TOTAL MAXIMUM DAILY LOAD (TMDL)

for

Ammonia Toxicity
&
Organic Enrichment/Dissolved Oxygen

in

Eagle Creek

Located in the

Tennessee Western Valley (Beech) Watershed

(HUC 06040001)

Benton & Decatur County, Tennessee

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LIST OF ABBREVIATIONS

ADB	Assessment Database
AIC	Allowable Instream Concentration
BMP	Best Management Practices
CCC	Criterion Continuous Concentration
CFR	Code of Federal Regulations
CFS	Cubic Feet per Second
CMC	Criterion Maximum Concentration
DO	Dissolved Oxygen
DWPC	Division of Water Pollution Control
EPA	Environmental Protection Agency
GIS	Geographic Information System
HUC	Hydrologic Unit Code
LA	Load Allocation
LSPC	Loading Simulation Program in C^{++}
MGD	Million Gallons per Day
MOS	Margin of Safety
MRLC	Multi-Resolution Land Characteristic
MS4	Municipal Separate Storm Sewer System
NPS	Nonpoint Source
NPDES	National Pollutant Discharge Elimination System
PCS	Permit Compliance System
Rf3	Reach File v.3
RM	River Mile
TDEC	Tennessee Department of Environment & Conservation
TDOT	Tennessee Department of Transportation
TMDL	Total Maximum Daily Load
USGS	United States Geological Survey
WCS	Watershed Characterization System
WLA	Waste Load Allocation
WWTF	Wastewater Treatment Facility

SUMMARY SHEET

Total Maximum Daily Load for Ammonia Toxicity & Organic Enrichment/DO in Eagle Creek, Tennessee Western Valley (Beech) Watershed (HUC 06040001)

Impaired Waterbody Information

State: Tennessee
Counties: Benton and Decatur
Watershed: Tennessee Western Valley (Beech) (HUC 06040001)
Constituents of Concern: Ammonia toxicity & organic enrichment/dissolved oxygen

Impaired Waterbodies:

	Waterbody ID	Waterbody	RM
1998 303(d) List	TN06040001003	Eagle Creek – Manleys Chapel Rd. to headwaters	10.5
Proposed 2002 303(d) List	TN06040001364_2000	Eagle Creek – Manleys Chapel Rd. to McIllwain Rd.	3.9
	TN06040001364_3000	Eagle Creek – McIllwain Rd. to headwaters	4.1

Designated Uses: Fish & aquatic life, irrigation, livestock watering & wildlife, and recreation.

Applicable Water Quality Standards (most stringent is for the protection of fish & aquatic life):

Ammonia Toxicity

The allowable instream concentration of ammonia (as nitrogen) for the protection of fish & aquatic life, are established in *1999 Update of Ambient Water Quality Criteria for Ammonia* (USEPA 1999). For a stream pH = 7.51 su and temperature = 25.28°C, the Criterion Continuous Concentration (CCC) is 2.16 mg/l and the Criterion Maximum Concentration (CMC) = 19.6 mg/l. The CCC & CMC were determined for cases where early life stages are present, but salmonids are not present.

Dissolved Oxygen

The dissolved oxygen shall be a minimum of 5 mg/l except in limited sections of streams where it can be clearly demonstrated that (i) the existing quality of the water due to irretrievable man-induced conditions cannot be restored to the desired minimum of 5 mg/l dissolved oxygen; or (ii) the natural background quality of the water is less than the desired minimum of 5 mg/l. Such exceptions shall be determined on an individual basis, but in no instance shall the dissolved oxygen concentration be less than 3 mg/l. The dissolved oxygen concentrations shall be measured at mid-depth in waters having a total depth of ten (10) feet or less, and at a depth of five (5) feet in waters having a total depth of greater than ten (10) feet. The dissolved oxygen concentration of recognized trout waters shall not be less than 6.0 mg/l. The above criteria are applicable to tailwaters. The dissolved oxygen concentration of trout waters which have been designated as supporting a naturally reproducing population shall not be less than 8.0 mg/l.

TMDL, WLAs, & LAs

Critical Condition: Summer low flow (7Q10 = 0 cfs). Eagle Creek flow, downstream of point sources, is equal to the sum of the design flows of the Pecan Shoppe of Camden (TN0040878) and North Forty truckstop (TN0059391).

Seasonality: TMDL, WLAs, & LAs determined for critical conditions (worst case).

MOS: Implicit - Conservative modeling assumptions
Explicit – $MOS_{Chronic}$ = 0.038 lbs/day (Ammonia toxicity only)
MOS_{Acute} = 1.341 lbs/day (Ammonia toxicity only)

TMDLs: Ammonia Toxicity
1.635 lbs/day (Acute)
0.180 lbs/day (Chronic)

Acute and chronic TMDLs are derived from the Criterion Maximum Concentration (CMC) and Criterion Continuous Concentration (CCC), and the design flows of the two point sources.

Organic Enrichment/Dissolved Oxygen
Considered to be equal to the maximum organic loading that will result in a minimum, instream dissolved oxygen concentration greater than 5 mg/l during critical conditions.

WLAs: Ammonia Toxicity
WLAs for critical conditions are derived from existing permit limits and facility design flows.

Facility	Ammonia Toxicity WLAs	
	Acute	Chronic
	[lbs/day]	[lbs/day]
Pecan Shoppe of Camden	0.025	0.050
North Forty Truckstop	0.117	0.234

Organic Enrichment/Dissolved Oxygen

WLAs for critical conditions are derived from existing permit limits and facility design flows. WLAs for ammonia are identical to those developed for ammonia toxicity.

Facility	Effluent Characteristic	Ammonia Toxicity WLAs	
		Acute	Chronic
		[lbs/day]	[lbs/day]
Pecan Shoppe of Camden	CBOD5	0.250	0.375
	Ammonia	0.025	0.050
	Dissolved Oxygen	6.0 mg/ minimum	
North Forty Truckstop	CBOD5	0.584	1.168
	Ammonia	0.117	0.234
	Dissolved Oxygen	6.0 mg/ minimum	

LAs: Ammonia Toxicity & Organic Enrichment/Dissolved Oxygen

Failing Septic Systems: Load Allocation = 0

AMMONIA TOXICITY & ORGANIC ENRICHMENT/DISSOLVED OXYGEN TOTAL MAXIMUM DAILY LOADS (TMDLs) FOR EAGLE CREEK TENNESSEE WESTERN VALLEY (BEECH) WATERSHED (HUC 06040001)

1.0 INTRODUCTION

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

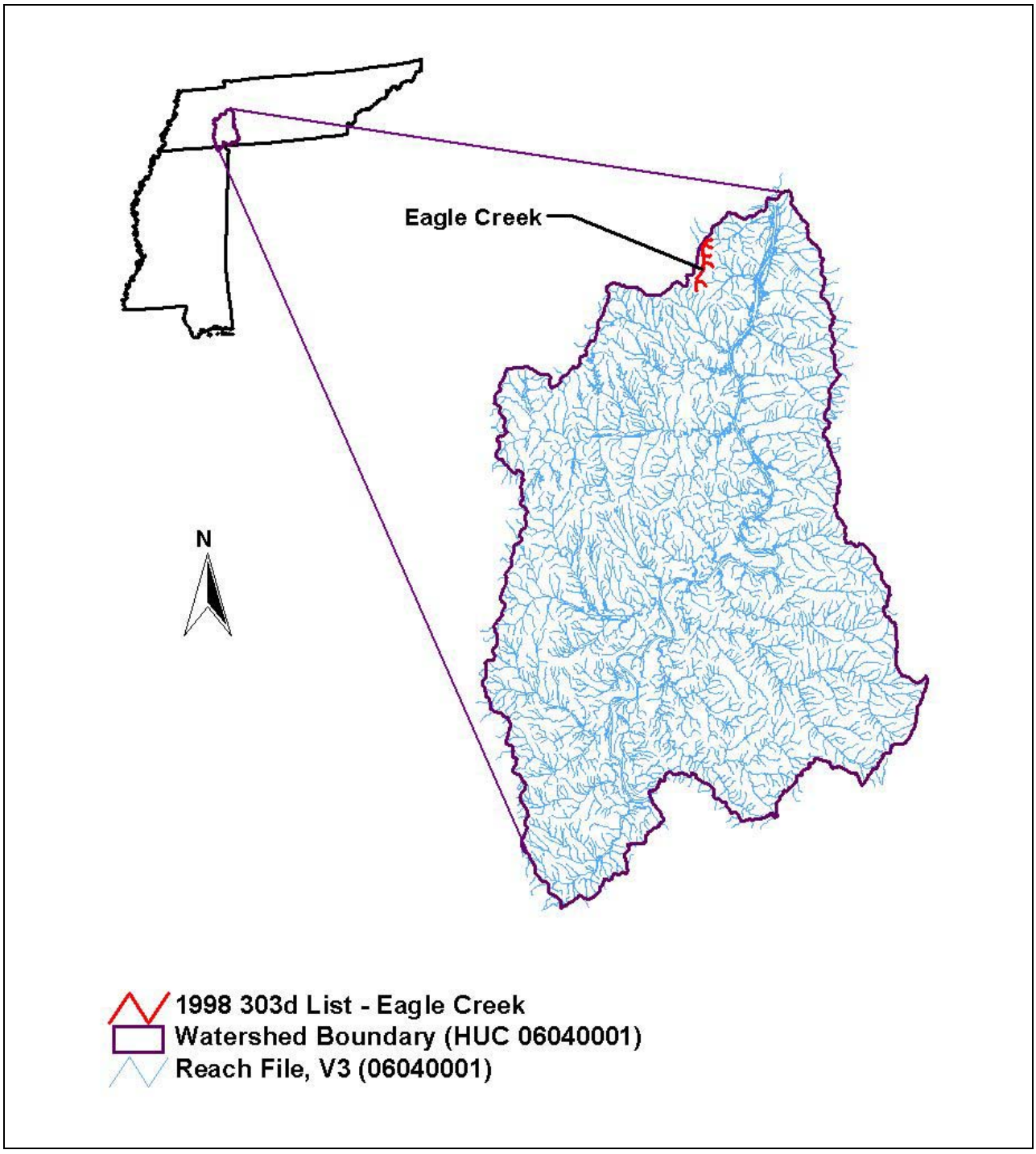
2.0 GENERAL WATERSHED DESCRIPTION

The Tennessee Western Valley (Beech) watershed (HUC 06040001) is located in western Tennessee (Figure 1) and includes parts of Benton, Chester, Decatur, Hardin, Henderson, McNairy, Perry, and Wayne Counties. Approximately 2.2% of the watershed is in northern Mississippi. The watershed lies within the Level III Southern Plains (65) and Interior Plateau (71) ecoregions. The largest portions of the watershed, including the impaired sections of Eagle Creek, are in the Level IV Southeastern Plains and Hills (65e) and Western Highland Rim (71f) ecoregions. The remainder of the watershed is in the Level IV Blackland Prairie (65a), Fall Line Hills (65i), and Transition Hills (65j) ecoregions as shown in Figure 2 (USEPA, 1997):

- The Southeastern Plains and Hills (65e) contain several north-south trending bands of sand and clay formations. Tertiary-age sand, clay, and lignite are to the west, and Cretaceous-age fine sand, fossiliferous micaceous sand, and silty clays are to the east. With elevations reaching over 650 feet, and more rolling topography and more relief than the Loess Plains (74b) to the west, streams have increased gradient, generally sandy substrates, and distinctive faunal characteristics for west Tennessee. The natural vegetation type is oak-hickory forest, grading into oak-hickory-pine to the south.

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

Figure 1 Location of the Tennessee Western Valley (Beech) Watershed



The Tennessee Western Valley (Beech) watershed has approximately 4,300 miles of streams (Rf3) and drains a total area of 2,087 square miles. Approximately 2.2% of the watershed area is located in Mississippi. Watershed land use distribution is based on the Multi-Resolution Land Characteristic (MRLC) databases derived from Landsat Thematic Mapper digital images from the period 1990-1993. Land use for the Tennessee Western Valley (Beech) watershed and the Eagle Creek subwatershed is summarized in Table 1 and shown in Figure 3.

