

TMDLS FOR TURBIDITY, CHLORIDE, SULFATE, AND TDS IN THE BOEUF RIVER AND BAYOU MACON BASINS, AR

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TMDLS FOR TURBIDITY, CHLORIDE, SULFATE, AND TDS
IN THE BOEUF RIVER AND BAYOU MACON BASINS, AR

Prepared for:

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EXECUTIVE SUMMARY

Section 303(d) of the Federal Clean Water Act requires states to identify waterbodies that are not meeting water quality standards and to develop total maximum daily pollutant loads for those waterbodies. A total maximum daily load (TMDL) is the amount of a pollutant that a waterbody can assimilate without exceeding the established water quality standard for that pollutant. Through a TMDL, pollutant loads can be allocated to point sources and nonpoint sources discharging to the waterbody.

The study area for this project consists of the Boeuf River and Bayou Macon basins in southeastern Arkansas. For both basins, the headwaters begin southeast of Pine Bluff and the general drainage pattern is southward into Louisiana. The study area comprises the Arkansas Department of Environmental Quality (ADEQ) Planning Segment 2A and is located entirely within the Delta ecoregion. The study area is about 86% cropland (mostly soybeans, cotton, and rice). The majority of the soybeans and cotton are irrigated, and essentially all of the rice is irrigated. The primary source of irrigation water is the alluvial aquifer, which has high concentrations of dissolved minerals in some areas.

A total of six reaches in the Bayou Macon and Boeuf River basins are included on the Arkansas 303(d) list as not supporting the aquatic life use due to exceedances of water quality standards for either siltation/turbidity, chloride, sulfate, or total dissolved solids (TDS) as shown in Table ES.1. The applicable numeric water quality standards for these reaches are 75 NTU for turbidity (because ADEQ considers all six reaches to be “channel-altered”), 90 mg/L chloride for Boeuf River, 48 mg/L chloride for Big Bayou and Oak Bayou, 411 mg/L TDS for Oak Bayou, 460 mg/L TDS for Boeuf River, and 30 mg/L sulfate for Boeuf River.

Table ES.1. 303(d) listing for stream reaches in this task order.

Reach No.	Stream Name	Source	Major cause	Minor cause(s)	Priority
08050001-022	Big Bayou	Agriculture	Siltation/turbidity	Chloride	Low
08050001-018	Boeuf River	Agriculture	Siltation/turbidity	Chloride, TDS*, Sulfate*	Low
08050001-019	Boeuf River	Agriculture	Siltation/turbidity	Chloride	Low
08050002-010	Oak Bayou	Agriculture	Siltation/turbidity	Chloride, TDS	Low
08050002-003	Bayou Macon	Agriculture	Siltation/turbidity	--	Low
08050002-006	Bayou Macon	Agriculture	Siltation/turbidity	--	Low

*Note: The 2002 final 303(d) list included all of the impairments shown in this table except TDS and sulfate for the Boeuf River (reach -018), which have been added to the 2004 FINAL 303(d) list.

ADEQ historical water quality data at seven locations were analyzed for long term trends, seasonal patterns, relationships between concentration and stream flow, and relationships between turbidity and total suspended solids (TSS). These analyses showed that turbidity values tended to be highest during December through May, during which time there are larger amounts of runoff and less ground cover on cropland, both of which would allow greater amounts of erosion. This is consistent with information in the Arkansas 2002 305(b) report, which states that high turbidity values are caused by runoff from intensive row crop agriculture. For chloride, TDS, and sulfate, high concentrations tended to occur at low stream flows and during May through November, while the concentrations at high stream flows and during December through April were generally low. This is consistent with the Arkansas 2002 305(b) report, which states that elevated chlorides are probably due to discharges of irrigation water taken from aquifers.

Because turbidity cannot be expressed as a mass load, the turbidity TMDLs were expressed using TSS as a surrogate for turbidity. A basin-wide regression between TSS and turbidity was developed for each season using turbidity and TSS data from all seven water quality stations. This resulted in target TSS concentrations of 68 mg/L for summer and 52 mg/L for winter.

All thirteen TMDLs (six turbidity, four chloride, two TDS, and one sulfate) were developed using the load duration curve methodology. This method illustrates allowable loading at a wide range of stream flow conditions. The steps for applying this methodology for the TMDLs in this report were: 1) developing a flow duration curve; 2) converting the flow duration curve to load duration curves; 3) plotting observed loads with load duration curves; 4) calculating the TMDL, MOS, WLA, and LA; and 5) calculating percent reductions. Based on the analyses of the water quality data, each TMDL was developed on a seasonal basis (i.e. calculating allowable loads and percent reductions for both summer and for winter.)

For the turbidity TMDLs, the wasteload allocations for point source contributions were set to ~~not applicable (NA)~~ ~~zero~~ because TSS in these TMDLs was considered to represent inorganic suspended solids (i.e., soil and sediment particles from erosion or sediment resuspension). The suspended solids discharged by point sources in the study area are assumed to consist primarily of organic solids rather than inorganic solids. Discharges of organic suspended solids from point sources are already addressed by ADEQ through their permitting of point sources to maintain water quality standards for dissolved oxygen.

For the turbidity TMDLs, an implicit margin of safety (MOS) was incorporated through the use of conservative assumptions. The primary conservative assumption was calculating the turbidity TMDLs assuming that TSS is a conservative parameter and does not settle out of the water column. For the TDS, chloride, and sulfate TMDLs, an explicit MOS was established as 10% of the TMDL.

Because point sources were considered to have negligible effect on existing violations of water quality standards, all of the load reductions were assigned to nonpoint sources. Wasteload allocations for chloride were developed for five point source discharges based on existing effluent concentrations with zero percent reduction. The nonpoint source percent reductions needed for these TMDLs are summarized in Table ES.2.

Technical assistance for implementation of these TMDLs will be provided by the Arkansas Soil and Water Conservation Commission (ASWCC) with input from local stakeholders and other agencies. For the turbidity TMDLs, implementation should occur throughout the Boeuf River and Bayou Macon basins, rather than just in the reaches with the higher percent reductions in Table ES.2.

Table ES.2. Summary of nonpoint source percent reductions.

Reach No.	Stream Name	Parameter	Summer % Reduction	Winter % Reduction
08050001-018	Boeuf River	Turbidity	0%	73%
08050001-019	Boeuf River	Turbidity	0%	80%
08050001-022	Big Bayou	Turbidity	0%	75%
08050002-010	Oak Bayou	Turbidity	0%	45%
08050002-006	Bayou Macon	Turbidity	0%	81%
08050002-003	Bayou Macon	Turbidity	0%	68%
08050001-018	Boeuf River	Chloride	**	0%
08050001-019	Boeuf River	Chloride	**	0%
08050001-022	Big Bayou	Chloride	55%	0%
08050002-010	Oak Bayou	Chloride	62%	0%
08050001-018	Boeuf River	TDS	**	0%
08050002-010	Oak Bayou	TDS	38%	0%
08050001-018	Boeuf River	Sulfate	10%	0%

** Percent reductions that were calculated for the Boeuf River for chloride and TDS during summer were 0%, but those values are not shown in this table because they were considered to be misleading and not indicative of actual conditions.

TABLE OF CONTENTS

1.0	INTRODUCTION	1-1
2.0	BACKGROUND INFORMATION	2-1
2.1	General Information.....	2-1
2.2	Topography	2-1
2.3	Soils.....	2-1
2.4	Land Use	2-2
2.5	Description of Hydrology	2-2
2.6	Irrigation	2-3
2.7	Channel Network	2-6
2.8	Water Quality Standards	2-6
2.9	Nonpoint Sources.....	2-7
2.10	Point Sources	2-8
2.11	Previous Water Quality Studies	2-8
3.0	EXISTING WATER QUALITY FOR TURBIDITY AND TSS	3-1
3.1	General Description of Data	3-1
3.2	Seasonal Patterns	3-1
3.3	Relationships Between Turbidity and Flow.....	3-1
3.4	Relationships Between TSS and Turbidity.....	3-1
4.0	EXISTING WATER QUALITY FOR CHLORIDE, TDS, AND SULFATE	4-1
4.1	General Description of Data	4-1
4.2	Seasonal Patterns	4-1
4.3	Relationships Between Concentration and Flow	4-1
5.0	TMDL DEVELOPMENT.....	5-1
5.1	Seasonality and Critical Conditions.....	5-1
5.2	Water Quality Targets.....	5-1
5.3	Methodology for TMDL Calculations	5-2
5.4	Flow Duration Curve	5-2
5.5	Load Duration Curves.....	5-3
5.6	Observed Loads	5-3
5.7	TMDL and MOS.....	5-4
5.8	Point Source Loads	5-4
5.9	Nonpoint Source Loads.....	5-5

TABLE OF CONTENTS (CONTINUED)

5.10	Percent Reductions.....	5-6
5.11	Future Growth.....	5-8
6.0	OTHER RELEVANT INFORMATION	6-1
6.1	Monitoring	6-1
6.2	Reasonable Assurances and Implementation.....	6-1
7.0	PUBLIC PARTICIPATION	7-1
8.0	REFERENCES	8-1

TABLES OF CONTENTS (CONTINUED)

LIST OF APPENDICES

APPENDIX A:	Maps
APPENDIX B:	Long Term Plots of Turbidity and TSS
APPENDIX C:	Seasonal Plots of Turbidity and TSS
APPENDIX D:	Plots of Turbidity vs. Flow and TSS
APPENDIX E:	Long Term Plots of Chloride, TDS, and Sulfate
APPENDIX F:	Seasonal Plots of Chloride, TDS, and Sulfate
APPENDIX G:	Plots of Chloride, TDS, and Sulfate vs. Flow
APPENDIX H:	Calculations for Summer Turbidity TMDLs
APPENDIX I:	Calculations for Winter Turbidity TMDLs
APPENDIX J:	Calculations for Summer Chloride TMDLs
APPENDIX K:	Calculations for Winter Chloride TMDLs
APPENDIX L:	Calculations for Summer TDS TMDLs
APPENDIX M:	Calculations for Winter TDS TMDLs
APPENDIX N:	Calculations for Summer Sulfate TMDL
APPENDIX O:	Calculations for Winter Sulfate TMDL
APPENDIX P:	WLAs for Individual Point Sources

LIST OF TABLES

Table ES.1	303(d) listing for stream reaches in this task order
Table ES.2	Summary of nonpoint source percent reductions
Table 1.1	303(d) listing for stream reaches in this task order
Table 2.1	Land use percentages for the study area
Table 2.2	Information for stream flow gaging stations
Table 2.3	Numeric water quality standards for TMDLs in this report
Table 2.4	Inventory of point source dischargers
Table 3.1	Summary of turbidity (NTU) data
Table 3.2	Summary of TSS data
Table 3.3	Results of regressions between TSS and turbidity for each station
Table 3.4	Results of basin wide regressions between TSS and turbidity
Table 4.1	Summary of TDS and Chloride data
Table 5.1	Target TSS concentrations for turbidity TMDLs
Table 5.2	Summary of turbidity TMDLs for July through November (summer)
Table 5.3	Summary of turbidity TMDLs for December through May (winter)
Table 5.4	Summary of chloride TMDLs for May through November (summer)
Table 5.5	Summary of chloride TMDLs for December through April (winter)
Table 5.6	Summary of TDS TMDLs for May through November (summer)
Table 5.7	Summary of TDS TMDLs for December through April (winter)
Table 5.8	Summary of sulfate TMDL for May through November (summer)
Table 5.9	Summary of sulfate TMDL for December through April (winter)
Table H.1	Turbidity TMDL calculations for summer
Table H.2	Calculations for TSS load and percent reduction for summer for Boeuf River at OUA0015A
Table H.3	Calculations for TSS load and percent reduction for summer for Boeuf River at UWBFR01
Table H.4	Calculations for TSS load and percent reduction for summer for Big Bayou at OUA0032
Table H.5	Calculations for TSS load and percent reduction for summer for Big Bayou at UWBGB01
Table H.6	Calculations for TSS load and percent reduction for summer for Oak Bayou at OUA0179
Table H.7	Calculations for TSS load and percent reduction for summer for Bayou Macon at UWBYM01

LIST OF TABLES (CONTINUED)

Table H.8	Calculations for TSS load and percent reduction for summer for Bayou Macon at UWBYM02
Table I.1	Turbidity TMDL calculations for winter
Table I.2	Calculations for TSS load and percent reduction for winter for Boeuf River at OUA0015A
Table I.3	Calculations for TSS load and percent reduction for winter for Boeuf River at UWBFR01
Table I.4	Calculations for TSS load and percent reduction for winter for Big Bayou at OUA0032
Table I.5	Calculations for TSS load and percent reduction for winter for Big Bayou at UWBGB01
Table I.6	Calculations for TSS load and percent reduction for winter for Oak Bayou at OUA0179
Table I.7	Calculations for TSS load and percent reduction for winter for Bayou Macon at UWBYM01
Table I.8	Calculations for TSS load and percent reduction for winter for Bayou Macon at UWBYM02
Table J.1	Calculations for allowable loads per unit area for chloride during summer
Table J.2	Calculations for chloride load and percent reduction for summer for Boeuf River at OUA0015A
Table J.3	Calculations for chloride load and percent reduction for summer for Boeuf River at UWBFR01
Table J.4	Calculations for chloride load and percent reduction for summer for Big Bayou at OUA0032
Table J.5	Calculations for chloride load and percent reduction for summer for Big Bayou at UWBGB01
Table J.6	Calculations for chloride load and percent reduction for summer for Oak Bayou OUA0179
Table K.1	Calculations for allowable loads per unit area for chloride during winter
Table K.2	Calculations for chloride load and percent reduction for winter for Boeuf River at OUA0015A
Table K.3	Calculations for chloride load and percent reduction for winter for Boeuf River at UWBFR01
Table K.4	Calculations for chloride load and percent reduction for winter for Big Bayou at OUA0032
Table K.5	Calculations for chloride load and percent reduction for winter for Big Bayou at UWBGB01
Table K.6	Calculations for chloride load and percent reduction for winter for Oak Bayou OUA0179

LIST OF TABLES (CONTINUED)

Table L.1	Calculations for allowable loads per unit area for TDS during summer
Table L.2	Calculations for TDS load and percent reduction for summer for Boeuf River at OUA0015A
Table L.3	Calculations for TDS load and percent reduction for Summer for Oak Bayou at OUA0179
Table M.1	Calculations for allowable loads per unit area for TDS during winter
Table M.2	Calculations for TDS load and percent reduction for winter for Boeuf River at OUA0015A
Table M.3	Calculations for TDS load and percent reduction for winter for Oak Bayou at OUA179
Table N.1	Calculations for allowable loads per unit area for sulfate during summer
Table N.2	Calculations for sulfate load and percent reduction for summer for Boeuf River at OUA0015A
Table O.1	Calculations for allowable loads per unit area for Sulfates during winter
Table O.2	Calculations for sulfate load and percent reduction for winter for Boeuf River at OUA0015A
Table P.1	Summary of WLAs for individual point sources

LIST OF FIGURES

Figure 2.1	Mean Monthly Precipitation in Arkansas City, AR
Figure 2.2	Mean Monthly Flows for Bayou Macon near Eudora, AR
Figure A.1	Map of study area
Figure A.2	Map of STATSGO soils data
Figure A.3	Land use map.
Figure A.4	USGS flow gages and stream channel network
Figure A.5	Locations of water withdrawals
Figure A.6	Locations of point sources
Figure A.7	Water quality monitoring stations
Figure B.1	Long term plot of turbidity for Boeuf River at OUA0015A
Figure B.2	Long term plot of turbidity at Boeuf River at UWBFR01
Figure B.3	Long term plot of turbidity for Big Bayou at OUA0032
Figure B.4	Long term plot of turbidity on Big Bayou at UWBGB01
Figure B.5	Long term plot of turbidity for Oak Bayou at OUA0179
Figure B.6	Long term plot of turbidity for Bayou Macon at UWBYM01
Figure B.7	Long term plot of turbidity for Bayou Macon at UWBYM02
Figure B.8	Long term plot of TSS for Boeuf River at OUA0015A
Figure B.9	Long term plot of TSS at Boeuf River at UWBFR01
Figure B.10	Long term plot of TSS for Big Bayou at OUA0032
Figure B.11	Long term plot of TSS on Big Bayou at UWBGB01
Figure B.12	Long term plot of TSS for Oak Bayou at OUA0179
Figure B.13	Long term plot of TSS for Bayou Macon at UWBYM01
Figure B.14	Long term plot of TSS for Bayou Macon at UWBYM02
Figure C.1	Seasonal plot of turbidity for Boeuf River at OUA0015A
Figure C.2	Seasonal plot of turbidity on Boeuf River at UWBFR01
Figure C.3	Seasonal plot of turbidity on Big Bayou at OUA0032
Figure C.4	Seasonal plot of turbidity on Big Bayou at UWBGB01
Figure C.5	Seasonal plot of turbidity for Oak Bayou at OUA0179
Figure C.6	Seasonal plot of turbidity for Bayou Macon at UWBYM01
Figure C.7	Seasonal plot of turbidity for Bayou Macon at UWBYM02
Figure C.8	Seasonal plot of TSS for Boeuf River at OUA00115A
Figure C.9	Seasonal plot of TSS on Boeuf River at UWBFR01
Figure C.10	Seasonal plot of TSS for Big Bayou at OUA0032
Figure C.11	Seasonal plot of TSS on Big Bayou at UWBGB01
Figure C.12	Seasonal plot of TSS for Oak Bayou at OUA0179
Figure C.13	Seasonal plot of TSS for Bayou Macon at UWBYM01
Figure C.14	Seasonal plot of TSS for Bayou Macon at UWBYM02

LIST OF FIGURES (CONTINUED)

Figure D.1	Turbidity vs. flow for Boeuf River at OUA0015A
Figure D.2	Turbidity vs. flow for Boeuf River at UWBFR01
Figure D.3	Turbidity vs. flow for Big Bayou at OUA0032
Figure D.4	Turbidity vs. flow for Big Bayou at UWBGB01
Figure D.5	Turbidity vs. flow for Oak Bayou at OUA0179
Figure D.6	Turbidity vs. flow for Bayou Macon at UWBYSM01
Figure D.7	Turbidity vs. flow for Bayou Macon at UWBYSM02
Figure D.8	TSS vs. turbidity for Boeuf River at OUA0015A
Figure D.9	TSS vs. turbidity for Boeuf River at UWBFR01
Figure D.10	TSS vs. turbidity TSS for Big Bayou at OUA0032
Figure D.11	TSS vs. turbidity on Big Bayou at UWBGB01
Figure D.12	TSS vs. turbidity for Oak Bayou at OUA0179
Figure D.13	TSS vs. turbidity on Bayou Macon at UWBYSM01
Figure D.14	TSS vs. turbidity for Bayou Macon at UWBYSM02
Figure D.15	Summer TSS vs. turbidity for all stations in basin
Figure D.16	Winter TSS vs. turbidity for all stations in basin
Figure E.1	Long term plot of chloride for Boeuf River at OUA0015A
Figure E.2	Long term plot of chloride for Boeuf River at UWBFR01
Figure E.3	Long term plot of chloride for Big Bayou at OUA0032
Figure E.4	Long term plot of chloride for Big Bayou at UWBGB01
Figure E.5	Long term plot of chloride for Oak Bayou at OUA0179
Figure E.6	Long term plot of TDS for Oak Bayou at OUA0179
Figure E.7	Long term plot of TDS for Boeuf River at OUA0015A
Figure E.8	Long term plot of sulfate for Boeuf River at OUA0015A
Figure F.1	Seasonal plot of chlorides for Boeuf River at OUA0015A
Figure F.2	Seasonal plot of chloride for Boeuf River at UWBFR01
Figure F.3	Seasonal plot of chloride for Big Bayou at OUA0032
Figure F.4	Seasonal plot of chloride for Big Bayou at UWBGB01
Figure F.5	Seasonal plot of chloride for Oak Bayou at OUA0179
Figure F.6	Seasonal plot of TDS for Oak Bayou at OUA0179
Figure F.7	Seasonal plot of TDS for Boeuf River at OUA0015A
Figure F.8	Seasonal plot of sulfate for Oak Bayou at OUA0179
Figure G.1	Chloride vs. flow for Boeuf River at OUA0015A
Figure G.2	Chloride vs. flow for Boeuf River at UWBFR01
Figure G.3	Chloride vs. flow for Big Bayou at OUA0032
Figure G.4	Chloride vs. flow for Big Bayou at UWBGB01
Figure G.5	Chloride vs. flow for Oak Bayou at OUA0179
Figure G.6	TDS vs. flow for Oak Bayou at OUA0179

LIST OF FIGURES (CONTINUED)

Figure G.7	TDS vs. flow for Boeuf River at OUA0015A
Figure G.8	Sulfate vs. flow for Oak Bayou at OUA0179
Figure H.1	Summer flow duration curve for USGS 07369680 Bayou Macon near Eudora
Figure H.2	Summer TSS load duration curve for Boeuf River at OUA0015A
Figure H.3	Summer TSS load duration curve for Boeuf River at UWBFR01
Figure H.4	Summer TSS load duration curve for Big Bayou at OUA0032
Figure H.5	Summer TSS load duration curve for Big Bayou at UWBGB01
Figure H.6	Summer TSS load duration curve for Oak Bayou at OUA0179
Figure H.7	Summer TSS load duration curve for Bayou Macon at UWBYM01
Figure H.8	Summer TSS load duration curve for Bayou Macon at UWBYM02
Figure I.1	Winter flow duration curve for USGS 07369680 Bayou Macon near Eudora
Figure I.2	Winter TSS load duration curve for Boeuf River at OUA0015A
Figure I.3	Winter TSS load duration curve for Boeuf River at UWBFR01
Figure I.4	Winter TSS load duration curve for Big Bayou at OUA032
Figure I.5	Winter TSS load duration curve for Big Bayou at UWBGB01
Figure I.6	Winter TSS load duration curve for Oak Bayou at OUA0179
Figure I.7	Winter TSS load duration curve for Bayou Macon at UWBYM01
Figure I.8	Winter TSS load duration curve for Bayou Macon at UWBYM02
Figure J.1	Summer flow duration curve for USGS 07369680 Bayou Macon near Eudora
Figure J.2	Summer chloride load duration curve for Boeuf River at OUA0015A
Figure J.3	Summer chloride load duration curve for Boeuf River at UWBFR01
Figure J.4	Summer chloride load duration curve for Big Bayou at OUA032
Figure J.5	Summer chloride load duration curve for Big Bayou at UWBGB01
Figure J.6	Summer chloride load duration curve for Oak Bayou at OUA0179
Figure K.1	Winter flow duration curve for USGS 07369680 Bayou Macon near Eudora
Figure K.2	Winter chloride load duration curve for Boeuf River at OUA0015A
Figure K.3	Winter chloride load duration curve for Boeuf River at UWBFR01
Figure K.4	Winter chloride load duration curve for Big Bayou at OUA032
Figure K.5	Winter chloride load duration curve for Big Bayou at UWBGB01
Figure K.6	Winter chloride load duration curve for Oak Bayou at OUA0179
Figure L.1	Summer flow duration curve for USGS 07369680 Bayou Macon near Eudora
Figure L.2	Summer TDS load duration curve for Boeuf River at OUA0015A
Figure L.3	Summer TDS load duration curve for Oak Bayou at OUA0179

LIST OF FIGURES (CONTINUED)

- Figure M.1 Winter flow duration curve for USGS 07369680 Bayou Macon near Eudora
Figure M.2 Winter TDS load duration curve for Boeuf River at OUA0015A
Figure M.3 Winter TDS load duration curve for Oak Bayou at OUA0179
- Figure N.1 Summer flow duration curve for USGS 07369680 Bayou Macon near Eudora
Figure N.2 Summer sulfate load duration curve for Boeuf River at OUA0015A
- Figure O.1 Winter flow duration curve for USGS 07369680 Bayou Macon near Eudora
Figure O.2 Winter sulfate load duration curve for Boeuf River at OUA0015A

1.0 INTRODUCTION

This report presents total maximum daily loads (TMDLs) for siltation/turbidity, chloride, sulfate, and total dissolved solids (TDS) for six stream reaches in the Boeuf River and Bayou Macon basins in southeastern Arkansas. Each of these stream reaches was included on the 2002 Arkansas 303(d) list (ADEQ 2002a) as not supporting its designated use of aquatic life. The sources of contamination and causes of impairment from the 303(d) listing are shown in Table 1.1. The TMDLs in this report were developed in accordance with Section 303(d) of the Federal Clean Water Act and the Environmental Protection Agency's (EPA) regulations in 40 CFR 130.7.

The purpose of a TMDL is to determine the pollutant loading that a waterbody can assimilate without exceeding the water quality standard for that pollutant and to establish the load reduction that is necessary to meet the standard in a waterbody. The TMDL is the sum of the wasteload allocation (WLA), the load allocation (LA), and a margin of safety (MOS). The WLA is the load allocated to point sources of the pollutant of concern, and the LA is the load allocated to nonpoint sources (NPS). The MOS is a percentage of the TMDL that takes into account any lack of knowledge concerning the relationship between pollutant loadings and water quality.

Table 1.1. 303(d) listing for stream reaches in this task order.

Reach No.	Stream Name	Source	Major cause	Minor cause(s)	Priority
08050001-022	Big Bayou	Agriculture	Siltation/turbidity	Chloride	Low
08050001-018	Boeuf River	Agriculture	Siltation/turbidity	Chloride, TDS*, Sulfate*	Low
08050001-019	Boeuf River	Agriculture	Siltation/turbidity	Chloride	Low
08050002-010	Oak Bayou	Agriculture	Siltation/turbidity	Chloride, TDS	Low
08050002-003	Bayou Macon	Agriculture	Siltation/turbidity	--	Low
08050002-006	Bayou Macon	Agriculture	Siltation/turbidity	--	Low

*Note: The 2002 final 303(d) list included all of the impairments shown in this table except TDS and sulfate for the Boeuf River (reach -018), which have been added to the 2004 FINAL 303(d) list.

2.0 BACKGROUND INFORMATION

2.1 General Information

The study area for this project consists of the Boeuf River and Bayou Macon basins in southeastern Arkansas (see Figure A.1 in Appendix A). For both basins, the headwaters begin southeast of Pine Bluff and the general drainage pattern is southward into Louisiana. These basins are bounded on the west by the Bayou Bartholomew basin, and on the north and east by levees along the Arkansas River and Mississippi River. Both basins lie entirely within the Delta ecoregion. The Boeuf River and its tributaries (including Big Bayou, Choctaw Bayou, and Cypress Creek) form United States Geological Survey (USGS) Hydrologic Unit 08050001. Bayou Macon and its tributaries (including Oak Bayou and Clay Bayou) form USGS Hydrologic Unit 08050002. The Arkansas portion of these basins is designated by ADEQ as Planning Segment 2A. The drainage area of the Boeuf River at the Arkansas – Louisiana state line is 755 mi² (USGS 1979). The drainage area of Bayou Macon at the Arkansas – Louisiana state line is 518 mi² (USGS 1979). The two counties that cover most of the Arkansas portion of these basins are Chicot and Desha.

2.2 Topography

The topography of the Boeuf River and Bayou Macon basins is mostly level with a few areas that are slightly undulating (USDA 1967, USDA 1972, COE 2001). In general, the typical slope of most of the land in these basins is about 0.5 ft of drop per 100 ft of distance (USDA 1967, USDA 1972). Some parts of this area are poorly drained and tend to flood for at least a month or more during most years (USDA 1972). One distinct topographic feature is Macon Ridge, which starts near Eudora and extends to the southwest into Louisiana (USDA 1967).

2.3 Soils

Soil characteristics for the Boeuf River and Bayou Macon basins are provided by the soil surveys for Chicot and Desha Counties (USDA 1967, USDA 1972) and by the STATSGO database, which is maintained by the USDA Natural Resources Conservation Service (NRCS). The STATSGO soils data are developed on a 1:250,000 scale and are not as detailed as the county soil surveys (prepared at a 1:24,000 scale). The NRCS is in the process of converting 1:24,000 scale data from county soil surveys into GIS format for its SSURGO database, but the SSURGO data are not yet available for much of the Boeuf River and Bayou Macon basins within Arkansas.

Figure A.2 (located in Appendix A) shows the spatial distribution of different soils based on data from the STATSGO database. The western part of the study area is covered mostly by the Perry-Portland-Rilla and the Rilla-Herbert-Perry groups of soils. The soil textures that are most common in these two groups are clay, silt loam, and silty clay. Much of the eastern part of the study area is covered by the Sharkey-Alligator-Tunica group of soils, which includes silty clay and clay soils.

2.4 Land Use

Land use data for the Arkansas portion of the Boeuf River and Bayou Macon basins were obtained from the GEOSTOR database, which is maintained by the Center for Advanced Spatial Technology (CAST) at the University of Arkansas in Fayetteville. These data were based on satellite imagery from 1999. The spatial distribution of these land uses is shown on Figure A.3 (located in Appendix A) and land use percentages are shown in Table 2.1. These data indicate that over 86% of the study area consists of cropland (soybeans, cotton, rice, sorghum, and corn). The area classified as open water should include catfish ponds, which cover approximately 17,300 acres in Chicot County and 2,750 acres in Desha County (AASS 2002). The combined acreage of catfish ponds for these two counties represents about 2.4% of the study area.

Table 2.1. Land use percentages for the study area.

Land use	Percentage of study area
Soybeans	46.5%
Cotton	26.5%
Rice	11.7%
Deciduous forest	4.8%
Water	4.8%
Mixed forest	2.5%
Urban	1.6%
Sorghum/corn	1.4%
Barren	0.2%
Total	100.0%

2.5 Description of Hydrology

Average precipitation for the study area is about 50-53 inches per year (USGS 1985a). Average monthly precipitation values for Arkansas City (near McGehee) are shown on Figure 2.1; these values are highest during winter and spring and lowest during summer and early fall.

The USGS has published daily stream flow data for the Boeuf River and Bayou Macon basins at one location in Arkansas and two locations in Louisiana just south of the Arkansas state line. The locations of these flow gages are shown on Figure A.4 (located in Appendix A). Basic information and statistics for these gages are summarized in Table 2.2. Recent flow data are available for only one of these three gages (Bayou Macon at Eudora). The average monthly flows for Bayou Macon at Eudora are shown on Figure 2.2; these values are highest for January and February and lowest for September and October.

There are several canals and ditches connecting the Boeuf River and Bayou Macon. These connections allow some of the stream flow in one basin to be diverted to the other basin. The fraction of water that is diverted from one basin to the other is variable and can be affected by things such as local rainfall patterns, hydraulic resistance from debris in each stream, etc. A Corp of Engineers pumping station that is located north of Lake Chicot diverts runoff from the northern part of the Bayou Macon basin into the Mississippi River. The location of this pumping

station is shown on Figure A.4. This pumping station was built in 1985 to reduce the amount of silt-laden runoff entering Lake Chicot; since then, the clarity in Lake Chicot has improved greatly. When water levels in the Mississippi River are high, up to 6500 cfs of water can be pumped through the levee into the Mississippi River; during other times, the structure allows water to flow by gravity through the levee into the Mississippi River (COE 2000).

In some instances, the flow in these basins is influenced by withdrawals of irrigation water directly from bayous or canals and by return flows of irrigation water draining from the fields. Most irrigation water, though, is withdrawn from groundwater. A database obtained from the Arkansas Soil and Water Conservation Commission (ASWCC) showed that there are over 800 surface water withdrawal sites and over 4500 groundwater withdrawal sites within the Arkansas portion of the Boeuf River and Bayou Macon basins. Approximately 98% of these withdrawal sites are for irrigation.

Table 2.2. Information for stream flow gaging stations (USGS 2002a and USGS 2004).

	Bouef River near AR/LA state line	Bayou Macon near Kilbourne, LA	Bayou Macon at Eudora, AR
USGS gage number	07367700	07369700	07369680
Descriptive location	LA Hwy 835, 2 miles south of AR/LA state line	LA Hwy 585, 3-4 miles east of Kilbourne, LA	US Hwy 65 along south edge of Eudora, AR
Period of record	Oct 1957 to Sep 1968 (continuous); Oct 1968 to Sep 2003 (scattered)	Oct 1957 to Sep 1968 (continuous); Oct 1968 to Feb 1987 (scattered)	October 1988 to current
Drainage area (mi ²)	785	504	500
Mean annual flow (cfs)	875	467	277

2.6 Irrigation

Based on 2001 data for Chicot and Desha counties, approximately 55% to 70% of the soybean acreage and 76% to 77% of the cotton acreage is irrigated (AASS 2002). Essentially 100% of the rice acreage is irrigated. Although more water is used for rice than for other crops, the average depth of irrigation water applied in Chicot and Desha counties is approximately 21 to 22 inches per year. The irrigation method used for virtually all rice and for some soybeans is flood irrigation with contour levees; furrow irrigation and a small amount of sprinkler irrigation (center pivot systems) are used on other soybean acreage and for cotton. With both flood irrigation and furrow irrigation, there is usually some water that eventually drains from the surface of the field into ditches or canals (Scott et. al. 1998). The timing of this drainage is variable, although a significant quantity of drainage occurs when rice fields are drained in late summer prior to harvest.

Figure 2.1. Mean Monthly Precipitation in Arkansas City, AR

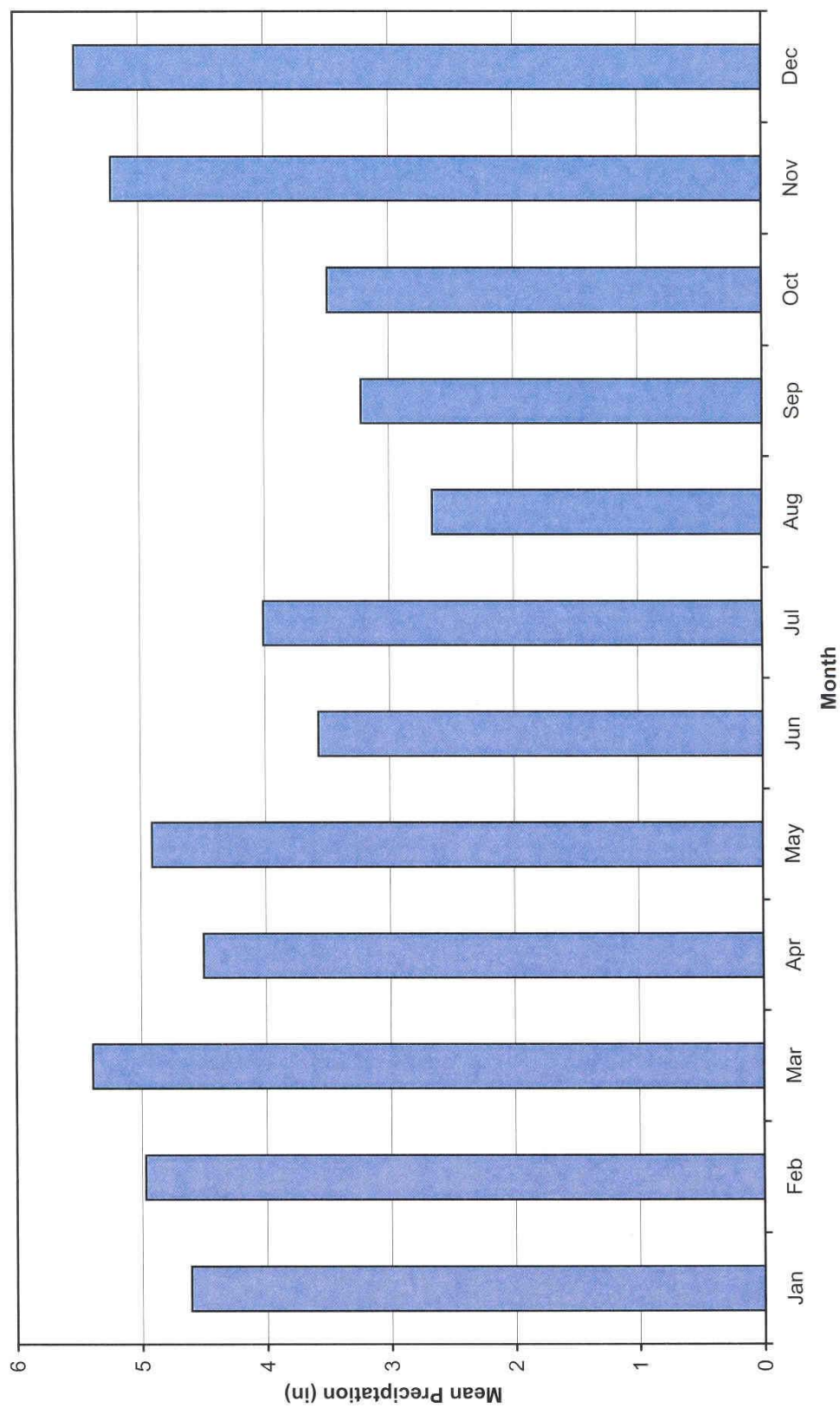
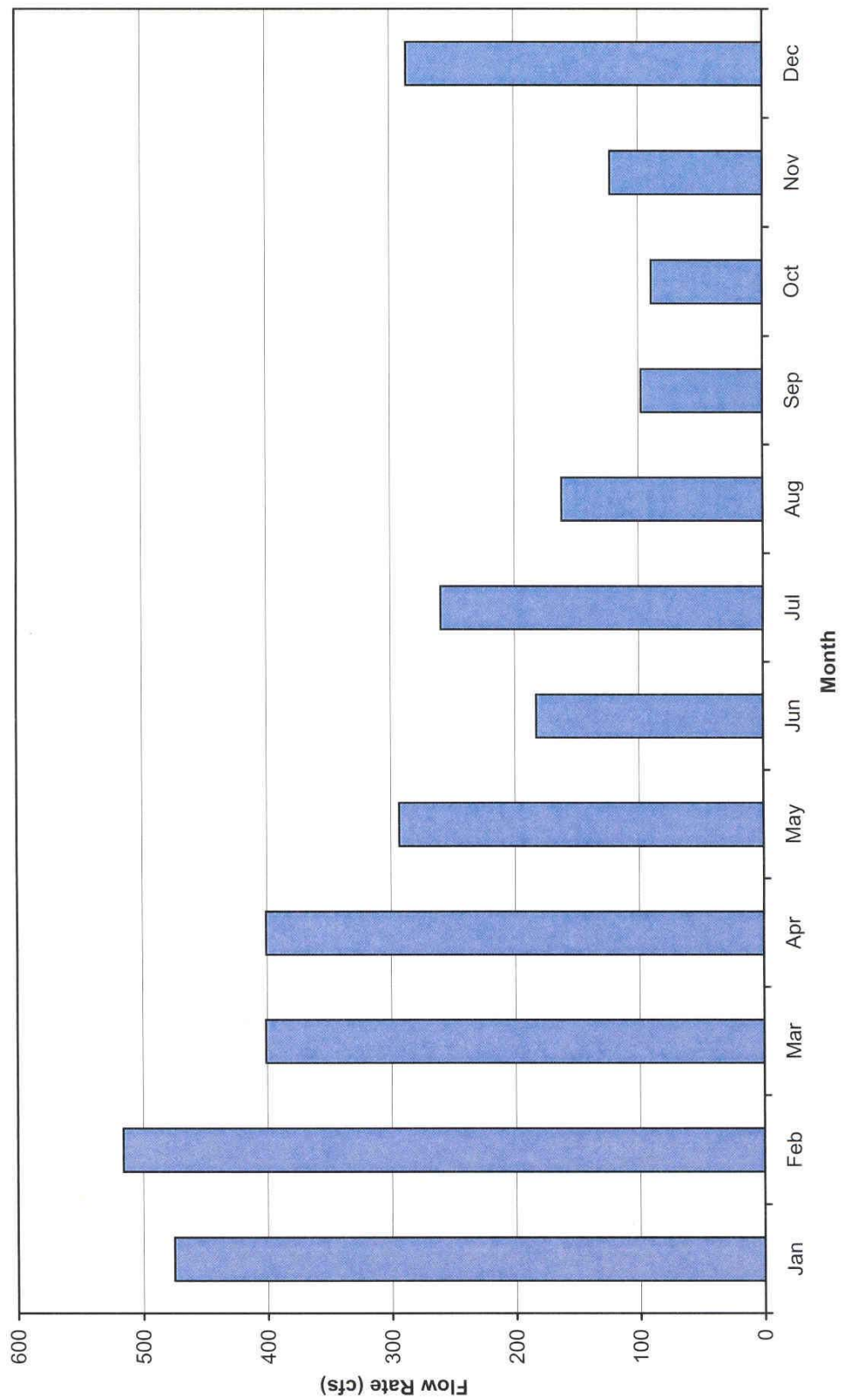


Figure 2.2. Mean Monthly Flows for Bayou Macon near Eudora, AR



2.7 Channel Network

Figure A.4 shows the stream channel network for the study area based on EPA's "Reach File 3" data. Many of the smaller stream channels have been straightened and/or deepened. In the latest 305(b) report, the discussion of water quality for planning segment 2A states that "the majority of the waters in this segment have been severely altered by channelization, ditching, and rerouting the drainage patterns" (ADEQ 2002a). Another description of this area states that "all of the major streams in the study area are either manmade canals or have been channelized. The canals and channelized streams are primarily flood control projects" (COE 2001). The Desha County soil survey states that "there is an intricate complex of drainage ditches in the county. Most of the major ones have recently been cleaned out, and the channels have been enlarged. This extensive system greatly improves the surface drainage of the county" (USDA 1972). These references support the use of the channel-altered designation for these six stream reaches listed in Table 2.3. There are also a few oxbow lakes that have been formed by changes in stream courses.

2.8 Water Quality Standards

Water quality standards for Arkansas waterbodies are listed by ecoregion in Regulation No. 2 (ADEQ 2002b). The Boeuf River and Bayou Macon basins are entirely within the Delta ecoregion. Designated uses for these basins include primary and secondary contact recreation; domestic, industrial, and agricultural water supply; and perennial Delta ecoregion fishery (for streams with at least 10 mi² of drainage area).

Section 2.503 of Regulation No. 2 provides both a narrative standard and a numeric standard that apply to siltation/turbidity. The general narrative standard is: "There shall be no distinctly visible increase in turbidity of receiving waters attributable to municipal, industrial, agricultural, other waste discharges or instream activities." The numeric turbidity standard for streams in the Delta ecoregion is 45 NTU for "least-altered" streams and 75 NTU for "channel-altered" streams. Regulation No. 2 does not include definitions of "least-altered" streams or "channel-altered" streams. Based on field observations and information mentioned in Section 2.7, ADEQ considers all six reaches in Table 1.1 to be channel-altered streams.

Section 2.511 of Regulation No. 2 lists numeric standards for chloride, TDS, and sulfate that are specific to Bayou Macon and the Boeuf River, as well as for other streams in the Delta ecoregion. The ecoregion standards for chloride, TDS, and sulfate are based on data from least disturbed reference streams plus allowable increases. The appropriate numeric criteria from the standards that were used for the TMDLs in this report are shown in Table 2.3.

Table 2.3. Numeric water quality standards for TMDLs in this report.

Reach No.	Stream Name	Least-altered or Channel-altered	Turbidity standard (NTU)	Chloride standard (mg/L)	TDS standard (mg/L)	Sulfate standard (mg/L)
08050001-018	Boeuf River	Channel-altered	75	90	460	30
08050001-019	Boeuf River	Channel-altered	75	90	--	--
08050001-022	Big Bayou	Channel-altered	75	48	--	--
08050002-010	Oak Bayou	Channel-altered	75	48	411	--
08050002-003	Bayou Macon	Channel-altered	75	--	--	--
08050002-006	Bayou Macon	Channel-altered	75	--	--	--

Note: Chloride, TDS, and sulfate standards are shown only for reaches that are impaired for those parameters.

As specified in EPA's regulations at 40 CFR 130.7(b)(2), applicable water quality standards include antidegradation requirements. Arkansas' antidegradation policy is listed in Sections 2.201 – 2.204 of Regulation No. 2. These sections impose the following requirements:

- 1) Existing instream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected.
- 2) Water quality that exceeds standards shall be maintained and protected unless allowing lower water quality is necessary to accommodate important economic or social development, although water quality must still be adequate to fully protect existing uses.
- 3) For outstanding state or national resource waters, those uses and water quality for which the outstanding waterbody was designated shall be protected.
- 4) For potential water quality impairments associated with a thermal discharge, the antidegradation policy and implementing method shall be consistent with Section 316 of the Clean Water Act.

2.9 Nonpoint Sources

Nonpoint sources of pollution in the study area are discussed in the 2002 305(b) report. For planning segment 2A (the Boeuf River and Bayou Macon basins), this report states that “the aquatic life use may be impaired due to frequent and very high turbidity and suspended solids values. It is clear that these conditions are caused by the runoff from intensive row crop agriculture which is the dominant land use within this segment” (ADEQ 2002a). Concerning nonpoint sources of chloride, the 305(b) report states that “elevated chlorides occur in lower Boeuf River and Big Bayou; this is probably from discharges of irrigation water taken from deep aquifers” (ADEQ 2002a).

2.10 Point Sources

Information for point source discharges in the Boeuf River and Bayou Macon basins (hydrologic units 08050001 and 08050002) was obtained by searching the Permit Compliance System on the EPA web site (PCS 2004). The search yielded 19 facilities with point source discharges. Search results, including flow rate and permit limits for total suspended solids (TSS), are included in Table 2.4. None of the facilities has permit limits for turbidity, chloride, sulfate, or TDS.

Locations of the permitted facilities are shown on Figure A.6 in Appendix A. Any point source discharges authorized under a general permit (rather than an individual permit) would not be revealed by this search.

2.11 Previous Water Quality Studies

There were several previous water quality studies that were particularly relevant for the TMDLs in this report. One of the studies was a water quality and biological assessment of the Boeuf River basin in Arkansas (USGS 2002b). This study included a water quality survey under relatively low flow conditions during November-December 1994 with turbidity measurements at 20 sites and chloride measurements at 24 sites. The turbidity values were above 75 NTU at 13 of the 20 sites (65%). The chloride values were above the ecoregion standard of 48 mg/L at only 4 out of 24 sites (17%); these values probably would have been higher if the survey had been conducted earlier in the year when irrigation water was draining from fields. This study also included monitoring of runoff during 11 different storms from a cotton field and from a forested area. Most of the turbidities from the cotton field runoff were between 18 NTU and 2,300 NTU, while most of the turbidities from the forested area were between 5 NTU and 71 NTU. The highest turbidities from the cotton field runoff occurred during March and April.

Another previous water quality study was a USGS investigation of saltwater in the alluvial aquifer in the Boeuf-Tensas basin (USGS 1985b). (Note: Because Bayou Macon flows into the Tensas basin in Louisiana, the Boeuf River and Bayou Macon basins are often referred to collectively as the Boeuf-Tensas basin.) This study showed that chloride concentrations in the alluvial aquifer were less than 200-300 mg/L in most of the study area except for the area between the Boeuf River and the southern part of Big Bayou, where concentrations ranged up to 1200 mg/L. The results of this study are relevant to the TMDLs in this report because the vast majority of irrigation water throughout the study area is from the alluvial aquifer. The fact that Bayou Macon is not on the 303(d) list for chloride is likely due at least in part to relatively lower chloride concentrations in the alluvial aquifer in the southeastern corner of the study area. A third relevant study is the Southeast Arkansas Feasibility Study (SAFS), which is an ongoing project being conducted by the Vicksburg District Corps of Engineers. This is not primarily a water quality study, but the purpose of the study is to “investigate measures for providing a plan for the development, utilization, and conservation, of water and related land resources of the Boeuf-Tensas Basin, ... and coordinate with the Soil Conservation Service to jointly develop a multipurpose flood control and comprehensive agricultural water supply plan, including a system of distributary canals for Chicot, Desha, Drew, Lincoln, and Jefferson Counties in Southeast Arkansas” (COE 2001). The SAFS project was initiated in response to problems with flooding and with agricultural water supply (i.e., rapidly declining groundwater levels). In addition to promoting agricultural water conservation through efficient use of water, this project will likely

result in surface water sources of irrigation water being developed in the future. Using less groundwater and more surface water for irrigation would likely reduce the chloride concentrations in streams throughout this area. As part of the SAFS project, the Boeuf-Tensas Regional Irrigation Water Distribution District has been created to manage regional distribution of irrigation water in the future.

The fourth previous study is a Wetland Planning Area (WPA) report for the Boeuf-Tensas basin in Arkansas. Currently, the report for this study is not yet finished, but it is anticipated to be available soon.

Table 2.4. Inventory of point source dischargers.

NPDES permit number	Facility name	Flow rate (MGD)	Discharge path to RF-1 Reach	RF-1 reach that discharge flows into	RF-1 reach on 303d list for chloride, sulfate, or TDS?
AR0021679	Gould City Of	0.15	Trib Kerch Can Cypress Ck	08050001-020	No
AR0022071	McGehee City Of	0.6		08050001-022	Chloride
AR0022250	Dermott City Of-South Pond	1.2		08050001-022	Chloride
AR0033707	Tillar City Of	0.09	Can #18 Macon Bu Boeuf Rv	08050001-019	Chloride
AR0033987	Dumas City Of	1.37	Can #19 Bu Macon	08050001-020	No
AR0039381	Grady City Of	0.07	Can #19 Bu Macon	08050001-020	No
AR0041297	Montrose City Of	0.1	Wards Bu Trib	08050001-022	Chloride
AR0042838	Farmland Industries Inc-South	0.38	Bu Macon	08050002-003	No
AR0046507	AR Hwy Dept-McGehee Hq	0.0005	Dit Can#18 Macon Bu Macon L Caneybu	08050001-019	Chloride
ARG340056	Delta Farmers Assn-Grady		Choctaw Bu Walnut Lk	08050001-021	No
ARG640119	Eudora City Of-PWTP	0.08	Dit Caney Bu Ouachita Rv 2a	08050002-003	No
AR0021610	Watson City Of	0.09	Red Fork Bu	08050002-008	No
AR0021849	Lake Village City Of	0.82	Ltl Lake Bu Bu Macon Boeuf Rv	08050002-006	No
AR0033839	Eudora City Of	0.6	Bu Macon	08050002-003	No
AR0037125	Mitchellville City Of	0.06	Can #19 Cypress Ck Amos Bu Boggy Bu	08050001-020	No
AR0039039	Delta Special School District	0.01	Dit Boggy Bu Clay Bu	08050002-009	No
AR0040827	AR Dept Of Correction-Cummins	0.8	Can #19	08050001-020	No
AR0050008	Chicot County Park	0.013	Lk Chicot Ditch Bu Macon Bayou ...	08050002-005	No
AR0050091	Chicot County-Ditch Bayou Boat	0.0005	Ditch Bu, Bu Macon	08050002-004	No

3.0 EXISTING WATER QUALITY FOR TURBIDITY AND TSS

3.1 General Description of Data

Turbidity and total suspended solids (TSS) data have been collected by ADEQ at 7 sites along the 6 stream reaches that are impaired for siltation/turbidity within the study area. Locations of these sampling sites are shown on Figure A.7 (located in Appendix A). Tables 3.1 and 3.2 show summaries of these data by season, including percentages of values above water quality standards. TSS data are included in this summary because TSS is needed as a surrogate parameter for expressing the siltation/turbidity TMDLs. Time series plots of data for the entire period at each station are shown on Figures B.1 – B.7 for turbidity and Figures B.8 – B.14 for TSS (located in Appendix B). These data were obtained from the ADEQ and STORET web sites (ADEQ 2004, STORET 2004).

3.2 Seasonal Patterns

The seasons in Tables 3.1 and 3.2 were defined based on visual examination of plots of turbidity versus day of the year (Figures C.1 – C.7; located in Appendix C). Even though the water quality standard for turbidity does not vary seasonally, the data were evaluated by seasons to show how existing water quality varies seasonally and to provide additional insight concerning causes of water quality problems. At all 7 stations, turbidity values tend to be higher during winter (December through May) and lower during summer (June through November). The higher turbidities in winter may be due to larger amounts of runoff and less ground cover on cropland, both of which would allow greater amounts of erosion. The seasonal plots of TSS (Figures C.8 – C.14) show a similar but less consistent seasonal pattern.

3.3 Relationships Between Turbidity and Flow

Plots of turbidity versus stream flow were also developed to examine any correlation between these two parameters (Figures D.1 – D.7; located in Appendix D). These plots show little or no correlation between turbidity and stream flow. This lack of correlation between turbidity and stream flow was not considered unusual because similar results occurred for the Bayou Bartholomew basin (which is adjacent to the Boeuf River basin) (FTN 2003).

3.4 Relationships Between TSS and Turbidity

Plots of TSS versus turbidity for each station (Figures D.8-D.14) show a noticeable correlation, with higher turbidity levels tending to correspond with higher TSS concentrations. Linear regression was performed on the natural logarithms of turbidity and TSS; the results of these regressions are summarized in Table 3.3. The regressions were performed using the natural logarithms of the data (rather than the raw data values) because most data such as turbidity and TSS fit a lognormal distribution better than a normal distribution.

Table 3.1. Summary of turbidity data.

Station	Station description	Period of record	December – May				June - November			
			No. of values	Median value (NTU)	No. of values above 75 NTU	% of values above 75 NTU	No. of values	Median value (NTU)	No. of values above 75 NTU	% of values above 75 NTU
OUA0015A	Boeuf River near AR-LA State Line	4/4/77-2/17/04	143	205	130	91%	140	21	41	29%
UWBFR01	Boeuf River at Hwy 278, 4 mi W of Chicot	6/6/94-9/10/01	7	230	6	86%	8	27	2	25%
OUA0032	Big Bayou near Jerome	4/4/77-9/10/01	32	185	30	94%	35	35	7	20%
UWBGB01	Big Bayou at Hwy 278, 5 mi E of Portland	6/6/94-9/10/01	7	170	6	86%	8	33	0	0%
OUA0179	Oak Bayou south of Pea Ridge	11/7/00-9/11/01	3	260	2	67%	3	31	0	0%
UWBYM01	Bayou Macon at Hwy 65 near Eudora	6/6/94-9/10/01	7	100	5	71%	9	35	0	0%
UWBYM02	Bayou Macon 5 mi above McMillan Corner	6/6/94-1/22/01	5	380	5	100%	7	18	2	29%

Table 3.2. Summary of TSS data.

Station	Description	Period of record	December - May				June - November			
			No. of values	Min.	Median	Max.	No. of values	Min.	Median	Max.
OUA0015A	Boeuf River near AR-LA State Line	12/14/71-2/17/04	162	7	118	1396	167	7	31	479
UWBFR01	Boeuf River at Hwy 278, 4 mi W of Chicot	6/6/94-9/10/01	7	30	150	368	8	23	36	614
OUA0032	Big Bayou near Jerome	9/9/72-9/10/01	42	24	96	1810	60	4	44	1215
UWBGB01	Big Bayou at Hwy 278, 5 mi E of Portland	6/6/94- 9/10/01	7	37	59	526	8	18	36	49
OUA0179	Oak Bayou south of Pea Ridge	11/7/00-9/11/01	3	46	100	130	3	21	43	67
UWBYM01	Bayou Macon at Hwy 65 near Eudora	6/6/94-9/10/01	7	30	109	814	9	9	64	94
UWBYM02	Bayou Macon 5 mi above McMillan Corner	6/6/94-1/22/01	5	28	50	244	7	2	7	203

Table 3.3. Results of regressions between TSS and turbidity for each station.

Sampling station	Regression equation	Number of data	R ²	Significance level (P value)
OUA0015A	$\ln \text{TSS} = 0.7110 * \ln \text{Turbidity} + 1.035$	268	0.80	5.3×10^{-95}
UWBFR01	$\ln \text{TSS} = 0.7026 * \ln \text{Turbidity} + 1.088$	14	0.79	2.0×10^{-5}
OUA0032	$\ln \text{TSS} = 0.7988 * \ln \text{Turbidity} + 0.6446$	49	0.73	3.9×10^{-15}
UWBGB01	$\ln \text{TSS} = 0.7282 * \ln \text{Turbidity} + 0.9721$	15	0.80	6.4×10^{-6}
OUA0179	$\ln \text{TSS} = 0.4965 * \ln \text{Turbidity} + 2.028$	6	0.86	7.5×10^{-3}
UWBYM01	$\ln \text{TSS} = 0.7177 * \ln \text{Turbidity} + 1.443$	16	0.61	3.5×10^{-4}
UWBYM02	$\ln \text{TSS} = 0.7529 * \ln \text{Turbidity} - 0.0383$	12	0.84	2.7×10^{-5}

The strength of the linear relationship is measured by the coefficient of determination (R²) calculated during the regression analysis (Zar 1996). The R² value is the percentage of the total variation in ln TSS that is explained or accounted for by the fitted regression (ln turbidity). For example, for station OUA0015A, 80% of the variation in TSS is accounted for by turbidity and the remaining 20% of variation in TSS is unexplained. The unexplained portion is attributed to factors other than turbidity. The correlation between TSS and turbidity was considered to be good, with R² values ranging from 0.61 to 0.86. These values are higher than R² values for turbidity and TSS from other approved TMDLs in eastern Arkansas (FTN 2001, FTN 2003) and northeastern Louisiana (EPA 2002).

The statistical significance of each regression was evaluated by computing the “P value” for the slope for each regression. The P value is essentially the probability that the slope of the regression line is really zero. Thus, a low P value indicates that a non-zero slope calculated from the regression analysis is statistically significant. For all 7 stations, the P value was less than 0.01, which is considered acceptable. It should be noted that the station that had the highest R² value (OUA0179) also had the largest (i.e., least significant) P value due to the small number of data points. Also, the small number of data points caused the slope of the regression at station OUA0179 (0.4965) to be considerably different than the slopes for the other stations (0.7026 to 0.7988).

The data for all stations in the study area were combined to develop two seasonal regression equations shown in Table 3.4 and Figures D.15 and D.16. This conclusion is based on similarities in land use in the study area and most of the individual station regressions being close to the same slope. Several of the stations had relatively few readings and combining them lends weight to the result. The data shows a marked seasonality as shown in Appendix C. The small data sets for some stations would have produced weak regressions for two seasons. An additional benefit of combining the data is a single regression for each season will be used throughout the study area.

Table 3.4. Results of basin wide regressions between TSS and turbidity.

Season	Regression equation	Number of data	R ²	Significance level (P value)
Dec – May	$\ln \text{TSS} = 0.806 * \ln \text{Turbidity} + 0.467$	196	0.64	1.05×10^{-44}
Jun – Nov	$\ln \text{TSS} = 0.771 * \ln \text{Turbidity} + 0.893$	200	0.77	1.78×10^{-64}

4.0 EXISTING WATER QUALITY FOR CHLORIDE, TDS, AND SULFATE

4.1 General Description of Data

Chloride, total dissolved solids (TDS), and sulfate data have been collected by ADEQ at 5 sites along the 4 stream reaches that are impaired for chloride, sulfate, or TDS within the study area. Locations of these sampling sites are shown on Figure A.7. Table 4.1 shows summaries of these data by season, including percentages of values above water quality standards. Time series plots of data for the entire period at each station are shown on Figures E.1 – E.5 for chloride, Figures E.6 – E.7 for TDS, and Figure E.8 for sulfate (located in Appendix E). Chloride, TDS, and sulfate data are shown here only for the stations on stream reaches that are impaired for each parameter. These data were obtained from the ADEQ and STORET web sites (ADEQ 2004, STORET 2004).

4.2 Seasonal Patterns

The seasons in Table 4.1 were defined based on visual examination of plots of chloride, TDS, and sulfate versus day of the year (Figures F.1 – F.8; located in Appendix F). Even though the water quality standards for chloride, TDS, and sulfate do not vary seasonally, the data were evaluated by seasons to show how existing water quality varies seasonally and to provide additional insight concerning causes of water quality problems. These plots show that chloride, TDS, and sulfate values tend to be higher during summer (May through November) and lower during winter (December through April). This seasonal pattern was also shown by the higher percentages of values exceeding standards during summer (Table 4.1). Based on information discussed in Section 2.0, the higher concentrations of chloride, TDS, and sulfate in summer are assumed to be due to application of irrigation water that is high in dissolved minerals concentrations.

4.3 Relationships Between Concentration and Flow

Plots of chloride, TDS, and sulfate versus stream flow were also developed to examine any correlation between concentration and flow (Figures G.1 – G.8; located in Appendix G). These plots show that the highest concentrations usually occur during relatively low flow periods and high flow periods usually have low concentrations. This pattern is consistent with the assumption that irrigation water is the primary source of dissolved minerals in the impaired reaches. Because high flow periods usually have low concentrations, storm runoff from the watershed does not appear to be the cause of water quality standards violations for chloride, sulfate, or TDS.

Table 4.1. Summary of chloride and TDS data.

Station	Station description	Period of record	Parameter	Standard (mg/L)	December - April				May - November			
					No. of values	Median (mg/L)	No. of values above standard	% of values above standard	No. of values	Median (mg/L)	No. of values above standard	% of values above standard
OUA0015A	Boeuf River near AR-LA State Line	12/14/71 – 2/17/04	Chloride	90	154	15	1	1%	327	33	61	19%
			TDS	460	81	218	0	0%	123	326	25	20%
			Sulfate	30	135	11	7	5%	188	26	73	39%
UWBFR01	Boeuf River at Hwy 278, 4 mi W of Chicot	6/6/94 – 9/10/01	Chloride	90	5	17	0	0%	10	58	3	30%
OUA0032	Big Bayou near Jerome, AR	6/11/74 – 9/10/01	Chloride	48	38	14	1	3%	53	49	29	55%
UWBGB01	Big Bayou at Hwy 278, 5 mi E of Portland	6/6/94 – 9/10/01	Chloride	48	5	19	1	20%	10	91	8	80%
OUA0179	Oak Bayou south of Pea Ridge	11/7/00 – 9/11/01	Chloride	48	2	8	0	0%	4	120	4	100%
			TDS	411	2	219	0	0%	4	532	4	100%

5.0 TMDL DEVELOPMENT

5.1 Seasonality and Critical Conditions

EPA's regulations at 40 CFR 130.7 require the determination of TMDLs to take into account critical conditions for stream flow, loading, and water quality parameters. Also, both Section 303(d) of the Clean Water Act and regulations at 40 CFR 130.7 require TMDLs to consider seasonal variations for meeting water quality standards. Therefore, the historical data and analyses discussed in Sections 3.0 and 4.0 were used to evaluate whether there were certain flow conditions or certain periods of the year that could be used to characterize critical conditions.

For the turbidity TMDLs, no significant relationships were found between turbidity and stream flow, but the seasonal plots of turbidity (Figures C.1 – C.7) showed higher values during the winter months (December through May) compared to the summer months (June through November). Therefore, the turbidity TMDLs were developed based on these seasons, but not for a specific flow condition. The methodology used to develop these TMDLs (load duration curve) addresses a wide range of flow conditions.

For chloride, TDS, and sulfate, the high concentrations tended to occur at low stream flows and during the summer months (May through November), while the concentrations at high stream flows and during winter months (December through April) were generally low. Therefore, the chloride, TDS, and sulfate TMDLs were developed using these seasons. The methodology used to develop these TMDLs (load duration curve) addresses a wide range of flow conditions.

5.2 Water Quality Targets

Turbidity is an expression of the optical properties in a water sample that cause light to be scattered or absorbed and may be caused by suspended matter, such as clay, silt, finely divided organic and inorganic matter, soluble colored organic compounds, and plankton and other microscopic organisms (Standard Methods 1999). Turbidity cannot be expressed as a load as preferred for TMDLs. To achieve a load based value, turbidity is often correlated with a surrogate parameter such as TSS that may be expressed as a load. For the turbidity TMDLs in this report, the basin wide relationships between turbidity and TSS presented in Table 3.4 were used to develop target TSS concentrations (i.e., numeric endpoints for the TMDLs). These relationships and the resulting target TSS concentrations are shown in Table 5.1.

Table 5.1. Target TSS concentrations for turbidity TMDLs.

Season	Regression equation	Turbidity standard	Target TSS concentration
Winter (Dec – May)	$\ln \text{TSS} = 0.806 * \ln \text{Turbidity} + 0.467$	75 NTU	52 mg/L
Summer (June – Nov)	$\ln \text{TSS} = 0.771 * \ln \text{Turbidity} + 0.893$	75 NTU	68 mg/L

The water quality targets for chloride and TDS were simply the water quality standards shown in Table 2.3 (90 mg/L chloride for Boeuf River, 48 mg/L chloride for other streams, 411

mg/L TDS for Oak Bayou, 460 mg/L TDS for Boeuf River, and 30 mg/L sulfate for Boeuf River). Chloride, TDS, and sulfate can easily be expressed as mass, so there was no need to use surrogate parameters.

5.3 Methodology for TMDL Calculations

The methodology used for all of the TMDLs in the report is the load duration curve. Because loading capacity varies as a function of the flow present in the stream, these TMDLs represent a continuum of desired loads over all flow conditions, rather than fixed at a single value. The basic elements of this procedure are documented on the Kansas Department of Health and Environment web site (KDHE 2003). This method was used to illustrate allowable loading at a wide range of flows. The steps for how this methodology was applied for the TMDLs in this report can be summarized as follows:

1. Develop a flow duration curve (Section 5.4)
2. Convert the flow duration curve to load duration curves (Section 5.5)
3. Plot observed loads with load duration curves (Section 5.6)
4. Calculate TMDL, MOS, WLA, and LA (Section 5.7)
5. Calculate percent reductions required to meet assessment criteria (Section 5.10)

5.4 Flow Duration Curve

A flow per unit area duration curve was developed for each season for the whole study area. Daily streamflow measurements from Bayou Macon at Eudora (USGS gage number 07369680) were separated into summer and winter data sets and each data set was sorted in increasing order and the percentile ranking of each flow was calculated. The data from the Eudora gage were used because the load duration methodology requires that the same flow data be used for developing the flow duration as for calculating observed loads from sampling data (the Eudora gage was the only flow gage with data during the years that water quality sampling occurred).

Because flows at the Eudora gage represented only a portion of the total flow in the watershed, the flows were adjusted. The only time period when flows were published for both Boeuf River and Bayou Macon was 1957-68, which is the period of record for continuous flows for Boeuf River near AR-LA state line (USGS gage number 07367700) and Bayou Macon near Kilbourne, LA (USGS gage number 07369700). Based on the mean annual flows from these two USGS gages (07367700 and 07369700), Bayou Macon represented approximately 34.8% of the total flow from both streams. Therefore, the flows for Bayou Macon at Eudora (07369680) were divided by 34.8%. In order to develop a flow duration curve to be used for different stream reaches with different drainage areas, the adjusted flows for Bayou Macon at Eudora were then divided by 1289 mi², which is the combined drainage area for the two flow gages near the state line (Boeuf River near AR-LA state line and Bayou Macon near Kilbourne). For each season, these adjusted flows per unit area were then plotted against their corresponding percent exceedances to yield the flow duration curves shown in Figures H.1 and I.1 (in Appendices H and I) for summer and winter, respectively.

5.5 Load Duration Curves

For each season and for each TMDL parameter (TSS, chloride, TDS, and sulfates), the adjusted flows per unit area from the flow duration curves were multiplied by the appropriate target concentration (from Section 5.2) to make an allowable load per unit area duration curve. Each load duration curve is a plot of tons per day per mi² of drainage area versus the percent exceedances from the flow duration curves. The eight sets of load duration curves are presented in the following appendices:

APPENDIX H:	load duration curve for TSS during summer
APPENDIX I:	load duration curve for TSS during winter
APPENDIX J:	load duration curve for chloride during summer
APPENDIX K:	load duration curve for chloride during winter
APPENDIX L:	load duration curve for TDS during summer
APPENDIX M:	load duration curve for TDS during winter
APPENDIX N:	load duration curve for sulfate during summer
APPENDIX O:	load duration curve for sulfate during winter

The calculations for these load duration curves are shown in Tables H.1, I.1, J.1, K.1, L.1, M.1, N.1, and O.1. Because the load duration curves were expressed per unit of drainage area, each curve was applicable at all sampling stations and for all stream reaches.

The load duration curve is beneficial when analyzing monitoring data with its corresponding flow information plotted as a load. This allows the monitoring data to be placed in relation to its place in the flow continuum. Assumptions of the probable source or sources of the impairment can then be made from the plotted data.

The load duration curve shows the calculation of the TMDL at any flow rather than at a single critical flow. The official TMDL number is reported as a single number, but the curve is provided to demonstrate the value of the acceptable load at any flow. This will allow analysis of load cases in the future for different flow regimes.

5.6 Observed Loads

For each season and each sampling station, observed loads were calculated by multiplying each observed concentration of TSS, chloride, TDS, or sulfate by the adjusted flow per unit area on the sampling day (calculations to obtain adjusted flows per unit area were discussed in Section 5.4). These observed loads were then plotted versus the percent exceedances of the flow per unit area on the sampling day and placed on the same plot as the load duration curve. These plots are shown in the appendices of this report as follows:

Figures H.2 – H.8:	plots of loads for TSS during summer
Figures I.2 – I.8:	plots of loads for TSS during winter
Figures J.2 – J.6:	plots of loads for chloride during summer
Figures K.2 – K.6:	plots of loads for chloride during winter
Figures L.2 – L.3:	plots of loads for TDS during summer
Figures M.2 – M.3:	plots of loads for TDS during winter

Figure N.2: plot of loads for sulfate during summer
Figure O.2: plot of loads for sulfate during winter

These plots provide visual comparisons between observed and allowable loads under different flow conditions. Observed loads that are plotted above the load duration curve (identified as “TMDL” curve in the legend) represent conditions where observed water quality concentrations exceed the target concentrations. Observed loads below the load duration curve represent conditions where observed water quality concentrations were less than target concentrations (i.e., not violating water quality standards).

The observed loads of TSS that occurred during the highest 10% of stream flows are not shown on Figures H.2 – H.8 and Figures I.2 – I.8. These loads were not included in the TMDL calculations because it is not considered feasible to control TSS during extremely high flows. This exclusion of data during the highest 10% of stream flows has been widely used for load duration curves throughout the U.S.

5.7 TMDL and MOS

Each TMDL was calculated as the area under the load duration curve. Because the load duration curves were expressed in mass per unit drainage area, the area under the curve was multiplied by the estimated area draining directly to that reach (i.e., excluding areas draining into upstream reaches). Due to the many hydraulic connections between different streams, delineation of drainage areas required some assumptions concerning direction of flow in connecting channels. For each turbidity TMDL, the allowable load during the highest 10% of stream flows was excluded (i.e., the TMDL was calculated as the area under the load duration curve between the 10% flow exceedance and the 100% flow exceedance). As mentioned in Section 5.6, this exclusion of loads for the highest 10% of stream flows has been widely used for load duration curves throughout the U.S. because it is not considered feasible to control TSS during extremely high flows.

