Total Copper TMDL Development
for
Cane Creek
Lower Hatchie River Watershed, Tennessee
(HUC 08010208)

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August 1, 1999

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ABSTRACT

Section 303(d) of the Clean Water Act requires each state to list those waters within its boundaries that do not meet minimum water quality standards for designated use classifications. States are required to develop Total Maximum Daily Loads (TMDLs) for these waterbodies. The TMDL process establishes the maximum amount of a pollutant that a waterbody can assimilate without exceeding water quality standards and allocates a portion of this load to all contributing pollutant sources. The goal of the TMDL is the restoration of water quality of a stream or lake above minimum acceptable levels through the reduction of pollutant loading. Cane Creek, a tributary of the Hatchie River, is identified on Tennessee's 1998 303(d) List as a waterbody that exceeds the minimum water quality standard for metals due to industrial point source discharges.

The TMDL utilizes Tennessee's general water quality criteria, permitted flows from point source dischargers, an appropriate Margin of Safety (MOS), and recently EPA approved site specific copper criteria studies for portions of the Cane Creek subwatershed to calculate the maximum amount of copper that can be discharged to Cane Creek and its tributaries without exceeding any applicable instream water quality criteria.

The existing permitted copper load from point source dischargers is 5.855 lbs/day. The Total Maximum Daily Load that would result in compliance with all applicable instream water quality criteria is 1.213 lbs/day. The TMDL proposes a phased approach to reduce the copper loading from point source discharges and requires an initial reduction of ~56.5% of the point source copper loading and an eventual further reduction of ~52.4% (~79.3% total reduction). The TMDL makes allowances for further site specific copper criteria studies in Cane Creek and revision of the TMDL if necessary.

TOTAL MAXIMUM DAILY LOAD (TMDL) DEVELOPMENT

CANE CREEK

LOWER HATCHIE WATERSHED

I. 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 meeting designated uses. The TMDL process establishes the allowable loadings of pollutants or other quantifiable parameters for a waterbody based on the relationship between pollution sources and in-stream water quality conditions, so that states can establish water quality based controls to reduce pollution from both point and nonpoint sources and restore and maintain the quality of their water resources (USEPA, 1991).

II. PROBLEM DEFINITION

Tennessee's final 1998 303(d) list was approved by EPA Region IV on September 17, 1998. The list identified Cane Creek, a tributary of the Hatchie River, as a waterbody that exceeds the minimum water quality standard for metals due to industrial point source discharges. The objective of this study is to develop a copper TMDL for the Cane Creek subwatershed from River Mile (RM) 17.9 to the confluence with the Hatchie River.

A. Background

The Lower Hatchie watershed (HUC 08010208) is located in southwestern Tennessee (Figure 1) with the major portion of the watershed falling within the Level III Mississippi Valley Loess Plains ecoregion (74). Hyde Creek (RM 13.9) and Nelson Creek (RM 16.5) are tributaries to Cane Creek which enters the Hatchie River at RM 27.5 (Figure 2). Cane Creek and Nelson Creek are in the Level IV Loess Plains subecoregion (74b). Streams in this ecoregion are generally low gradient and mucky with silt and sand bottoms, and most have been channelized. Hyde Creek is in the Level IV Bluff Hills subecoregion (74a). Streams in this subecoregion have localized reaches of increased gradient and small areas of gravel substrate that create aquatic habitats that are distinct from 74b (USEPA, 1997).

Cane Creek was channelized in 1970-1971 from old U.S. Highway 51 in Ripley to the confluence with the Hatchie River to provide flood control and drainage for agricultural lands in the basin. Based on USGS reports, the length of this channel was reduced from about 29 to 17 miles and the average slope increased from 0.00058 ft./ft. to about 0.00096 ft./ft. with the average cross-sectional area increased by 15 percent. The modifications in Cane Creek triggered erosion and scour processes within the channel.