Figure 2 Level IV Ecoregions in the Tennessee Western Valley (Kentucky Lake) Watershed

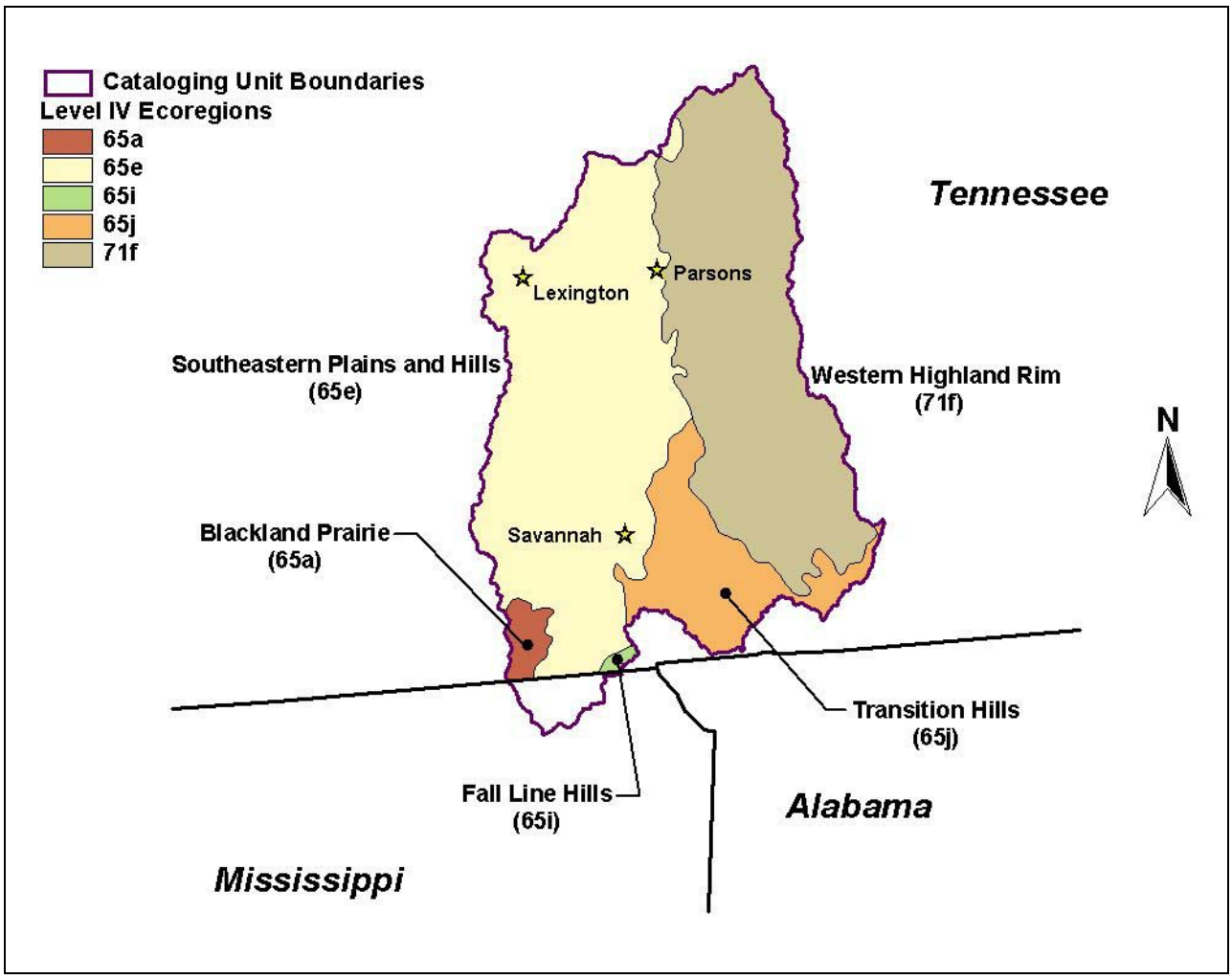


Figure 3 MRLC Land Use Distribution – Tennessee Western Valley (Beech) Watershed

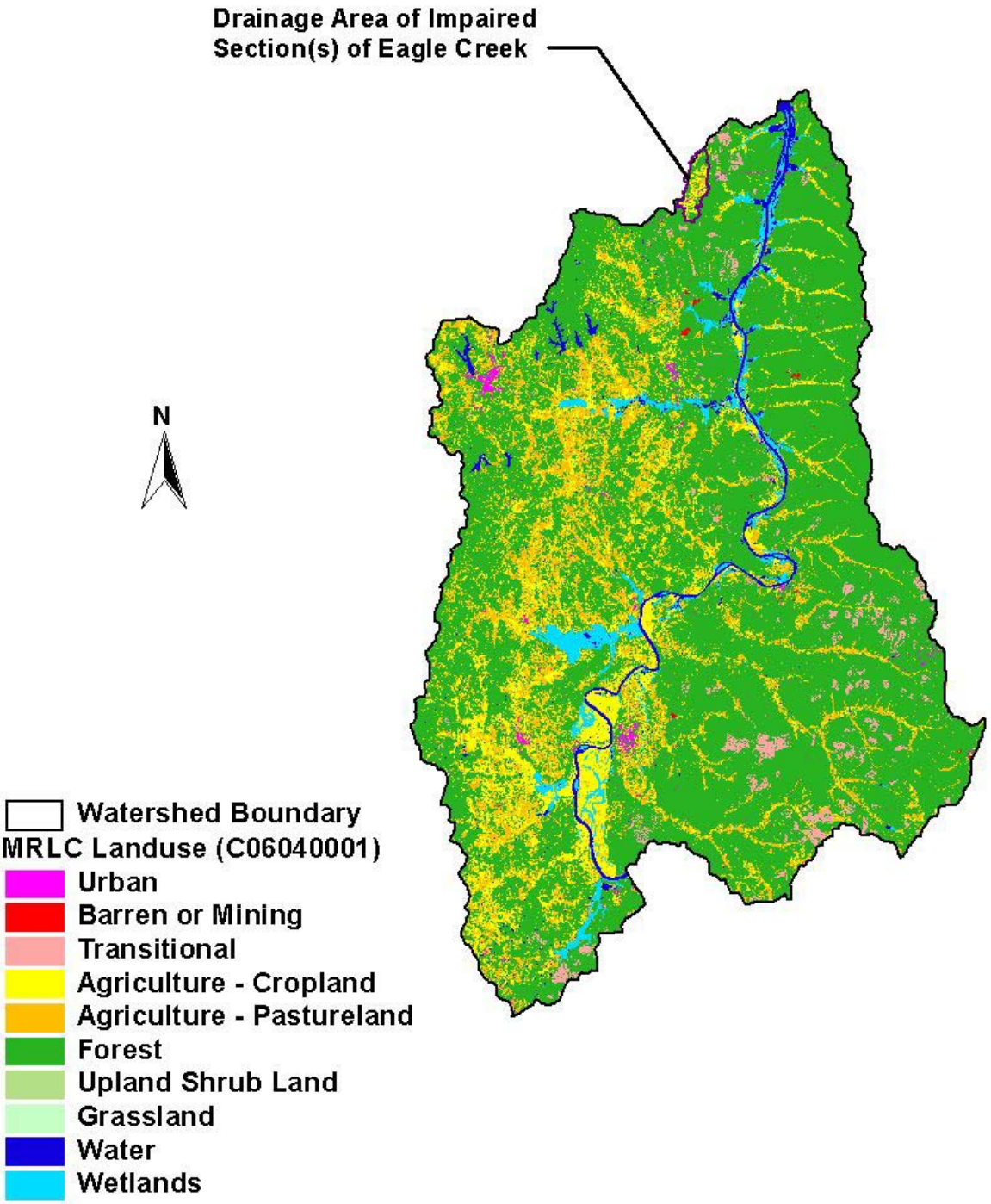


Table 1 MRLC Land Use Distribution – Tennessee Western Valley (Beech) Watershed

Land Use	Area			
	Tennessee Western Valley (Beech) (HUC 06040001)		Drainage Area – Impaired Section(s) Of Eagle Creek	
	[acres]	[%]	[acres]	[%]
Open Water	26,612	2.0	1	0.0
Low Intensity Residential	4,256	0.3	—	—
High Intensity Residential	727	0.1	—	—
High Intensity Commercial /Industrial/Transportation	2,555	0.2	110	2.0
Bare Rock/Sand/Clay	23	0.0	—	—
Transitional	27,995	2.1	1	0.0
Deciduous Forest	708,441	53.0	2,092	38.5
Evergreen Forest	98,033	7.3	134	2.5
Mixed Forest	121,049	9.1	199	3.7
Pasture/Hay	167,054	12.5	941	17.3
Row Crops	141,013	10.5	1,923	35.4
Other Grasses (Urban/Recreational)	725	0.1	32	0.6
Woody Wetlands	32,403	2.4	—	—
Emergent Herbaceous Wetlands	4,051	0.3	—	—
Quarries/Strip Mines/Gravel Pits	882	0.1	—	—
Total	1,335,819	100.0	5,433	100.0

3.0 PROBLEM DEFINITION

The State of Tennessee's final 1998 303(d) list (TDEC, 1998) was approved by the U.S. Environmental Protection Agency (EPA), Region IV on September 17, 1998. The list identified a portion of Eagle Creek in the Tennessee Western Valley (Beech) watershed as not fully supporting designated use classifications due to organic enrichment/low DO and unionized ammonia (see Table 2). The designated use classifications for Eagle Creek and its tributaries include fish and aquatic life, irrigation, livestock watering & wildlife, and recreation.

Note: The term "unionized ammonia" was used in the 303(d) list to characterize the toxic effects of ammonia with respect to fish & aquatic life. In this document, however, the term "ammonia toxicity" will be used to represent these effects.

Table 2 1998 303(d) List For Eagle Creek

Waterbody ID	Impacted Waterbody	RM Partially Supporting	RM Not Supporting	CAUSE (Pollutant)	Pollutant Source
TN06040001003	EAGLE CREEK – From Manleys Chapel Rd to headwaters is partial	10.5		Unionized Ammonia Organic Enrichment/DO	Onsite wastewater system Urb. Runoff/storm sewers

Table 3 Proposed Final 2002 303(d) List for Eagle Creek

Waterbody ID	**Impacted Waterbody**	Use Support		**CAUSE (Pollutant)**	**Pollutant Source**	**Reference to 1998 303(d) List Waterbody ID**
		Partial	Not			
TN06040001364 – 2000 [a]	EAGLE CREEK	3.9		Organic Enrichment/Low DO	Minor. Municipal Point Source **Onsite Wastewater System (Septic Tanks)**	TN06040001003
TN06040001364 – 3000 [b]	EAGLE CREEK		5.1	Unionized Ammonia Organic Enrichment/Low DO Pathogens	Minor. Municipal Point Source **Onsite Wastewater System (Septic Tanks)**	TN06040001003

a. Branch near Manleys Chapel Road to McIllwain Road.
b. McIllwain Road to headwaters.

Waterbodies in the Tennessee Western Valley (Beech) watershed were reassessed by the State in 2002 (TDEC, 2002) using more recent data and a revised waterbody identification system. (see Table 3). The waterbody listing in Table 3 represents a more precisely defined waterbody assessment than that listed in the 1998 303(d) list (ref: Table 2). A summary of the most recent assessment of the two impaired segments of Eagle Creek are presented in Appendix A. The information presented in this appendix is excerpted from the EPA/TDEC Assessment Database (ADB) and is referenced to the waterbody IDs in Table 3. ADB information may be accessed at: http://gwidc.gwi.memphis.edu/website/wpc_arcmap. Eagle Creek from the Kentucky Lake embayment to Manleys Chapel Road was assessed as fully supporting.