Both Section 303(d) of the Clean Water Act and regulations at 40 CFR 130.7 require TMDLs to include a MOS to account for uncertainty in available data or in the actual effect that controls will have on the loading reductions and receiving water quality. The MOS may be expressed explicitly as unallocated assimilative capacity or implicitly through conservative assumptions used in establishing the TMDL. For the turbidity TMDLs, an implicit MOS was incorporated through the use of conservative assumptions. The primary conservative assumption was calculating the turbidity TMDLs assuming that TSS is a conservative parameter and does not settle out of the water column. For the TDS, chloride, and sulfate TMDLs, an explicit MOS was established as 10% of the TMDL .

5.8 Point Source Loads

For the turbidity TMDLs, the WLAs for the point sources were set to ~~NA~~ ~~zero~~ because the surrogate being used for turbidity (TSS) is considered to represent inorganic suspended solids (i.e., soil and sediment particles from erosion or sediment resuspension). The suspended solids discharged by point sources in the Bayou Macon and Boeuf River basins are assumed to consist primarily of organic solids rather than inorganic solids. Discharges of organic suspended solids from point sources are already addressed by ADEQ through their permitting of point sources to

maintain water quality standards for DO. The WLAs to support the six turbidity TMDLs will not require any changes to the permits concerning inorganic suspended solids. It then follows that future growth for these permits or new permits wouldn't be restricted by these turbidity TMDLs.

For the chloride TMDLs, the WLAs for the point sources were calculated by determining the combined design flow of all of the point sources that discharge to that reach and multiplying that total flow times an assumed effluent chloride concentration of 60 mg/L. This assumed chloride concentration was based on the measured value in the NPDES permit application for the City of Dermott wastewater treatment plant; no other effluent concentrations of chloride were found among NPDES permit applications for dischargers in the study area. The value of 60 mg/L of chloride was consistent with literature values for medium strength domestic wastewater (Metcalf & Eddy 1991). The WLAs for the TDS and sulfate TMDLs were zero because no point sources discharge into Oak Bayou (reach 08050002-010) or the Boeuf River (reach 08050001-018). The five WLAs for individual point sources are summarized in Appendix P. WLAs are not needed for the other 14 point sources listed in Table 2.4 because they do not discharge to a reach that is impaired due to chloride, sulfate, or TDS.

Future growth for the point sources discharging to the Boeuf River (reach 08050001-019) is not limited by these TMDLs as long as the effluent concentrations of chloride are less than the water quality standard of 90 mg/L. As demonstrated by the load duration curve, the assimilative capacity for chloride in the stream increases as the total amount of flow in the stream increases. Therefore, as the flow from point source discharges increases, the allowable chloride loading for point sources also increases. For the point sources discharging to the Boeuf River (reach 08050001-019), no portion of the TMDL was explicitly designated as future growth.

Future growth for the point sources discharging to Big Bayou (reach 08050001-022) was calculated by allowing an arbitrary 50% increase in the current design flow rates with no change in the effluent concentration of 60 mg/L chloride. Because the assumed effluent concentration was greater than the water quality standard of 48 mg/L chloride for Big Bayou, the portion of the increase that was above the standard (12 mg/L multiplied by 50% of current design flows) was explicitly designated as future growth.

Although the chloride, TDS, and sulfate TMDLs for other reaches do not include any WLAs or future growth, new point sources could begin discharging to those reaches and grow without being limited by these TMDLs as long as their discharge concentrations were at or below the water quality standards for the parameter(s) for which the reach was impaired.

5.9 Nonpoint Source Loads

For the turbidity TMDLs, the LAs for nonpoint sources were set equal to the TMDLs because the WLAs were ~~NA~~ zero and the MOS was implicit. For the chloride, sulfate, and TDS TMDLs, each LA was calculated as the TMDL minus the sum of the WLA, the MOS, and future growth.

Calculations for the TMDLs, WLAs, and LAs are shown in the appendices of this report as follows:

Tables H.2 – H.8:	calculations for TSS during summer
Tables I.2 – I.8:	calculations for TSS during winter
Tables J.2 – J.6:	calculations for chloride during summer

Tables K.2 – K.6: calculations for chloride during winter
Table L.2 – L.3: calculations for TDS during summer
Table M.2 – M.3: calculations for TDS during winter
Table N.2: calculations for sulfate during summer
Table O.2: calculations for sulfate during winter

5.10 Percent Reductions

In addition to calculating allowable loads, estimates were made for percent reductions of nonpoint source loads that would be necessary for each impaired reach to meet water quality standards. Each load percent reduction was calculated from the following equation:

$$\text{Load percent reduction} = 100\% \times (\text{Existing load} - (\text{TMDL} - \text{MOS})) / \text{Existing load}$$

These load percent reductions are shown along with the results of the TMDL calculations in Tables 5.2 – 5.9.

In addition to calculating percent reductions based on average loads as shown above, the observed loads were also analyzed to see what percent reductions would be needed for the observed data to meet ADEQ's assessment criteria for supporting designated uses (ADEQ 2002a). The observed loads of TSS, chloride, TDS, and sulfate at each sampling station and for each season were reduced by certain percentages until the number of loads above the load duration curve (i.e., the number of exceedances) was within the allowable number of exceedances for supporting designated uses. For TSS, the allowable numbers of loads above the load duration curve were calculated as the number of observed values times 25% (and then rounded up to the next whole number). For chloride, TDS, and sulfate, the allowable numbers of loads above the load duration curve were calculated as the number of observed values times 10% (and then rounded up to the next whole number). The results of these percent reduction calculations are shown in the same tables as for the TMDL, WLA, and LA calculations (tables are listed by parameter and season in Section 5.9). These percent reductions based on meeting the assessment criteria were provided only as supplemental information; the load percent reductions are the values that should be used for implementation of these TMDLs.

Table 5.2. Summary of turbidity TMDLs for June through November (summer).

Reach ID	Stream name	Loads (tons/day of TSS)					Percent reduction needed
		WLA	LA	MOS	Future growth	TMDL	
08050001-018	Boeuf River	<u>0NA</u>	6.39	implicit	0	6.39	0%
08050001-019	Boeuf River	<u>0NA</u>	6.27	implicit	0	6.27	0%
08050001-022	Big Bayou	<u>0NA</u>	6.72	implicit	0	6.72	0%
08050002-010	Oak Bayou	<u>0NA</u>	4.84	implicit	0	4.84	0%
08050002-006	Bayou Macon	<u>0NA</u>	2.58	implicit	0	2.58	0%
08050002-003	Bayou Macon	<u>0NA</u>	3.13	implicit	0	3.13	0%

Table 5.3. Summary of turbidity TMDLs for December through May (winter).

Reach ID	Stream name	Loads (tons/day of TSS)					Percent reduction needed
		WLA	LA	MOS	Future growth	TMDL	
08050001-018	Boeuf River	0NA	10.93	implicit	0	10.93	73%
08050001-019	Boeuf River	0NA	10.73	implicit	0	10.73	80%
08050001-022	Big Bayou	0NA	11.50	implicit	0	11.50	75%*
08050002-010	Oak Bayou	0NA	8.29	implicit	0	8.29	45%
08050002-006	Bayou Macon	0NA	4.41	implicit	0	4.41	81%
08050002-003	Bayou Macon	0NA	5.36	implicit	0	5.36	68%

* Percent reduction for Big Bayou was based on calculations for station OUA0032 rather than station UWBGB01 because data from station OUA0032 yielded a higher percent reduction.

Table 5.4. Summary of chloride TMDLs for May through November (summer).

Reach ID	Stream name	Loads (tons/day of chloride)					Percent reduction needed
		WLA	LA	MOS	Future growth	TMDL	
08050001-018	Boeuf River	0	14.55	1.62	0	16.17	**
08050001-019	Boeuf River	0.02	14.27	1.59	0	15.88	**
08050001-022	Big Bayou	0.48	7.63	0.91	0.05	9.07	55%*
08050002-010	Oak Bayou	0	5.89	0.65	0	6.54	62%

* Percent reduction for Big Bayou was based on calculations for station OUA0032 rather than station UWBGB01 because data from station OUA0032 yielded a higher percent reduction.

** Due to the distribution of the observed data and flow conditions during which exceedances occurred, the percent reductions for the Boeuf River for chloride during summer were 0%. The value of 0% is not shown in this table because it was considered to be misleading and not indicative of actual conditions.

Table 5.5. Summary of chloride TMDLs for December through April (winter).

Reach ID	Stream name	Loads (tons/day of chloride)					Percent reduction needed
		WLA	LA	MOS	Future growth	TMDL	
08050001-018	Boeuf River	0	36.12	4.01	0	40.13	0%
08050001-019	Boeuf River	0.02	35.44	3.94	0	39.40	0%
08050001-022	Big Bayou	0.48	19.73	2.25	0.05	22.51	0%
08050002-010	Oak Bayou	0	14.61	1.62	0	16.23	0%

Table 5.6. Summary of TDS TMDLs for May through November (summer).

Reach ID	Stream name	Loads (tons/day of TDS)					Percent reduction needed
		WLA	LA	MOS	Future growth	TMDL	
08050001-018	Boeuf River	0	74.39	8.27	0	82.66	**
08050002-010	Oak Bayou	0	50.38	5.60	0	55.98	38%

** Due to the distribution of the observed data and the flow conditions during which exceedances occurred, the percent reduction for the Boeuf River for TDS during summer was 0%. The value of 0% is not shown in this table because it was considered to be misleading and not indicative of actual conditions.

Table 5.7. Summary of TDS TMDLs for December through April (winter).

Reach ID	Stream name	Loads (tons/day of TDS)					Percent reduction needed
		WLA	LA	MOS	Future growth	TMDL	
08050001-018	Boeuf River	0	184.61	20.51	0	205.12	0%
08050002-010	Oak Bayou	0	125.04	13.89	0	138.93	0%

Table 5.8. Summary of sulfate TMDL for May through November (summer).

Reach ID	Stream name	Loads (tons/day of Sulfates)					Percent reduction needed
		WLA	LA	MOS	Future growth	TMDL	
08050001-018	Boeuf River	0	4.85	0.54	0	5.39	10%

Table 5.9. Summary of sulfate TMDL for December through April (winter).

Reach ID	Stream name	Loads (tons/day of Sulfates)					Percent reduction needed
		WLA	LA	MOS	Future growth	TMDL	
08050001-018	Boeuf River	0	12.04	1.34	0	13.38	0%

5.11 Future Growth

Strategies for future growth for specific reaches and pollutants were discussed in Section 5.8. These strategies were not formulated on every possible change that could happen within a reach. The most obvious thing that cannot be predicted is the exact location of a new load to the reach. For situations outside the guidelines of Section 5.8, the load duration curves for the reach-pollutant combination can be used in conjunction with the assumptions and approach in this document to determine if a proposed change is bounded by the acceptable load shown on the load duration curve. This will guide the management of the segment with the goal of meeting water quality standards as the point and nonpoint source loads change.

6.0 OTHER RELEVANT INFORMATION

6.1 Monitoring

In accordance with Section 106 of the federal Clean Water Act and under its own authority, ADEQ has established a comprehensive program for monitoring the quality of the State's surface waters. ADEQ collects surface water samples at various locations, utilizing appropriate sampling methods and procedures for ensuring the quality of the data collected. The objectives of the surface water monitoring program are to determine the quality of the state's surface waters, to develop a long-term data base for long term trend analysis, and to monitor the effectiveness of pollution controls. The data obtained through the surface water monitoring program is used to develop the state's biennial 305(b) report (Water Quality Inventory) and the 303(d) list of impaired waters.

6.2 Reasonable Assurances and Implementation

For some of the chloride TMDLs, significant nonpoint source reductions are required while point source loads are not being reduced and are even allowed a small amount of future growth. Therefore, it is required to provide reasonable assurances that reductions of nonpoint source loads of chloride are likely to occur.

As discussed previously in this report, irrigation with groundwater is believed to be the primary cause of exceedances of water quality standards for chloride. Reducing the use of groundwater for irrigation is one of the primary goals of the Southeast Arkansas Feasibility Study (SAFS), which is being conducted by the Vicksburg district Corps of Engineers, along with ASWCC and other partner agencies. This study was prompted by rapidly declining groundwater levels, which is a serious concern among state and federal agencies as well as farmers in eastern Arkansas. This project includes promoting agricultural water conservation, such as installing tailwater recovery systems to reduce runoff of irrigation water, and building reservoirs to store storm runoff during wet seasons and use it later for irrigation water. Results of this project will also likely include development of one or more major surface water sources of irrigation water. Options for major surface water sources that are being evaluated by the Corps of Engineers include diverting water from the Arkansas River into a network of canals for distribution throughout the Boeuf River and Bayou Macon basins. Water in the Arkansas River at Dam No. 2 has an average chloride concentration of less than 70 mg/L (ADEQ 2002a), which is significantly lower than chloride concentrations in groundwater that is currently being used for irrigation (ranging up to 1200 mg/L; USGS 1985b).

In addition to the SAFS project, ASWCC will continue its ongoing efforts to address nonpoint source pollution in the Boeuf River and Bayou Macon basins as well as other parts of Arkansas. The ASWCC utilizes the monitoring information discussed in Section 6.1 to establish priorities so that voluntary nonpoint source program activities may be directed toward these priority sources. ASWCC receives federal funding under the Clean Water Act Section 319(h) nonpoint source program. ASWCC will continue to work cooperatively with federal, state, and local partners that assist in implementation of educational programs and watershed protection and restoration projects to restore the designated uses of waterbodies.

The status and expected impact of the SAFS project, in addition to ongoing programs by the ASWCC, satisfies the requirement for reasonable assurances that reductions of nonpoint source loads of chloride are likely to occur.

7.0 PUBLIC PARTICIPATION

When EPA establishes a TMDL, federal regulations require EPA to publicly notice and seek comment concerning the TMDL. Pursuant to a May 2000 consent decree, these TMDLs were prepared under contract to EPA. After development of the TMDLs, EPA prepared a notice seeking comments, information, and data from the general public and affected public. No comments, data, or information were submitted during the public comment period. EPA has transmitted the final TMDLs to ADEQ for implementation and for incorporation into ADEQ's current water quality management plan.

8.0 REFERENCES

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APPENDIX A

Maps

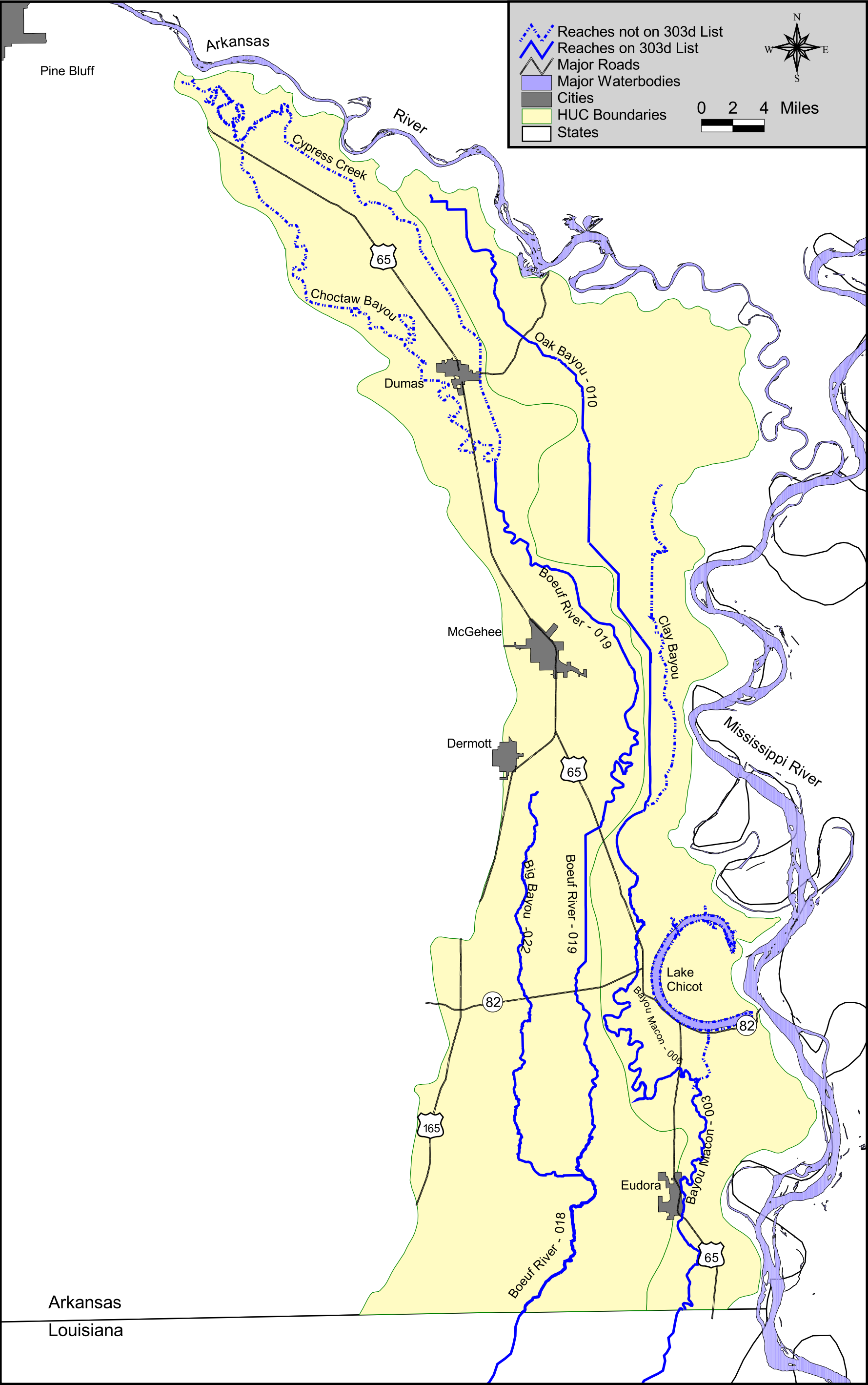


Figure A.1. Map of study area.

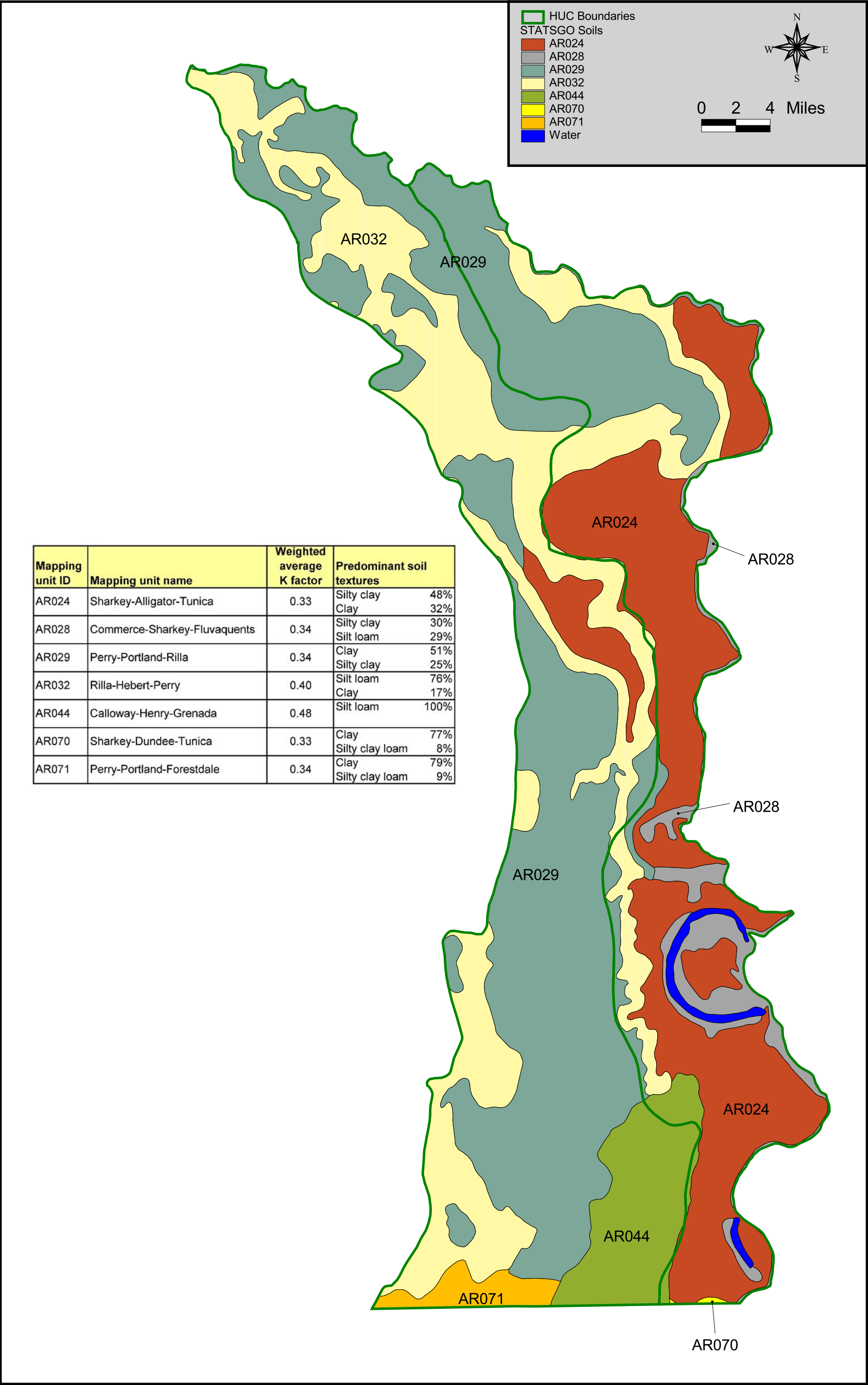


Figure A.2. Map of STATSGO soils data.

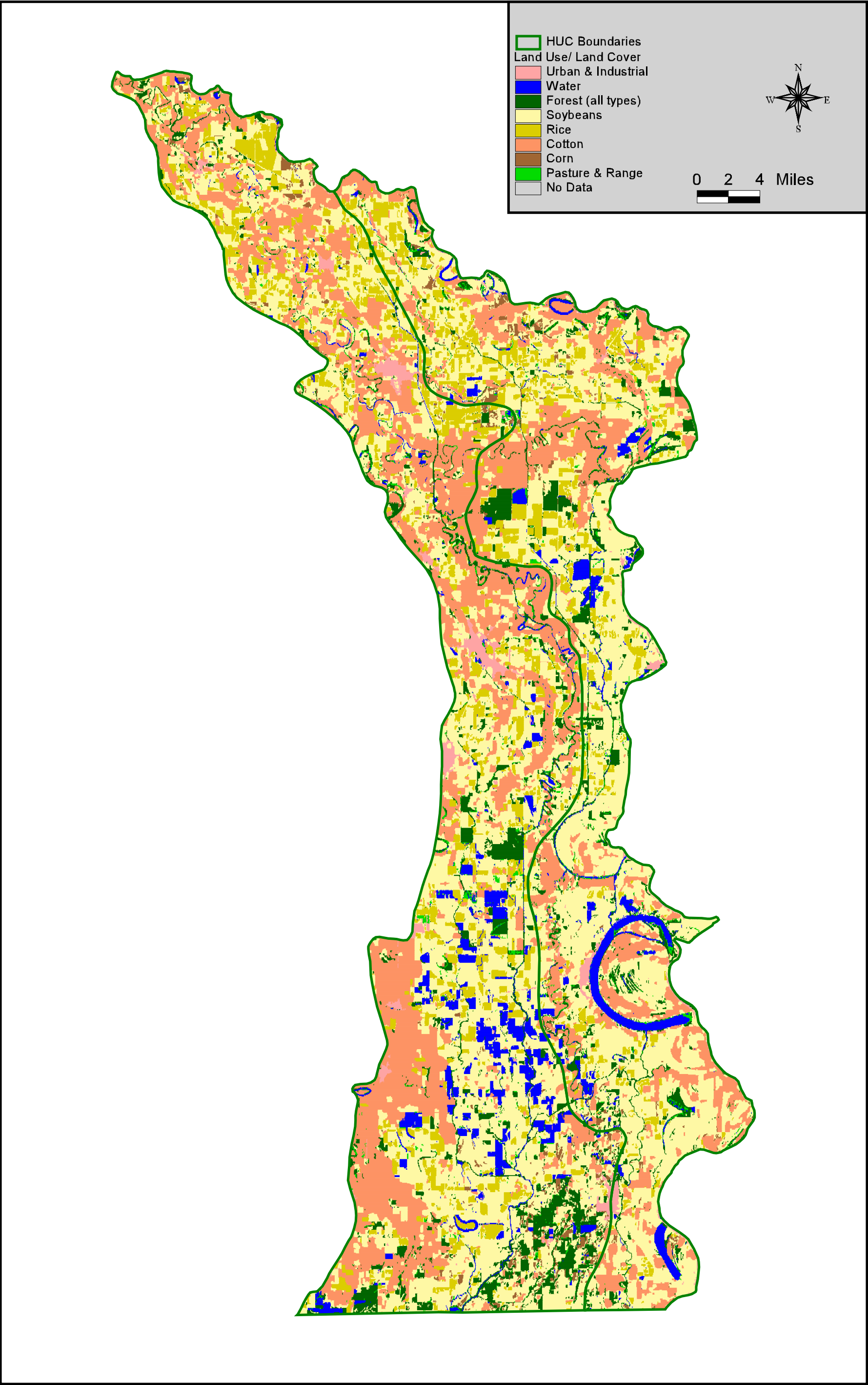


Figure A.3. Land use map.

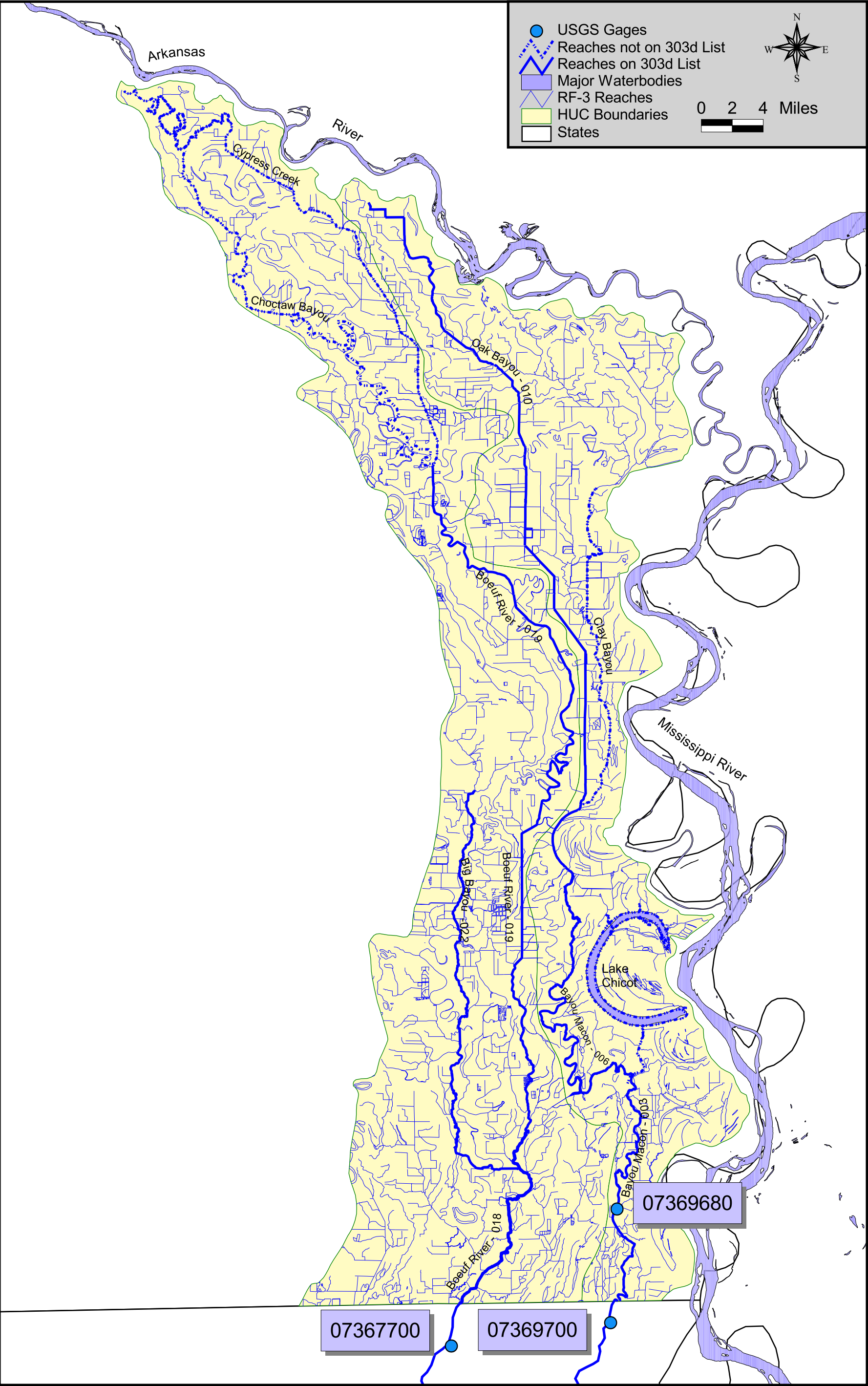


Figure A.4. USGS flow gages and stream channel network.

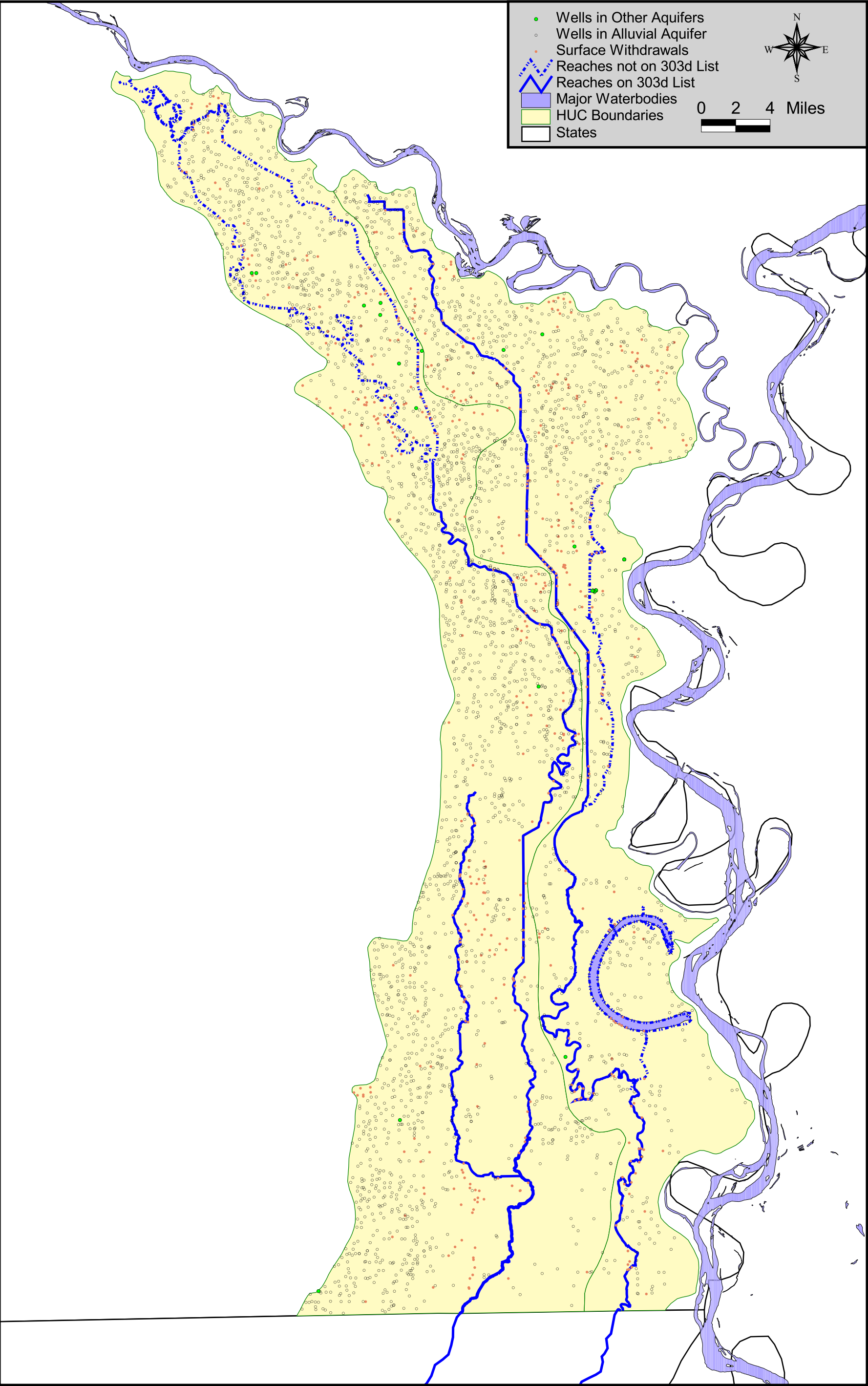


Figure A.5. Locations of water withdrawals.

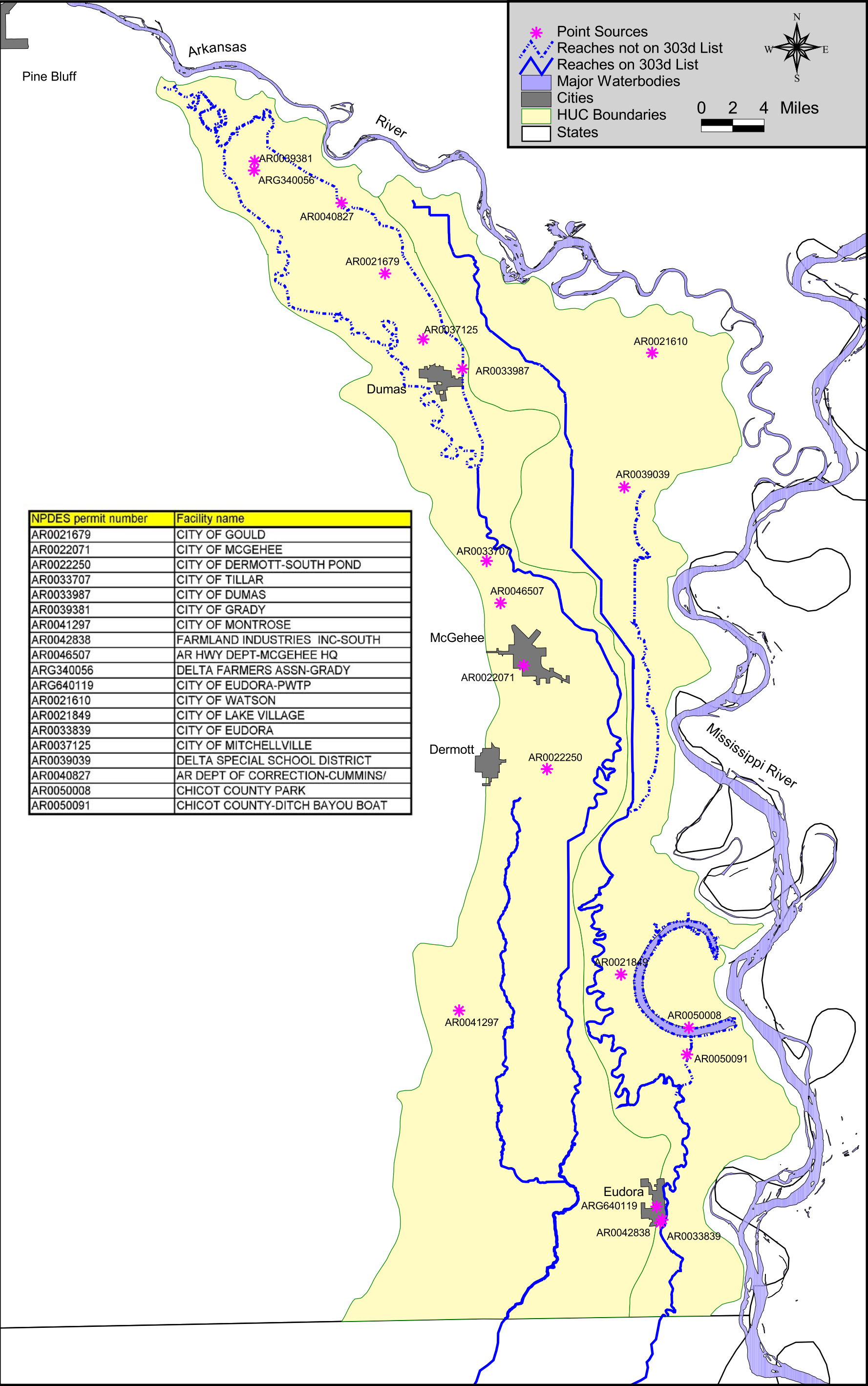


Figure A.6. Locations of point sources.

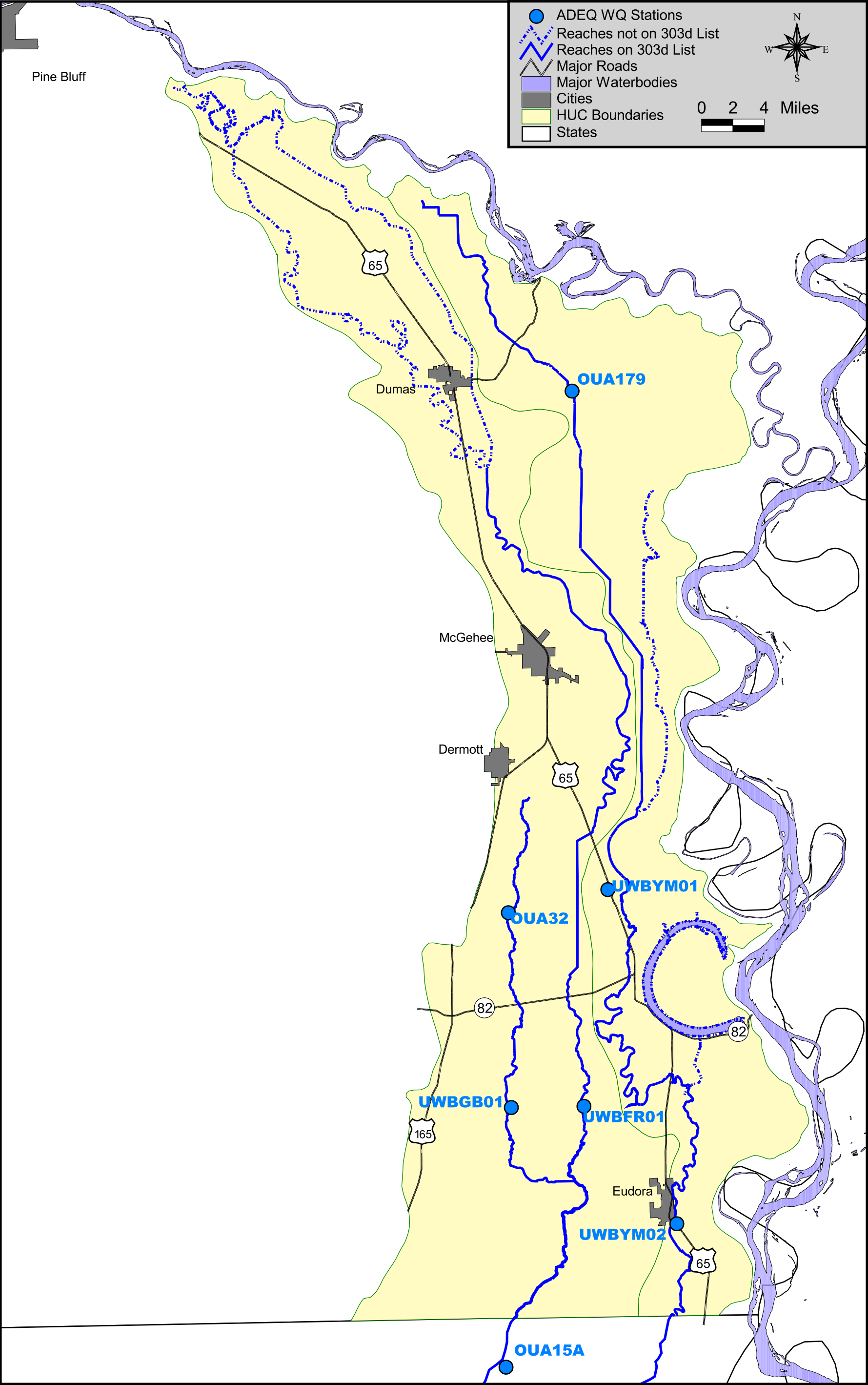


Figure A.7. Water quality monitoring stations.