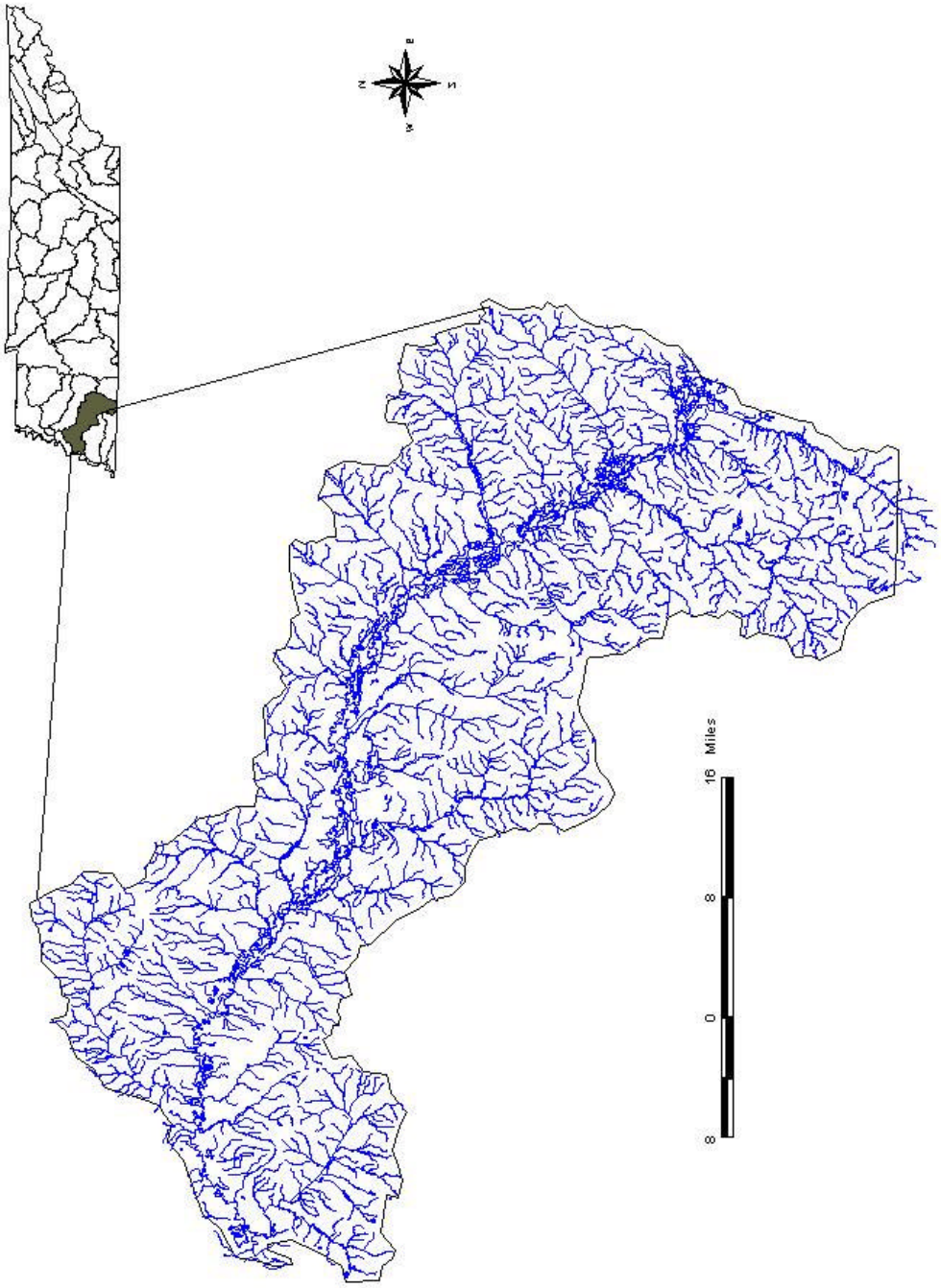

Figure 1 Location of the Lower Hatchie Watershed

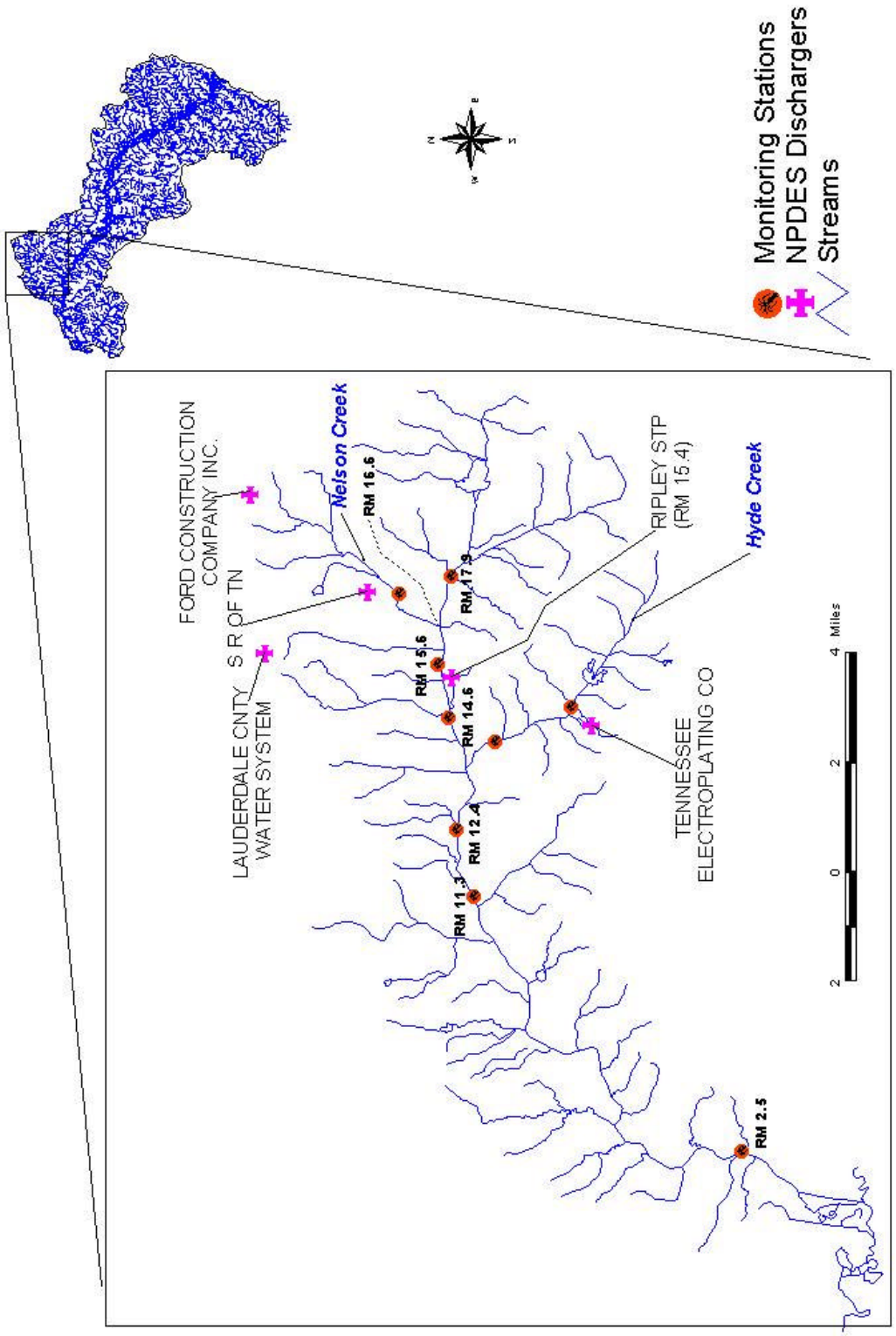

Figure 2 Cane Creek Subwatershed

The approximate total length of Cane Creek and its tributaries is 167 river miles. The mainstem is approximately 20 miles long and drains an area of 81.8 square miles. The designated use classifications for surface waters are fish and aquatic life, irrigation, livestock watering, and recreation. The major impact of elevated metal concentrations is to the fish and aquatic life use classification.

Point sources which discharge into Cane Creek and its tributaries are (see Figure 2):

Point Source	NPDES Permit No.	Discharge Route
SR of Tennessee	TN0026565	RM 0.6 of an unnamed tributary to RM 1.0 of Old Nelson Creek to RM 16.5 of Cane Creek
Ripley STP	TN0025364	RM 15.4 of Cane Creek
Tennessee Electroplating	TN0001180	RM 0.6 of an unnamed tributary to RM 2.3 of Hyde Creek to RM 13.9 of Cane Creek

Both SR of Tennessee (SRT) and Tennessee Electroplating (TEP) are engaged in the injection molding, electroplating, and painting of plastic automotive parts. The plating processes require the use of a high pH electroless copper solution. In order to prevent the copper from precipitating out in the copper bath, the copper must be in a strongly chelated form with EDTA used as the chelating agent. All rinse waters, leaks, and spills are treated in on-site wastewater treatment facilities that utilize chemical treatment to remove metals except for the copper that is complexed with EDTA. These copper/EDTA rinsewaters are treated separately to remove the vast majority of copper before it is combined with other chemically treated waters. The combined wastewaters undergo biological treatment to reduce BOD levels prior to combination with noncontact cooling water and discharge to the receiving streams.

B. Stream Monitoring

The instream monitoring network (see Figure 2) for the Cane Creek subwatershed includes one site in Nelson Creek at RM 1.0, two sites in Hyde Creek at RM 1.0 and RM 2.3 (upstream of discharge tributary; serves as Hyde Creek's background), and six sites in Cane Creek at RMs 2.5, 11.3, 12.4, 14.6, 15.6, and 17.9 (serves as Cane Creek's background). Pertinent ambient water quality data collected at these sites between 1989 and 1998 are tabulated in Table 1.

Table 1 Ambient Monitoring Data in the Cane Creek Subwatershed

	Units	Location								
		Cane Creek						Hyde Creek		Nelson Crk.