4.0 TARGET IDENTIFICATION

Note: Ammonia can impact fish & aquatic life directly through toxic effects or, indirectly, as a factor in instream oxygen depletion. In this document, sections entitled "Ammonia Toxicity" deal with toxicity issues, while ammonia as a factor in oxygen depletion is addressed in sections entitled "Organic Enrichment/Dissolved Oxygen".

4.1 Ammonia Toxicity

The allowable instream concentration of ammonia (as nitrogen) in Eagle Creek for the protection of fish & aquatic life, are established in *1999 Update of Ambient Water Quality Criteria for Ammonia* (USEPA 1999). For waters where salmonids are not present, the Criterion Maximum Concentration (CMC) is a function of pH and for waters when early life stages are present (most stringent), the Criterion Continuous Concentration (CCC) is a function of both pH and temperature. The critical conditions (most stringent criteria) for ammonia toxicity are during periods of high temperature and high stream pH.

From *1999 Update of Ambient Water Quality Criteria for Ammonia*:

When salmonids are not present:

$$CMC = \frac{0.411}{1 + 10^{7.204-pH}} + \frac{58.4}{1 + 10^{pH-7.204}} \qquad \text{Salmonids not present}$$

When fish early life stages are present:

$$CCC = \left\{ \frac{0.0577}{1 + 10^{7.688-pH}} + \frac{2.487}{1 + 10^{pH-7.688}} \right\} \bullet \text{MIN}\left[2.85,\ 1.45 \bullet 10^{0.028 \bullet (25 - T)}\right]$$

In accordance with the guidance in the *1999 Update of Ambient Water Quality Criteria for Ammonia*, freshwater aquatic life should be protected if:

- The one-hour concentration of total ammonia nitrogen does not exceed the CMC, more than once every three years on average.

- The 30-day average concentration of total ammonia nitrogen does not exceed the CCC, more than once every three years on average. In addition, the highest four-day average within the 30-day period should not exceed 2.5 times the CCC.

For the purposes of this TMDL, the target allowable instream concentrations (AICs) of ammonia correspond to the CMC and CCC, calculated using the maximum temperature (25.28°C) and pH (7.51 su) values found in data collected at water quality monitoring stations located in the impaired segments of Eagle Creek (see Table 4). The acute AIC (CMC) is 19.6 mg/l and the chronic AIC (CCC) is 2.16 mg/l.

4.2 Organic Enrichment/Dissolved Oxygen

Several narrative criteria, applicable to organic enrichment, nutrients, and dissolved oxygen are established in *State of Tennessee Water Quality Standards, Chapter 1200-4-3 General Water Quality Criteria, October 1999* (TDEC, 1999):

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

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

Applicable to the Fish & Aquatic Life use classification:

> The dissolved oxygen shall be a minimum of 5 mg/l except in limited sections of streams where it can be clearly demonstrated that (i) the existing quality of the water due to irretrievable man-induced conditions cannot be restored to the desired minimum of 5 mg/l dissolved oxygen; or (ii) the natural background quality of the water is less than the desired minimum of 5 mg/l. Such exceptions shall be determined on an individual basis, but in no instance shall the dissolved oxygen concentration be less than 3 mg/l. The dissolved oxygen concentrations shall be measured at mid-depth in waters having a total depth of ten (10) feet or less, and at a depth of five (5) feet in waters having a total depth of greater than ten (10) feet. The dissolved oxygen concentration of recognized trout waters shall not be less than 6.0 mg/l. The above criteria are applicable to tailwaters. The dissolved oxygen concentration of trout waters which have been designated as supporting a naturally reproducing population shall not be less than 8.0 mg/l.

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

Since Eagle Creek is not designated as a trout stream, the minimum dissolved oxygen concentration of 5 mg/l specified for the protection of fish and aquatic life will be used as the target for these TMDLs. TMDLs established to protect fish and aquatic life will also protect all other use classifications from adverse impacts due to organic enrichment, nutrients, and low dissolved oxygen.

5.0 WATER QUALITY ASSESSMENT AND DEVIATION FROM TARGET

There are several water quality monitoring stations that provide ammonia and dissolved oxygen data for Eagle Creek:

- EAGLE011.3BN – Eagle Creek at Pauline Road (RM 11.3). Data is from 8/99 through 7/00.
- EAGLE012.5BN – Eagle Creek at Gossett Road (RM 12.5). Data is from 8/99 through 7/00.
- Additional monitoring site on Eagle Creek, upstream of the North Forty Truckstop (no formal station ID).
- EAGLE013.1BN – Eagle Creek at Old Highway 69 (RM 13.1). Data is from 8/99 through 7/00.

The location of these monitoring stations is shown in Figure 4.

5.1 Ammonia Toxicity

Monitoring data and corresponding calculated water quality criteria for ammonia in Eagle Creek are summarized in Table 4. There are a number of exceedances of the calculated CCC at EAGLE012.5BN (RM 12.5), EAGLE013.1BN (RM 13.1), and the station upstream of the North Forty Truckstop. These monitoring stations are all located in the upstream section of Eagle Creek (TN06040001364_3000) identified as impaired due to ammonia toxicity.

5.2 Organic Enrichment/Dissolved Oxygen

Dissolved oxygen sampling data from water quality monitoring stations are summarized in Table 5. There are violations of the instream dissolved oxygen reported at all four stations.

6.0 SOURCE ASSESSMENT

An important part of TMDL analysis is the identification of individual sources, or source categories of pollutants in the watershed that affect instream ammonia and dissolved oxygen concentrations and the amount of pollutant loading contributed by each of these sources. Ammonia is a pollutant of concern due its potential toxicity to aquatic life. With respect to instream dissolved oxygen, pollutants of concern include carbonaceous biochemical oxygen demand (CBOD), total nitrogen (composed of organic nitrogen, ammonia, nitrate, & nitrite), and total phosphorus. CBOD, a measure of oxygen required for oxidation of carbonaceous organic matter, and nitrification processes (conversion of ammonia to nitrate) directly effect instream dissolved oxygen levels. Nitrogen and phosphorus also indirectly affect dissolved oxygen levels as nutrients that are essential to algae growth. Algal oxygen production, due to photosynthesis, and oxygen consumption, due to respiration, cause diurnal variations in stream dissolved oxygen levels.

Under the Clean Water Act, sources are classified as either point or nonpoint sources. Under 40 CFR §122.2, a point source is defined as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. The National Pollutant Discharge Elimination System (NPDES) program regulates point source discharges. Point sources can be described by two broad categories: 1) NPDES regulated municipal and industrial wastewater treatment facilities (WWTFs) and 2) NPDES regulated industrial activities and municipal storm water discharges (Municipal Separate Storm Sewer Systems [MS4s]). A TMDL must provide Waste Load Allocations (WLAs) for all NPDES regulated point sources. Nonpoint sources are diffuse sources that cannot be identified as entering a waterbody through a discrete conveyance at a single location. For the purposes of this TMDL, all sources of pollutant loading not regulated by NPDES permits are considered nonpoint sources. The TMDL must provide a Load Allocation (LA) for these sources.

6.1 Point Sources

6.1.1 NPDES Regulated Municipal and Industrial Wastewater Treatment Facilities

Both treated and untreated sanitary wastewater contains the primary nutrients nitrogen (organic nitrogen, ammonia, nitrate, & nitrite) and phosphorus (organic & inorganic). Both the Pecan Shoppe of Camden (TN0040878) and the North Forty Truckstop (TN0059391) are authorized to discharge treated sanitary wastewater to the impaired segments of Eagle Creek (see Figure 5 & photographs in Appendix C). Permit limits and monitoring requirements for selected effluent characteristics are summarized in Table 6 for these facilities.

In accordance with the provisions of their NPDES permits, the Pecan Shoppe of Camden and the North Forty Truckstop monitor their effluent for specified pollutants and submit the results monthly on Monthly Operation Reports (MORs). Monitoring results from both facilities for the period from1/1/99 through 10/31/02 are presented in Appendix B and summarized in Table 7. There are numerous violations of permit limits reported by each facility (a single monthly sample that violates both Monthly Average and Daily Maximum limits is reported as two violations).

