0 Basis for §303(d) Listing

2.1 Introduction

Section 303(d) of the Clean Water Act (CWA) as amended by the Water Quality Act of 1987 and EPA's Water Quality Planning and Management Regulations [(Title 40 of the Code of Federal Regulations (CFR), Part 130)] requires states to identify waterbodies which do not meet water quality criteria applicable to their designated use classifications. Identified waters are prioritized according to the severity of pollution with respect to use classification. Total Maximum Daily Loads (TMDLs) for all pollutants resulting in violations of applicable water quality standards are established for each identified stream segment. These loads are then established at levels necessary to implement applicable water quality standards with consideration to seasonal variations and incorporation of Margins of Safety (MOS). The TMDL process establishes the allowable loading of pollutants, or other quantifiable parameters of a waterbody, based on the relationship between pollution sources and in-stream water quality conditions. States can then establish water-quality based controls to reduce pollution from both point and non-point sources in restoring and maintaining the quality of their water resources (USEPA, 1991).

The State of Alabama identified Catoma Creek as being impaired by organic loading (i.e., $CBOD_u$ and NBOD) for a length of 21.3 miles, as set forth in the State of Alabama's 1996, 1998, and 2000 §303(d) lists of impaired waters. Catoma Creek was first added to Alabama's §303(d) use impairment list in 1996 for organic enrichment/low dissolved oxygen (OE/DO), based upon a 50% noncompliance of DO measurements recorded in 1989 and subsequent 40% noncompliance of recorded measurements from 1991 as referenced from ADEM's December 1992 *Alabama Clean Water Strategy Water Quality Assessment Report*. Catoma Creek is prioritized as "medium" on the list, is located almost entirely in Montgomery County, and lies within the Alabama River basin.

The TMDL developed for Catoma Creek illustrates procedures necessary for restoring a waterbody which is impaired as a result of low dissolved oxygen levels. This TMDL is representative of a multi-phased-approach in which needed pollutant load reductions are determined, load reduction controls are implemented, and in which subsequent water quality is monitored and remediation strategies are assessed. Certain flexibility may be warranted in re-evaluating load reduction targets and control actions whenever monitoring results indicate continuing water quality impairment or attainment of water quality standards.

2.2 Problem Definition

The Catoma Creek watershed encompasses nearly 360 square miles of drainage area. During periods of dry weather, the watershed experiences comparatively little or no flow. Water quality data collected between 1998 and 2001, confirmed dissolved oxygen impairments which typically occurred during the summer months (May through November). In general, depressed instream DO concentrations result from the decay of oxygen demanding waste originating from both point and non-point sources, algal respiration, and/or sediment oxygen demand.

<u>Waterbody Impaired:</u> Catoma Creek – from Ramer Creek to the Alabama River for a length of 21.3 miles.

<u>Water Quality Criteria Violation:</u> Dissolved Oxygen (DO) Levels Depressed Below 5 mg/l.

<u>Pollutant of Concern:</u> Organic Enrichment ($CBOD_u$/NBOD)

<u>Water Use Classification:</u> Fish & Wildlife

The impaired stream segment of Catoma Creek, is currently classified as Fish & Wildlife. Usage of waters in this classification is described in ADEM Administrative Code R. 335-6-10-.09(5)(a), (b), (c), and (d) and is summarized below.

(a) Best usage of waters:

Fishing, propagation of fish, aquatic life, and wildlife, along with any other usage with the exception of swimming and water-contact sports or as a water supply source for drinking or food processing purposes.

(b) Conditions related to best usage:

Waters shall be suitable for fish, aquatic life, and wildlife propagation. The quality of salt and estuarine waters to which this classification is assigned shall additionally be favorable for the propagation of shrimp and crabs.

(c) Other usage of waters:

Such waters may furthermore be used for incidental water contact and recreation during June through September. Water contact, however, is strongly discouraged in the vicinity of discharges or other conditions beyond the control of the Department or the Alabama Department of Public Health.

(d) Conditions related to other usage:

Waters, under proper sanitary supervision of controlling health authorities, shall satisfy accepted standards of water quality for outdoor swimming and other whole body water-contact sports.

3.0 Technical Basis for TMDL Development

3.1 Water Quality Target Identification

In accordance with ADEM's Water Quality Regulations (ADEM Administrative Code R. 335-6-10-.09-(5)(e)(4.)) the dissolved oxygen criteria for a diversified warm water biota, including game fish, shall not be less than 5 mg/l at any given time; except under extreme conditions resulting from natural causes during which it may range between 5 and 4 mg/l, provided that all other water quality parameters remain favorable. Normal seasonal and daily fluctuations shall be maintained above these levels.

The minimum dissolved oxygen concentration for a stream classified as Fish and Wildlife is 5.0 mg/l. As is with this TMDL, a minimum instream dissolved oxygen level of 5.0 mg/l will be maintained during critical conditions. Target $CBOD_u$ and NBOD concentrations shall not deplete dissolved oxygen concentrations below this level.

3.2 Source Assessment

Point and non-point sources may jointly contribute $CBOD_u$ and NBOD (i.e., organic loading) to a given waterbody. Dissolved oxygen depletion likewise occurs as the result of oxygen consumption from organisms which consume organic material found either on or within stream sediments, referred to as Sediment Oxygen Demand (SOD). This SOD component is ultimately derived from discharges and runoff in combination with additional organic material produced by existing waterbody plants. Potential sources of organic loading are numerous and often occur simultaneously. In rural areas, storm runoff from row crops, livestock pastures, animal waste application sites, and feedlots potentially transport sizable organic loads. Poorly or inadequately treated municipal sewage represents a major contribution of organic compounds which when hydrolyzed create additional loading. Urban storm water runoff and sanitary sewer overflows, as well as, combined sewer overflows may similarly result in considerable organic loading.

Non-point source pollution to surface waters occurs as the result of natural erosion and weathering of soils, rocks, and uncultivated land; as the result of erosion from large agriculturally cultivated land areas and pasturelands with unconfined grazing livestock which lessen or reduce normal vegetative ground cover and promote streambank damage when allowed direct access to streams; as the result of urban erosion from cleared or barren construction sites and wash-off of accumulated dust and litter from impervious street and roadway surfaces; and as the result of erosion from unpaved or dirt roadways.

While pollutant loading from erosion occurs as the result of or during storm events when overall stream flow is relatively higher, the adverse effects or impact of such loading are neither short-lived nor altogether immediate. Particularly during summer months, long intervals between rain events are characterized by higher temperatures of greater evaporation potential which result in lower stream velocities and decreased stream depths, with the full impact of pollutant loading being delayed until such critical conditions develop.

All potential load sources within the watershed were identified by principal land use/cover activities (e.g., agricultural management activities). Source assessments were applied in development and analysis of TMDL allocations. Assessment of organic loadings within the Catoma Creek watershed was restricted to non-point sources and MS4 discharges, since no significant industrial or municipal wastewater treatment facility discharges were identified.

3.2.2. Point Sources within the Catoma Creek Watershed

ADEM maintains a database of current National Pollutant Discharge Elimination System (NPDES) permits and Geographical Information System (GIS) files which identify the locations of permitted discharges within the state. The Surface Water Quality Screening Assessment of the Alabama River Basin 2000, dated April 26, 2002, listed a total of 49 NPDES permitted facilities of various types.

Of these, the one Public or Municipal wastewater treatment plant listed facility, Catoma Creek WWTP, no longer discharges to Catoma Creek. Of the three Semi Public/Private listed wastewater treatment plant facilities, one, the Green Lantern Restaurant was inactivated and resultantly tied directly to a collection system for ultimate treatment at another facility since 1996. Another, the Oak Hills Water Company, began disposal of treated effluent by method of spray irrigation prior to 1996 as well. Load allocations resulting from any known violation of permit limitations would have been impossible to directly quantify. Their effects, however, were ultimately represented and evaluated through water quality modeling of the Catoma Creek watershed. The one mining NPDES permitted facility, Saco Wood Pit, would have had contributed neither $CBOD_u$ nor NBOD. Forty three listed NPDES permitted facilities were classified as Construction/Stormwater, the effects or contributions of which were represented through land use characterization. Evaluation of flow contributions from the remaining two NPDES permitted facilities having direct discharge to Catoma Creek or its tributaries was as follows:

Effluent Percentages in Relation to Total Catoma Creek Flow at Point of Discharge or Tributary Confluence

Pike Road Plantation WWTP:

Averaged DMR Recorded Effluent Flow (12/01 through 2/02):	0.0450 mgd 0.0696 cfs
Flow of UT to Catoma Creek at Confluence with Catoma Creek:	0.2060 cfs
Catoma Creek Flow Immediately Upstream of UT to Catoma Creek:	1.6790 cfs

Percentage of Effluent to Overall Stream at Point of Discharge: 3.56 %

It should also be noted that NPDES Permit Limits for Pike Road Plantation WWTP were established for conditions in which critical flow of the UT to Catoma Creek was zero.

Paper Chemicals of Alabama

Averaged Reported Non-contact Cooling Water Discharge: 0.0230 mgd
0.0356 cfs

Combined UT to Catoma Creek and Catoma Creek Flows
At Their Confluence: 3.4760 cfs

Percentage of Effluent to Overall Stream Flow at Point of Discharge
To Catoma Creek: 1.01 %

None of the listed facilities were thus considered significant contributors to the impaired stream segment.

3.2.3. NPDES Construction Activities and Municipal Separate Storm Sewer Systems

Construction activities disturbing 1 or more acres of land, and Municipal Separate Storm Sewer Systems (MS4s) serving municipalities with urban residential populations greater than 50,000 people and overall population densities of 1,000 people per square mile are currently regulated by the State's NPDES program.