		RM 2.5	RM 11.3	RM 12.4	RM 14.6	RM15.6	RM 17.9	RM 1.0	RM 2.3	RM 1.0
Hardness (as CaCO3)										
No. of Samples	--	6	3	5	12	12	10	10	10	12
Mean	[mg/l]	165.1	216	162	169.4	216	81.7	316.8	105	847.2
Minimum	[mg/l]	62	120	27	23	22	17	102	38	358
Maximum	[mg/l]	359	377	289	273	549	144	780	197	1486
TSS										
No. of Samples	--	6	3	5	11	12	9	11	10	12
Mean	[mg/l]	238.8	96.3	71.6	110.0	104.8	68.5	45	37.6	18.5
25th Percentile Value	[mg/l]	27	48.7	26.5	26.5	33	25	11.7	10.0	1.0
Minimum	[mg/l]	24	22	25	17	17	13	4	4	1
Maximum	[mg/l]	587	138	196	600	600	129	146	138	158
Total Copper										
No. of Samples	--	6	3	5	13	12	10	11	10	12
Mean	[ug/l]	15.6	27	15.6	21.2	45.8	8.2	21.9	6.4	181.1
Minimum	[ug/l]	3	6	3	6	4	2	3	1	38
Maximum	[ug/l]	28	55	35	35	178	25	57	19	502

Sediment data collected from 1992 to 1995 are analyzed and summarized for copper in Table 2. Ambient monitoring data indicate elevated total recoverable copper concentrations in the water column relative to the nominal state water quality criteria. Because there is no promulgated numeric sediment criteria for copper, sediment data are used for detecting the potential accumulation or build up. In view of the limited data available, no obvious evidence of copper buildup in sediment is indicated.

Table 2 Copper Concentrations in Sediment

Stream Location	Copper Concentration [mg/kg]	Year
Nelson Creek at RM 1.1	63	1992
	13	1995
Hyde Creek at RM 2.3	16	1992
	12	1993
Hyde Creek at RM 1.0	16	1992
	70	1993
Cane Creek at RM 17.9	11	1992
	9	1993
	17	1994
Cane Creek at RM 15.6	8	1994
Cane Creek at RM 11.3	8	1992
	<1	1993

C. Target Identification

The allowable criteria for total copper in the Cane Creek subwatershed is established in *State of Tennessee Water Quality Standards, Chapter 1200-4-3 General Water Quality Criteria, July 1995*. The nominal instream concentration for total recoverable copper for the protection of fish & aquatic life are a function of both stream hardness (as $CaCO_3$) and total suspended solids (TSS) and are normally applicable to surface waters throughout Tennessee. The Standards, however, also make provision for the development of site specific criteria which supercede the nominal criteria in a particular location. The Water-Effect Ratio Procedure (WER) is one of three recognized types of site specific studies and is a means to account for a difference between the toxicity of a metal in laboratory dilution water and its toxicity in the water at the site.

