DRAFT TMDL REPORT

WHIG CREEK BASIN TMDL FOR COPPER
HUC 1110203-931 (WHIG CREEK, AR)

TMDL Report

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY, REGION 6, DALLAS, TX
and the
Arkansas Department of Environmental Quality

Prepared by

PARSONS

September 2003

DRAFT TMDL REPORT

WHIG CREEK BASIN TMDL FOR COPPER

HUC 1110203-931 (WHIG CREEK, AR)

TMDL Report

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY REGION 6, DALLAS, TX
and the
Arkansas Department of Environmental Quality

Prepared by

PARSONS

8000 Centre Park Dr., Suite 200
Austin, Texas 78754

SEPTEMBER 2003

EXECUTIVE SUMMARY

The Federal Clean Water Act (CWA), §305(b), requires states to produce a periodic inventory comparing water quality conditions to established water quality standards for surface waters. Section 303(d) of the Federal CWA requires states to identify water bodies not meeting state water quality standards and to a develop total maximum daily loads (TMDL) for those water bodies. A TMDL is the amount of a pollutant a water body can assimilate without exceeding the established water quality standard for that pollutant. Numeric and narrative standards are contained in Arkansas' Surface Water Quality Standards (ASWQS) (Regulation 2) as adopted by the Arkansas Pollution Control and Ecology Commission. Through a TMDL, pollutant loads can be distributed or allocated to point sources and non point sources discharging to the water body. This report describes the TMDL for dissolved copper in Whig Creek, Arkansas.

Whig Creek basin is located in the Arkansas Planning Segment 3F within the Arkansas River Basin in hydrologic unit code 11110203-931. Whig Creek was listed on the Arkansas Department of Environmental Quality's (ADEQ) 1998 §303(d) list as not supporting water quality standards for aquatic life use and drinking water use as a result of the existence of heavy metals and nutrients. The 1998 305(b) report identified copper in Whig Creek as the pollutant of concern and identified municipal point source dischargers as the source.

This report documents the data and assessment utilized to establish a TMDL for copper in accordance with the requirements of §303 of the CWA and U.S. Environmental Protection Agency (USEPA) guidance. The purpose of this TMDL is to determine the copper loading Whig Creek can assimilate without exceeding the water quality standard for that pollutant.

Whig Creek is located on the south side of the city of Russellville, Arkansas in Pope County. The small watershed of Whig Creek is approximately 14 square-miles and the creek flows approximately 10.2 miles before joining with the Arkansas River below Dardanelle Reservoir.

The upper portion of Whig Creek is intermittent. The only substantive dry-weather discharge into Whig Creek is the City of Russellville's wastewater treatment plant (WWTP). The WWTP has a National Pollutant Discharge Elimination System Permit No. AR0021768. The monthly average permitted discharge rate is 6.5 million gallons per day (MGD). There is no flow upstream of the WWTP discharge during extended dry weather.

The acute dissolved copper ASWQS is calculated to be 4.61 µg/L. The chronic dissolved copper ASWQS is calculated to be 3.47 µg/L. The chronic standard is lower than the acute standard. Therefore, the water quality target for dissolved copper in Whig Creek during the 7-day average, 10-year frequency low stream flow (7Q10) is 3.47 µg/L. Analysis of 28 ambient water samples, out of 56 samples collected at Station ARK0067

between January 1995 and March 2003, detected dissolved copper in concentrations above 3.47 µg/L.

A TMDL must be developed to be protective during low flow (7Q10) as well as high flow conditions. The formula for a TMDL is as follows:

TMDL = WLA + LA + MOS

Where WLA is the waste load allocation of point source discharges, LA is the load allocation for NPS contributions and background levels, and MOS is a margin of safety to account for the lack of full understanding of the contributions to the creek's ecosystem.

A Waste Load Allocation (WLA) is an instream, pound per day pollutant (copper) load allocation used to calculate permit limits for point sources. A point source can be either a dry-weather or storm water discharge. Dry weather discharges are, by and large, from wastewater treatment plants. Storm water point sources are typically associated with urban and industrialized areas. Since urban and industrial areas comprise approximately 1 percent of the Whig Creek watershed and there are no storm water data, the WLA for this TMDL will focus on the WWTP point source.

A WLA for a WWTP is calculated using the permitted discharge rate and low flow (7Q10) instream conditions. During the 7Q10, a point-source discharge (WWTP) has the least amount of receiving stream dilution thereby producing the highest concentration of pollutants in the stream.

The instream WLA, beginning at the point of the Russellville WWTP discharge, is calculated using a simple mass balance formula shown below. The WLA calculation uses the chronic aquatic life ASWQS maximum dissolved copper concentration (0.00347 mg/l) and the WWTP's NPDES permitted flow rate of 6.5 mgd (USEPA 2000). The WLA in pounds per day (ppd) for dissolved copper (Cu) is determined by using the following calculation:

$$\mathbf{WLA = Cu_{chronic\ std} * Q\ mgd * 8.34}$$

Where: $Cu_{chronic\ std}$ = 0.00347 mg/L and Q = 6.5 mgd. The 8.34 in the equation is a unit conversion factor.

$$\mathbf{WLA = 0.00347\ mg/L * 6.50\ mgd * 8.34 = 0.188\ ppd}$$

A load allocation (LA) is also calculated using the same method as the WLA. The LA is used to allocate pollutant loading to NPS and instream background quantities. Unfortunately, water quality data collected at Station AR0067 is not correlated with flow data. A review of the water quality data from Station AR0067 summarized by month (1995 – 2003) shows consistent exceedances during dry months such as July, August, and September and occasional exceedances for the other months. The 1997 TMDL investigation report contains water quality data (1 sample per station) collected from 1 station upstream and 4 stations downstream of the WWTP discharge (ADEQ 1997). The single sample collected upstream of the discharge did not contain a detectable amount of

copper. Copper was detected in the 4 samples collected downstream of the discharge. This indirect evidence suggests NPS or background contribution of dissolved copper is less than the ASWQS chronic criteria or non-detectable. There is no data indicating a NPS is a source of copper to Whig Creek.