Pollutant loadings from MS4s enter surface waters in response to storm events. MS4s discharge to waterbodies during storm events by way of road drainage systems, curb and gutter systems, ditches, and storm drains. Such systems convey urban runoff from barren surfaces as well as wash-off of accumulated street dust and litter from impervious roadway surfaces during rain events. The purpose of both construction and MS4 NPDES permits is to eliminate or minimize the extent to which these pollutants discharge to neighboring streams. The City of Montgomery's MS4 is incorporated under Phase I of the NPDES Storm Water Program. Load allocations applied to regulated construction activities will be addressed through NPDES permits in the form of Best Management Practices (BMPs).

The City of Montgomery together with the State of Alabama Department of Transportation are required under NPDES Permit ALS000004 to conduct representative wet-weather monitoring of Montgomery's MS4; assess the effectiveness and adequacy of existing control measures implemented under the Storm Water Management Program

(SWMP); estimate annual cumulative pollutant loadings delivered by the MS4; estimate event mean concentrations and seasonal pollutants of major outfall discharges; identify and prioritize areas and locations within the MS4 which require additional controls; identify areas and locations which demonstrate significant improvement or reveal noticeable degradation in water quality; and periodically inspect, survey, and monitor the effectiveness and functioning of existing MS4 structural controls.

Representative wet-weather monitoring is periodically conducted at select locations for conventional pollutants which include sampling of Biochemical Oxygen Demand (BOD_5), Chemical Oxygen Demand (COD), Total Suspended Solids (TSS), Total Dissolved Solids (TDS), Total Nitrogen, Total Kjeldahl Nitrogen (TKN), Total Phosphorus, Dissolved Phosphorus, Oil and grease, and pH.

3.2.4. Non-Point Sources within the Catoma Creek Watershed

Table 3-2 details principal land usage within the Catoma Creek watershed. Land use activities, as derived from the *Watershed Management Plan for Catoma Creek*, are presented in Figure 3-1. The October 1998 *Watershed Management Plan for Catoma Creek* was developed through an interactive stakeholder process, which included a Steering Committee, a Technical Committee, and an Education/Outreach Committee. Predominant land uses within the watershed consist of forest, pasture, and wetlands at 33.6 %, 30.7 %, and 11.8 %, respectively.

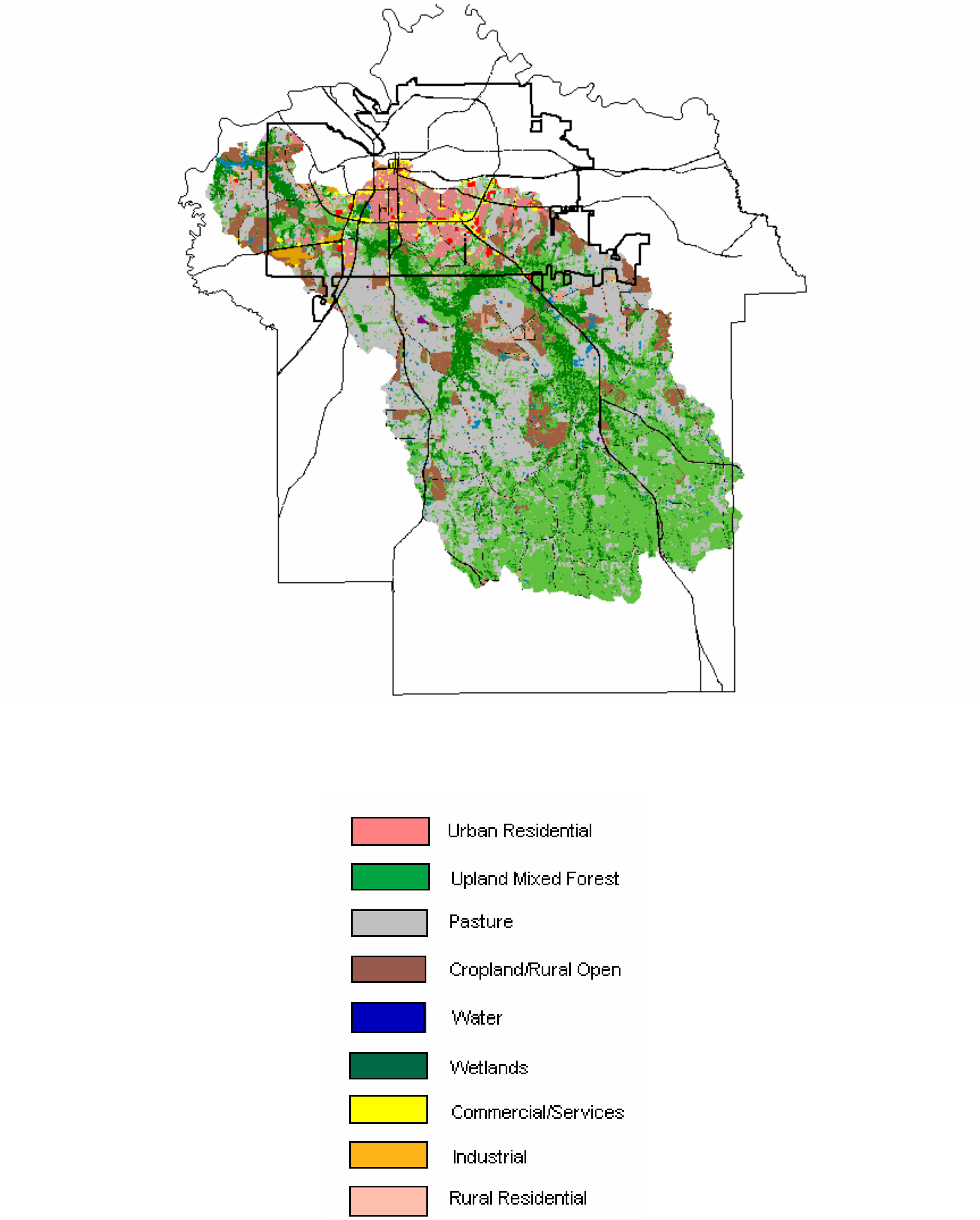
Table 3-2. Land Use in the Catoma Creek Watershed.

LAND USE	PERCENTAGE
Commercial/Services	1.2
Concentrated Animal	0.1
Cropland	0.6
Forested Wetland	11.6
Industrial	0.6
Major Roadways	3.1
Nonforested Wetland	0.2
Open Water	1.3
Pasture	30.7
Rural Open	8.0
Rural Residential	2.6
Transitional/Construction	0.3
Upland Mixed Forest	33.6
Urban Open/Undeveloped	1.3
Urban Resid./Multi-Family	0.5
Urban Resid./ Single Family	4.5
Total	100.0

Combined predominant land uses of forest, pasture, and wetlands accordingly represent 76.1 % of the watershed's overall characterization. Each land use has the potential of contributing organic loading due to runoff/erosion of land surface organic material.

Major sources of organic enrichment from non-point sources within the Catoma Creek watershed were associated with forest, wetland, and pasture land use activities. Organic enrichment from forest land relative to other land uses is comparatively insignificant, given that forest lands tend to filter out any naturally occurring pollution. Some organic loading may, however, be derived from forested areas owing to the presence of wild animals such as deer, raccoons, turkeys, waterfowl, etc. Control of such sources would be limited to best management practices (BMPs) of land management which are commonly viewed as impractical. By contrast, agricultural lands represent major sources of potential organic loading. Runoff from pastures, animal operations, improper land application of animal wastes, and animals with direct access to streams, all illustrate mechanisms by which organic loadings can enter or be introduced into streams.

Figure 3-1. Land Use Map for the Catoma Creek Watershed.



3.3 Loading Capacity – Linking Numeric Water Quality Targets and Pollutant Sources

EPA regulations define loading, or assimilative capacity, as the maximum loading that a waterbody can receive without violating water quality standards (40 CFR Part 130.2(f)).

According to ADEM's Water Quality Regulations (ADEM Admin. Code R. 335-6-10-.09-(5)(e)(4.)) the dissolved oxygen criteria for a diversified warm water biota, including game fish, shall not be less than 5 mg/l at any given time; except under extreme conditions resulting from natural causes during which it may range between 5 and 4 mg/l, provided that all other water quality parameters remain favorable. Normal seasonal and daily fluctuations shall be maintained above these levels.

Setting the DO water quality criterion of 5.0 mg/l as the numerical target, a TMDL was conducted at critical conditions to determine Catoma Creek's total loading capacity. This was accomplished through multiple modeling simulations in which various source contribution loadings were adjusted in order to achieve the dissolved oxygen target. The final simulation represents the TMDL or total loading capacity for Catoma Creek. Had significant contributing industrial or municipal wastewater treatment facility discharges been identified, additional model analyses would have been required in assessing their relative impact.

Pollutant concentrations for the various land uses were assigned in proportion to measured concentrations derived from the *Catoma Creek Watershed Management Plan* prepared for the Water Works and Sanitary Sewer Board of the City of Montgomery by CH_2M HILL, October 1998. In model calibration, concentrations were subsequently adjusted as needed in aligning model predicted instream pollutant concentrations within reasonable comparison to observed main channel collected field data.

3.4 Data Availability and Analysis

3.4.1. <u>Watershed Characteristics</u>

A. <u>General Description</u>: Catoma Creek, located almost entirely in Montgomery County, is a tributary to the Alabama River and therefore a part of the Alabama River basin. Catoma Creek is a part of the United States Geological Survey (USGS) 03150201 cataloging unit. The 303(d) listed impaired segment of Catoma Creek is further designated by NRCS (Natural Resources Conservation Service) as sub-watershed 080 (Lower Catoma Creek).