APPENDIX B

Long Term Plots of Turbidity and TSS

Figure B.1. Long Term Plot of Turbidity for Boeuf River at OUA0015A

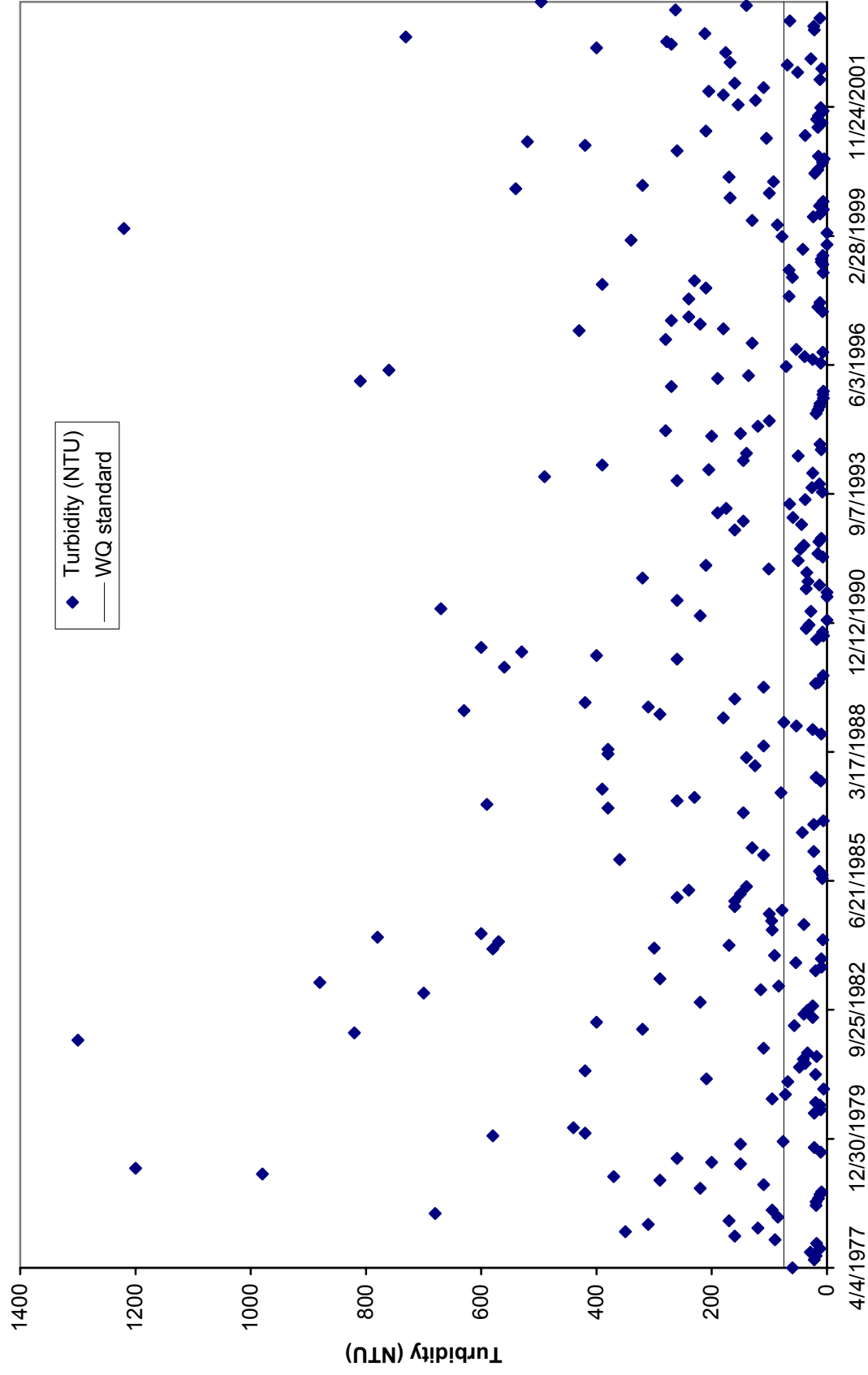


Figure B.2. Long Term Plot of Turbidity at Boeuf River at UWBFR01

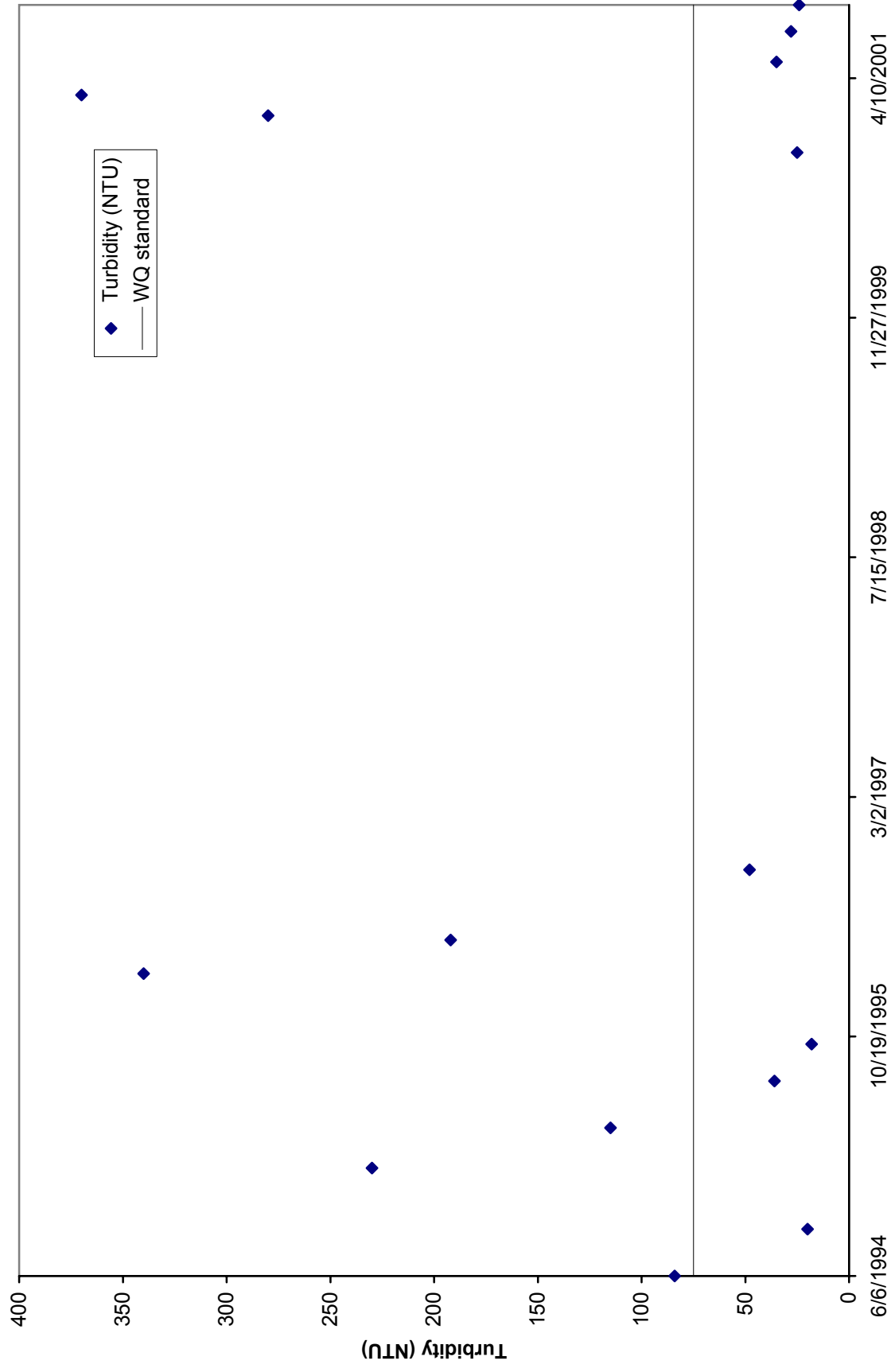


Figure B.3. Long Term Plot of Turbidity for Big Bayou at OUA0032

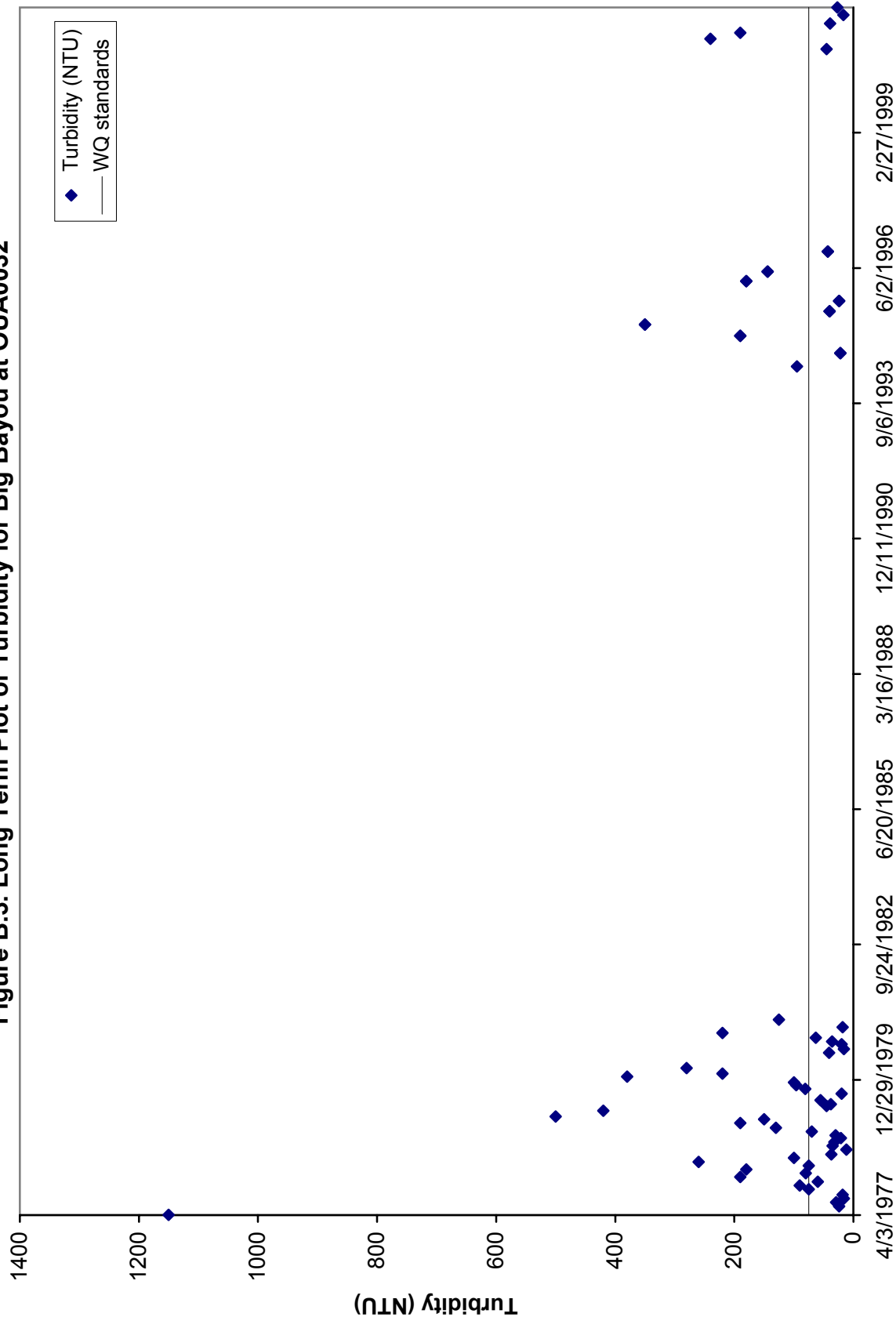


Figure B.4. Long Term Plot of Turbidity on Big Bayou at UWGB01

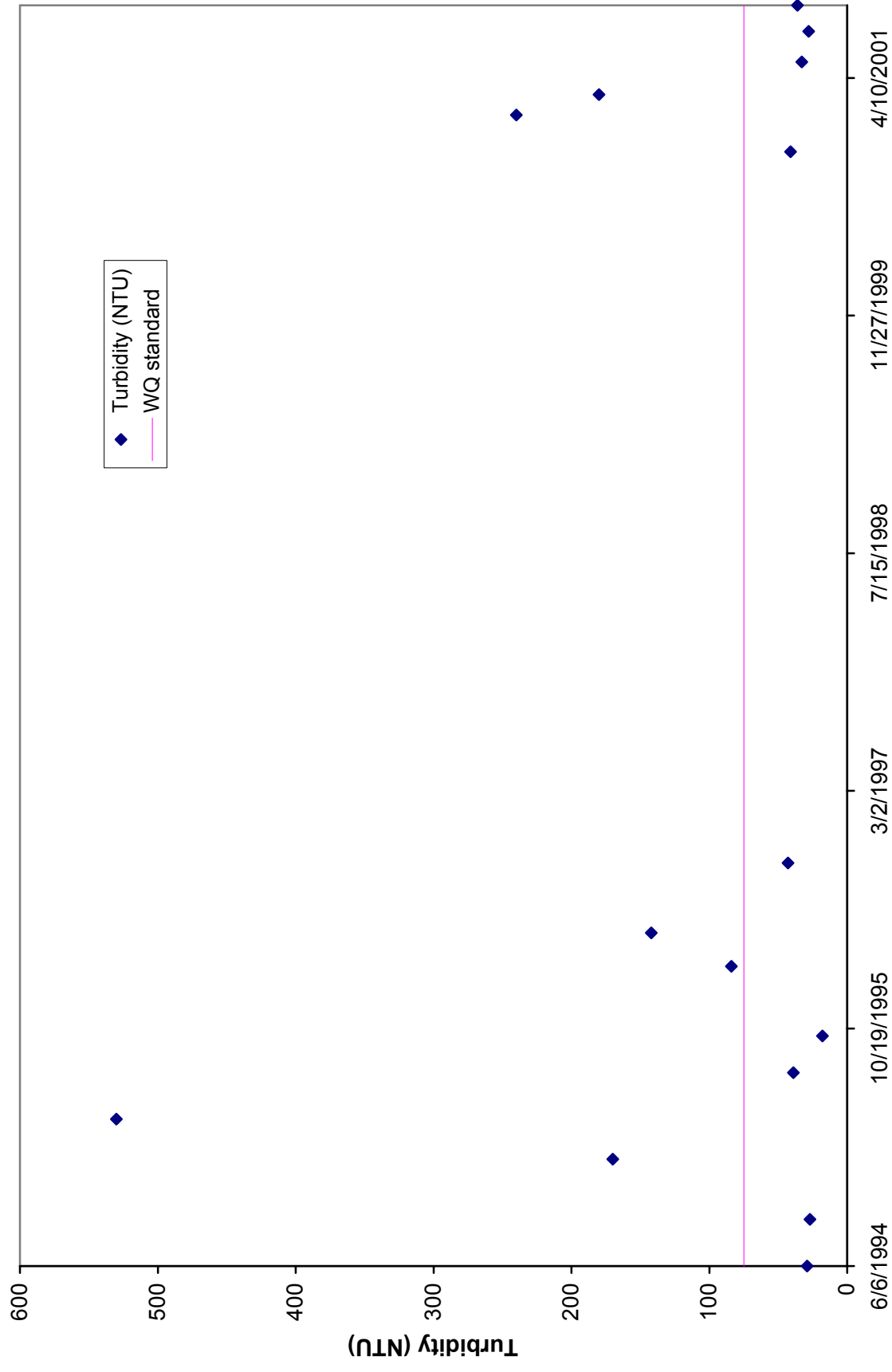


Figure B.5. Long Term Plot of Turbidity for Oak Bayou at OUA0179

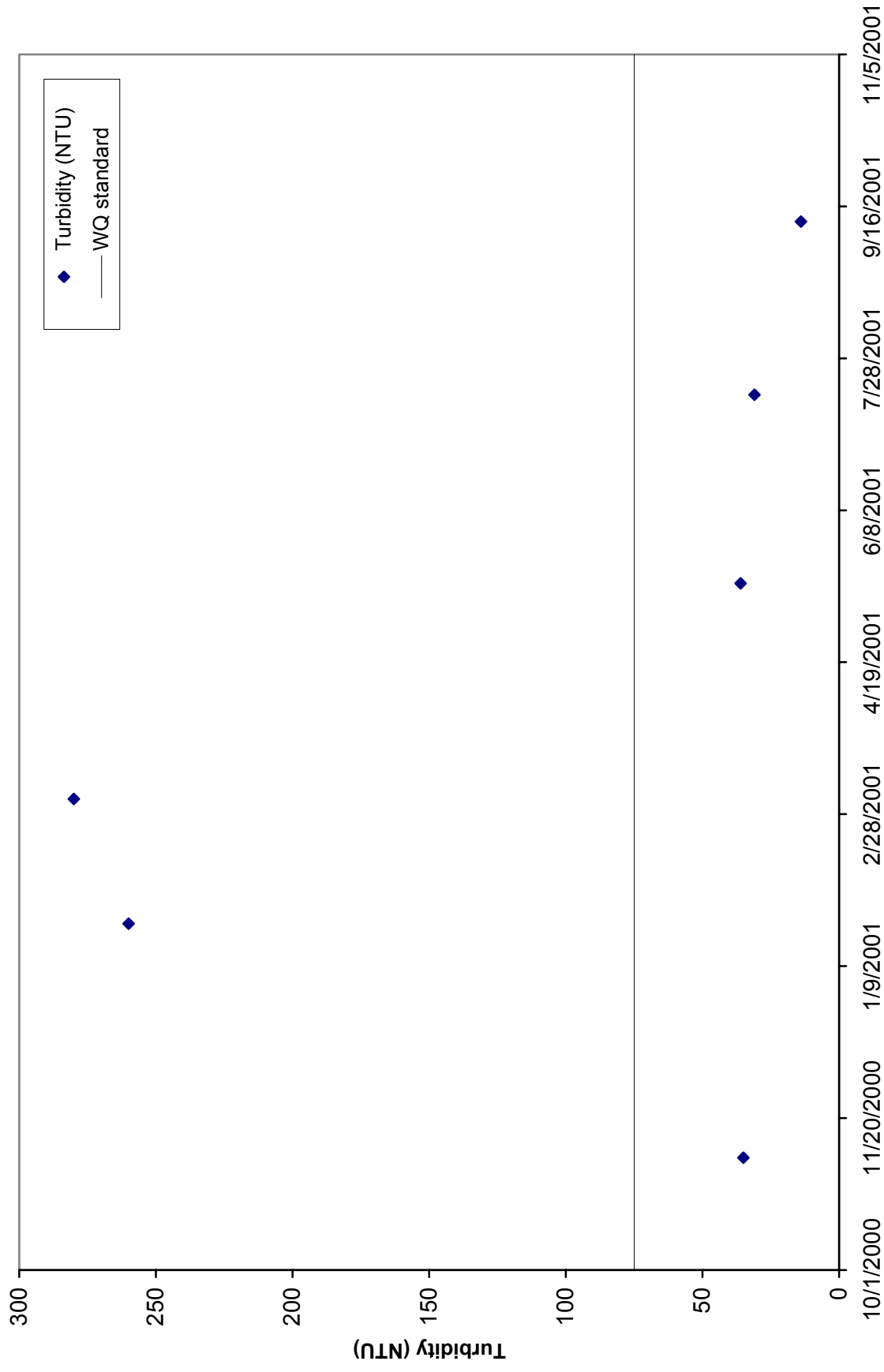


Figure B.6. Long Term Plots of Turbidity for Bayou Macon at UWBYM01

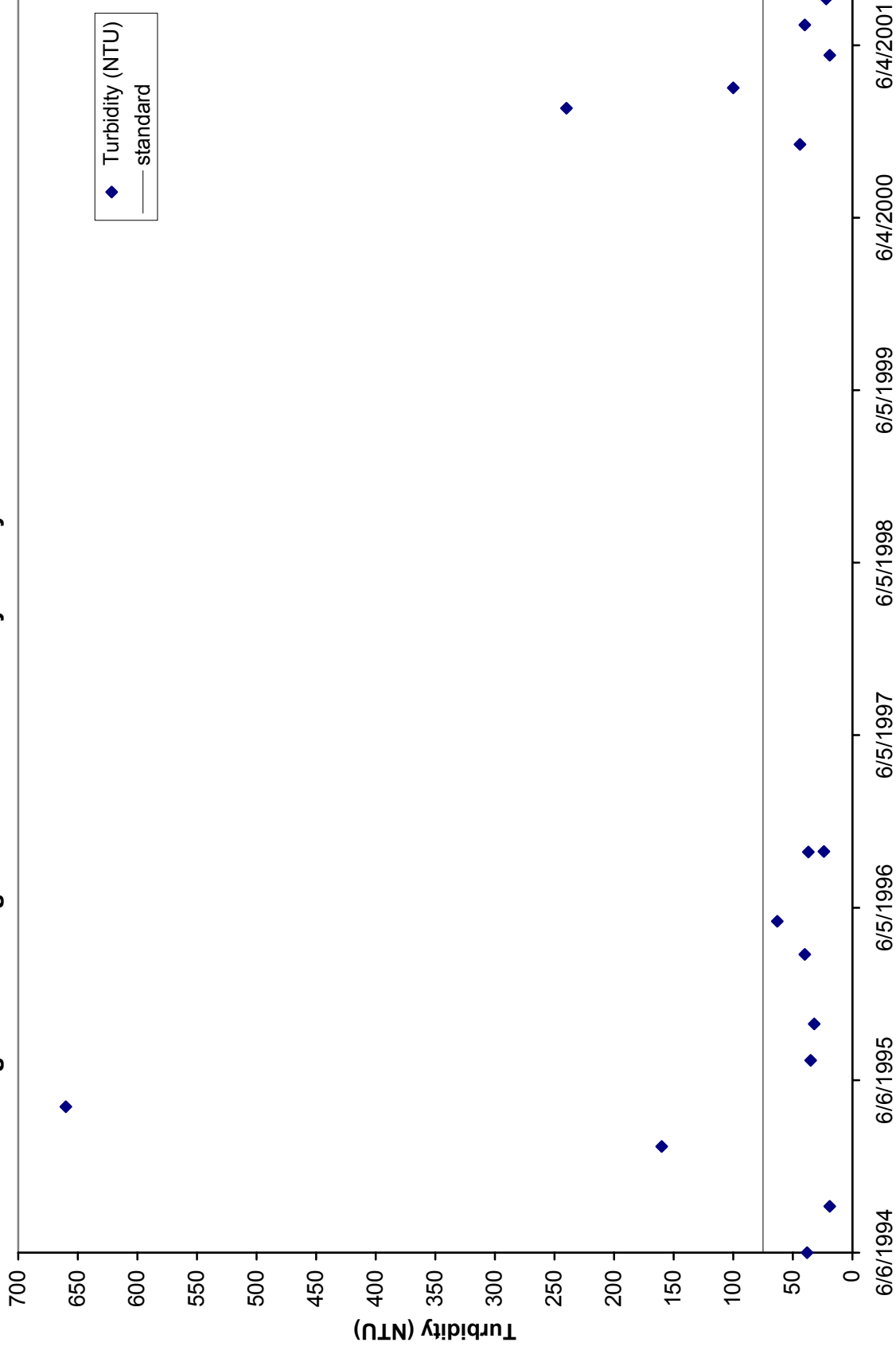


Figure B.7. Long Term Plot of Turbidity for Bayou Macon at UWBYM02

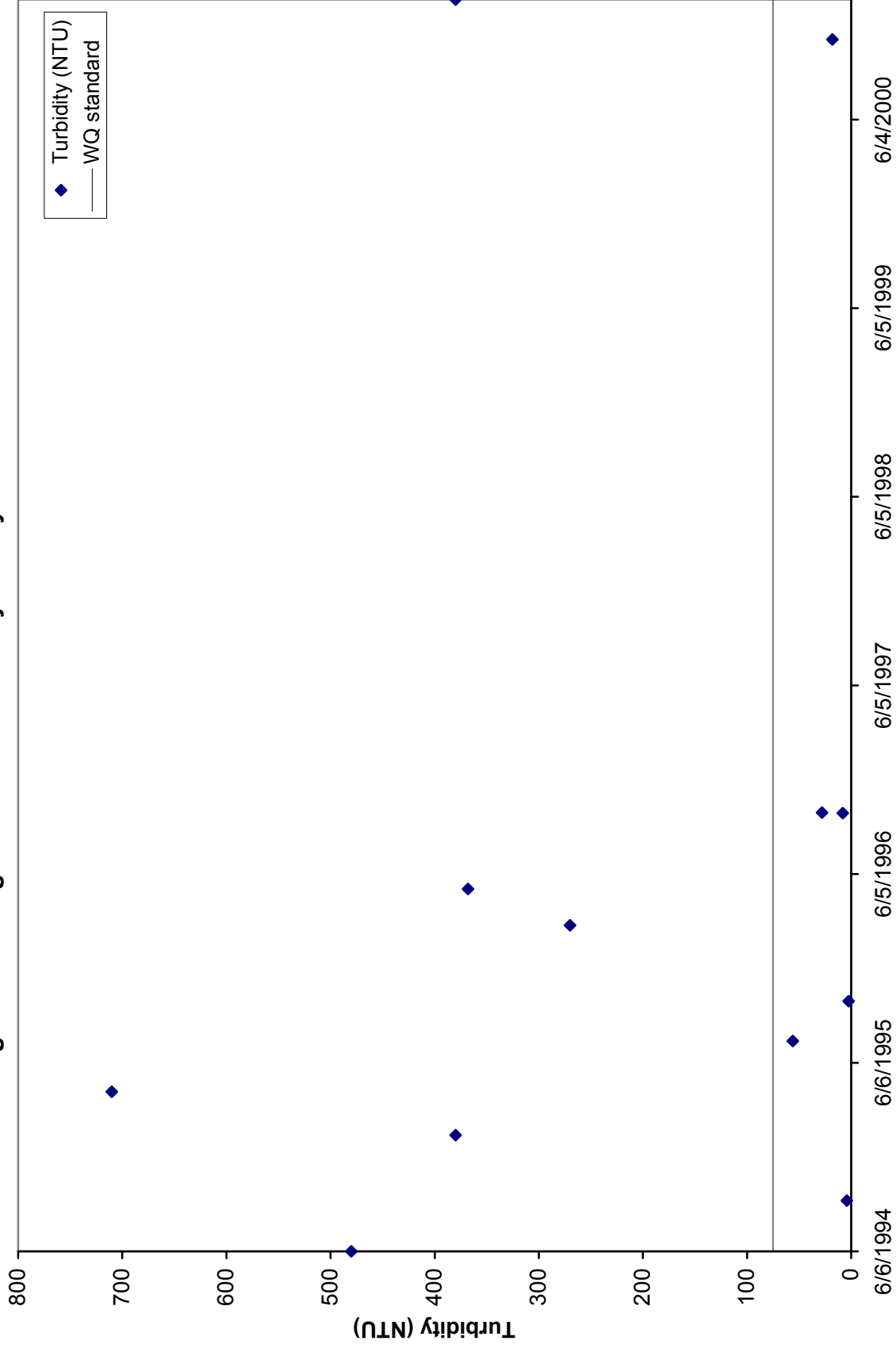


Figure B.8. Long Term Plot of TSS for Boeuf River at OUA0015A

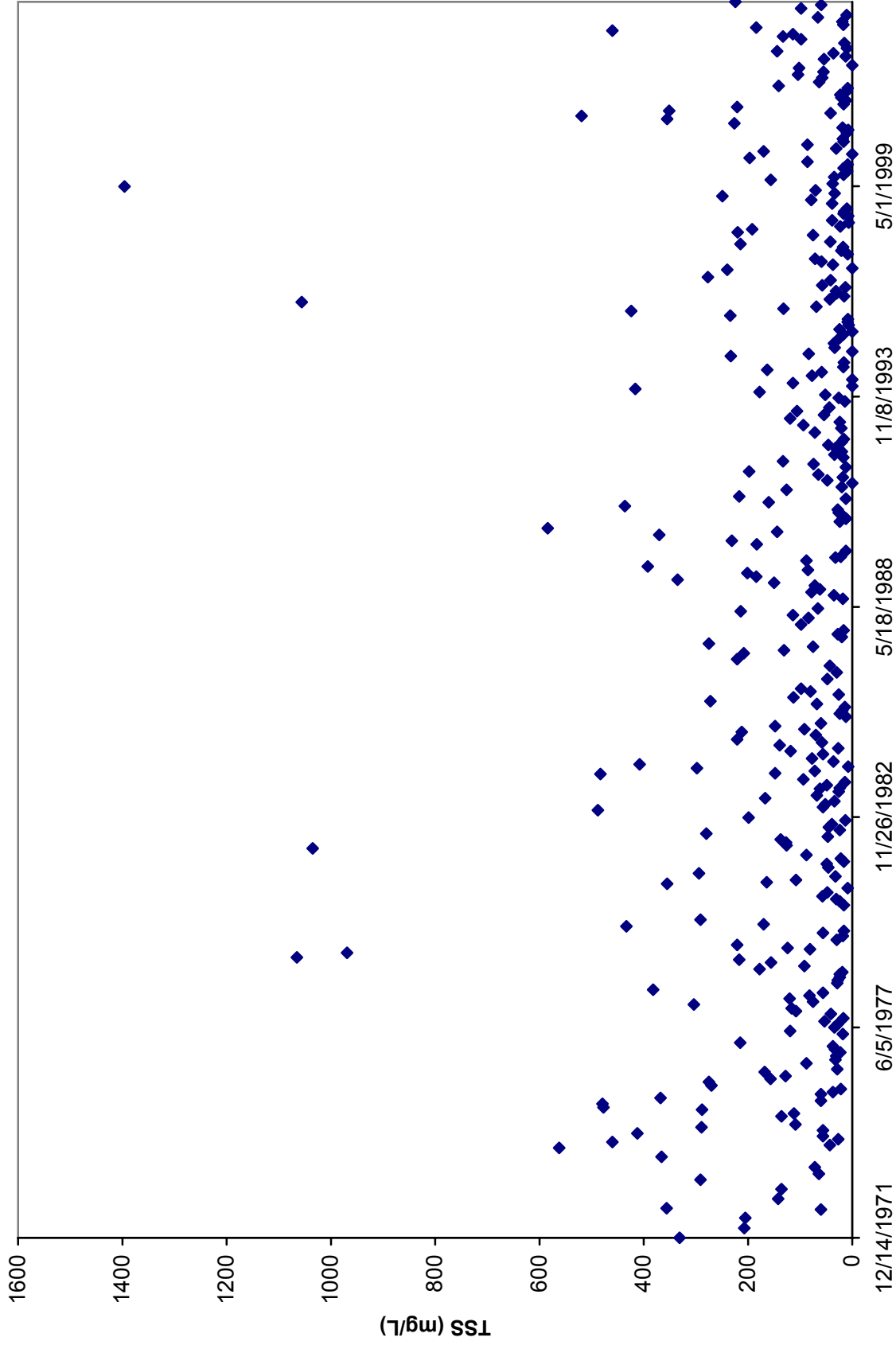


Figure B.9. Long Term Plot of TSS at Boeuf River at UWBFR01

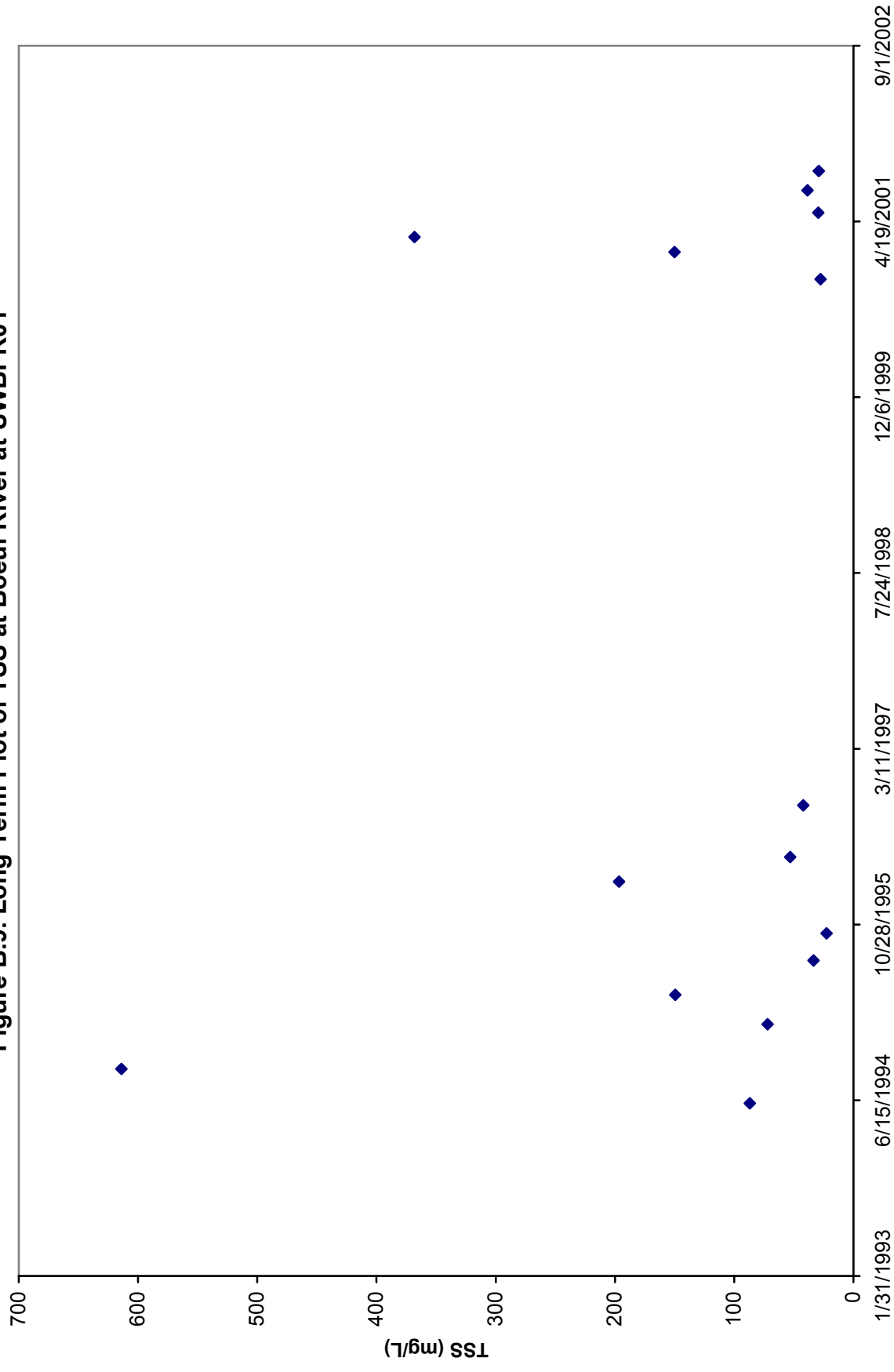


Figure B.10. Long Term Plot of TSS for Big Bayou at OUA0032

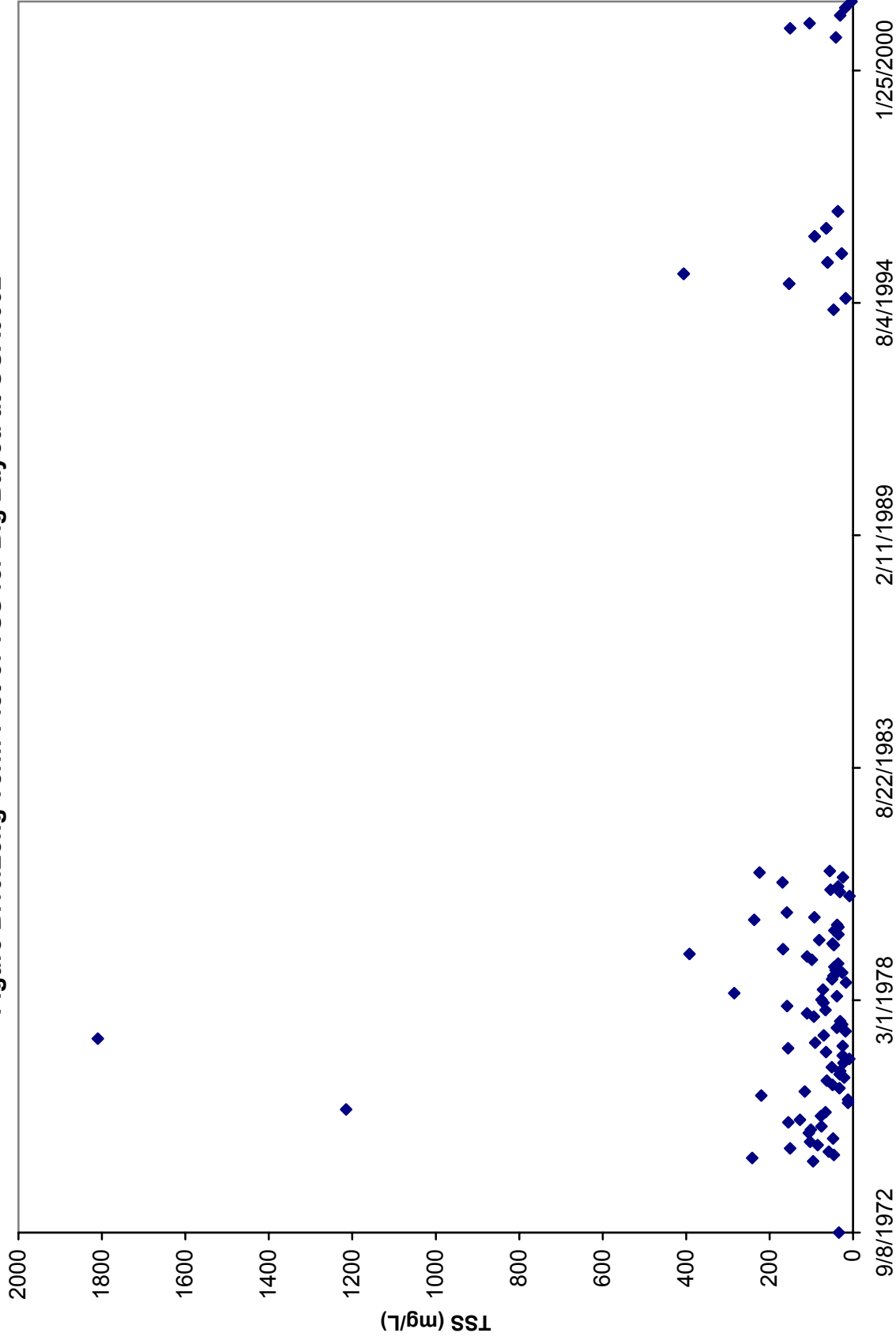


Figure B.11. Long Term Plot of TSS on Big Bayou at UWBGB01

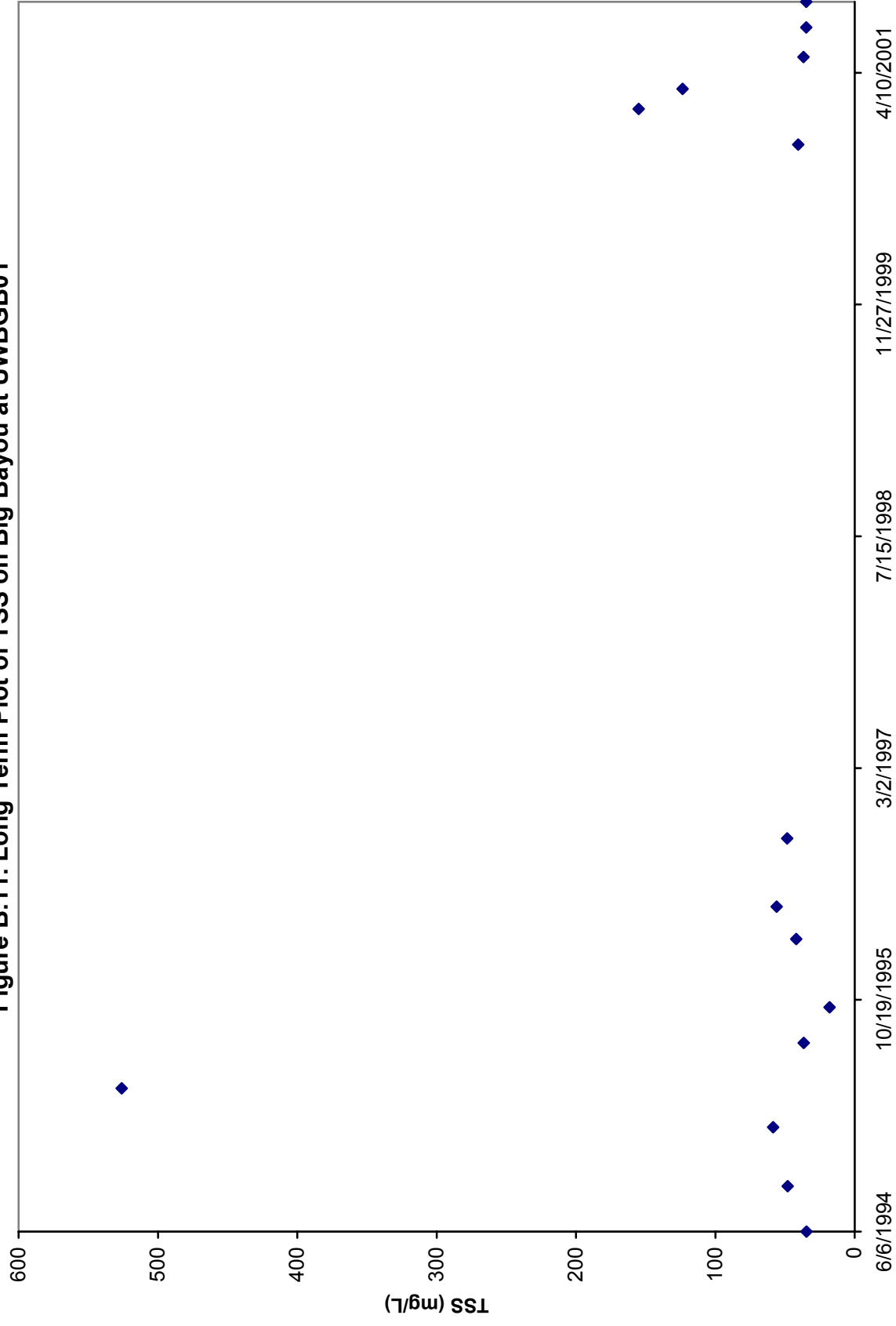


Figure B.12. Long Term Plot of TSS for Oak Bayou at OUA0179

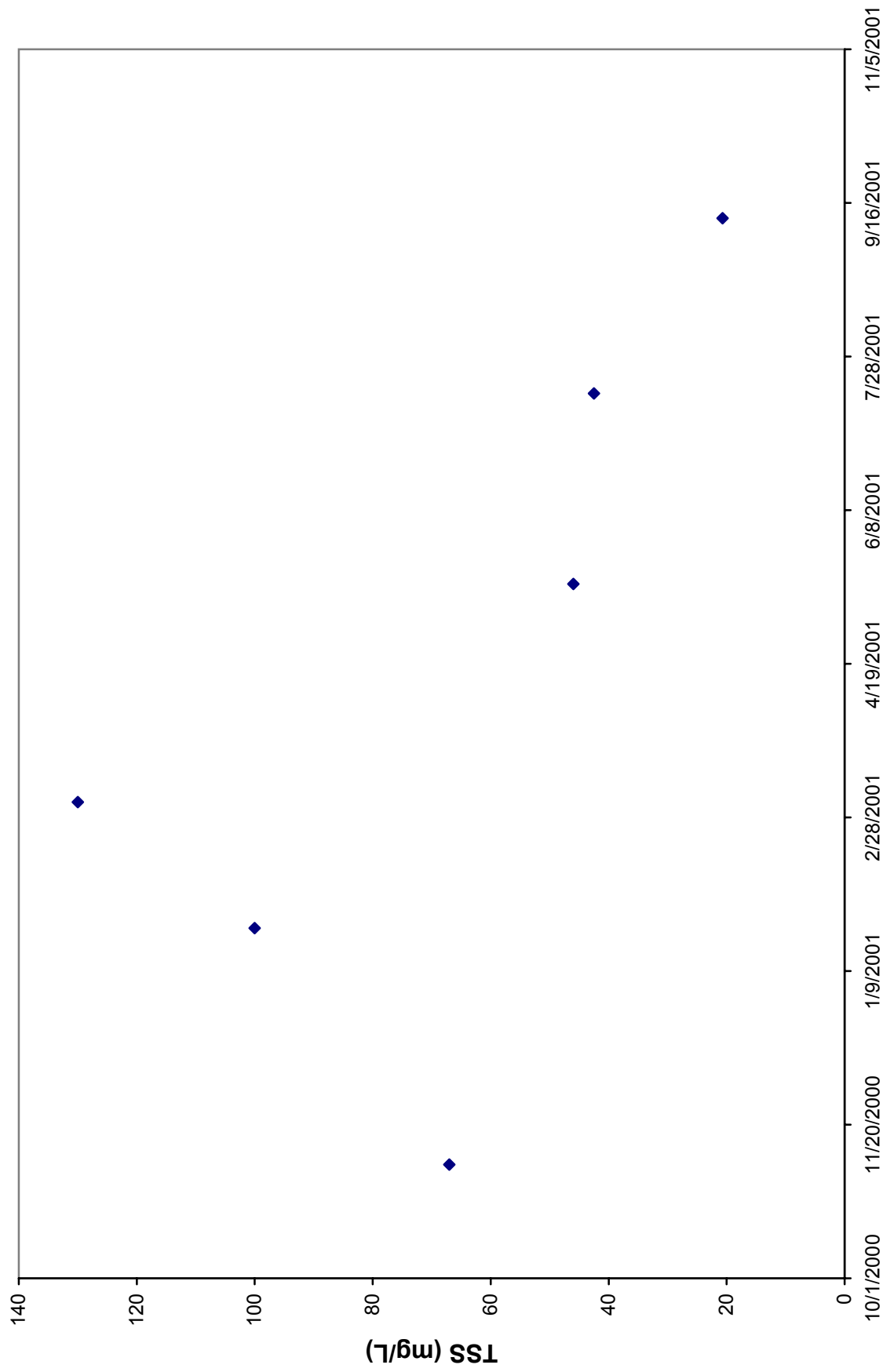


Figure B.13. Long Term Plot of TSS for Bayou Macon at UWBYM01

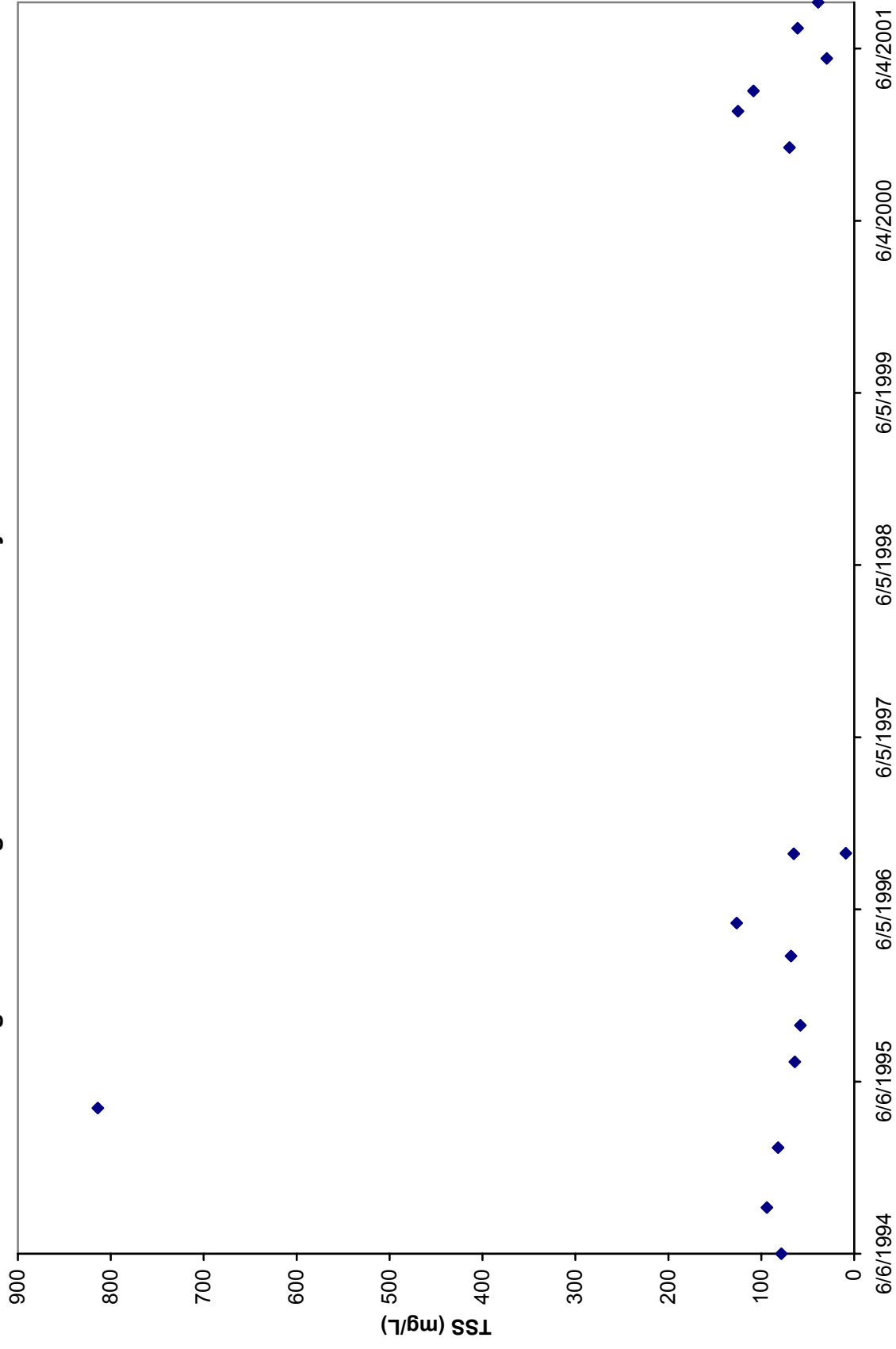
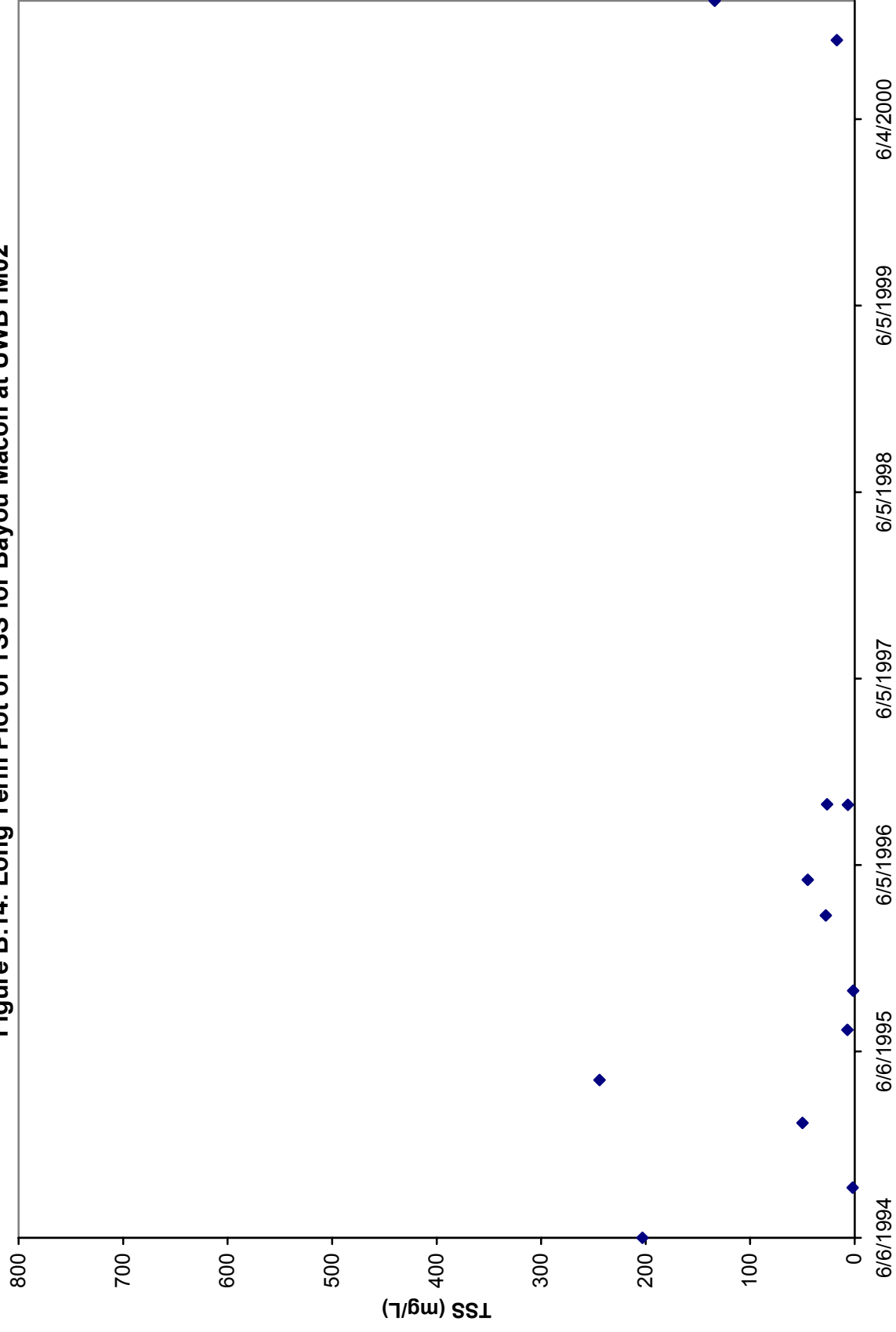


Figure B.14. Long Term Plot of TSS for Bayou Macon at UWBYM02



APPENDIX C

Seasonal Plots of Turbidity and TSS

Figure C.1. Seasonal Plot of Turbidity for Boeuf River at OUA0015A

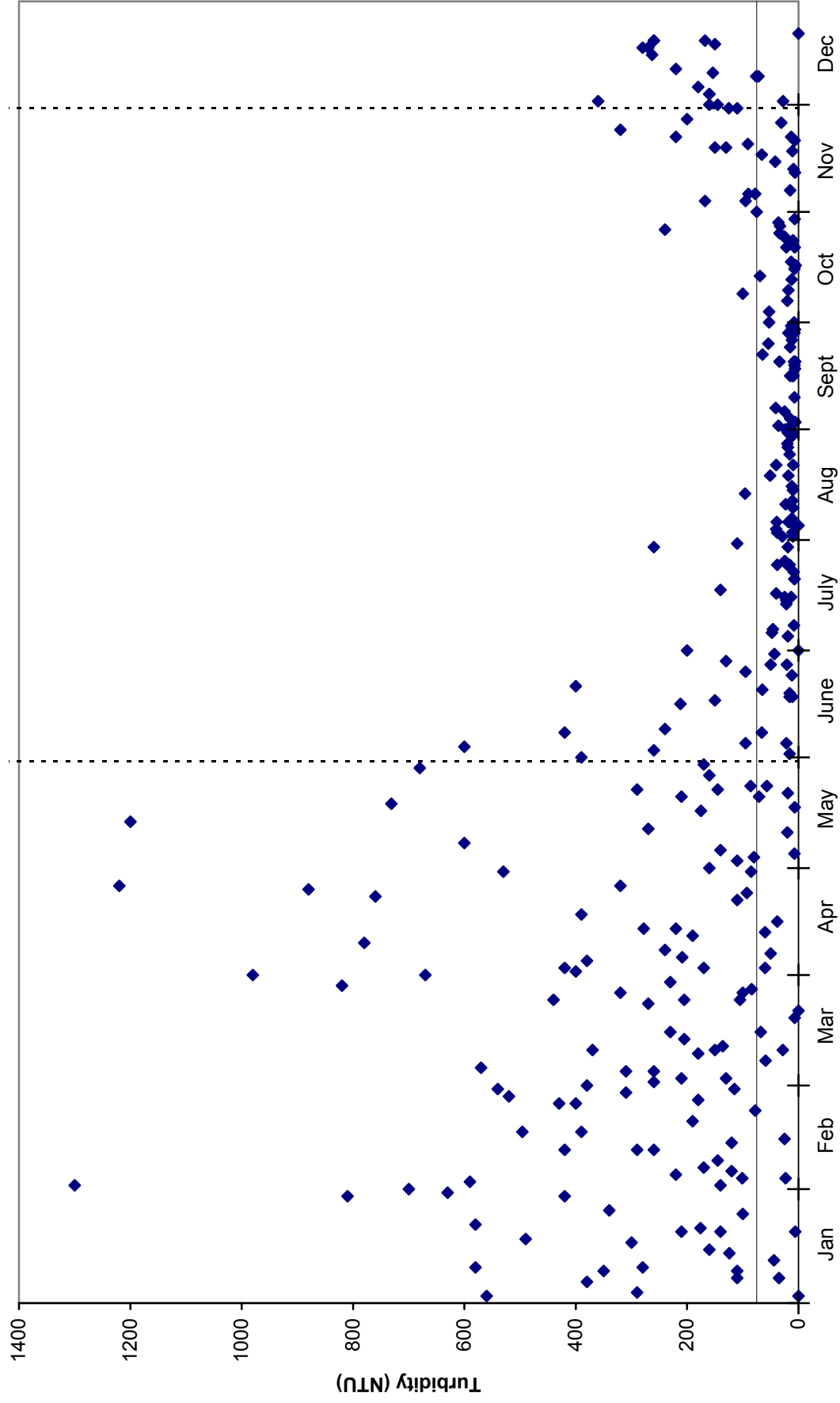


Figure C.2. Seasonal Plot of Turbidity on Boeuf River at UWBFR01

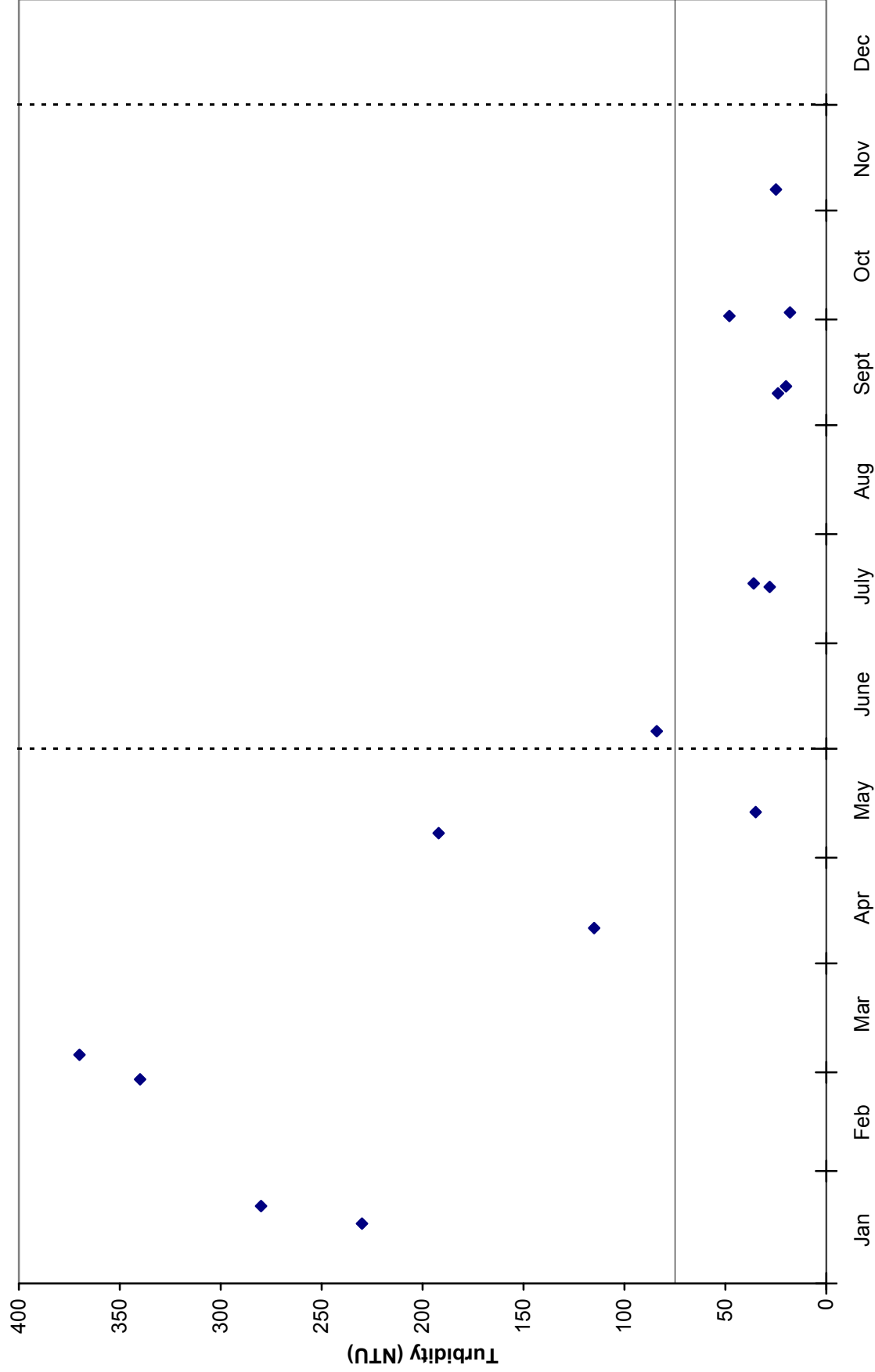


Figure C.3. Seasonal Plot of Turbidity for Big Bayou at OUA0032

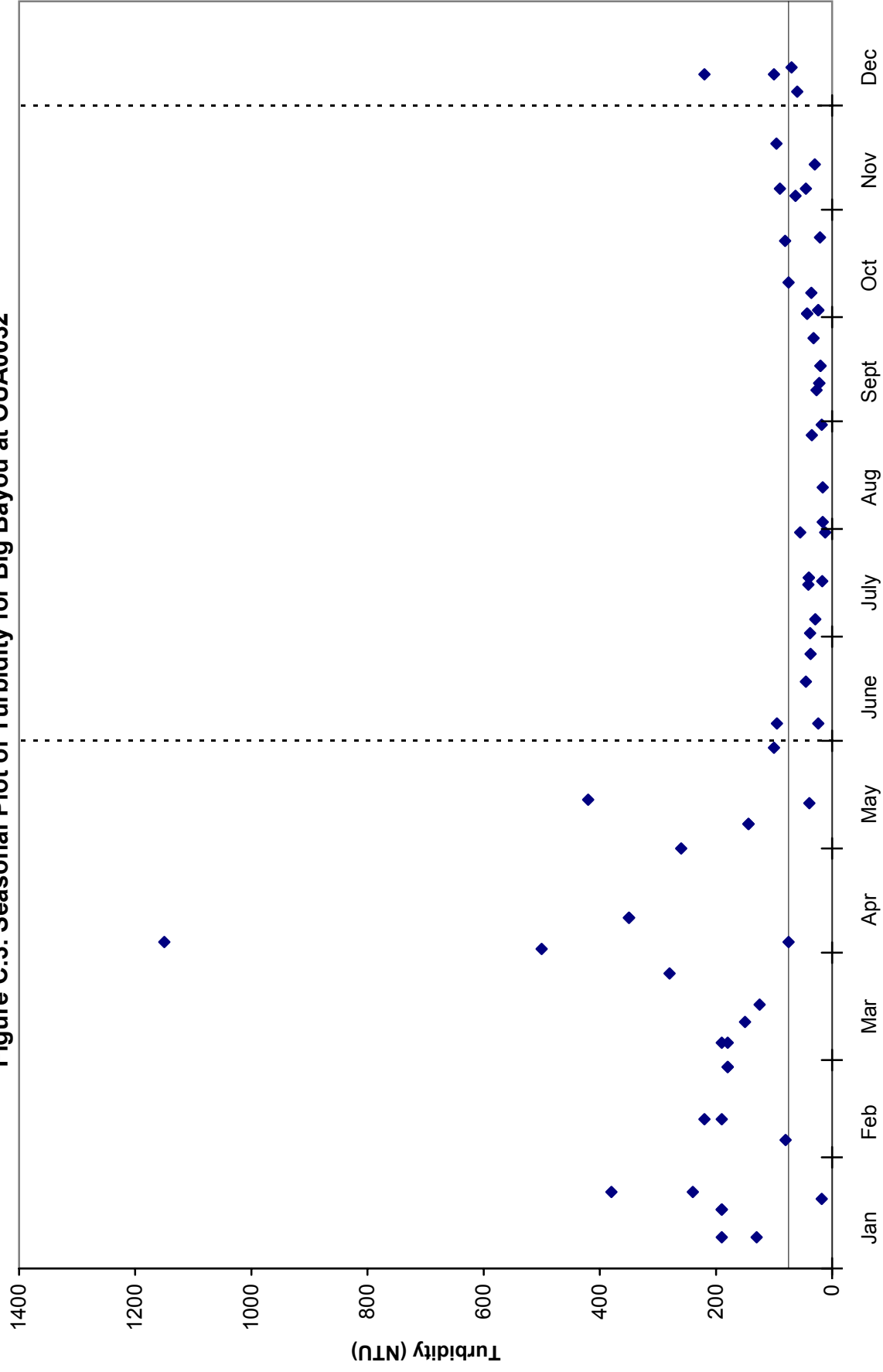


Figure C.4. Seasonal Plot of Turbidity on Big Bayou at UWBGB01

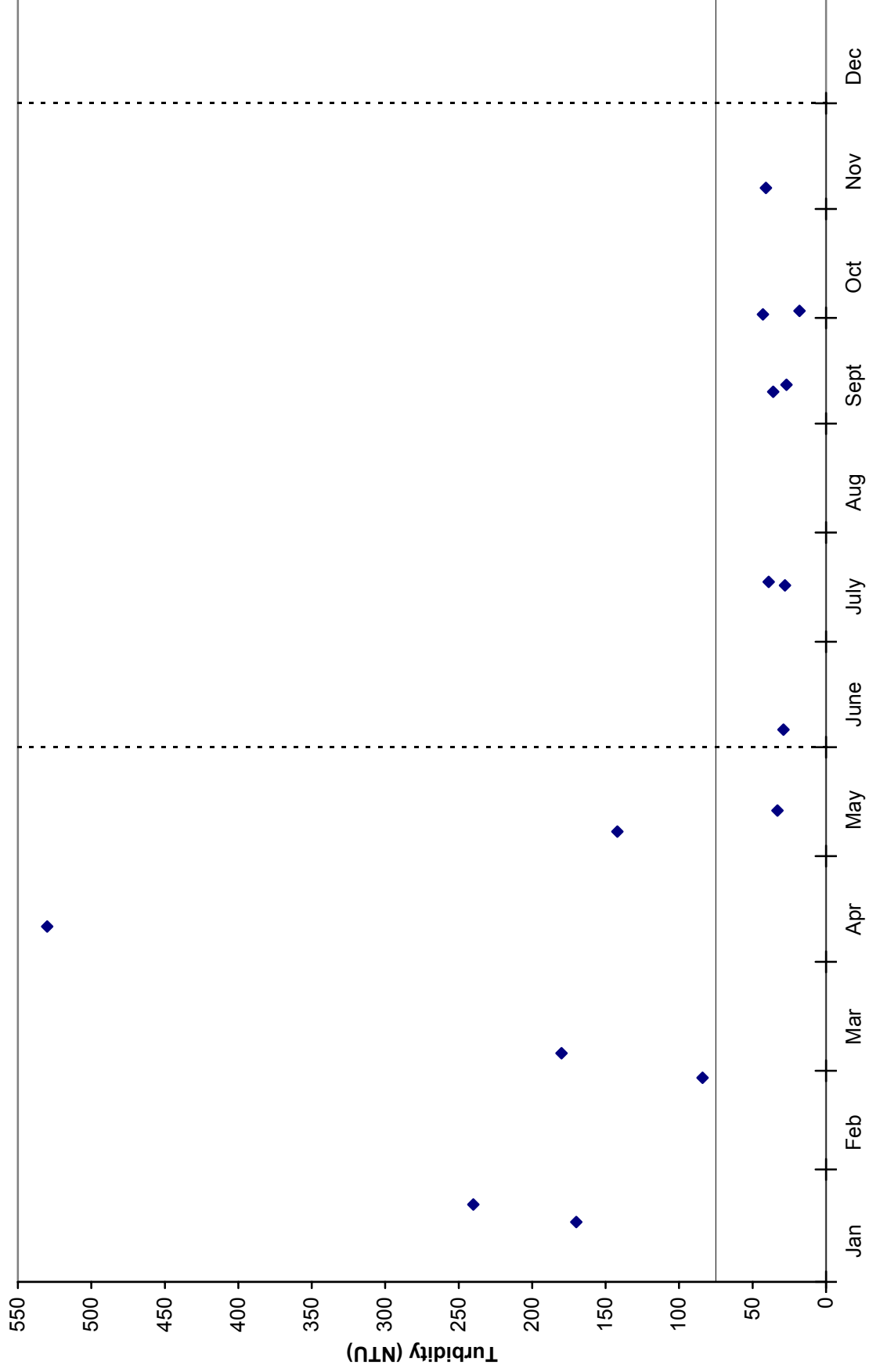


Figure C.5. Seasonal plot of Turbidity for Oak Bayou at OUA0179

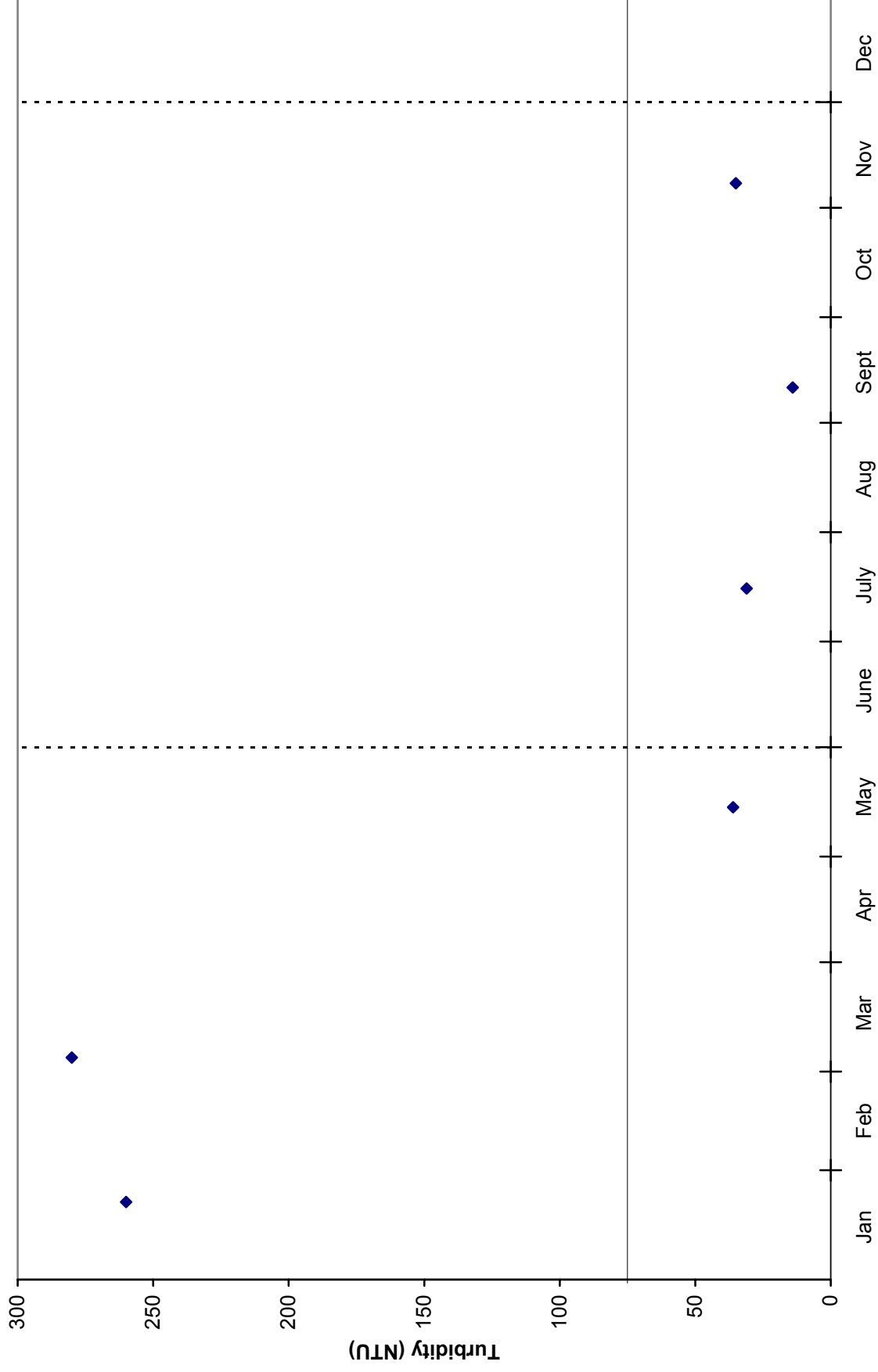


Figure C.6. Seasonal Plot of Turbidity for Bayou Macon at UWBYM01

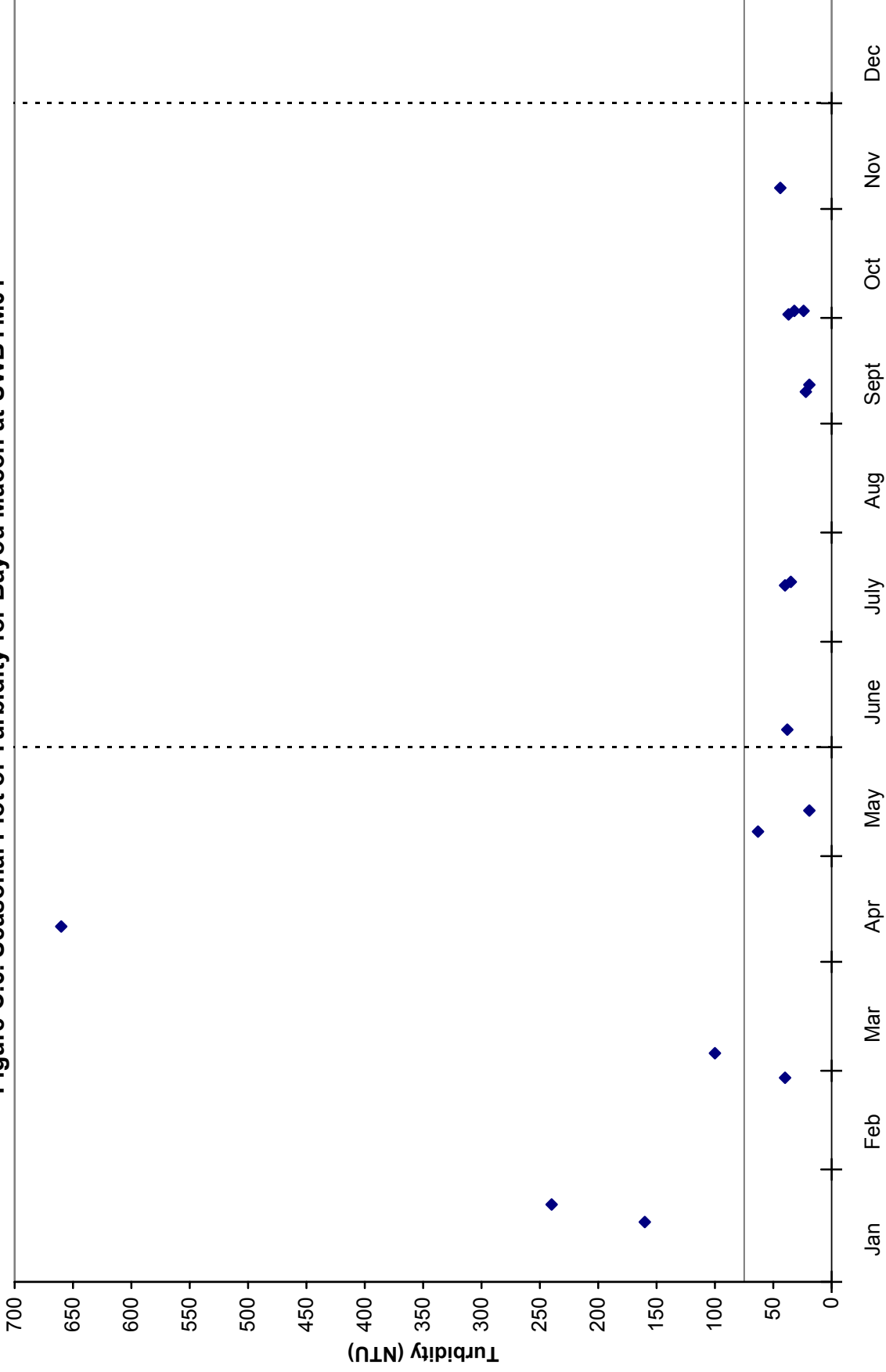


Figure C.7. Seasonal Plot of Turbidity for Bayou Macon at UWBYM02

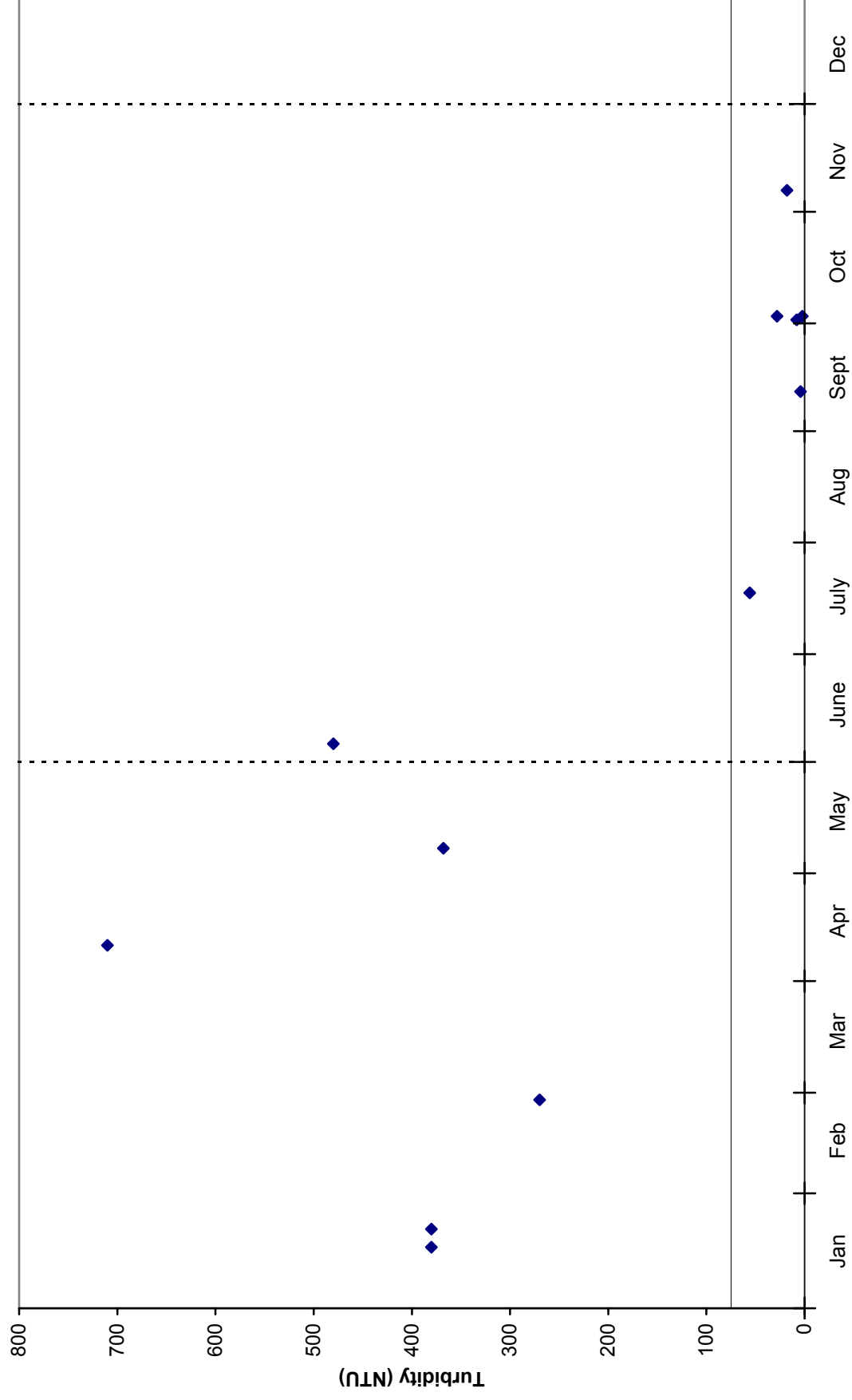


Figure C.8. Seasonal Plot of TSS for Boeuf River at OUA0015A

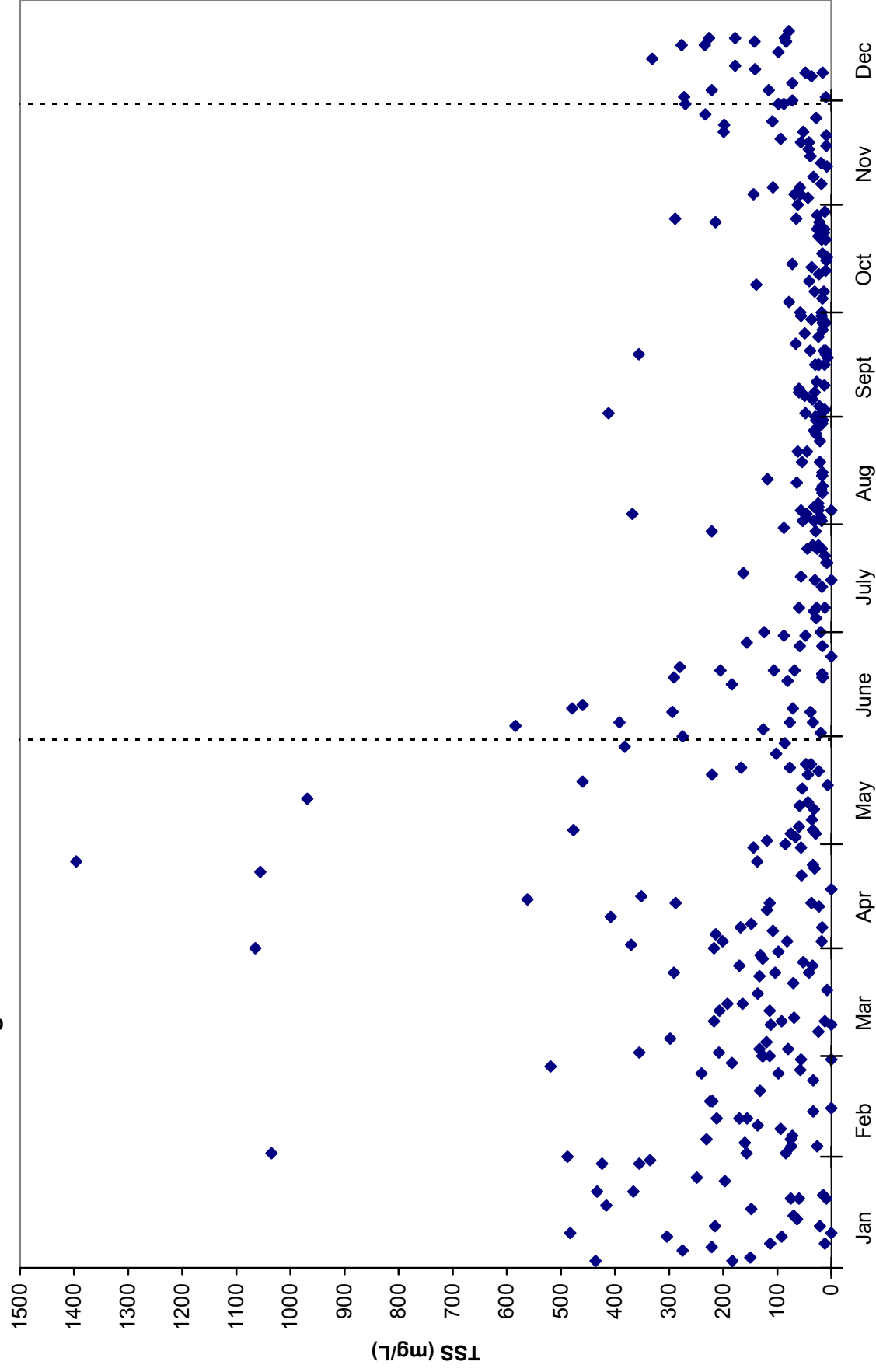


Figure C.9. Seasonal Plot of TSS on Boeuf River at UWBFR01

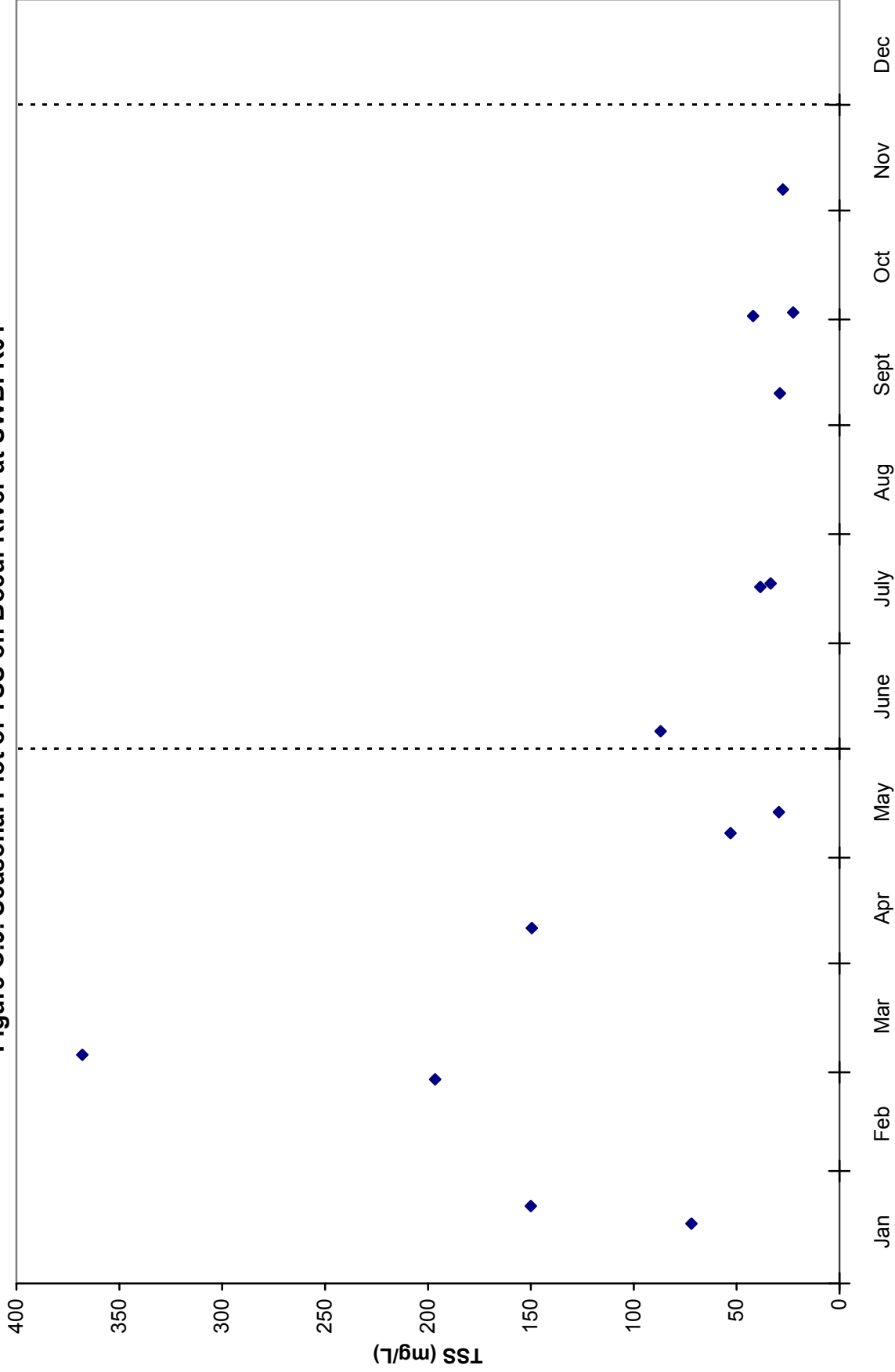


Figure C.10. Seasonal Plot of TSS for Big Bayou at OUA0032

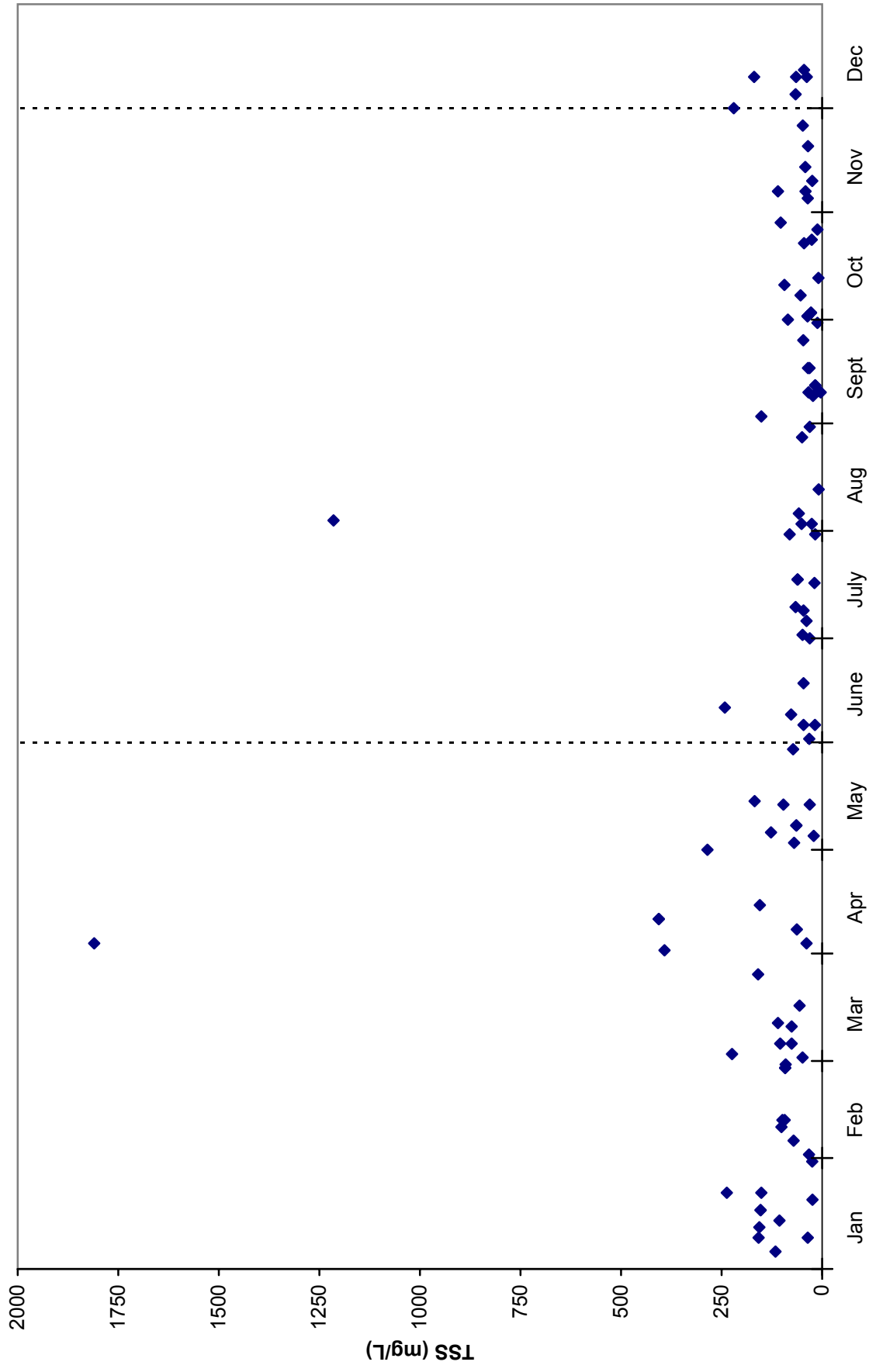


Figure C.11. Seasonal Plot of TSS on Big Bayou at UWGBB01

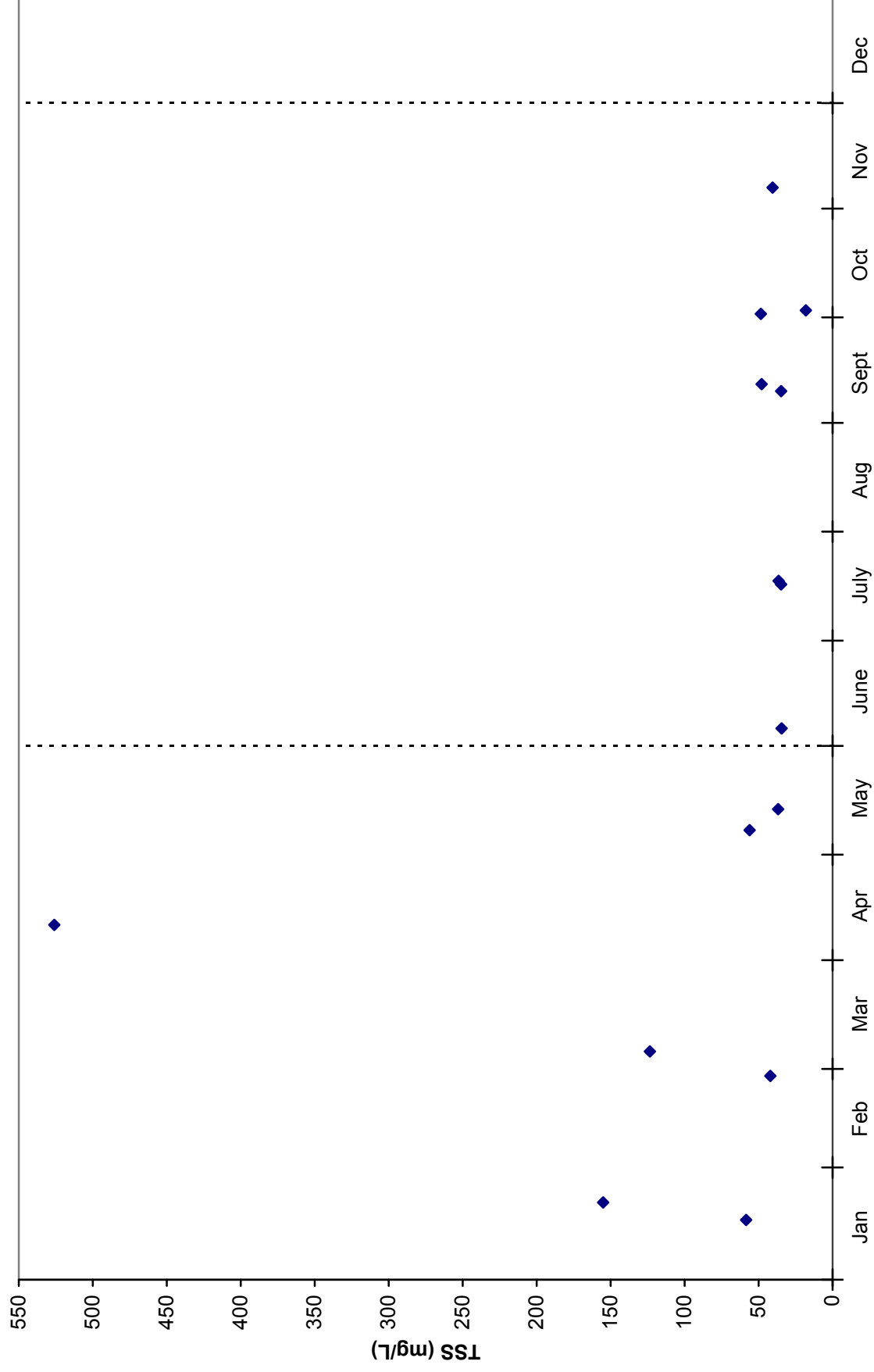


Figure C.12. Seasonal plot of TSS for Oak Bayou at OUA0179

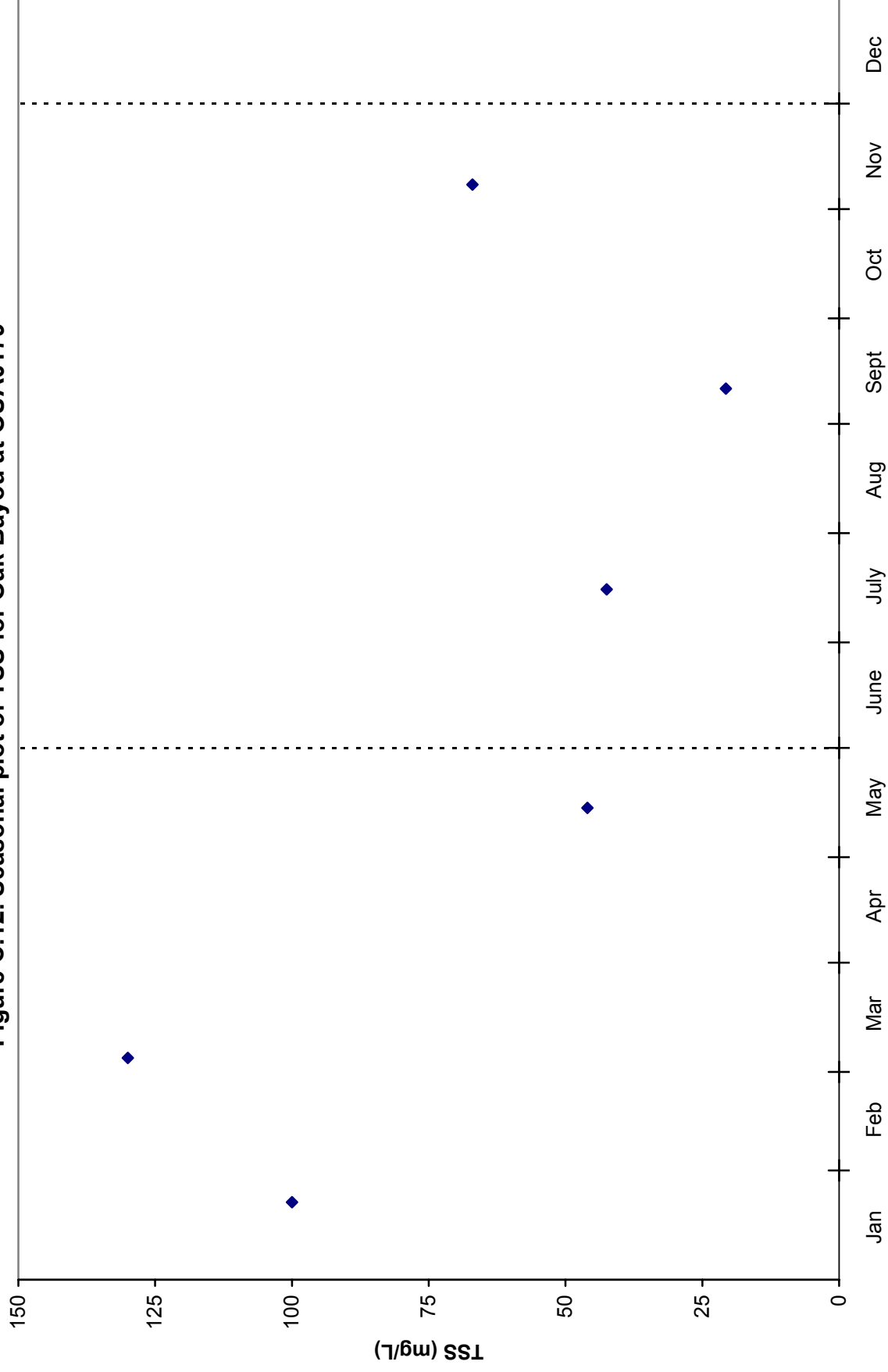


Figure C.13. Seasonal Plot of TSS for Bayou Macon at UWBYM01

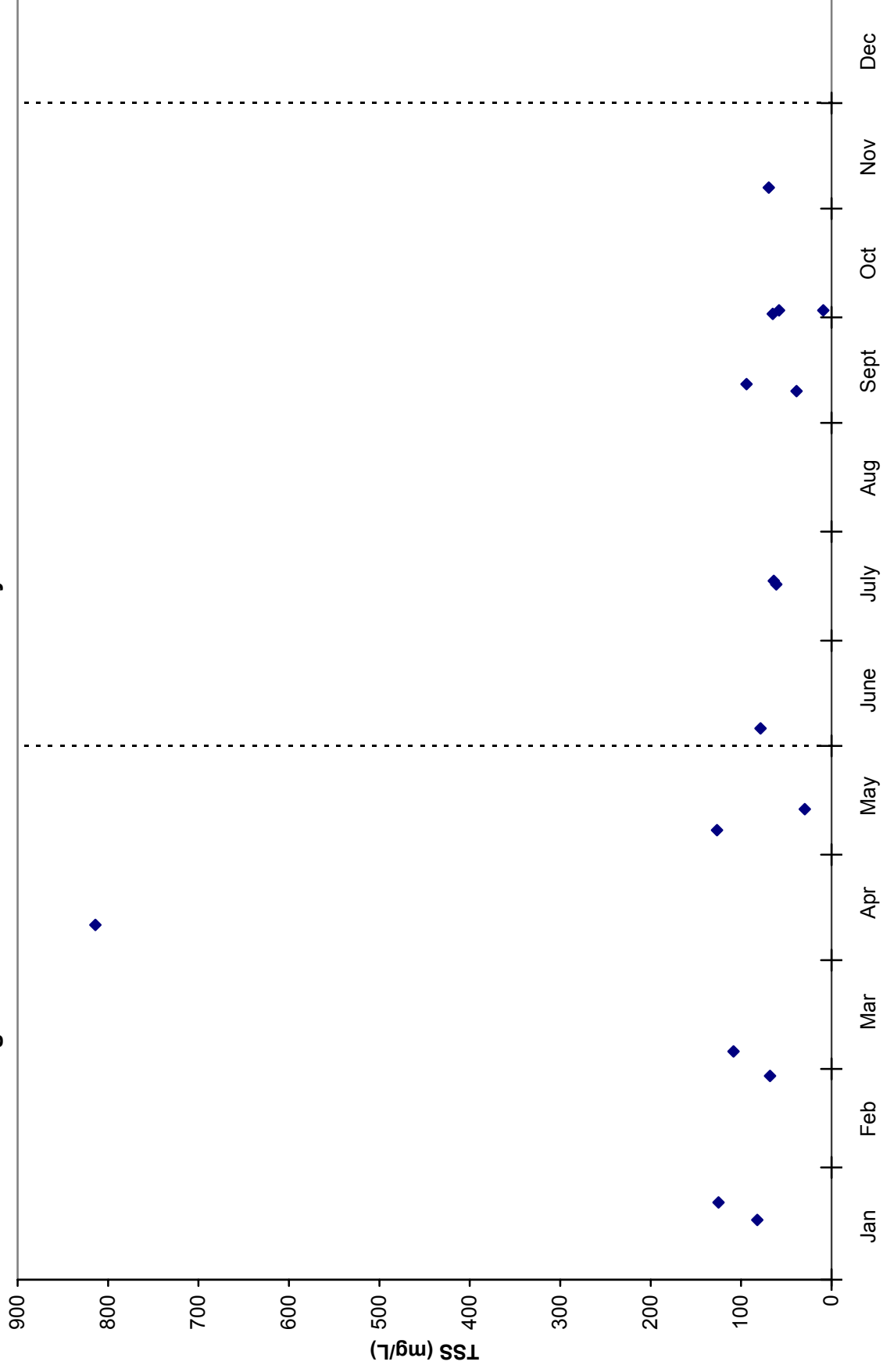
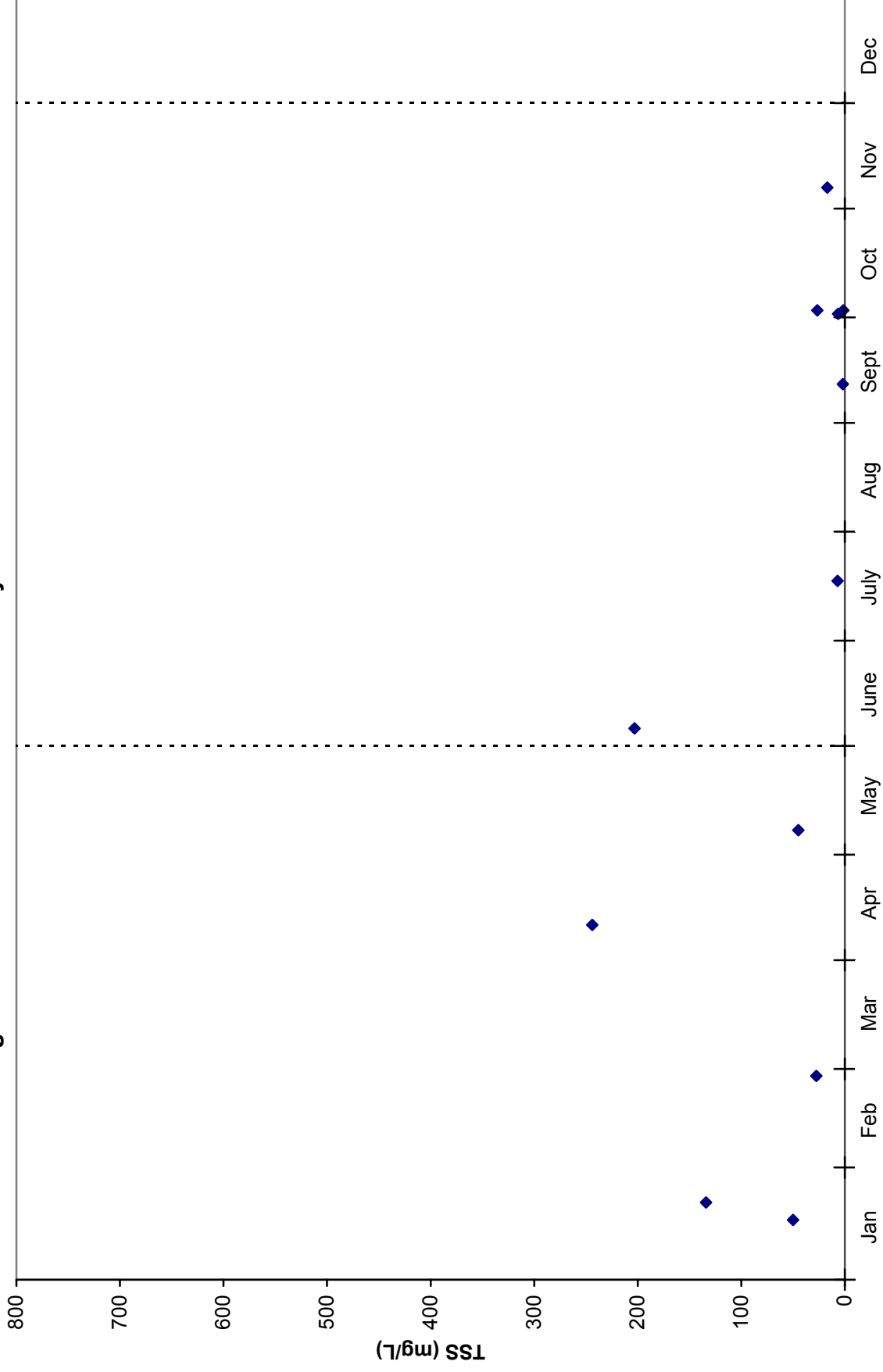