Figure 4 Location of Water Quality Monitoring Stations in Eagle Creek

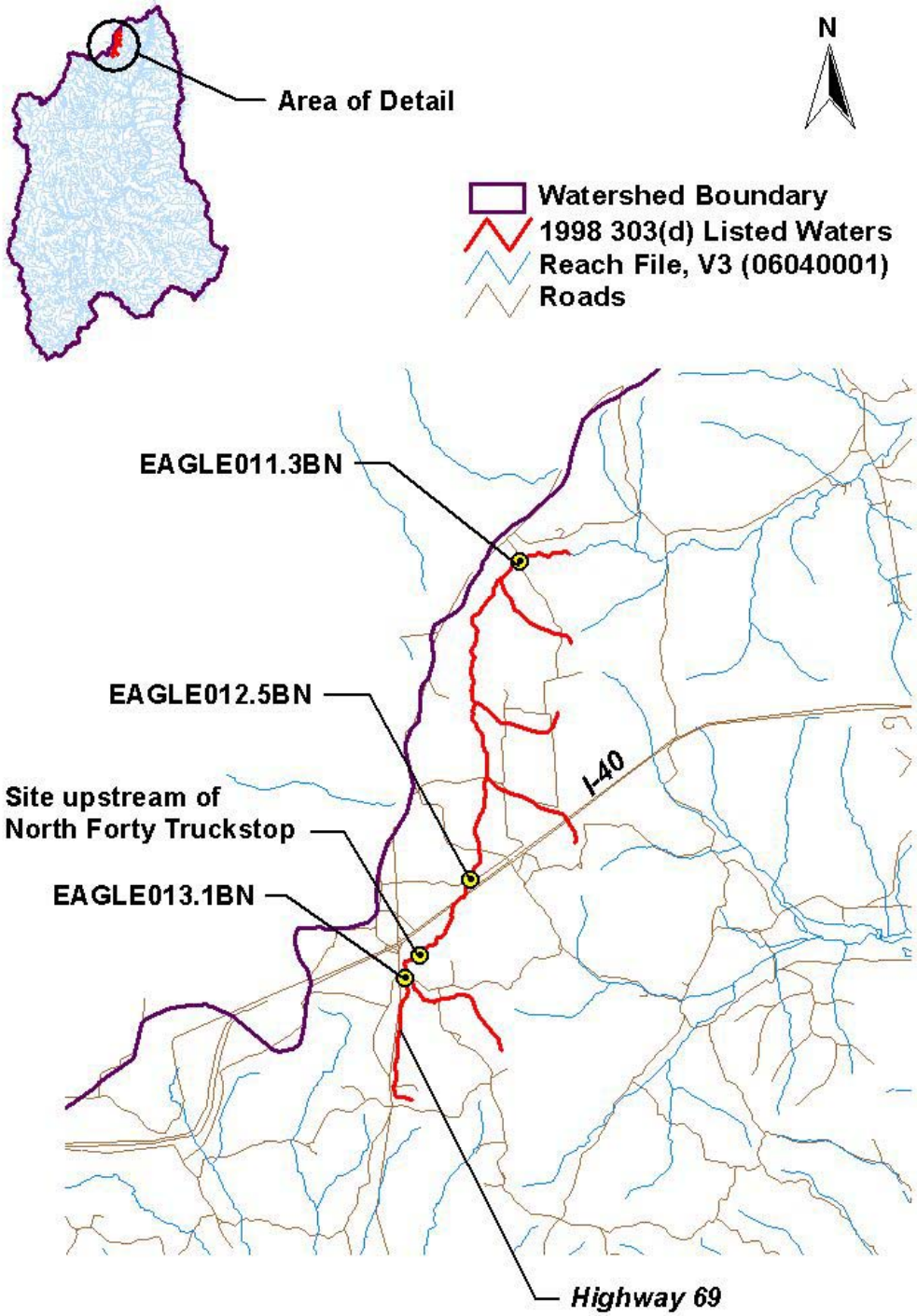


Table 4 Eagle Creek Ammonia Monitoring Data & Calculated Criteria

Monitoring Station	Date	Monitoring Data			CCC	CMC
		PH	Temp.	NH3 (as N)		
		[su]	[°C]	[mg/l]	[mg/l]	[mg/l]
EAGLE011.3BN	8/10/99	6.54	24.24	<0.02	3.54	48.1
	9/1/99	6.53	20.3	0.04	4.57	48.3
	11/2/99	6.5	13.8	<0.02	6.67	48.8
	12/8/99	6.33	8.26	<0.02	6.80	51.6
	1/5/00	6.78	7.2	0.02	6.33	42.5
	2/8/00	7.0	5.12	<0.02	5.91	36.1
	3/8/00	6.73	13.5	<0.02	6.40	43.8
	4/4/00	6.88	14.2	0.02	6.16	39.8
	5/2/00	7.18	17.3	0.14	4.55	30.2
	6/13/00	—	—	0.04	—	—
	7/18/00	5.84	23.01	0.02	4.04	56.0
EAGLE012.5BN	8/10/99	6.98	25.28	0.2	2.97	36.7
	11/2/99	7.3	13.0	2.75	5.08	26.2
	12/8/99	6.91	5.75	**9.61**	6.10	38.9
	1/5/00	7.27	6.7	3.05	5.17	27.2
	2/8/00	6.92	3.03	1.47	6.08	38.6
	3/8/00	7.13	13.4	0.54	5.59	31.9
	4/4/00	6.85	11.5	0.09	6.21	40.6
	5/2/00	7.46	18.8	0.39	3.43	21.1
	6/13/00	—	—	0.35	—	—
EAGLE013.1BN	8/10/99	6.91	22.58	**35**	3.63	38.9
	9/2/99	7.22	21.43	**32.6**	3.41	28.9
	10/28/99	6.47	11.75	0.02	6.69	49.4
	11/3/99	7.35	7.5	**15.1**	4.91	24.6
	12/9/99	6.76	9.58	**18.7**	6.36	43.1
	4/4/00	7.04	11.8	0.56	5.82	34.8
	5/2/00	7.43	22.2	**3.8**	2.82	22.0
	6/13/00	7.27	23.15	**24.5**	2.97	27.2
Eagle Creek u/s North Forty Truckstop	11/3/99	7.08	8.4	3.26	5.72	33.5
	12/9/99	—	—	3.28	—	—
	1/5/00	7.07	4.3	2.62	5.74	33.8
	2/9/00	7.43	3.7	1.11	4.63	22.0
	3/9/00	7.23	15.8	0.6	4.88	28.5
	4/4/00	6.47	11.1	0.41	6.69	49.4
	5/2/00	7.51	20.0	0.93	3.04	19.6
	6/13/00	7.17	21.32	**12.2**	3.53	30.5

Table 5 Eagle Creek Dissolved Oxygen Monitoring Data

Monitoring Station	Date	DO [mg/l]	CBOD5 [mg/l]	NH_3 (as N) [mg/l]	NO_2-NO_3 [mg/l]	T. Phosphate [mg/l]
EAGLE011.3BN	8/10/99	4.56	<2	<0.02	0.29	0.02
	9/1/99	2.5	<2	0.04	<0.01	<0.004
	10/6/99	3.29	<2	—	—	—
	11/2/99	5.74	<2	<0.02	0.04	0.04
	12/8/99	7.41	<2	<0.02	0.10	<0.004
	1/5/00	11.2	<2	0.02	1.03	0.17
	2/8/00	13.44	<2	<0.02	1.03	<0.004
	3/8/00	9.42	<2	<0.02	1.29	<0.004
	4/4/00	9.58	<2	0.02	0.59	0.01
	5/2/00	9.25	<2	0.14	1.33	0.004
	6/13/00	—	<2	0.04	1.10	0.02
	7/18/00	3.73	<2	0.02	0.73	<0.004
EAGLE012.5BN	8/10/99	3.30	—	0.2	<0.01	0.10
	11/2/99	5.6	8	2.75	<0.01	0.76
	12/8/99	5.17	2	**9.61**	0.21	0.50
	1/5/00	6.8	4	3.05	0.45	0.36
	2/8/00	13.36	<2	1.47	1.57	0.17
	3/8/00	8.42	<2	0.54	0.97	0.18
	4/4/00	9.36	<2	0.09	0.21	0.03
	5/2/00	7.37	<2	0.39	0.48	0.11
	6/13/00	—	3	0.35	0.06	0.07
EAGLE013.1BN	8/10/99	2.32	2	**35**	0.03	2.26
	9/2/99	3.86	<2	**32.6**	0.35	0.64
	10/28/99	10.3	—	0.02	—	<0.004
	11/3/99	3.17	2	**15.1**	0.41	0.37
	12/9/99	6.30	<2	**18.7**	1.78	0.67
	4/4/00	7.94	<2	0.56	0.36	0.11
	5/2/00	11.1	3	**3.8**	0.19	0.25
	6/13/00	6.37	3	**24.5**	0.30	0.48
Eagle Creek u/s North Forty Truckstop	11/3/99	1.55	18	3.26	<0.01	0.26
	12/9/99	—	<2	3.28	0.6	0.06
	1/5/00	9.77	<2	2.62	0.37	0.33
	2/9/00	10.17	<2	1.11	0.47	0.02
	3/9/00	7.87	<2	0.6	0.16	0.03
	4/4/00	9.08	<2	0.41	0.17	0.46
	5/2/00	7.59	<2	0.93	0.22	0.13
	6/13/00	4.13	<2	**12.2**	0.56	0.05

Figure 5 Eagle Creek in the Vicinity of Interstate 40 & Highway 69

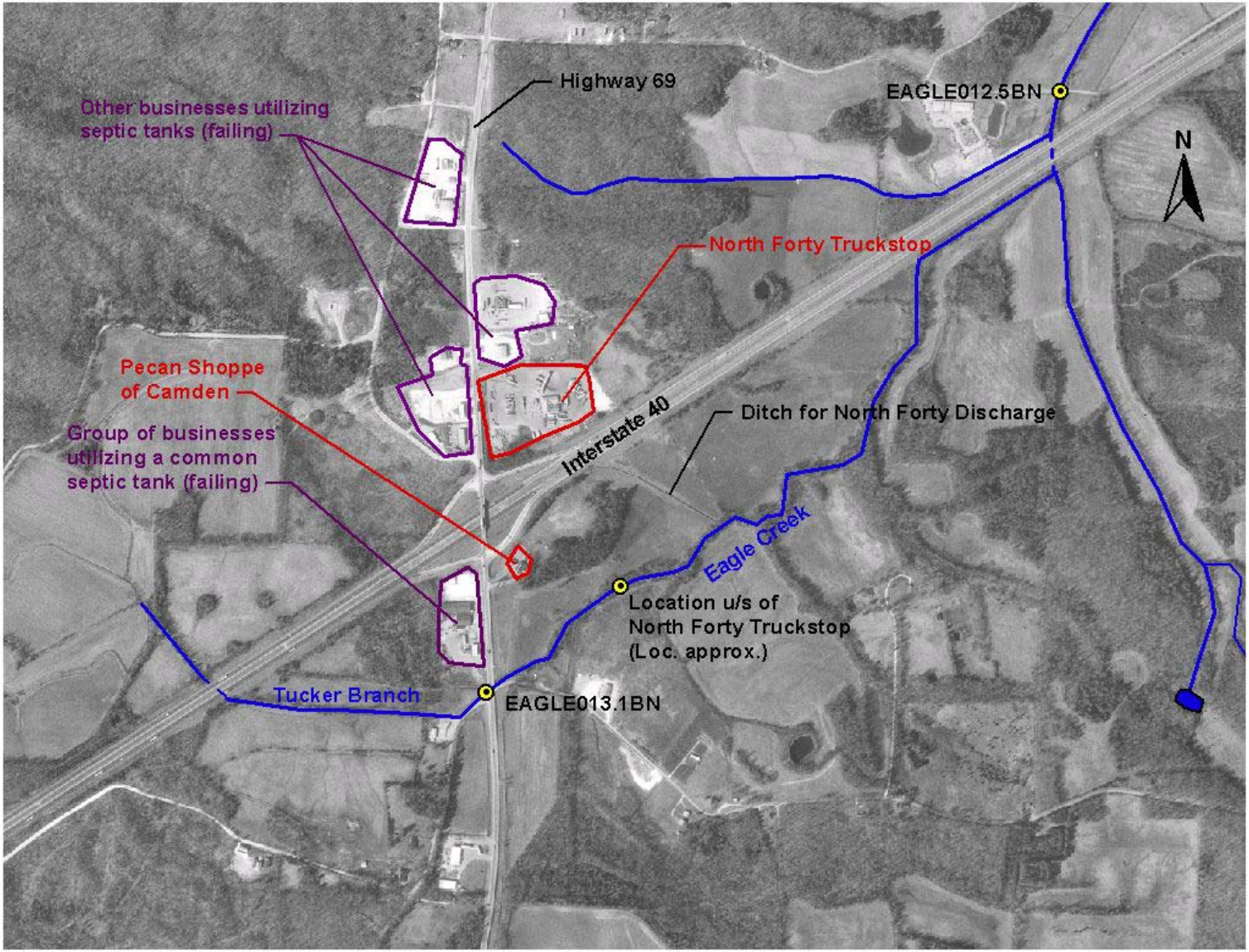


Table 6 - NPDES Permit Limits for Pecan Shoppe of Camden & North Forty Truckstop

Facility	Facility Design Flow	Effluent Characteristic	Monitoring Frequency	Season [a]	Monthly Average Concen.	Daily Maximum Concen.
	[MGD]				[mg/l]	[mg/l]
Pecan Shoppe of Camden (TN0040878)	0.003	$CBOD_5$	1/month	Y	10	15
		Ammonia	1/month	S	1	2
			1/month	W	5	10
		Dissolved Oxygen	5/week	Y	6.0 minimum	
North Forty Truckstop (TN0059391)	0.007	$CBOD_5$	1/month	Y	10	20
		Ammonia	1/month	S	2	4
			1/month	W	5	10
		Dissolved Oxygen	2/week	Y	6.0 minimum	

Notes: a. Seasonal abbreviations: S = Summer (5/1 through 10/31); W = Winter (11/1 through 4/30); Y = Entire Year.

Table 7 Monthly Operation Report Summary for Pecan Shoppe of Camden & North Forty Truckstop (1/1/99 – 10/31/02)

		$CBOD_5$	Ammonia	Dissolved Oxygen
		[mg/l]	[mg/l]	[mg/l]
Pecan Shoppe Of Camden	Average	13.77	39.16	2.49
	Median	12.75	34.70	1.60
	Minimum	6.7	1.2	0.1
	Maximum	30.5	77.5	6.8
	Violations of Permit Limit *	45	78	747
	Data Points	31	40	43
North Forty Truckstop	Average	14.18	30.45	4.00
	Median	13.95	28.60	3.80
	Minimum	5.3	1.4	1.2
	Maximum	30.0	61.3	6.7
	Violations of Permit Limit *	34	78	232
	Data Points	28	39	28

* Violations are referenced to limits and monitoring frequency in Table 6.

Samples of effluent from both facilities were also obtained by personnel from the Jackson Environmental Assistance Center (EAC) on those days when stream sampling of Eagle Creek was conducted (ref.: Tables 4 & 5). The results of this sampling, summarized in Table 8, also shows numerous exceedances of facility permit limits.