   Catoma Creek is created by the confluence of Baskins Mill Creek and Little Sandy Creek approximately 10 miles south-southeast of Montgomery, Alabama in Sec. 23, R19E, T14N. Catoma Creek covers a linear distance of roughly 41 miles, encompasses a total drainage area of nearly 360 square miles, and holds a current stream use classification of Fish & Wildlife (F&W).

B. Geological Description: The Catoma Creek watershed consists largely of two major formations: Alluvial Coastal and Low Terrace Deposits (Q_{alt}) contained along the immediate stream drainage areas and Mooreville Chalk (K_m) located outside those immediate areas. The first is of Quaternary System and Holocene Series consisting of very pale-orange to grayish varicolored fine to coarse quartz sand with clay lenses and gravel in places composed of both quartz and chert. The second being of Cretaceous System, Upper Series, and Selma Group consisting of yellow-gray to olive-gray compact fossiliferous clayey chalk and chalky marl; unconformable base contact characterized by a bed of glauconitic, chalky sand of phosphate pellets and fossiliferous molds; and a top Arcola Limestone Member consisting of two to four beds of light-gray brittle, dense, fossiliferous limestone separated by beds of light-gray to pale-olive calcareous clay.

Two additional formations found in limited areas of the watershed's southern most reaches are the Cusseta Sand Member of the Ripley Formation (K_{rc}) and Demopolis Chalk (K_d), both of the Cretaceous System, Upper Series, and Selma Group. This third formation consists of cross-bedded, medium to coarse sand; glauconitic, fossiliferous fine sand; and dark-gray fossiliferous micaceous, carbonaceous clay. This member occurs at the base of the Ripley Formation extending from Georgia westward into Montgomery County where it merges with the Demopolis Chalk which consists of light-gray to medium-light-gray compact, brittle chalk overlain by abundantly fossiliferous chalky marl, very clayey chalk, and calcareous clay (Bluffport Mar Member).

C. Eco-region Description: Ecoregion designations are of significance to the biological assessment process. Ecoregions are areas which feature a high degree of similarity and homogeneity in reference to perceived patterns of land use, naturally occurring vegetation, and local soil types. All streams within the Catoma Creek watershed are classified as part of the Southern Plains Ecoregion (65) which consists of irregular plains with broad interstream areas comprising a mosaic of cropland, pasture, woodland, and forest. Natural vegetation is characteristically oak-hickory-pine and Southern mixed forest. Elevations and relief are greater than Southern Coastal Plains (75), but generally less than much of the Piedmont (45) to the north. Streams are of relatively low-gradient and sandy-bottomed. The Catoma Creek watershed is further subdivided into the Southeastern Flood Plains and Low Terraces (65p), Flatwoods/Blackland Prairie Margins (65b), Blackland Prairie (65a), and Southern Hilly Gulf Coastal Plain (65d).

The northern boundary of Montgomery County, inclusive of the last several miles of Catoma Creek, consists of Southeastern Floodplains and Low Terraces (65p) which is defined as a riverine ecoregion of large sluggish rivers and backwaters consisting of ponds, swamps, and oxbow lakes. River swamp forests of bald cypress and water tupelo along with oak-dominated bottomland hardwood forests provide vital wildlife corridors and habitat. Cropland consists typically of higher, better-drained terraces, while hardwood forests dominate lower floodplain areas.

A narrow stretch of Flatwoods/Blackland Prairie Margins (65b) extends across an area immediately south of the Southeastern Flood Plains and Low Terraces (65p). Flatwoods constitute most of the forested lowland areas, exhibiting little relief and formed primarily upon dark, massive marine clay. Soils are deep, clayey, somewhat-poorly to poorly drained, and acidic. Blackland Prairie Margins contain undulating, irregular plains, with slightly more relief than Flatwoods, tending toward heavier clay soils that become sticky when wet, hard and cracked when dry, and provide limited drainage.

Continuing south, Blackland Prairies (65a) cover the greatest portion of the watershed, constituting flat to undulating regions of distinctive Cretaceous-age chalk, marl, and calcareous clay. Clayey soils tend toward shrinkage and cracking when dry and swelling when wet. Streams experience high variability in flow, effectively limiting the distribution of certain fish species. Where sweetgum, post oak, red cedar, and patches of bluestem prairie were once mainstay, cropland, pasture, and small patches of mixed hardwoods now dominate. Pond-raised catfish aquaculture has shown considerable increase in recent years.

Southern Hilly Gulf Coastal Plains (65d) extend over the southernmost reaches of the watershed, characterized by dissected irregular plains and gently rolling hills which were shaped over east-west trending bands of sand, clay, and marl formations. Broad cuestas with gentle south slopes and steeper north-facing slopes prevail with a mix of clayey, loamy, and sandy soils. Greater rolling topography, higher elevations, and more relief are exhibited. Naturally occurring oak-hickory-pine forests grade southward into southern mixed forests with land coverage consisting mostly of forests and woodlands with occasional cropland and pasture activities.

D. Other Notable Characteristics: None

3.4.2 Available Biological, Chemical, and Physical Water Quality Data

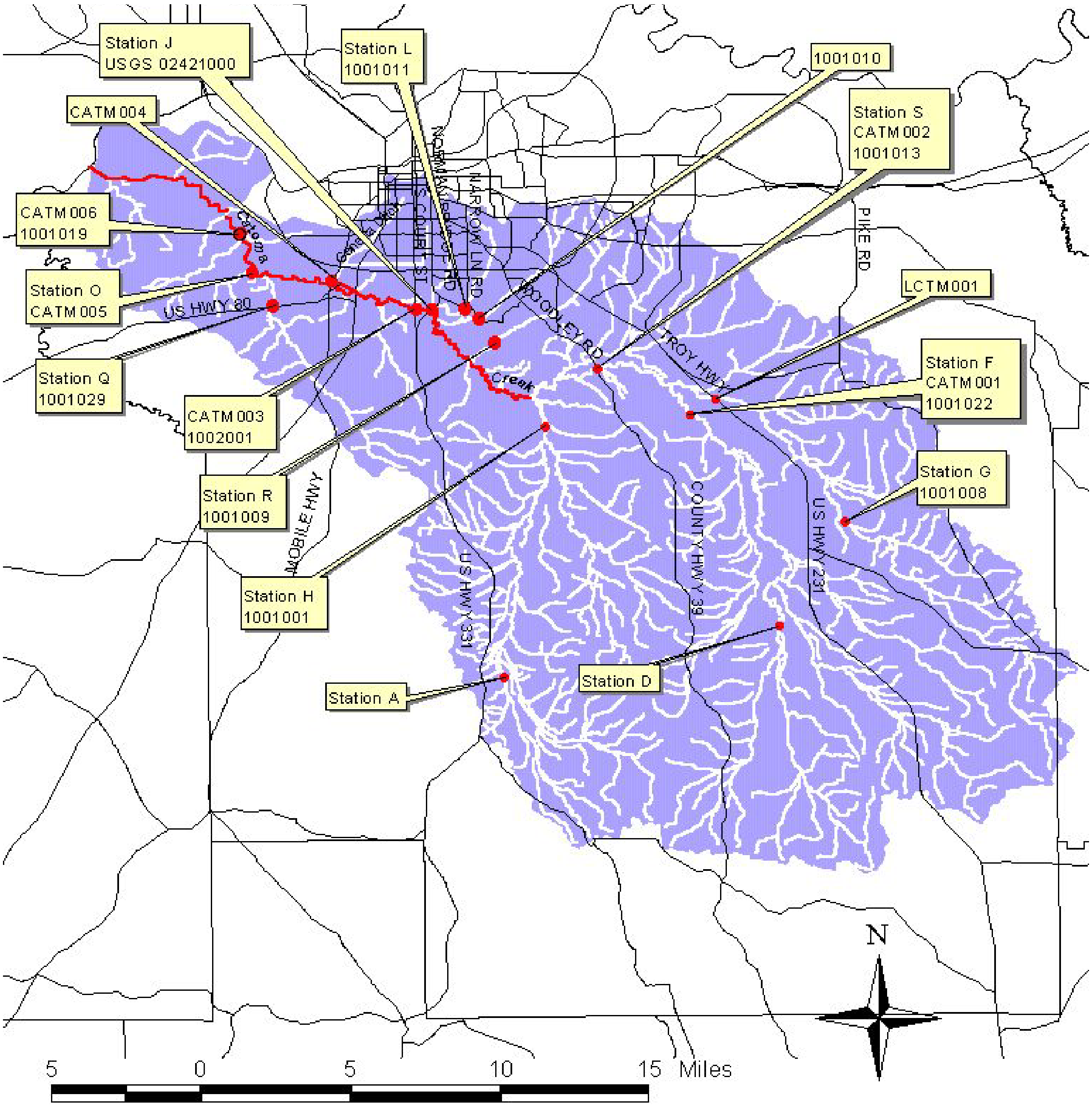
Biological Data

While biological water quality data was neither used nor required in developing the Catoma Creek TMDL, considerable study was undertaken during November 1995 and June 1996 by the consulting firm of CH2M HILL in developing their *October 1998 Watershed Management Plan for Catoma Creek.* Benthic macroinvertebrates (e.g., aquatic insects, crayfish, and mussels) and fish, including both native non-game and game fish, were collected and evaluated as indicators of overall stream environment conditions and compared to known benthic and fish community conditions of relatively undisturbed streams of similar size and geographical region.