In accordance with the requirements of their existing NPDES permits, SRT and TEP conducted copper WER studies for their respective receiving streams. These studies were approved by EPA Region IV in November 1998 and established a site specific chronic criteria for total copper of 296.21 μg/l for Nelson Creek and 357.00 μg/l for Hyde Creek.

The target value for the Cane Creek Subwatershed is considered to be the mass load of total copper that can be assimilated by the receiving waters, with an appropriate margin of safety (MOS), without violating the most stringent applicable instream water quality criteria in any stream segment. This corresponds to the chronic allowable instream concentration for the protection of fish & aquatic life during summer low flow conditions (no dilutional baseflow).

In the absence of a WER for Cane Creek downstream of RM 15.4, the nominal criteria were calculated and compared for each segment of the creek. The lowest calculated segment criteria was used as the target value. In the case of both SRT and TEP, the primary receiving waters (unnamed tributaries, Nelson Creek, Cane Creek from RM 16.5 to RM 15.4, and Hyde Creek) are considered to be effluent dominated with zero baseflow. Therefore, the site specific criteria developed in the approved WERs were used as the target values for these waters.

D. Copper Loading and Water Quality Assessment

In the NPDES permits issued in 1995, total copper discharges from the SRT and TEP facilities were limited to a monthly average concentration of 0.8 mg/l and a daily maximum concentration of 1.6 mg/l. As stated in the permit rationale, these limits were retained from a previous permit and were 10 to 13 times higher than calculated instream water quality criteria based on nominal values of TSS (10 mg/l) and hardness (250 mg/l). The rationale further stated that the facilities had provided reports which indicated “that the permitted levels of copper, when combined with certain levels of EDTA, may not pose a water quality concern with respect to metals toxicity.” The 1995 permits stipulated, however, that SRT and TEP were to perform a Water Effects Ratio (WER) study for copper on their respective receiving streams to determine how much of the ambient or instream copper concentrations are bioavailable and toxic. The studies were conducted in accordance with *Interim Guidance on the Determination and Use of Water-Effect Ratios for Metals* (USEPA 1994) and submitted on May 19, 1998. EPA Region IV approved the site specific criteria studies on November 2, 1998.

A comparison of instream monitoring data with the chronic water quality criteria determined in Section IV indicates only one data point (Nelson Creek @ RM 1.0) that exceeds instream criteria. It should be noted, however, that instream monitoring was not conducted during critical low flow conditions. The discharge of total copper at levels greater than the Waste Load Allocations (WLAs) developed in Section IV (including existing permit concentration levels) will cause the exceedance of instream water quality criteria under critical low flow conditions. 40 CFR §122.44(d)(1)(i) states that:

> Limitations must control all pollutants or pollutant parameters (either conventional, nonconventional, or toxic pollutants) which the Director determines are or may be discharged at a level which will cause, have the reasonable potential to cause, or contribute to an excursion above any State water quality standard, including State narrative criteria for water quality.

Implementation of this TMDL will result in the reduction of copper loading to the Cane Creek subwatershed and compliance with instream water quality standards for copper under all flow conditions.

III. SOURCE ASSESSMENT

A. Point Sources

The only known point sources discharging copper into Cane Creek and its tributaries are SRT, TEP, and the Ripley STP. The present permit limits for copper discharges from these facilities are tabulated in Table 3.

Table 3 Existing Permitted Point Source Discharge Limits

	Discharge	Effluent Limits	
Facility	Flow	Monthly Avg.	Daily Max.
	[MGD]	[ug/l]	[ug/l]
SR	0.393	800	1600
TEP	0.437	800	1600
Ripley STP	1.660	20	--

B. Nonpoint Sources

The major landuse classifications within the Cane Creek drainage area (1992 TWRA GIS landuse/landcover data) are pasture (57.5%), cropland (26.9%), forest (10.3%), and urban (2.6%). The Division of Water Pollution Control (DWPC) considers the impact of nonpoint source loads of copper to be small relative to the point source loads as a cause of Cane Creek not fully supporting its designated use classifications.

IV. 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), nonpoint 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:

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

There are two basic methods for incorporating the MOS (USEPA, 1991a): 1) implicitly incorporate the MOS using conservative model assumption to develop allocations, or 2) explicitly specify a portion of the total TMDL as the MOS and use the remainder for allocations.

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 (e.g. pounds per day), toxicity, or other appropriate measure.

Calculation of TMDL and WLAs

A TMDL for copper was determined for Cane Creek using the following methodology:

1. The 3-day average, 20-year recurrence interval (3Q20) low flow listed for Cane Creek at USGS partial record Station No. 07030100 (RM 14.9) is 0.11 cfs (USGS 1992). This flow is based on data collected between October 1, 1957 and September 30, 1962 and does not reflect the Ripley STP and SRT facility discharges. The 3Q20 low flow of Cane Creek upstream of the confluence with Nelson Creek (RM 16.5) was considered to be zero for analysis purposes.