Figure C.14. Seasonal Plot of TSS for Bayou Macon at UWBYM02



APPENDIX D

Plots of Turbidity vs. Flow and TSS

Figure D.1. Turbidity vs. flow for Boeuf River at OUA0015A

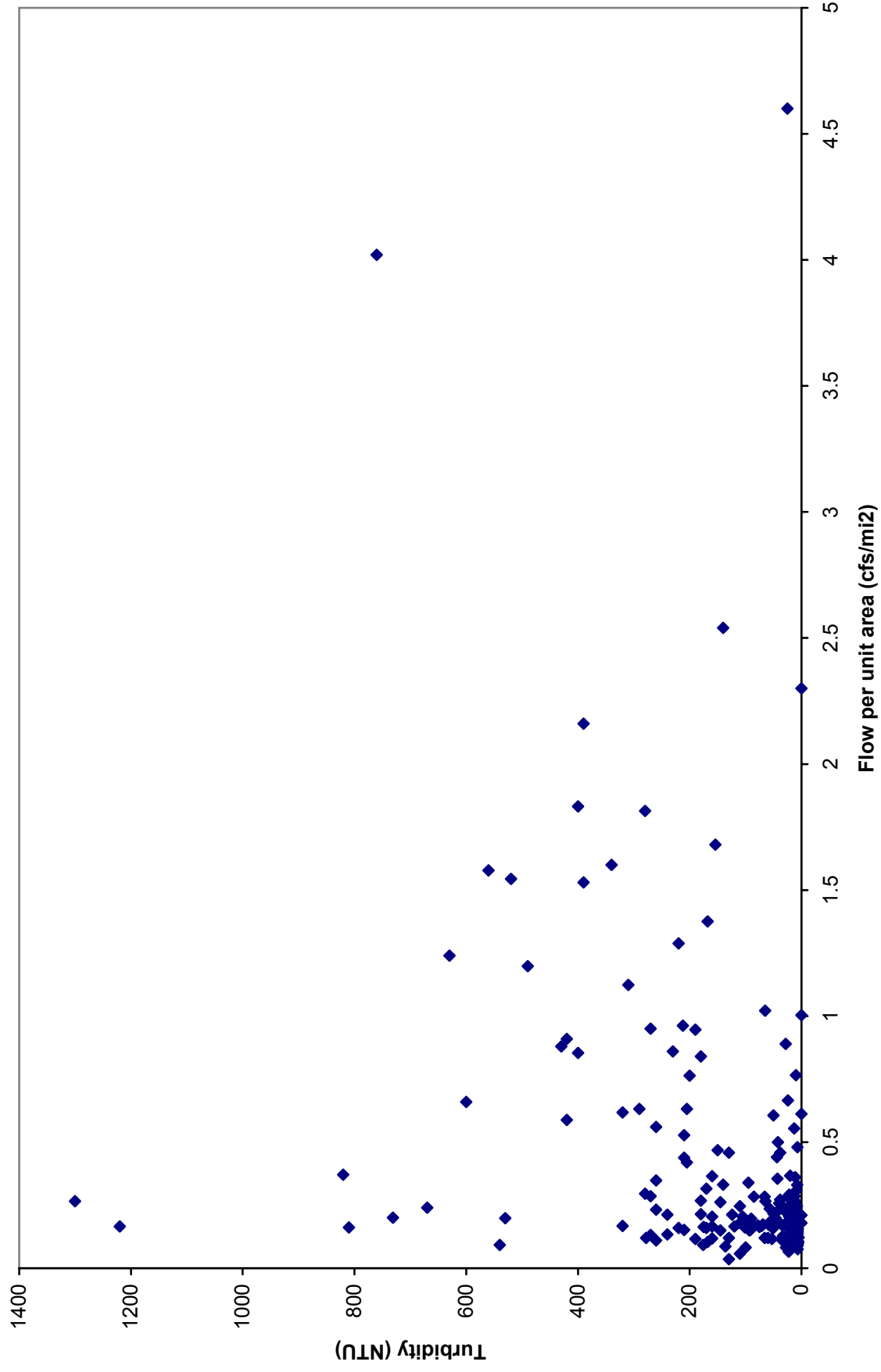


Figure D.2. Turbidity vs. Flow for Boeuf River at UWBFR01

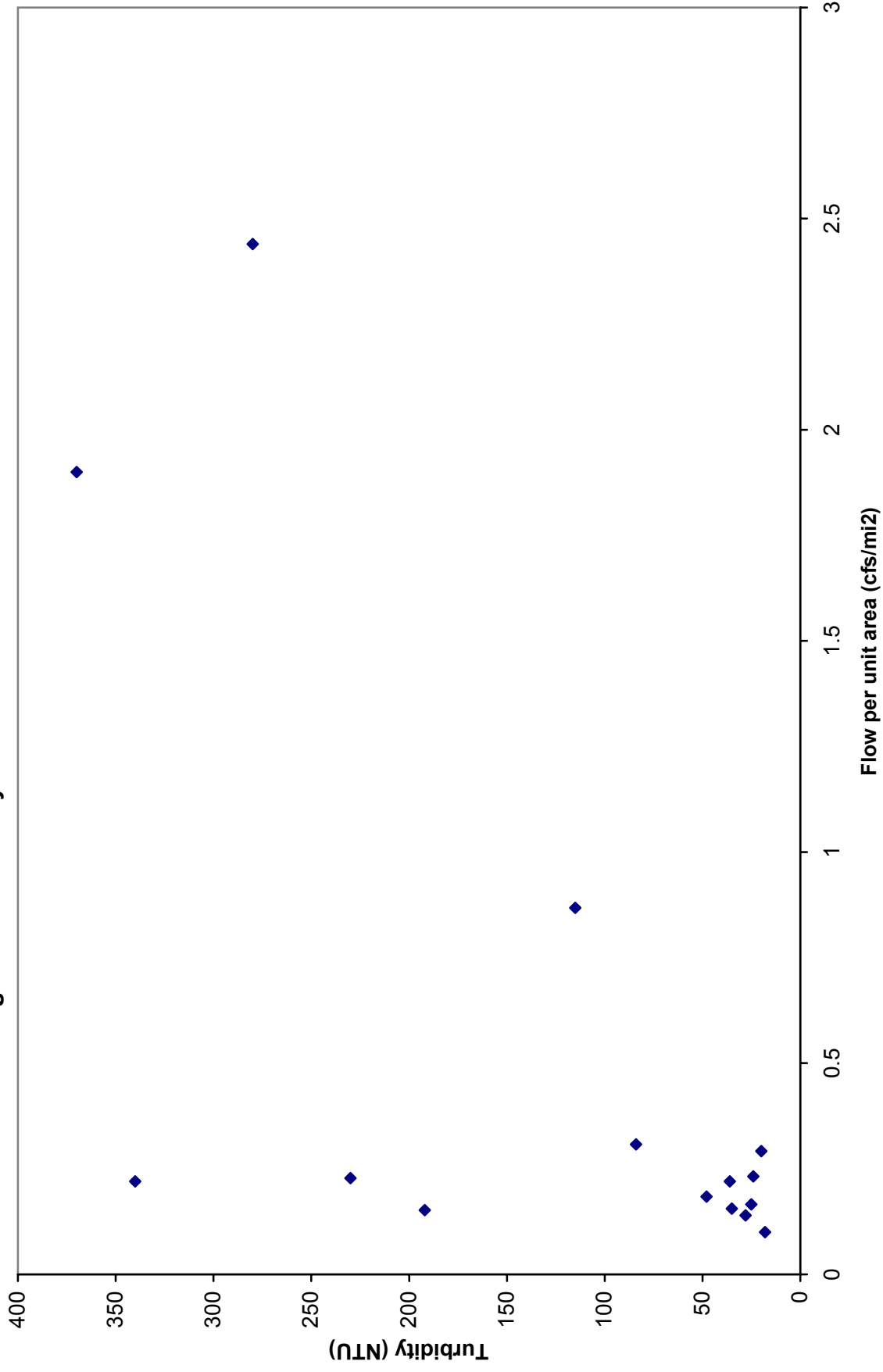


Figure D.3. Turbidity vs. Flow for Big Bayou at OUA00032

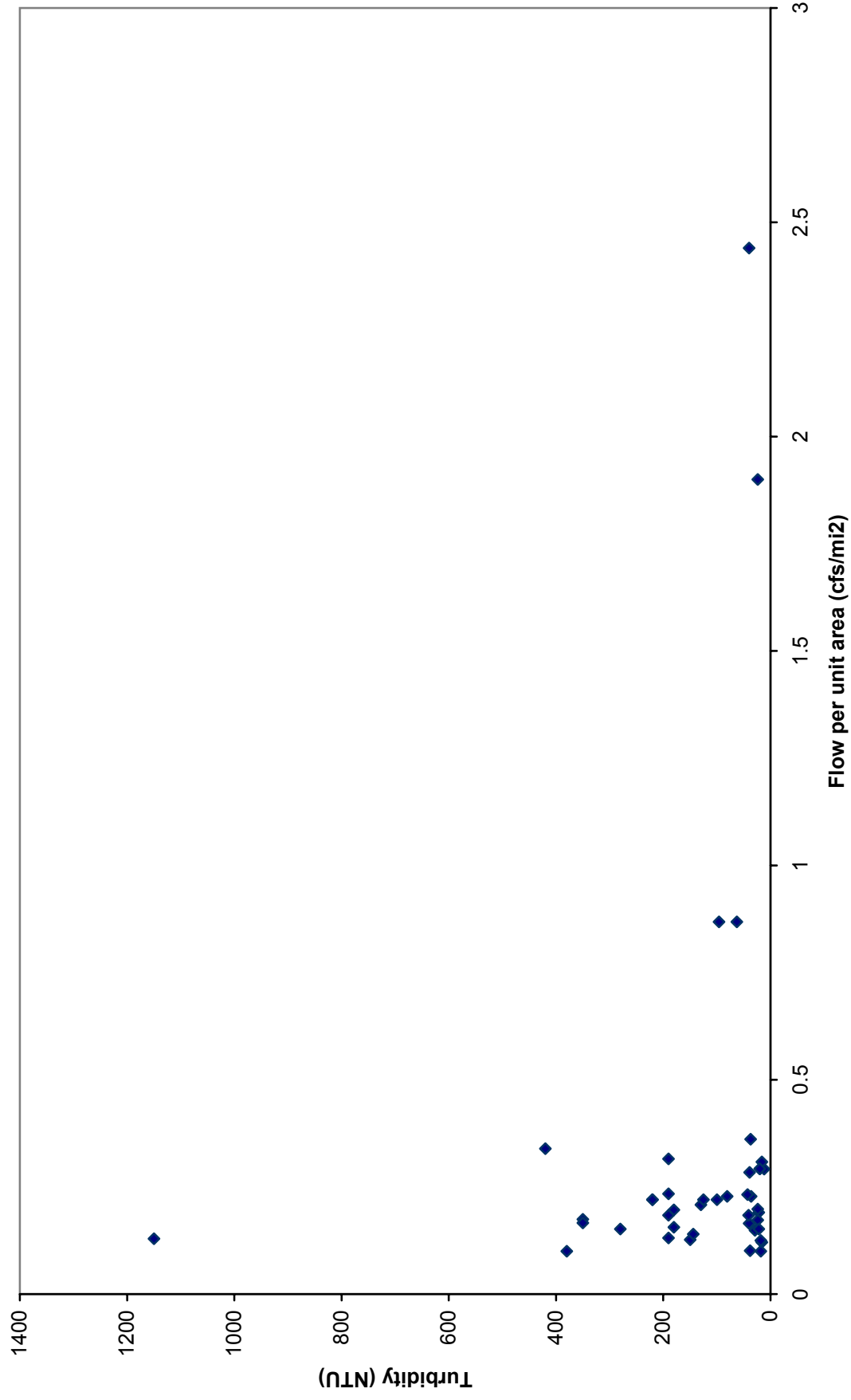


Figure D.4. Turbidity vs. Flow for Big Bayou at UWBGB01

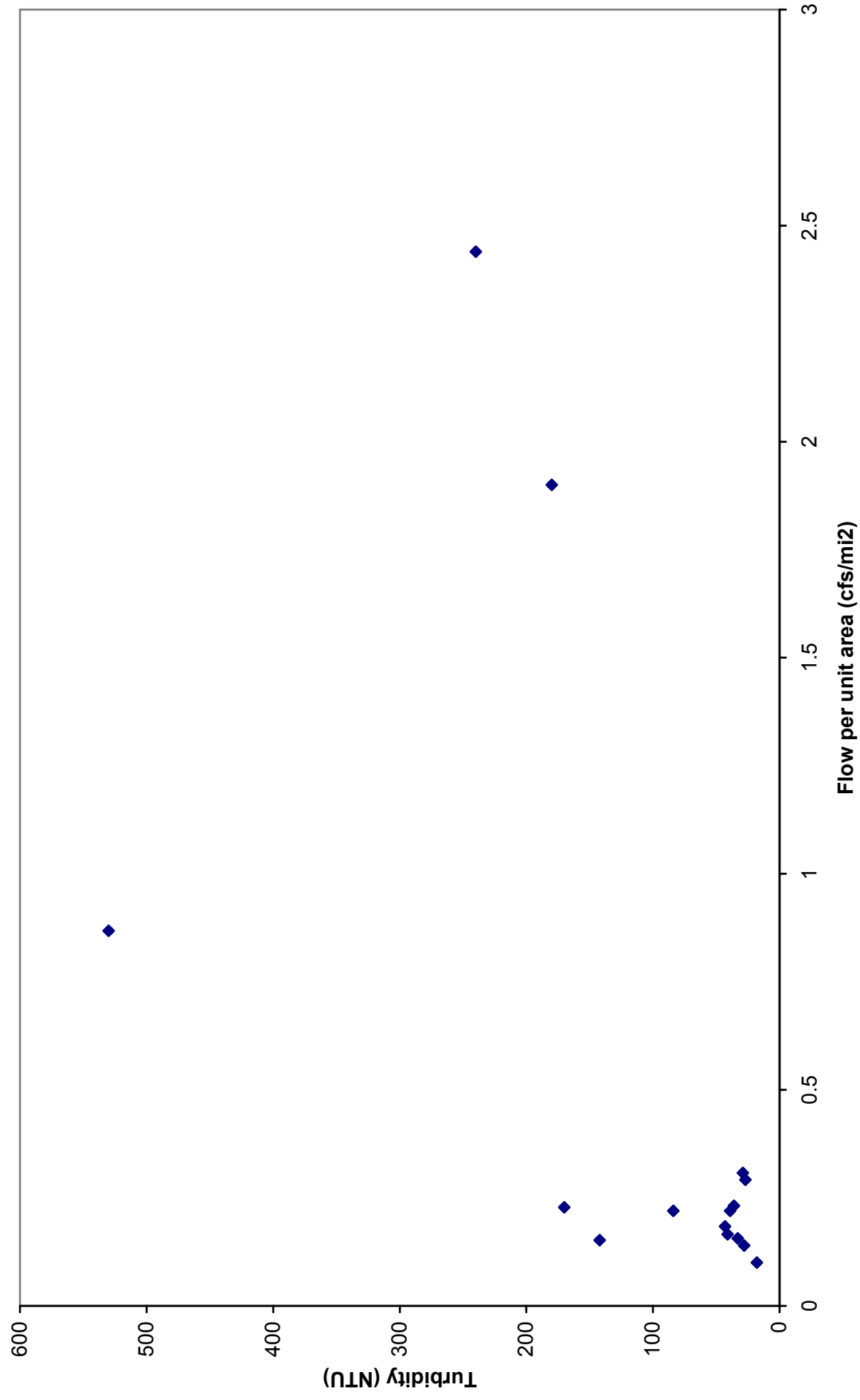


Figure D.5. Turbidity vs. Flow for Oak Bayou at OUA0179

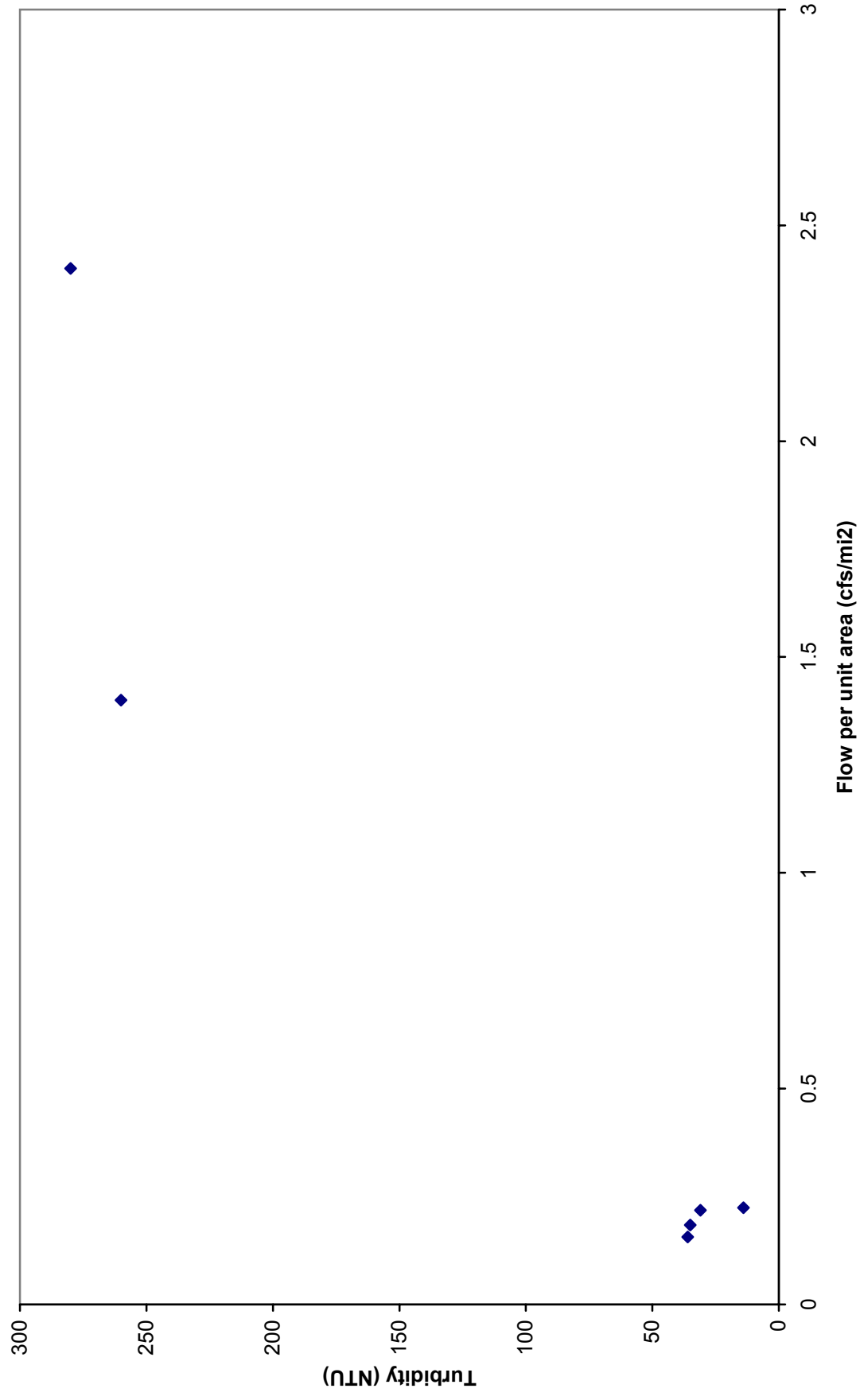


Figure D.6. Turbidity vs. Flow for Bayou Macon at UWBYM01

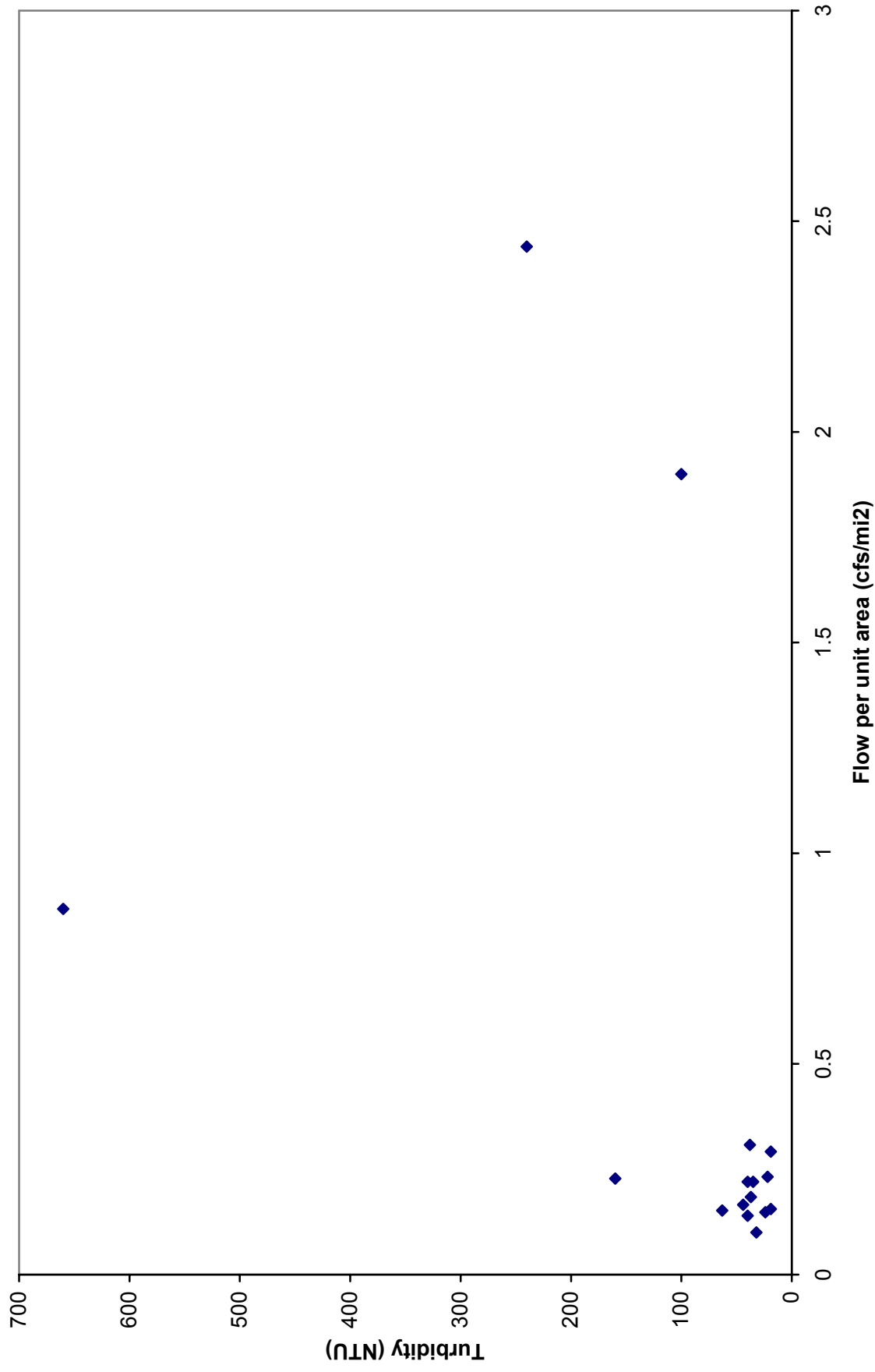


Figure D.7. Turbidity vs. Flow for Bayou Macon at UWBYM02

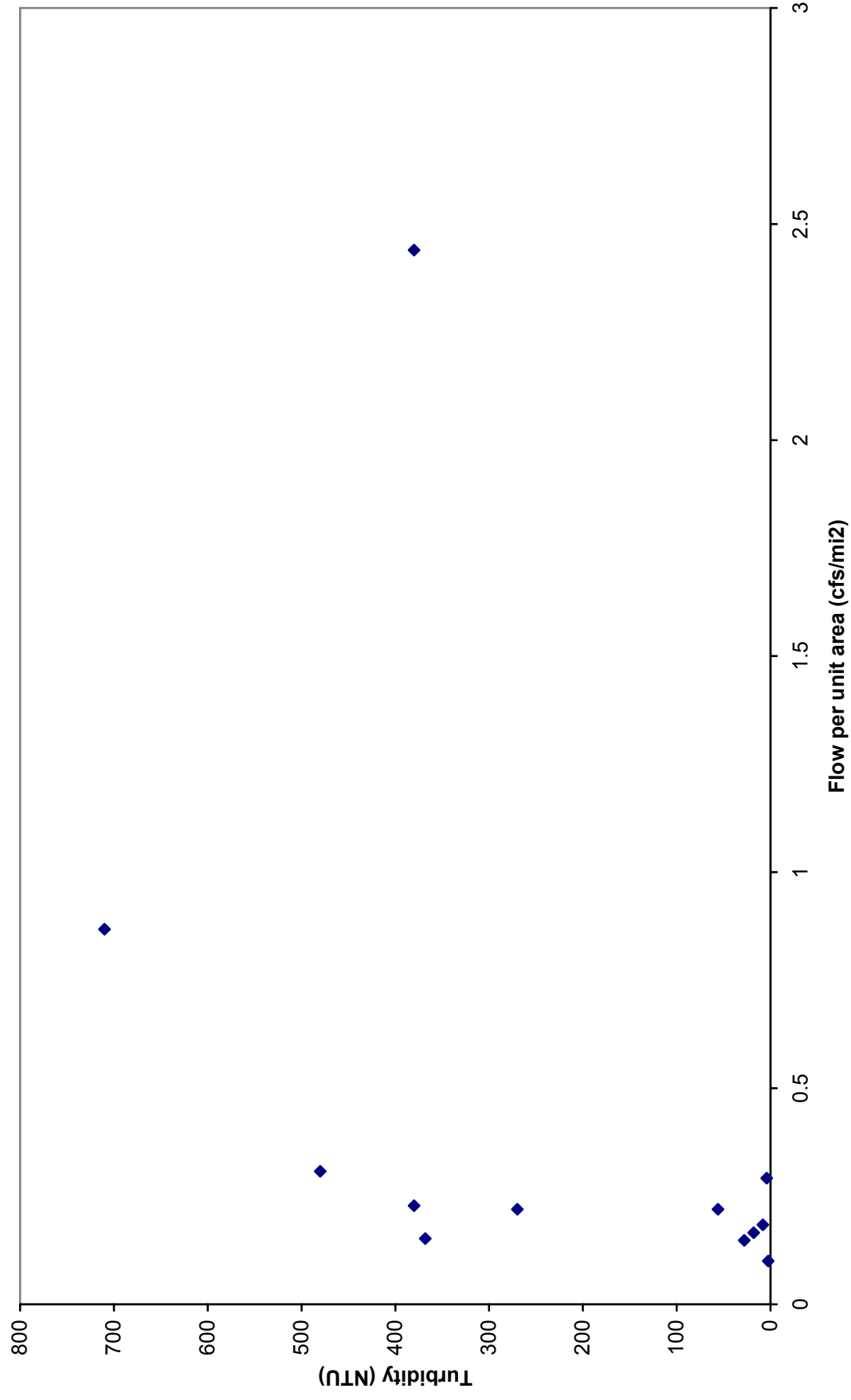


Figure D.8. TSS vs. Turbidity for Boeuf River at OUA0015A

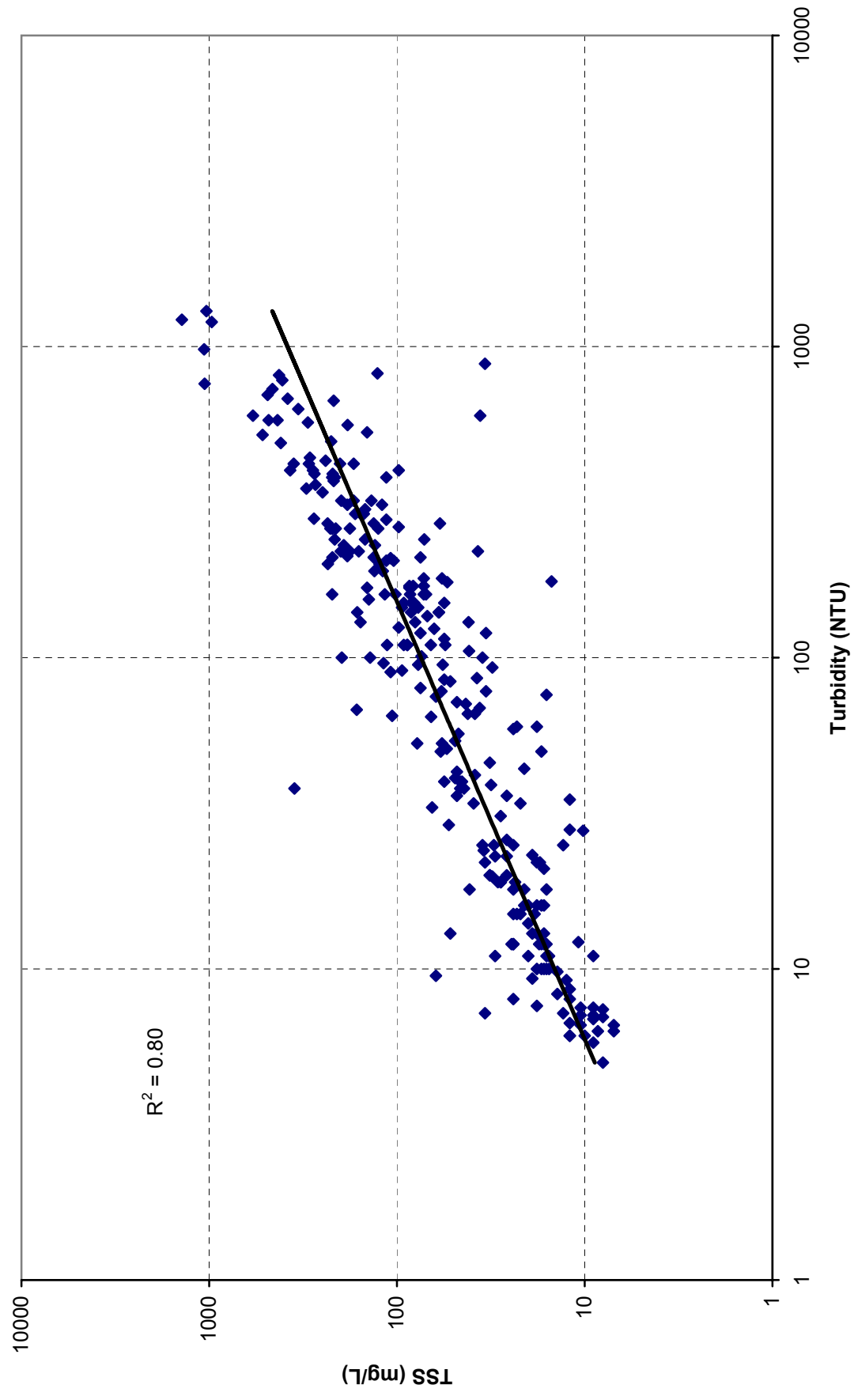


Figure D.9. TSS vs. Turbidity for Boeuf River at UWBFR01

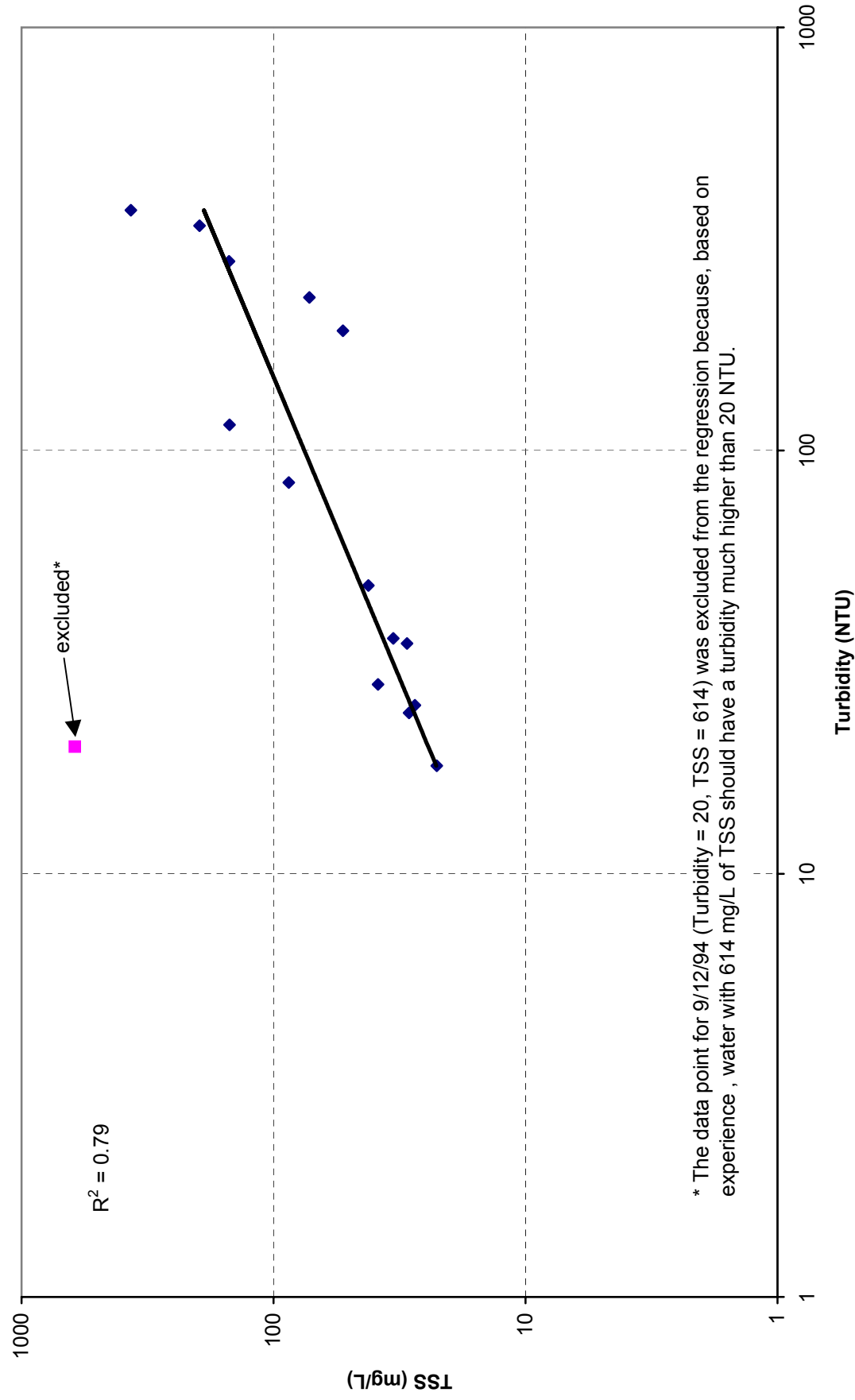


Figure D.10. TSS vs. Turbidity TSS for Big Bayou at OUA0032

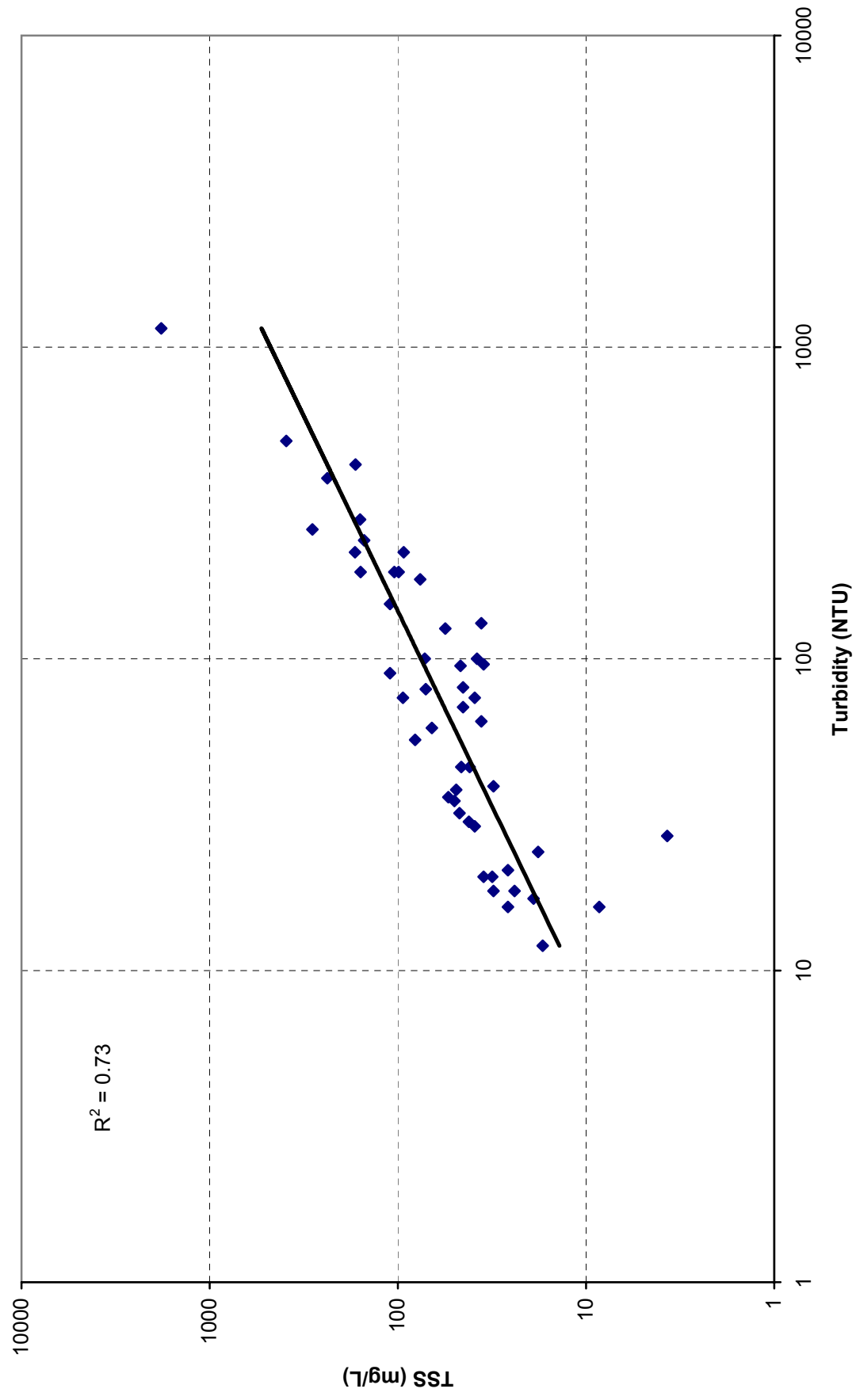


Figure D.11. TSS vs. Turbidity on Big Bayou at UWBGB01

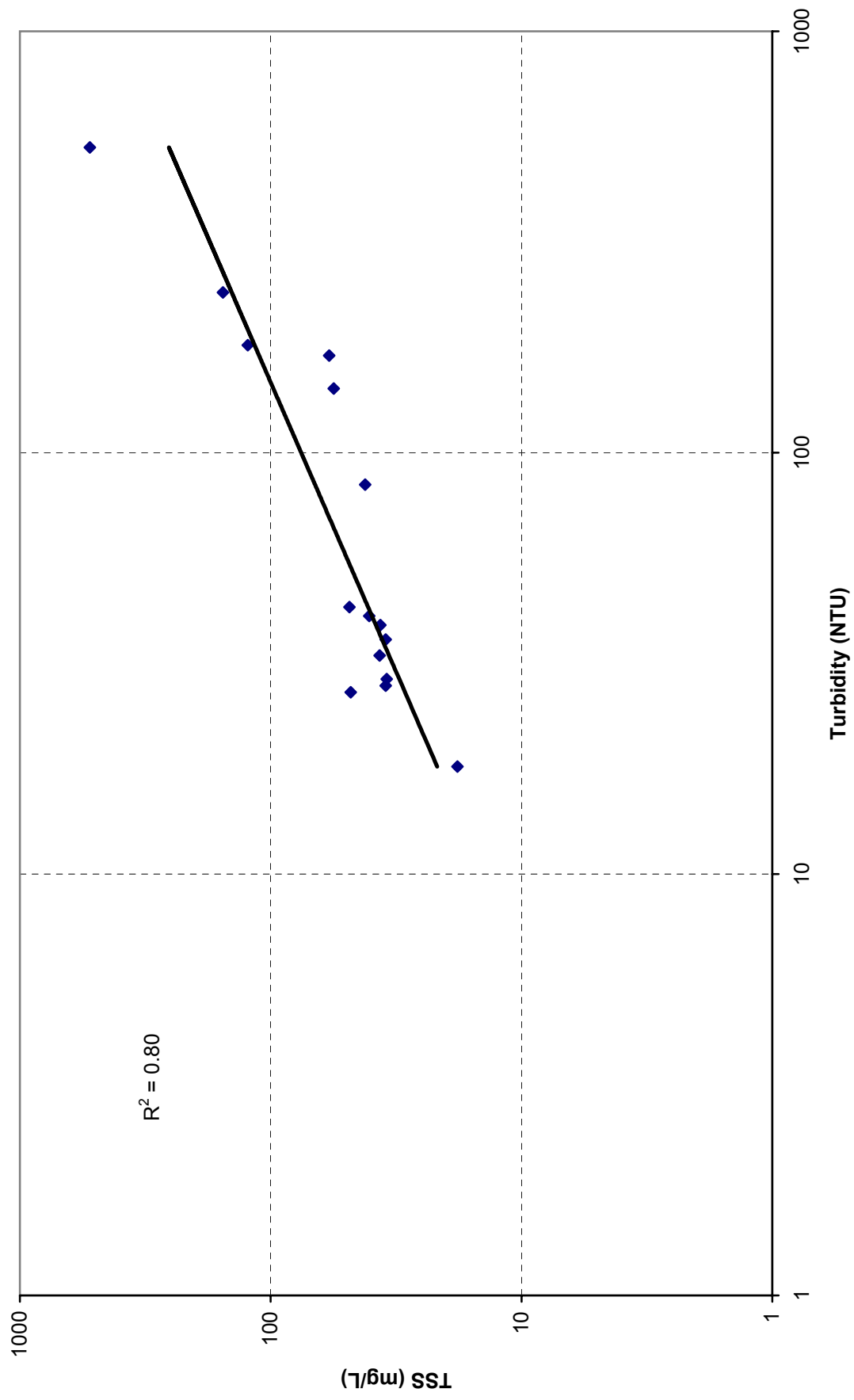


Figure D.12. TSS vs. Turbidity for Oak Bayou at OUA0179

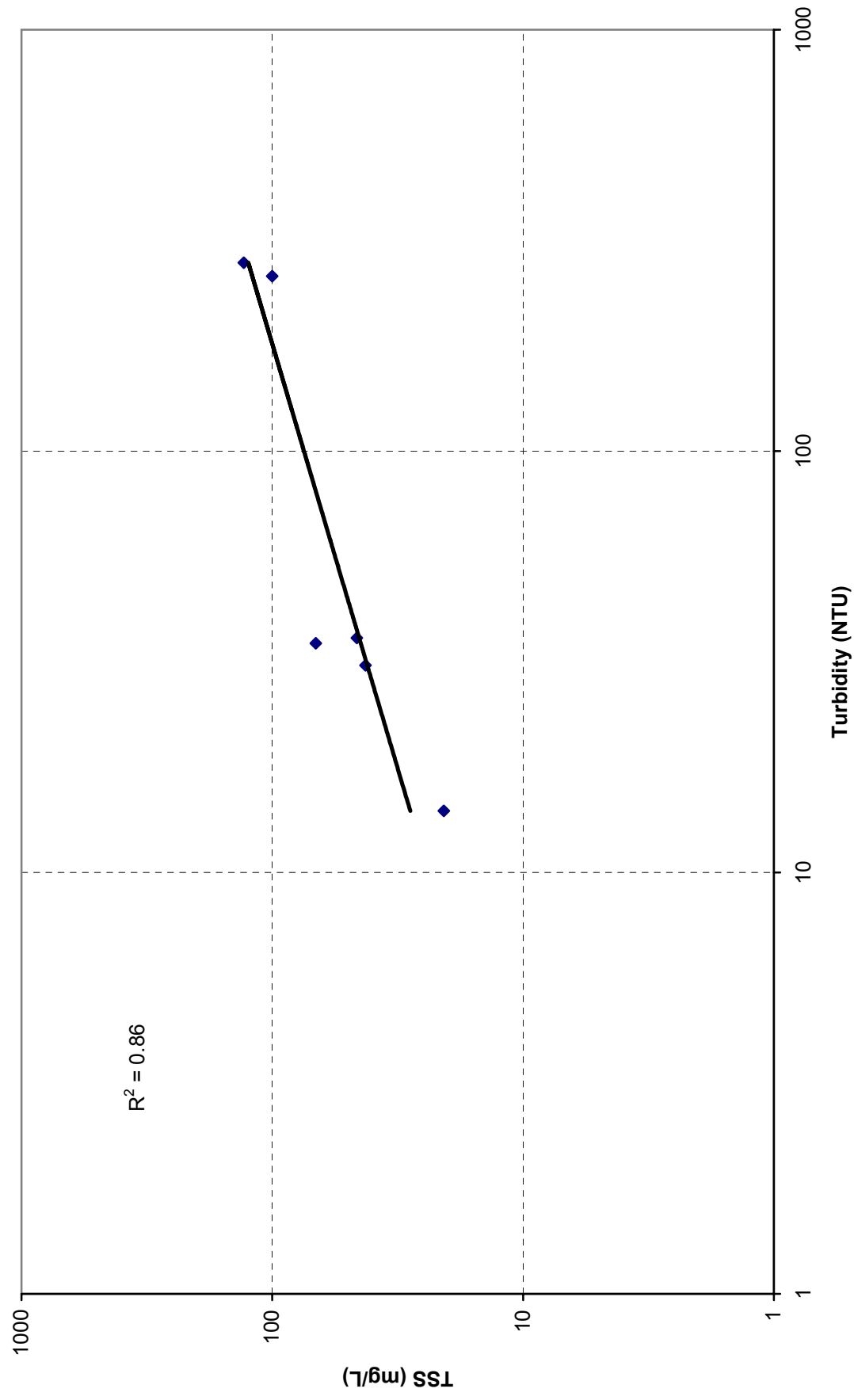


Figure D.13. TSS vs. Turbidity on Bayou Macon at UWBYM01

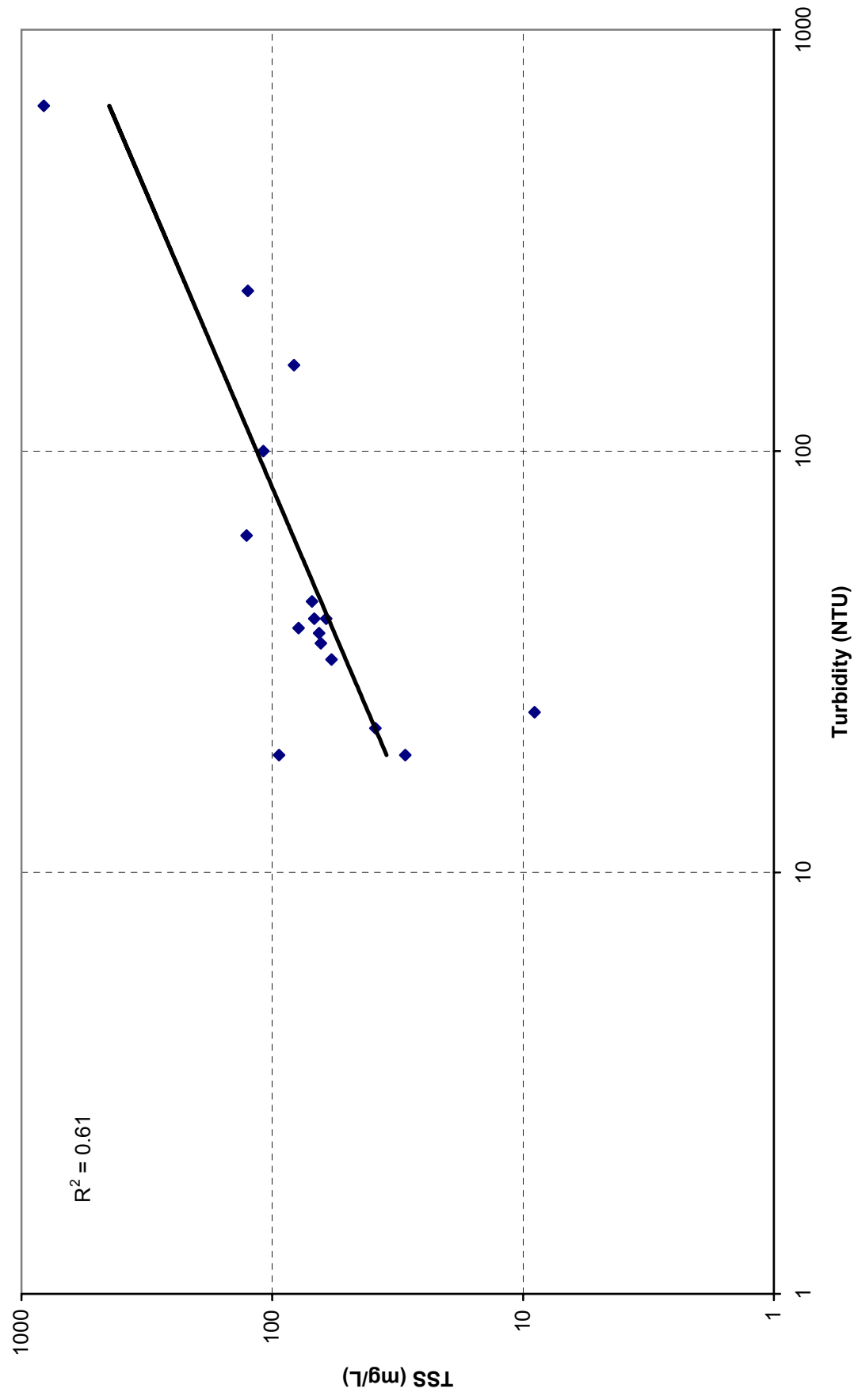


Figure D.14. TSS vs. Turbidity for Bayou Macon at UWBYM02

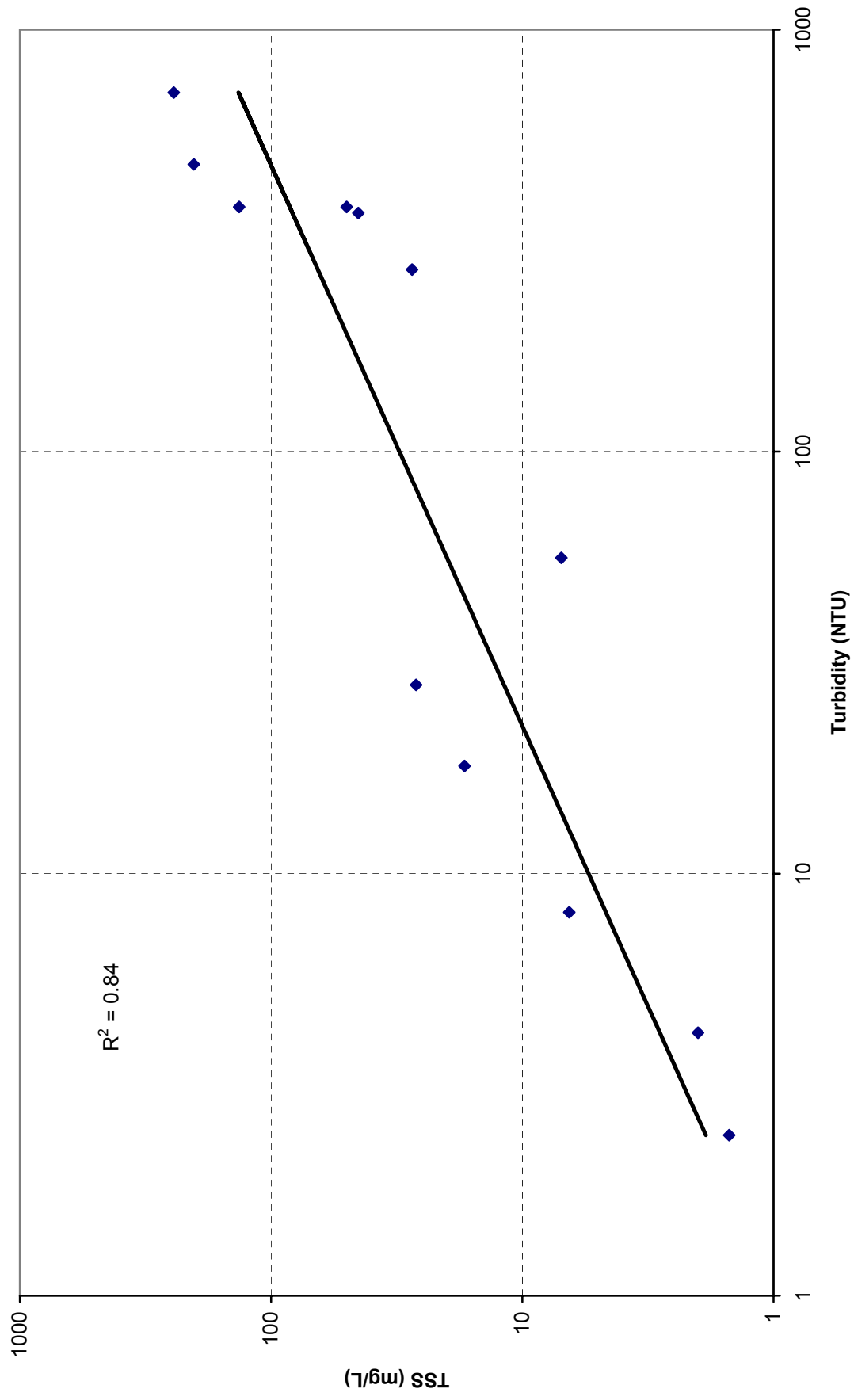


Figure D.15. Summer TSS vs. Turbidity for All Stations in Basin

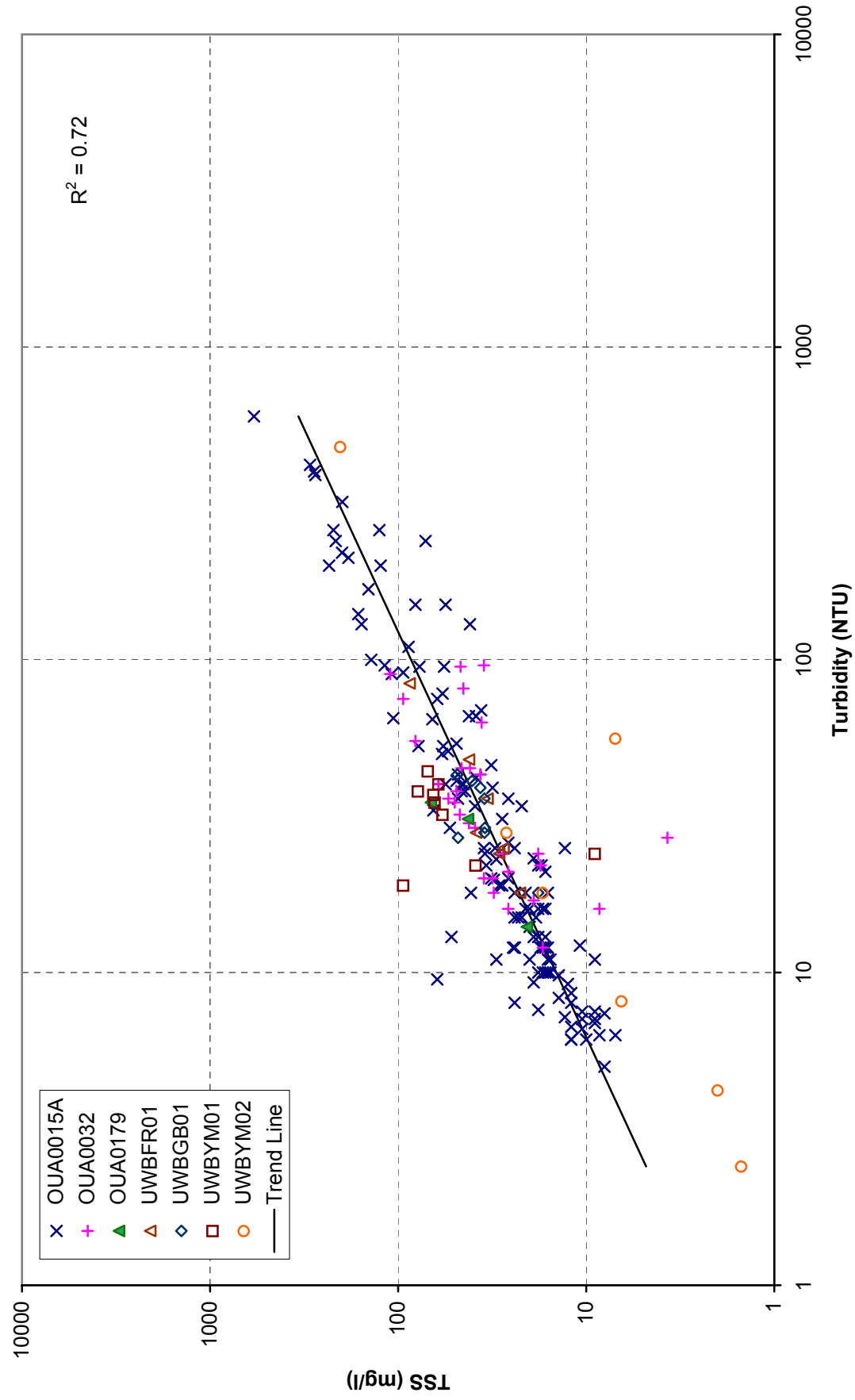
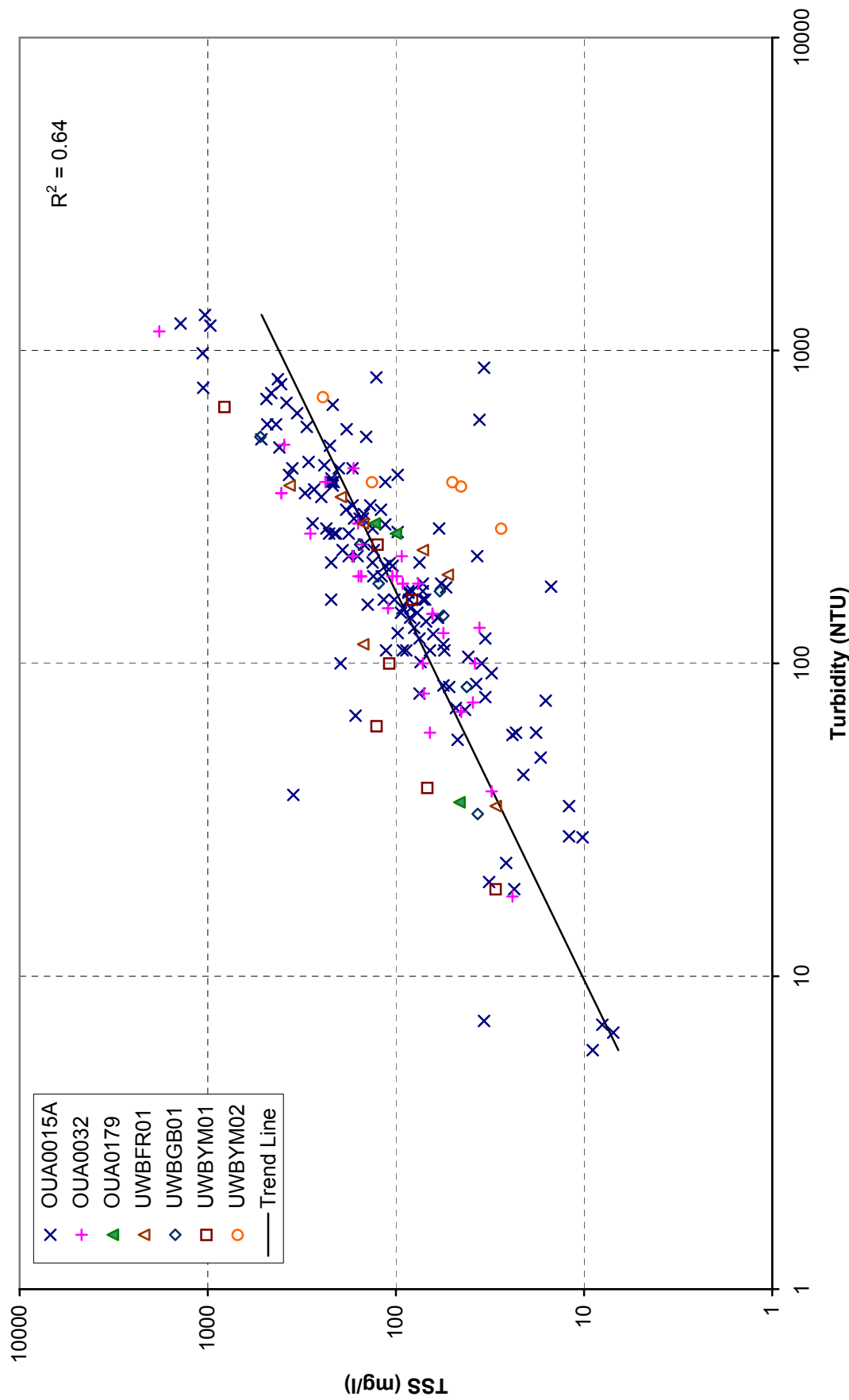