Chemical Data

Water Quality data for the Catoma Creek watershed was collected by volunteer-citizens of the Alabama Water Watch (AWW) and Montgomery Water Watch (MWW) cooperatives, the Water Works and Sanitary Sewer Board of the City of Montgomery (MWW&SSB), by CH2M HILL in developing their *October 1998 Watershed Management Plan for Catoma Creek* and by ADEM. After careful evaluation of all available water quality data spanning the most recent five year period, water quality measurements recorded on September 19, 2001 by MWW&SSB provided the most thorough and inclusive representation of critical conditions for TMDL development. Data was collected from multiple sampling locations along Catoma Creek, as well as, from various locations along its contributing or feeding streams. A map displaying the locations of these sampling stations appears on the following page in Figure 3-2. A summary of related water chemistry data is provided in Appendix 9.2.

Figure 3-2. Map of Sampling Locations for the Catoma Creek Watershed.



Physical Data

A $7Q_{10}$ flow represents the minimum 7-day flow which occurs, on average, over a 10-year recurrence interval, whereas, a $7Q_2$ flow represents the minimum 7-day flow that occurs, on average, over a 2-year recurrent period. These flows are conventionally used in representing critical flow conditions for summer and winter seasons respectively.

Both $7Q_{10}$ and $7Q_2$ flows can be determined either from available United States Geological Survey (USGS) gauge data or by use of the Bingham Equation. The Bingham Equation is referenced from page 3 of the Geological Survey of Alabama's, *Low-Flow Characteristics of Alabama Streams, Bulletin 117*. Emphasis should be given that the Bingham Equation is only applicable to calculating $7Q_{10}$ and $7Q_2$ flows and is not functional in determining other type condition flows.

Equations used in determining $7Q_{10}$ and $7Q_2$ flows from continuous USGS gauging station recorded data are as follows:

$$7Q_{10}\text{ (cfs)} = \frac{(7Q_{10}\text{ @ USGS Station (cfs))}}{\text{(Drainage Area @ USGS Station (mi}^2\text{))}} * \text{(Watershed Drainage Area (mi}^2\text{))}$$

$$7Q_{2}\text{ (cfs)} = \frac{(7Q_{2}\text{ @ USGS Station (cfs))}}{\text{(Drainage Area @ USGS Station (mi}^2\text{))}} * \text{(Watershed Drainage Area (mi}^2\text{))}$$

Low flow estimates employing the Bingham Equation are based upon a stream's recession index (G, no units), drainage area (A, mi^2), and mean annual precipitation (P, inches):

$$7Q_{10}\text{ (cfs)} = 0.15\text{x}10^{-5}(G-30)^{1.35}(A)^{1.05}(P-30)^{1.64}$$

$$7Q_{2}\text{ (cfs)} = 0.24\text{x}10^{-4}(G-30)^{1.07}(A)^{0.94}(P-30)^{1.51}$$

Whenever possible, $7Q_{10}$ and $7Q_2$ determinations from USGS gauge data are preferred over equation derived values in affording greater reliability and accuracy in the prediction of true or actual critical flow conditions.

For purposes of this TMDL, data collected on September 19, 2001 provided the most comprehensive representation of critical low flow (worst-case) conditions available. A winter TMDL was not performed since extremely few DO violations occurred during winter months (December through April), thereby indicating that the DO criterion is being met during those months. Annual calculated $7Q_{10}$ summer stream flows for Catoma Creek at both headwaters and mouth were compared to flows measured on September 19, 2001. Calculated $7Q_{10}$ flows derived from USGS flow gauge 02421000, located adjacent to Norman Bridge Road, for both headwaters and gauge locations were 0.0 cfs. This required use of the Bingham Equation in establishing a critical flow for Catoma Creek at its mouth (or model end) of 1.43 cfs. While September 19, 2001 headwater and model end flows of 0.6 cfs and 3.78 cfs were clearly higher than their respective $7Q_{10}$ values, water quality data from that date still provided the best available representation of critical flow conditions. Use of 0.0 cfs $7Q_{10}$ flows was precluded, since TMDL model development and function necessitates input of at least some flow, however minimal.

In absence of adequate flow measurements, headwater, tributary, and main stem monitoring station flows were established from drainage area ratio comparisons to the known flow measurement recorded at USGS flow gauge 02421000. The accuracy and reliability of these ratio derived flow values were substantiated by the limited number of actual flow measurements that were available, and as such were subsequently used in development of the critical condition TMDL model. They were distributed accordingly as tributary or incremental flow (IF), with IF apportioned to segment length.

3.5 Critical Conditions

Summer months (May – November) generally represent critical conditions for instream dissolved oxygen concentrations as a result of lower precipitation and higher temperatures which lead to shallower stream depths, slower velocities, increased residence time, and decreased re-aeration. Increased residence time allows for additional decay which further depletes stream dissolved oxygen. Reaction rates for $CBOD_u$ and NBOD (i.e., organic loading) are temperature dependent and thereby increase with higher temperatures.

Low intensity rains typically occur with greater frequency in winter months with the absence of land surface build-up of organic material, resulting in a more uniform load distribution. Higher flows in connection with lower temperatures effectively result in less residence time and lower decay rates that are capable of handling higher organic loads.

3.6 Margin of Safety (MOS)

Methods for integrating a MOS (USEPA, 1991) are either: 1) implicit, by input of conservative model assumptions, or 2) explicit by allocating a specified portion or percentage of the TMDL as the MOS itself.

The MOS chosen for this TMDL is implicit by way of conservative model input parameters (temperature, flow and DO concentrations) which are representative of worse case or critical conditions. Conservative temperature values correspond to highest average maximum temperatures that would normally be expected during critical flow conditions. Input flows likewise reflect low flow critical conditions. Dissolved oxygen concentration for incremental flow was set at 70% of saturation concentration, 15% lower than the 85% normally assumed for typical waste load allocation. Applied stream depths were derived from ADEM stream depth measurements recorded between 5-2-00 and 1-10-01. Shallow observed stream depths, ranging between 1.0 and 2.5 feet, were applied to the first 15 segments of the reach, with depths between 6.0 and 8.0 assigned to end stream and embayment segments, which effectively intensified Sediment Oxygen

Demand (SOD). In absence of actual velocity values from intensive stream surveys, default values of 0.10 feet/second were generated by the model, which allowed further amplification of CBOD decay.

4.0 Water Quality Model Development

4.1 Water Quality Model Selection and Setup

Since impairments, noted from available data, occurred during periods of low flow, a steady-state modeling approach was adopted in representing all corresponding conditions of impairment. A steady state TMDL Spreadsheet Water Quality Model (SWQM) developed by ADEM was selected in view of the following reasons:

- It represents a simplified approach absent of unnecessary or undue complexity.
- It conforms to ADEM standards for development of wasteload allocations.
- It affords development with limited data.
- It allows for input and assessment of tributary, point, and non-point source load contributions.

The selected TMDL spreadsheet model furthermore provides a complete spatial view in accounting for stream variations throughout the entire modeled reach. Dissolved oxygen is derived from a modified Streeter-Phelps equation which considers oxygen demand resulting from carbonaceous decay, as well as, from nitrification or ammonia decay. Each stream reach segment is divided into twenty-one computational elements, with each element recognized as the functioning equivalent of a completely mixed reaction.

The following assumptions were made in TMDL model development:

- DO concentration for incremental flow was set at 70% of saturation temperature. (MOS)
- Incremental and tributary loadings were apportioned according to principal land use patterns.
- $CBOD_u$/ $CBOD_5$ ratios for non-point and MS4 sources were set at 1.5.
- NBOD was set equal to 4.57 times the Total Kjeldahl Nitrogen (TKN) concentration.
- Forested land use corresponded to background conditions with incremental flow concentrations of 2 mg/l $CBOD_u$, 0.01 mg/l NH_3-N, and 0.36 mg/l TON.

4.1.1. SOD Representation

Sediment Oxygen Demand (SOD) in relation to the decomposition of organic materials can represent a significant portion of overall oxygen demand within shallow streams as a result of stream bed sediment accumulation and build up. This SOD component is ultimately derived from discharges and runoff in conjunction with the production of new organic material generated by existing stream plants. Measured SOD reaction rates for unimpaired streams are conventionally used in determining achievable SOD target values for assessed impaired stream segments of same or similar ecoregion. Ecoregion based reference streams of similar land use character and stream conditions generally contain less pasture, cropland, and urban areas, as well as more forested areas when compared to impaired watersheds. Unimpaired reference watersheds are considered the "least impacted" in a given ecoregion and , as such, the pollutant loading from these watersheds serve as appropriate targets in TMDL development.

In absence of SOD values from a specific reference site for Catoma Creek, an average mean SOD reaction rate value for all measured streams within the state of Alabama, both impaired as well as unimpaired, was derived from EPA, Region IV's *Sediment Oxygen Demand Data Insitu Chamber Measurements 1988-1997* database (representing mixed land uses and varying degrees of point source activity). This average mean SOD value of 0.103 O_2/ft^2/day was uniformly applied to all reach segments during critical model calibration.

4.1.2. Calibration Data

Model calibration was performed using water quality data (ref: Appendix 9.2) collected on September 19, 2001, which was representative of low flow and low dissolved oxygen critical conditions. Stream condition data, consisting of water temperature, DO, CBOD, and NH_3-N was incorporated into the calibrated model TMDL spreadsheet. Values for TON were inferred from previously recorded measurements of similar temperature and stream flow conditions at each same monitoring station.