The Arkansas Continuing Planning Process (CPP), page D-48, Appendix D states: *All available receiving stream data must also be evaluated for appropriateness... Where data are not available or the pollutants were not detected, the background contribution will be assumed to be zero.* As discussed above, NPS and background contribution of copper is believed to be non-detectable. Therefore, the LA for copper in Whig Creek is zero.

Federal regulations [40 CFR §130.7(c)(1)] require that TMDLs take into consideration a margin of safety (MOS). USEPA guidance allows for use of implicit or explicit expressions of the MOS, or both. When conservative assumptions are used in development of the TMDL, or conservative factors are used in the calculations, the MOS is implicit. The following conservative assumptions were made providing an implicit MOS.

The revised future WWTP permit will limit total copper by concentration and in ppd with no instream dilution allowance. Procedures used by the ADEQ to convert chronic dissolved copper criteria into a total copper permit limit are conservative and provide an implicit MOS built into the calculations. As an example, the calculation to determine the permit limit is based on the long term average (LTA) treatment efficiency based on a 90 percent probability that the discharge will meet the WLA. It is common knowledge that a mechanical WWTP's efficiency is greater during prolonged dry weather than under wet weather conditions. The log-normal probability distribution curves for treatment plant performance used by USEPA to determine the LTA takes into account wet weather reduction in efficiency for calculating the 90th percentile discharge concentration of copper (USEPA 1996). During wet weather periods there will be water flowing in Whig Creek, further diluting the WWTP discharge. Another conservative assumption that is the WLA calculation uses the design flow rather than actual effluent flows, which are lower. Since the WWTP permit already contains a built-in MOS and there is no LA or explicit MOS, the MOS in the TMDL calculation is zero.

The TMDL is equal to the WLA and includes an implicit MOS. The TMDL will meet water quality standards under critical conditions. The TMDL calculation is shown below.

TMDL = WLA + LA + MOS

0.188 ppd = 0.188 ppd + 0 ppd + 0 ppd

TABLE OF CONTENTS

EXECUTIVE SUMMARY ES-1
LIST OF TABLES ii
LIST OF FIGURES ii
ACRONYMS AND ABBREVIATIONS iii
SECTION 1 INTRODUCTION 1-1
SECTION 2 STUDY AREA DESCRIPTION 2-1
SECTION 3 PROBLEM DEFINITION AND ENDPOINT IDENTIFICATION 3-1
3.1 Problem Definition 3-1
3.2 Endpoint Identification 3-1
SECTION 4 IDENTIFICATION OF POLLUTION SOURCES 4-1
4.1 Point Source – City of Russellville WWTP 4-1
4.2 Nonpoint Sources and Background Concentrations 4-1
SECTION 5 TMDL CALCULATIONS 5-1
5.1 Current Load Evaluation 5-1
5.2 Waste Load Allocation 5-1
5.3 Load Allocation 5-1
5.4 Seasonal Variability 5-2
5.5 Margin of Safety 5-2
5.6 TMDL Calcuation 5-2
5.7 Future Water Quality Monitoring 5-2
5.8 Reasonable assurances 5-3
SECTION 6 PUBLIC PARTICIPATION 6-1
SECTION 7 LIST OF REFERENCES 7-1

APPENDICES

Appendix A Water Quality Data
Appendix B Public Comments and USEPA Responses

LIST OF TABLES

Table 2.1 Aggregate Land Use Summary Whig Creek Watershed 2-1

LIST OF FIGURES

Figure 2.1 Whig Creek Basin Location Map 2-2
Figure 3.1 Whig Creek Basin Sampling and Discharger Location 3-2
Figure 3.2 Dissolved Copper in Whig Creek Station ARK0067 3-3

ACRONYMS AND ABBREVIATIONS

µg/L	Micrograms per liter
7Q10	7-day average, 10-year frequency low stream flow
ADEQ	Arkansas Department of Environmental Quality
ASWQS	Arkansas' Surface Water Quality Standards
CAST	Center for Advanced Spatial Technologies
Cu	Copper
CWA	Clean Water Act
HUC	Hydrologic unit code
LA	Load allocation
LTA	Long term average
mg/L	Milligrams per liter
MGD	Million gallons per day
MOS	Margin of safety
ppd	Pounds per day
TMDL	Total maximum daily load
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WLA	Waste load allocation
WWTP	Wastewater treatment plant

SECTION 1
INTRODUCTION

The Federal Clean Water Act (CWA), §305(b), requires states to produce a periodic inventory comparing water quality conditions to established water quality standards for surface waters. Standards for the State of Arkansas are specified in Regulation 2 adopted by the Arkansas Pollution Control and Ecology Commission. Arkansas' Surface Water Quality Standards (ASWQS) specify that surface waters will not be toxic to aquatic life. Pursuant to the Federal CWA §303(d), states must establish total maximum daily loads (TMDL) for pollutants contributing to violations of water quality standards.

Whig Creek basin is located in the Arkansas Planning Segment 3F within the Arkansas River Basin in hydrologic unit code (HUC) 11110203-931. Whig Creek is listed in the 1998 CWA §303(d) list as not supporting water quality standards for aquatic life use and drinking water use as a result of the existence of heavy metals and nutrients. In ADEQ's 2002 CWA §303(d) list, Whig Creek was again listed as being impaired for aquatic life as a result of elevated copper levels. The 1998 305(b) report identifies municipal point source dischargers as the source for the elevated levels of copper.

This report documents the data and assessment utilized to establish a TMDL for copper for Whig Creek basin in Arkansas in accordance with requirements of §303 of the CWA (40 CFR 130.7) and U.S. Environmental Protection Agency (USEPA) guidance. The purpose of this TMDL is to determine the amount of copper loading the water body can assimilate without exceeding the water quality standard.

The TMDL also establishes the load reduction necessary to meet the standard in the water body. The TMDL consists of the waste load allocation (WLA), the load allocation (LA), and a margin of safety (MOS). The WLA is the fraction of the total load apportioned to point sources. The LA is the fraction of the total load apportioned to nonpoint sources. The MOS is a percentage of the TMDL that accounts for the uncertainty associated with the model assumptions and data inadequacies.