2. Since the receiving streams for the SRT discharge have a baseflow of zero at critical low flow conditions, the flows of these waters were considered to consist entirely of effluent from the SRT facility. Therefore, a low flow of 0.393 MGD was used for the unnamed tributary receiving the SRT discharge, Nelson Creek, and Cane Creek from the confluence with Nelson Creek to immediately upstream of the Ripley STP discharge (RM 15.4). This flow rate represents the mean of the monthly average flows reported by the facility on Discharge Monitoring Reports (DMRs) from

January 1993 through November 1998. The maximum allowable mass load of total copper for these waterbodies is calculated using this flow and the chronic copper criteria determined in the WER (296.21 μg/l).

3. Likewise, since the receiving streams for the TEP discharge have a baseflow of zero at critical low flow conditions, the flows of these waters were considered to consist entirely of effluent from the TEP facility. Therefore, a low flow of 0.437 MGD was used for the unnamed tributary receiving the TEP discharge and Hyde Creek. This flow rate represents the mean of the monthly average flows reported by the facility on Discharge Monitoring Reports (DMRs) from January 1993 through November 1998. The maximum allowable mass load of total copper for these waterbodies is calculated using this flow and the chronic copper criteria determined in the WER (357.00 μg/l). This flow and mass load enters Cane Creek at RM 13.9.

4. The design flow of the Ripley STP (1.66 MGD) and the monthly average copper limit (20 μg/l) specified in NPDES Permit No. TN0025364 were used to compute the mass load contributed by the STP. This load enters Cane Creek at RM 15.4.

5. The maximum allowable mass load of total copper for Cane Creek downstream of RM 15.4 was calculated at several locations using the appropriate flow and the chronic copper criteria determined for that location based on: a) the hardness based equations contained in *Tennessee General Water Quality Criteria* (Chapter 1200-4-3-.03, July 1995); b) the chronic conversion factor (CCF) and translator contained *in The Metals Translator: Guidance For Calculating A Total Recoverable Permit Limit From a Dissolved Criterion* (EPA 823-B-96-007, June 1996); c) the average hardness computed from available monitoring data; and d) the 25th percentile TSS computed from available monitoring data.

6. The location in Cane Creek, downstream of Hyde Creek, that had the lowest allowable mass load of total copper was at RM 12.4 (Table 4). This load was considered to be the TMDL for the subwatershed.

Table 4 Calculation of Maximum Allowable Copper Load in Cane Creek

Stream Location	Flow		Average Hardness	25th %tile TSS	Applicable Total Copper Chronic Criteria	Maximum Allowable Load
	[cfs]	[MGD]	[mg/l]	[mg/l]	[ug/l]	[lb/day]
Nelson Creek	0.608	0.3931	--	--	296.2	0.9710
Cane Creek at RM 15.6	0.608	0.3931	216.0	33.0	296.2	0.9710
Cane Creek at RM 14.6	3.176	2.0533	169.4	26.5	60.7	1.0395
Hyde Creek	0.676	0.4370	--	--	357.0	1.3012
Cane Creek at RM 12.4	3.852	2.4903	162.0	26.5	58.4	1.2129
Cane Creek at RM 11.3	3.852	2.4903	216.0	48.7	83.6	1.7363
Cane Creek at RM 2.5	3.852	2.4903	165.1	27.0	59.6	1.2378

7. Since Cane Creek is considered to be a zero flow stream above RM 15.4, the background copper load (LA) at RM 17.9 is zero.

8. The WLA for the Ripley STP was maintained at the existing level.

$$WLA_{STP} = (Q_{design})\ (8.34)\ (C_{permit})$$

$$WLA_{STP} = (1.66\ MGD)\ (8.34)\ (0.020\ mg/l) = 0.2769\ lb/day$$

9. No additional mass load was reserved as an explicit MOS. An implicit MOS was incorporated into the TMDL analysis through the use of conservative assumptions (3Q20 low flow for the background stream flow and 25th percentile TSS for instream allowable concentration calculation).

10. WLAs were calculated for SRT and TEP in proportion to the nominal mass load of each facility as determined by the discharge flow and instream criteria determined by the WER studies.

Nominal mass load:

$M_{TEP\ Nom} = (Q_{TEP})\ (8.34)\ (C_{WER\text{-}TEP}) = (0.437\ MGD)\ (8.34)\ (0.357\ mg/l) = 1.3011\ lb/day$

$M_{SRT\ Nom} = (Q_{SRT})\ (8.34)\ (C_{WER\text{-}SRT}) = (0.393\ MGD)\ (8.34)\ (0.29621\ mg/l) = 0.9709\ lb/day$

$M_{Nom} = M_{TEP\ Nom} + M_{SRT\ Nom} = 1.3011\ lb/day + 0.9709\ lb/day = 2.2720\ lb/day$

Facility portion of the nominal mass load:

$M_{TEP\ Nom}/M_{Nom} = (1.3011\ lb/day) / (2.2720\ lb/day) = 0.5727$

$M_{SRT\ Nom}/M_{Nom} = (0.9709\ lb/day) / (2.2720\ lb/day) = 0.4273$

Calculation of WLAs:

$TMDL = WLA_{SRT} + WLA_{TEP} + WLA_{STP} + LA + MOS$

$WLA_{SRT} + WLA_{TEP} = TMDL - WLA_{STP} - LA - MOS$

$WLA_{SRT} + WLA_{TEP} = (1.2129\ lb/day) - (0.2769\ lb/day) - (0.0\ lb/day) - (0\ lb/day)$