4.2 Water Quality Model Summary

The critical model reach consisted of 17 segments with an impaired portion consisting of the last 7 segments for an overall impaired length or distance of 21.3 miles. A schematic flow diagram of the entire modeled reach is presented as Figure 4-1. A user's guide to ADEM's TMDL water quality model has been provided in Appendix 9.4 which explains much of the theoretical basis, physical/chemical mechanisms, and principles upon which the model was designed.

Definitions of various abbreviations used in the following model reach schematic are as follows:

DA = Drainage Area in square miles

Q = Flow in cfs

cfs = cubic feet per second

EL = Elevation in feet at segment beginning or end

Avg H = Average segment height in feet

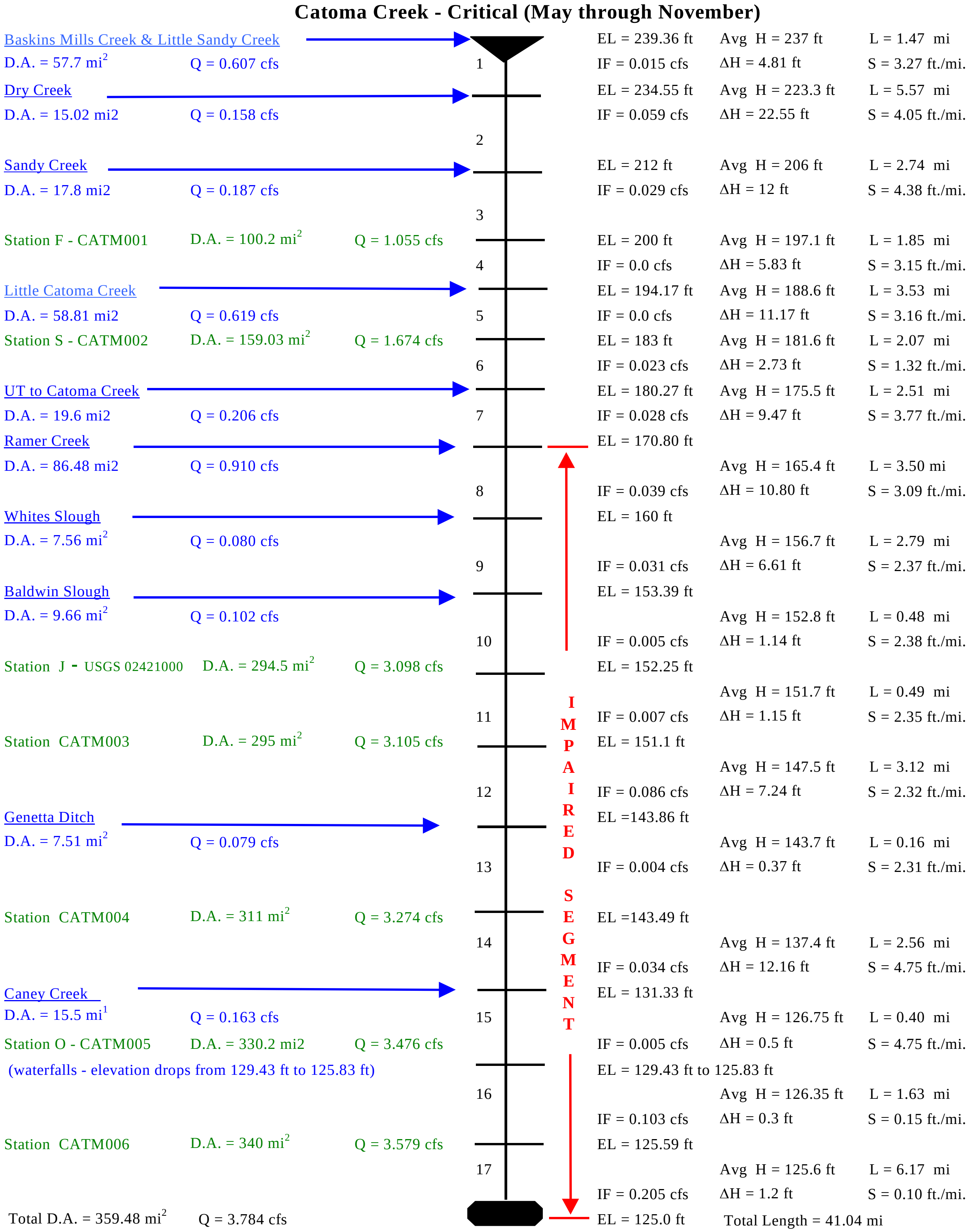
L = Length of segment in miles

ΔH = Change in height from segment beginning to segment end in feet

S = Slope of segment in feet per mile

IF = Incremental Flow in cfs per given segment

Figure 4-1. Schematic of the Modeled Reach at Critical Conditions.



4.3 Loading Reduction Analysis

4.4.1. <u>Calibrated Model</u>

Instream DO violations indicated from September 19, 2001 field data occurred 9.78 miles downstream of the headwaters at Sampling Station F – CATM001 and again at 15.16 miles at Sampling Station S – CATM002, with measured DO concentration values of 4.3 mg/l at both locations. Water quality data from the sampling event was used as input in performing the calibrated simulation. Non-point source and MS4 pollutant loadings were adjusted to simulate projected mainstream DO values as close as possible to measured mainstream values, while preserving reasonable representation of stream water quality conditions for the recorded sampling event.

Figure 4-2, below plots calibrated model DO predictions against measured DO data.

Figure 4-2. Calibrated Model DO Predictions vs. Actual DO Field Data.

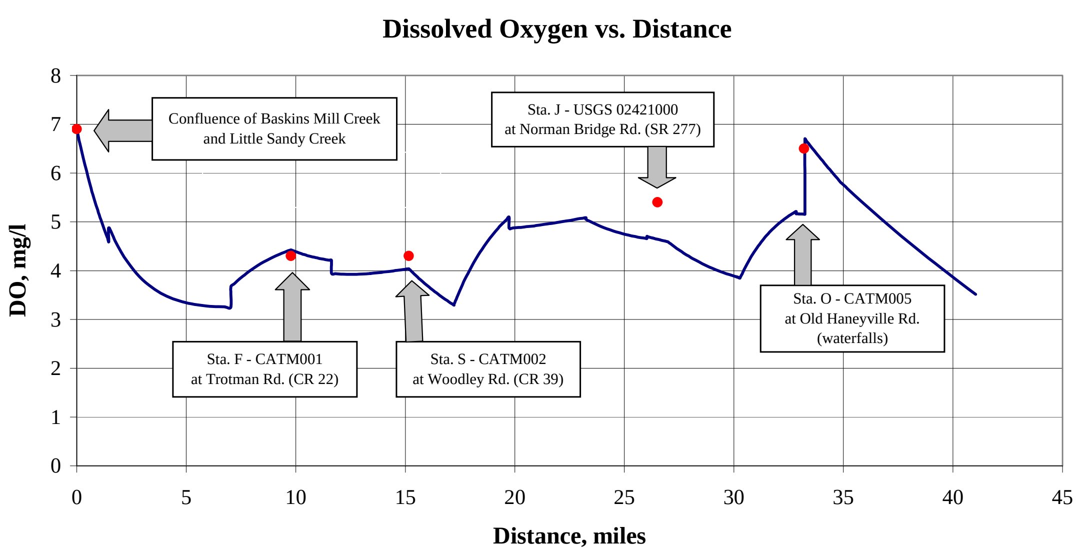


Table 4-1 provides comparison between input headwater and tributary parameter values and calibrated model projected values for main stream locations of lowest predicted DO and model's end.

Table 4-1. Calibrated Model Input and Lowest Projected DO and End Model Parameters

Description	$CBOD_u$ (mg/l)	NH_3-N (mg/l)	TON (mg/l)	DO (mg/l)	Flow (cfs)	Temp (°C)
Headwaters	2.95	0.014	0.573	6.90	0.61	20.4
Dry Creek	3.01	0.015	0.639	6.00	0.16	23.6
Sandy Creek	2.88	0.017	0.687	5.50	0.19	23.5
Little Catoma Creek	3.21	0.021	0.585	3.50	0.62	22.5
Unnamed Tributary To Catoma Creek	3.70	0.017	0.624	3.50	0.21	23.8
Ramer Creek	3.18	0.023	0.721	4.40	0.91	22.8
Whites Slough	5.26	0.017	0.618	3.90	0.08	27.0
Baldwin Slough	6.45	0.016	0.594	6.00	0.10	27.5
Genetta Ditch	7.58	0.017	0.629	4.00	0.08	28.0
Caney Branch	3.79	0.025	1.043	4.20	0.16	23.0
Lowest Projected DO (@ 7.04 mi.)	0.89	0.018	0.567	3.25	0.84	21.2
Model End	0.21	0.018	0.575	3.51	3.78	23.5

Table 4-2 provides a summary of incremental flow parameter values as applied to the calibrated TMDL model.