Arkansas' antidegradation policy is in §2.201 of the ASWQS. The antidegradation policy, "*requires existing instream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected.*" Whig Creek is not considered a High Quality Water, Outstanding Resource Water, Extraordinary Resource Water, or Natural and Scenic Waterway as defined by the ASWQS.

SECTION 2
STUDY AREA DESCRIPTION

Whig Creek is located on the south side of the City of Russellville, Arkansas in Pope County (Figure 2.1). Whig Creek is located in the Arkansas Planning Segment 3F within the Arkansas River basin in HUC 11110203. The small watershed of Whig Creek, which lies in the Arkansas River Valley Ecoregion, is approximately 14 square-miles and the creek flows 10.2 miles before joining with the Arkansas River below Dardanelle Reservoir.

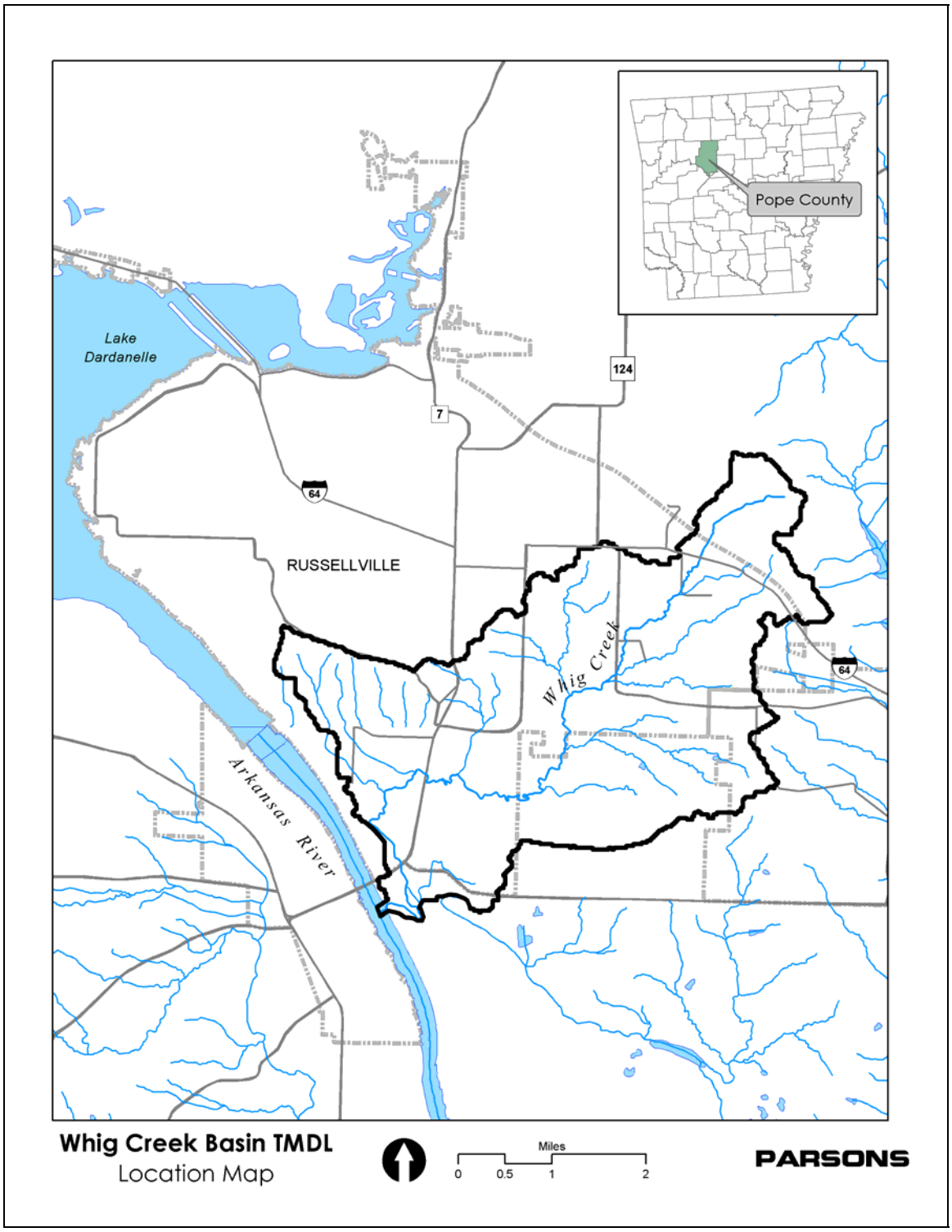
Land cover in the Whig Creek Basin is predominately agricultural and pastureland with a small amount of urban residential and urban commercial development. The watershed is south of the City of Russellville. The city had a population of approximately 23,700 in 2002, and a population growth rate of 11.3 percent from 1990 through 2000 (U.S. Census Bureau 2000). Future population growth is projected to continue.

Table 2.1 Aggregate Land Use Summary Whig Creek Watershed

LAND USE	ACRES	AREA (sq. miles)	PERCENT OF TOTAL AREA
Agriculture: Crops	737.7	1.153	8.3
Coniferous Forest	255.3	0.399	2.9
Deciduous Alluvial Forest	1,467.9	2.294	16.4
Herbaceous/Pasture/Forage	6,324.9	9.883	70.8
Mixed Forest	50.6	0.079	.6
Urban Commercial-Industrial	35.4	0.055	.4
Urban Residential	52.8	0.083	.6
Water	5.8	0.009	.1
Totals	8,930.4	13.955	100

Whig Creek is an intermittent stream in a watershed with an average annual rainfall of 46 to 48 inches a year (SCAS 2003). No USGS streamflow gages are present on Whig Creek, and the only substantive dry-weather discharge into Whig Creek is the City of Russellville's wastewater treatment plant (WWTP). The WWTP has a National Pollutant Discharge Elimination System (NPDES) Permit No. AR0021768 with a permitted discharge of 6.5 million gallons per day (MGD).