Figure D.16. Winter TSS vs. Turbidity for All Stations in Basin



APPENDIX E

Long Term Plots of Chloride and TDS

Figure E.1. Long Term Plot of Chloride for Boeuf River at OUA0015A

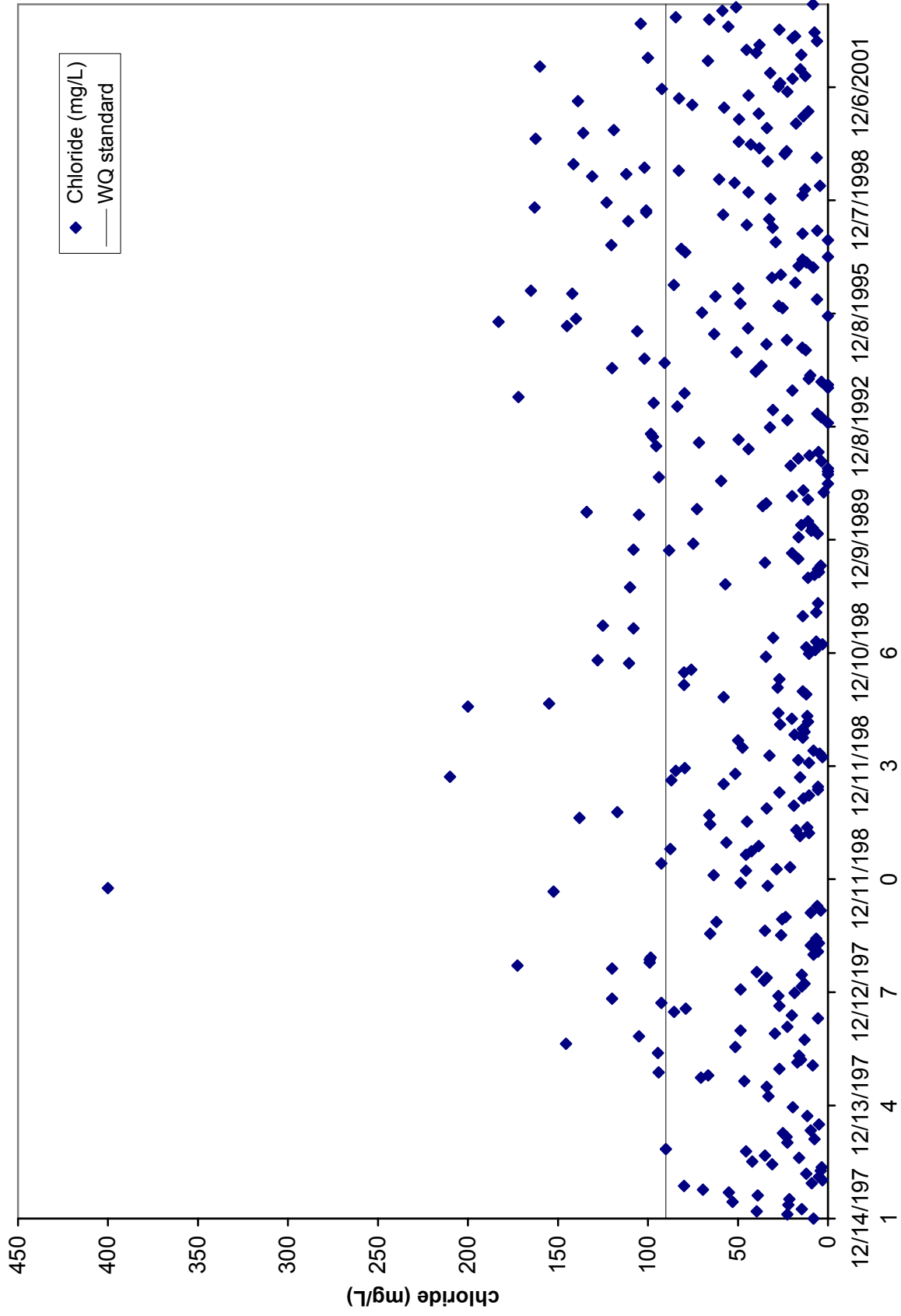


Figure E.2. Long Term Plot of Chloride for Boeuf River at UWBFR01

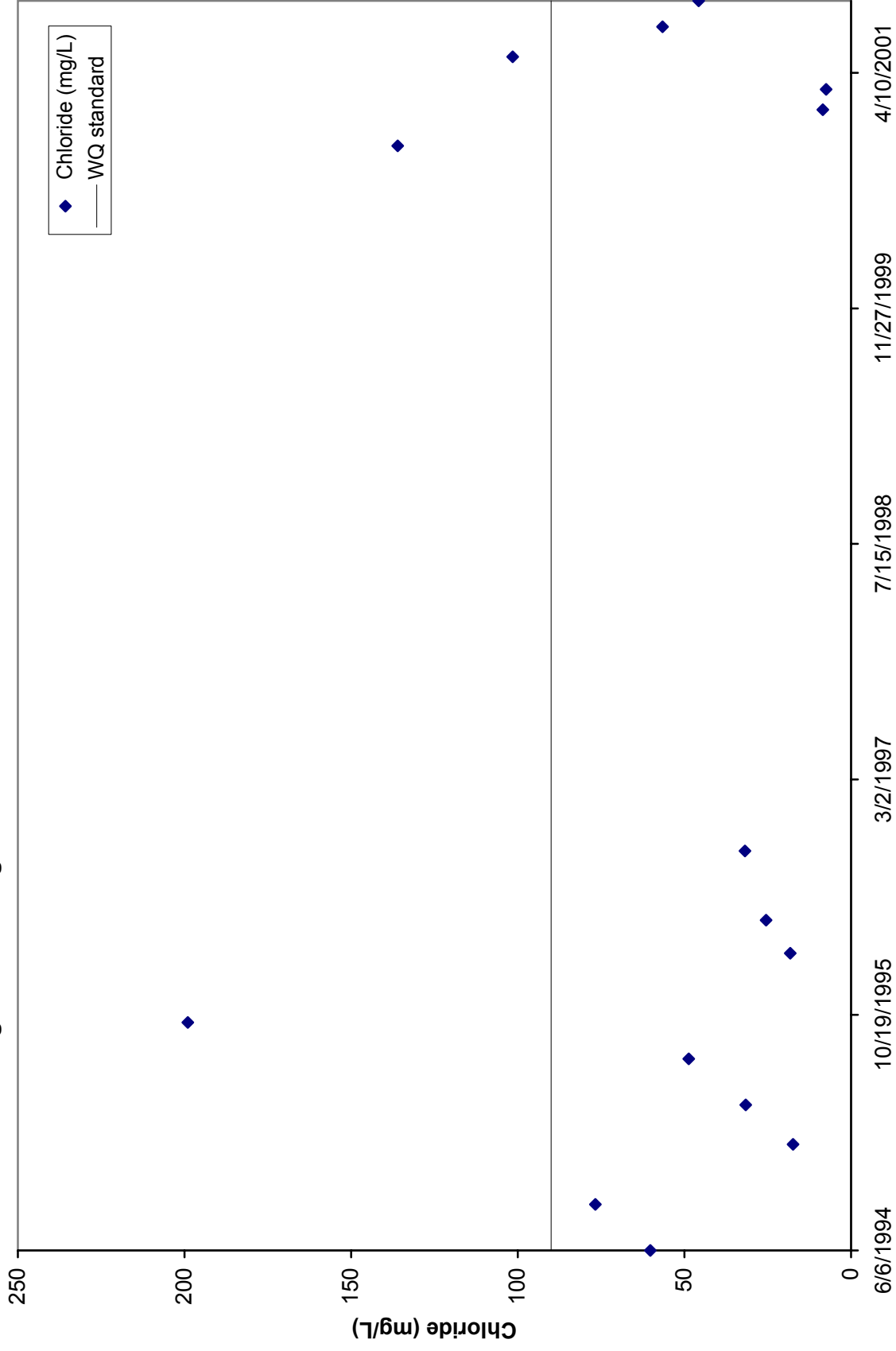


Figure E.3. Long Term Plot of Chloride for Big Bayou at OUA0032

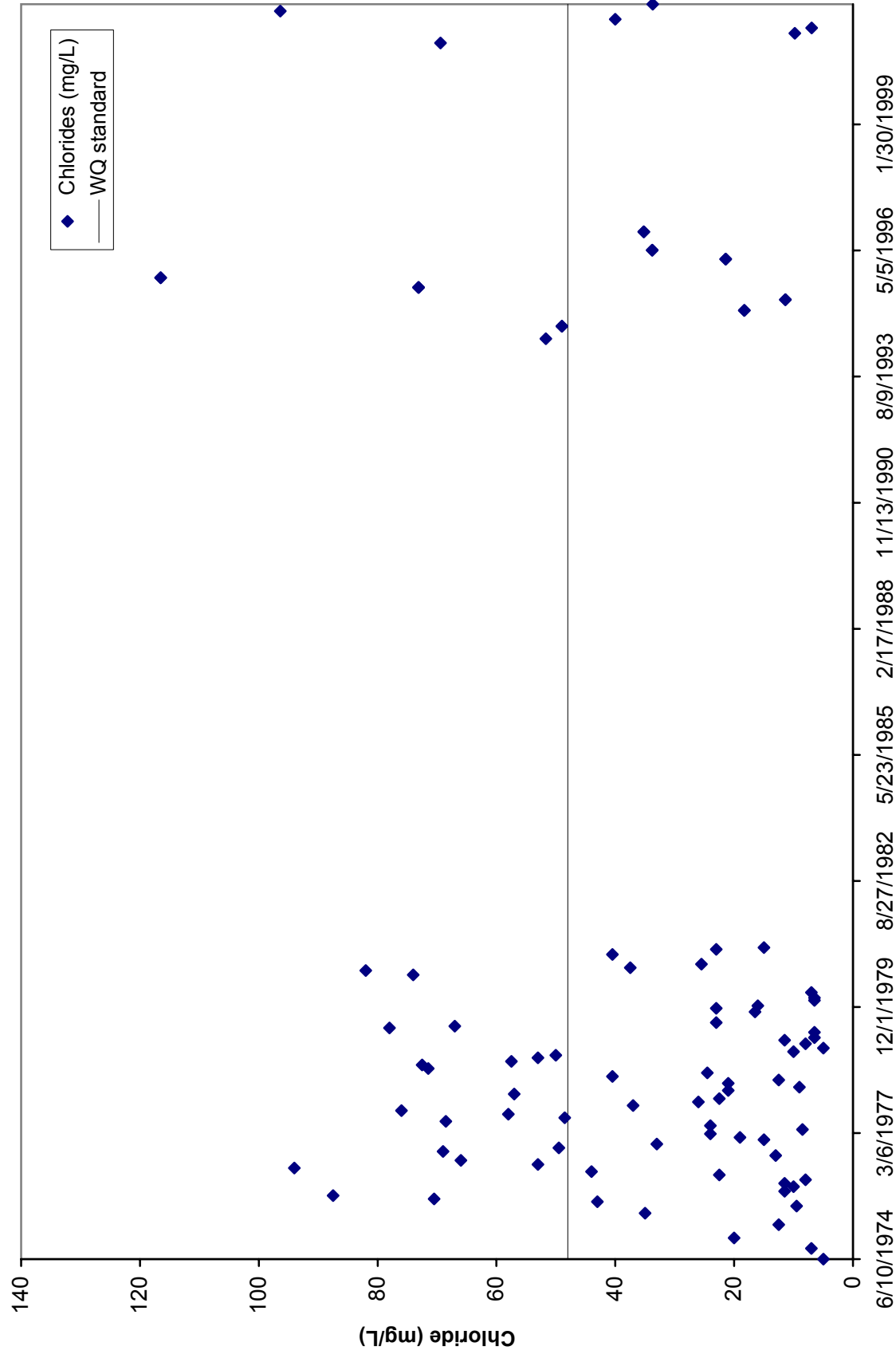


Figure E.4. Long Term Plot of Chloride for Big Bayou at UWBGB01

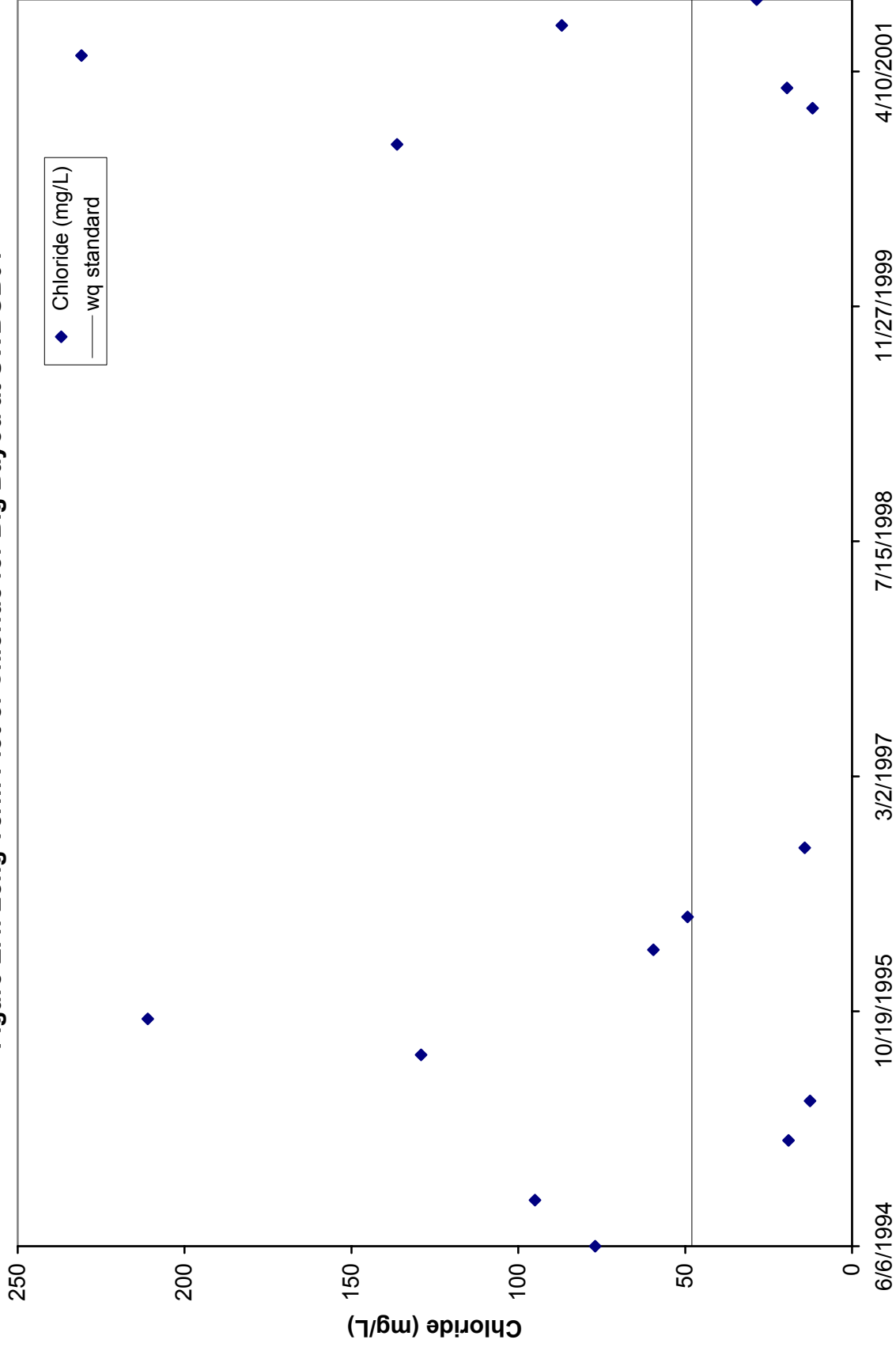


Figure E.5. Long Term Plot of Chloride for Oak Bayou at OUA0179

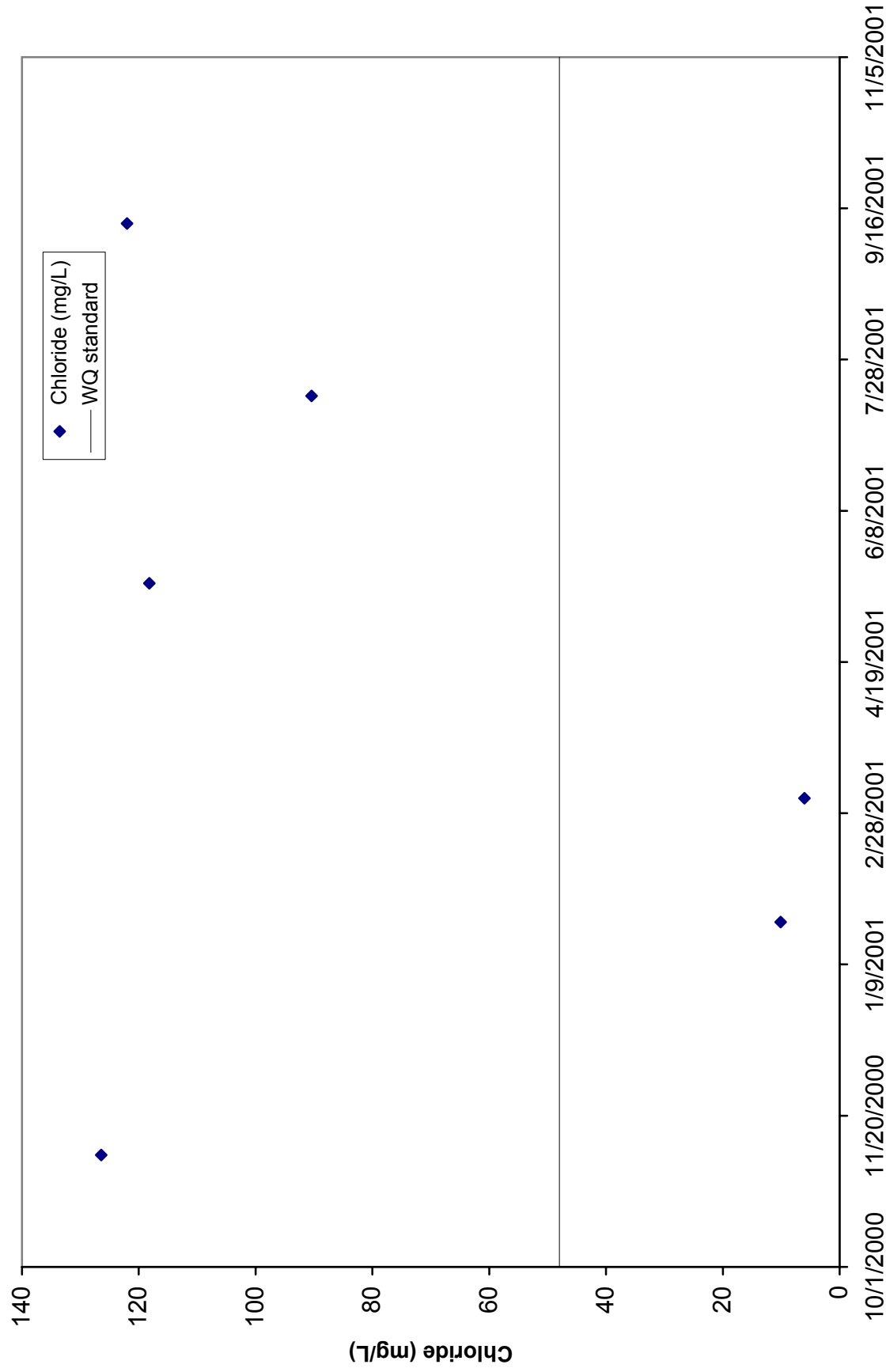


Figure E.6. Long Term Plot of TDS for Oak Bayou at OUA0179

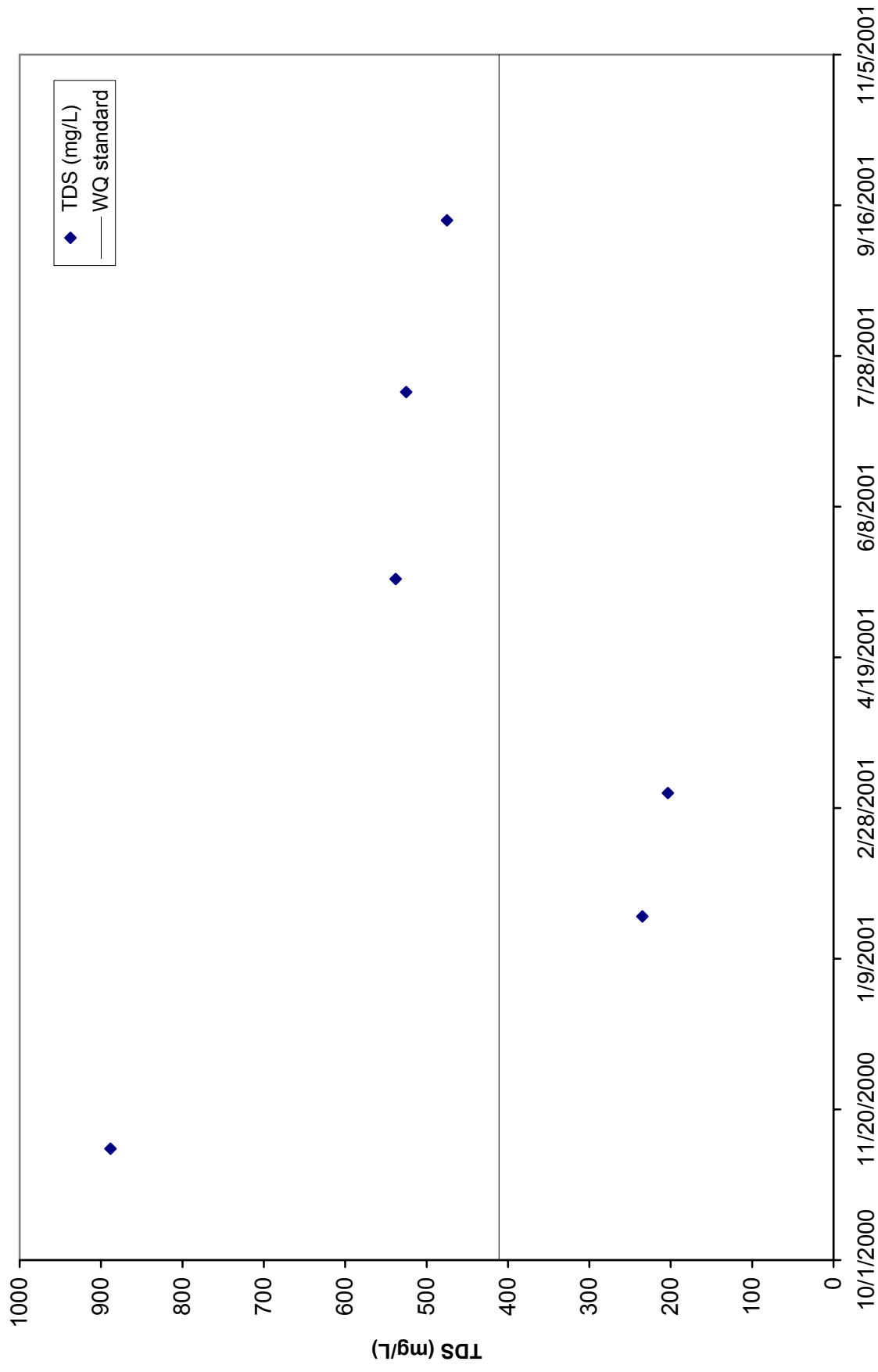


Figure E.7. Long Term Plot of TDS for Beouf River at OUA0015A

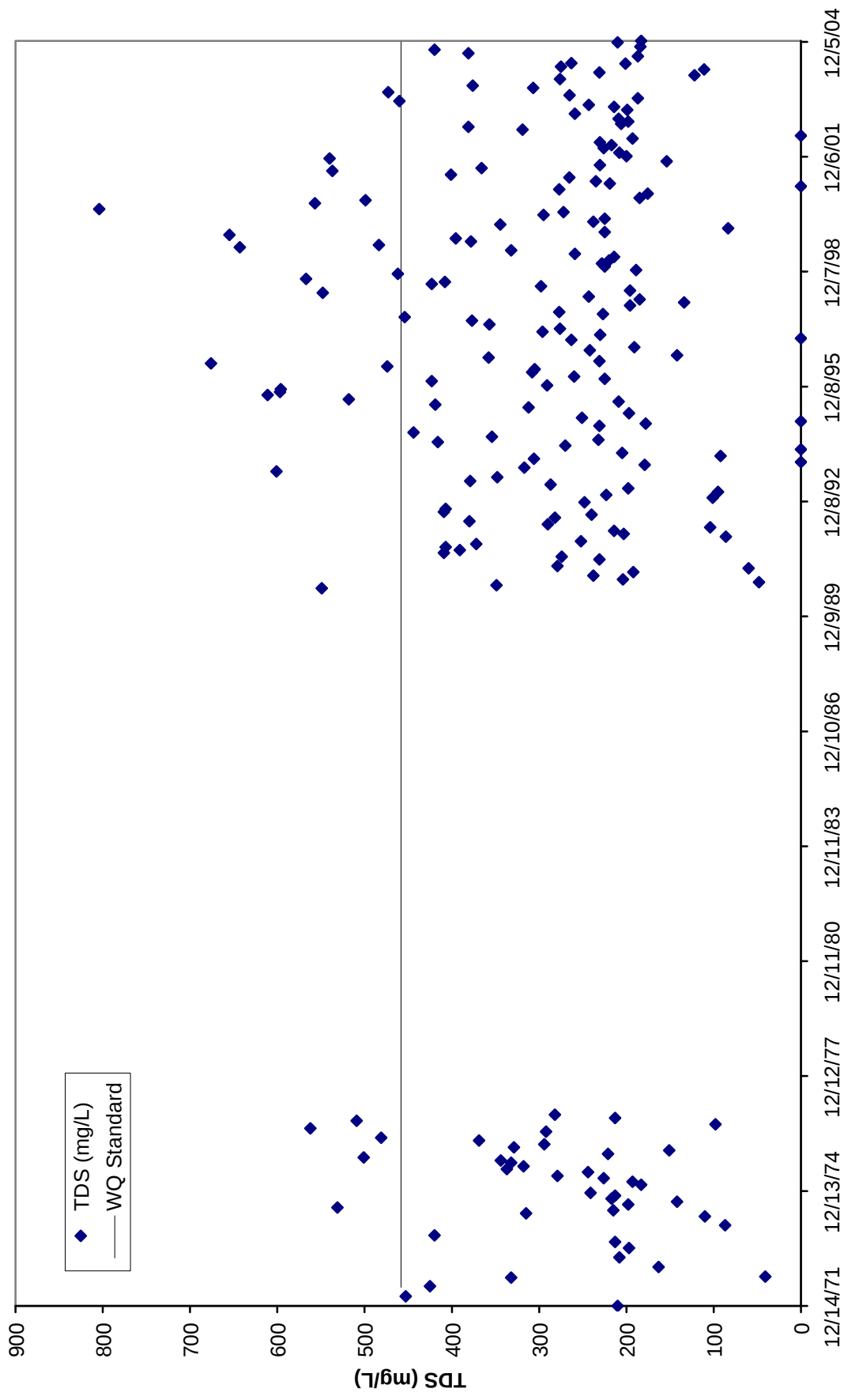
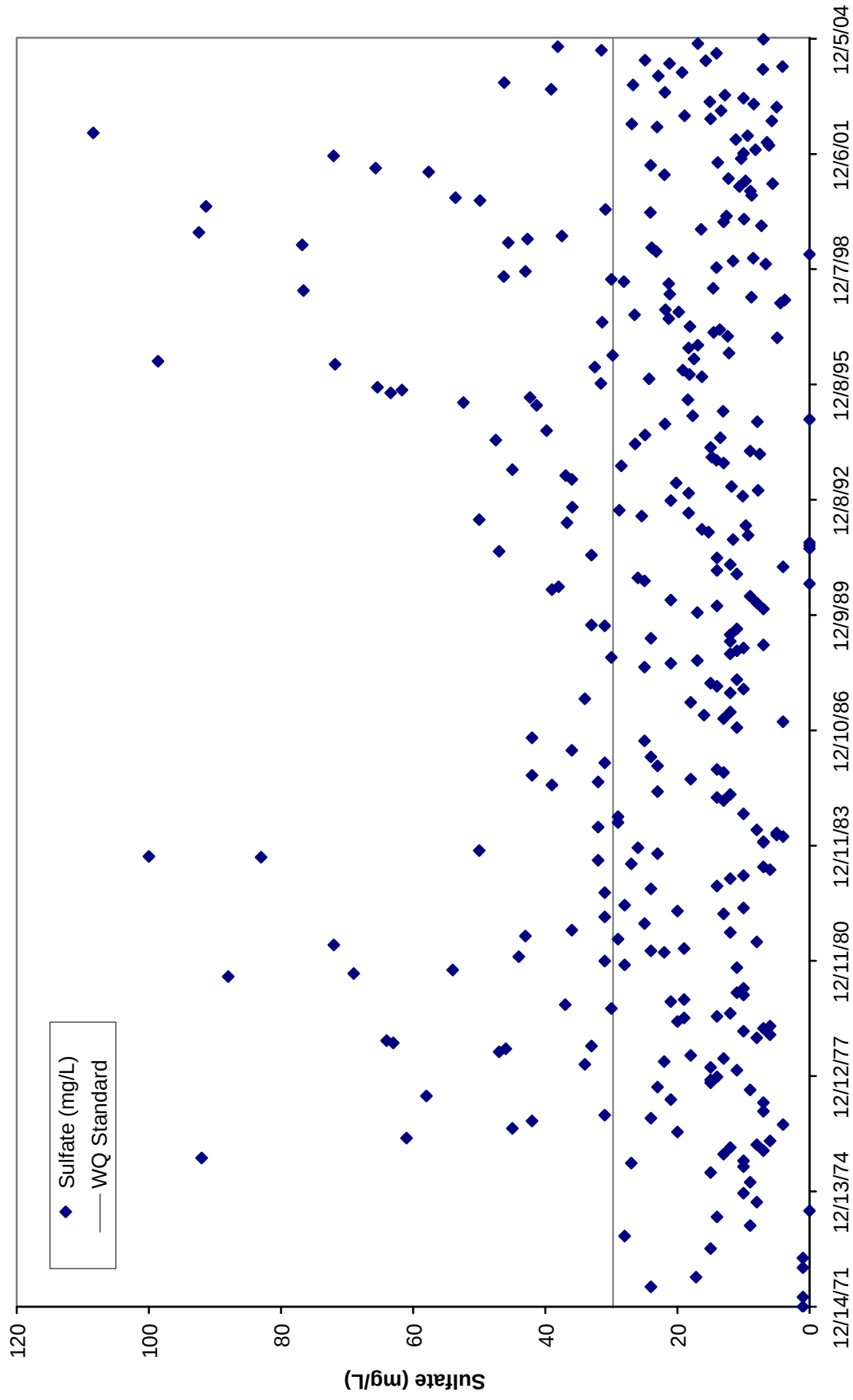


Figure E.8. Long Term Plot of Sulfate for Boeuf River at OUA0015A



APPENDIX F

Seasonal Plots of Chloride and TDS

Figure F.1. Seasonal Plot of Chlorides for Boeuf River at OUA0015A

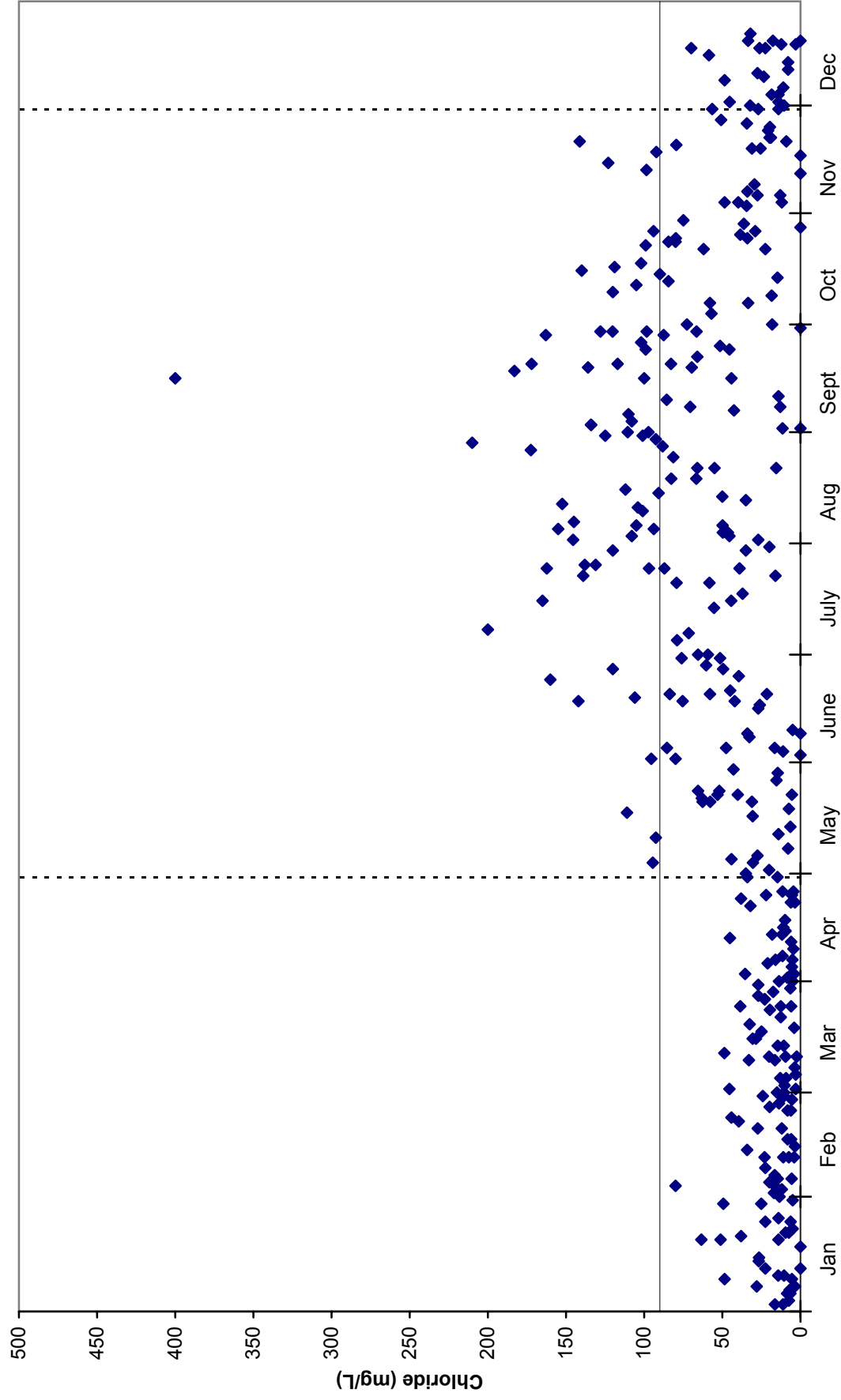


Figure F.2. Seasonal Plot of Chloride for Boeuf River at UWBFR01

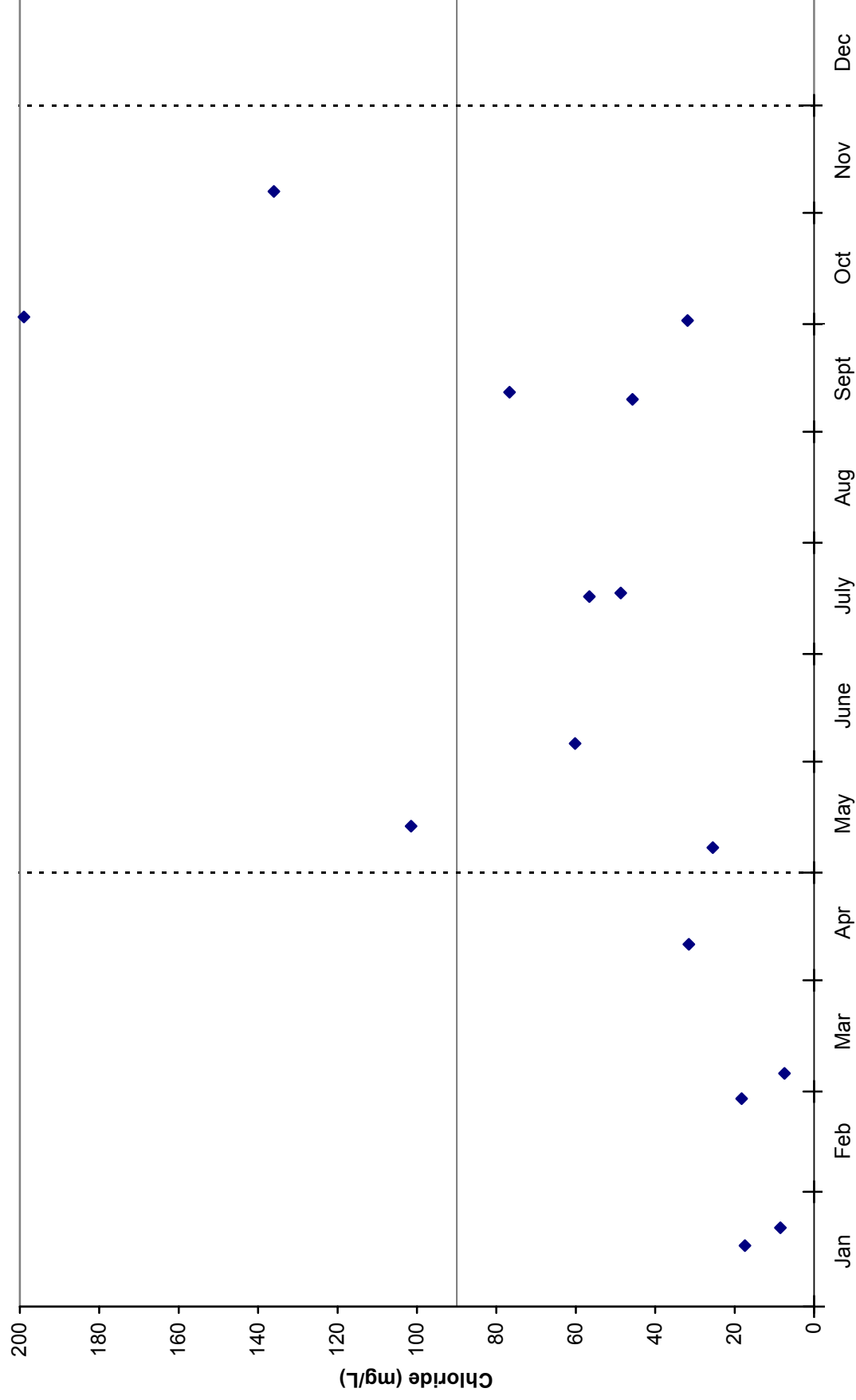


Figure F.3. Seasonal Plot of Chloride for Big Bayou at OUA0032

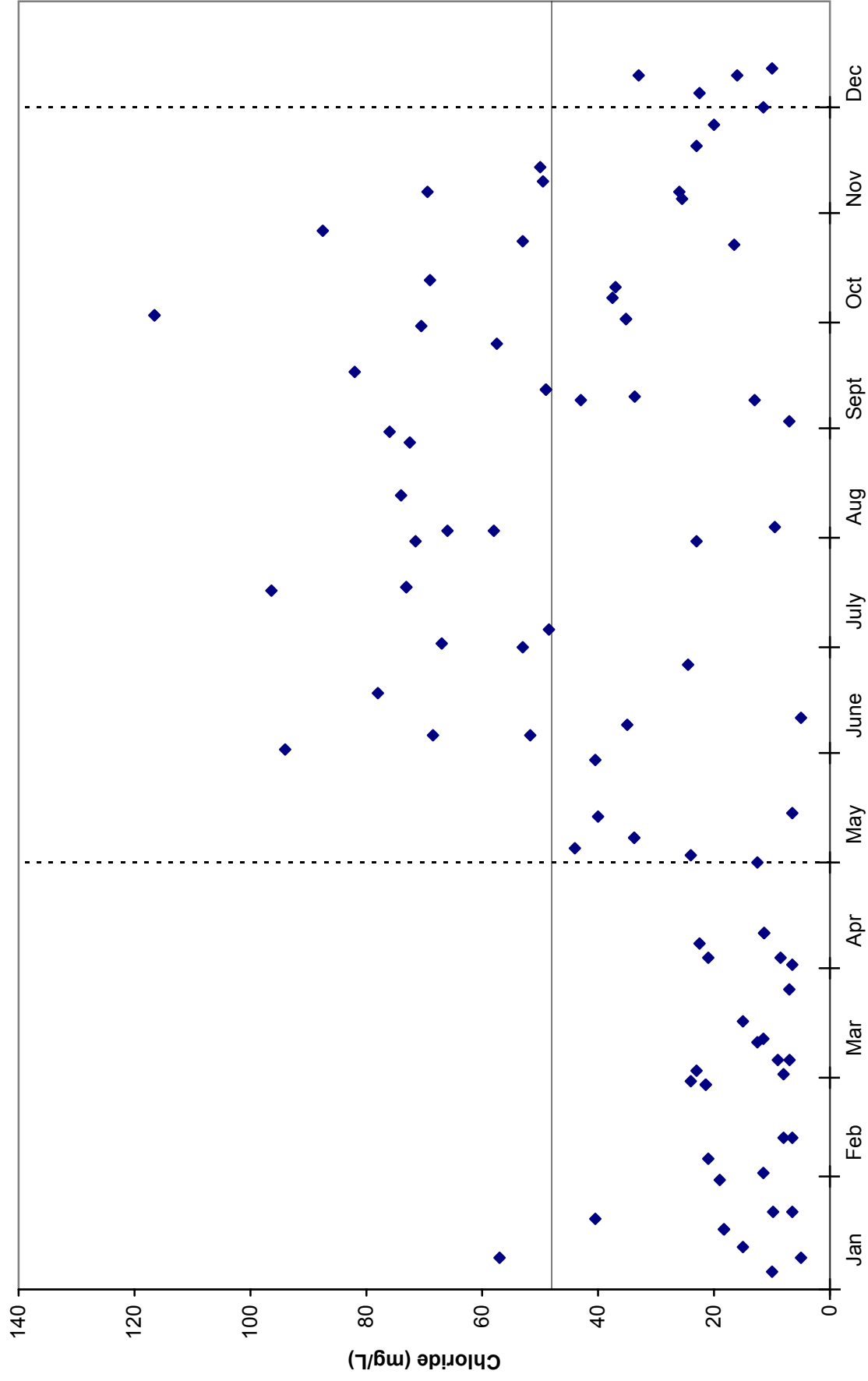


Figure F.4. Seasonal Plot of Chloride For Big Bayou at UWBG01

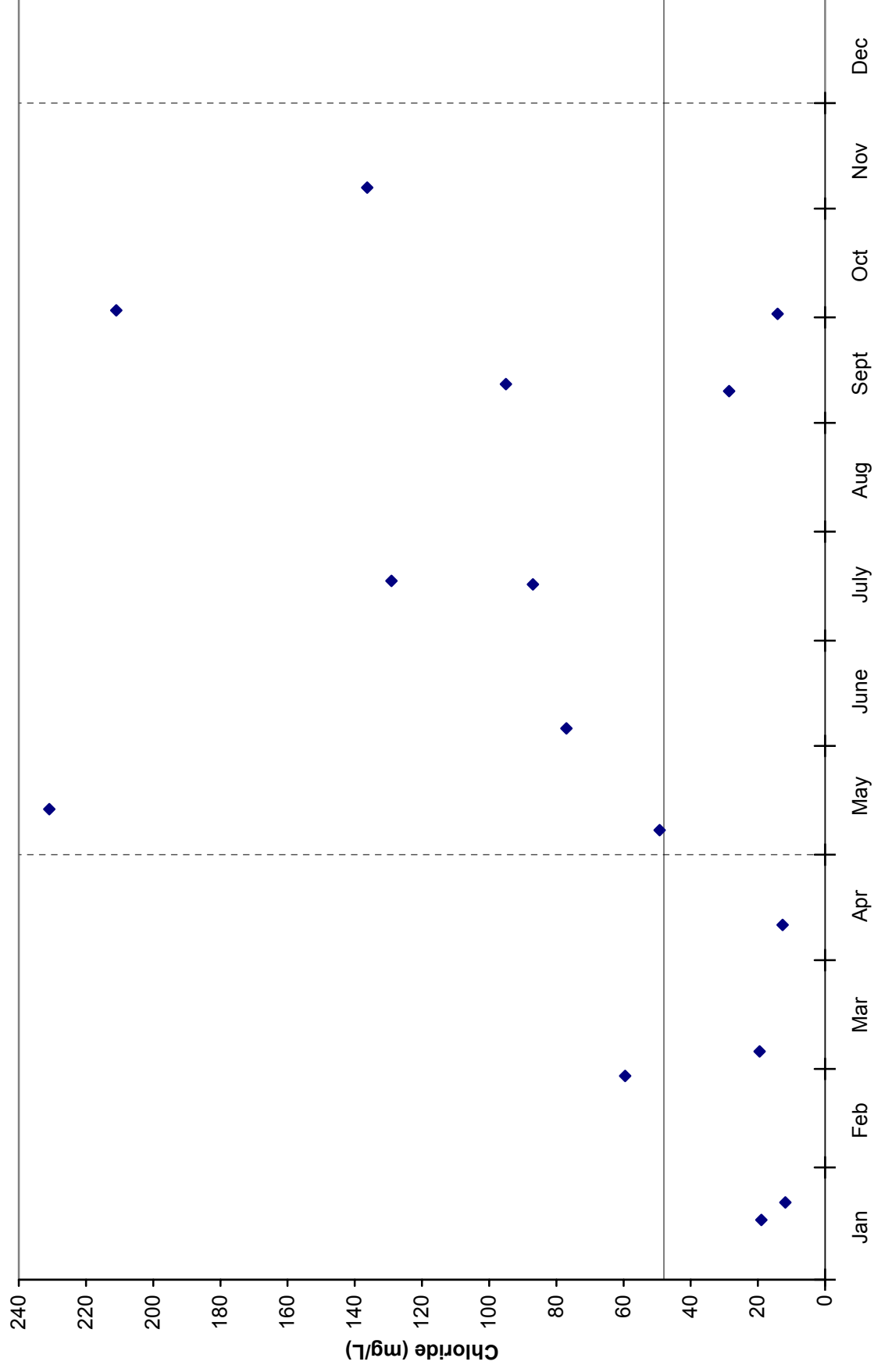


Figure F.5. Seasonal plot of Chloride for Oak Bayou at OUA0179

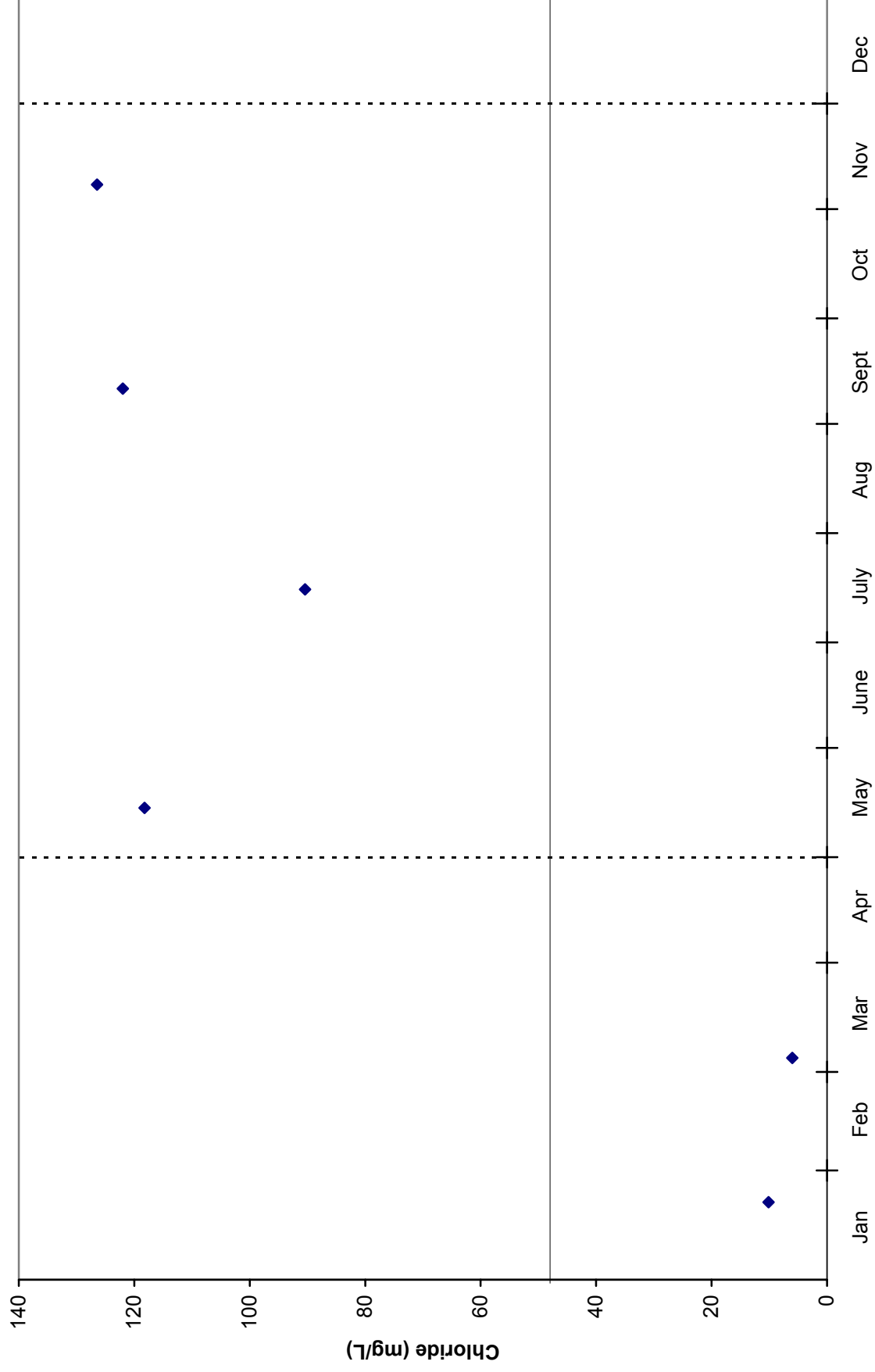


Figure F.6. Seasonal plot of TDS for Oak Bayou at OUA0179

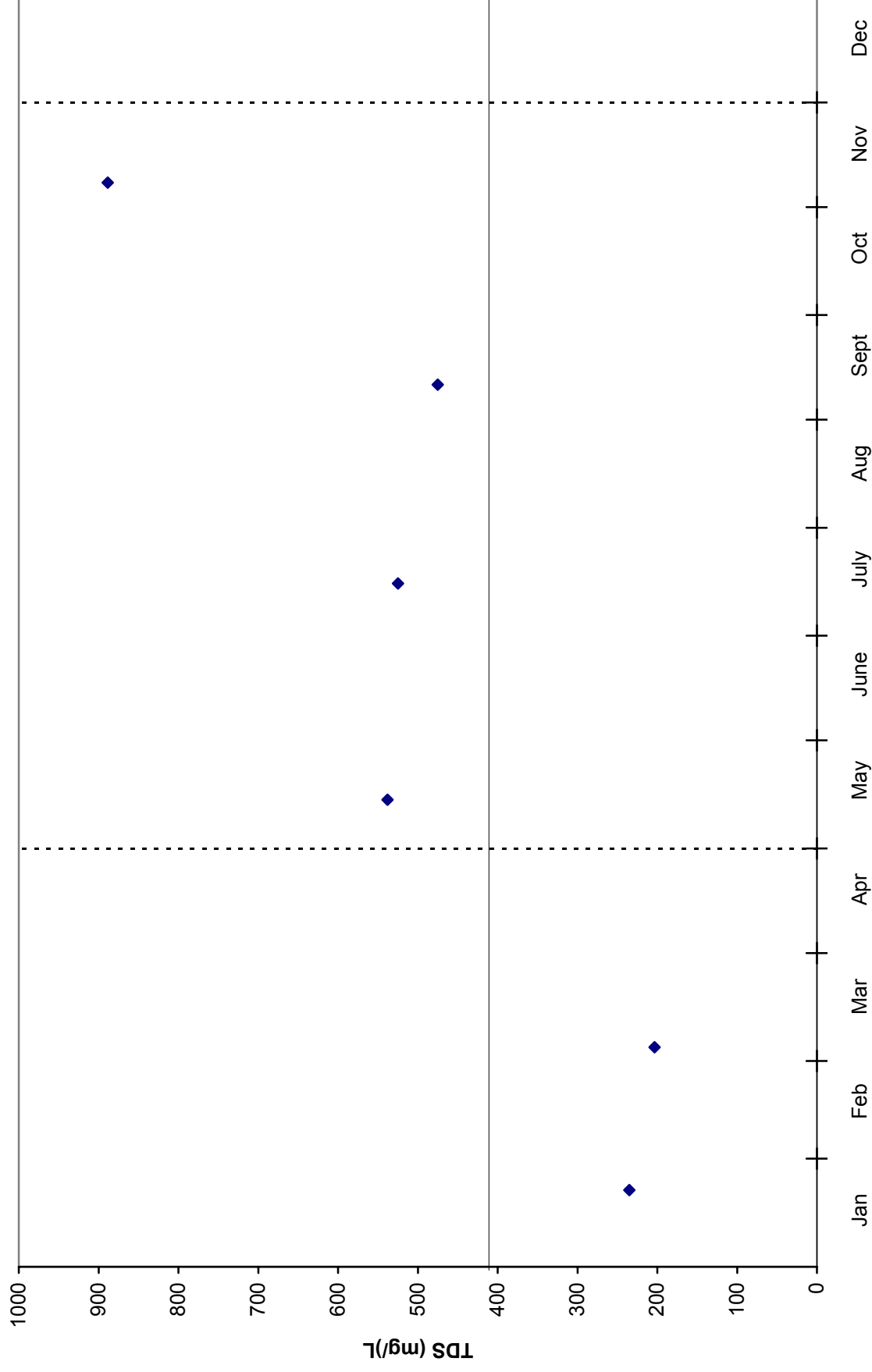


Figure F.7. Seasonal plot of TDS for Beouf River at OUA0015A

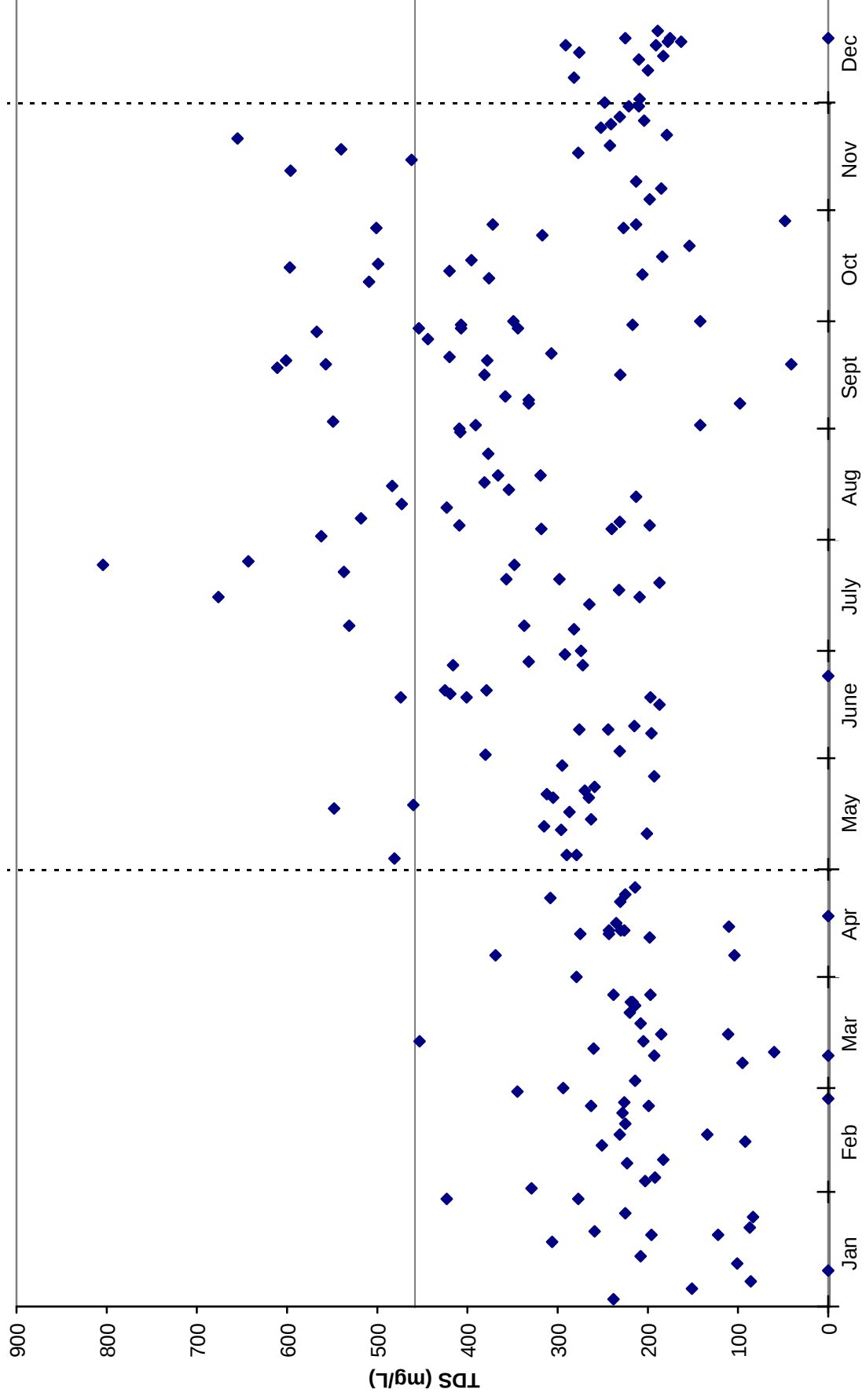
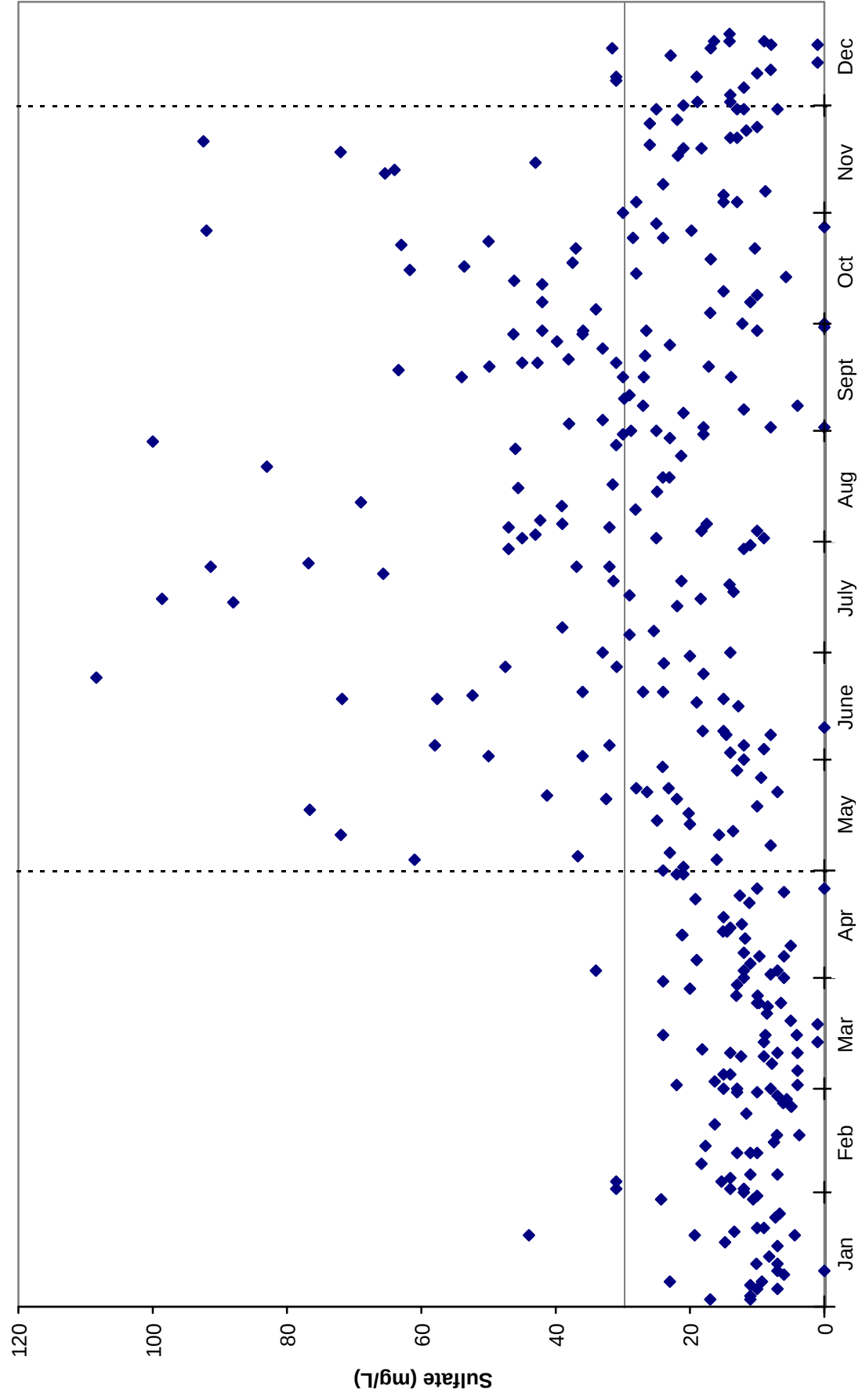