Table 8 Summary of Facility Effluent Sampling by Jackson EAC

Facility	Date	$CBOD_5$ [mg/l]	NH_3 [mg/l]	NO_2-NO_3 [mg/l]	T. Phos. [mg/l]	DO [mg/l]
Pecan Shoppe of Camden	8/10/99	6	66.0	0.26	5.14	2.97
	9/2/99	<2	33.5	3.64	2.94	7.15
	10/7/99	2	33.9	5.40	3.82	2.53
	11/3/99	3	25.1	2.38	1.51	5.38
	12/9/99	3	71.1	4.34	4.28	
	1/5/00	2	20.0	0.76	0.73	6.99
	2/9/00	2	49.0	11.1	1.12	7.39
	3/9/00	6	13.5	0.14	3.03	8.1
	4/4/00	<2	19.5	0.42	24.5	2.98
	5/2/00					
	6/13/00	5	77.0	0.03	5.88	3.53
	7/18/00	3	92.0	0.04	4.25	3.24
North Forty Truckstop	8/10/99	16	35.7	0.03	5.87	2.34
	9/2/99	8	27.4	0.06	7.23	3.25
	10/7/99	13	36.3	0.05	9.07	3.15
	11/3/99	11	33.8	0.02	9.55	2.99
	12/9/99	20	47.7	0.17	17.5	
	1/5/00	7	26.7	0.56	0.72	4.37
	2/9/00	22	25.1	0.19	5.77	3.9
	3/9/00	13	47	0.1	11.8	2.26
	4/4/00	10	42.5	0.06	14.2	2.69
	5/2/00	26	49.8	0.06	16.6	1.62
	6/13/00	14	67.8	0.11	12	3.8
	7/18/00	18	67	0.04	22.2	5.25

6.1.2 NPDES Regulated Municipal Separate Storm Sewer Systems (MS4s)

Municipal Separate Storm Sewer Systems (MS4s) are considered point sources of nutrients . These discharges occur in response to storm events through road drainage systems, curb and gutter systems, ditches, and storm drains. Large and medium MS4s serving populations greater than 100,000 people are required to obtain an NPDES storm water permit. As of March 2003, small MS4s serving urbanized areas, or having the potential to exceed instream water quality standards, are required to obtain a permit under the Phase II storm water regulations. An urbanized area is defined as an entity with a residential population of at least 50,000 people and an overall population density of at 1,000 people per square mile. At present, there are no Phase I or II entities that discharge to Eagle Creek.

6.2 Nonpoint Sources

Possible nonpoint sources of ammonia, other nutrients, and organic materials include urban runoff (from areas not covered under an MS4 permit), atmospheric deposition, failing septic systems, and agricultural runoff on land associated with fertilizer application and livestock waste. Although there is undoubtedly some ammonia and organic loading from agricultural runoff, the primary source of ammonia and organic materials loading to Eagle Creek appears to be due to failing septic systems. A number of businesses, utilizing a common septic system that is known to be failing, are located in the vicinity of the two permitted dischargers, in close proximity to Eagle Creek (see Figure 5 & photographs in Appendix C).

7.0 DEVELOPMENT OF TOTAL MAXIMUM DAILY LOAD

The TMDL process quantifies the amount of a pollutant that can be assimilated in a waterbody, identifies the sources of the pollutant, and recommends regulatory or other actions to be taken to achieve compliance with applicable water quality standards based on the relationship between pollution sources and in-stream water quality conditions. A TMDL can be expressed as the sum of all point source loads (Waste Load Allocations), non-point source loads (Load Allocations), and an appropriate margin of safety (MOS) which takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

$$TMDL = \Sigma WLAs + \Sigma LAs + MOS$$

The objective of a TMDL is to allocate loads among all of the known pollutant sources throughout a watershed so that appropriate control measures can be implemented and water quality standards achieved. 40 CFR §130.2 (i) states that TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measure.

7.1 Critical Conditions

Since the primary sources of both ammonia and organic loading to Eagle Creek appear to be permitted point source discharges and failing septic systems, the critical flow condition is the one that provides minimum dilution. The 7Q10 low flow of Eagle Creek is 0 cfs, resulting in a flow downstream of the Pecan Shoppe of Camden and the North Forty Truckstop equal to the sum of the discharge flows from these facilities. For the purposes of these TMDLs, the facility design flows were used to calculate the critical flow:

$$Q_{Critical} = Q_{Pecan\ Shoppe} + Q_{North\ 40\ Truckstop}$$

$$Q_{Critical} = 0.003\ MGD + 0.007\ MGD = 0.010\ MGD$$

The critical flow condition occurs during the summer months. The characteristic higher water temperatures result in more stringent chronic ammonia toxicity criteria (CCC) and lower oxygen saturation concentrations (lower reaeration).

7.2 Ammonia Toxicity

7.2.1 Determination of Total Maximum Daily Load

The TMDL for ammonia toxicity in Eagle Creek was determined by applying the acute (19.6 mg/l) and chronic (2.16 mg/l) allowable instream concentrations (AICs) developed in Section 4.1 to the critical flow condition. Ammonia toxicity TMDLs are, therefore, equal to:

$$TMDL_{Acute} = (Q_{Critical})\ (AIC_{Acute})\ (UCF) = (0.010\ MGD)\ (19.6\ mg/l)\ (8.34) = 1.635\ lbs/day$$

Where UCF = unit conversion factor

$$TMDL_{Chronic} = (Q_{Critical})\ (AIC_{Chronic})\ (UCF) = (0.010\ MGD)\ (2.16\ mg/l)\ (8.34) = 0.180\ lbs/day$$

7.2.2 Seasonal Variation

The critical condition for ammonia toxicity is considered to be the worst case condition. Measures taken to comply with the TMDL, WLAs, and LAs during the critical condition will also result in compliance with instream water quality standards during other seasons and flow regimes.

7.2.3 Determination of Waste Load Allocations

There are two permitted point sources that discharge ammonia to the impaired segments of Eagle Creek. Waste Load Allocations (WLAs) during the critical condition for the Pecan Shoppe of Camden (TN0040878) and the North Forty Truckstop (TN0059391) are equal to the limits specified in their existing permits applied to the respective design flow of each facility. Existing permit limits and calculated WLAs are summarized in Table 9.

Table 9 Ammonia Toxicity WLAs for Point Source Dischargers

Facility	Facility Design Flow	Season *	NPDES Permit Limit		WLAs	
			Monthly Average	Daily Maximum	Chronic	Acute
	[MGD]		[mg/l]	[mg/l]	[lbs/day]	[lbs/day]
Pecan Shoppe of Camden (TN0040878)	0.003	S	1	2	0.025	0.050
North Forty Truckstop (TN0059391)	0.007	S	2	4	0.117	0.234

* Seasonal abbreviations: S = Summer (5/1 through 10/31); W = Winter (11/1 through 4/30); Y = Entire Year.

7.2.4 Determination of Load Allocations

LAs for nonpoint source loading associated with normal stream background are not applicable for the critical condition (stream flow = 0 cfs). LAs for failing septic systems are zero for all flow conditions.

7.2.5 Margin of Safety

There are two methods for incorporating a MOS in the analysis: a) implicitly incorporate the MOS using conservative model assumptions to develop allocations; or b) explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations. An implicit MOS was incorporated through the use of conservative modeling assumptions which include:

- Selection of maximum observed pH and temperature values to calculate allowable instream concentrations (AICs).
- Selection of the 7Q10 low flow (minimal dilution) for application of AICs.

In addition, an explicit MOS is also provided:

$$TMDL = \Sigma\ WLAs + \Sigma\ LAs + MOS$$

$$MOS = TMDL - \Sigma\ WLAs - \Sigma\ LAs$$

$$\therefore \quad MOS_{Acute} = (1.635\ lbs/day) - (0.050\ lbs/day + 0.234\ lbs/day) - (0) = 1.341\ lbs/day$$

$$MOS_{Chronic} = (0.180\ lbs/day) - (0.025\ lbs/day + 0.117\ lbs/day) - (0) = 0.038\ lbs/day$$

7.3 Organic Enrichment/Dissolved Oxygen

7.3.1 Determination of Total Maximum Daily Load, Waste Load Allocations, & Load Allocations

The TMDL for organic enrichment/dissolved oxygen for Eagle Creek is considered to be equal to the maximum organic loading that will result in a minimum, instream dissolved oxygen concentration greater than the target 5 mg/l during critical conditions.

In order to determine if the current permit limits for the Pecan Shoppe of Camden and North Forty Truckstop were adequate to maintain a minimum dissolved oxygen concentration of 5.0 mg/l under critical conditions, a modified Streeter-Phelps model was constructed of Eagle Creek in the vicinity of the two facilities. Simulations were performed representing worst case permitted facility discharge at critical conditions. This analysis was based on the assumption that loading due to failing septic systems is eliminated Model input parameters are summarized in Table 10.

Table 10 Input Parameters for Eagle Creek Dissolved Oxygen Model

	Parameter	Value	Basis of Value
Pecan Shoppe Of Camden Discharge	Flow	0.003 MGD	STP design flow
	$CBOD_5$	10 mg/l	NPDES Permit No. TN0040878
	NH_3 (as N)	1.0 mg/l	NPDES Permit No. TN0040878 (Summer)
	DO	6.0 mg/l	NPDES Permit No. TN0040878
North Forty Truckstop Discharge	Flow	0.007 MGD	STP design flow
	$CBOD_5$	10 mg/l	NPDES Permit No. TN0059391
	NH_3 (as N)	0.44 mg/l *	NPDES Permit No. TN0059391 (Summer) *
	DO	6.0 mg/l	NPDES Permit No. TN0059391
Stream Background	Flow	0 cfs	7Q10 of Eagle Creek
	$CBOD_5$	1.5 mg/l	Tennessee/EPA Stream Model Agreement
	NH_3 (as N)	0.1 mg/l	Tennessee/EPA Stream Model Agreement
	DO	6.0 mg/l	Tennessee/EPA Stream Model Agreement
	Temperature	30°C	Tennessee/EPA Stream Model Agreement

* Permit limit is 2 mg/l at the facility compliance point. Value shown for input to Eagle Creek and has been adjusted to account for ammonia reduction in ditch (~ 0.2 mi.) between compliance point and Eagle Creek. The reduction (~78%) was based on field data collected in 1991.

The results of the low-flow simulation show a dissolved sag in Eagle Creek of 5.247 mg/l approximately 0.55 miles downstream of the North Forty Truckstop discharge ditch. The model output is included in Appendix D.

7.3.2 Seasonal Variation

The critical condition is considered to be the worst case condition with respect to organic enrichment/dissolved oxygen. Measures taken to comply with the TMDL, WLAs, and LAs during the critical condition will also result in compliance with instream water quality standards during other seasons and flow regimes.

7.3.3 Determination of Waste Load Allocations

WLAs for the Pecan Shoppe of Camden and the North Forty Truckstop during critical conditions are equal to the current NPDES permit limits applied to the respective design flow of each facility. Calculation of WLAs is similar to the methodology for ammonia toxicity WLAs in Section 7.1.3. WLAs for the two point sources for organic enrichment/dissolved oxygen are summarized in Table 11. It should be noted that the ammonia WLAs for organic enrichment/dissolved oxygen are the same as those developed for ammonia toxicity.

Table 11 Summary of Organic Enrichment/Dissolved Oxygen WLAs During Critical Conditions

Facility	Effluent Characteristic	Design Flow	Season *	NPDES Permit Limits		WLAs	
				Monthly Average Concen.	Daily Maximum Concen.	Chronic	Acute
		[MGD]		[mg/l]	[mg/l]	[lbs/day]	[lbs/day]
Pecan Shoppe of Camden (TN0040878)	$CBOD_5$	0.003	Y	10	15	0.250	0.375
	Ammonia		S	1	2	0.025	0.050
	Dissolved Oxygen		Y	6.0 minimum		6.0 mg/l minimum	
North Forty Truckstop (TN0059391)	$CBOD_5$	0.007	Y	10	20	0.584	1.168
	Ammonia		S	2	4	0.117	0.234
	Dissolved Oxygen		Y	6.0 minimum		6.0 mg/l minimum	

* Seasonal abbreviations: S = Summer (5/1 through 10/31); W = Winter (11/1 through 4/30); Y = Entire Year.