Figure 2.1 Whig Creek Basin Location Map



SECTION 3
PROBLEM DEFINITION AND ENDPOINT IDENTIFICATION

3.1 PROBLEM DEFINITION

The purpose of this TMDL report is to meet requirements of CWA §303(d), which requires the ADEQ or USEPA to develop a pollutant load allocation (LA) for each pollutant identified on the State's USEPA-approved 303(d) List. ADEQ's 1998 303(d) List identified copper in Whig Creek as a pollutant of concern. The priority ranking for the Whig Creek TMDL was medium on the 1998 303(d) list and elevated to high on the 2002 303(d) list. Whig Creek was listed as being impaired for aquatic life as a result of elevated copper levels. Periodic sampling of Whig Creek at the ambient water quality monitoring station provided historical data from ADEQ. In June 1997, an intensive investigation report was completed by ADEQ to validate the water quality, physical habitat, macroinvertebrates, and fish in Whig Creek (ADEQ 1997). In December 2000, a TMDL for nitrate for Whig Creek was completed and approved by USEPA (USEPA 2000).

Figure 3.1 identifies the location of the WWTP in the City of Russellville and Station ARK0067. Historical data are presented in Figure 3.2, which provides the dissolved copper concentrations for 56 ambient water samples collected at Station ARK0067 between January 1995 and March 2003. Analysis of 28 ambient water samples detected dissolved copper in concentrations above 3.47 micrograms per liter (µg/L) for this period.

3.2 ENDPOINT IDENTIFICATION

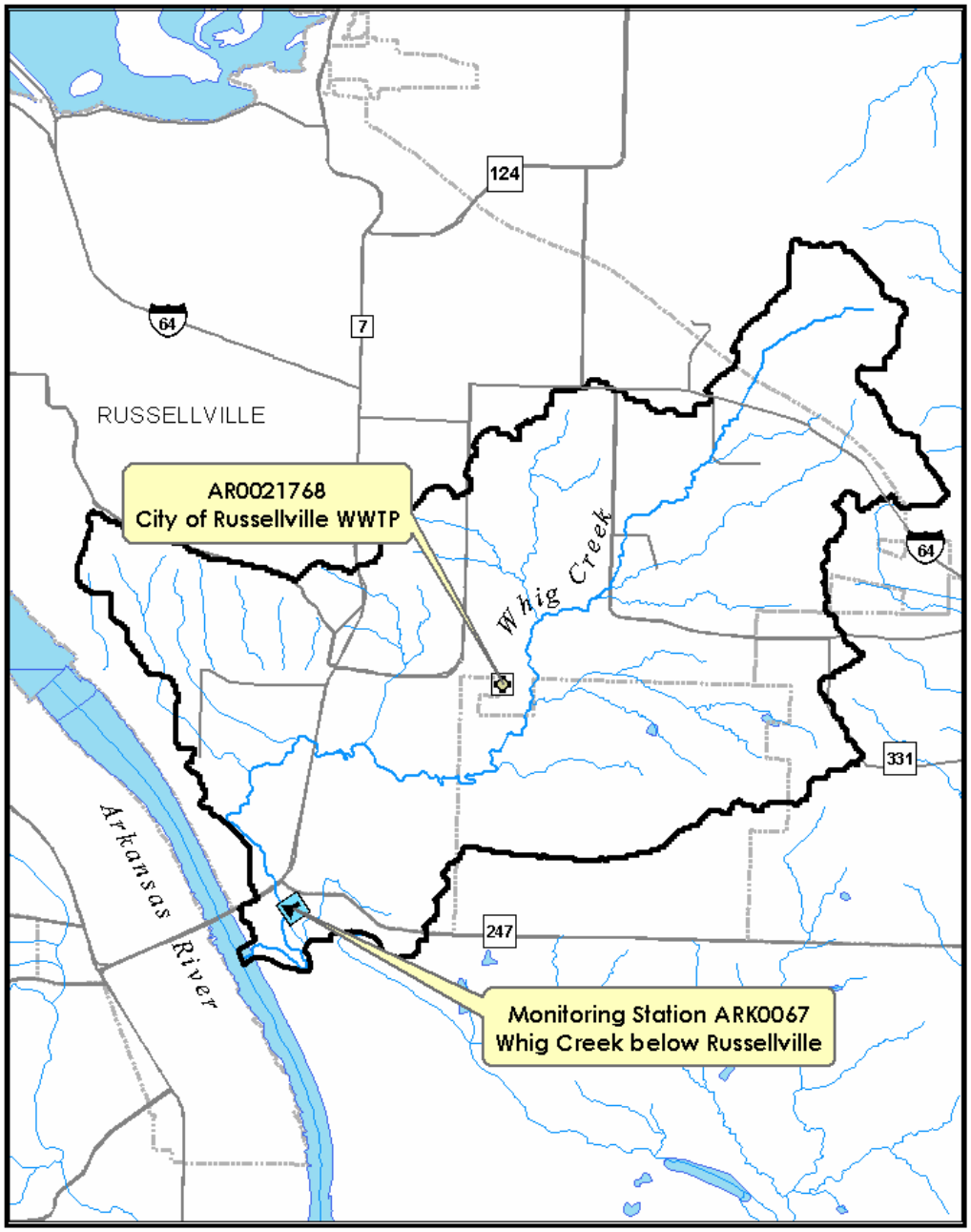
The ASWQS define designated uses of specific water body valleys. Designated uses for Whig Creek from its headwaters to the Arkansas River include primary contact recreation; secondary contact recreation; perennial Arkansas River Valley fishery; domestic, industrial, and agriculture water supply; and propagation of fish and wildlife.