Figure F.8. Seasonal plot of Sulfate for Beouf River at OUA0015A



APPENDIX G

Plots of Chloride and TDS vs Flow

Figure G.1. Chloride vs. Flow for Boeuf River at OUA0015A

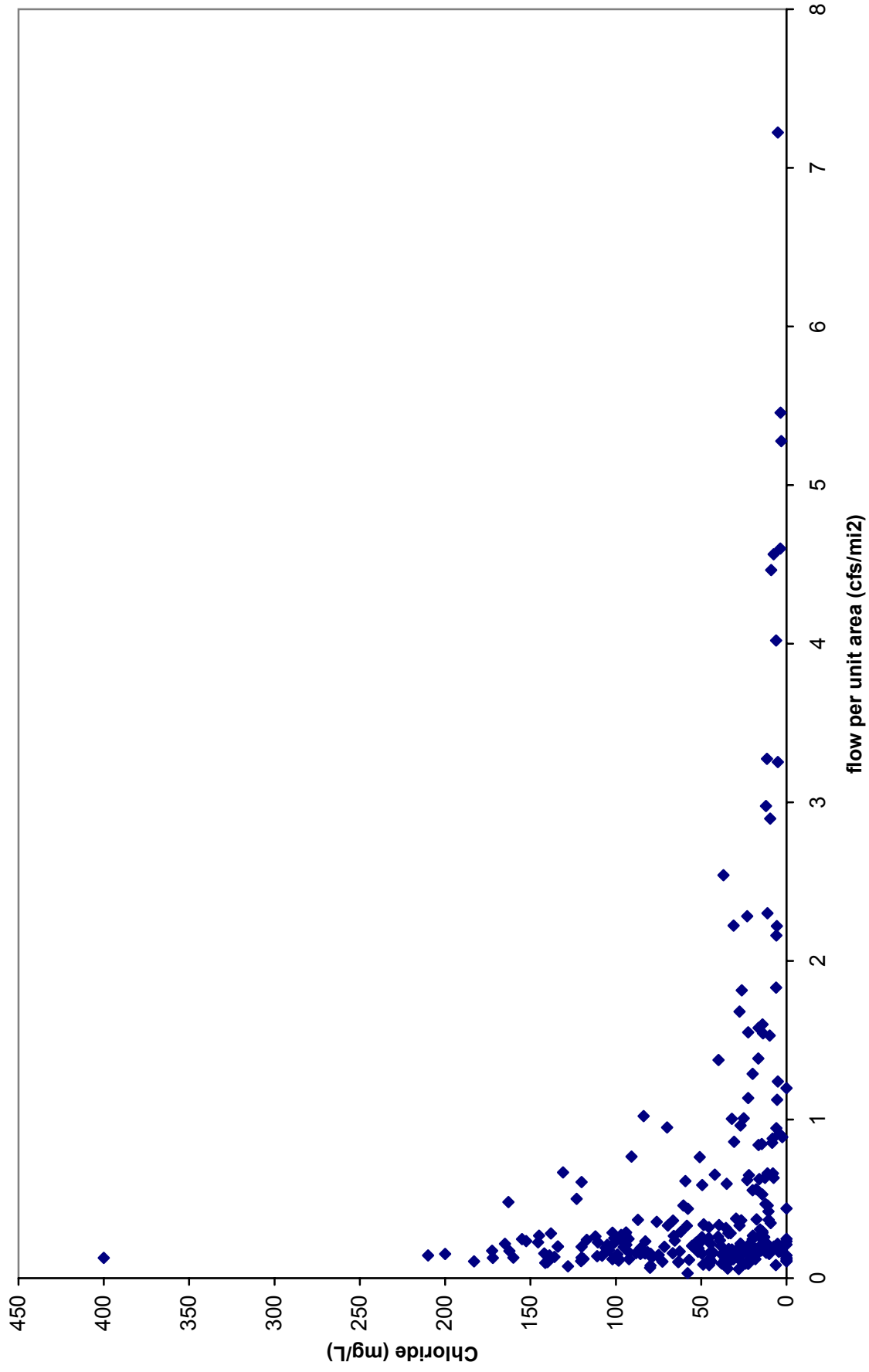


Figure G.2. Chloride vs. Flow for Boeuf River at UWBFR01

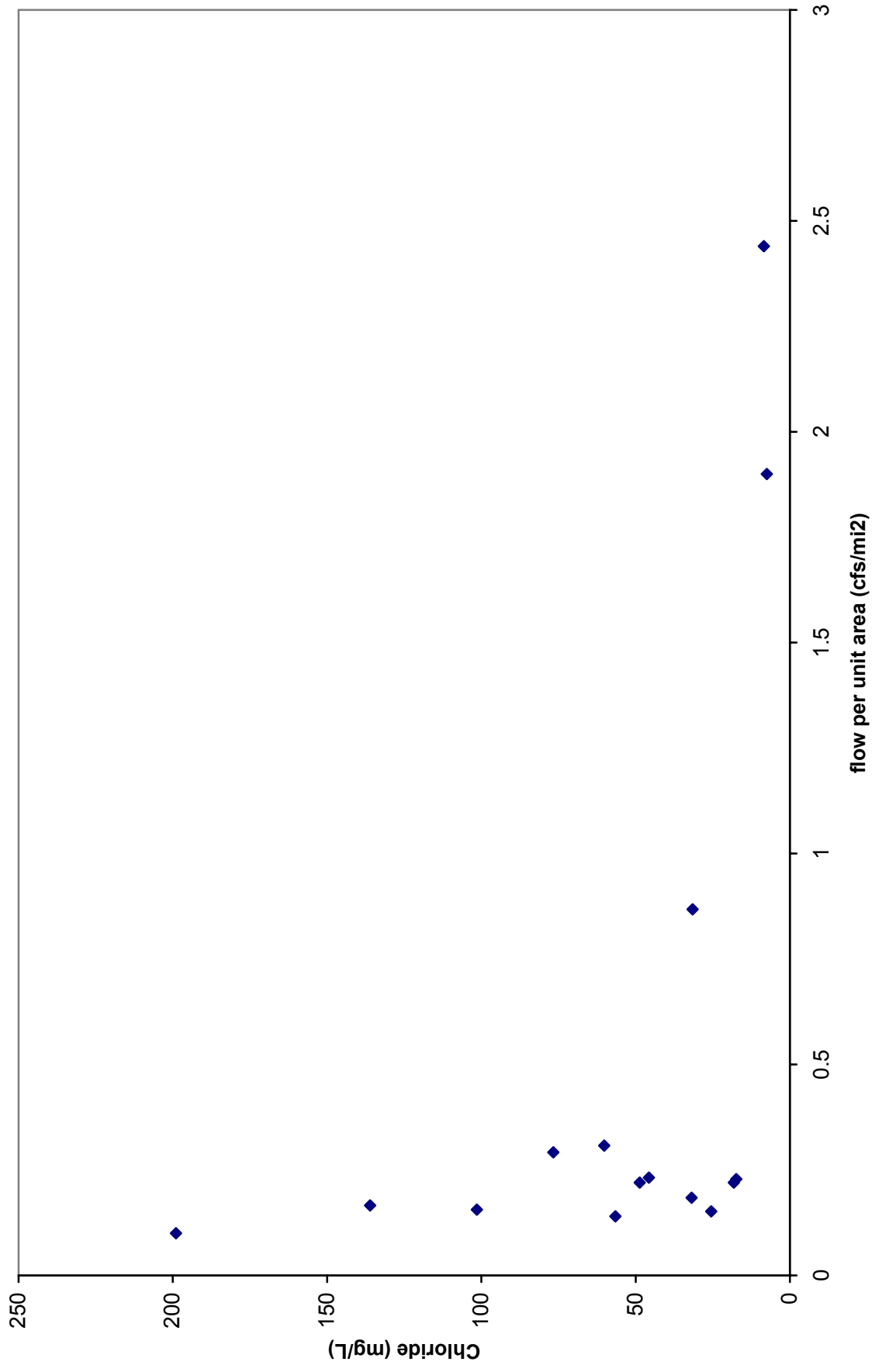


Figure G.3. Chloride vs. Flow for Big Bayou at OUA0032

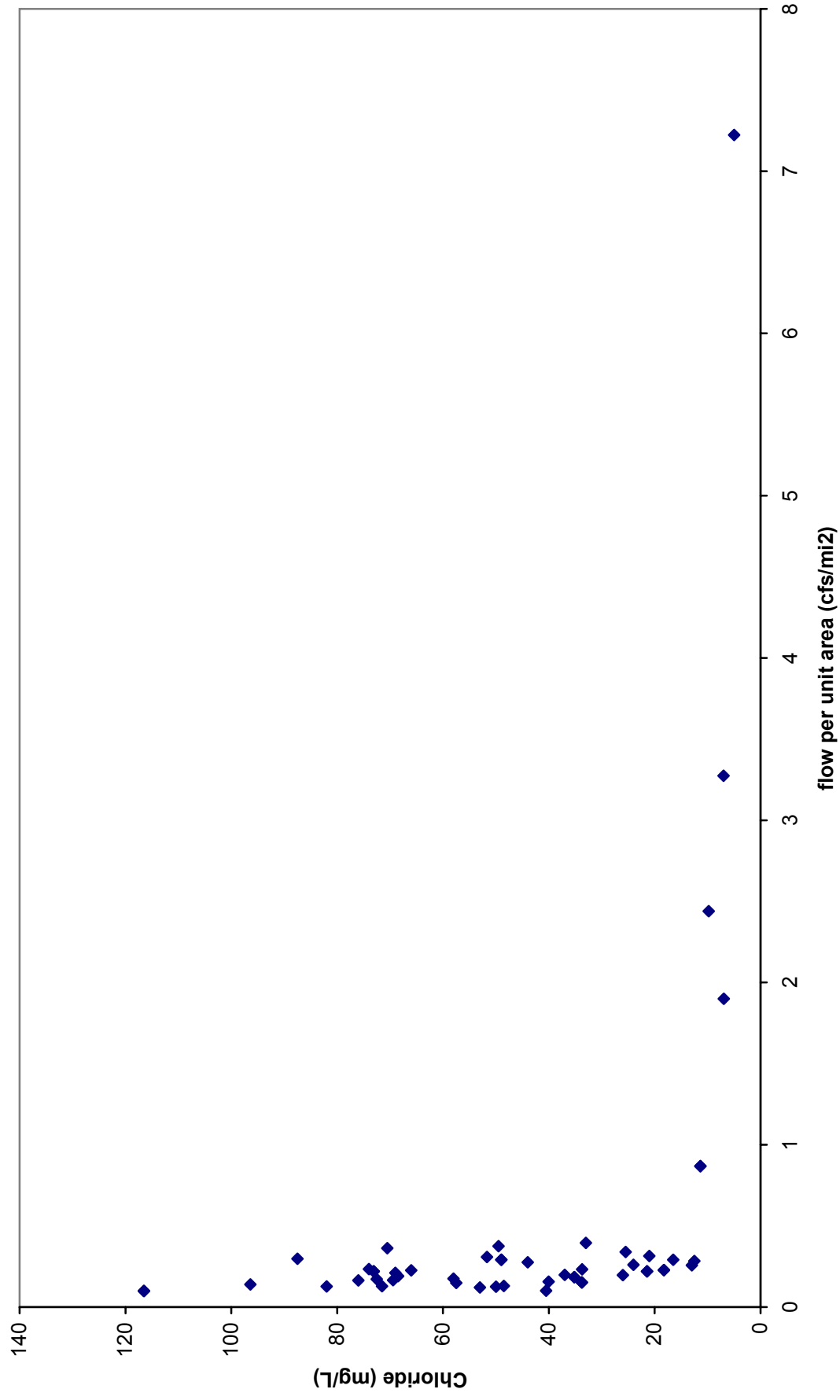


Figure G.4. Chloride vs. Flow for Big Bayou at UWBGB01

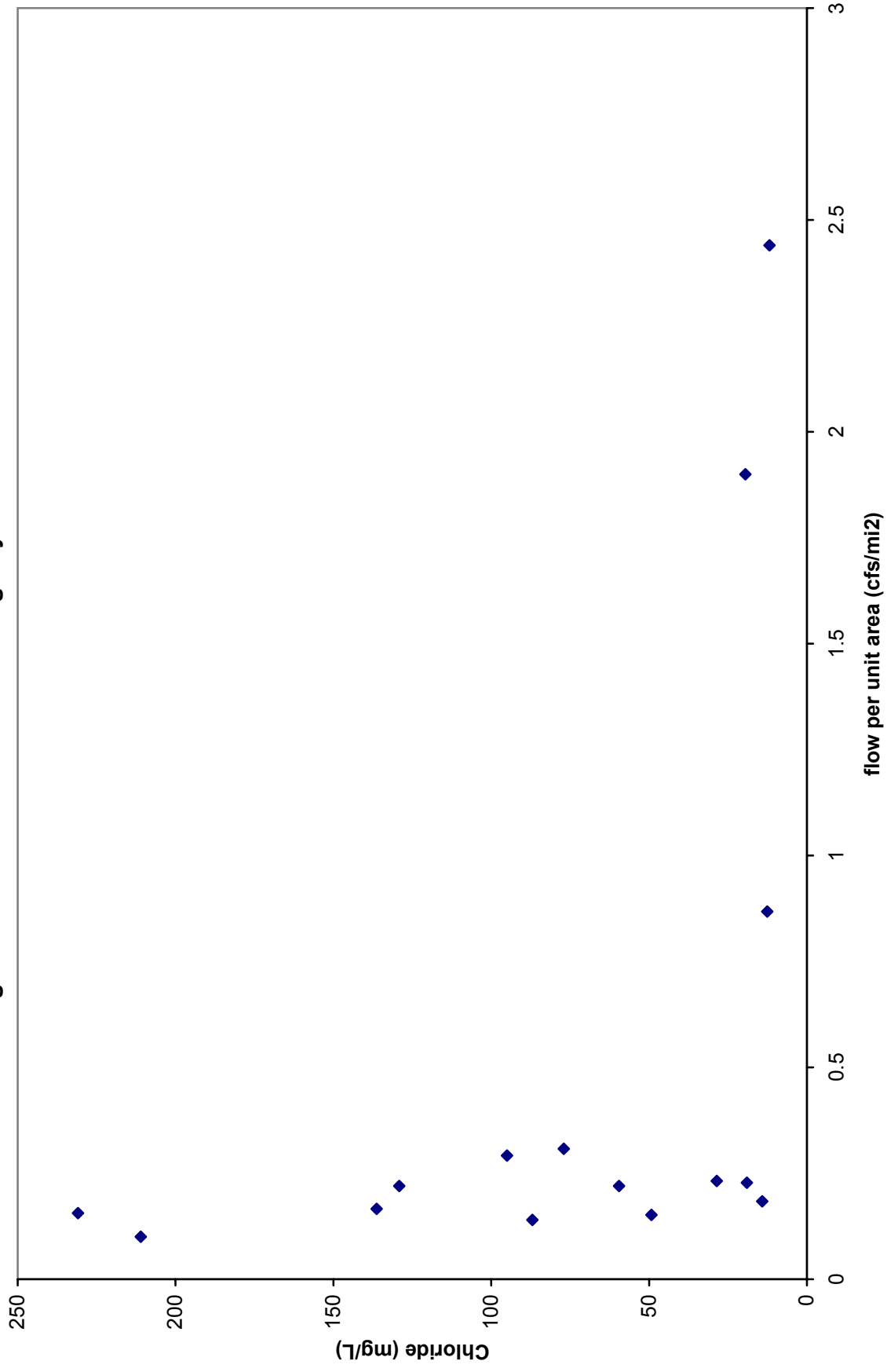


Figure G.5. Chloride vs. Flow for Oak Bayou at OUA0179

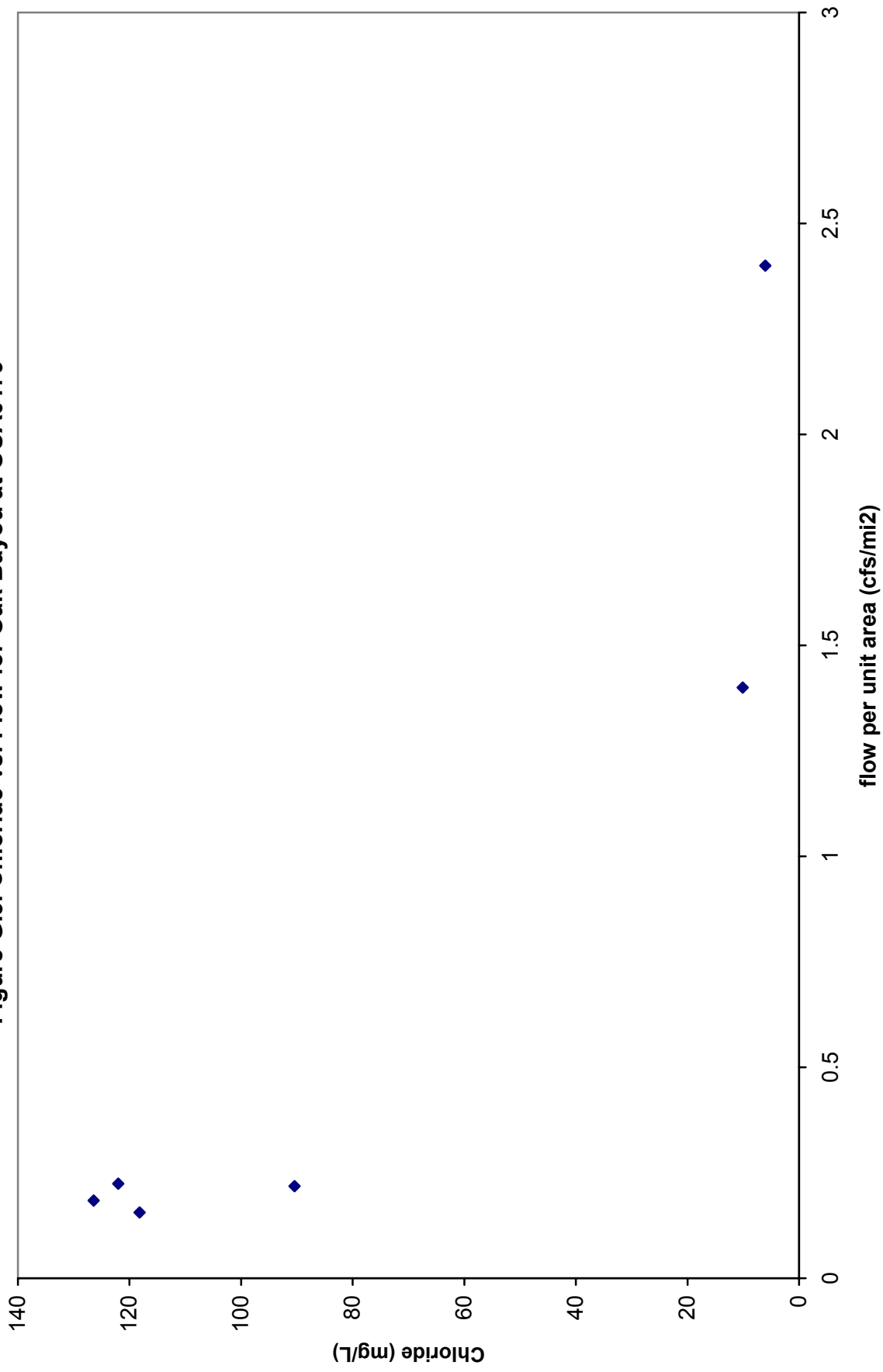


Figure G.6. TDS vs. Flow for Oak Bayou at OUA0179

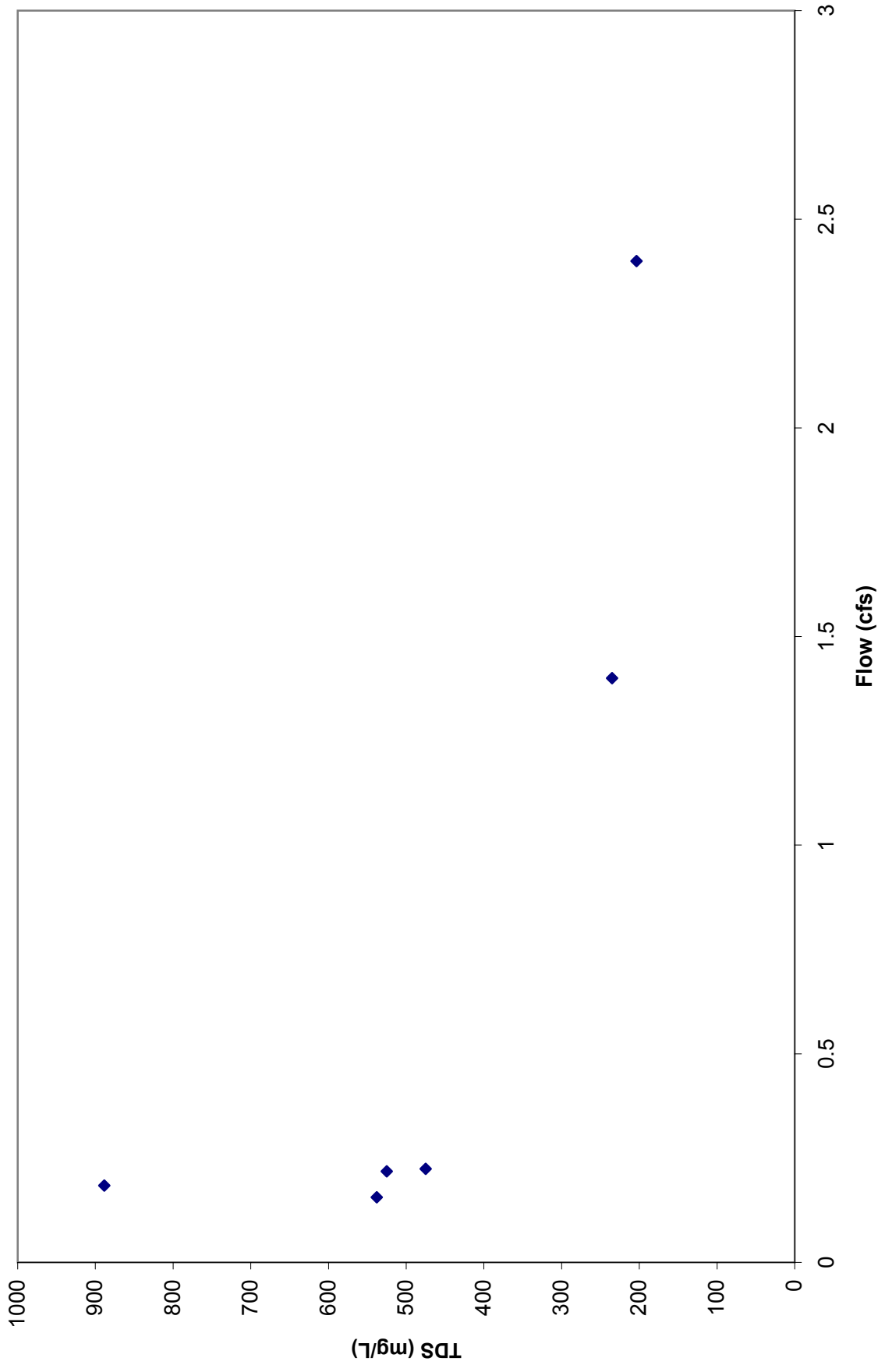


Figure G.7. TDS vs. flow for Beouf River at OUA0015A

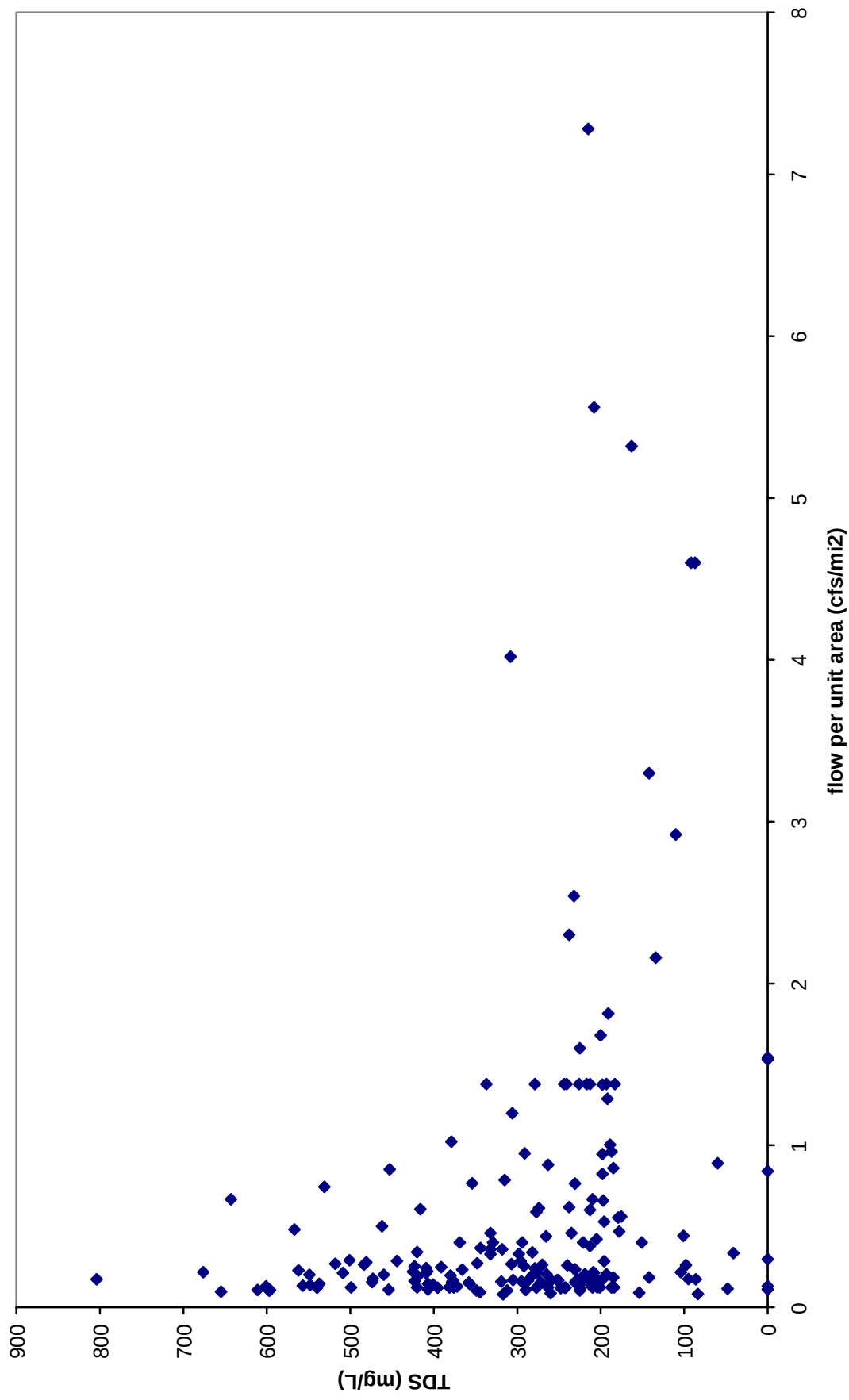
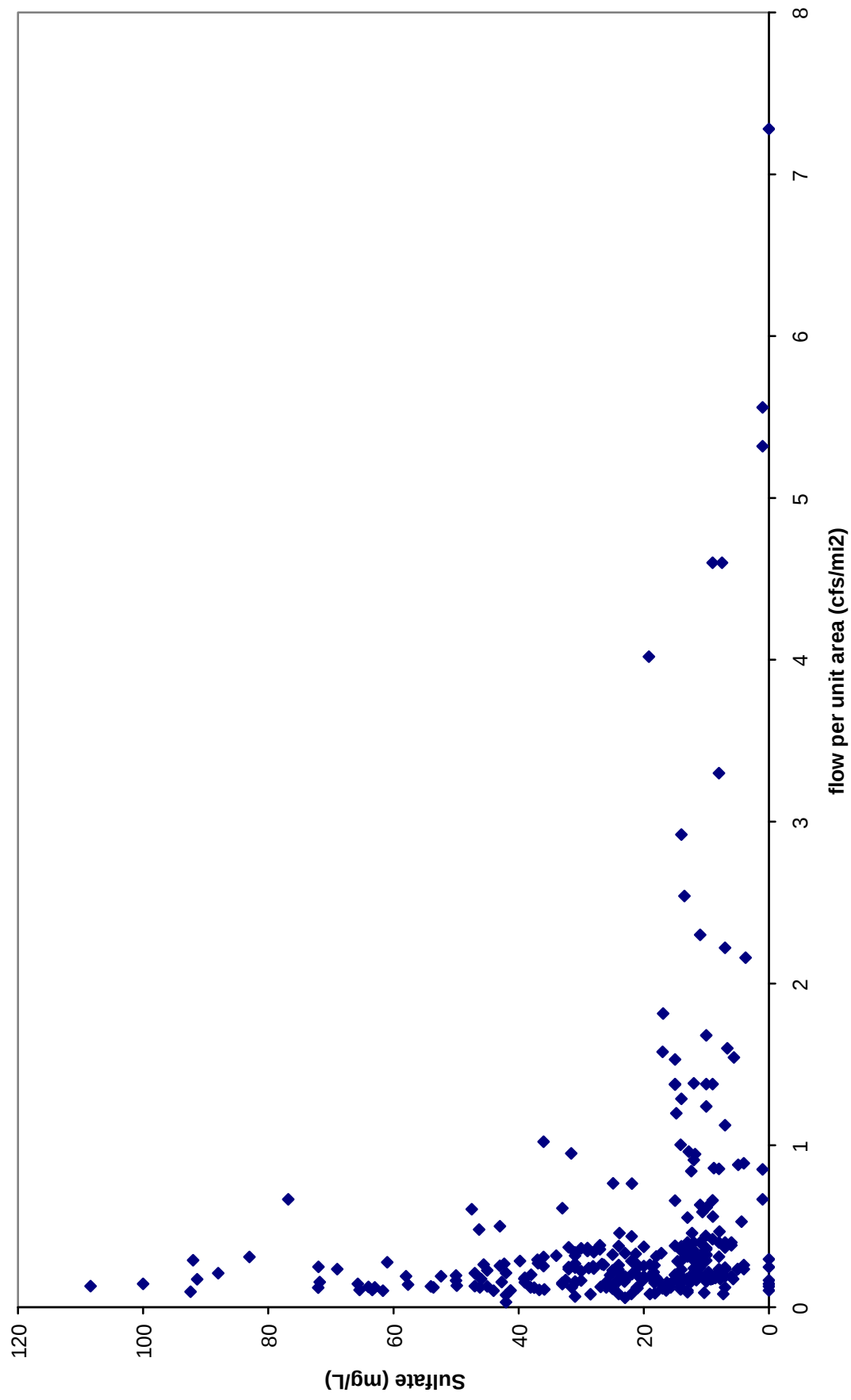


Figure G.8. Sulfate vs. Flow for Beouf River at OUA0015A



APPENDIX H

Calculations for Summer Turbidity TMDLs

TABLE H.1. TURBIDITY TMDL CALCULATIONS FOR SUMMER

Percentage of total flow in basin represented by Bayou Macon:

Avg. annual flow 1958-67 (cfs)	Percent of combined flow	Drainage area (mi ²)
875	65.2%	785
467	34.8%	504
1,342	100.0%	1,289

USGS gage number and name
07367700 Boeuf River near AR/LA state line
07369700 Bayou Macon near Kilbourne, LA

Turbidity standard = 75 NTU
TSS target = 68 mg/L

Observed		Percent		Adjusted flow for entire basin			"Width" for		Allowable TSS load		"Area under TMDL	
flow at		exceedance		flow for observed			area under		to meet standard		curve"	
Season	Date	flow	flow	flow	cfs	cfs/mi ²	cms/mi ²	curves	(tons/day)/mi ²	(tons/day)/mi ²	(tons/day)/mi ²	(tons/day)/mi ²
A	B	C	D	E = C / 34.8%	F = E / 1289 mi ²	G = E / 35.32	H = D1 - D2	I = G * 68 mg/L *conversion	J = H * I			
SUMMER	6/22/02	24	99.98%	69.0	0.054	0.0015	0.04%	0.01	3.58E-06			
SUMMER	6/20/02	25	99.95%	71.8	0.056	0.0016	0.04%	0.01	3.73E-06			
SUMMER	6/21/02	26	99.91%	74.7	0.058	0.0016	0.04%	0.01	3.88E-06			
SUMMER	6/19/02	31	99.87%	89.1	0.069	0.0020	0.04%	0.01	4.63E-06			
SUMMER	10/10/01	32	99.84%	92.0	0.071	0.0020	0.04%	0.01	4.78E-06			
SUMMER	10/31/01	35	99.80%	100.6	0.078	0.0022	0.04%	0.01	5.22E-06			
SUMMER	11/25/01	36	99.76%	103.4	0.080	0.0023	0.04%	0.01	5.37E-06			
SUMMER	6/23/02	36	99.73%	103.4	0.080	0.0023	0.04%	0.01	5.37E-06			

For brevity, most of the rows in this spreadsheet have been hidden (between the 10.29% and the 99.73% exceedances).

SUMMER	10/19/91	276	10.29%	793.1	0.615	0.0174	0.04%	0.11	4.12E-05			
SUMMER	11/23/93	277	10.26%	796.0	0.618	0.0175	0.04%	0.11	4.13E-05			
SUMMER	7/7/94	277	10.22%	796.0	0.618	0.0175	0.04%	0.11	4.13E-05			
SUMMER	7/29/96	278	10.18%	798.9	0.620	0.0175	0.04%	0.11	4.15E-05			
SUMMER	10/18/91	279	10.15%	801.7	0.622	0.0176	0.04%	0.11	4.16E-05			
SUMMER	11/27/88	280	10.11%	804.6	0.624	0.0177	0.04%	0.11	4.18E-05			
SUMMER	6/11/89	280	10.07%	804.6	0.624	0.0177	0.04%	0.11	4.18E-05			
SUMMER	6/28/93	280	10.04%	804.6	0.624	0.0177	0.04%	0.11	4.18E-05			
SUMMER	7/5/91	281	10.00%	807.5	0.626	0.0177	0.04%	0.12	4.19E-05			

TOTALS: 89.98% 3.55E-02

FILE: R:\PROJECTS\2110-613\TECH\TMDL\TMDL TSS-SUMMER.XLS

TABLE H.2. CALCULATIONS FOR TSS LOADS AND PERCENT REDUCTION
FOR SUMMER FOR BOEUF RIVER AT OUA0015A (REACH 08050001-018)

Summer target TSS conc. = 68 mg/L
Percent reduction needed = 0%

Error check for reduction is / is not needed: ok
Error check for less or more reduction needed: ok

Season	Date	Observed TSS at OUA0015A (mg/L)	Flow per unit area on sampling day (cms/mi ²)	Percent exceedance for flow on sampling day	Current TSS load (tons/day)/mi ²	Reduced TSS load (tons/day)/mi ²	Allowable TSS load (tons/day)/mi ²	Reduced load less than or equal to allow. load?
SUMMER	10/26/93	26.0	0.0025	98.4%	0.006	0.0063	0.0164	Yes
SUMMER	10/23/01	10.5	0.0028	96.8%	0.003	0.0028	0.0184	Yes
SUMMER	11/22/99	9.0	0.0030	94.8%	0.003	0.0026	0.0197	Yes
SUMMER	10/17/95	9.0	0.0032	92.9%	0.003	0.0028	0.0209	Yes
SUMMER	10/2/90	18.0	0.0033	92.0%	0.006	0.0056	0.0213	Yes
SUMMER	9/19/95	7.0	0.0033	90.5%	0.002	0.0022	0.0217	Yes
SUMMER	11/13/95	8.5	0.0033	90.4%	0.003	0.0027	0.0217	Yes
SUMMER	9/30/97	17.5	0.0034	88.5%	0.006	0.0057	0.0221	Yes
SUMMER	9/29/92	16.0	0.0035	88.2%	0.005	0.0053	0.0225	Yes
SUMMER	10/30/90	26.0	0.0036	85.6%	0.009	0.0089	0.0234	Yes
SUMMER	10/4/88	78.0	0.0037	84.8%	0.027	0.0272	0.0238	No
SUMMER	11/19/96	41.5	0.0038	82.2%	0.015	0.0150	0.0246	Yes
SUMMER	11/18/97	42.0	0.0038	82.0%	0.015	0.0151	0.0246	Yes
SUMMER	10/19/99	16.5	0.0038	81.3%	0.006	0.0060	0.0246	Yes
SUMMER	11/19/01	9.0	0.0038	80.9%	0.003	0.0032	0.0246	Yes
SUMMER	11/27/90	28.0	0.0039	80.2%	0.010	0.0103	0.0250	Yes
SUMMER	10/17/00	8.0	0.0039	79.5%	0.003	0.0029	0.0250	Yes
SUMMER	9/17/02	12.5	0.0040	76.4%	0.005	0.0047	0.0258	Yes
SUMMER	10/29/91	65.0	0.0040	76.0%	0.025	0.0250	0.0262	Yes
SUMMER	9/21/93	14.0	0.0040	75.9%	0.005	0.0054	0.0262	Yes
SUMMER	10/28/97	214.5	0.0042	72.4%	0.086	0.0864	0.0274	No
SUMMER	9/19/00	10.5	0.0042	72.2%	0.004	0.0042	0.0274	Yes
SUMMER	6/19/01	16.5	0.0044	69.3%	0.007	0.0069	0.0287	Yes

Season	Date	Observed TSS at OUA0015A (mg/L)	Flow per unit area on sampling day (cms/mi2)	Percent exceedance for flow on sampling day	Current TSS load (tons/day)/mi2	Reduced TSS load (tons/day)/mi2	Allowable TSS load (tons/day)/mi2	Reduced load less than or equal to allow. load?
SUMMER	9/5/89	22.0	0.0045	68.9%	0.009	0.0094	0.0291	Yes
SUMMER	10/1/91	18.0	0.0045	67.4%	0.008	0.0078	0.0295	Yes
SUMMER	7/22/97	9.0	0.0045	66.9%	0.004	0.0039	0.0295	Yes
SUMMER	7/24/01	12.0	0.0045	66.6%	0.005	0.0052	0.0295	Yes
SUMMER	10/31/89	12.0	0.0046	66.1%	0.005	0.0053	0.0299	Yes
SUMMER	9/10/96	13.0	0.0048	62.3%	0.006	0.0059	0.0311	Yes
SUMMER	9/17/01	23.0	0.0048	61.9%	0.011	0.0105	0.0311	Yes
SUMMER	6/27/00	16.5	0.0049	60.6%	0.008	0.0076	0.0315	Yes
SUMMER	6/18/96	15.5	0.0049	59.9%	0.007	0.0073	0.0320	Yes
SUMMER	9/21/99	10.0	0.0049	59.7%	0.005	0.0047	0.0320	Yes
SUMMER	8/29/89	32.0	0.0050	59.5%	0.015	0.0152	0.0324	Yes
SUMMER	8/20/02	54.3	0.0050	59.1%	0.026	0.0258	0.0324	Yes
SUMMER	1/1/188	62.0	0.0052	57.5%	0.031	0.0306	0.0336	Yes
SUMMER	8/26/97	21.0	0.0052	57.2%	0.010	0.0104	0.0336	Yes
SUMMER	11/25/91	198.0	0.0053	55.8%	0.100	0.1000	0.0344	No
SUMMER	7/25/00	18.0	0.0054	53.9%	0.009	0.0093	0.0352	Yes
SUMMER	10/15/02	36.2	0.0055	53.2%	0.019	0.0189	0.0356	Yes
SUMMER	8/12/03	19.0	0.0056	52.5%	0.010	0.0101	0.0361	Yes
SUMMER	10/1/96	57.5	0.0058	50.0%	0.032	0.0318	0.0377	Yes
SUMMER	1/1/7/00	18.5	0.0058	49.9%	0.010	0.0102	0.0377	Yes
SUMMER	6/20/95	17.0	0.0061	46.1%	0.010	0.0098	0.0393	Yes
SUMMER	6/2/92	20.0	0.0062	44.6%	0.012	0.0118	0.0402	Yes
SUMMER	7/7/92	32.0	0.0062	43.7%	0.019	0.0190	0.0406	Yes
SUMMER	9/4/90	12.0	0.0063	42.8%	0.007	0.0072	0.0410	Yes
SUMMER	7/15/03	17.3	0.0064	40.7%	0.011	0.0106	0.0418	Yes
SUMMER	6/10/97	71.5	0.0067	37.8%	0.046	0.0456	0.0434	No
SUMMER	7/16/96	30.5	0.0068	36.3%	0.020	0.0198	0.0442	Yes
SUMMER	9/1/98	15.5	0.0070	33.7%	0.010	0.0103	0.0455	Yes
SUMMER	6/4/91	126.0	0.0073	31.1%	0.088	0.0879	0.0475	No

Season	Date	Observed TSS at OUA0015A (mg/L)	Flow per unit area on sampling day (cms/mi ²)	Percent exceedance for flow on sampling day	Current TSS load (tons/day)/mi ²	Reduced TSS load (tons/day)/mi ²	Allowable TSS load (tons/day)/mi ²	Reduced load less than or equal to allow. load?
SUMMER	8/20/01	21.0	0.0073	30.8%	0.015	0.0146	0.0475	Yes
SUMMER	8/6/96	31.5	0.0074	30.5%	0.022	0.0222	0.0479	Yes
SUMMER	9/1/92	20.0	0.0076	28.9%	0.015	0.0145	0.0496	Yes
SUMMER	8/1/89	88.0	0.0078	28.1%	0.065	0.0651	0.0504	No
SUMMER	9/3/91	48.0	0.0078	27.3%	0.036	0.0358	0.0508	Yes
SUMMER	8/11/98	16.5	0.0080	26.7%	0.012	0.0125	0.0516	Yes
SUMMER	8/4/92	46.0	0.0081	26.1%	0.036	0.0357	0.0529	Yes
SUMMER	8/17/99	16.5	0.0083	25.3%	0.013	0.0131	0.0541	Yes
SUMMER	9/23/03	65.8	0.0084	24.9%	0.053	0.0526	0.0545	Yes
SUMMER	8/8/95	24.5	0.0085	24.7%	0.020	0.0197	0.0549	Yes
SUMMER	7/26/93	44.0	0.0086	24.1%	0.036	0.0360	0.0557	Yes
SUMMER	6/9/98	38.5	0.0090	22.1%	0.033	0.0329	0.0582	Yes
SUMMER	9/27/94	16.0	0.0090	21.9%	0.014	0.0138	0.0586	Yes
SUMMER	7/22/98	8.0	0.0104	17.5%	0.008	0.0079	0.0676	Yes
SUMMER	6/29/99	156.5	0.0145	12.5%	0.215	0.2154	0.0938	No
SUMMER	9/29/98	10.5	0.0151	11.6%	0.015	0.0151	0.0983	Yes
SUMMER	11/16/98	38.5	0.0158	11.3%	0.058	0.0579	0.1024	Yes
SUMMER	11/23/93	52.0	0.0175	10.3%	0.087	0.0866	0.1135	Yes
SUMMER	6/28/94	58.5*	0.0191*	9.0%	*	*	*	*
SUMMER	7/2/91	20.0*	0.0193*	8.9%	*	*	*	*
SUMMER	7/27/99	34.5*	0.0210*	7.8%	*	*	*	*
SUMMER	11/28/94	233.0*	0.0241*	5.3%	*	*	*	*
SUMMER	8/16/94	17.0*	0.0242*	5.2%	*	*	*	*
SUMMER	6/17/03	184.0*	0.0304*	4.2%	*	*	*	*
SUMMER	6/21/93	106.0*	0.0323*	3.7%	*	*	*	*

Season	Date	Observed TSS at OUA0015A (mg/L)	Flow per unit area on sampling day (cms/mi ²)	Percent exceedance for flow on sampling day	Current TSS load (tons/day)/mi ²	Reduced TSS load (tons/day)/mi ²	Allowable TSS load (tons/day)/mi ²	Reduced load less than or equal to allow. load?
SUMMER	11/5/02	144.0*	0.0434*	2.7%	*	*	*	*
SUMMER	6/6/89	392.0*	0.0437*	2.6%	*	*	*	*
SUMMER	7/19/94	163.0*	0.0802*	1.1%	*	*	*	*
TOTALS =			0.4224		1.560		Total number of values = Allowable % of exceedances = Allowable no. of exceedances = No. of exceedances before reductions = No. of exceedances after reductions =	70 25% 18 7 7

* Values with asterisks not used in any computations

Flow weighted average TSS (mg/L) = $(1.560 / 0.4224) / \text{conversion} =$

39 mg/L

Average flow per unit area for summer (excluding top 10%) =

Estimated drainage area for reach 18 =

Average flow for summer for reach 18 = $0.0055 * 180 =$

0.0055 cms/mi²

180 mi²

0.984 cms

Existing total TSS load for summer for reach 18

= $39 \text{ mg/L} * 0.984 \text{ cms} * \text{conversions} =$

3.65 tons/day

Existing point source load of inorganic suspended solids for reach 18 =

0.00 tons/day

Existing NPS TSS load for summer for reach 18 = $3.65 - 0.00 =$

3.65 tons/day

Total allowable TSS loading per unit area to meet stds (from Table H.1) =

Total allowable TSS loading for reach 18 = $3.55\text{E-}2 * 180 \text{ mi}^2 =$

3.55E-02 tons/day/mi²

6.39 tons/day

Explicit MOS = zero (only implicit MOS is used)

0.00 tons/day

WLA for TSS for summer for reach 18 =

0.00 tons/day

LA for TSS for summer for reach 18 = TMDL - explicit MOS - WLA =

6.39 tons/day

FILE: R:\PROJECTS\2110-613\TECH\TMDL\TMDL TSS-SUMMER.XLS

TABLE H.3. CALCULATIONS FOR TSS LOADS AND PERCENT REDUCTION FOR SUMMER FOR BOEUF RIVER AT UWBFR01 (REACH 08050001-019)

Summer target TSS conc. = 68 mg/L
Percent reduction needed = 0%

Error check for reduction is / is not needed: ok
Error check for less or more reduction needed: ok

Season	Date	Observed TSS at UWBFR01 (mg/L)	Flow per unit area on sampling day (cms/mi2)	Percent exceedance for flow on sampling day	Current TSS load (tons/day)/mi2	Reduced TSS load (tons/day)/mi2	Allowable TSS load (tons/day)/mi2	Reduced load less than or equal to allow. load?
SUMMER	10/3/95	22.5	0.0032	93.6%	0.007	0.0068	0.0205	Yes
SUMMER	7/17/01	38.5	0.0044	69.2%	0.016	0.0162	0.0287	Yes
SUMMER	11/6/00	27.5	0.0052	56.1%	0.014	0.0137	0.0340	Yes
SUMMER	10/1/96	42.0	0.0058	50.0%	0.023	0.0232	0.0377	Yes
SUMMER	7/18/95	33.5	0.0069	34.7%	0.022	0.0222	0.0451	Yes
SUMMER	9/10/01	29.0	0.0073	30.8%	0.020	0.0202	0.0475	Yes
SUMMER	9/12/94	614.0*	0.0092*	20.6%	0.539*	0.5389	0.0598	No
SUMMER	6/6/94	87.0	0.0097	19.3%	0.081	0.0805	0.0631	No

TOTALS = 0.0426

0.183
Total number of values = 8
Allowable % of exceedances = 25%
Allowable no. of exceedances = 2
No. of exceedances before reductions = 2
No. of exceedances after reductions = 2

* Values with asterisks not used to calculate flow-wtd avg TSS

Flow weighted average TSS (mg/L) = (0.183 / 0.0426) / conversion = 45 mg/L

Average flow per unit area for summer (excluding top 10%) = 0.0055 cms/mi2

Estimated drainage area for reach 19 = 176 mi2

Average flow for summer for reach 19 = 0.0055 * 176 = 0.966 cms

Existing total TSS load for summer for reach 19

= 45 mg/L * 0.966 cms * conversions = 4.14 tons/day

Existing point source load of inorganic suspended solids for reach 19 =	0.00 tons/day
Existing NPS TSS load for summer for reach 19 = 4.14 - 0.00 =	4.14 tons/day
Total allowable TSS loading per unit area to meet stds (from Table H.1) =	3.55E-02 tons/day/mi ²
Total allowable TSS loading for reach 19 = 3.55E-2 * 176 mi ² =	6.27 tons/day
Explicit MOS = zero (only implicit MOS is used)	0.00 tons/day
WLA for TSS for summer for reach 19 =	0.00 tons/day
LA for TSS for summer for reach 19 = TMDL - explicit MOS - WLA =	6.27 tons/day

FILE: R:\PROJECTS\21110-613\TECH\TMDL\TMDL TSS-SUMMER.XLS

TABLE H.4. CALCULATIONS FOR TSS LOADS AND PERCENT REDUCTION
FOR SUMMER FOR BIG BAYOU AT OUA0032 (REACH 08050001-022)

Summer target TSS conc. = 68 mg/L
Percent reduction needed = 0%

Error check for reduction is / is not needed: ok
Error check for less or more reduction needed: ok

Season	Date	Observed TSS at OUA0032 (mg/L)	Flow per unit area on sampling day (cms/mi ²)	Percent exceedance for flow on sampling day	Current TSS load (tons/day)/mi ²	Reduced TSS load (tons/day)/mi ²	Allowable TSS load (tons/day)/mi ²	Reduced load less than or equal to allow. load?
SUMMER	10/3/95	27.5	0.0032	93.6%	0.008	0.0083	0.0205	Yes
SUMMER	7/17/01	19.0	0.0044	69.2%	0.008	0.0080	0.0287	Yes
SUMMER	11/6/00	41.5	0.0052	56.1%	0.021	0.0207	0.0340	Yes
SUMMER	10/1/96	36.5	0.0058	50.0%	0.020	0.0202	0.0377	Yes
SUMMER	7/18/95	61.0	0.0069	34.7%	0.040	0.0403	0.0451	Yes
SUMMER	9/10/01	3.7	0.0073	30.8%	0.003	0.0026	0.0475	Yes
SUMMER	9/12/94	17.5	0.0092	20.6%	0.015	0.0154	0.0598	Yes
SUMMER	6/6/94	46.5	0.0097	19.3%	0.043	0.0430	0.0631	Yes

TOTALS = 0.0518

0.158
Total number of values = 8
Allowable % of exceedances = 25%
Allowable no. of exceedances = 2
No. of exceedances before reductions = 0
No. of exceedances after reductions = 0

Flow weighted average TSS (mg/L) = (0.158 / 0.0518) / conversion = 32 mg/L

Average flow per unit area for summer (excluding top 10%) =

Estimated drainage area for reach 22 =

Average flow for summer for reach 22 = 0.0055 * 189 =

0.0055 cms/mi²
189 mi²
1.035 cms

Existing total TSS load for summer for reach 22

= 32 mg/L * 1.035 cms * conversions =

3.15 tons/day

Existing point source load of inorganic suspended solids for reach 22 = 0.00 tons/day

Existing NPS TSS load for summer for reach 22 = 3.15 - 0.00 = 3.15 tons/day

Total allowable TSS loading per unit area to meet stds (from Table H.1) = 3.55E-02 tons/day/mi²
Total allowable TSS loading for reach 22 = 3.55E-2 * 189 mi² = 6.72 tons/day

Explicit MOS = zero (only implicit MOS is used) 0.00 tons/day

WLA for TSS for summer for reach 22 = 0.00 tons/day

LA for TSS for summer for reach 22 = TMDL - explicit MOS - WLA = 6.72 tons/day

FILE: R:\PROJECTS\21110-613\TECH\TMDL\TMDL TSS-SUMMER.XLS

TABLE H.5. CALCULATIONS FOR TSS LOADS AND PERCENT REDUCTION
FOR SUMMER FOR BIG BAYOU AT UWBGB01 (REACH 08050001-022)

Summer target TSS conc. = 68 mg/L
Percent reduction needed = 0%

Error check for reduction is / is not needed: ok
Error check for less or more reduction needed: ok

Season	Date	Observed TSS at UWBGB01 (mg/L)	Flow per unit area on sampling day (cms/mi ²)	Percent exceedance for flow on sampling day	Current TSS load (tons/day)/mi ²	Reduced TSS load (tons/day)/mi ²	Allowable TSS load (tons/day)/mi ²	Reduced load less than or equal to allow. load?
SUMMER	10/3/95	18.0	0.0032	93.6%	0.005	0.0054	0.0205	Yes
SUMMER	7/17/01	34.8	0.0044	69.2%	0.015	0.0146	0.0287	Yes
SUMMER	11/6/00	40.5	0.0052	56.1%	0.020	0.0202	0.0340	Yes
SUMMER	10/1/96	48.5	0.0058	50.0%	0.027	0.0268	0.0377	Yes
SUMMER	7/18/95	36.5	0.0069	34.7%	0.024	0.0241	0.0451	Yes
SUMMER	9/10/01	34.8	0.0073	30.8%	0.024	0.0243	0.0475	Yes
SUMMER	9/12/94	48.0	0.0092	20.6%	0.042	0.0421	0.0598	Yes
SUMMER	6/6/94	34.5	0.0097	19.3%	0.032	0.0319	0.0631	Yes

TOTALS = 0.0518

0.190 Total number of values = 8
 Allowable % of exceedances = 25%
 Allowable no. of exceedances = 2
 No. of exceedances before reductions = 0
 No. of exceedances after reductions = 0

Flow weighted average TSS (mg/L) = (0.190 / 0.0518) / conversion = 38 mg/L

Average flow per unit area for summer (excluding top 10%) =

Estimated drainage area for reach 22 =

Average flow for summer for reach 22 = 0.0055 * 189 =

0.0055 cms/mi²
 189 mi²
 1.035 cms

Existing total TSS load for summer for reach 22

= 38 mg/L * 1.035 cms * conversions =

3.74 tons/day

Existing point source load of inorganic suspended solids for reach 22 = 0.00 tons/day

Existing NPS TSS load for summer for reach 22 = 3.74 - 0.00 = 3.74 tons/day

Total allowable TSS loading per unit area to meet stds (from Table H.1) = 3.55E-02 tons/day/mi²

Total allowable TSS loading for reach 22 = 3.55E-2 * 189 mi² = 6.72 tons/day

Explicit MOS = zero (only implicit MOS is used) 0.00 tons/day

WLA for TSS for summer for reach 22 = 0.00 tons/day

LA for TSS for summer for reach 22 = TMDL - explicit MOS - WLA = 6.72 tons/day

FILE: R:\PROJECTS\21110-613\TECH\TMDL\TMDL TSS-SUMMER.XLS

TABLE H.6. CALCULATIONS FOR TSS LOADS AND PERCENT REDUCTION
FOR SUMMER FOR OAK BAYOU AT OUA0179 (REACH 08050002-010)

Summer target TSS conc. = 68 mg/L
Percent reduction needed = 0%

Error check for reduction is / is not needed: ok
Error check for less or more reduction needed: ok

Season	Date	Observed TSS at OUA0179 (mg/L)	Flow per unit area on sampling day (cms/mi2)	Percent exceedance for flow on sampling day	Current TSS load (tons/day)/mi2	Reduced TSS load (tons/day)/mi2	Allowable TSS load (tons/day)/mi2	Reduced load less than or equal to allow. load?
SUMMER	11/7/00	67.0	0.0058	49.9%	0.037	0.0371	0.0377	Yes
SUMMER	7/16/01	42.5	0.0069	35.0%	0.028	0.0278	0.0447	Yes
SUMMER	9/11/01	20.7	0.0071	32.8%	0.014	0.0139	0.0459	Yes
TOTALS =					0.079	Total number of values = 3		
					Allowable % of exceedances = 25%			
					Allowable no. of exceedances = 1			
					No. of exceedances before reductions = 0			
					No. of exceedances after reductions = 0			

Flow weighted average TSS (mg/L) = (0.079 / 0.0198) / conversion = 42 mg/L

Average flow per unit area for summer (excluding top 10%) = 0.0055 cms/mi2

Estimated drainage area for reach 10 = 136 mi2

Average flow for summer for reach 10 = 0.0055 * 136 = 0.746 cms

Existing total TSS load for summer for reach 10

= 42 mg/L * 0.746 cms * conversions = 2.98 tons/day

Existing point source load of inorganic suspended solids for reach 10 = 0.00 tons/day

Existing NPS TSS load for summer for reach 10 = 2.98 - 0.00 = 2.98 tons/day

Total allowable TSS loading per unit area to meet stds (from Table H.1) =	3.55E-02 tons/day/mi2
Total allowable TSS loading for reach 10 = $3.55E-2 * 136 \text{ mi}^2 =$	4.84 tons/day
Explicit MOS = zero (only implicit MOS is used)	0.00 tons/day
WLA for TSS for summer for reach 10 =	0.00 tons/day
LA for TSS for summer for reach 10 = TMDL - explicit MOS - WLA =	4.84 tons/day

FILE: R:\PROJECTS\21110-613\TECH\TMDL\TMDL TSS-SUMMER.XLS

TABLE H.7. CALCULATIONS FOR TSS LOADS AND PERCENT REDUCTION
FOR SUMMER FOR BAYOU MACON AT UWBYM01 (REACH 08050002-006)

Summer target TSS conc. = 68 mg/L
Percent reduction needed = 0%

Error check for reduction is / is not needed: ok
Error check for less or more reduction needed: ok

Season	Date	Observed TSS at UWBYM01 (mg/L)	Flow per unit area on sampling day (cms/mi ²)	Percent exceedance for flow on sampling day	Current TSS load (tons/day)/mi ²	Reduced TSS load (tons/day)/mi ²	Allowable TSS load (tons/day)/mi ²	Reduced load less than or equal to allow. load?
SUMMER	10/3/95	58.0	0.0032	93.6%	0.017	0.0174	0.0205	Yes
SUMMER	7/17/01	61.0	0.0044	69.2%	0.026	0.0257	0.0287	Yes
SUMMER	10/2/96	9.0	0.0047	64.7%	0.004	0.0040	0.0303	Yes
SUMMER	11/6/00	69.5	0.0052	56.1%	0.035	0.0347	0.0340	No
SUMMER	10/1/96	65.0	0.0058	50.0%	0.036	0.0359	0.0377	Yes
SUMMER	7/18/95	64.0	0.0069	34.7%	0.042	0.0423	0.0451	Yes
SUMMER	9/10/01	38.8	0.0073	30.8%	0.027	0.0271	0.0475	Yes
SUMMER	9/12/94	94.0	0.0092	20.6%	0.082	0.0825	0.0598	No
SUMMER	6/6/94	78.5	0.0097	19.3%	0.073	0.0727	0.0631	No

TOTALS = 0.0565

0.342 Total number of values = 9
 Allowable % of exceedances = 25%
 Allowable no. of exceedances = 3
 No. of exceedances before reductions = 3
 No. of exceedances after reductions = 3

Flow weighted average TSS (mg/L) = (0.342 / 0.0565) / conversion= 64 mg/L

Average flow per unit area for summer (excluding top 10%) = 0.0055 cms/mi²
 Estimated drainage area for reach 6 = 73 mi²
 Average flow for summer for reach 6 = 0.0055 * 73 = 0.397 cms

Existing total TSS load for summer for reach 6 = 64 mg/L * 0.397 cms * conversions =	2.42 tons/day
Existing point source load of inorganic suspended solids for reach 6 =	0.00 tons/day
Existing NPS TSS load for summer for reach 6 = 2.42 - 0.00 =	2.42 tons/day
Total allowable TSS loading per unit area to meet stds (from Table H.1) =	3.55E-02 tons/day/mi ²
Total allowable TSS loading for reach 6 = 3.55E-2 * 73 mi ² =	2.58 tons/day
Explicit MOS = zero (only implicit MOS is used)	0.00 tons/day
WLA for TSS for summer for reach 6 =	0.00 tons/day
LA for TSS for summer for reach 6 = TMDL - explicit MOS - WLA =	2.58 tons/day

FILE: R:\PROJECTS\2110-613\TECH\TMDL\TMDL TSS-SUMMER.XLS

TABLE H.8. CALCULATIONS FOR TSS LOADS AND PERCENT REDUCTION
FOR SUMMER FOR BAYOU MACON AT UWBYM02 (REACH 08050002-003)

Summer target TSS conc. = 68 mg/L
Percent reduction needed = 0%

Error check for reduction is / is not needed: ok
Error check for less or more reduction needed: ok

Season	Date	Observed TSS at UWBYM02 (mg/L)	Flow per unit area on sampling day (cms/mi ²)	Percent exceedance for flow on sampling day	Current TSS load (tons/day)/mi ²	Reduced TSS load (tons/day)/mi ²	Allowable TSS load (tons/day)/mi ²	Reduced load less than or equal to allow. load?
SUMMER	10/3/95	1.5	0.0032	93.6%	0.000	0.0005	0.0205	Yes
SUMMER	10/2/96	26.5	0.0047	64.7%	0.012	0.0118	0.0303	Yes
SUMMER	11/6/00	17.0	0.0052	56.1%	0.008	0.0085	0.0340	Yes
SUMMER	10/1/96	6.5	0.0058	50.0%	0.004	0.0036	0.0377	Yes
SUMMER	7/18/95	7.0	0.0069	34.7%	0.005	0.0046	0.0451	Yes
SUMMER	9/12/94	2.0	0.0092	20.6%	0.002	0.0018	0.0598	Yes
SUMMER	6/6/94	203.0*	0.0097*	19.3%	0.188*	0.1879	0.0631	No

TOTALS = 0.0350

0.0307
Total number of values = 7
Allowable % of exceedances = 25%
Allowable no. of exceedances = 2
No. of exceedances before reductions = 1
No. of exceedances after reductions = 1

* Values with asterisks not used to calculate flow wtd avg TSS

Flow weighted average TSS (mg/L) = (0.031 / 0.0350) / conversion = 9 mg/L

Average flow per unit area for summer (excluding top 10%) = 0.0055 cms/mi²

Estimated drainage area for reach 3 = 88 mi²

Average flow for summer for reach 3 = 0.0055 * 88 = 0.482 cms

Existing total TSS load for summer for reach 3

= 9 mg/L * 0.482 cms * conversions = 0.41 tons/day

Existing point source load of inorganic suspended solids for reach 3 = 0.00 tons/day

Existing NPS TSS load for summer for reach 3 = 0.41 - 0.00 =

0.41 tons/day

Total allowable TSS loading per unit area to meet stds (from Table H.1) =

3.55E-02 tons/day/mi²

Total allowable TSS loading for reach 3 = 3.55E-2 * 88 mi² =

3.13 tons/day

Explicit MOS = zero (only implicit MOS is used)

0.00 tons/day

WLA for TSS for summer for reach 3 =

0.00 tons/day

LA for TSS for summer for reach 3 = TMDL - explicit MOS - WLA =

3.13 tons/day

FILE: R:\PROJECTS\2110-613\TECH\TMDL\TMDL TSS-SUMMER.XLS

Figure H.1. Summer Flow Duration Curve for USGS 07369680 Bayou Macon near Eudora

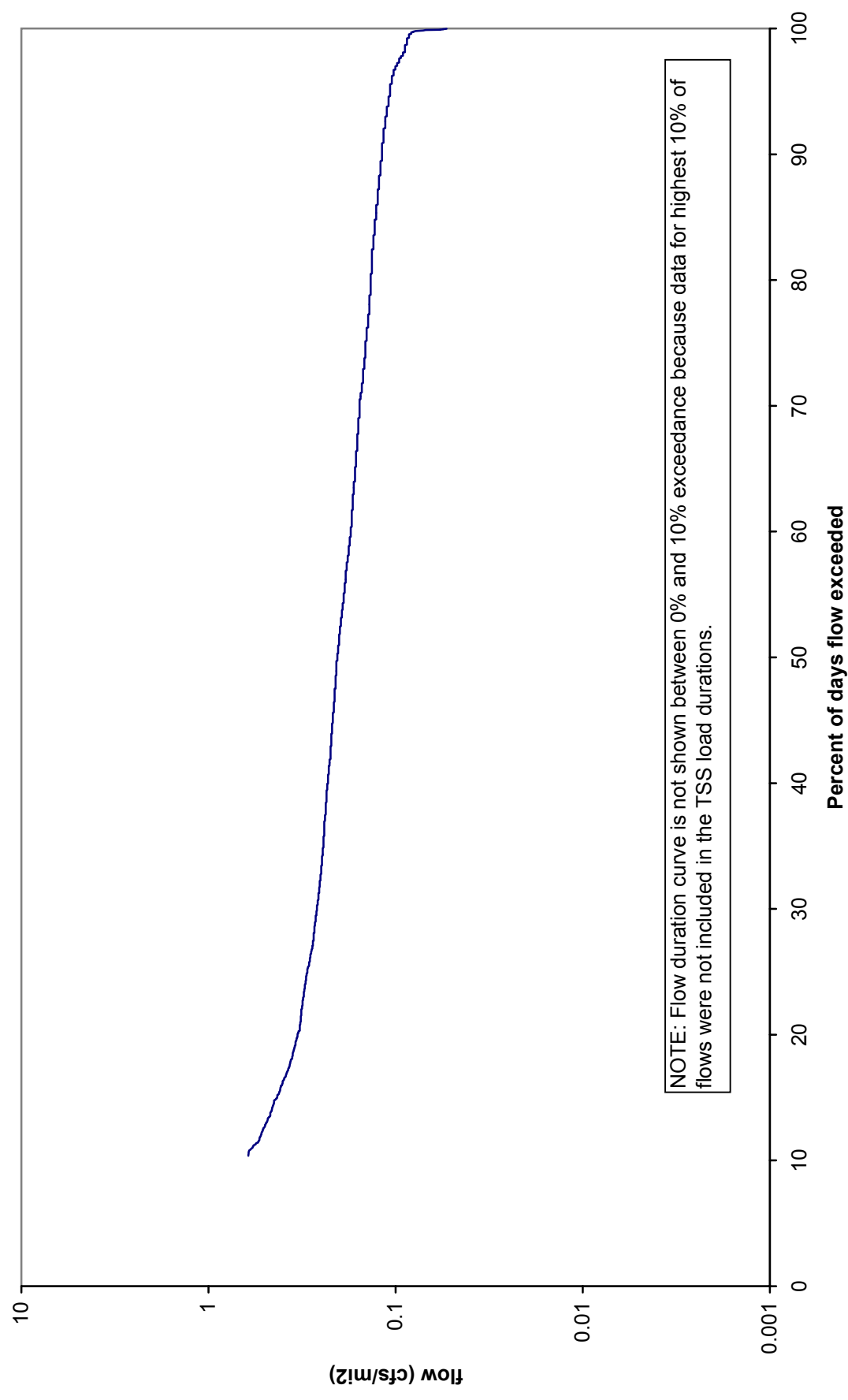


Figure H.2. Summer TSS Load Duration Curve for Boeuf River at OUA0015A

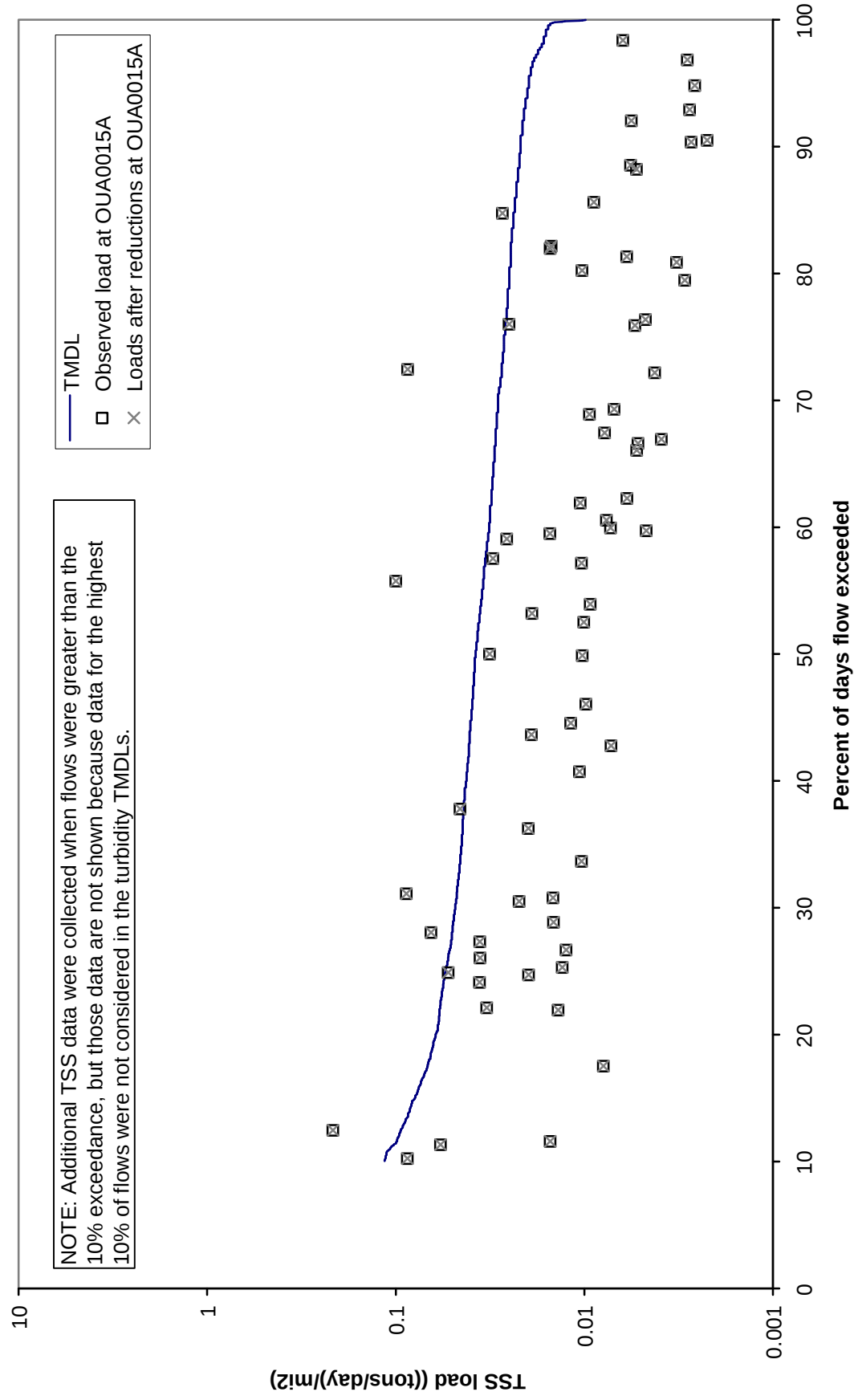


Figure H.3. Summer TSS Load Duration Curve for Boeuf River at UWBFR01

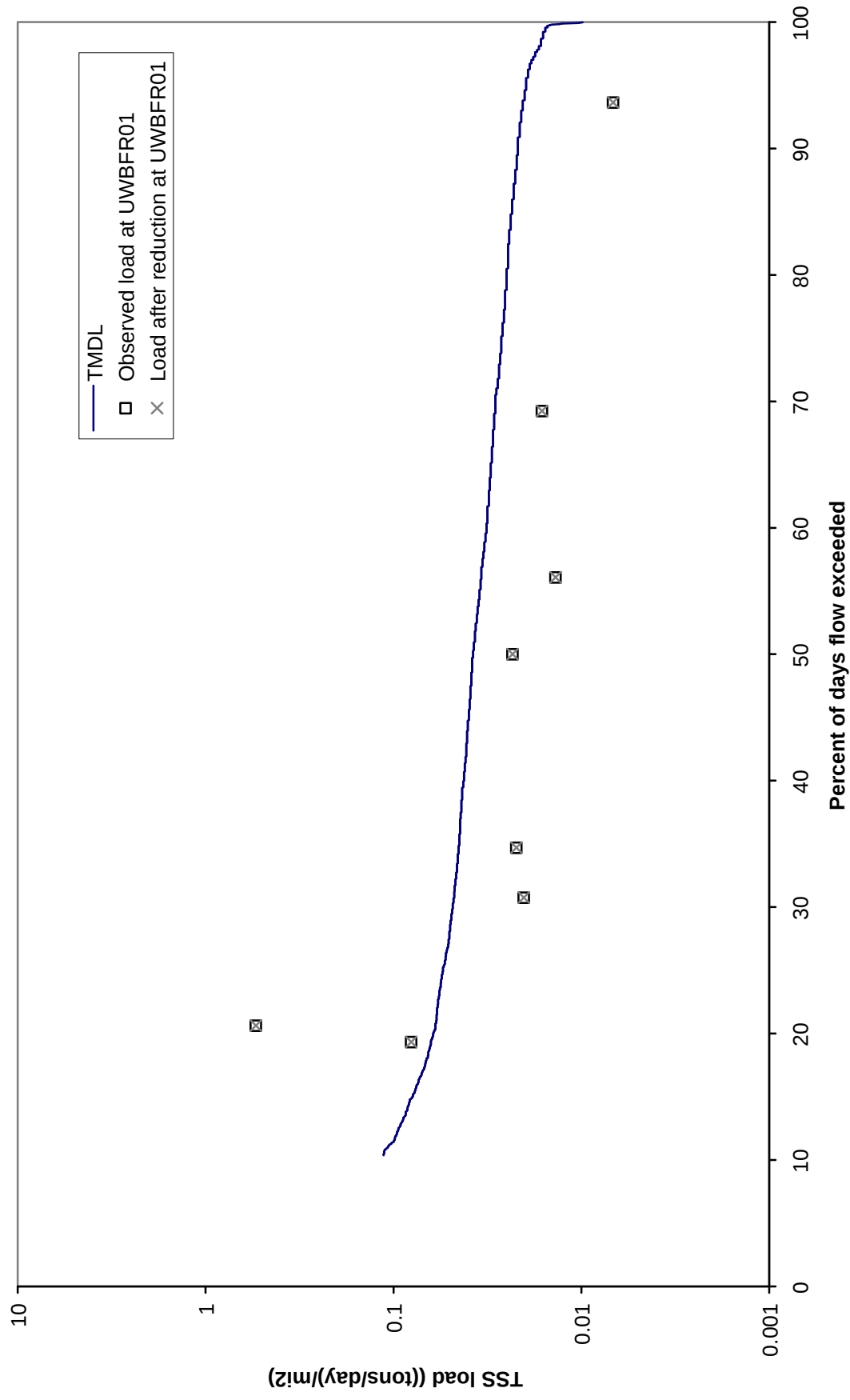


Figure H.4. Summer TSS Load Duration Curve for Big Bayou at OUA0032

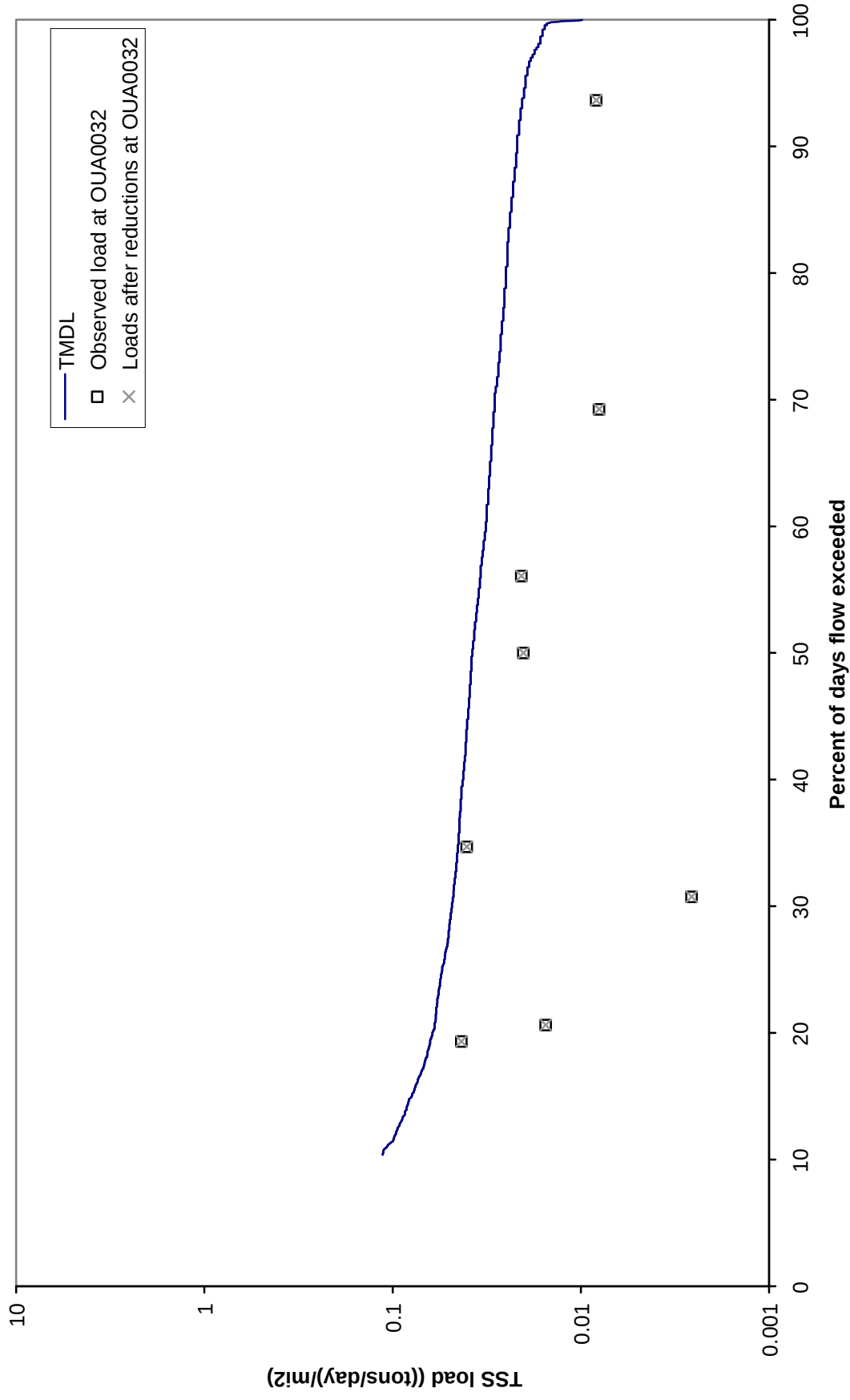


Figure H.5. Summer TSS Load Duration Curve for Big Bayou at UWBGB01

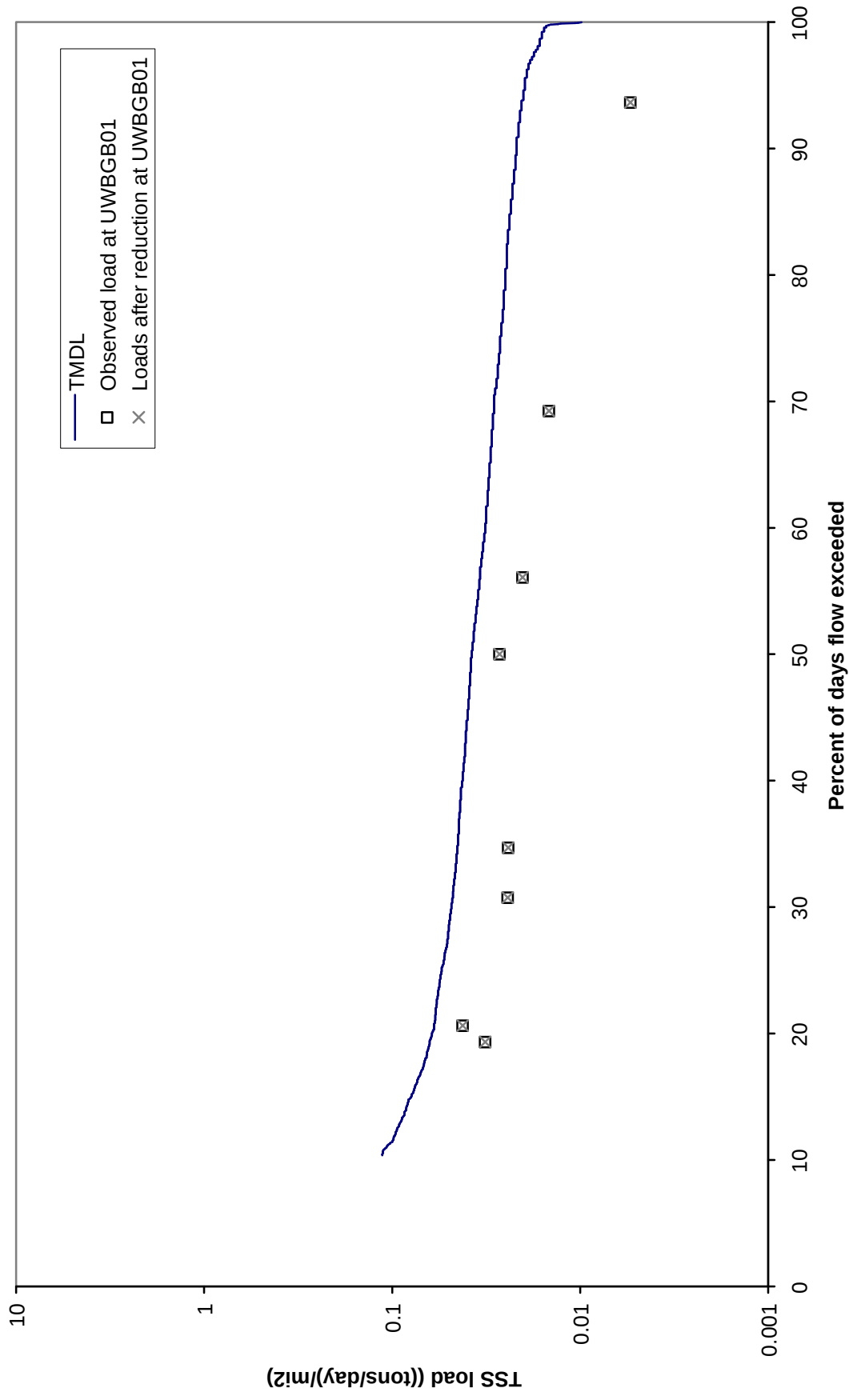


Figure H.6. Summer TSS Load Duration Curve for Oak Bayou at OUA0179

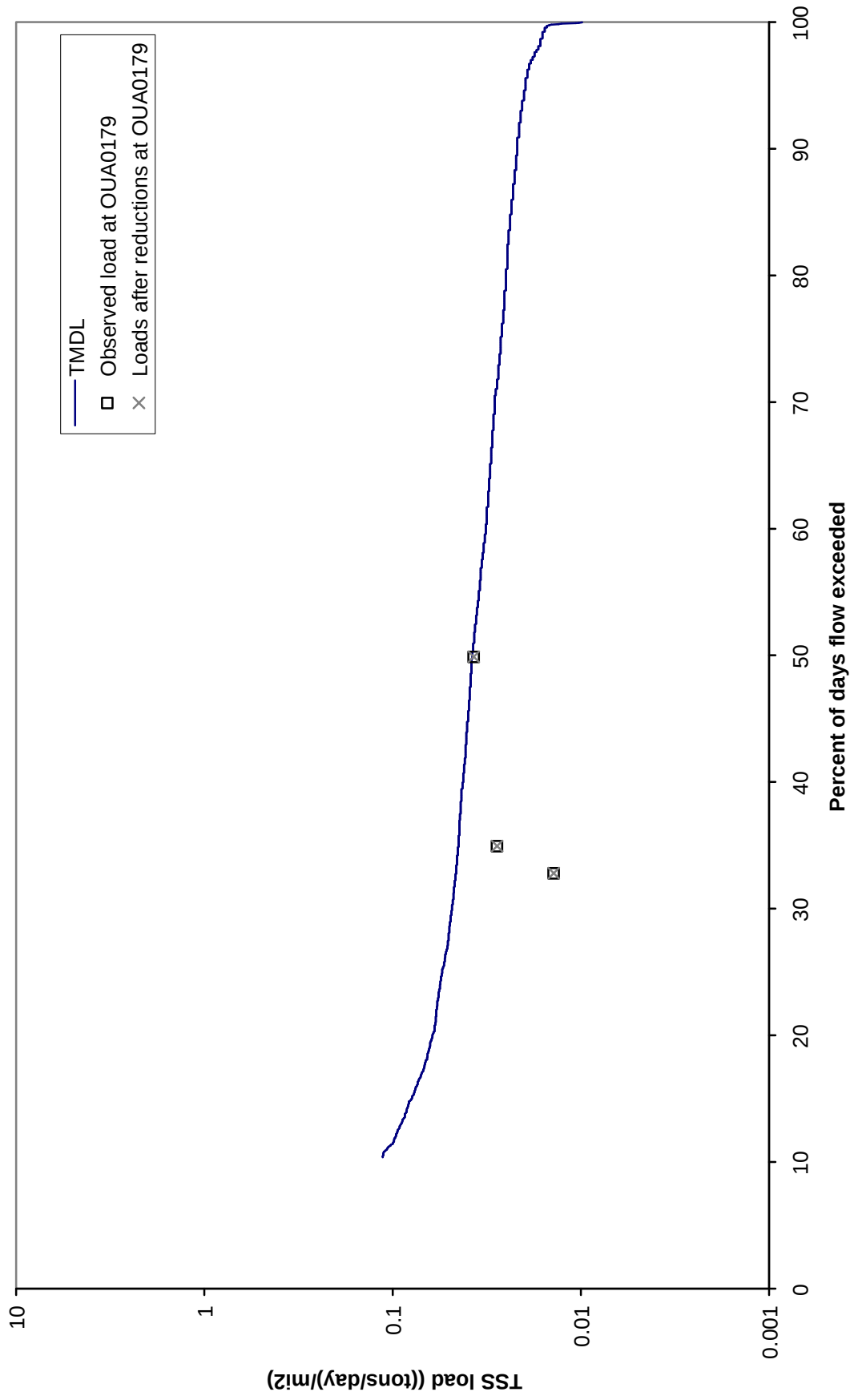


Figure H.7. Summer TSS Load Duration Curve for Bayou Macon at UWBMY01

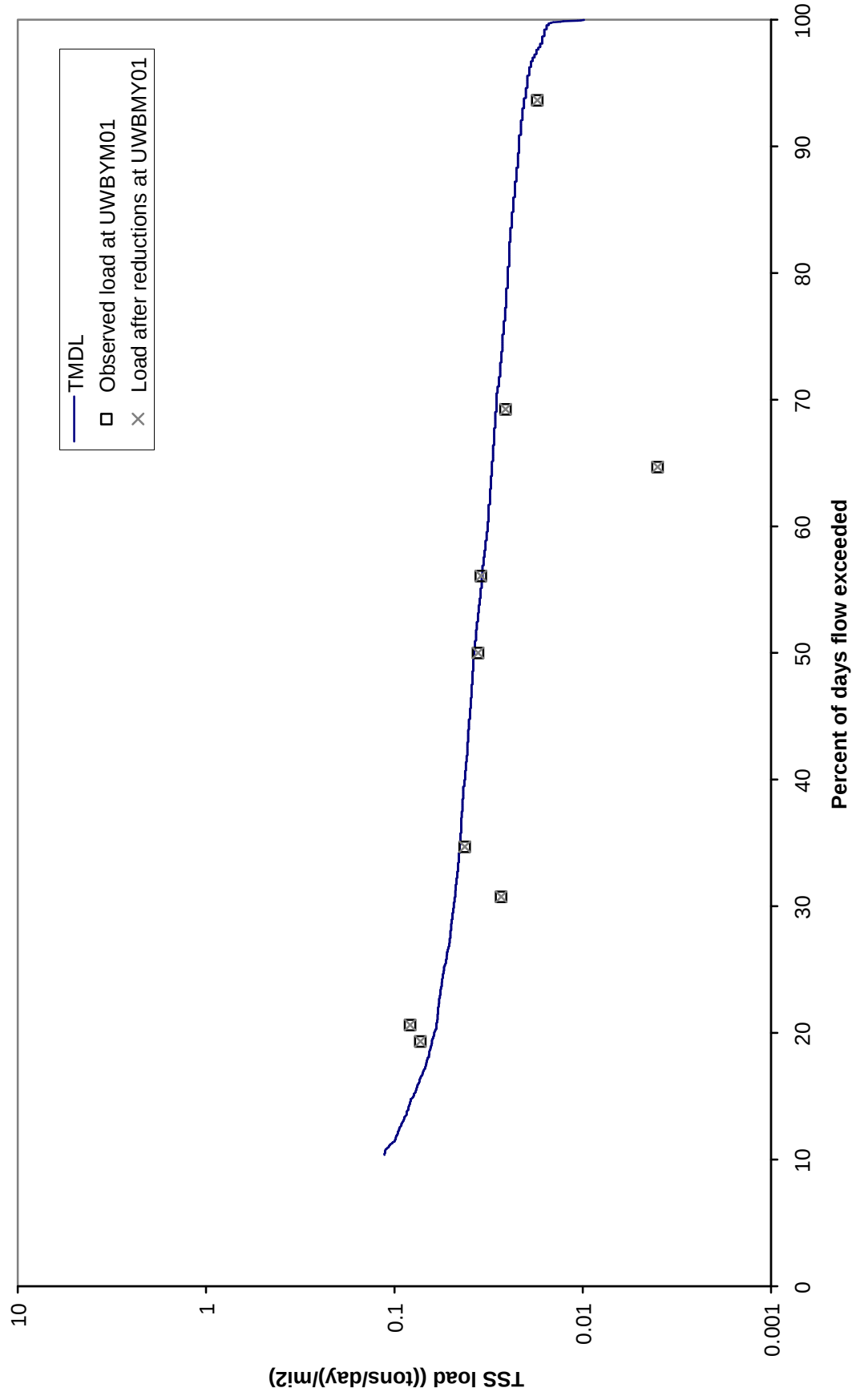
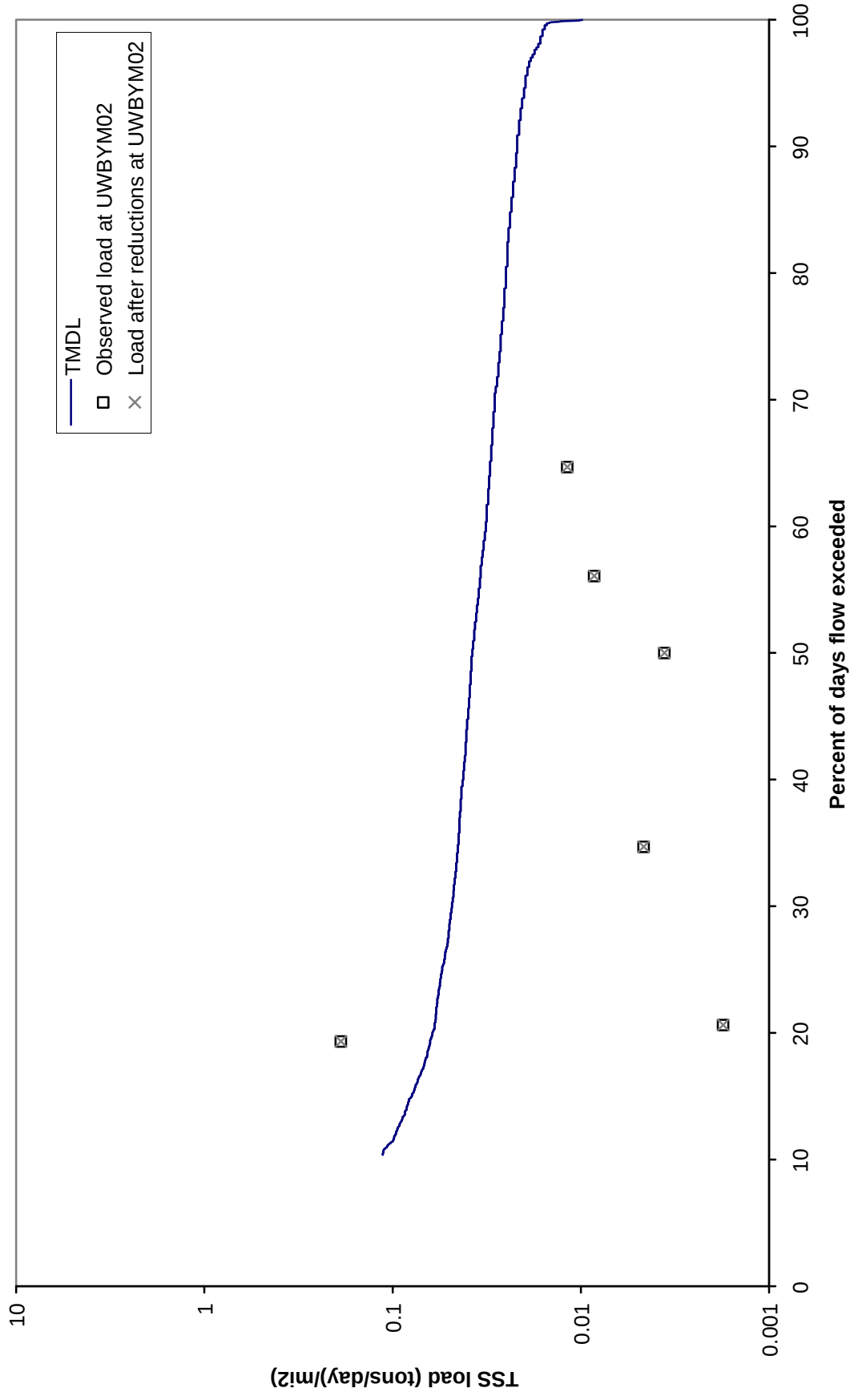