7.3.4 Determination of Load Allocations

LAs for stream background are zero for the critical condition. The LA for failing septic systems is equal to zero for all flow conditions.

7.3.5 Margin of Safety

For organic enrichment TMDLs, an implicit MOS was incorporated through the use of conservative modeling assumptions, which included:

- Background stream flow = 0 cfs (minimum dilution).
- Water temperature = 30°C.
- Point sources discharges at facility design flow and at permit limits.

8.0 IMPLEMENTATION PLAN

8.1 Waste Load Allocations & Load Allocations

WLAs for ammonia toxicity and organic enrichment/dissolved oxygen correspond to the existing permit limits for the Pecan Shoppe of Camden (TN0040878) and the North Forty Truckstop (TN0059391). Both of these facilities, however, have a long history of permit violations implying that wastewater treatment plants are not adequate to comply with permit limits, or that the plants are not operated and maintained properly. Enforcement action against these facilities, as well as facilities utilizing failing septic tanks, is under consideration by TDEC.

At the present time, Benton County and Decatur County are cooperating in the planning and construction of a regional wastewater treatment system to serve this area. The discharge from this proposed facility will be to the Tennessee River, completely removing all discharges to Eagle Creek. This facility could be completed as early as late 2004 and is considered by the Division of Water Pollution Control to be a feasible solution to pollutant loading to Eagle Creek. In the interim, however, action to minimize pollutant loading to Eagle Creek is required. Possible options include upgrade of existing treatment facilities or the transport of wastewater to an outside treatment facility.

8.2 Additional Stream Monitoring

Tennessee's watershed management approach specifies a five-year cycle for planning and assessment. Each watershed will be examined (or re-examined) on a rotating basis. Generally, in years two and three of the five-year cycle, water quality data are collected in support of water quality assessment (including TMDL development) and planning activities. Therefore, a watershed TMDL is developed one to two years prior to commencement of the next cycle's monitoring period. Continued monitoring of the ammonia and dissolved oxygen concentrations at multiple water quality sampling points in Eagle Creek will verify that the implementation measures described in Section 8.1 will result in achieving minimum water quality standards.

9.0 PUBLIC PARTICIPATION

In accordance with 40 CFR §130.7, the proposed ammonia toxicity and organic enrichment/dissolved oxygen TMDLs for Eagle Creek were placed on Public Notice for a 35-day period (9/22/03 – 10/27/03) and comments solicited. Steps that were taken in this regard include:

1) Notice of the proposed TMDLs was posted on the Tennessee Department of Environment and Conservation website. The announcement invited public and stakeholder comment and provided a link to a downloadable version of the TMDL document. The Public Notice Announcement is included as Appendix E.

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

3) Draft copies of the proposed TMDLs were sent to the Pecan Shoppe of Camden and the North Forty Truckstop and comments solicited.

No written comments were received during the Public Notice period.

10. FURTHER INFORMATION

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

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

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

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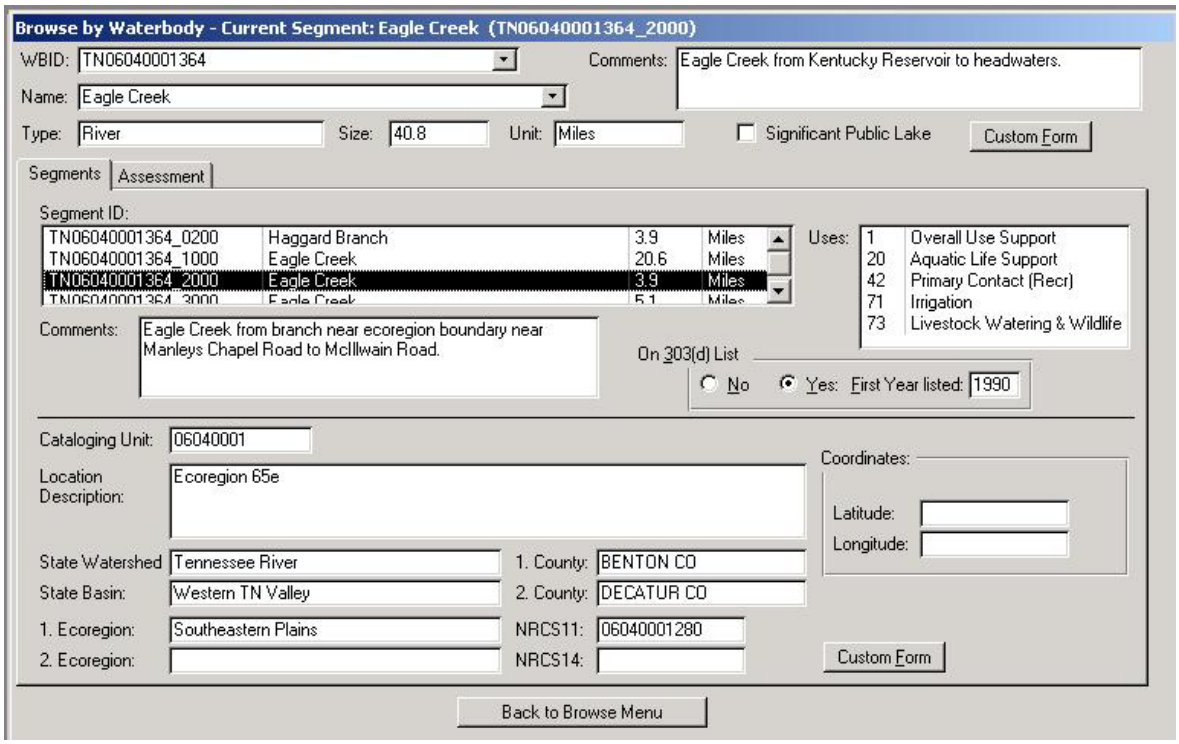
APPENDIX A

Eagle Creek 2002 Assessment Summary

Figure A-1 Assessment Summary of Eagle Creek – Manleys Chapel Road to McIllwain Road (TN06040001364_2000)



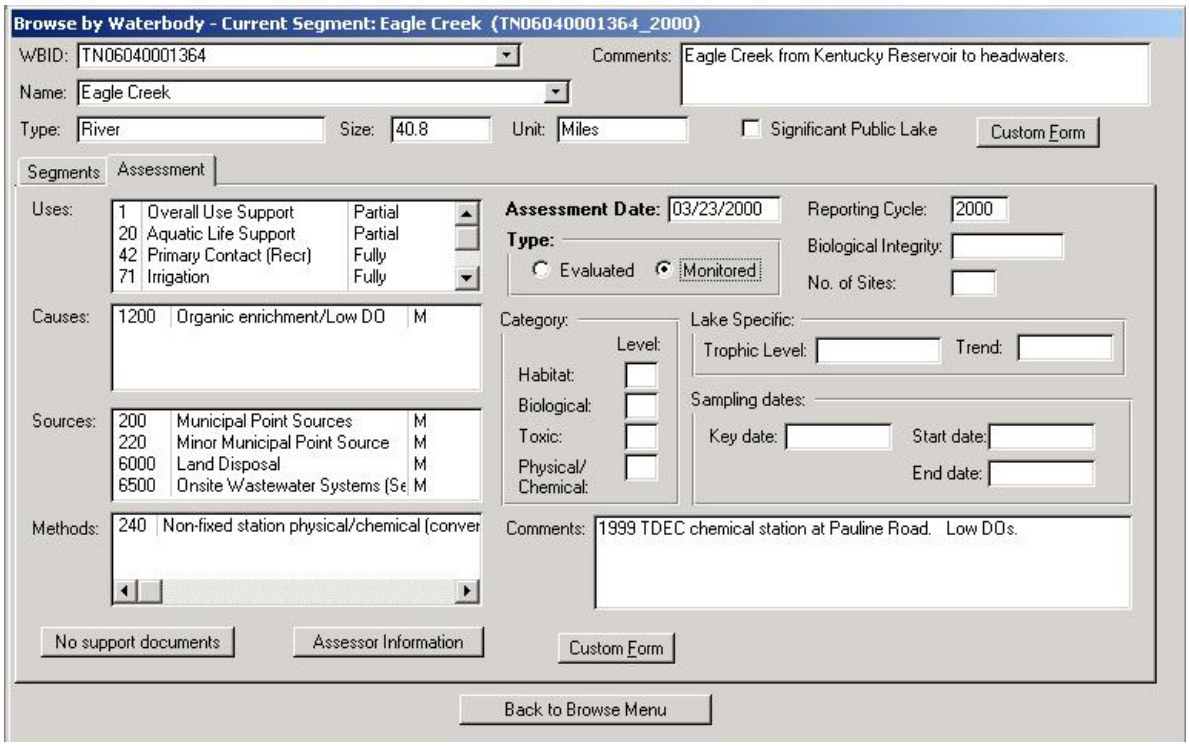
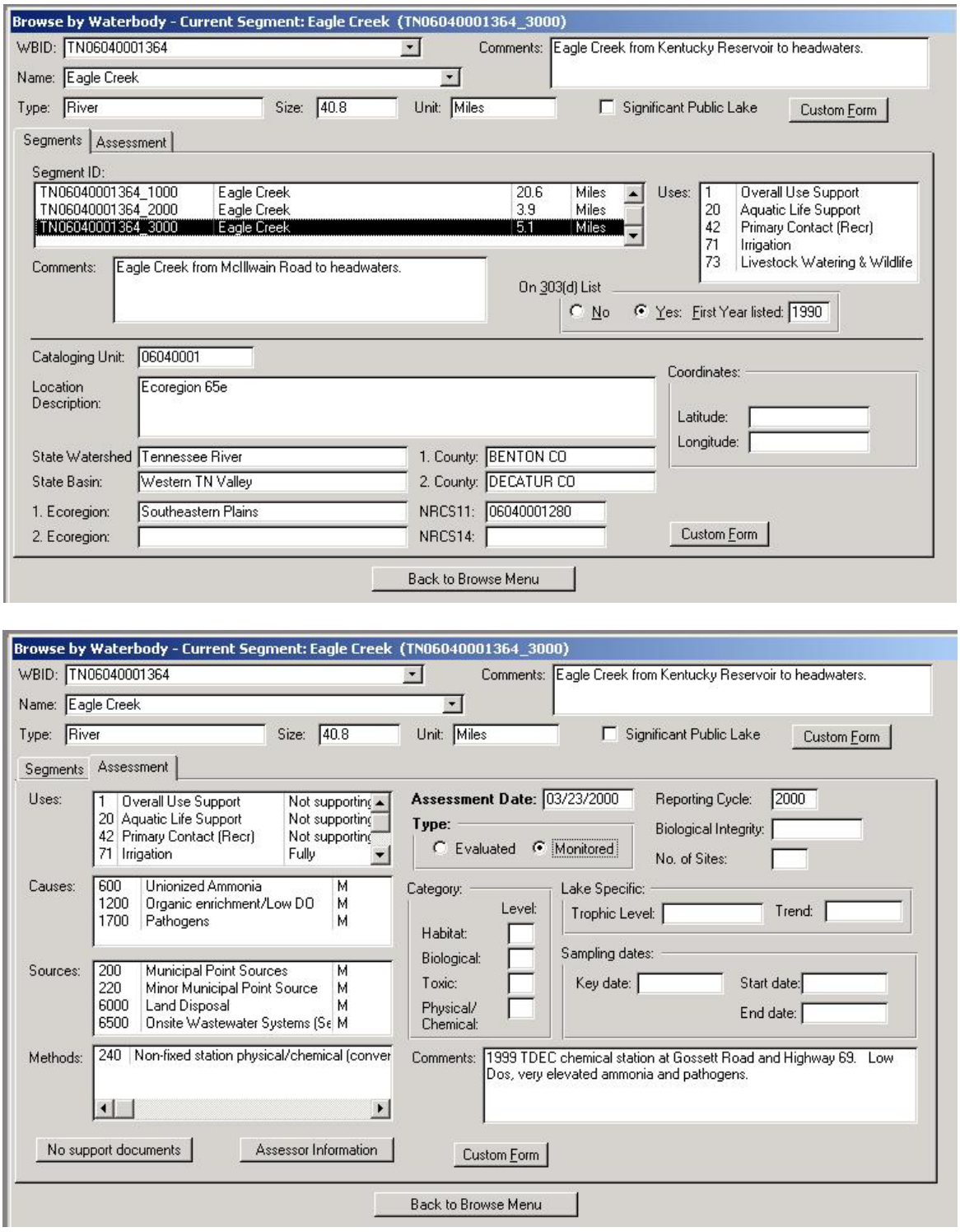