Table 4-2. Calibrated Model Incremental Flow Parameters

Segments	$CBOD_u$ (mg/l)	NH_3-N (mg/l)	TON (mg/l)	DO (mg/l)	Flow (cfs)	Temp. (°C)
1	3.01	0.015	0.639	6.00	0.02	23.0
2	3.12	0.015	0.624	6.00	0.06	23.0
3	3.07	0.016	0.652	6.00	0.03	23.0
4	0.00	0.000	0.000	5.78	0.00	25.0
5	0.00	0.000	0.000	5.78	0.00	25.0
6	2.99	0.019	0.608	5.78	0.02	25.0
7	3.02	0.019	0.688	5.58	0.03	28.0
8	3.12	0.019	0.601	5.58	0.04	28.0
9	3.22	0.019	0.712	5.48	0.03	29.0
10	4.79	0.020	0.753	5.48	0.01	29.0
11	4.79	0.020	0.753	5.38	0.01	27.1
12	4.79	0.020	0.753	5.38	0.09	27.1
13	5.19	0.015	0.542	5.38	0.00	27.1
14	5.19	0.015	0.542	5.38	0.03	27.1
15	3.56	0.020	0.827	5.38	0.01	27.1
16	3.56	0.020	0.827	5.38	0.10	27.1
17	3.56	0.020	0.827	5.38	0.21	27.1

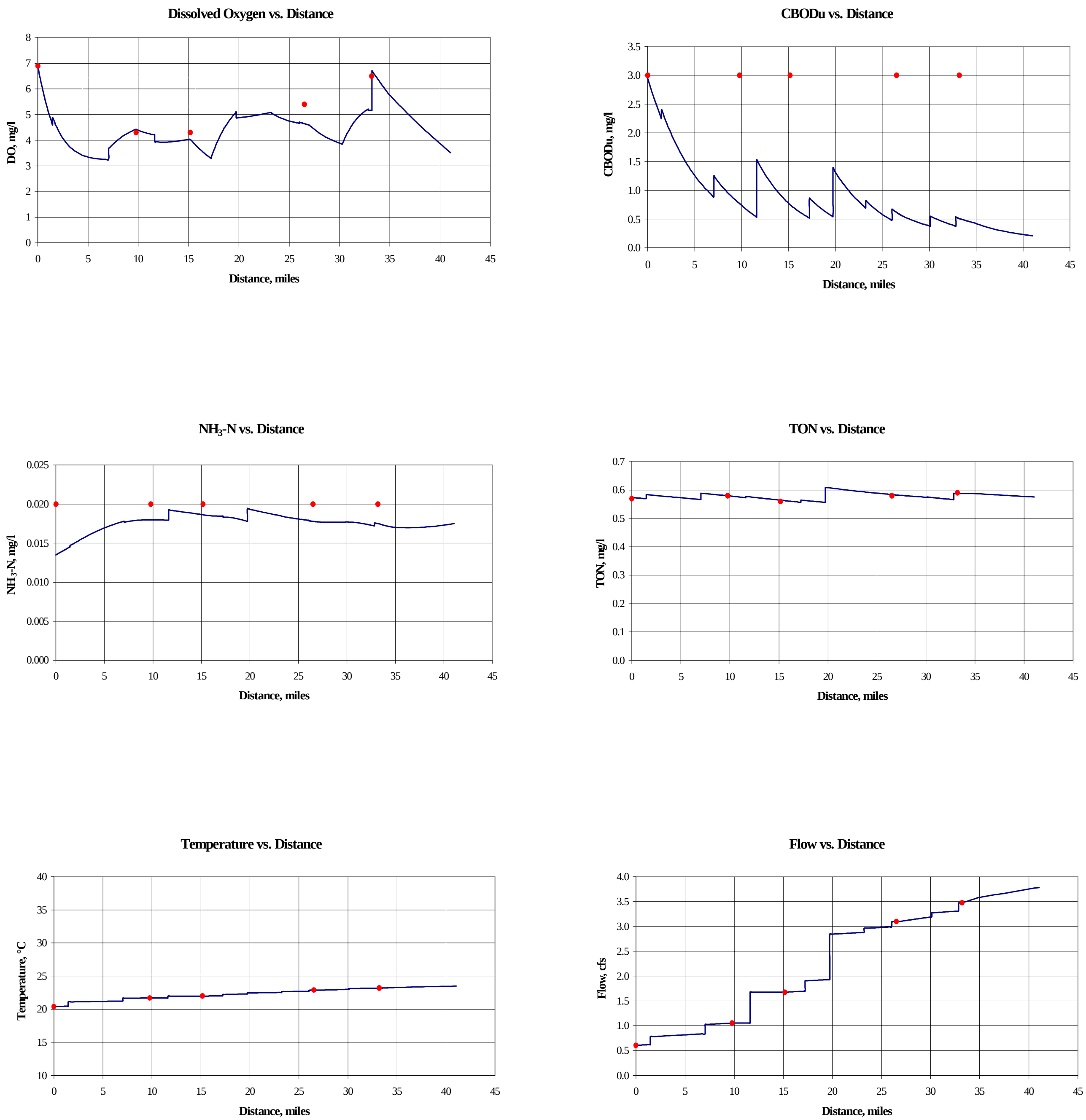
Table 4-3 provides comparison between field measured mainstream parameter values and calibrated model projected values at various locations within the model reach.

Table 4-3. Comparison of Projected Calibrated Model Parameters to Actual Mainstream Field Data

Description	**$CBOD_u$ (mg/l)**	**NH_3-N (mg/l)**	**TON (mg/l)**	**DO (mg/l)**	**Flow (cfs)**	**Temp (^oC)**
Actual Conditions @ 9.78 miles	< 3.00	< 0.020	0.580	4.30	1.06	21.7
Projected Conditions @ 9.78 miles	0.77	0.018	0.580	4.43	1.06	21.7
Actual Conditions @ 15.16 miles	< 3.00	< 0.020	0.560	4.30	1.67	22.0
Projected Conditions @ 15.16 miles	0.75	0.019	0.564	4.04	1.67	22.0
Actual Conditions @ 26.51 miles	< 3.00	< 0.020	0.580	5.40	3.10	22.9
Projected Conditions @ 26.51 miles	0.62	0.018	0.584	4.64	3.10	22.9

Graphical presentation of calibrated model predicted mainstream parameter values together with measured mainstream parameter values is provided in Figure 4-3.

Figure 4-3. Calibrated Model Predictions.



4.4.2. Load Reduction Model

The second simulation, hereafter referred to as the "load reduction model", adjusted non-point source and MS4 loadings from the calibrated model to bring impaired waterbody segments into compliance with the required 5 mg/l water quality criterion for DO. The critical/calibrated TMDL for this waterbody revealed strong connections between elevated CBOD levels and SOD reaction rates (resulting from stream sediment accumulation) and resulting Organic Enrichment/Low Dissolved Oxygen (OE/DO) impairment. Table 4-4 provides a comparison between input headwater and tributary parameter values and load reduction model projected values for locations of lowest predicted DO and the model's end.

Table 4-4. Load Reduction Model Input and Lowest Projected DO and End Model Parameters

Description	$CBOD_u$ (mg/l)	NH_3-N (mg/l)	TON (mg/l)	DO (mg/l)	Flow (cfs)	Temp (^oC)
Headwaters	1.99	0.014	0.573	6.90	0.61	20.4
Dry Creek	1.99	0.015	0.639	6.00	0.16	23.6
Sandy Creek	1.97	0.017	0.687	5.50	0.19	23.5
Little Catoma Creek	1.97	0.021	0.585	3.50	0.62	22.5
Unnamed Tributary To Catoma Creek	1.97	0.017	0.624	3.50	0.21	23.8
Ramer Creek	1.98	0.023	0.721	4.40	0.91	22.8
Whites Slough	1.98	0.017	0.618	3.90	0.08	27.0
Baldwin Slough	1.98	0.016	0.594	6.00	0.10	27.5
Genetta Ditch	1.99	0.017	0.629	4.00	0.08	28.0
Caney Branch	1.98	0.025	1.043	4.20	0.16	23.0
Lowest Projected DO (@ 11.63 mi.)	0.95	0.019	0.577	5.03	1.67	22.0
Model End	0.11	0.016	0.575	5.38	3.78	23.5

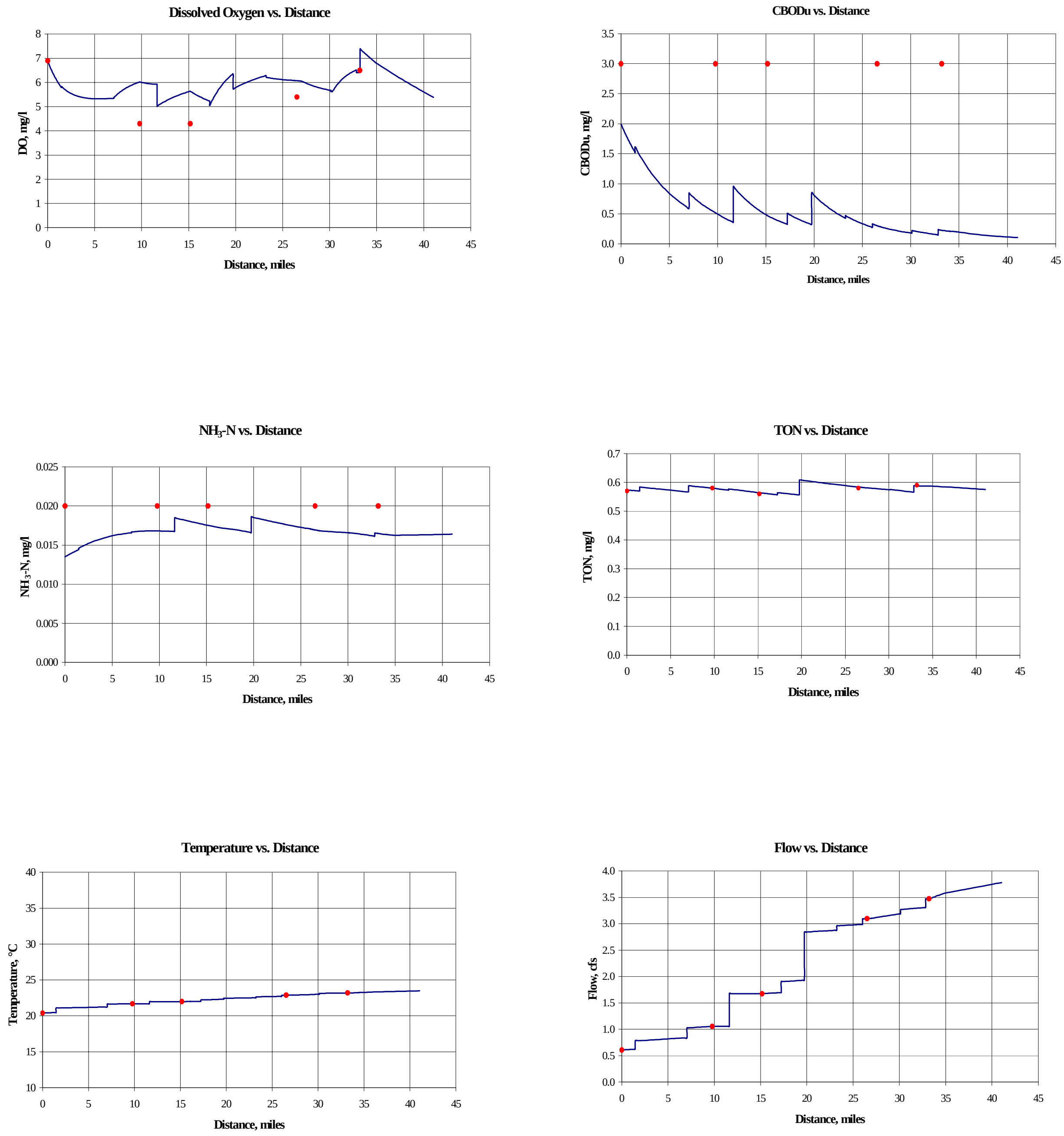
Table 4-5 on the following page, provides a summary of incremental flow parameter values which were applied to the load reduction TMDL model.