$WLA_{SRT} + WLA_{TEP} = 0.9360\ lb/day$

therefore:

$WLA_{TEP} = (M_{TEP\ Nom}/M_{Nom})\ (WLA_{SRT} + WLA_{TEP}) = (0.5727)\ (0.9360\ lb/day)$

$WLA_{TEP} = 0.5360\ lb/day$

and

$WLA_{SRT} = (M_{SRT\ Nom}/M_{Nom})\ (WLA_{SRT} + WLA_{TEP}) = (0.4273)\ (0.9360\ lb/day)$

$WLA_{SRT} = 0.4000\ lb/day$

11. In order to verify that the calculated WLAs did not result in an exceedance of water quality criteria at any point in Cane Creek, Nelson Creek, or Hyde Creek, the equivalent instream concentration was computed for the mass load at each location (Table 5).

Table 5 WLAs - Verification of Compliance With Water Quality Criteria

Location	Stream Flow [cfs]	Total Copper Chronic Criteria [ug/l]	Instream Mass Load [lb/day]	Equiv Concen. [ug/l]
Nelson Creek	0.608	296.2	0.4000	122.0
Cane Creek at RM 15.6	0.698	296.2	0.4000	106.3
Cane Creek at RM 14.6	3.176	60.7	0.6769	39.5
Hyde Creek	0.676	357.0	0.5360	147.1
Cane Creek at RM 12.4	3.852	58.4	1.2129	58.4

12. In summary, the revised WLAs for the three point sources are:

Point Source	WLA	Equivalent Facility "End of Pipe" Concentration
Ripley STP	0.277 lb/day	20 ug/l
SRT	0.400 lb/day	122 ug/l
TEP	0.536 lb/day	147.1 ug/l

V. TMDL IMPLEMENTATION RECOMMENDATIONS

The TMDL analysis was performed using the best data available to specify WLAs that will improve the water quality, with respect to copper, of Cane Creek so as to support its designated use classifications. Implementation recommendations include:

1) Modification of NPDES Permit No. TN0026565 to incorporate the WLA calculated for the SRT discharge as a monthly average limit for total copper. The concentration determined in the WER study (296.2 ug/l) is recommended as an interim limit during any compliance schedule. The recommended interim limit is a significant reduction in copper loading compared to the present permit limit. Toxicity testing of the facility effluent is also recommended during any compliance schedule and for two years after implementation of the WLA.

2) Modification of NPDES Permit No. TN0001180 to incorporate the WLA calculated for the TEP discharge as a monthly average limit for total copper. The concentration determined in the WER study (357.0 ug/l) is recommended as an interim limit during any compliance schedule. The recommended interim limit is a significant reduction in copper loading compared to the present permit limit. Toxicity testing of the facility effluent is also recommended during any compliance schedule and for two years after implementation of the WLA.

3) Requirement for biological assessments of benthics in Hyde Creek, Nelson Creek, and Cane Creek during any compliance schedule and once after implementation of WLAs.

4) Retention of the existing monthly average limit for total copper in TN0025364 for the Ripley STP discharge. This limit is equivalent to the calculated WLA for this facility.

5) The copper TMDL for Cane Creek was based on the water quality criteria derived from the WER studies for Nelson Creek and Hyde Creek and calculated from the hardness based equations contained in *Tennessee General Water Quality Criteria* (used with the chronic conversion factor (CCF) and translator contained in EPA guidance (USEPA, 1996)) for Cane Creek downstream of RM 15.4. As an alternative to the incorporation of the calculated WLAs in the SRT and TEP permits, it is recommended that a copper WER study be conducted for Cane Creek between RM 15.4 and RM 12.4 and the TMDL revised to incorporate the results of the WER study.

VI. SUMMARY

Cane Creek has been placed on the State of Tennessee's 303(d) list of impaired water bodies for copper. Using available data and a suitable MOS, a TMDL was calculated so that water quality criteria for total copper would not be exceeded in Cane Creek. Since the analysis was conducted using worst case low flows (3Q20) for Cane Creek, Nelson Creek, and Hyde Creek, the resulting TMDL was considered to be protective of water quality throughout the year. Based on this TMDL, appropriate WLAs for copper were determined for the point sources in the subwatershed.

VII. PUBLIC PARTICIPATION

In accordance with 40 CFR §130.7, announcement of the availability of a copper TMDL for the Cane Creek subwatershed was made to the public, affected dischargers, and other concerned parties and comments solicited. Steps taken in this regard include:

1) Notice was posted on the Tennessee Department of Environment and Conservation website on May 7, 1999 (see Appendix A). During the period from posting until the close of the comment period on July 15, 1999, the Public Notice announcement was downloaded 192 times and the TMDL document 109 times. A total of four letters containing comments were received.

2) A Legal Notice (similar to the website announcement) was sent to a number of newspapers in Tennessee to be published in the classified section on, or soon after May 21, 1999. Newspapers included:

   Chattanooga Free Press
   The Jackson Sun
   Johnson City Press
   The Knoxville News-Sentinel
   The Commercial Appeal (Memphis)
   Tri-State Defender (Memphis)
   The Tennessean (Nashville)
   The Tennessee Tribune (Nashville)

3) A hardcopy of the website announcement was mailed to 187 governmental agencies, environmental groups, business organizations, agricultural groups, and individuals.