Figure H.8. Summer TSS Load Duration Curve for Bayou Macon at UWBYM02



APPENDIX I

Calculations for Winter Turbidity TMDLs

TABLE I.1. TURBIDITY TMDL CALCULATIONS FOR WINTER

Percentage of total flow in basin represented by Bayou Macon:

Avg. annual flow 1958-67 (cfs)	Percent of combined flow	Drainage area (mi ²)
875	65.2%	785
467	34.8%	504
1,342	100.0%	1,289

USGS gage number and name
07367700 Boeuf River near AR/LA state line
07369700 Bayou Macon near Kilbourne, LA

Turbidity standard = 75 NTU
TSS target = 52 mg/L

Season	Date	Observed flow at Eudora (cfs)	Percent exceedance for observed flow	Adjusted flow for entire basin				"Width" for area under curves	Allowable TSS load to meet standard curve"	Area under TMDL curve"
				E = C / 34.8%	cfs	F = E / 1289 mi ²	G = E / 35.32 cms/mi ²			
A	B	C	D					H = D1 - D2	I = G * 52 mg/L * conversion	J = H * I
WINTER	05/21/95	32	99.98%	92.0	92.0	0.071	0.0020	0.04%	0.01	3.64E-06
WINTER	05/22/95	32	99.95%	92.0	92.0	0.071	0.0020	0.04%	0.01	3.64E-06
WINTER	05/20/95	33	99.91%	94.8	94.8	0.074	0.0021	0.04%	0.01	3.76E-06
WINTER	02/22/00	35	99.87%	100.6	100.6	0.078	0.0022	0.04%	0.01	3.99E-06
WINTER	02/23/00	35	99.84%	100.6	100.6	0.078	0.0022	0.04%	0.01	3.99E-06
WINTER	05/19/95	36	99.80%	103.4	103.4	0.080	0.0023	0.04%	0.01	4.10E-06
WINTER	02/21/00	36	99.76%	103.4	103.4	0.080	0.0023	0.04%	0.01	4.10E-06
WINTER	02/20/00	37	99.73%	106.3	106.3	0.082	0.0023	0.04%	0.01	4.21E-06
WINTER	02/24/00	37	99.69%	106.3	106.3	0.082	0.0023	0.04%	0.01	4.21E-06

For brevity, most of the rows in this spreadsheet have been hidden (between the 10.30% and the 99.69% exceedances).

WINTER	05/06/89	1040	10.30%	2988.5	2,318	0.0656	0.04%	0.32	1.18E-04
WINTER	02/08/97	1050	10.26%	3017.2	2,341	0.0663	0.04%	0.33	1.20E-04
WINTER	12/22/01	1050	10.23%	3017.2	2,341	0.0663	0.04%	0.33	1.20E-04
WINTER	03/22/02	1050	10.19%	3017.2	2,341	0.0663	0.04%	0.33	1.20E-04
WINTER	02/20/94	1060	10.15%	3046.0	2,363	0.0669	0.04%	0.33	1.21E-04
WINTER	02/19/01	1060	10.12%	3046.0	2,363	0.0669	0.04%	0.33	1.21E-04
WINTER	01/18/90	1070	10.08%	3074.7	2,385	0.0675	0.04%	0.33	1.22E-04
WINTER	01/24/90	1080	10.04%	3103.4	2,408	0.0682	0.04%	0.34	1.23E-04
WINTER	02/14/92	1080	10.01%	3103.4	2,408	0.0682	0.04%	0.34	1.23E-04

TOTALS: 90.01% 6.08E-02

TABLE I.2. CALCULATIONS FOR TSS LOADS AND PERCENT REDUCTION
FOR WINTER FOR BOEUF RIVER AT OUA0015A (REACH 08050001-018)

Winter target TSS conc. = 52 mg/L
Percent reduction needed = 72%

Error check for reduction is / is not needed: ok
Error check for less or more reduction needed: ok

Season	Date	Observed TSS at OUA0015A (mg/L)	Flow per unit area on sampling day (cms/mi ²)	Percent exceedance for flow on sampling day	Current TSS load (tons/day)/mi ²	Reduced TSS load (tons/day)/mi ²	Allowable TSS load (tons/day)/mi ²	Reduced load less than or equal to allow. load?
WINTER	1/25/00	197.0	0.0026	99.0%	0.049	0.0136	0.0128	No
WINTER	12/3/02	10.2	0.0026	98.8%	0.003	0.0007	0.0128	Yes
WINTER	3/12/96	69.0	0.0027	98.2%	0.018	0.0050	0.0134	Yes
WINTER	1/21/03	15.0	0.0029	96.1%	0.004	0.0012	0.0143	Yes
WINTER	5/23/95	23.5	0.0033	94.0%	0.007	0.0021	0.0162	Yes
WINTER	12/20/99	86.0	0.0033	93.9%	0.027	0.0075	0.0162	Yes
WINTER	5/5/92	34.0	0.0033	93.9%	0.011	0.0030	0.0165	Yes
WINTER	12/20/93	178.0	0.0035	92.4%	0.059	0.0165	0.0171	Yes
WINTER	2/20/96	132.0	0.0037	90.0%	0.046	0.0129	0.0181	Yes
WINTER	12/1/92	72.0	0.0037	89.5%	0.026	0.0072	0.0184	Yes
WINTER	4/14/98	23.0	0.0038	88.3%	0.008	0.0023	0.0187	Yes
WINTER	4/15/03	114.0	0.0038	88.1%	0.041	0.0115	0.0187	Yes
WINTER	3/25/03	133.0	0.0042	84.7%	0.053	0.0148	0.0205	Yes
WINTER	5/19/98	7.0	0.0044	83.6%	0.003	0.0008	0.0215	Yes
WINTER	2/9/93	94.0	0.0047	79.7%	0.042	0.0119	0.0233	Yes
WINTER	4/24/00	31.0	0.0047	79.3%	0.014	0.0039	0.0233	Yes
WINTER	3/3/92	133.0	0.0048	79.1%	0.061	0.0170	0.0237	Yes
WINTER	4/15/97	37.0	0.0050	75.6%	0.018	0.0050	0.0249	Yes
WINTER	5/30/00	86.0	0.0050	75.4%	0.041	0.0116	0.0249	Yes
WINTER	2/4/92	74.0	0.0051	75.1%	0.036	0.0101	0.0252	Yes
WINTER	1/30/96	424.0	0.0051	75.0%	0.206	0.0578	0.0252	No
WINTER	5/18/93	54.0	0.0052	74.3%	0.027	0.0075	0.0255	Yes
WINTER	5/2/89	85.0	0.0052	73.7%	0.042	0.0119	0.0258	Yes

Season	Date	Observed TSS at OUA0015A (mg/L)	Flow per unit area on sampling day (cms/mi2)	Percent exceedance for flow on sampling day	Current TSS load (tons/day)/mi2	Reduced TSS load (tons/day)/mi2	Allowable TSS load (tons/day)/mi2	Reduced load less than or equal to allow. load?
WINTER	2/14/95	33.5	0.0052	73.5%	0.017	0.0047	0.0258	Yes
WINTER	4/27/99	1396.0	0.0052	73.2%	0.697	0.1950	0.0258	No
WINTER	5/25/99	37.5	0.0052	73.2%	0.019	0.0052	0.0258	Yes
WINTER	5/21/96	43.0	0.0053	73.0%	0.022	0.0061	0.0261	Yes
WINTER	2/23/99	33.5	0.0054	72.2%	0.017	0.0048	0.0265	Yes
WINTER	1/7/92	12.0	0.0054	71.7%	0.006	0.0017	0.0268	Yes
WINTER	3/9/93	24.0	0.0055	70.5%	0.013	0.0035	0.0271	Yes
WINTER	3/28/95	35.0	0.0056	69.5%	0.019	0.0052	0.0274	Yes
WINTER	3/23/99	70.5	0.0057	68.0%	0.038	0.0107	0.0280	Yes
WINTER	4/23/02	55.3	0.0057	67.8%	0.030	0.0084	0.0280	Yes
WINTER	5/20/03	460.0	0.0063	62.4%	0.277	0.0774	0.0311	No
WINTER	3/26/01	41.3	0.0064	61.5%	0.025	0.0071	0.0317	Yes
WINTER	5/28/02	102.0	0.0064	61.4%	0.063	0.0175	0.0317	Yes
WINTER	1/14/02	63.3	0.0067	60.1%	0.040	0.0113	0.0330	Yes
WINTER	12/6/88	72.0	0.0068	60.0%	0.046	0.0130	0.0333	Yes
WINTER	4/7/92	17.0	0.0068	59.3%	0.011	0.0031	0.0336	Yes
WINTER	4/2/91	217.0	0.0076	54.9%	0.157	0.0438	0.0373	No
WINTER	5/24/94	77.0	0.0083	51.0%	0.061	0.0170	0.0408	Yes
WINTER	2/26/02	57.5	0.0085	50.4%	0.046	0.0130	0.0417	Yes
WINTER	5/13/97	59.0	0.0090	48.3%	0.051	0.0142	0.0445	Yes
WINTER	3/15/94	114.0	0.0133	37.9%	0.144	0.0403	0.0654	Yes
WINTER	5/22/01	220.9	0.0138	36.9%	0.291	0.0814	0.0682	No
WINTER	1/12/93	21.0	0.0139	36.9%	0.028	0.0078	0.0685	Yes
WINTER	4/17/01	351.1	0.0145	35.8%	0.483	0.1353	0.0713	No
WINTER	12/19/94	83.5	0.0148	35.2%	0.117	0.0329	0.0728	Yes
WINTER	1/20/98	75.0	0.0167	32.4%	0.119	0.0333	0.0822	Yes
WINTER	12/19/00	226.3	0.0177	31.2%	0.381	0.1067	0.0871	No
WINTER	1/30/01	355.0	0.0186	30.4%	0.627	0.1757	0.0915	No
WINTER	3/27/00	170.0	0.0195	29.2%	0.316	0.0884	0.0962	Yes

Season	Date	Observed TSS at OUA0015A (mg/L)	Flow per unit area on sampling day (cms/mi2)	Percent exceedance for flow on sampling day	Current TSS load (tons/day)/mi2	Reduced TSS load (tons/day)/mi2	Allowable TSS load (tons/day)/mi2	Reduced load less than or equal to allow. load?
WINTER	1/3/89	150.0	0.0199	28.7%	0.285	0.0798	0.0983	Yes
WINTER	3/26/02	104.0	0.0199	28.7%	0.198	0.0553	0.0983	Yes
WINTER	3/17/98	192.0	0.0271	23.3%	0.496	0.1390	0.1338	No
WINTER	2/25/97	240.0	0.0278	23.0%	0.635	0.1777	0.1369	No
WINTER	3/12/91	12.0	0.0281	22.7%	0.032	0.0090	0.1385	Yes
WINTER	4/4/89	201.0	0.0287	22.4%	0.550	0.1539	0.1416	No
WINTER	4/13/93	119.0	0.0299	22.0%	0.338	0.0947	0.1472	Yes
WINTER	12/18/95	234.0	0.0300	21.9%	0.668	0.1871	0.1478	No
WINTER	12/22/98	78.5	0.0317	21.0%	0.237	0.0663	0.1562	Yes
WINTER	2/28/89	184.0	0.0355	18.9%	0.622	0.1741	0.1749	Yes
WINTER	1/18/94	416.0	0.0378	17.8%	1.498	0.4194	0.1864	No
WINTER	1/31/89	335.0	0.0391	17.2%	1.249	0.3496	0.1930	No
WINTER	2/5/91	160.0	0.0406	16.7%	0.619	0.1734	0.2004	Yes
WINTER	2/27/01	519.0	0.0487	13.9%	2.409	0.6744	0.2403	No
WINTER	1/26/99	249.0	0.0505	13.4%	1.197	0.3353	0.2490	No
WINTER	12/11/01	141.0	0.0530	12.7%	0.712	0.1994	0.2614	Yes
WINTER	12/17/96	277.0	0.0572	12.0%	1.510	0.4229	0.2823	No
WINTER	2/25/03	98.0	0.0578	11.8%	0.540	0.1511	0.2851	Yes
WINTER	2/17/98	220.0*	0.0682*	9.9%	*	*	*	*
WINTER	1/2/91	436.0*	0.0726*	9.2%	*	*	*	*
WINTER	4/23/96	1056.0*	0.1269*	3.9%	*	*	*	*
TOTALS =			1.0257		18.794		Total number of values = Allowable % of exceedances = Allowable no. of exceedances = No. of exceedances before reductions = No. of exceedances after reductions =	70 25% 18 51 18

* Values with asterisks not used in any computations

Flow weighted average TSS (mg/L) = (18.794 / 1.0257) / conversion =	192 mg/L
Average flow per unit area for winter =	0.0123 cms/mi2
Estimated drainage area for reach 18 =	180 mi2
Average flow for winter for reach 18 = 0.0123 * 180 =	2.217 cms
Existing total TSS load for winter for reach 18 = 192 mg/L * 2.217 cms * conversions =	40.54 tons/day
Existing point source load of inorganic suspended solids for reach 18 =	0.00 tons/day
Existing NPS TSS load for winter for reach 18 = 40.54 - 0.00 =	40.54 tons/day
Total allowable TSS loading per unit area to meet stds (from Table I.1) =	6.08E-02 tons/day/mi2
Total allowable TSS loading for reach 18 = 6.08E-2 * 180 mi2 =	10.93 tons/day
Explicit MOS = zero (only implicit MOS is used)	0.00 tons/day
WLA for TSS for winter for reach 18 =	0.00 tons/day
LA for TSS for winter for reach 18 = TMDL - explicit MOS - WLA =	10.93 tons/day

FILE: R:\PROJECTS\2110-613\TECH\TMDL\TMDL TSS-WINTER.XLS

TABLE I.3. CALCULATIONS FOR TSS LOADS AND PERCENT REDUCTION
FOR WINTER FOR BOEUF RIVER AT UWBFR01 (REACH 08050001-019)

Winter target TSS conc. = 52 mg/L
Percent reduction needed = 66%

Error check for reduction is / is not needed: ok
Error check for less or more reduction needed: ok

Season	Date	Observed TSS at UWBFR01 (mg/L)	Flow per unit area on sampling day (cms/mi2)	Percent exceedance for flow on sampling day	Current TSS load (tons/day)/mi2	Reduced TSS load (tons/day)/mi2	Allowable TSS load (tons/day)/mi2	Reduced load less than or equal to allow. load?
WINTER	5/7/96	53.0	0.0048	78.6%	0.024	0.0082	0.0237	Yes
WINTER	5/14/01	29.5	0.0049	77.0%	0.014	0.0047	0.0243	Yes
WINTER	2/27/96	196.5	0.0069	58.2%	0.130	0.0442	0.0342	No
WINTER	1/17/95	72.0	0.0072	56.8%	0.049	0.0168	0.0355	Yes
WINTER	4/11/95	149.5	0.0274	23.3%	0.390	0.1326	0.1351	Yes
WINTER	3/6/01	368.0	0.0600	11.3%	2.102	0.7145	0.2957	No
WINTER	1/22/01	150.0*	0.0770*	8.5%	*	*	*	*

TOTALS = 0.1112

2.709
Total number of values = 6
Allowable % of exceedances = 25%
Allowable no. of exceedances = 2
No. of exceedances before reductions = 5
No. of exceedances after reductions = 2

* Values with asterisks not used in any computations

Flow weighted average TSS (mg/L) = (2.709 / 0.1112) / conversion = 256 mg/L

Average flow per unit area for winter =

Estimated drainage area for reach 19 =

Average flow for winter for reach 19 = 0.0123 * 176 =

0.0123 cms/mi2
176 mi2
2.177 cms

Existing total TSS load for winter for reach 19

= 256 mg/L * 2.177 cms * conversions =

53.07 tons/day

Existing point source load of inorganic suspended solids for reach 19 =

0.00 tons/day

Existing NPS TSS load for winter for reach 19 = 53.07 - 0.00 =

53.07 tons/day

Total allowable TSS loading per unit area to meet stds (from Table I.1) =

6.08E-02 tons/day/mi²

Total allowable TSS loading for reach 19 = 6.08E-2 * 176 mi² =

10.73 tons/day

Explicit MOS = zero (only implicit MOS is used)

0.00 tons/day

WLA for TSS for winter for reach 19 =

0.00 tons/day

LA for TSS for winter for reach 19 = TMDL - explicit MOS - WLA =

10.73 tons/day

FILE: R:\PROJECTS\2110-613\TECH\TMDL\TMDL TSS-WINTER.XLS

TABLE I.4. CALCULATIONS FOR TSS LOADS AND PERCENT REDUCTION
FOR WINTER FOR BIG BAYOU AT OUA0032 (REACH 08050001-022)

Winter target TSS conc. = 52 mg/L
Percent reduction needed = 51%

Error check for reduction is / is not needed: ok
Error check for less or more reduction needed: ok

Season	Date	Observed TSS at OUA0032 (mg/L)	Flow per unit area on sampling day (cms/mi2)	Percent exceedance for flow on sampling day	Current TSS load (tons/day)/mi2	Reduced TSS load (tons/day)/mi2	Allowable TSS load (tons/day)/mi2	Reduced load less than or equal to allow. load?
WINTER	5/7/96	64.0	0.0048	78.6%	0.029	0.0143	0.0237	Yes
WINTER	5/14/01	31.0	0.0049	77.0%	0.015	0.0071	0.0243	Yes
WINTER	2/27/96	92.0	0.0069	58.2%	0.061	0.0298	0.0342	Yes
WINTER	1/17/95	153.0	0.0072	56.8%	0.105	0.0514	0.0355	No
WINTER	4/11/95	406.0	0.0274	23.3%	1.059	0.5190	0.1351	No
WINTER	3/6/01	104.5	0.0600	11.3%	0.597	0.2924	0.2957	Yes
WINTER	1/22/01	151.0*	0.0770*	8.5%	*	*	*	*

TOTALS = 0.1112

1.865
Total number of values = 6
Allowable % of exceedances = 25%
Allowable no. of exceedances = 2
No. of exceedances before reductions = 5
No. of exceedances after reductions = 2

* Values with asterisks not used in any computations

Flow weighted average TSS (mg/L) = (1.865 / 0.1112) / conversion = 176 mg/L

Average flow per unit area for winter = 0.0123 cms/mi2
Estimated drainage area for reach 22 = 189 mi2
Average flow for winter for reach 22 = 0.0123 * 189 = 2.331 cms

Existing total TSS load for winter for reach 22
= 176 mg/L * 2.331 cms * conversions = 39.08 tons/day

Existing point source load of inorganic suspended solids for reach 22 = 0.00 tons/day

Existing NPS TSS load for winter for reach 22 = 39.08 - 0.00 =

39.08 tons/day

Total allowable TSS loading per unit area to meet stds (from Table I.1) =

6.08E-02 tons/day/mi²

Total allowable TSS loading for reach 22 = 6.08E-2 * 189 mi² =

11.50 tons/day

Explicit MOS = zero (only implicit MOS is used)

0.00 tons/day

WLA for TSS for winter for reach 22 =

0.00 tons/day

LA for TSS for winter for reach 22 = TMDL - explicit MOS - WLA =

11.50 tons/day

FILE: R:\PROJECTS\2110-613\TECH\TMDL\TMDL TSS-WINTER.XLS

TABLE I.5. CALCULATIONS FOR TSS LOADS AND PERCENT REDUCTION
FOR WINTER FOR BIG BAYOU AT UWGB01 (REACH 08050001-022)

Winter target TSS conc. = 52 mg/L
Percent reduction needed = 12%

Error check for reduction is / is not needed: ok
Error check for less or more reduction needed: ok

Season	Date	Observed TSS at UWGB01 (mg/L)	Flow per unit area on sampling day (cms/mi2)	Percent exceedance for flow on sampling day	Current TSS load (tons/day)/mi2	Reduced TSS load (tons/day)/mi2	Allowable TSS load (tons/day)/mi2	Reduced load less than or equal to allow. load?
WINTER	5/7/96	56.0	0.0048	78.6%	0.026	0.0225	0.0237	Yes
WINTER	5/14/01	36.8	0.0049	77.0%	0.017	0.0152	0.0243	Yes
WINTER	2/27/96	42.0	0.0069	58.2%	0.028	0.0244	0.0342	Yes
WINTER	1/17/95	58.5	0.0072	56.8%	0.040	0.0353	0.0355	Yes
WINTER	4/11/95	526.0	0.0274	23.3%	1.372	1.2076	0.1351	No
WINTER	3/6/01	123.5	0.0600	11.3%	0.705	0.6206	0.2957	No
WINTER	1/22/01	155.0*	0.0770*	8.5%	*	*	*	*

TOTALS = 0.1112

2.188
Total number of values = 6
Allowable % of exceedances = 25%
Allowable no. of exceedances = 2
No. of exceedances before reductions = 4
No. of exceedances after reductions = 2

* Values with asterisks not used in any computations

Flow weighted average TSS (mg/L) = (2.188 / 0.1112) / conversion = 207 mg/L

Average flow per unit area for winter = 0.0123 cms/mi2
Estimated drainage area for reach 22 = 189 mi2
Average flow for winter for reach 22 = 0.0123 * 189 = 2.331 cms

Existing total TSS load for winter for reach 22
= 207 mg/L * 2.331 cms * conversions = 45.96 tons/day

Existing point source load of inorganic suspended solids for reach 22 = 0.00 tons/day

Existing NPS TSS load for winter for reach 22 = 45.96 - 0.00 =

45.96 tons/day

Total allowable TSS loading per unit area to meet stds (from Table I.1) =

6.08E-02 tons/day/mi²

Total allowable TSS loading for reach 22 = 6.08E-2 * 189 mi² =

11.50 tons/day

Explicit MOS = zero (only implicit MOS is used)

0.00 tons/day

WLA for TSS for winter for reach 22 =

0.00 tons/day

LA for TSS for winter for reach 22 = TMDL - explicit MOS - WLA =

11.50 tons/day

FILE: R:\PROJECTS\2110-613\TECH\TMDL\TMDL TSS-WINTER.XLS

TABLE I.6. CALCULATIONS FOR TSS LOADS AND PERCENT REDUCTION
FOR WINTER FOR OAK BAYOU AT OUA0179 (REACH 08050002-010)

Winter target TSS conc. = 52 mg/L
Percent reduction needed = 0%

Error check for reduction is / is not needed: ok
Error check for less or more reduction needed: ok

Season	Date	Observed TSS at OUA0179 (mg/L)	Flow per unit area on sampling day (cms/mi ²)	Percent exceedance for flow on sampling day	Current TSS load (tons/day)/mi ²	Reduced TSS load (tons/day)/mi ²	Allowable TSS load (tons/day)/mi ²	Reduced load less than or equal to allow. load?
WINTER	5/15/01	46.0	0.0049	76.9%	0.022	0.0216	0.0243	Yes
WINTER	1/23/01	100.0	0.0442	15.1%	0.421	0.4208	0.2179	No
WINTER	3/5/01	130.0*	0.0757*	8.6%	*	*	*	*
TOTALS =					0.442	Total number of values = 2 Allowable % of exceedances = 25% Allowable no. of exceedances = 1 No. of exceedances before reductions = 1 No. of exceedances after reductions = 1		

* Values with asterisks not used in any computations

Flow weighted average TSS (mg/L) = (0.442 / 0.0491) / conversion = 95 mg/L

Average flow per unit area for winter =

Estimated drainage area for reach 10 =

Average flow for winter for reach 10 = 0.0123 * 136 =

Existing total TSS load for winter for reach 10

= 95 mg/L * 1.681 cms * conversions =

15.20 tons/day

Existing point source load of inorganic suspended solids for reach 10 =

0.00 tons/day

Existing NPS TSS load for winter for reach 10 = 15.20 - 0.00 =

15.20 tons/day

Total allowable TSS loading per unit area to meet stds (from Table I.1) =	6.08E-02 tons/day/mi2
Total allowable TSS loading for reach 10 = $6.08E-2 * 136 \text{ mi}^2 =$	8.29 tons/day
Explicit MOS = zero (only implicit MOS is used)	0.00 tons/day
WLA for TSS for winter for reach 10 =	0.00 tons/day
LA for TSS for winter for reach 10 = TMDL - explicit MOS - WLA =	8.29 tons/day

FILE: R:\PROJECTS\2110-613\TECH\TMDL\TMDL TSS-WINTER.XLS

TABLE I.7. CALCULATIONS FOR TSS LOADS AND PERCENT REDUCTION
FOR WINTER FOR BAYOU MACON AT UWBYM01 (REACH 08050002-006)

Winter target TSS conc. = 52 mg/L
Percent reduction needed = 53%

Error check for reduction is / is not needed: ok
Error check for less or more reduction needed: ok

Season	Date	Observed TSS at UWBYM01 (mg/L)	Flow per unit area on sampling day (cms/mi2)	Percent exceedance for flow on sampling day	Current TSS load (tons/day)/mi2	Reduced TSS load (tons/day)/mi2	Allowable TSS load (tons/day)/mi2	Reduced load less than or equal to allow. load?
WINTER	5/7/96	126.5	0.0048	78.6%	0.058	0.0272	0.0237	No
WINTER	5/14/01	29.5	0.0049	77.0%	0.014	0.0065	0.0243	Yes
WINTER	2/27/96	68.0	0.0069	58.2%	0.045	0.0211	0.0342	Yes
WINTER	1/17/95	82.0	0.0072	56.8%	0.056	0.0264	0.0355	Yes
WINTER	4/11/95	814.0	0.0274	23.3%	2.124	0.9981	0.1351	No
WINTER	3/6/01	108.5	0.0600	11.3%	0.620	0.2912	0.2957	Yes
WINTER	1/22/01	125.0*	0.0770*	8.5%	*	*	*	*

TOTALS = 0.1112

2.916
Total number of values = 6
Allowable % of exceedances = 25%
Allowable no. of exceedances = 2
No. of exceedances before reductions = 5
No. of exceedances after reductions = 2

* Values with asterisks not used in any computations

Flow weighted average TSS (mg/L) = (2.916 / 0.1112) / conversion = 275 mg/L

Average flow per unit area for winter =

Estimated drainage area for reach 6 =

Average flow for winter for reach 6 = 0.0123 * 73 =

Existing total TSS load for winter for reach 6

= 275 mg/L * 0.894 cms * conversions =

23.42 tons/day

Existing point source load of inorganic suspended solids for reach 6 =

0.00 tons/day

Existing NPS TSS load for winter for reach 6 = 23.42 - 0.00 =

23.42 tons/day

Total allowable TSS loading per unit area to meet stds (from Table I.1) =

6.08E-02 tons/day/mi²

Total allowable TSS loading for reach 6 = 6.08E-2 * 73 mi² =

4.41 tons/day

Explicit MOS = zero (only implicit MOS is used)

0.00 tons/day

WLA for TSS for winter for reach 6 =

0.00 tons/day

LA for TSS for winter for reach 6 = TMDL - explicit MOS - WLA =

4.41 tons/day

FILE: R:\PROJECTS\2110-613\TECH\TMDL\TMDL TSS-WINTER.XLS

TABLE I.8. CALCULATIONS FOR TSS LOADS AND PERCENT REDUCTION
FOR WINTER FOR BAYOU MACON AT UWBYM02 (REACH 08050002-003)

Winter target TSS conc. = 52 mg/L
Percent reduction needed = 0%

Error check for reduction is / is not needed: ok
Error check for less or more reduction needed: ok

Season	Date	Observed TSS at UWBYM02 (mg/L)	Flow per unit area on sampling day (cms/mi ²)	Percent exceedance for flow on sampling day	Current TSS load (tons/day)/mi ²	Reduced TSS load (tons/day)/mi ²	Allowable TSS load (tons/day)/mi ²	Reduced load less than or equal to allow. load?
WINTER	5/7/96	45.0	0.0048	78.6%	0.021	0.0206	0.0237	Yes
WINTER	2/27/96	27.5	0.0069	58.2%	0.018	0.0182	0.0342	Yes
WINTER	1/17/95	50.0	0.0072	56.8%	0.034	0.0343	0.0355	Yes
WINTER	4/11/95	244.0	0.0274	23.3%	0.637	0.6366	0.1351	No
WINTER	1/22/01	134.0*	0.0770*	8.5%	*	*	*	*
TOTALS =			0.0463		0.710			
						Total number of values =		4
						Allowable % of exceedances =		25%
						Allowable no. of exceedances =		1
						No. of exceedances before reductions =		1
						No. of exceedances after reductions =		1

* Values with asterisks not used in any computations

Flow weighted average TSS (mg/L) = (0.710 / 0.0463) / conversion =

161 mg/L

Average flow per unit area for winter =

0.0123 cms/mi²

Estimated drainage area for reach 3 =

88 mi²

Average flow for winter for reach 3 = 0.0123 * 88 =

1.087 cms

Existing total TSS load for summer for reach 3

= 161 mg/L * 1.087 cms * conversions =

16.66 tons/day

Existing point source load of inorganic suspended solids for reach 3 =

0.00 tons/day

Existing NPS TSS load for winter for reach 3 = 16.66 - 0.00 =

16.66 tons/day

Total allowable TSS loading per unit area to meet stds (from Table I.1) =

6.08E-02 tons/day/mi²

Total allowable TSS loading for reach 3 = 6.08E-2 * 88 mi² =

5.36 tons/day

Explicit MOS = zero (only implicit MOS is used)

0.00 tons/day

WLA for TSS for winter for reach 3 =

0.00 tons/day

LA for TSS for winter for reach 3 = TMDL - explicit MOS - WLA =

5.36 tons/day

FILE: R:\PROJECTS\2110-613\TECH\TMDL\TMDL TSS-WINTER.XLS

Figure I.1. Winter Flow Duration Curve for USGS 07369680 Bayou Macon near Eudora

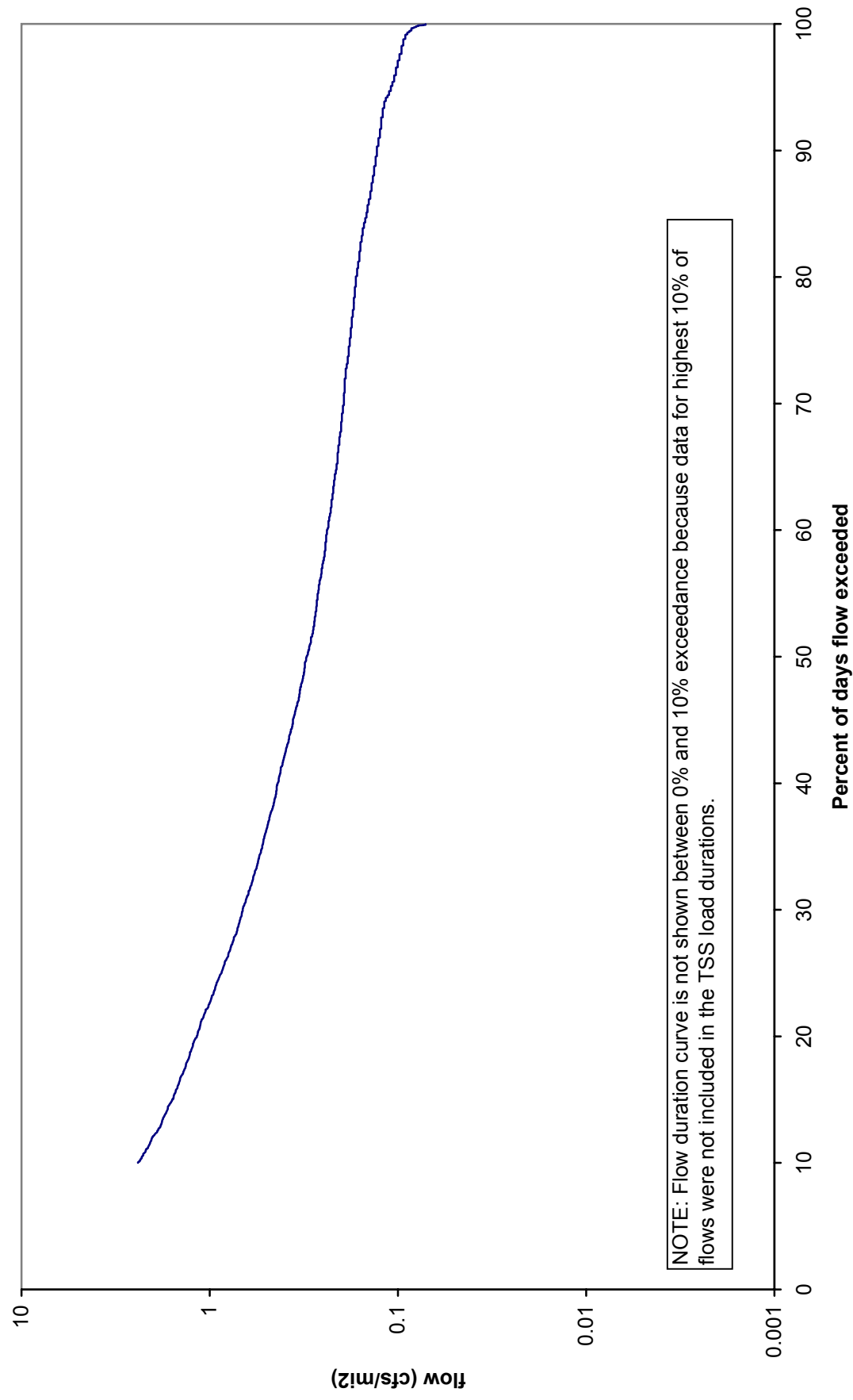


Figure I.2. Winter TSS Load Duration Curve for Boeuf River at OUA00015A

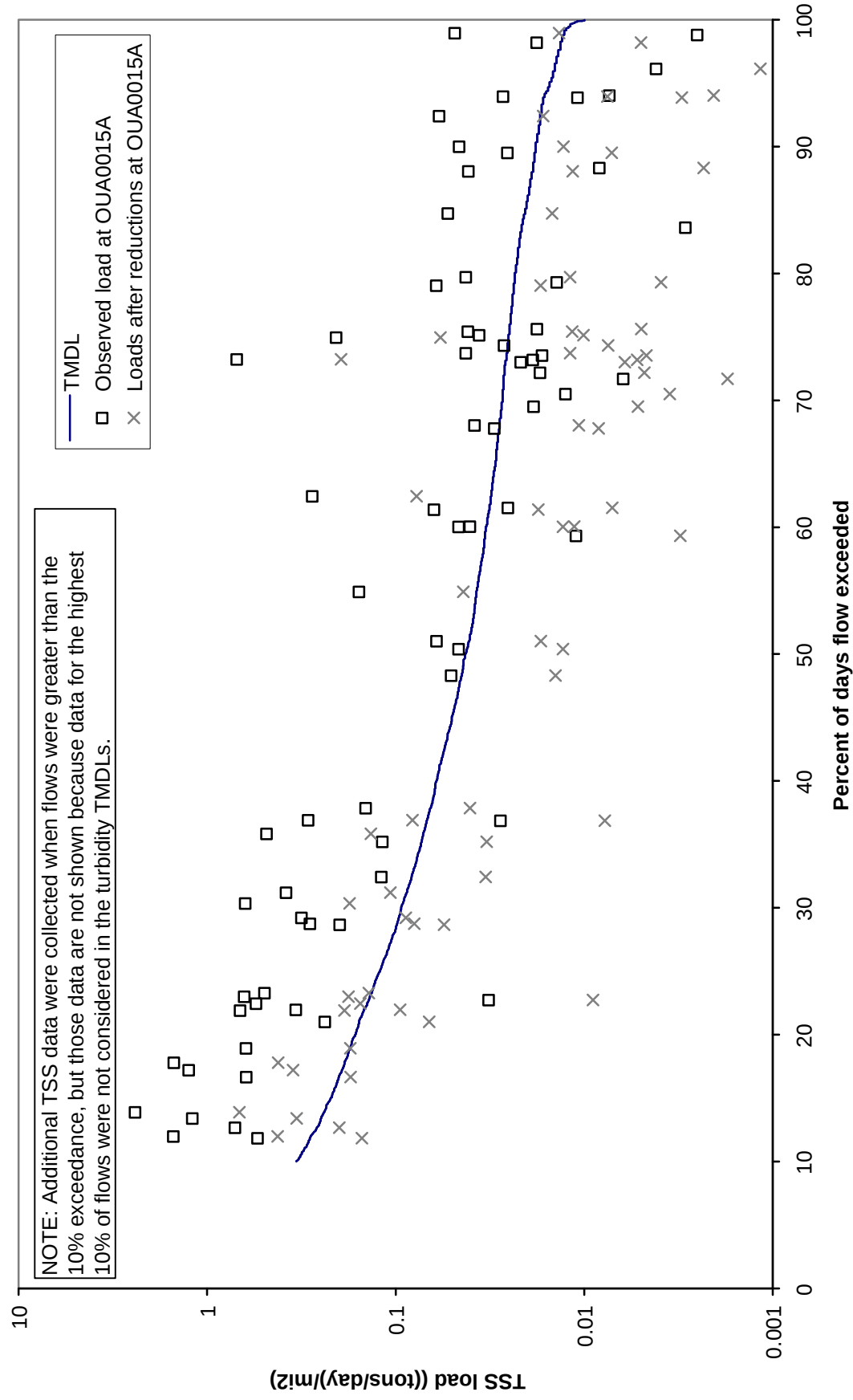


Figure I.3. Winter TSS Load Duration Curve for Boeuf River at UWBFR01

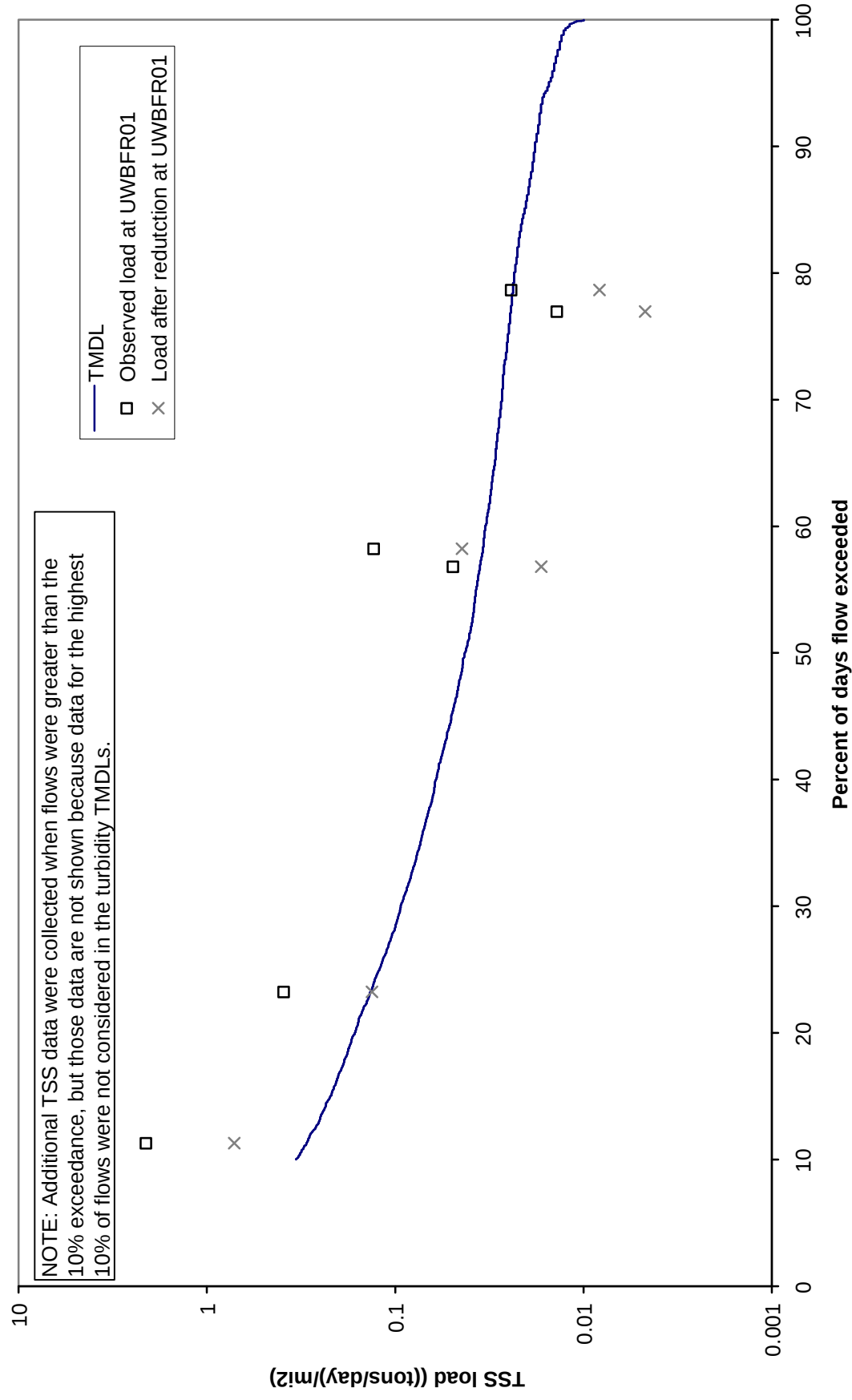


Figure I.4. Winter TSS Load Duration Curve for Big Bayou at OUA0032

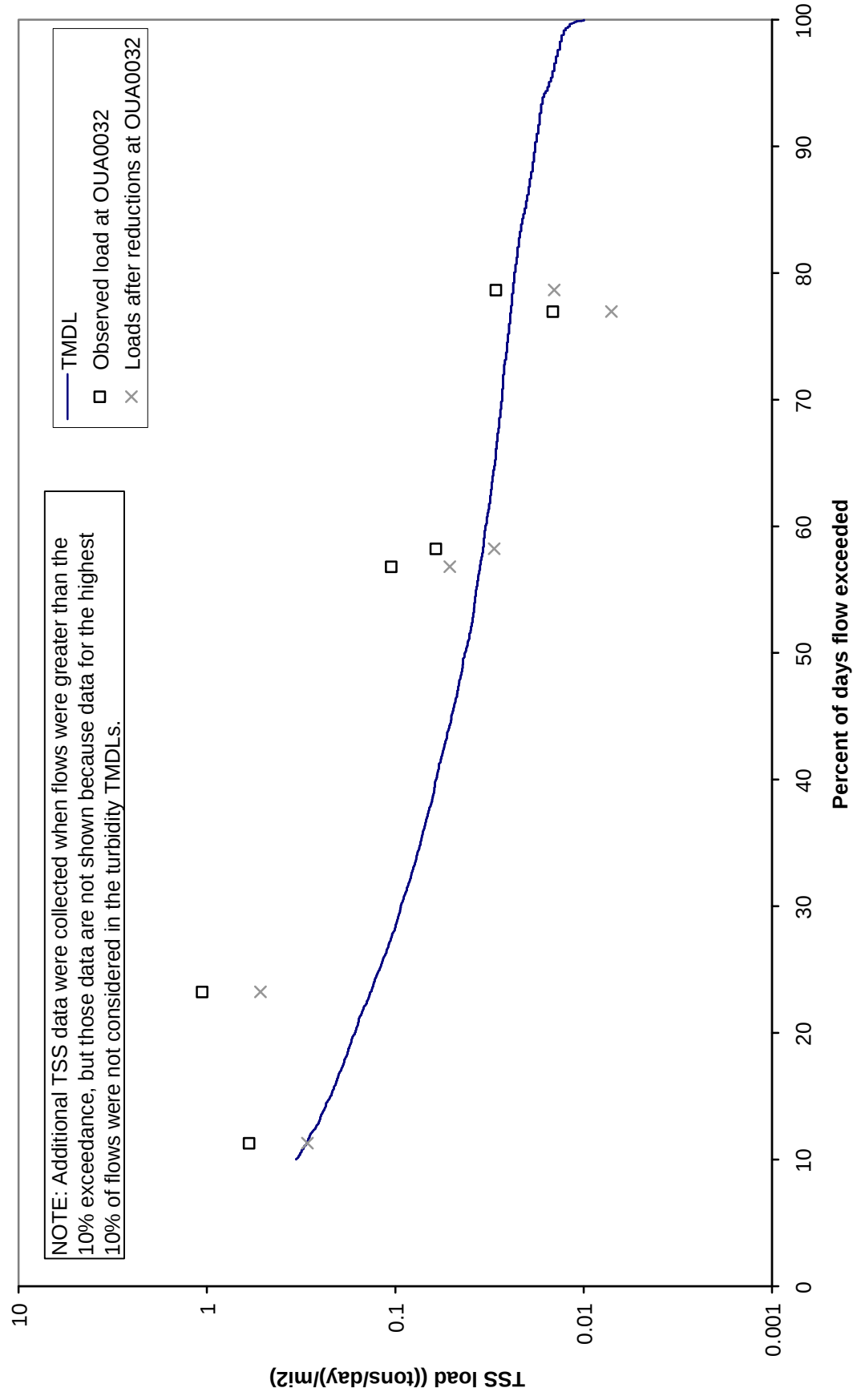


Figure I.5. Winter TSS Load Duration Curve for Big Bayou at UWGB01

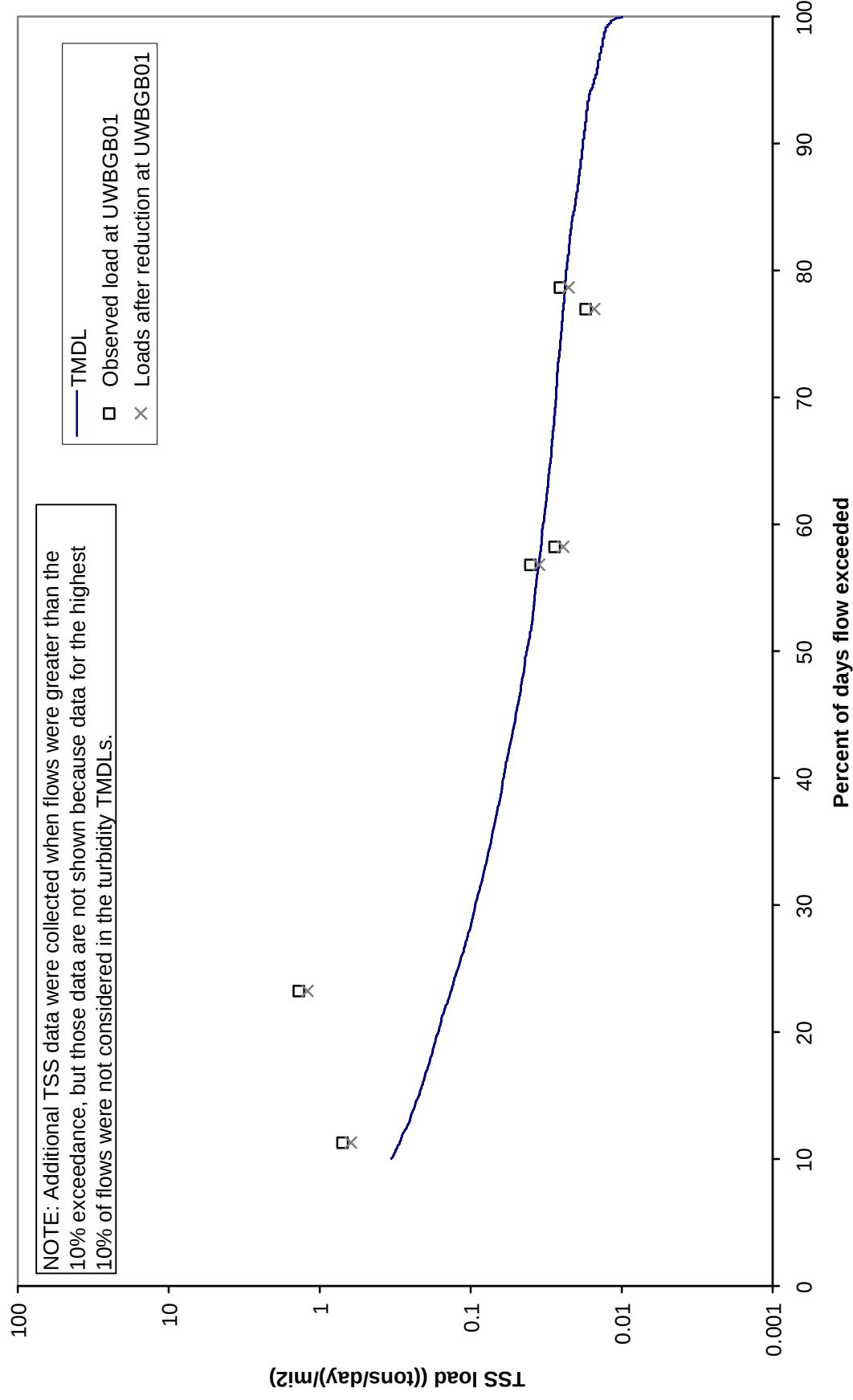


Figure I.6. Winter TSS Load Duration Curve for Oak Bayou at OUA0179

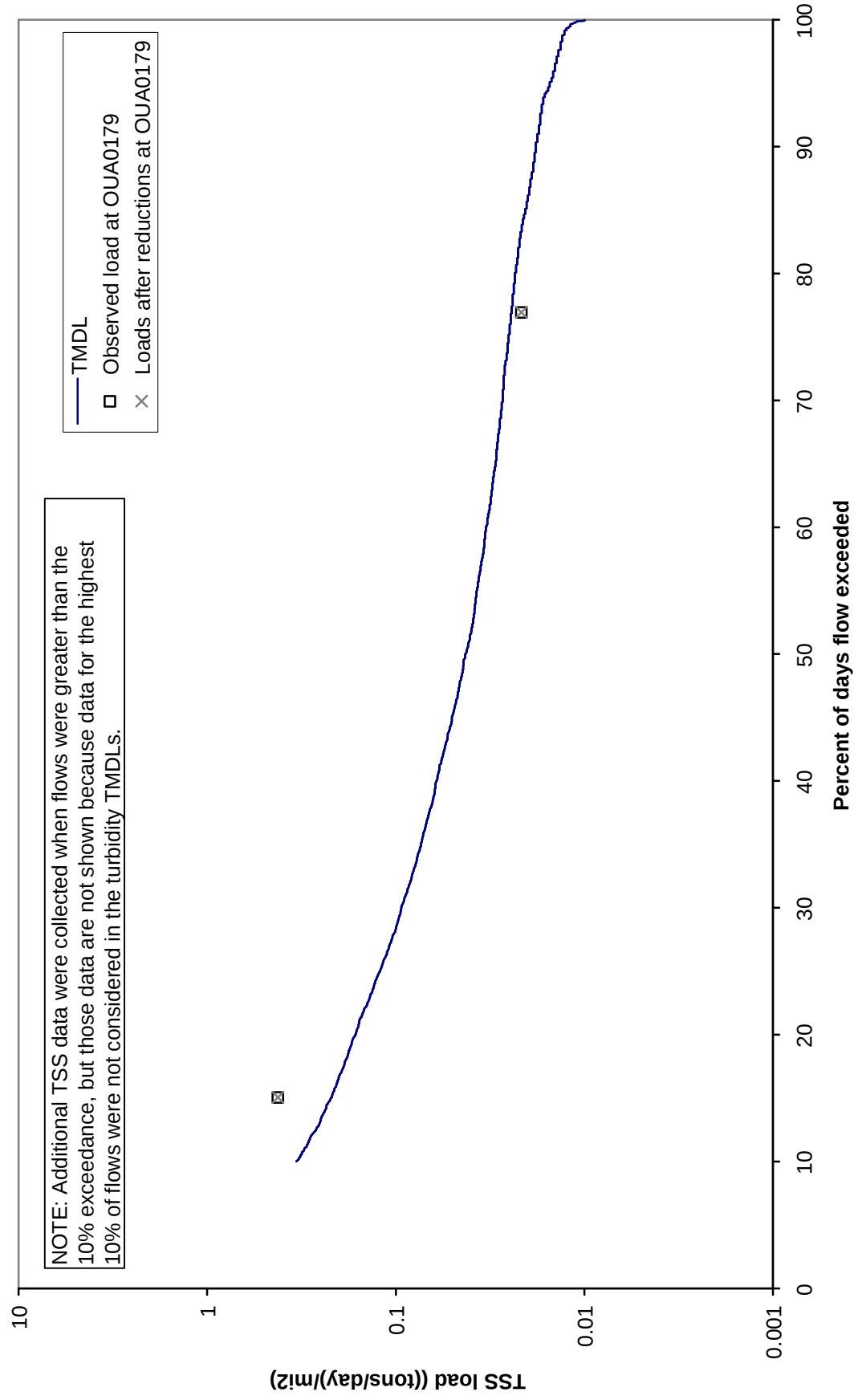


Figure I.7. Winter TSS Load Duration Curve for Bayou Macon at UWBMYM01

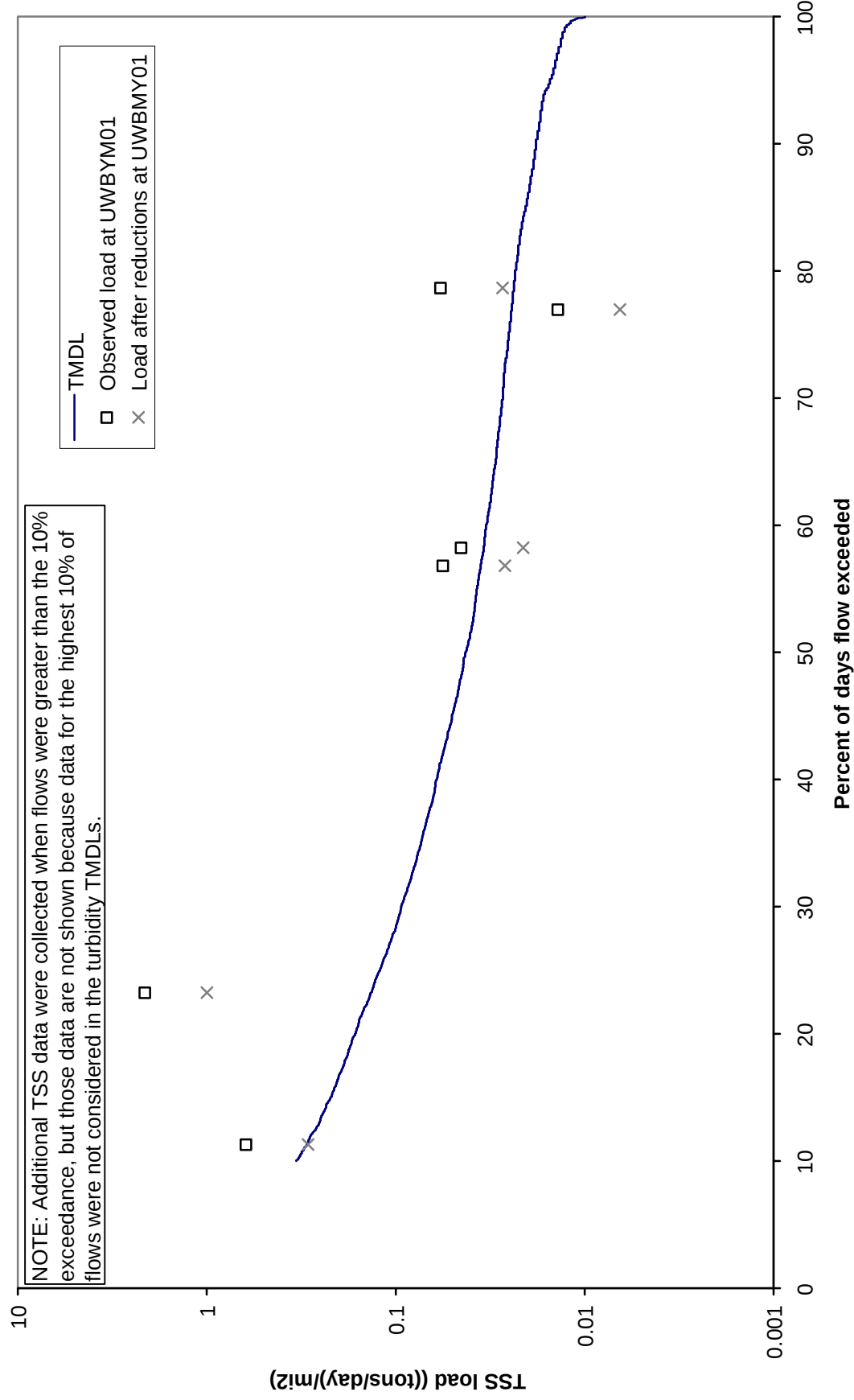
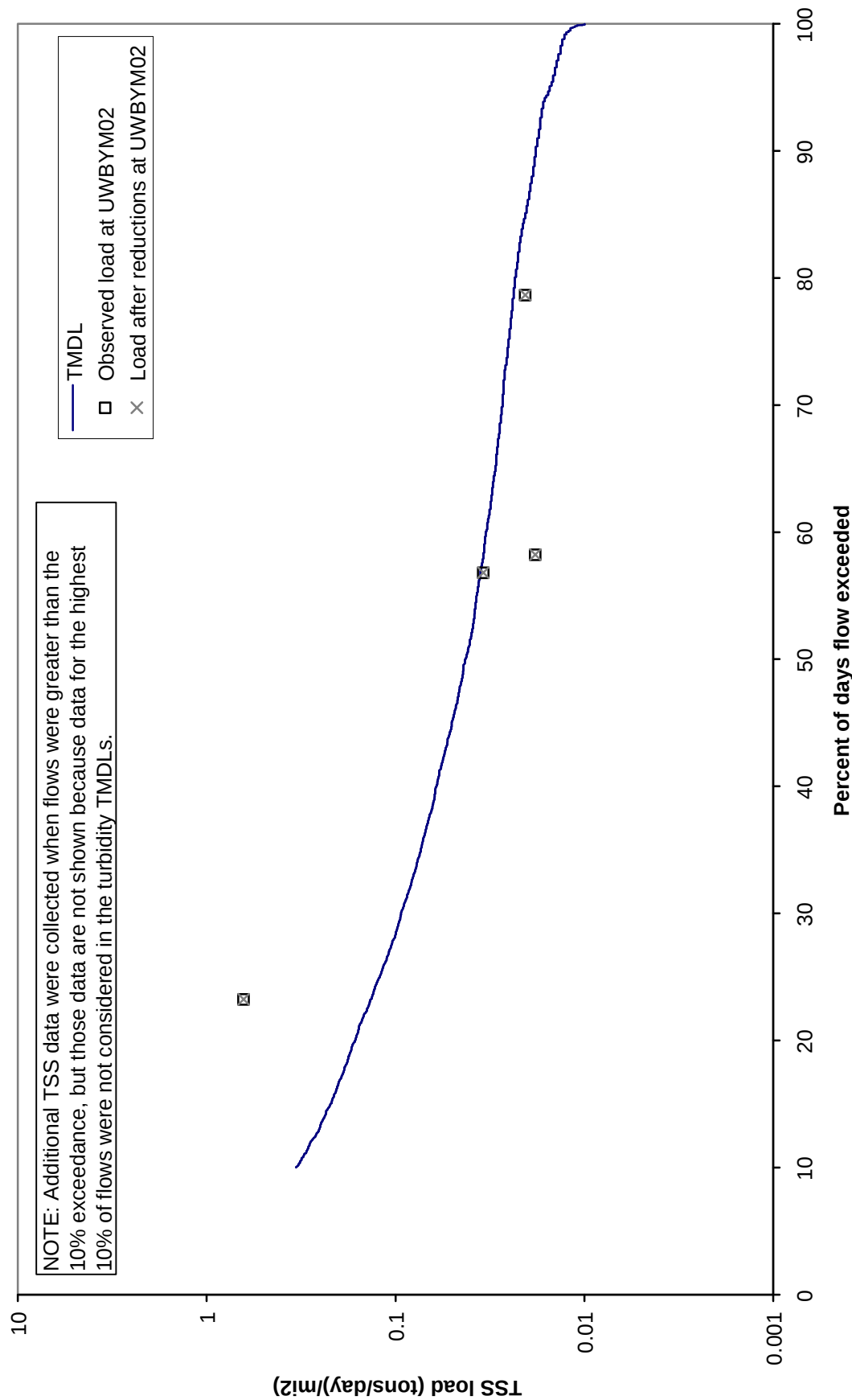


Figure I.8. Winter TSS Load Duration Curve for Bayou Macon at UWBYM02



APPENDIX J

Calculations for Summer Chloride TMDLs

TABLE J.1. CALCULATIONS FOR ALLOWABLE LOADS PER UNIT AREA FOR CHLORIDE DURING SUMMER

Percentage of total flow in basin represented by Bayou Macon:

USGS gage number and name		Avg. annual flow 1957-68 (cfs)	Drainage area (mi2)	Percent of combined flow
07367700	Boeuf River near AR/LA state line	875	785	65.2%
07369700	Bayou Macon near Kilbourne, LA	467	504	34.8%
		1,342	1,289	100.0%

Margin of Safety (MOS) = 10%

Observed flow at Eudora				Percent exceedance for observed flow				Boeuf River				Other Streams			
Season		Date		Observed flow (cfs)		Percent exceedance		Adjusted flow for entire basin		Chloride standard = 90 mg/L		Chloride standard = 48 mg/L			

For brevity, most of the rows in this spreadsheet have been hidden (between the 99.77% and the 0.23% exceedances).