Table 4-5. Load Reduction Model Incremental Flow Parameters

Segments	$CBOD_u$ (mg/l)	NH_3-N (mg/l)	TON (mg/l)	DO (mg/l)	Flow (cfs)	Temp. (^oC)
1	1.99	0.015	0.639	6.00	0.02	23.0
2	1.95	0.015	0.624	6.00	0.06	23.0
3	1.96	0.016	0.652	6.00	0.03	23.0
4	0.00	0.000	0.000	5.78	0.00	25.0
5	0.00	0.000	0.000	5.78	0.00	25.0
6	1.98	0.019	0.608	5.78	0.02	25.0
7	1.98	0.019	0.688	5.58	0.03	28.0
8	1.99	0.019	0.601	5.58	0.04	28.0
9	1.99	0.019	0.712	5.48	0.03	29.0
10	1.98	0.020	0.753	5.48	0.01	29.0
11	1.98	0.020	0.753	5.38	0.01	27.1
12	1.98	0.020	0.753	5.38	0.09	27.1
13	1.97	0.015	0.542	5.38	0.00	27.1
14	1.97	0.015	0.542	5.38	0.03	27.1
15	1.94	0.020	0.827	5.38	0.01	27.1
16	1.94	0.020	0.827	5.38	0.10	27.1
17	1.94	0.020	0.827	5.38	0.21	27.1

Graphical presentation of load reduction model predicted mainstream parameter values together with field measured mainstream parameter values is provided in Figure 4-4.

Figure 4-4. Load Reduction Model Predictions.



4.4.3. Required Reductions

Total organic loadings (i.e., $CBOD_u$ and NBOD) were determined for both calibrated and load reduction models. Total organic loading for the calibrated model was 135.8 lbs/day, while total organic loading for the load reduction model was 104.9 lbs/day. This difference would require a 22.8 % reduction in pollutant loading to bring Catoma Creek into compliance with ADEM's dissolved oxygen criterion of 5.0 mg/l. In view of the fact that existing TON and NH_3-N loadings were already negligibly low and their further reduction was found to have little or no effect on raising instream DO levels, no adjustments to their concentrations were considered necessary.

In the process of determining further needed load reductions, all land uses, with the exception of open water, were ultimately set to the $CBOD_u$ background concentration for forest land. While this adjustment effectively lowered instream $CBOD_u$ values, it alone, proved to be inadequate in raising DO to the requisite 5 mg/l minimal level. Calibrated model flow conditions were at such exceptionally low levels (inclusive of incremental flow) that any changes made to land use would have minimal impact.

Given that the accumulation of stream sediments are the result of run off/erosion, reasonably achievable reductions in SOD (consistent with EPA, Region IV's *Sediment Oxygen Demand Data Insitu Chamber Measurements 1988-1997* database) were performed until an instream DO of 5 mg/l was attained. While $CBOD_u$ and NBOD loadings have relatively minor effect in the direct causation of low DO values in Catoma Creek, they do however, contribute toward the build-up of SOD and thereby indirectly contribute to DO impairment. Additionally while the SOD in Catoma Creek may be relatively low in comparison to other streams, low flow, high temperatures, and low reaeration combined during critical conditions result in considerable impact from SOD. It thus becomes both reasonable and necessary to reduce SOD in achieving water quality standards under critical conditions by reducing $CBOD_u$ and NBOD loadings. Over the long term, reductions made to SOD in achieving the required DO water quality criterion will be directly related to proportional reductions in both $CBOD_u$ and NBOD loadings.

Wasteload allocation (WLA) was assigned to Montgomery's MS4 as a percentage of the overall load allocation (LA) contributed from both MS4 and non-point source areas within the Catoma Creek watershed since both sources typically occur in response to various storm or rain events. Given the limited availability of data concerning Montgomery's MS4, it was not possible to accurately quantify pollutant loadings conveyed directly or exclusively from MS4 areas. Montgomery's MS4 encompasses approximately 13.2% of Catoma Creek's total drainage area. Pollutant loadings for Montgomery's MS4 therefore correspond to 13.2% of the total pollutant loading and are represented as a WLA.

A summary of reductions for all land uses is presented in Table 4-6.

Table 4-6 Reductions Necessary to Meet the TMDL at the Time of this Report, in the Catoma Creek Watershed HUC AL/03150201-080_01

Loading Parameter	Existing Loads		Allowable Loads		Reductions	
	WLA(1)	LA	WLA(1)	LA	% WLA	% LA
CBODu	9.4 lbs/day	61.8 lbs/day	5.3 lbs/day	35.0 lbs/day	43.6	43.4
NBOD	8.5 lbs/day	56.1 lbs/day	8.5 lbs/day	56.1 lbs/day	0.0	0.0

(1) NOTE: MS4 Stormwater Phase I contributions are represented in terms of WLA.

Required reductions are to be accomplished through TMDL implementation with follow up monitoring to determine resulting effectiveness. Appropriately designed and adequately established BMPs are expected to provide the necessary load reduction from all sources. Follow up monitoring as discussed further in this document will be performed on rotational basis.

4.4 Seasonal Variation

Regulations require that TMDLs be established with consideration of seasonal variations. Since impairments only occurred during summer months, development of a winter TMDL was not necessitated.

5.0 Conclusions

The State of Alabama first identified Catoma Creek as being impaired by organic loading (i.e., $CBOD_u$ and NBOD) in the State of Alabama's 1996 §303(d) lists of impaired waters based upon a 50% noncompliance of DO measurements recorded in 1989 and subsequent 40% noncompliance of recorded measurements from 1991. In accordance with ADEM's water quality standards, the minimum required instream dissolved oxygen concentration for waters classified as Fish and Wildlife is 5.0 mg/l. A DO criterion of 5.0 mg/l was used as the target for determining the required pollutant reductions needed to bring Catoma Creek into compliance with the applicable DO criterion for Fish and Wildlife stream use classification.

Water quality data collected between 1998 and 2001, further confirmed dissolved oxygen impairments which typically occurred during the summer months (May through November). Dissolved oxygen impairments in Catoma Creek were attributable to low flows and high temperatures as evidenced during summer sampling events. Based on ADEM's data analysis, a steady state modeling approach was determined appropriate for TMDL development. In examining all available water quality data covering the most recent five year period, water quality measurements recorded on September 19, 2001, provided the most thorough and inclusive representation of critical conditions for TMDL development. Field data from this sampling event was used as input in performing the calibrated simulation.

In absence of SOD values from a specific reference site for Catoma Creek, an average mean SOD reaction rate value for all measured streams within the state of Alabama, both impaired as well as unimpaired, was derived from EPA, Region IV's *Sediment Oxygen Demand Data Insitu Chamber Measurements 1988-1997* database (representing mixed land uses and varying degrees of point source activity).

Non-point source and MS4 pollutant loadings were adjusted to simulate projected mainstream DO values as close as possible to measured mainstream values, while preserving reasonable representation of stream water quality conditions for the recorded sampling event.

A second simulation, referred to as the "load reduction model", adjusted non-point source and MS4 pollutant loadings from the calibrated model to bring impaired waterbody segments into compliance with the required 5mg/l water quality criterion for DO. The critical TMDL for this waterbody revealed strong connections between elevated CBOD levels and SOD reaction rates (resulting from stream sediment accumulation) and resulting Organic Enrichment/Low Dissolved Oxygen (OE/DO) impairment.