Both general narrative standards and numerical criteria are defined in the ASWQS. Numeric metals criteria apply during the (7Q10). The aquatic life standard for dissolved copper is based on acute and chronic mathematical formulas dependent on hardness (as $CaCO_3$). The formulas are as follows:

Acute Dissolved Copper Standard in µg/L = $e^{[0.9422(\ln \text{hardness})] - 1.464}$

Chronic Dissolved Copper Standard µg/L = $e^{[0.8545(\ln \text{hardness})] - 1.465}$

Figure 3.1 Whig Creek Basin Sampling and Discharger Location

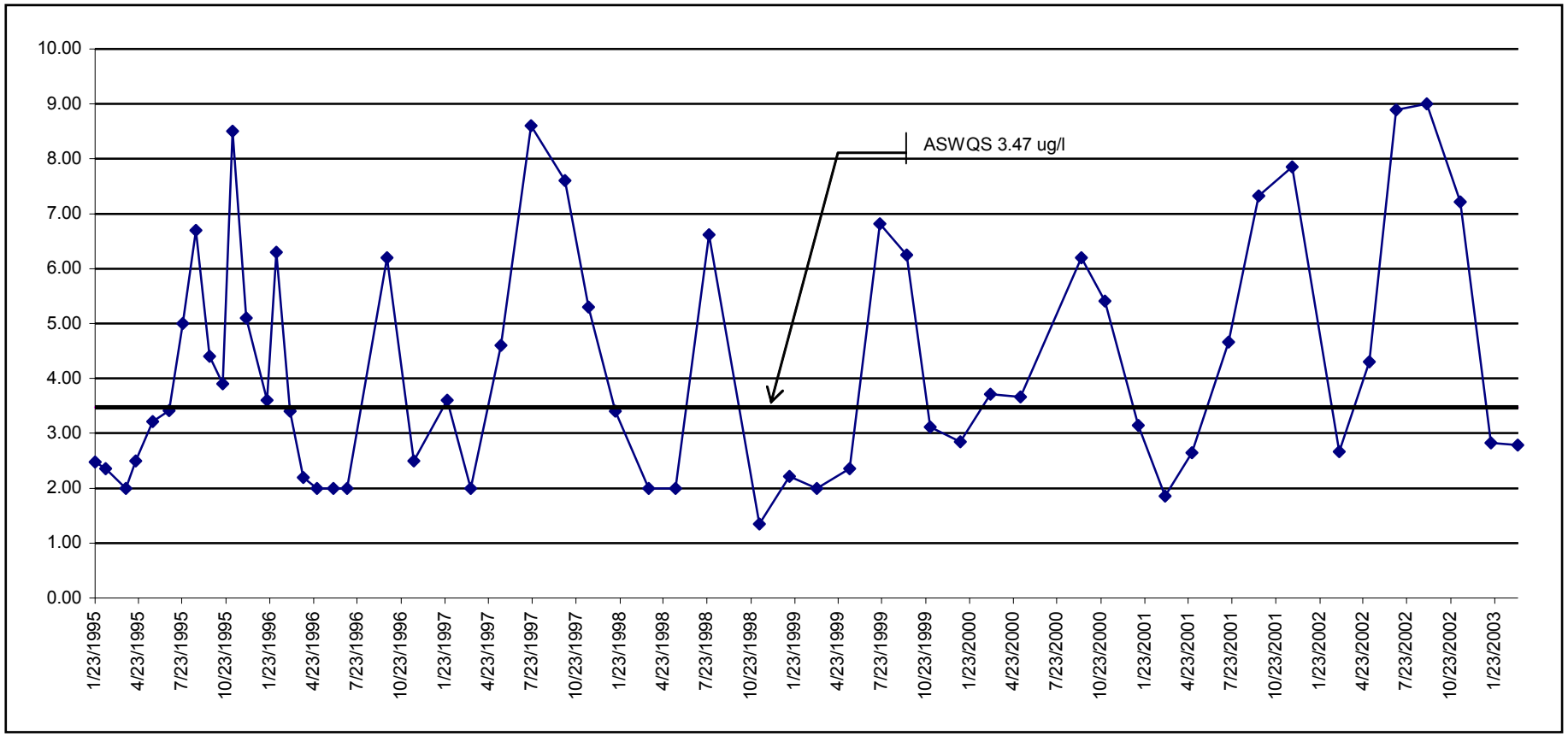


Whig Creek Basin TMDL
Sampling and Discharger Location

Miles
0 0.25 0.5 1 1.5

PARSONS

Figure 3.2 Dissolved Copper in Whig Creek Station ARK0067



The ADEQ Continuing Planning Process document, Appendix D, Page D-51, water quality standards for metals must be calculated using default hardness values listed in Attachment VI. The required default hardness value is 25 mg/l for tributaries to the Arkansas River.[1] The acute dissolved copper standard is calculated to be 4.61 µg/L. The chronic dissolved copper ASWQS is calculated to be 3.47 µg/L. The chronic standard is lower than the acute standard; therefore, the ASWQS for dissolved copper in Whig Creek during the 7Q10 is 3.47 µg/L.

[1] Based on water samples collected between January 1994 and March 2003, the long term average hardness value for Whig Creek is 60.66 milligrams per liter (mg/L).

SECTION 4
IDENTIFICATION OF POLLUTION SOURCES

The sources of copper identified in the 1998 Arkansas 305(b) Report are listed as municipal point sources. Further investigation of existing data and information revealed the following point and nonpoint sources of copper.

4.1 POINT SOURCE – CITY OF RUSSELLVILLE WWTP

The only significant dry-weather discharger to Whig Creek is the City of Russellville. Grace Manufacturing ceased discharging into Whig Creek in Spring 2002. The specialty metal fabricator now discharges to the city's sewer system.

The City of Russellville WWTP (NPDES Permit No. AR0021768) is permitted to discharge up to 6.5 MGD of treated wastewater to Whig Creek. Figure 3.1 identifies the location of the WWTP in the Whig Creek basin. The city's most recent permit renewal application was received by EPA on July 1, 2002. Effluent sample analysis of total copper indicated the maximum concentration in 4 samples was 0.011 mg/l. The average of the 4 samples was 0.008 mg/l. The analytical method used was Method 200.7 with an MDL of 0.01.