Figure A-2 Assessment Summary of Eagle Creek – McIllwain Road to Headwaters (TN06040001364_3000)



APPENDIX B

Effluent Data Submitted on Monthly Operation Reports for NPDES Permitted Facilities

Table B-1 Monthly Operation Report Summary for Pecan Shoppe of Camden

Month	CBOD5		Ammonia		Dissolved Oxygen - Minimum	
	Concen. [mg/l]	Number of Violations Of Limits	Concen. [mg/l]	Number of Violations Of Limits	Concen. [mg/l]	Number of Violations Of Limits
Jan-99	9.5	0	1.19	0	6.8	0
Feb-99						
Mar-99	12	1	34.7	2	6.0	0
Apr-99	21.4	2	18.8	2	4.3	11
May-99	10.4	1	29.4	2	4.0	9
Jun-99	13.3	1	34.7	2	4.9	11
Jul-99	13.6	1	38.9	2	5.0	16
Aug-99	9.4	0	71.7	2	3.6	22
Sep-99	14.5	1	31.2	2	5.1	15
Oct-99	9.3	0	41.3	2	5.1	8
Nov-99	8	0	29.8	2	5.0	7
Dec-99	10.5	1	48.4	2	5.7	2
Jan-00	7.3	0	50.6	2	4.6	5
Feb-00	16.2	2	34.6	2	5.0	7
Mar-00	14.1	1	36.9	2	3.2	8
Apr-00					3.4	5
May-00	19	2	62.9	2	0.1	4
Jun-00	14.4	1	73.1	2	0.1	23
Jul-00	10.4	1	65.5	2	0.7	21
Aug00	9	0	77.5	2	0.9	22
Sep00	14.3	1	73.8	2	0.9	21
Oct-00	8.7	0	72.9	2	1.3	23
Nov-00	12.6	1	72.4	2	2.0	19
Dec-00	6.7	0	33.6	2	2.5	20
Jan-01	10.1	1	65.1	2	3.0	21
Feb-01	11	1			2.1	19
Mar-01	9.7	0	6.83	1	3.7	15
Apr-01	12.4	1	12.6	2	1.4	21
May-01	20.3	2	54.3	2	1.4	22
Jun-01	17	2			1.1	21
Jul-01	22.3	2	52.4	2	1.1	22
Aug01	14.3	1	34.7	2	1.0	23
Sep01	17	2	21.7	2	1.1	20
Oct-01	10		20.8	2	1.7	23
Nov-01	11	1	23.7	2	1.1	22
Dec-01	7	0	6.83	1	1.1	21
Jan-02	7.7	0	2.47	0	2.1	22
Feb-02	12.9	1	14.4	2	1.6	22
Mar-02	30.5	2	22.3	2	1.1	21
Apr-02	16.4	2	19.8	2	1.0	22
May-02	19	2	48.3	2	1.0	21
Jun-02	26.5	2	40.3	2	1.0	22
Jul-02	15.9	2	56.3	2	1.0	23
Aug02	19.7	2	67.1	2	1.4	21
Sep02	9.4	0	22.8	2	0.9	22
Oct-02	21	2	18.2	2	1.1	22

Table B-2 Monthly Operation Report Summary for North Forty Truckstop

Month	CBOD5		Ammonia		Dissolved Oxygen - Minimum	
	Concen. [mg/l]	Number of Violations Of Limits	Concen. [mg/l]	Number of Violations Of Limits	Concen. [mg/l]	Number of Violations Of Limits
Jan-99	7.6	0	1.41	0		
Feb-99	5.5	0	10.1	2	6.7	0
Mar-99	9.66	0	28.6	2	5.7	1
Apr-99	5.3	0	22.4	2	6.1	0
May-99						
Jun-99	7.66	0	16.5	2	6.1	0
Jul-99	8.99	0	21.9	2	6.2	0
Aug-99	16.9	1	35.9	2	6.6	0
Sep-99	20.4	2	26.3	2	6.2	0
Oct-99	15.4	1	24.7	2	6.4	0
Nov-99	15.2	1	34.3	2	6.3	0
Dec-99	29	2	57.2	2	6.3	0
Jan-00	19.1	1	31.8	2	6.2	0
Feb-00	9.2	0	42.1	2	6.3	0
Mar-00	18	1	28.6	2	2.5	6
Apr-00	12	1	42.7	2	1.5	8
May-00	10.3	1	36.4	2	1.2	9
Jun-00	17	1	53.9	2	2.3	8
Jul-00	22	2	43.6	2	2.5	8
Aug00	14	1	38.3	2	2.2	9
Sep00	13.6	1	61.3	2	1.9	9
Oct-00	14.7	1	55.8	2	2.1	8
Nov-00	17.2	1	27.4	2	2.3	9
Dec-00	27.5	2	19.9	2	2.5	8
Jan-01	20.5	2	33.9	2	2.5	9
Feb-01						
Mar-01						
Apr-01						
May-01	30	2	31.1	2	2.2	9
Jun-01						
Jul-01	13.8	1	18.8	2	2.8	9
Aug01	7.3	0	15.9	2	3.5	9
Sep01	7	0	19.4	2	4.2	8
Oct-01						
Nov-01	7	0	19.3	2	2.9	9
Dec-01	8.5	0	30.5	2	3.8	9
Jan-02	12.3	1	12.3	2	3.8	8
Feb-02	13.9	1	33.5	2	3.6	8
Mar-02	15	1	25.8	2	3.8	9
Apr-02	14.9	1	24.2	2	3.7	9
May-02	14.3	1	23.5	2	3.8	9
Jun-02	8.7	0	23.9	2	3.8	8
Jul-02	11.4	1	36.3	2	3.9	9
Aug02	19.2	1	50.2	2	3.8	9
Sep02	12.2	1	26.7	2	3.7	8
Oct-02	14.8	1	31.7	2	4.0	10

APPENDIX C

Photographs – Eagle Creek

Figure C-1 North Forty Truckstop Wastewater Treatment Plant

Figure C-2 North Forty Truckstop Effluent Discharge to Eagle Creek

Figure C-3 Common Septic Field (Facilities Southwest of Highway 69 Overpass of Interstate 40)

Figure C-4 Common Septic Field Leacheate (Facilities Southwest of Highway 69 Overpass of Interstate 40)

Figure C-5 Septic Tanks in the Vicinity of Tucker Creek

Figure C-6 Eagle Creek at Gossett Road (Vicinity of EAGLE012.5BN)

APPENDIX D

Streeter-Phelps Model Output - Eagle Creek (Summer Low Flow Conditions)

DIVISION OF WATER POLLUTION CONTROL
STREAM MODELING OUTPUT FILE VERSION 1.04

DATE: 03/05/03 CHECKED BY COUNTY: Benton

FACILITY: Eagle Creek OE/DO TMDL QUAD: 21SE & 21NE
STREAM: Eagle Creek Run: EAGLE002 BASIN: HUC 06040001

BACKGROUND CONDITIONS
** K1=CBOD REMOVAL K2=REAERATION
** K3=NITROGENOUS DEOXYGENATION
** K4=CBOD DECAY K5=SOD

CBOD (mg/l). . : 1.5
NH3-N (mg/l) . : 0.10
DO (mg/l). . . : 6.00
TEMP (C) . . . : 30.00
FLOW (cfs) . . : 0.00

SEGMENT NO. 1 OF 6

SEGMENT NAME: Pecan Shoppe
PERMIT NO: TN0040878

K VALUES FOR REMOVAL RATE ARE DEFAULT UNLESS
MARKED WITH ( ) WHICH INDICATES ENTERED BY MODELER

K1= 0.69 K2= 6.00 K3= 0.86 K4= 0.69 TEMP CORRECTED

K1= 0.40 K2= 4.73 K3= 0.50 K4= 0.40 UNCORRECTED

K2 (1/day) AT 20 C : 4.73
SLOPE (ft/mi) OF SEGMENT: 26.30

STREAM VELOCITY (fps) . . . . . : 0.100
TEMPERATURE USED THIS SEGMENT. . . : 30.00
DISCHARGER FLOWRATE (cfs)/(MGD) . : 0.005 / 0.0030

PROPOSED STANDARDS

CBOD (mg/l) . . : 10.0
NH3-N (mg/l). . : 1.00
DO (mg/l) . . . : 6.00

R.M.	SEG.LEN	TIME	CBOD	TOTAL AMMONIA-N	DO	TOXIC pH ABOVE
MILES	MILES	HOURS	mg/l	mg/l	mg/l	SU
13.100	0.000	0.000	10.000	1.000	6.000	7.73
13.050	0.050	0.733	9.791	0.974	5.873	7.74
13.000	0.100	1.467	9.587	0.949	5.775	7.75
12.950	0.150	2.200	9.387	0.924	5.702	7.76
12.900	0.200	2.933	9.191	0.900	5.650	7.77
12.850	0.250	3.667	9.000	0.877	5.615	7.79
12.800	0.300	4.400	8.812	0.854	5.593	7.80

SEGMENT NO. 2 OF 6

SEGMENT NAME: N.40 Truckstop
PERMIT NO: TN0059391

K VALUES FOR REMOVAL RATE ARE DEFAULT UNLESS
MARKED WITH ( ) WHICH INDICATES ENTERED BY MODELER

K1= 0.69 K2= 3.86 K3= 0.52 K4= 0.69 TEMP CORRECTED

K1= 0.40 K2= 3.04 K3= 0.30 K4= 0.40 UNCORRECTED

K2 (1/day) AT 20 C : 3.04
SLOPE (ft/mi) OF SEGMENT: 16.90

STREAM VELOCITY (fps) . . . . . : 0.100
TEMPERATURE USED THIS SEGMENT. . . : 30.00
DISCHARGER FLOWRATE (cfs)/(MGD) . : 0.011 / 0.0070

PROPOSED STANDARDS

CBOD (mg/l) . . : 10.0
NH3-N (mg/l). . : 0.44
DO (mg/l) . . . : 6.00

R.M.	SEG.LEN	TIME	CBOD	TOTAL AMMONIA-N	DO	TOXIC pH ABOVE	
MILES	MILES	HOURS	mg/l	mg/l	mg/l	SU	
12.800	0.000	4.400	9.644	0.564	5.878	7.99	
12.750	0.050	5.133	9.442	0.555	5.744	8.00	
12.700	0.100	5.867	9.245	0.547	5.632	8.00	
12.650	0.150	6.600	9.053	0.538	5.538	8.01	
12.600	0.200	7.333	8.864	0.530	5.461	8.02	
12.550	0.250	8.067	8.679	0.521	5.399	8.03	
12.500	0.300	8.800	8.498	0.513	5.349	8.03	
12.450	0.350	9.533	8.321	0.505	5.311	8.04	
12.400	0.400	10.267	8.147	0.497	5.283	8.05	
12.350	0.450	11.000	7.977	0.489	5.264	8.06	
12.300	0.500	11.733	7.811	0.482	5.252	8.06	
12.250	0.550	12.467	7.648	0.474	5.247	8.07	<- D.O. SAG
12.200	0.600	13.200	7.488	0.467	5.248	8.08	

SEGMENT NO. 3 OF 6

SEGMENT NAME: Slope Change 1
PERMIT NO:

K VALUES FOR REMOVAL RATE ARE DEFAULT UNLESS
MARKED WITH ( ) WHICH INDICATES ENTERED BY MODELER

K1= 0.69 K2= 6.16 K3= 0.86 K4= 0.69 TEMP CORRECTED

K1= 0.40 K2= 4.86 K3= 0.50 K4= 0.40 UNCORRECTED

K2 (1/day) AT 20 C : 4.86
SLOPE (ft/mi) OF SEGMENT: 27.00

STREAM VELOCITY (fps) . . . . . : 0.100
TEMPERATURE USED THIS SEGMENT. . . : 30.00
DISCHARGER FLOWRATE (cfs)/(MGD) . : 0.000 / 0.0000

PROPOSED STANDARDS

CBOD (mg/l) . . : 0.0
NH3-N (mg/l). . : 0.00
DO (mg/l) . . . : 0.00

R.M.	SEG.LEN	TIME	CBOD	TOTAL AMMONIA-N	DO	TOXIC pH ABOVE	
MILES	MILES	HOURS	mg/l	mg/l	mg/l	SU	
12.200	0.000	13.200	7.488	0.467	5.248	8.08	<- D.O. SAG
12.150	0.050	13.933	7.332	0.455	5.384	8.09	
12.100	0.100	14.667	7.179	0.443	5.501	8.10	
12.050	0.150	15.400	7.029	0.431	5.604	8.12	
12.000	0.200	16.133	6.883	0.420	5.695	8.13	
11.950	0.250	16.867	6.739	0.409	5.776	8.14	
11.900	0.300	17.600	6.598	0.398	5.848	8.15	
11.850	0.350	18.333	6.461	0.388	5.912	8.17	
11.800	0.400	19.067	6.326	0.378	5.971	8.18	
11.750	0.450	19.800	6.194	0.368	6.024	8.19	
11.700	0.500	20.533	6.065	0.359	6.073	8.21	
11.650	0.550	21.267	5.938	0.349	6.118	8.22	
11.600	0.600	22.000	5.814	0.340	6.160	8.23	
11.550	0.650	22.733	5.693	0.331	6.200	8.25	
11.500	0.700	23.467	5.574	0.323	6.237	8.26	
11.450	0.750	24.200	5.458	0.314	6.272	8.27	

SEGMENT NO. 4 OF 6

SEGMENT NAME: Slope Change 2
PERMIT NO:

K VALUES FOR REMOVAL RATE ARE DEFAULT UNLESS
MARKED WITH ( ) WHICH INDICATES ENTERED BY MODELER

K1= 0.69 K2= 4.95 K3= 0.86 K4= 0.69 TEMP CORRECTED

K1= 0.40 K2= 3.91 K3= 0.50 K4= 0.40 UNCORRECTED

K2 (1/day) AT 20 C : 3.91
SLOPE (ft/mi) OF SEGMENT: 21.70

STREAM VELOCITY (fps) . . . . . : 0.100
TEMPERATURE USED THIS SEGMENT. . . : 30.00
DISCHARGER FLOWRATE (cfs)/(MGD) . : 0.000 / 0.0000

PROPOSED STANDARDS

CBOD (mg/l) . . : 0.0
NH3-N (mg/l). . : 0.00
DO (mg/l) . . . : 0.00

R.M.	SEG.LEN	TIME	CBOD	TOTAL AMMONIA-N	DO	TOXIC pH ABOVE	
MILES	MILES	HOURS	mg/l	mg/l	mg/l	SU	
11.450	0.000	24.200	5.458	0.314	6.272	8.27	
11.400	0.050	24.933	5.344	0.306	6.261	8.28	
11.350	0.100	25.667	5.233	0.298	6.256	8.30	
11.300	0.150	26.400	5.124	0.290	6.256	8.31	<- D.O. SAG
11.250	0.200	27.133	5.017	0.283	6.260	8.32	
11.200	0.250	27.867	4.912	0.275	6.267	8.34	
11.150	0.300	28.600	4.810	0.268	6.277	8.35	
11.100	0.350	29.333	4.709	0.261	6.289	8.36	
11.050	0.400	30.067	4.611	0.255	6.304	8.38	
11.000	0.450	30.800	4.515	0.248	6.320	8.39	
10.950	0.500	31.533	4.421	0.241	6.337	8.41	
10.900	0.550	32.267	4.329	0.235	6.355	8.42	
10.850	0.600	33.000	4.238	0.229	6.374	8.43	
10.800	0.650	33.733	4.150	0.223	6.393	8.45	
10.750	0.700	34.467	4.063	0.217	6.413	8.46	
10.700	0.750	35.200	3.978	0.212	6.433	8.48	
10.650	0.800	35.933	3.895	0.206	6.454	8.49	
10.600	0.850	36.667	3.814	0.201	6.474	8.50	
10.550	0.900	37.400	3.735	0.196	6.495	8.52	
10.500	0.950	38.133	3.657	0.190	6.515	8.53	
10.450	1.000	38.867	3.580	0.186	6.536	8.55	
10.400	1.050	39.600	3.506	0.181	6.556	8.56	
10.350	1.100	40.333	3.433	0.176	6.576	8.58	
10.300	1.150	41.067	3.361	0.171	6.596	8.59	
10.250	1.200	41.800	3.291	0.167	6.616	8.61	
10.200	1.250	42.533	3.222	0.163	6.635	8.62	
10.150	1.300	43.267	3.155	0.158	6.655	8.64	
10.100	1.350	44.000	3.089	0.154	6.673	8.65	
10.050	1.400	44.733	3.025	0.150	6.692	8.67	
10.000	1.450	45.467	2.962	0.146	6.710	8.69	
9.950	1.500	46.200	2.900	0.143	6.728	8.70	

9.900	1.550	46.933	2.839	0.139	6.746	8.72
9.850	1.600	47.667	2.780	0.135	6.763	8.73
9.800	1.650	48.400	2.722	0.132	6.780	8.75
9.750	1.700	49.133	2.665	0.128	6.796	8.77
9.700	1.750	49.867	2.610	0.125	6.813	8.78
9.650	1.800	50.600	2.555	0.122	6.829	8.80

SEGMENT NO. 5 OF 6

SEGMENT NAME: Slope Change 3
PERMIT NO:

K VALUES FOR REMOVAL RATE ARE DEFAULT UNLESS
MARKED WITH ( ) WHICH INDICATES ENTERED BY MODELER

K1= 0.52 K2= 3.86 K3= 0.52 K4= 0.52 TEMP CORRECTED

K1= 0.30 K2= 3.04 K3= 0.30 K4= 0.30 UNCORRECTED

K2 (1/day) AT 20 C : 3.04
SLOPE (ft/mi) OF SEGMENT: 16.90

STREAM VELOCITY (fps) . . . . . : 0.100
TEMPERATURE USED THIS SEGMENT. . . : 30.00
DISCHARGER FLOWRATE (cfs)/(MGD) . : 0.000 / 0.0000

PROPOSED STANDARDS

CBOD (mg/l) . . : 0.0
NH3-N (mg/l). . : 0.00
DO (mg/l) . . . : 0.00

R.M.	SEG.LEN	TIME	CBOD	TOTAL AMMONIA-N	DO	TOXIC pH ABOVE	
MILES	MILES	HOURS	mg/l	mg/l	mg/l	SU	
9.650	0.000	50.600	2.555	0.122	6.829	8.80	<- D.O. SAG
9.600	0.050	51.333	2.515	0.120	6.845	8.81	
9.550	0.100	52.067	2.476	0.118	6.861	8.82	
9.500	0.150	52.800	2.437	0.116	6.876	8.83	
9.450	0.200	53.533	2.399	0.114	6.891	8.84	
9.400	0.250	54.267	2.361	0.112	6.904	8.85	
9.350	0.300	55.000	2.324	0.111	6.917	8.87	
9.300	0.350	55.733	2.288	0.109	6.930	8.88	
9.250	0.400	56.467	2.252	0.107	6.942	8.89	
9.200	0.450	57.200	2.216	0.106	6.954	8.90	
9.150	0.500	57.933	2.182	0.104	6.965	8.91	
9.100	0.550	58.667	2.147	0.102	6.976	8.92	
9.050	0.600	59.400	2.114	0.101	6.987	8.93	

SEGMENT NO. 6 OF 6

SEGMENT NAME: Slope Change 4
PERMIT NO:

K VALUES FOR REMOVAL RATE ARE DEFAULT UNLESS
MARKED WITH ( ) WHICH INDICATES ENTERED BY MODELER

K1= 0.52 K2= 5.43 K3= 0.86 K4= 0.52 TEMP CORRECTED

K1= 0.30 K2= 4.28 K3= 0.50 K4= 0.30 UNCORRECTED

K2 (1/day) AT 20 C : 4.28
SLOPE (ft/mi) OF SEGMENT: 23.80

STREAM VELOCITY (fps) . . . . . : 0.100
TEMPERATURE USED THIS SEGMENT. . . : 30.00
DISCHARGER FLOWRATE (cfs)/(MGD) . : 0.000 / 0.0000

PROPOSED STANDARDS

CBOD (mg/l) . . : 0.0
NH3-N (mg/l). . : 0.00
DO (mg/l) . . . : 0.00

R.M.	SEG.LEN	TIME	CBOD	TOTAL AMMONIA-N	DO	TOXIC pH ABOVE	
MILES	MILES	HOURS	mg/l	mg/l	mg/l	SU	
9.050	0.000	59.400	2.114	0.101	6.987	8.93	<- D.O. SAG
9.000	0.050	60.133	2.081	0.098	7.018	8.95	
8.950	0.100	60.867	2.048	0.096	7.045	8.97	
8.900	0.150	61.600	2.016	0.093	7.070	8.99	
8.850	0.200	62.333	1.984	0.091	7.091	9.01 +	
8.800	0.250	63.067	1.953	0.088	7.110	9.03 +	
8.750	0.300	63.800	1.922	0.086	7.127	9.06 +	
8.700	0.350	64.533	1.892	0.084	7.143	9.08 +	
8.650	0.400	65.267	1.863	0.082	7.157	9.10 +	
8.600	0.450	66.000	1.833	0.079	7.169	9.12 +	

APPENDIX E

Public Notice Announcement

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

PUBLIC NOTICE OF AVAILABILITY OF PROPOSED TOTAL MAXIMUM DAILY LOADS (TMDLs) FOR AMMONIA TOXICITY & ORGANIC ENRICHMENT/LOW DISSOLVED OXYGEN IN EAGLE CREEK, LOCATED IN THE TENNESSEE WESTERN VALLEY (BEECH) WATERSHED (HUC 06040001), TENNESSEE

Announcement is hereby given of the availability of Tennessee's proposed Total Maximum Daily Loads (TMDLs) for ammonia toxicity and organic enrichment/low dissolved oxygen in Eagle Creek located in the Tennessee Western Valley (Beech) Watershed in western Tennessee. Section 303(d) of the Clean Water Act requires states to develop TMDLs for waters on their impaired waters list. TMDLs must determine the allowable pollutant load that the water can assimilate, allocate that load among the various point and nonpoint sources, include a margin of safety, and address seasonality.

Portions of Eagle Creek are listed on Tennessee's final 1998 303(d) list and proposed 2002 303(d) list as not supporting designated use classifications due, in part, to ammonia toxicity and organic enrichment/low dissolved oxygen associated with facility onsite wastewater systems. The TMDLs utilize Tennessee's general water quality criteria, EPA ambient water quality criteria for ammonia, and an appropriate Margin of Safety (MOS) to establish allowable loading, during summer low-flow (worst case) conditions, which will result in reduced in-stream concentrations and the attainment of water quality standards.

The proposed ammonia toxicity and organic enrichment/low dissolved oxygen TMDLs may be downloaded from the Department of Environment and Conservation website:

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

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

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

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

Persons wishing to comment on the TMDLs are invited to submit their comments in writing no later than October 27, 2003 to:

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

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

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