Total organic loadings (i.e., $CBOD_u$ and NBOD) were determined for both calibrated and load reduction models. Their difference would require a 22.8 % reduction in non-point source and MS4 pollutant loadings to bring Catoma Creek into compliance with the ADEM's dissolved oxygen criterion of 5.0 mg/l. Since existing TON and NH_3-N loadings were already negligibly low and their further reduction was found to have little or no effect on raising instream DO levels, no adjustments to their concentrations were considered necessary. In determining further needed load reductions, all land uses, with the exception of open water, were ultimately set to the $CBOD_u$ background concentration for forest land. While this adjustment effectively lowered instream $CBOD_u$ values, it proved to be inadequate in raising DO to the desired 5 mg/l minimal level. Flow conditions were at such exceptionally low levels (inclusive of incremental flow) that any changes made to land use would have had only minimal impact.

Given that the accumulation of stream sediments are the result of run off/erosion, reasonably achievable reductions in SOD (consistent with the average minimum SOD value of 0.065 gmO_2/ft^2/day for the state of Alabama as determined from EPA, Region IV's *Sediment Oxygen Demand Data Insitu Chamber Measurements 1988-1997* database) were performed until an instream DO of 5 mg/l was attained.

Impairment to Catoma Creek was derived exclusively from non-point source (NPS) and MS4 pollutant loadings, for which needed reductions will be sought under TMDL implementation. Based on TMDL analysis, Table 5-1 summarizes the pollutant source reductions required to achieve an instream dissolved oxygen concentration of 5.0 mg/l. All loads represent the combination of Ultimate Carbonaceous Biochemical Oxygen Demand ($CBOD_u$) and Nitrogenous Biochemical Oxygen Demand (NBOD) components.

A summary of the TMDL is presented in Table 5-1.

Table 5-1. Reductions Necessary to Meet the TMDL at the Time of this Report, in the Catoma Creek Watershed HUC AL/03150201-080_01

Loading Parameter	Existing Loads		Allowable Loads		Reductions	
	WLA(1)	LA	WLA(1)	LA	% WLA	% LA
CBODu	9.4 lbs/day	61.8 lbs/day	5.3 lbs/day	35.0 lbs/day	43.6	43.4
NBOD	8.5 lbs/day	56.1 lbs/day	8.5 lbs/day	56.1 lbs/day	0.0	0.0

(1) NOTE: MS4 Stormwater Phase I contributions are represented in terms of WLA.

6.0 TMDL Implementation

6.1 Non-Point Source Approach

Impairment to Catoma Creek is derived exclusively from non-point source (NPS) and MS4 pollutant loads, for which needed reductions will be sought under TMDL implementation. Reductions in pollutant loading from non-point sources will be achieved through a phased approach. Voluntary, incentive-based mechanisms will be used in implementing NPS management measures and in achieving measurable reductions in pollutant loading. Cooperation and active participation by the general public, as well as, various industrial, commercial, and environmental groups are vital to successful TMDL implementation. Local citizen-led management measures offer the most effective and comprehensive opportunity for reducing non-point source pollutant loadings. TMDL implementation activities will be coordinated through interaction with local entities in conjunction with Clean Water Partnership efforts.

With regards to the reduction of non-point source pollutant loading, government agencies and concerned stakeholders should, at minimum, be directed toward the implementation and maintenance of more conservation minded farming practices, with consideration given to conservation tillage, contour strips, and/or no till farming; installation of grass buffer strips or zones along existing streams; reduction or elimination of potentially destructive activities within riparian areas; and toward the minimization of construction induced impacts to streams.

Primary implementation will employ concurrent education and outreach, training, technology transfer, and technical assistance with incentive-based pollutant management measures. The ADEM Office of Education and Outreach (OEO) will provide needed assistance to public and private stakeholders. Planning and oversight will be available from ADEM's Section 319 non-point source grant program. The Clean Water Act (CWA) Section 319 grant program was created to fund further NPS pollutant source identification, pollutant reduction, educational outreach, pollution prevention, and needed management measures in restoring impaired waters.

Resources for corrective actions may be provided through the Alabama Cooperative Extension System (education and outreach); the USDA-Natural Resources Conservation Service (NRCS) (technical assistance) and Farm Services Agency (FSA) (federal cost-share funding); and the Alabama Soil and Water Conservation Committee (state agricultural cost share funding and management measure implementation assistance) through local Soil and Water Conservation Districts, or Resource Conservation and Development Councils (funding, project implementation, and coordination). Additional assistance is also available from the Alabama Department of Public Health (septic systems), Alabama Department of Agriculture and Industries (pesticides), and the Alabama Department of Industrial Relations and Department of Interior - Office of Surface Mining (abandoned minelands), Natural Heritage Program and US Fish and Wildlife Service (threatened and endangered species). Land use and population issues are addressed through the Non-point Source for Municipal Officials (NEMO) education and outreach program. Memorandums of Agreements (MOAs) may also be used in formally defining roles and responsibilities of various involved parties.

Additional public/private assistance is available through the Alabama Clean Water Partnership (CWP) Program, which applies a local citizen-based environmental protection approach in coordinating water restoration and protection efforts. Interaction between state and river basin specific CWPs will advance TMDL implementation by providing much needed communication and information exchange among community-based groups, governmental, industrial, and special interest groups, and other concerned individuals. The CWP was developed in order to assist in the planning, development, and execution of restoration strategies, eliminate duplication of efforts, and allow for the most effective and efficient use of available resources in restoring impaired waters.

Local regulations or ordinances related to zoning, land use, or storm water control may be warranted. Funding through general revenues, bond issuance, special taxes, utility fees, or impact fees may also be required. Needed point source reductions of MS4 discharges/contributions will initially be sought through voluntary implementation of BMPs. The Alabama Water Pollution Control Act enables ADEM to monitor water quality, issue permits, conduct inspections, and pursue enforcement of discharge activities and conditions which threaten water quality. The NPDES permit program is also authorized in regulating animal feeding operations and land applied animal wastes. The State Clean Water Revolving Fund (SRF) additionally offers low interest loans to local qualifying governments which seek needed water quality improvements.

Long-term water quality improvements will determine the effectiveness of TMDL implementation. Follow-up evaluation of water quality may necessitate revision of initial TMDL results. ADEM will continue monitoring water quality in keeping with the rotational river basin schedule. Assessments may include local citizen-volunteer monitoring through the Alabama Water Watch Program and/or data collected by agencies, universities, or other entities trained in the use of standardized monitoring and assessment methodologies. Core management measures are to include, water quality improvements, designated use support, the preservation and enhancement of public health and ecology, pollution prevention, load reductions, implementation of NPS controls, and efforts in changing public perception, awareness, attitudes, and behavior.

Control alternatives for TMDL implementation are also detailed within the *October 1998 Watershed Management Plan for Catoma Creek* which was developed by the environmental consulting firm of CH2M HILL for the Water Works and Sanitary Sewer Board of the City of Montgomery. Some proposals include streambank stabilization and restoration, development of stormwater retention ponds and livestock watering ponds, establishment of vegetated riparian buffer corridors, limitation of livestock access to streams, septic tank inspection and maintenance, and establishment of various public education and outreach activities with regards to watershed awareness.

6.2 Point Source Approach

No load reduction is currently applied to any municipal or industrial wastewater treatment facility given that their contribution and impact to the impaired stream segment were not determined significant.

7.0 Follow Up Monitoring

ADEM has adopted a basin-by-basin approach to water quality management which classifies Alabama's fourteen major river basins into five key groups. This watershed approach is based on a five-year rotational cycle which encompasses planning, monitoring, assessment, TMDLs, WLAs/LAs, and permit issuance. ADEM water quality resources are to be allocated toward the annual intensive study of a select basin group. The effectiveness of TMDL implementation will be assessed within the context of the State's rotating watershed management approach. Watershed monitoring and assessment activities are to provide the necessary information by which load reduction measures can be evaluated. Monitoring data and pollutant source identification measures will enable the implementation and direction of needed BMPs to specific areas within the watershed itself. Continued monitoring of §303(d) listed waters will adhere to the following projected schedule:

River Basin Group	Schedule
Tallapoosa / Alabama / Coosa	2005
Escatawpa / Upper Tombigbee / Lower Tombigbee / Mobile	2006
Cahaba / Black Warrior	2007
Tennessee	2008
Choctawhatchee / Chipola / Perdido-Escambia / Chattahoochee	2009

Monitoring will assist in the ongoing assessment and evaluation of water quality conditions resulting from the implementation of corrective measures within each watershed. This TMDL is to be subsequently reevaluated and revised as needed to assure continued attainment of applicable water quality standards.

Appendix I of the *October 1998 Watershed Management Plan for Catoma Creek* presents a comprehensive long-term monitoring program consisting of specific monitoring locations, sampling frequencies, and data analysis in assessing the effectiveness and success of various implemented watershed improvement and restoration activities.

8.0 Public Participation

As part of the public participation process, this TMDL was be placed on public notice and made available for review and comment. The public notice was prepared and published in the four major daily newspapers in Montgomery, Huntsville, Birmingham, and Mobile, as well as submitted to persons who have requested to be on ADEM's postal and electronic mailing distributions. In addition, the public notice and subject TMDL was made available on ADEM's Website: www.adem.state.al.us. The public can also request paper or electronic copies of the TMDL by contacting Mr. Chris Johnson at 334-271-7827 or clj@adem.state.al.us. The public was given an opportunity to review the TMDL and submit comments to the Department in writing. At the end of the public review period, all written comments received during the public notice period became part of the administrative record. ADEM considered all comments received by the public prior to finalization of this TMDL and subsequent submission to EPA Region 4 for final review and approval.

Appendix 9.1
References

References

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Appendix 9.2
Water Quality Data

Appendix 9.3
Water Quality Model
Input and Output Files

CALIBRATED MODEL

LOAD REDUCTION MODEL

9.4
Spreadsheet Water Quality Model (SWQM) User Guide