4.2 NONPOINT SOURCES AND BACKGROUND CONCENTRATIONS

Land use and land cover in the Whig Creek watershed is predominantly pastureland, shrubs and forest (91%). With urban, commercial, and industrial development comprising less than 1 percent of the land use in the watershed, nonpoint sources of copper from urban runoff is most probably insignificant. Agriculture lands account for the remaining 8 percent of the land use. No literature sources were found that indicated this type of land mix, if uncontaminated, produced detectable amounts of copper in storm water runoff. See Table 2.1 for a breakdown of land uses within the Whig Creek basin.

The 1997 TMDL investigation report contains water quality data collected from 1 sampling point upstream and 4 sampling points downstream of the WWTP discharge. The single sample collected upstream of the discharge did not contain a detectable amount of copper. Copper was detected in the 4 samples collected downstream of the discharge.

A review of the water quality data from Station AR0067 summarized by month (1995 – 2003) shows consistent exceedances during dry months such as July, August, and September and occasional exceedances for the other months. This indirect evidence suggests there is no detectable NPS or background contribution of copper. There is no data indicating NPS is a source of copper to Whig Creek.

SECTION 5
TMDL CALCULATIONS

5.1 CURRENT LOAD EVALUATION

A TMDL must be developed to be protective during low flow (7Q10) as well as high flow conditions. The formula for a TMDL is as follows:

TMDL = WLA + LA + MOS

Where WLA is the waste load allocation of point source discharges, LA is the load allocation for NPS contributions and background levels, and MOS is a margin of safety to account for the lack of full understanding of the creeks ecosystem.

5.2 WASTE LOAD ALLOCATION

A Waste Load Allocation (WLA) is an instream, pound per day pollutant (copper) load allocation used to calculate permit limits for point sources. A point source can be either a dry-weather or storm water discharge. Dry weather discharges are by and large from wastewater treatment plants. Storm water point sources are typically associated with urban and industrialized areas. Since urban and industrial areas comprise approximately 1 percent of the Whig Creek watershed and there are no storm water data, the WLA for this TMDL will focus on the WWTP point source.

A WLA for a WWTP is calculated using the permitted discharge rate and low flow (7Q10) instream conditions. During the 7Q10, a point-source discharge (WWTP) has the least amount of receiving stream dilution thereby producing the highest concentration of pollutants in the stream.

The instream WLA, beginning at the point of the Russellville WWTP discharge, is calculated using a simple mass balance formula shown below. The WLA calculation uses the chronic aquatic life ASWQS maximum dissolved copper concentration (0.00347 mg/l) and the WWTP's NPDES permitted flow rate of 6.5 mgd (USEPA 2000). The WLA in pounds per day (ppd) for dissolved copper (Cu) is determined by using the following calculation:

$$\mathbf{WLA = Cu_{chronic\ std} * Q\ mgd * 8.34}$$

Where: $Cu_{chronic\ std}$ = 0.00347 mg/L and Q = 6.5 mgd. The 8.34 in the equation is a unit conversion factor.

WLA = 0.00347 mg/L * 6.50 mgd * 8.34 = 0.188 ppd

5.3 LOAD ALLOCATION

A load allocation (LA) is also calculated using the same method as subsection 5.2. The LA is used to allocate pollutant loading to NPS and instream background quantities.

As discussed in Subsection 4.2, NPS and background contribution of copper is believed to be non-detectable. Therefore, the LA for copper in Whig Creek is zero.

5.4 SEASONAL VARIABILITY

Federal regulations [40 CFR §130.7(c)(1)] require that TMDLs take into consideration a seasonal variability in applicable standards. The ASWQS for copper apply year around. Therefore, seasonal variability is not applicable to this TMDL.

5.5 MARGIN OF SAFETY

Federal regulations [40 CFR §130.7(c)(1)] require that TMDLs take into consideration a margin of safety (MOS). USEPA guidance allows for use of implicit or explicit expressions of the MOS, or both. When conservative assumptions are used in development of the TMDL, or conservative factors are used in the calculations, the MOS is implicit. The following conservative assumptions were made providing an implicit MOS.

The revised future WWTP permit will limit total copper by concentration and in ppd with no instream dilution allowance. Procedures used by the ADEQ to convert chronic dissolved copper criteria into a total copper permit limit are conservative and provide an implicit MOS built into the calculations. As an example, the calculation to determine the permit limit is based on the long term average (LTA) treatment efficiency based on a 90 percent probability that the discharge will meet the WLA. It is common knowledge that a mechanical WWTP's efficiency is greater during prolonged dry weather than under wet weather conditions. The log-normal probability distribution curves for treatment plant performance used by USEPA to determine the LTA takes into account wet weather reduction in efficiency for calculating the 90th percentile discharge concentration of copper (USEPA 1996). During wet weather periods there will be water flowing in Whig Creek, further diluting the WWTP discharge. Another conservative assumption that is the WLA calculation uses the design flow rather than actual effluent flows, which are lower. Since the WWTP permit already contains a built-in MOS and there is no LA or explicit MOS, the MOS in the TMDL calculation is zero.

5.6 TMDL CALCULATION

The TMDL is equal to the WLA and includes an implicit MOS. The TMDL will meet water quality standards under critical conditions.

TMDL = WLA + LA + MOS

0.188 ppd = 0.188 ppd + 0 ppd + 0 ppd

5.7 FUTURE WATER QUALITY MONITORING

The ADEQ plans to continue water quality monitoring at Station ARK0067 for dissolved copper in accordance with its annual ambient water quality monitoring

program. This TMDL recommends ADEQ use EPA Method 1669 - Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels for ultra-clean copper sampling and analysis. Continued copper concentration monitoring at both ARK0067 and the WWTP discharge will provide the data necessary for demonstrating TMDL compliance.

5.8 REASONABLE ASSURANCES

Based on available data and this TMDL, the exceedance of the ASWQS for dissolved copper in Whig Creek is due to the discharge from the City of Russellville's WWTP. The future revised NPDES permit will provide reasonable assurances by limiting total copper (concentration and load) to the equivalent of end-of-pipe ASWQS for dissolved copper.

This TMDL recommends the addition of a reopener clause in the future NPDES permit for the Russellville WWTP. The reopener clause may be necessary should future ambient water monitoring show no progress or an increase in the ambient copper concentration.