4) A series of four public meetings were held to present information concerning the Tennessee TMDL program, in general, and the Cane Creek copper TMDL. Two of these meetings were held in Ripley, Tennessee on June 24, 1999 and two in Nashville on May 28 & 29, 1999. One of the meetings in each location was held at 2 PM and the other meetings at 7 PM. A total of 13 citizens attended the public meetings.

5) A separate meeting was held on April 20, 1999 with representatives of SR of Tennessee and Tennessee Electroplating, the point source discharges primarily affected by the TMDL.

6) A separate meeting was held on June 21, 1999 with representatives of the Southern Environmental Law Center and the Tennessee Environmental Council to discuss TMDL technical issues.

A summary of comments received during the public comment period and the Division of Water Pollution Control responses are contained in Appendix B.

VIII. FURTHER INFORMATION

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

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

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

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APPENDIX A

PUBLIC NOTICE OF

TOTAL MAXIMUM DAILY LOAD (TMDL) FOR

CANE CREEK, LOWER HATCHIE WATERSHED

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

PUBLIC NOTICE OF AVAILABILITY OF TOTAL COPPER TOTAL MAXIMUM DAILY LOAD (TMDL) FOR CANE CREEK, LOWER HATCHIE WATERSHED

PUBLIC MEETINGS FOR THE TMDL

June 24, 1999 (Thursday) 2:00pm and 7:00pm at TN Technology Center; Ripley, Tennessee

June 28, 1999 (Monday) 2:00pm at 17th Floor Conference Room, L&C Tower, 401Church Street, Nashville, Tennessee

June 29, 1999 (Tuesday) 7:00pm at Radnor Lake State Park, 1160 Otter Creek Road, Nashville, Tennessee

Announcement is hereby given of the availability of Tennessee's total maximum daily load (TMDL) for total copper for Cane Creek subwatershed from river mile (RM) 17.9 to the confluence with the Hatchie River. Section 303(d) of the Clean Water Act requires states to develop a TMDL 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.

Cane Creek is listed on Tennessee's final 1998 303(d) list as not supporting its designated use classifications due, in part, to discharge of metals from industrial point sources. The TMDL utilizes recently completed site specific copper criteria studies for portions of the Cane Creek subwatershed and proposes a phased approach to reduce the copper loading from point sources. The TMDL requires an initial reduction of 56% of the point source copper loading and an eventual further reduction of 52% (79% total reduction). The TMDL makes allowances for further site specific copper criteria studies in Cane Creek and revision of the TMDL if necessary.

INFORMATION: Click here to download the 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 TMDL are invited to submit their comments in writing no later than July 15, 1999 to:

Division of Water Pollution Control
Watershed Management Section
7th Floor, L & C Annex
401 Church Street
Nashville, TN 37243-1534

All comments received prior to that date will be considered when revising the TMDL. A final TMDL will be submitted to the U.S. Environmental Protection Agency by August 1, 1999.

The TMDL and supporting information are on file at the Division of Water Pollution Control, 7th 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.

APPENDIX B

RESPONSE TO PUBLIC COMMENTS FOR
TOTAL MAXIMUM DAILY LOAD (TMDL) FOR
CANE CREEK, LOWER HATCHIE WATERSHED

TOPICAL SUMMARY OF COMMENTS ON THE CANE CREEK COPPER TMDL

In some cases, comments have been paraphrased for clarity.

1. Comment: TMDL is too difficult for average citizens to understand.

   Response: TMDLs that involve variable water quality criteria are inherently more complicated than those involving a single criteria value at all locations in a watershed. In the Cane Creek copper TMDL, the applicable instream concentration is either based on site specific criteria developed through approved Water Effects Ratio (WER) studies or the general criteria contained in *State of Tennessee Water Quality Standards, Chapter 1200-4-3 General Water Quality Criteria, July 1995.* The general instream concentration for copper is a function of both hardness and Total Suspended Solids (TSS) and varies depending on location. Section II.D. of the TMDL has been modified and expanded to clarify these points. In addition, an abstract has been added to the document to clearly summarize the conclusions.

2. Comment: The calculation of the maximum copper load that can be assimilated by the receiving streams under critical conditions is highly dependent on the stream flows used. A USGS gaging station (No. 07030100) is located at Cane Creek RM 14.9, which is downstream from the discharges of the SR of Tennessee facility and the Ripley STP. The 3Q20 low flow of 0.11 cfs for this station should include the discharges of both facilities. The stream flow used in the TMDL at RM 14.6, however, is the sum of the STP design flow (1.66 MGD) and the SRT average flow (0.393 MGD). This discrepancy is not explained.

   Response: The 3Q20 low flow for USGS Partial Record Station No. 07030100 is based on flow data recorded during the period 10/1/57 – 9/30/62 and correlated with data from a continuous record station. The listed low flow of 0.11 cfs does not include the effect of the point source dischargers. This point has been clarified in Section IV of the TMDL.

3. Comment: Current state water quality standards do not give the equation that allows for consideration of TSS in calculating instream allowable concentrations for certain metals. It may be in some reference, but we question if it is at this time the official state method.