SECTION 6
PUBLIC PARTICIPATION

When USEPA establishes a TMDL, 40 C.F.R. § 130.7(d)(2) requires USEPA to publish a public notice and seek comments concerning the TMDL. USEPA prepared this TMDL pursuant to the consent decree required by Sierra Club V. Whitman, Case No. LR-C-99-114 (E.D. Ark). Federal regulation requires that public notice be provided through the Federal Register and through newspapers published in the local area. The Federal Register notice was issued on _____(Volume_____, Number _____, and page _____). This TMDL was also noticed in local newspapers. Comments and additional information received by USEPA during the 30-day public comment period were evaluated and this TMDL has been revised accordingly. Comments and USEPA responses can be found in Appendix B. USEPA will provide notice to ADEQ that this TMDL has been made final. USEPA will also request ADEQ to incorporate the TMDL into the state Water Quality Management Plan.

SECTION 7
LIST OF REFERENCES

ADEQ 1997. Arkansas Department of Environmental Quality (ADEQ). 1997. *TMDL Investigation of Water Quality Impairments to Whig Creek, Pope County, Arkansas*. ADEQ Report #WQ-97-06-01.

ADEQ 1998. Arkansas Department of Environmental Quality (ADEQ). 1998. *1998 303(d) List*.

ASWQS 2000. Arkansas Department of Environmental Quality (ADEQ). *Arkansas Pollution Control and Ecology Commission Regulation No. 2. Arkansas Surface Water Quality Standards*. January 2000.

CCP 2000. Arkansas Department of Environmental Quality (ADEQ). *State of Arkansas: Continuing Planning Process*. January, 2000.

CAST 1999. Center for Advanced Spatial Technologies (CAST) 1999. *1999 Land use/ Land Cover dataset.* http://www.cast.uark.edu/cast/geostor/index.html.

SCAS 2003. Spatial Climate Analysis Service (SCAS) 2000. *Average Annual Rainfall Arkansas.* http://www.ocs.orst.edu/prism/about_SCAS.html. [accessed May 2003].

TSD 1991. U.S. EPA, Technical Support Document for Water Quality-based Toxic Control, EPA/505/2-90-001, March 1991.

U.S. Census Bureau 2000. *Summary File 4, Arkansas. U.S. Census Bureau 2000.*

USEPA 1996, U.S. EPA NPDES Permit Writers' Manual, EPA-833-B-96-003, December 1996.

USEPA 2000, U.S. Environmental Protection Agency, Region 6. Whig Creek TMDL for Nitrate. December 2000.

APPENDIX A
WATER QUALITY DATA

Copper Sample Date	COPPER, DISSOLVED (UG/L AS CU)	Hardness Sample Date	HARDNESS, CA MG CALCULATED (MG/L AS CACO3)	pH Sample Date	pH	TSS Sample Date	TSS
1/23/95	2.48	9/26/94	54.30	11/7/94	6.37	10/17/94	3.00
2/13/95	2.36	10/17/94	57.40	12/12/94	6.56	11/7/94	6.00
3/27/95	2.00	11/7/94	56.40	1/23/95	6.74	12/12/94	8.50
4/17/95	2.50	12/12/94	42.00	2/13/95	7.33	1/23/95	5.50
5/22/95	3.21	1/23/95	44.12	3/27/95	6.84	2/13/95	4.50
6/26/95	3.41	1/23/95	44.00	4/17/95	6.76	3/27/95	2.50
7/24/95	5.00	2/13/95	61.20	5/22/95	6.76	4/17/95	14.50
8/21/95	6.70	2/13/95	56.88	7/24/95	6.68	5/22/95	15.00
9/18/95	4.40	3/27/95	69.60	8/21/95	7.20	6/26/95	15.00
10/16/95	3.90	3/27/95	70.00	9/18/95	7.15	7/24/95	177.50
11/6/95	8.50	4/17/95	64.90	10/16/95	7.24	8/21/95	14.00
12/4/95	5.10	4/17/95	64.70	11/6/95	7.10	9/18/95	7.00
1/16/96	3.60	5/22/95	70.26	12/4/95	7.01	10/16/95	6.00
2/5/96	6.30	5/22/95	70.00	1/16/96	6.86	11/6/95	2.00
3/4/96	3.40	6/26/95	78.39	2/5/96	7.28	12/4/95	5.50
4/1/96	2.20	6/26/95	78.00	3/4/96	7.46	1/16/96	8.00
4/29/96	2.00	7/24/95	35.23	4/1/96	6.97	2/5/96	13.50
6/3/96	2.00	7/24/95	35.00	4/29/96	6.66	3/4/96	8.50
7/1/96	2.00	8/21/95	64.46	6/3/96	6.70	4/1/96	8.50
9/23/96	6.20	8/21/95	65.00	7/1/96	6.81	4/29/96	35.00
11/18/96	2.50	9/18/95	90.45	8/5/96	7.03	6/3/96	11.50
1/27/97	3.60	9/18/95	91.00	9/23/96	6.73	7/1/96	11.50
3/17/97	2.00	10/16/95	98.90	10/28/96	7.03	8/5/96	11.50
5/19/97	4.60	10/16/95	99.00	11/18/96	6.37	9/23/96	15.00
7/21/97	8.60	11/6/95	110.22	12/16/96	6.15	10/28/96	15.50
9/29/97	7.60	11/6/95	110.00	1/27/97	6.24	11/18/96	9.50
11/17/97	5.30	12/4/95	63.20	2/24/97	6.36	12/16/96	19.00
1/12/98	3.40	12/4/95	63.00	3/17/97	6.73	2/24/97	55.50
3/23/98	2.00	1/16/96	68.97	4/21/97	6.46	3/17/97	9.00
5/18/98	2.00	1/16/96	69.00	6/2/97	6.92	4/21/97	10.50
7/27/98	6.62	2/5/96	58.05	7/21/97	7.28	5/19/97	17.00
11/9/98	1.35	2/5/96	58.00	8/25/97	7.27	6/2/97	11.50
1/11/99	2.22	3/4/96	51.82	9/29/97	7.02	7/21/97	18.00
3/9/99	(BDL)	3/4/96	51.00	10/27/97	7.33	8/25/97	14.00
5/17/99	2.36	4/1/96	55.45	11/17/97	6.80	9/29/97	13.50
7/19/99	6.82	4/1/96	55.00	12/15/97	7.40	10/27/97	4.00
9/13/99	6.25	4/29/96	55.26	1/12/98	6.59	11/17/97	4.00
11/1/99	3.11	4/29/96	55.00	4/27/98	6.41	12/15/97	4.00
1/3/00	2.84	6/3/96	60.93	5/18/98	7.18	1/12/98	5.00
3/6/00	3.71	6/3/96	61.00	7/27/98	7.22	2/9/98	1.50
5/8/00	3.66	7/1/96	83.62	8/24/98	7.33	4/27/98	33.00
9/11/00	6.2	7/1/96	84.00	11/9/98	6.42	5/18/98	6.50
10/30/00	5.41	9/23/96	65.47	12/7/98	6.85	6/22/98	9.00
1/8/01	3.14	9/23/96	66.00	1/11/99	6.99	7/27/98	10.50