   Response: Chapter 1200-4-3-.02(8) of *State of Tennessee Water Quality Standards, July 1995* states that one of the methods currently used to relate dissolved metal criteria to total recoverable limits is through the use of “average ratios based on ambient data”. This is a reference to

the use of linear partition coefficients to calculate a metals translator to go from a dissolved criterion to a total recoverable instream concentration. The linear partition coefficients and relationships were developed by EPA from STORET data in the 1980s and have been used in the determination of NPDES permit limits for certain metals (cadmium, copper, lead, nickel, silver, and zinc) in Tennessee since 1991. Since the results of this TMDL will be implemented through NPDES permit requirements, utilization of these methods is appropriate. 40 CFR §122.45(c) requires that permit limits be expressed as total recoverable metal. The revised water quality standards to be issued later this year provide a clearer explanation of these procedures.

4. Comment: Cane Creek and the other tributaries involved in this TMDL appear to suffer from a variety of pollution problems beyond copper, as indicated by the 303(d) list. Our general feeling is that it is inappropriate to address the clean up of these streams by raising the allowable amount of one pollutant, copper, by a site specific standard, as proposed in this TMDL, without addressing the other, and in some cases related, problems that will also need to be addressed if these waters are ever to meet uses.

Response: A TMDL is pollutant specific. Additional TMDLs will be developed in the future to address the other pollutants identified on the 303(d) list as being a cause of impairment to the Cane Creek subwatershed.

5. Comment: It is not clear that the current state standards allow the WER process to replace the general criteria for copper or other parameters, as used in this TMDL with copper-EDTA. If such an alternative standard is used , it must be approved by the Water Quality Control Board

Response: The use of site specific criteria is provided for in Chapter 1200-4-3-.02(8) of *State of Tennessee Water Quality Standards, , July 1995*. This section of the Standards further states:

> When the Division develops and/or adopts site-specific criteria for any substances for which generally applicable criteria have been adopted, the site-specific criteria will supersede the adopted criteria.

The Water Effect Ratio Procedure is one of the methods recognized by EPA for the development of site-specific criteria and the guidance for this procedure is referenced in Chapter 1200-4-3-.02(8).

6. Comment: For copper, it appears that calculations for loads from the STP and industries were based on average copper, not maximum values, again differing from our concept of a TMDL and taking away from any margin of safety.

   Response: The TMDL for the Cane Creek Subwatershed is considered to be the greatest mass load of total copper that can be assimilated by the receiving waters, with an appropriate margin of safety (MOS), without violating the most stringent applicable instream water quality criteria in any stream segment. This corresponds to the chronic allowable instream concentration for the protection of fish & aquatic life during summer low flow conditions (no dilutional baseflow). The TMDL will be implemented through requirements in the SRT and TEP discharge permits. In Tennessee, monthly average permit limits are used for the protection of fish & aquatic life from chronic effects. Appropriate daily maximum permit limits will be developed by the permit writer to protect against acute effects.

Since the following comments address similar issues, a single response has been provided.

7. Comment: If a TMDL is to be calculated for low flow critical conditions, then it would seem that the STP flow during low flow conditions (recorded when the gage is at or near low flow) should be used, which would be expected to be much lower than design flow, and the SRT maximum flow of copper waste, not average flow be used.

   Comment: If TSS is used to calculate allowable instream concentrations, the value used should reflect low flow and unpolluted conditions. The use of the 25^{th} percentile value includes the effect of high flow numbers, and would not seem representative of the low flow critical conditions for which the daily maximum load should be calculated.

   Comment: Cane Creek is on the 303(d) list for excess sediment. This, along with the photos shown at the meeting of the stream that had been recently channelized and vegetation removed from its banks, suggests that instream values of TSS reflect a polluted state, not clean, and should not be used as the basis for a copper TMDL that allows for higher copper with higher TSS. Instead, the TMDL would seem more appropriate if based on a stream with the TSS problems theoretically under control.

   Comment: While hardness is clearly allowed by current regulations for determining the standard, for the purposes of a low flow TMDL, only hardness values at low flow would seem appropriate. For the TMDL calculations, the average hardness was used, and from the data given a wide range from low to high at most stations suggests that high flow data might be included.

Response: Water quality calculations for metals in Tennessee are been made on the basis of 3Q20/30Q2 low stream flows, design flows for STPs, long term average flows for industrial dischargers, and mean values of instream hardness (as $CaCO_3$) and TSS. The Division of Water Pollution Control (the "Division") considers the results of these calculations to be reasonable and protective of stream designated uses. This methodology has been used consistently for many years in the determination of Waste Load Allocations (WLAs) for point source dischargers. NPDES permits containing metals limits derived in this manner have been approved by EPA Region IV.

As stated in the TMDL, an implicit Margin of Safety (MOS) was incorporated through the use of conservative assumptions in the analysis. These include a stream flow equal to the 3Q20 low flow and the 25^{th} percentile value of TSS (75% of sample values are greater). The 3Q20 low flow is by definition (three day average low flow with a 20 year recurrence interval) very conservative, and is made more so by the assumption that this value is equal to zero rather than 0.11 cfs as reported by USGS for Station No. 07030100. In addition, continued Whole Effluent Toxicity (WET) testing conducted by SRT and TEP indicates that EDTA complexed copper is less toxic to fish and aquatic life than copper alone as suggested by the WER results for Nelson and Hyde Creeks. The division believes that SRT and TEP plan to conduct additional WER studies for Cane Creek below the Ripley STP discharge.

Other safeguards are also incorporated in the implementation recommendations. In addition to numerical limits for total copper, continued WET testing of the SRT and TEP discharges and benthic macroinvertebrate biological assessments of Nelson, Hyde, and Cane Creeks are specified.