Copper Sample Date	COPPER, DISSOLVED (UG/L AS CU)	Hardness Sample Date	HARDNESS, CA MG CALCULATED (MG/L AS CACO3)	pH Sample Date	pH	TSS Sample Date	TSS
3/5/01	1.86	11/18/96	46.15	2/1/99	6.59	8/24/98	5.50
4/30/01	2.64	11/18/96	46.00	3/9/99	6.35	9/28/98	9.00
7/16/01	4.66	1/27/97	53.86	4/12/99	6.64	10/26/98	2.50
9/17/01	7.33	1/27/97	54.00	5/17/99	6.76	11/9/98	1348.00
11/26/01	7.85	3/17/97	60.30	6/21/99	7.01	12/7/98	6.00
3/4/02	2.66	3/17/97	60.00	7/19/99	7.18	1/11/99	3.50
5/6/02	4.3	5/19/97	67.70	8/9/99	7.22	2/1/99	9.50
7/1/02	8.89	5/19/97	68.00	9/13/99	7.39	3/9/99	22.90
9/3/02	9.00	7/21/97	51.49	10/4/99	7.41	4/12/99	8.50
11/12/02	7.22	7/21/97	52.00	11/1/99	6.62	5/17/99	10.00
1/14/03	2.82	9/29/97	67.42	11/29/99	6.9	6/21/99	5.50
3/11/03	2.78	9/29/97	67.00	1/3/00	6.68	7/19/99	5.50
		11/17/97	61.54	1/31/00	6.88	8/9/99	6.50
		11/17/97	62.00	3/6/00	6.96	9/13/99	5.50
		1/12/98	61.55	4/3/00	6.85	10/4/99	4.50
		1/12/98	61.00	5/8/00	6.87	11/1/99	48.00
		3/23/98	55.93	6/5/00	7.13	11/29/99	1.00
		3/23/98	56.00	7/17/00	7.63	1/3/00	546.00
		5/18/98	69.33	8/14/00	7.63	3/6/00	3.50
		5/18/98	69.00	10/9/00	7.68	4/3/00	4.00
		7/27/98	55.01	10/30/00	7.59	5/8/00	15.50
		7/27/98	55.00	12/11/00	7.1	6/5/00	7.50
		9/28/98	77.00	1/8/01	6.87	7/17/00	6.00
		11/9/98	17.15	2/5/01	7.55	8/14/00	18.50
		11/9/98	17.00	3/5/01	6.56	9/11/00	3.50
		1/11/99	57.00	4/2/01	7.05	10/9/00	5.50
		3/9/99	42.00	4/30/01	7.05	10/30/00	4.50
		5/17/99	64.00	6/4/01	7.02	12/11/00	5.70
		7/19/99	64.00	7/16/01	7.01	1/8/01	5.00
		9/13/99	48.00	8/20/01	7.48	2/5/01	6.50
		11/1/99	27.00	9/17/01	7.08	3/5/01	10.80
		1/3/00	24.00	11/26/01	7.1	4/2/01	6.00
		3/6/00	48.00	12/17/01	6.75	4/30/01	10.30
		5/8/00	67.00	1/14/02	7.28	6/4/01	10.80
		7/17/00	57.00	2/11/02	6.78	7/16/01	7.00
		9/11/00	54.00	3/4/02	7.01	8/20/01	7.00
		10/30/00	56.00	4/1/02	7.07	9/17/01	4.50
		1/8/01	54.00	5/6/02	7.2	10/29/01	2.00
		3/5/01	44.00	6/3/02	7.28	11/26/01	12.00
		4/30/01	54.00	7/1/02	7.49	12/17/01	51.50
		7/16/01	53.00	8/6/02	7.39	1/14/02	13.00
		9/17/01	57.00	10/15/02	7.43	2/11/02	5.50
		11/26/01	61.00	11/12/02	7.01	3/4/02	9.80
		3/4/02	46.00	12/16/02	6.99	4/1/02	9.30
		5/6/02	62.00	1/14/03	7.21	5/6/02	13.50

Copper Sample Date	COPPER, DISSOLVED (UG/L AS CU)	Hardness Sample Date	HARDNESS, CA MG CALCULATED (MG/L AS CACO3)	pH Sample Date	pH	TSS Sample Date	TSS
		7/1/02	64.00	2/11/03	7.04	6/3/02	9.70
		9/3/02	63.00	3/11/03	7.08	7/1/02	27.00
		11/12/02	69.00			8/6/02	10.30
		1/14/03	64.00			9/3/02	7.50
		3/11/03	85.00			10/15/02	3.00
						11/12/02	2.50
						12/16/02	3.80
						1/14/03	3.80
						2/11/03	2.30
						3/11/03	4.80
						4/1/03	3.20
Average	4.26		60.66				30.65
Maximum	9.00		110.22		7.68		1348.00
Minimum	1.35		17.00		6.15		1.00

APPENDIX B
PUBLIC COMMENTS AND USEPA RESPONSES