SUMMER	05/03/91	3110	0.23%	8936.8	6.933	0.1963	0.1963	0.03%	1.68	1.51	5.24E-04	0.90	0.81	2.80E-04
SUMMER	05/06/91	3110	0.20%	8936.8	6.933	0.1963	0.1963	0.03%	1.68	1.51	5.24E-04	0.90	0.81	2.80E-04
SUMMER	05/02/91	3130	0.17%	8994.3	6.978	0.1976	0.1976	0.03%	1.69	1.52	5.28E-04	0.90	0.81	2.81E-04
SUMMER	05/04/91	3130	0.14%	8994.3	6.978	0.1976	0.1976	0.03%	1.69	1.52	5.28E-04	0.90	0.81	2.81E-04
SUMMER	05/05/91	3130	0.11%	8994.3	6.978	0.1976	0.1976	0.03%	1.69	1.52	5.28E-04	0.90	0.81	2.81E-04
SUMMER	05/01/91	3170	0.08%	9109.2	7.067	0.2001	0.2001	0.03%	1.72	1.54	5.34E-04	0.91	0.82	2.85E-04
SUMMER	05/31/98	3250	0.05%	9339.1	7.245	0.2051	0.2051	0.03%	1.76	1.58	5.48E-04	0.94	0.84	2.92E-04
SUMMER	05/30/98	3270	0.02%	9396.6	7.290	0.2064	0.2064	0.03%	1.77	1.59	5.51E-04	0.94	0.85	2.94E-04

TOTALS = 100.00%

9.00E-02

4.80E-02

FILE: R:\PROJECTS\2110-613\TECH\TMDL\TMDL CHLORIDES-SUMMER.XLS

TABLE J.2. CALCULATIONS FOR CHLORIDE LOADS AND PERCENT REDUCTION
FOR SUMMER FOR BOEUF RIVER AT OUA0015A (REACH 08050001-018)

WQ standard for chloride = 90 mg/L
Percent reduction needed = 43%

Error check for reduction is / is not needed: ok
Error check for less or more reduction needed: ok

Season	Date	Observed chloride at OUA0015A (mg/L)	Flow per unit area on sampling day (cms/mi ²)	Percent exceedance for flow on sampling day	Current chloride load (tons/day)/mi ²	Reduced chloride load (tons/day)/mi ²	Allowable chloride load with MOS incorporated (tons/day)/mi ²	Reduced load less than or equal to allow. load?
SUMMER	9/23/03	66.0	0.0084	27.1%	0.053	0.0301	0.0648	Yes
SUMMER	8/12/03	104.0	0.0056	53.6%	0.055	0.0314	0.0428	Yes
SUMMER	7/15/03	55.3	0.0064	42.2%	0.034	0.0193	0.0497	Yes
SUMMER	6/17/03	27.0	0.0304	5.0%	0.078	0.0445	0.2342	Yes
SUMMER	5/20/03	7.4	0.0063	43.3%	0.004	0.0025	0.0487	Yes
SUMMER	11/5/02	39.8	0.0434	3.3%	0.165	0.0938	0.3350	Yes
SUMMER	10/15/02	14.8	0.0055	54.3%	0.008	0.0044	0.0424	Yes
SUMMER	9/17/02	100.0	0.0040	77.6%	0.038	0.0216	0.0307	Yes
SUMMER	8/20/02	66.6	0.0050	60.6%	0.032	0.0180	0.0385	Yes
SUMMER	6/25/02	160.0	0.0041	75.2%	0.063	0.0356	0.0316	No
SUMMER	5/28/02	15.4	0.0064	42.3%	0.009	0.0054	0.0497	Yes
SUMMER	11/19/01	92.3	0.0038	81.7%	0.033	0.0190	0.0292	Yes
SUMMER	10/23/01	22.5	0.0028	96.9%	0.006	0.0035	0.0219	Yes
SUMMER	9/17/01	44.2	0.0048	63.7%	0.020	0.0115	0.0370	Yes
SUMMER	8/20/01	82.7	0.0073	32.8%	0.058	0.0329	0.0565	Yes
SUMMER	7/24/01	139.0	0.0045	68.3%	0.060	0.0343	0.0351	Yes
SUMMER	6/19/01	75.4	0.0044	70.8%	0.032	0.0181	0.0341	Yes
SUMMER	5/22/01	57.7	0.0138	14.4%	0.076	0.0433	0.1066	Yes
SUMMER	11/7/00	33.9	0.0058	50.9%	0.019	0.0107	0.0448	Yes
SUMMER	10/17/00	118.9	0.0039	80.4%	0.044	0.0249	0.0297	Yes
SUMMER	9/19/00	136.0	0.0042	73.6%	0.055	0.0312	0.0326	Yes
SUMMER	7/25/00	162.4	0.0054	55.2%	0.084	0.0478	0.0419	No
SUMMER	6/27/00	49.5	0.0049	62.4%	0.023	0.0131	0.0375	Yes
SUMMER	5/30/00	42.9	0.0050	59.9%	0.021	0.0118	0.0390	Yes
SUMMER	11/22/99	141.3	0.0030	95.0%	0.041	0.0232	0.0234	Yes
SUMMER	10/19/99	102.0	0.0038	82.1%	0.037	0.0210	0.0292	Yes

<u>Season</u>	<u>Date</u>	Observed chloride at OUA0015A (mg/L)	Flow per unit area on sampling day (cms/mi ²)	Percent exceedance for flow on sampling day	Current chloride load (tons/day)/mi ²	Reduced chloride load (tons/day)/mi ²	Allowable chloride load with MOS incorporated (tons/day)/mi ²	Reduced load less than or equal to allow. load?
SUMMER	9/21/99	82.8	0.0049	61.5%	0.039	0.0221	0.0380	Yes
SUMMER	8/17/99	112.0	0.0083	27.5%	0.089	0.0507	0.0643	Yes
SUMMER	7/27/99	131.0	0.0210	8.7%	0.262	0.1495	0.1621	Yes
SUMMER	6/29/99	60.4	0.0145	13.9%	0.083	0.0474	0.1115	Yes
SUMMER	5/25/99	51.9	0.0052	57.4%	0.026	0.0148	0.0404	Yes
SUMMER	11/16/98	123.0	0.0158	12.4%	0.185	0.1054	0.1217	Yes
SUMMER	9/29/98	162.9	0.0151	12.9%	0.235	0.1340	0.1169	No
SUMMER	9/1/98	101.0	0.0070	35.7%	0.067	0.0384	0.0540	Yes
SUMMER	8/11/98	101.0	0.0080	28.8%	0.076	0.0436	0.0614	Yes
SUMMER	7/22/98	58.3	0.0104	19.6%	0.058	0.0330	0.0803	Yes
SUMMER	6/9/98	32.7	0.0090	24.3%	0.028	0.0159	0.0691	Yes
SUMMER	5/19/98	111.0	0.0044	72.3%	0.046	0.0262	0.0336	Yes
SUMMER	10/28/97	29.0	0.0042	73.8%	0.012	0.0067	0.0326	Yes
SUMMER	9/30/97	120.3	0.0034	89.2%	0.039	0.0223	0.0263	Yes
SUMMER	8/26/97	81.4	0.0052	58.6%	0.040	0.0229	0.0399	Yes
SUMMER	7/22/97	79.2	0.0045	68.6%	0.034	0.0195	0.0351	Yes
SUMMER	5/13/97	14.1	0.0090	23.7%	0.012	0.0069	0.0696	Yes
SUMMER	11/19/96	31.1	0.0038	82.8%	0.011	0.0064	0.0292	Yes
SUMMER	10/1/96	18.1	0.0058	51.0%	0.010	0.0057	0.0448	Yes
SUMMER	9/10/96	85.6	0.0048	64.1%	0.039	0.0223	0.0370	Yes
SUMMER	8/6/96	49.8	0.0074	32.5%	0.035	0.0200	0.0570	Yes
SUMMER	7/16/96	165.0	0.0068	38.0%	0.107	0.0611	0.0526	No
SUMMER	6/18/96	142.0	0.0049	61.7%	0.067	0.0380	0.0380	Yes
SUMMER	5/21/96	62.6	0.0053	56.8%	0.032	0.0180	0.0409	Yes
SUMMER	10/17/95	140.0	0.0032	93.3%	0.043	0.0245	0.0248	Yes
SUMMER	9/19/95	183.0	0.0033	91.0%	0.058	0.0332	0.0258	No
SUMMER	8/8/95	145.0	0.0085	26.9%	0.117	0.0666	0.0652	No
SUMMER	7/17/95	44.4	0.0068	38.1%	0.029	0.0164	0.0526	Yes
SUMMER	6/20/95	106.0	0.0061	47.4%	0.061	0.0349	0.0467	Yes
SUMMER	5/23/95	63.2	0.0033	92.4%	0.020	0.0113	0.0253	Yes
SUMMER	11/28/94	50.8	0.0241	6.2%	0.117	0.0665	0.1860	Yes
SUMMER	9/27/94	102.0	0.0090	24.1%	0.088	0.0500	0.0696	Yes

<u>Season</u>	<u>Date</u>	Observed chloride at OUA0015A (mg/L)	Flow per unit area on sampling day (cms/mi ²)	Percent exceedance for flow on sampling day	Current chloride load (tons/day)/mi ²	Reduced chloride load (tons/day)/mi ²	Allowable chloride load with MOS incorporated (tons/day)/mi ²	Reduced load less than or equal to allow. load?
SUMMER	8/16/94	90.8	0.0242	6.2%	0.209	0.1192	0.1865	Yes
SUMMER	7/19/94	37.0	0.0802	1.6%	0.282	0.1610	0.6184	Yes
SUMMER	6/28/94	120.0	0.0191	9.9%	0.219	0.1246	0.1475	Yes
SUMMER	5/24/94	40.1	0.0083	27.6%	0.032	0.0180	0.0638	Yes
SUMMER	11/23/93	19.8	0.0175	11.1%	0.033	0.0188	0.1349	Yes
SUMMER	10/26/93	79.7	0.0025	98.4%	0.019	0.0109	0.0195	Yes
SUMMER	9/21/93	172.0	0.0040	77.1%	0.066	0.0377	0.0312	No
SUMMER	7/26/93	96.9	0.0086	26.3%	0.079	0.0452	0.0662	Yes
SUMMER	6/21/93	83.7	0.0323	4.6%	0.257	0.1466	0.2488	Yes
SUMMER	5/18/93	30.6	0.0052	58.8%	0.015	0.0086	0.0399	Yes
SUMMER	9/29/92	98.4	0.0035	88.7%	0.033	0.0185	0.0268	Yes
SUMMER	9/1/92	97.2	0.0076	30.9%	0.071	0.0403	0.0589	Yes
SUMMER	8/4/92	49.6	0.0081	28.3%	0.038	0.0219	0.0628	Yes
SUMMER	7/7/92	71.6	0.0062	45.2%	0.043	0.0243	0.0482	Yes
SUMMER	6/2/92	95.5	0.0062	46.0%	0.056	0.0321	0.0477	Yes
SUMMER	5/5/92	44.1	0.0033	91.5%	0.014	0.0080	0.0258	Yes
SUMMER	11/25/91	20.7	0.0053	57.0%	0.010	0.0060	0.0409	Yes
SUMMER	8/6/91	93.9	0.0066	40.9%	0.059	0.0338	0.0511	Yes
SUMMER	7/2/91	59.3	0.0193	9.7%	0.109	0.0622	0.1490	Yes
SUMMER	11/27/90	34.3	0.0039	81.1%	0.013	0.0072	0.0297	Yes
SUMMER	10/30/90	36.2	0.0036	86.0%	0.012	0.0071	0.0278	Yes
SUMMER	10/2/90	72.7	0.0033	92.6%	0.023	0.0130	0.0253	Yes
SUMMER	9/4/90	134.0	0.0063	44.2%	0.081	0.0459	0.0487	Yes
SUMMER	8/7/90	105.0	0.0057	51.9%	0.057	0.0327	0.0443	Yes
SUMMER	6/5/90	11.1	0.0208	8.8%	0.022	0.0126	0.1607	Yes
SUMMER	5/1/90	14.8	0.0062	45.3%	0.009	0.0050	0.0482	Yes
TOTALS =			0.7741		5.171			
				Total number of values =		84		
				Allowable % of exceedances =		10%		
				Allowable no. of exceedances =		9		
				No. of exceedances before reductions =		35		
				No. of exceedances after reductions =		7		

Flow weighted average chloride (mg/L) = (5.171 / 0.7741) / conversion = 70 mg/L

Average flow per unit area for summer =	0.0105 cms/mi2
Estimated drainage area for reach 18 =	180 mi2
Average flow for summer for reach 18 = $0.0105 * 180 =$	1.887 cms
Existing total chloride load for summer for reach 18 = $70 \text{ mg/L} * 1.887 \text{ cms} * \text{conversions} =$	12.58 tons/day
Sum of design flows for point sources for reach 18 =	0.000 cms
Assumed effluent chloride concentration for point sources =	60 mg/L
Existing point source chloride load for summer for reach 18 = = $0.000 \text{ cms} * 60 \text{ mg/L} * \text{conversions} =$	0.00 tons/day
Existing NPS chloride load for summer for reach 18 = $12.58 - 0.00 =$	12.58 tons/day
Total allowable loading per unit area to meet stds (from Table J.1) =	9.00E-02 tons/day/mi2
Total allowable loading for reach 18 = $9.00\text{E-}2 * 180 \text{ mi2} =$	16.17 tons/day
Explicit MOS for chloride for summer for reach 18 ($10\% * 16.17$) =	1.62 tons/day
WLA for chloride for summer for reach 18 (same as existing load) =	0.00 tons/day
LA for chloride for summer for reach 18 = total - MOS - WLA =	14.55 tons/day

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Assumed effluent chloride concentration for point sources =	60 mg/L
Existing point source chloride load for summer for reach 19 = = 0.004 cms * 60 mg/L * conversions =	0.0227 tons/day
Existing NPS chloride load for summer for reach 19 = 12.53 - 0.02 =	12.51 tons/day
Total allowable loading per unit area to meet stds (from Table J.1) =	9.00E-02 tons/day/mi ²
Total allowable loading for reach 19 = 9.00E-2 * 176 mi ² =	15.88 tons/day
Explicit MOS for chloride for summer for reach 19 (10% * 15.88) =	1.59 tons/day
WLA for chloride for summer for reach 19 (same as existing load) =	0.02 tons/day
Point source future growth: Assumed increase in design flow = 50% = Effluent conc. in excess of standard = MAX (0, 60 - 90) = Future growth explicit load = 0.002 * 0 * conversions =	0.002 cms 0 mg/L 0 tons/day
LA for chloride for summer for reach 19 = total - MOS - WLA - FG =	14.27 tons/day

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TABLE J.4. CALCULATIONS FOR CHLORIDE LOADS AND PERCENT REDUCTION
FOR SUMMER FOR BIG BAYOU AT OUA0032 (REACH 08050001-022)

WQ standard for chloride = 48 mg/L		Error check for reduction is / is not needed:		ok				
Percent reduction needed = 56%		Error check for less or more reduction needed:		ok				
Season	Date	Observed chloride at OUA0032 (mg/L)	Flow per unit area on sampling day (cms/mi2)	Percent exceedance for flow on sampling day	Current chloride load (tons/day)/mi2	Reduced chloride load (tons/day)/mi2	Allowable chloride load with MOS incorporated (tons/day)/mi2	Reduced load less than or equal to allow. load?
SUMMER	9/10/01	33.7	0.0073	32.8%	0.023	0.0103	0.0301	Yes
SUMMER	7/17/01	96.4	0.0044	70.8%	0.041	0.0178	0.0182	Yes
SUMMER	5/14/01	40.0	0.0049	61.4%	0.019	0.0083	0.0203	Yes
SUMMER	11/6/00	69.4	0.0052	57.3%	0.035	0.0152	0.0216	Yes
SUMMER	10/1/96	35.2	0.0058	51.0%	0.019	0.0086	0.0239	Yes
SUMMER	5/7/96	33.8	0.0048	64.2%	0.015	0.0068	0.0197	Yes
SUMMER	10/3/95	116.5	0.0032	94.0%	0.035	0.0154	0.0130	No
SUMMER	7/18/95	73.1	0.0069	36.7%	0.048	0.0213	0.0286	Yes
SUMMER	9/12/94	49.0	0.0092	22.8%	0.043	0.0189	0.0379	Yes
SUMMER	6/6/94	51.7	0.0097	21.5%	0.048	0.0211	0.0400	Yes
TOTALS =		0.0615		0.327		Total number of values = 10		
						Allowable % of exceedances = 10%		
						Allowable no. of exceedances = 1		
						No. of exceedances before reductions = 6		
						No. of exceedances after reductions = 1		
Flow weighted average chloride (mg/L) = (0.327 / 0.0615) / conversion = 56 mg/L								
Average flow per unit area for summer = 0.0105 cms/mi2								
Estimated drainage area for reach 22 = 189 mi2								
Average flow for summer for reach 22 = 0.0105 * 189 = 1.984 cms								
Existing total chloride load for summer for reach 22 = 10.58 tons/day								
= 56 mg/L * 1.984 cms * conversions = 0.083 cms								
Sum of design flows for point sources for reach 22 =								

Assumed effluent chloride concentration for point sources =	60 mg/L
Existing point source chloride load for summer for reach 22 =	0.48 tons/day
= 0.083 cms * 60 mg/L * conversions =	
Existing NPS chloride load for summer for reach 22 = 10.58 - 0.48 =	10.10 tons/day
Total allowable loading per unit area to meet stds (from Table J.1) =	
Total allowable loading for reach 22 = 4.80E-2 * 189 mi ² =	4.80E-02 tons/day/mi ²
Explicit MOS for chloride for summer for reach 22 (10% * 9.07) =	9.07 tons/day
WLA for chloride for summer for reach 22 (same as existing load) =	0.91 tons/day
Point source future growth:	
Assumed increase in design flow = 50% =	0.042 cms
Effluent conc. in excess of standard = MAX (0, 60 - 48) =	12 mg/L
Future growth explicit load = 0.042 * 12 * conversions =	0.05 tons/day
LA for chloride for summer for reach 22 = total - MOS - WLA - FG =	7.63 tons/day

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TABLE J.5. CALCULATIONS FOR CHLORIDE LOADS AND PERCENT REDUCTION
FOR SUMMER FOR BIG BAYOU AT UWBGB01 (REACH 08050001-022)

WQ standard for chloride = 48 mg/L		Error check for reduction is / is not needed:		ok				
Percent reduction needed = 80%		Error check for less or more reduction needed:		ok				
<u>Season</u>	<u>Date</u>	Observed chloride at UWBGB01 (mg/L)	Flow per unit area on sampling day (cms/mi2)	Percent exceedance for flow on sampling day	Current chloride load (tons/day)/mi2	Reduced chloride load (tons/day)/mi2	Allowable chloride load with MOS incorporated (tons/day)/mi2	Reduced load less than or equal to allow. load?
SUMMER	9/10/01	28.6	0.0073	32.8%	0.020	0.0040	0.0301	Yes
SUMMER	7/17/01	87.0	0.0044	70.8%	0.037	0.0073	0.0182	Yes
SUMMER	5/14/01	230.9	0.0049	61.4%	0.108	0.0217	0.0203	No
SUMMER	11/6/00	136.3	0.0052	57.3%	0.068	0.0136	0.0216	Yes
SUMMER	10/1/96	14.2	0.0058	51.0%	0.008	0.0016	0.0239	Yes
SUMMER	5/7/96	49.3	0.0048	64.2%	0.023	0.0045	0.0197	Yes
SUMMER	10/3/95	211.0	0.0032	94.0%	0.063	0.0127	0.0130	Yes
SUMMER	7/18/95	129.1	0.0069	36.7%	0.085	0.0171	0.0286	Yes
SUMMER	9/12/94	95.0	0.0092	22.8%	0.083	0.0167	0.0379	Yes
SUMMER	6/6/94	77.0	0.0097	21.5%	0.071	0.0143	0.0400	Yes
TOTALS =		0.0615		0.567		Total number of values = 10		
Flow weighted average chloride (mg/L) = (0.567 / 0.0615) / conversion =		97 mg/L		Allowable % of exceedances = 10%		Allowable no. of exceedances = 1		
Average flow per unit area for summer =		0.0105 cms/mi2		No. of exceedances before reductions = 8		No. of exceedances after reductions = 1		
Estimated drainage area for reach 22 =		189 mi2						
Average flow for summer for reach 22 = 0.0105 * 189 =		1.984 cms						
Existing total chloride load for summer for reach 22		18.33 tons/day						
= 97 mg/L * 1.984 cms * conversions =		0.083 cms						
Sum of design flows for point sources for reach 22 =								

Assumed effluent chloride concentration for point sources =	60 mg/L
Existing point source chloride load for summer for reach 22 = = 0.083 cms * 60 mg/L * conversions =	0.48 tons/day
Existing NPS chloride load for summer for reach 22 = 18.33 - 0.48 =	17.85 tons/day
Total allowable loading per unit area to meet stds (from Table J.1) =	
Total allowable loading for reach 22 = 4.80E-2 * 189 mi ² =	4.80E-02 tons/day/mi ² 9.07 tons/day
Explicit MOS for chloride for summer for reach 22 (10% * 9.07) =	0.91 tons/day
WLA for chloride for summer for reach 22 (same as existing load) =	0.48 tons/day
Point source future growth:	
Assumed increase in design flow = 50% =	0.042 cms
Effluent conc. in excess of standard = MAX (0, 60 - 48) =	12 mg/L
Future growth explicit load = 0.042 * 12 * conversions =	0.05 tons/day
LA for chloride for summer for reach 22 = total - MOS - WLA - FG =	7.63 tons/day

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TABLE J.6. CALCULATIONS FOR CHLORIDE LOADS AND PERCENT REDUCTION
FOR SUMMER FOR OAK BAYOU AT OUA0179 (REACH 08050002-010)

WQ standard for chloride = 48 mg/L		Error check for reduction is / is not needed:		ok				
Percent reduction needed = 65%		Error check for less or more reduction needed:		ok				
<u>Season</u>	<u>Date</u>	Observed chloride at OUA0179 (mg/L)	Flow per unit area on sampling day (cms/mi2)	Percent exceedance for flow on sampling day	Current chloride load (tons/day)/mi2	Reduced chloride load (tons/day)/mi2	Allowable chloride load with MOS incorporated (tons/day)/mi2	Reduced load less than or equal to allow. load?
SUMMER	9/11/01	122.0	0.0071	34.8%	0.082	0.029	0.0291	Yes
SUMMER	7/16/01	90.4	0.0069	36.9%	0.059	0.021	0.0283	Yes
SUMMER	5/15/01	118.2	0.0049	61.3%	0.055	0.019	0.0203	Yes
SUMMER	11/7/00	126.4	0.0058	50.9%	0.070	0.024	0.0239	No
TOTALS =			0.0247		0.267	Total number of values = 4		
					Allowable % of exceedances = 10%			
					Allowable no. of exceedances = 1			
					No. of exceedances before reductions = 4			
					No. of exceedances after reductions = 1			
Flow weighted average chloride (mg/L) = (0.267 / 0.0247) / conversion = 113 mg/L								
Average flow per unit area for summer = 0.0105 cms/mi2								
Estimated drainage area for reach 10 = 136 mi2								
Average flow for summer for reach 10 = 0.0105 * 136 = 1.430 cms								
Existing total chloride load for summer for reach 10 = 15.39 tons/day								
Sum of design flows for point sources for reach 10 = 0.000 cms								
Assumed effluent chloride concentration for point sources = 60 mg/L								
Existing point source chloride load for summer for reach 10 = 0.00 tons/day								
Existing NPS chloride load for summer for reach 10 = 15.39 - 0.00 = 15.39 tons/day								

Total allowable loading per unit area to meet stds (from Table J.1) =	
Total allowable loading for reach 10 = $4.80\text{E-}2 * 136 \text{ mi}^2 =$	4.80E-02 tons/day/mi2 6.54 tons/day
Explicit MOS for chloride for summer for reach 10 ($10\% * 6.54$) =	0.65 tons/day
WLA for chloride for summer for reach 10 (same as existing load) =	0.00 tons/day
LA for chloride for summer for reach 10 = total - MOS - WLA =	5.89 tons/day

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Figure J.1. Summer Flow Duration Curve for USGS 07369680 Bayou Macon near Eudora

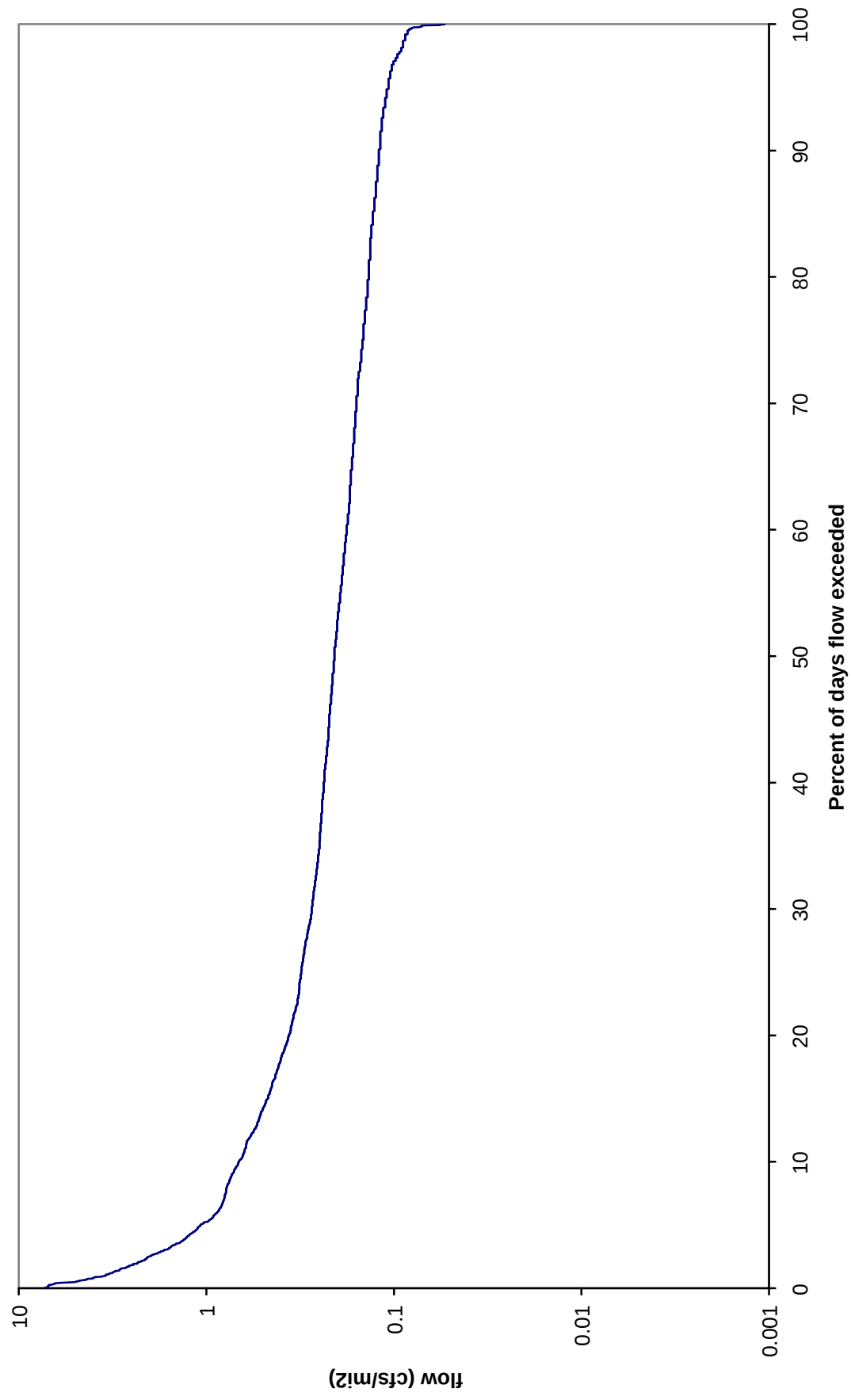


Figure J.2. Summer Chloride Load Duration Curve for Boeuf River at OUA0015A

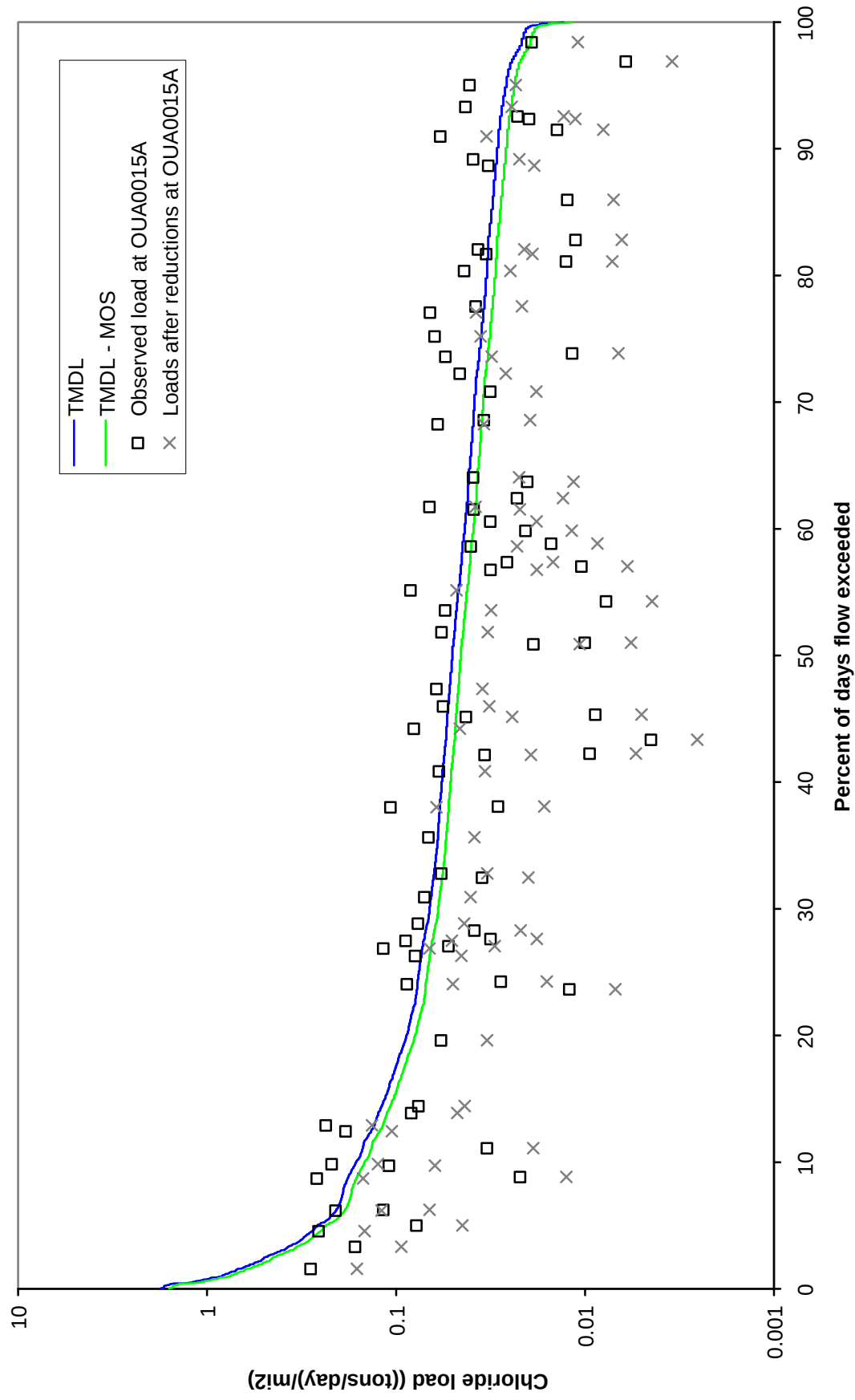


Figure J.3. Summer Chloride Load Duration Curve for Boeuf River at UWBFR01

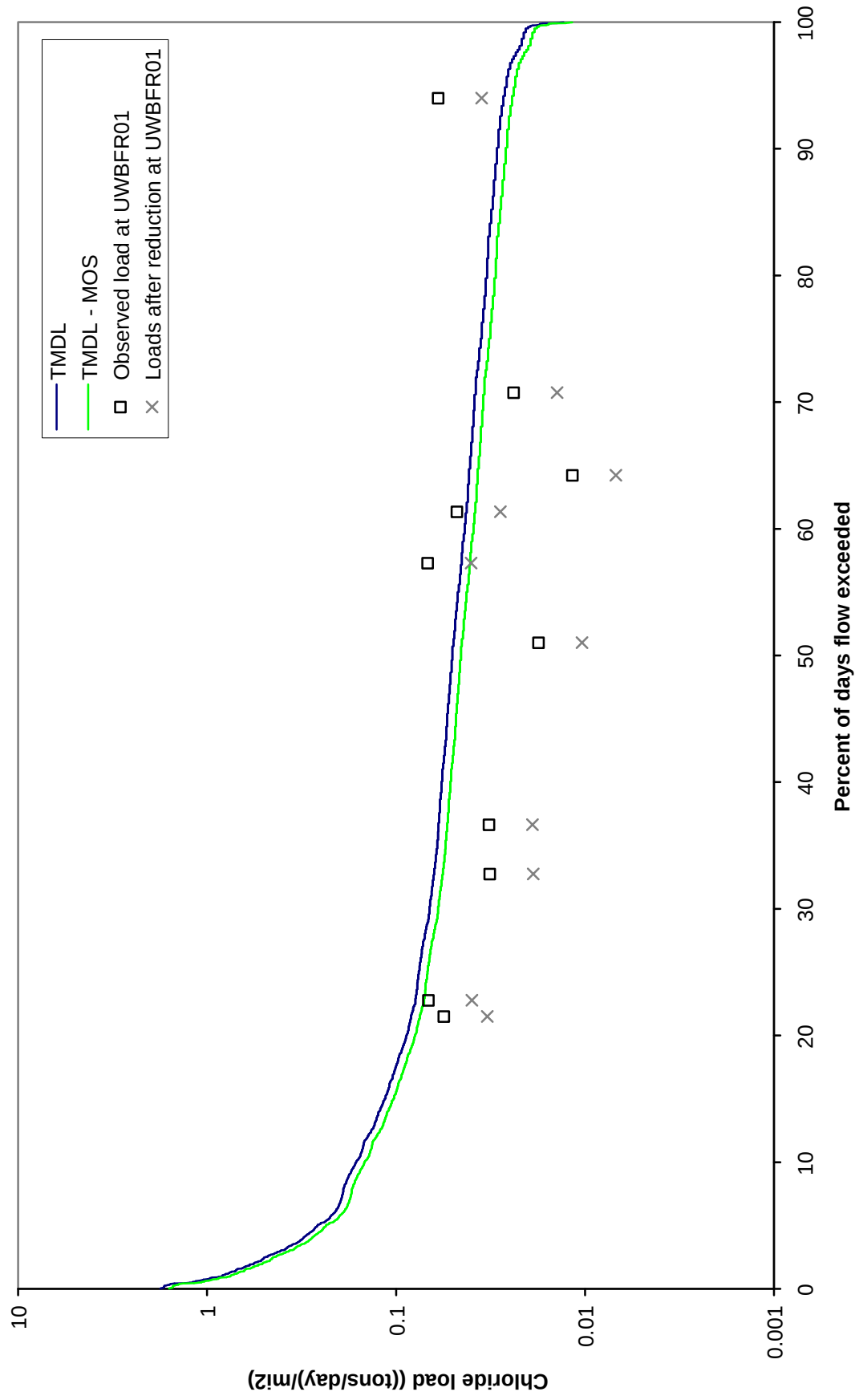


Figure J.4. Summer Chloride Load Duration Curve for Big Bayou at OUA0032

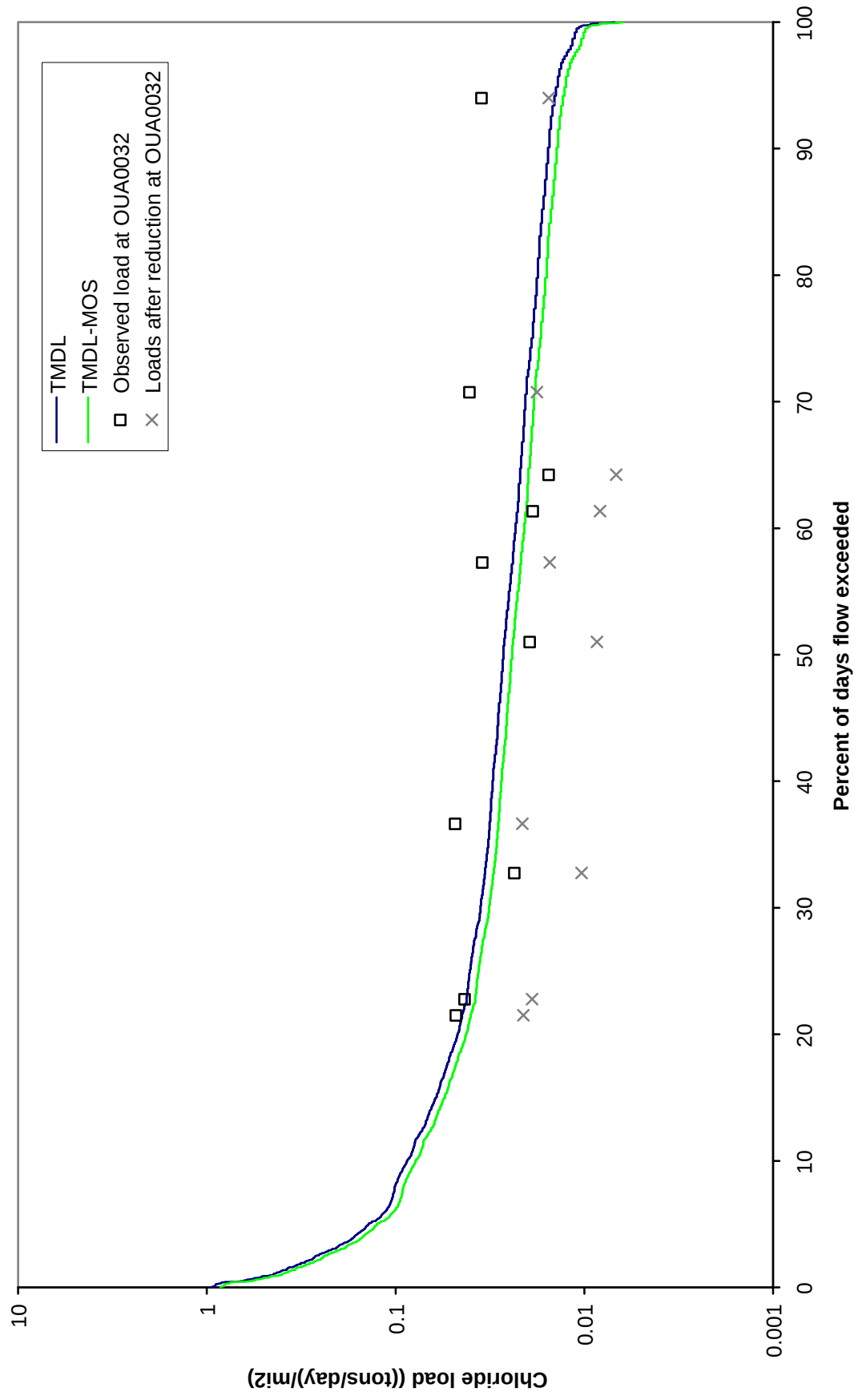


Figure J.5. Summer Chloride Load Duration Curve for Big Bayou at UWBGB01

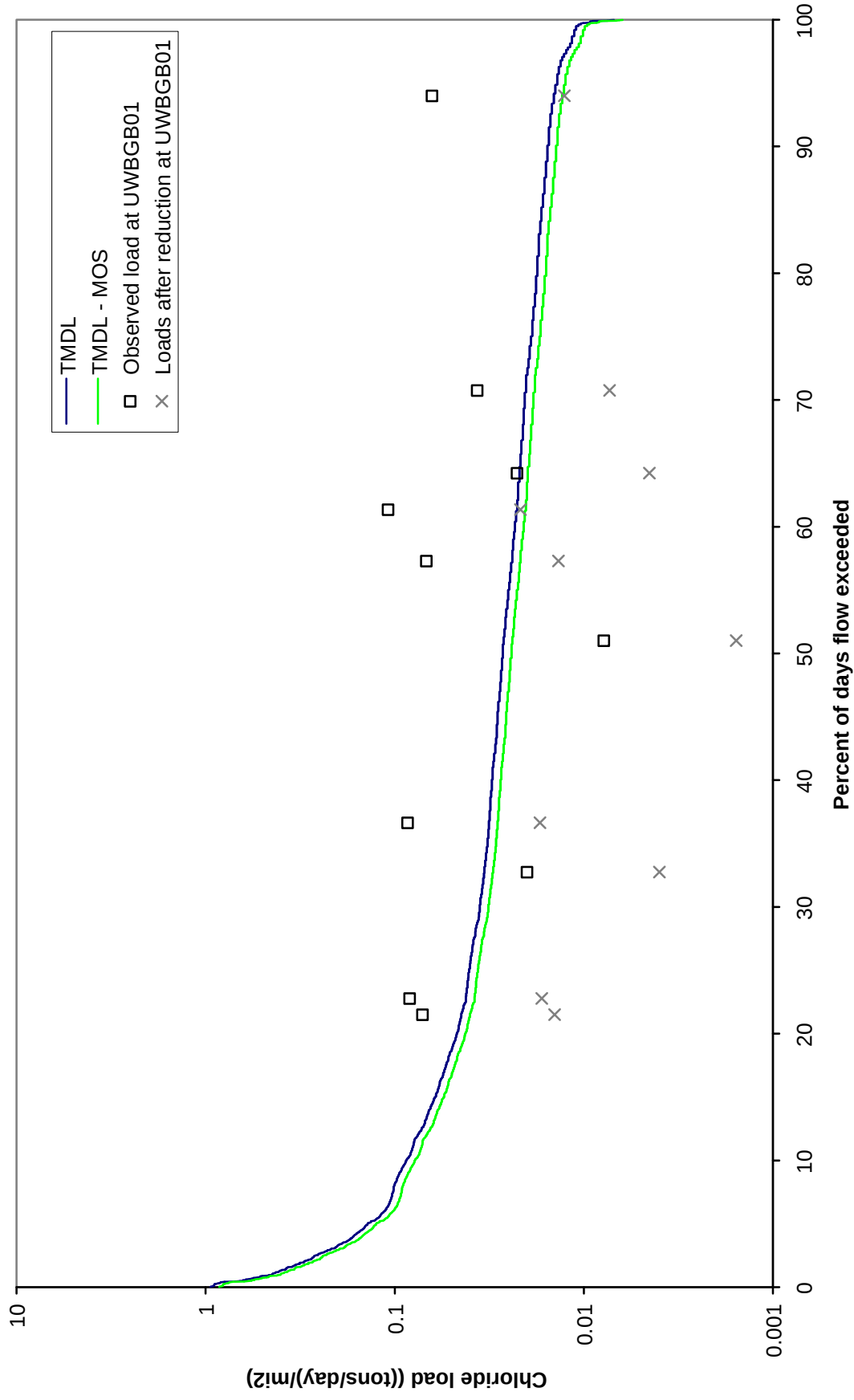
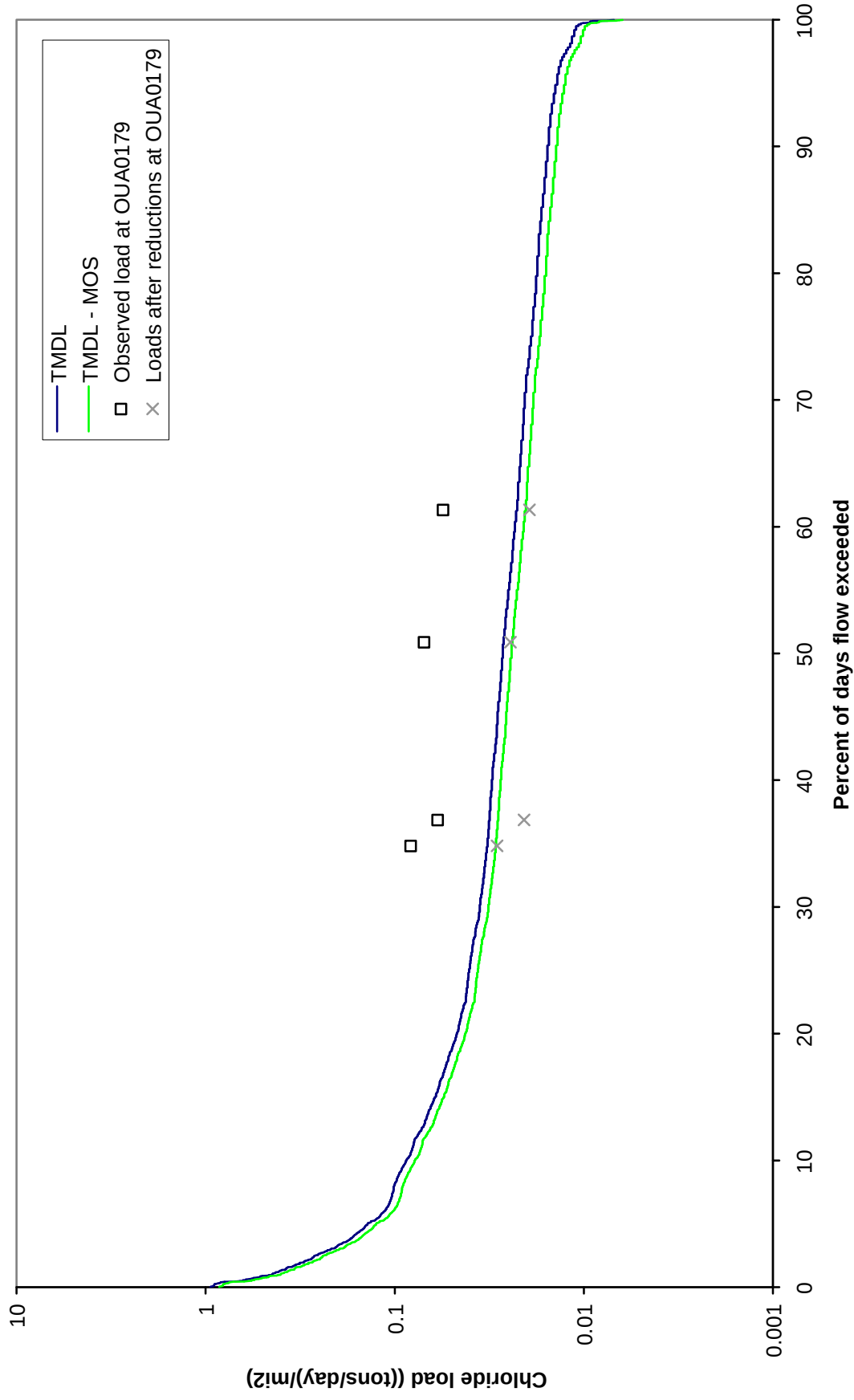


Figure J.6. Summer Chloride Load Duration Curve for Oak Bayou at OUA0179



APPENDIX K

Calculations for Winter Chloride TMDLs

TABLE K.1. CALCULATIONS FOR ALLOWABLE LOADS PER UNIT AREA FOR CHLORIDE DURING WINTER

Percentage of total flow in basin represented by Bayou Macon:

USGS gage number and name		Avg. annual flow 1958-67 (cfs)	Drainage area (mi2)	Percent of combined flow
07367700	Boeuf River near AR/LA state line	875	785	65.2%
07369700	Bayou Macon near Kilbourne, LA	467	504	34.8%
		1,342	1,289	100.0%

		Boeuf	Others
TMDL =	2.344052752	1.250161467 (gm/sec)/mi2	
Total allowable load =	0.223246884	0.119065005 (tons/day)/mi2	

Margin of Safety (MOS) = 10%

										Boeuf River				Other Streams			
										Chloride standard = 90 mg/L				Chloride standard = 48 mg/L			
Season	Date	Observed flow at Eudora (cfs)	Percent exceedance for observed flow	Adjusted flow for entire basin cfs	"Width" for area under curves	Allowable chloride load at this flow (tons/day)/mi2	Target chloride load at this flow (tons/day)/mi2	"Area under TMDL curve" (tons/day)/mi2	Allowable chloride load at this flow (tons/day)/mi2	Target chloride load at this flow (tons/day)/mi2	"Area under TMDL curve" (tons/day)/mi2	Allowable chloride load at this flow (tons/day)/mi2	Target chloride load at this flow (tons/day)/mi2	"Area under TMDL curve" (tons/day)/mi2	Allowable chloride load at this flow (tons/day)/mi2	Target chloride load at this flow (tons/day)/mi2	"Area under TMDL curve" (tons/day)/mi2
A	B	C	D	E = C / 34.8%	H = D1 - D2	F = E / 1289 mi2	G = E / 35.32		I = G * 90 mg/L	J = I * (1 - MOS)	K = H * I	L = G * 48 mg/L	J = I * (1 - MOS)	N = H * L			
WINTER	02/22/00	35	99.98%	100.6	0.04%	0.078	0.0022		0.02	0.02	8.35E-06	0.01	0.01	4.45E-06			
WINTER	02/23/00	35	99.93%	100.6	0.04%	0.078	0.0022		0.02	0.02	8.35E-06	0.01	0.01	4.45E-06			
WINTER	02/21/00	36	99.89%	103.4	0.04%	0.080	0.0023		0.02	0.02	8.59E-06	0.01	0.01	4.58E-06			
WINTER	02/20/00	37	99.85%	106.3	0.04%	0.082	0.0023		0.02	0.02	8.83E-06	0.01	0.01	4.71E-06			
WINTER	02/24/00	37	99.80%	106.3	0.04%	0.082	0.0023		0.02	0.02	8.83E-06	0.01	0.01	4.71E-06			
WINTER	03/05/00	38	99.76%	109.2	0.04%	0.085	0.0024		0.02	0.02	9.06E-06	0.01	0.01	4.83E-06			
WINTER	03/06/00	38	99.71%	109.2	0.04%	0.085	0.0024		0.02	0.02	9.06E-06	0.01	0.01	4.83E-06			
WINTER	03/07/00	38	99.67%	109.2	0.04%	0.085	0.0024		0.02	0.02	9.06E-06	0.01	0.01	4.83E-06			
For brevity, most of the rows in this spreadsheet have been hidden (between the 99.67% and the 0.33% exceedances).																	
WINTER	04/30/91	3200	0.33%	9195.4	0.04%	7.134	0.2020		1.73	1.56	7.63E-04	0.92	0.83	4.07E-04			
WINTER	04/26/95	3250	0.29%	9339.1	0.04%	7.245	0.2051		1.76	1.58	7.75E-04	0.94	0.84	4.13E-04			
WINTER	02/01/99	3310	0.24%	9511.5	0.04%	7.379	0.2089		1.79	1.61	7.90E-04	0.96	0.86	4.21E-04			
WINTER	01/30/99	3500	0.20%	10057.5	0.04%	7.803	0.2209		1.89	1.70	8.35E-04	1.01	0.91	4.45E-04			
WINTER	01/31/99	3560	0.15%	10229.9	0.04%	7.936	0.2247		1.93	1.73	8.49E-04	1.03	0.92	4.53E-04			
WINTER	04/25/95	3790	0.11%	10890.8	0.04%	8.449	0.2392		2.05	1.85	9.04E-04	1.09	0.98	4.82E-04			
WINTER	04/24/95	4150	0.07%	11925.3	0.04%	9.252	0.2619		2.25	2.02	9.90E-04	1.20	1.08	5.28E-04			
WINTER	04/23/95	4170	0.02%	11982.8	0.04%	9.296	0.2632		2.26	2.03	9.95E-04	1.20	1.08	5.31E-04			
										TOTALS =				1.19E-01			
										2.23E-01							

FILE: R:\PROJECTS\2110-613\TECH\TMDL\TMDL CHLORIDES-WINTER.XLS

TABLE K.2. CALCULATIONS FOR CHLORIDE LOADS AND PERCENT REDUCTION FOR
WINTER FOR BOEUF RIVER AT OUA0015A (REACH 08050001-018)

WQ standard for chloride = 90 mg/L
Percent reduction needed = 0%

Error check for reduction is / is not needed:
Error check for less or more reduction needed:

Season	Date	Observed chloride at OUA0015A (mg/L)	Flow per unit area on sampling day (cms/mi ²)	Percent exceedance for flow on sampling day	load (gm/s/load (tons/ unit area	Observed chloride times flow per unit area	Current chloride load (tons/day)/mi ²	Reduced chloride load (tons/day)/mi ²
WINTER	4/15/03	18.2	0.00379	88.4%	0.07	0.006564	0.007	0.0066
WINTER	3/25/03	19.6	0.00417	85.3%	0.08	0.007776	0.008	0.0078
WINTER	2/25/03	6.1	0.05782	13.1%	0.35	0.033423	0.033	0.0334
WINTER	1/21/03	38.0	0.00290	96.1%	0.11	0.010508	0.011	0.0105
WINTER	12/3/02	45.3	0.00259	99.0%	0.12	0.011165	0.011	0.0112
WINTER	4/23/02	32.1	0.00568	69.9%	0.18	0.01735	0.017	0.0174
WINTER	3/26/02	12.6	0.01995	31.6%	0.25	0.023916	0.024	0.0239
WINTER	2/26/02	19.7	0.00846	52.6%	0.17	0.015861	0.016	0.0159
WINTER	1/14/02	26.6	0.00669	62.3%	0.18	0.016962	0.017	0.0170
WINTER	12/11/01	27.5	0.05302	14.0%	1.46	0.138861	0.139	0.1389
WINTER	4/17/01	11.0	0.01445	38.6%	0.16	0.015074	0.015	0.0151
WINTER	3/26/01	38.5	0.00644	63.7%	0.25	0.023582	0.024	0.0236
WINTER	2/27/01	13.7	0.04873	15.4%	0.67	0.063671	0.064	0.0637
WINTER	1/30/01	49.4	0.01856	33.4%	0.92	0.087252	0.087	0.0873
WINTER	12/19/00	17.7	0.01767	34.3%	0.31	0.029792	0.030	0.0298
WINTER	4/24/00	38.0	0.00473	80.1%	0.18	0.017132	0.017	0.0171
WINTER	3/27/00	23.0	0.01950	32.2%	0.45	0.042722	0.043	0.0427
WINTER	2/29/00	24.1	0.00290	96.2%	0.07	0.006664	0.007	0.0067
WINTER	1/25/00	6.3	0.00259	99.2%	0.02	0.00154	0.002	0.0015
WINTER	12/20/99	33.5	0.00328	93.7%	0.11	0.010472	0.010	0.0105
WINTER	4/27/99	4.5	0.00524	75.0%	0.02	0.00222	0.002	0.0022
WINTER	3/23/99	12.7	0.00568	70.1%	0.07	0.006871	0.007	0.0069
WINTER	2/23/99	44.1	0.00536	74.0%	0.24	0.022533	0.023	0.0225
WINTER	1/26/99	14.1	0.05049	14.8%	0.71	0.067807	0.068	0.0678

<u>Season</u>	<u>Date</u>	Observed chloride at OUA0015A (mg/L)	Flow per unit area on sampling day (cms/mi2)	Percent exceedance for flow on sampling day	load (gm/s) load (tons/c	Observed chloride times flow per unit area	Current chloride load (tons/day)/mi2	Reduced chloride load (tons/day)/mi2
WINTER	12/22/98	32.0	0.03168	23.3%	1.01	0.096565	1.014	0.0966
WINTER	4/14/98	45.1	0.00379	88.6%	0.17	0.016256	0.171	0.0163
WINTER	3/17/98	30.7	0.02714	25.9%	0.83	0.079252	0.832	0.0793
WINTER	2/17/98	6.0	0.06817	11.0%	0.41	0.038914	0.409	0.0389
WINTER	1/20/98	14.2	0.01666	35.5%	0.24	0.022467	0.236	0.0225
WINTER	4/15/97	11.9	0.00505	76.9%	0.06	0.005708	0.060	0.0057
WINTER	3/11/97	16.3	0.02651	26.4%	0.43	0.041277	0.433	0.0413
WINTER	2/25/97	8.2	0.02777	25.6%	0.23	0.021644	0.227	0.0216
WINTER	12/17/96	26.2	0.05725	13.3%	1.50	0.142641	1.498	0.1426
WINTER	4/23/96	6.1	0.12687	4.0%	0.78	0.073946	0.776	0.0739
WINTER	3/12/96	48.7	0.00271	98.3%	0.13	0.012599	0.132	0.0126
WINTER	2/20/96	27.4	0.00366	90.5%	0.10	0.009556	0.100	0.0096
WINTER	1/30/96	25.1	0.00511	76.3%	0.13	0.01224	0.129	0.0122
WINTER	12/18/95	69.9	0.02998	24.4%	2.10	0.199727	2.097	0.1997
WINTER	3/28/95	22.8	0.00555	71.5%	0.13	0.012052	0.127	0.0121
WINTER	2/14/95	34.2	0.00524	75.3%	0.18	0.017068	0.179	0.0171
WINTER	1/10/95	14.2	0.00934	50.1%	0.13	0.012633	0.133	0.0126
WINTER	12/19/94	12.3	0.01477	38.1%	0.18	0.017302	0.182	0.0173
WINTER	4/19/94	9.9	0.04828	15.4%	0.48	0.045434	0.477	0.0454
WINTER	3/15/94	10.6	0.01325	40.7%	0.14	0.013381	0.140	0.0134
WINTER	2/15/94	3.6	0.14517	2.8%	0.52	0.049773	0.523	0.0498
WINTER	4/13/93	6.0	0.02985	24.4%	0.18	0.017032	0.179	0.0170
WINTER	3/9/93	3.7	0.00549	72.2%	0.02	0.001951	0.020	0.0020
WINTER	2/9/93	22.5	0.00473	80.5%	0.11	0.010144	0.107	0.0101
WINTER	12/1/92	32.2	0.00372	90.0%	0.12	0.01142	0.120	0.0114
WINTER	4/7/92	5.3	0.00682	61.5%	0.04	0.003408	0.036	0.0034
WINTER	3/3/92	10.2	0.00480	79.8%	0.05	0.00466	0.049	0.0047
WINTER	2/4/92	16.5	0.00511	76.5%	0.08	0.008034	0.084	0.0080
WINTER	1/7/92	3.6	0.00543	73.5%	0.02	0.001846	0.019	0.0018
WINTER	4/2/91	13.7	0.00757	57.3%	0.10	0.009883	0.104	0.0099

Season	Date	Observed chloride at OUA0015A (mg/L)	Flow per unit area on sampling day (cms/mi2)	Percent exceedance for flow on sampling day	load (gm/s) load (tons/c	Observed chloride times flow per unit area	Current chloride load (tons/day)/mi2	Reduced chloride load (tons/day)/mi2
WINTER	3/12/91	2.4	0.02809	25.3%	0.07	0.006474	0.006	0.0065
WINTER	2/5/91	19.9	0.04065	18.6%	0.81	0.077038	0.077	0.0770
WINTER	1/2/91	11.1	0.07259	10.3%	0.81	0.076734	0.077	0.0767
WINTER	4/3/90	8.4	0.02695	26.2%	0.23	0.021561	0.022	0.0216
WINTER	3/6/90	9.2	0.01098	45.6%	0.10	0.009623	0.010	0.0096
WINTER	2/6/90	5.7	0.07006	10.8%	0.40	0.038033	0.038	0.0380
WINTER	1/2/90	16.3	0.04980	15.1%	0.81	0.077309	0.077	0.0773

TOTALS = 1.4173

#REF!

1.995
Total nu
Allowable % o
Allowable no. o
No. of exceedances bei
No. of exceedances a

Flow weighted average chloride (mg/L) = (1.995 / 1.4173) / conversion =

Average flow per unit area for winter =

Estimated drainage area for reach 18 =

Average flow for winter for reach 18 = 0.0260 * 180 =

Existing total chloride load for winter for reach 18

= 15 mg/L * 4.682 cms * conversions =

%

Sum of design flows for point sources for reach 18 =

Assumed effluent chloride concentration for point sources =

Existing point source chloride load for winter for reach 18 =

= 0.000 cms * 60 mg/L * conversions =

Existing NPS chloride load for winter for reach 18 = 6.69 - 0.00 =

Total allowable loading per unit area to meet stds (from Table K.1) =

Total allowable loading for reach 18 = 2.23E-1 * 180 mi2 =

2.23E-01 tons/day/mi2
40.13 tons/day

15 mg/L

0.0260 cms/mi2

180 mi2

4.682 cms

6.69 tons/day

0.000 cms

60 mg/L

0.00 tons/day

6.69 tons/day

Explicit MOS for chloride for winter for reach 18 (10% * 40.13) =
WLA for chloride for winter for reach 18 (same as existing load) =
LA for chloride for winter for reach 18 = total - MOS - WLA =

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4.01 tons/day
0.00 tons/day
36.12 tons/day

TABLE K.3. CALCULATIONS FOR CHLORIDE LOADS AND PERCENT REDUCTION
FOR WINTER FOR BOEUF RIVER, AT UWBFR01 (REACH 08050001-019)

WQ standard for chloride = 90 mg/L		Error check for reduction is / is not needed:		ok				
Percent reduction = 0%		Error check for less or more reduction needed:		ok				
Season	Date	Observed chloride at UWBFR01 (mg/L)	Flow per unit area on sampling day (cms/mi2)	Percent exceedance for flow on sampling day	Current chloride load (tons/day)/mi2	Reduced chloride load (tons/day)/mi2	Allowable chloride load with MOS incorporated (tons/day)/mi2	Reduced load less than or equal to allow. load?
WINTER	3/6/01	7.5	0.0600	12.5%	0.043	0.0426	0.51396	Yes
WINTER	1/22/01	8.5	0.0770	9.4%	0.062	0.0622	0.66004	Yes
WINTER	2/27/96	18.2	0.0069	60.3%	0.012	0.0120	0.05951	Yes
WINTER	4/11/95	31.6	0.0274	25.9%	0.082	0.0824	0.23480	Yes
WINTER	1/17/95	17.4	0.0072	59.0%	0.012	0.0119	0.06168	Yes
TOTALS =			0.1785		0.211			
					Total number of values =	5		
					Allowable % of exceedances =	10%		
					Allowable no. of exceedances =	1		
					No. of exceedances before reductions =	0		
					No. of exceedances after reductions =	0		
Flow weighted average chloride (mg/L) = (0.211 / 0.1785) / conversion = 12 mg/L								
Average flow per unit area for winter =								
Estimated drainage area for reach 19 =								
Average flow for winter for reach 19 = 0.0260 * 176 =								
Existing total chloride load for winter for reach 19								
= 12 mg/L * 4.597 cms * conversions =								
Sum of design flows for point sources for reach 19 =								
Assumed effluent chloride concentration for point sources =								
Existing point source chloride load for winter for reach 19 =								
= 0.004 cms * 60 mg/L * conversions =								
Existing NPS chloride load for winter for reach 19 = 5.25 - 0.02 =								
5.23 tons/day								

Total allowable loading per unit area to meet stds (from Table J.1) =	2.23E-01 tons/day/mi2
Total allowable loading for reach 19 = 2.23E-1 * 176 mi2 =	39.40 tons/day
Explicit MOS for chloride for winter for reach 19 (10% * 39.40) =	3.94 tons/day
WLA for chloride for winter for reach 19 (same as existing load) =	0.02 tons/day
Point source future growth:	
Assumed increase in design flow = 50% =	0.002 cms
Effluent conc. in excess of standard = MAX (0, 60 - 90) =	0 mg/L
Future growth explicit load = 0.000 * 0 * conversions =	0 tons/day
LA for chloride for summer for reach 19 = total - MOS - WLA - FG =	35.44 tons/day

FILE: R:\PROJECTS\2110-613\TECH\TMDL\TMDL CHLORIDES-WINTER.XLS

TABLE K.4. CALCULATIONS FOR EXISTING CHLORIDE LOADS AND PERCENT REDUCTION FOR WINTER FOR BIG BAYOU AT OUA0032 (REACH 08050001-022)

WQ standard for chloride = 48 mg/L		Error check for reduction is / is not needed:		ok				
Percent reduction = 0%		Error check for less or more reduction needed:		ok				
Season	Date	Observed chloride at OUA0032 (mg/L)	Flow per unit area on sampling day (cms/mi2)	Percent exceedance for flow on sampling day	Current chloride load (tons/day)/mi2	Reduced chloride load (tons/day)/mi2	Allowable chloride load with MOS incorporated (tons/day)/mi2	Reduced load less than or equal to allow. load?
WINTER	3/6/01	7.0	0.05996	12.5%	0.040	0.0397	0.24670	Yes
WINTER	1/22/01	9.8	0.07700	9.4%	0.072	0.0718	0.31682	Yes
WINTER	2/27/96	21.4	0.00694	60.3%	0.014	0.0142	0.02857	Yes
WINTER	4/11/95	11.4	0.02739	25.9%	0.030	0.0297	0.11270	Yes
WINTER	1/17/95	18.3	0.00720	59.0%	0.013	0.0125	0.02960	Yes
TOTALS =		0.17850		0.168		Total number of values = 5		5
						Allowable % of exceedances =		10%
						Allowable no. of exceedances =		1
						No. of exceedances before reductions =		0
						No. of exceedances after reductions =		0

Flow weighted average chloride (mg/L) = (0.168 / 0.1785) / conversion = 10 mg/L

Average flow per unit area for winter =

Estimated drainage area for reach 22 =

Average flow for winter for reach 22 = 0.0260 * 189 =

Existing total chloride load for winter for reach 22

= 10 mg/L * 4.924 cms * conversions =

Sum of design flows for point sources for reach 22 =

Assumed effluent chloride concentration for point sources =

Existing point source chloride load for winter for reach 22 =

= 0.083 cms * 60 mg/L * conversions =

Existing NPS chloride load for winter for reach 22 = 4.69 - 0.48 =	4.21 tons/day
Total allowable loading per unit area to meet stds (from Table J.1) =	1.19E-01 tons/day/mi ²
Total allowable loading for reach 22 = 1.19E-1 * 189 mi ² =	22.51 tons/day
Explicit MOS for chloride for winter for reach 22 (10% * 22.51) =	2.25 tons/day
WLA for chloride for winter for reach 22 (same as existing load) =	0.48 tons/day
Point source future growth:	
Assumed increase in design flow = 50% =	0.042 cms
Effluent conc. in excess of standard = MAX (0, 60 - 48) =	12 mg/L
Future growth explicit load = 0.000 * 0 * conversions =	0.05 tons/day
LA for chloride for winter for reach 22 = total - MOS - WLA - FG =	19.73 tons/day

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TABLE K.5. CALCULATIONS FOR EXISTING CHLORIDE LOADS AND PERCENT REDUCTION FOR WINTER FOR BIG BAYOU AT UWBGB01 (REACH 08050001-022)

WQ standard for chloride = 48 mg/L		Error check for reduction is / is not needed:		ok				
Percent reduction = 0%		Error check for less or more reduction needed:		ok				
Season	Date	Observed chloride at UWBGB01 (mg/L)	Flow per unit area on sampling day (cms/mi2)	Percent exceedance for flow on sampling day	Current chloride load (tons/day)/mi2	Reduced chloride load (tons/day)/mi2	Allowable chloride load with MOS incorporated (tons/day)/mi2	Reduced load less than or equal to allow. load?
WINTER	2/27/96	59.5	0.0069	60.3%	0.039	0.0394	0.02857	No
WINTER	1/17/95	19.0	0.0072	59.0%	0.013	0.0130	0.02960	Yes
WINTER	4/11/95	12.6	0.0274	25.9%	0.033	0.0329	0.11270	Yes
WINTER	3/6/01	19.5	0.0600	12.5%	0.111	0.1112	0.24670	Yes
WINTER	1/22/01	11.9	0.0770	9.4%	0.087	0.0870	0.31682	Yes
TOTALS =		0.1785		0.283		Total number of values = 5		5
Flow weighted average chloride (mg/L) = (0.283 / 0.1785) / conversion =		17 mg/L		Allowable % of exceedances = 10%		Allowable no. of exceedances = 1		1
Average flow per unit area for winter =		0.0260 cms/mi2		No. of exceedances before reductions = 1		No. of exceedances after reductions = 1		1
Estimated drainage area for reach 22 =		189 mi2						
Average flow for winter for reach 22 = 0.0260 * 189 =		4.924 cms						
Existing total chloride load for winter for reach 22		7.97 tons/day						
= 17 mg/L * 4.924 cms * conversions =								
Sum of design flows for point sources for reach 22 =		0.083 cms						
Assumed effluent chloride concentration for point sources =		60 mg/L						
Existing point source chloride load for winter for reach 22 =		0.48 tons/day						
= 0.083 cms * 60 mg/L * conversions =								

Existing NPS chloride load for winter for reach 22 = $7.97 - 0.48 =$	7.49 tons/day
Total allowable loading per unit area to meet stds (from Table J.1) =	1.19E-01 tons/day/mi ²
Total allowable loading for reach 22 = $1.19E-1 * 189 \text{ mi}^2 =$	22.51 tons/day
Explicit MOS for chloride for winter for reach 22 ($10\% * 22.51$) =	2.25 tons/day
WLA for chloride for winter for reach 22 (same as existing load) =	0.48 tons/day
Point source future growth:	
Assumed increase in design flow = 50% =	0.04 cms
Effluent conc. in excess of standard = MAX (0, 60 - 48) =	12.00 mg/L
Future growth explicit load = $0.042 * 12 * \text{conversions} =$	0.05 tons/day
LA for chloride for winter for reach 22 = total - MOS - WLA - FG =	19.73 tons/day

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TABLE K.6. CALCULATIONS FOR EXISTING CHLORIDE LOADS AND PERCENT REDUCTION FOR WINTER FOR OAK BAYOU OUA0179 (REACH 08050002-010)

WQ standard for chloride = 48 mg/L		Error check for reduction is / is not needed:		ok				
Percent reduction = 0%		Error check for less or more reduction needed:		ok				
		Observed chloride at OUA179 (mg/L)	Flow per unit area on sampling day (cms/mi2)	Percent exceedance for flow on sampling day	Current chloride load (tons/day)/mi2	Reduced chloride load (tons/day)/mi2	Allowable chloride load with MOS incorporated (tons/day)/mi2	Reduced load less than or equal to allow. load?
Season	Date							
WINTER	1/23/01	10.1	0.0442	16.7%	0.043	0.0426	0.18178	Yes
WINTER	3/5/01	6.0	0.0757	9.5%	0.044	0.0436	0.31162	Yes
TOTALS =			0.1199		0.086		Total number of values =	2
							Allowable % of exceedances =	10%
							Allowable no. of exceedances =	1
							No. of exceedances before reductions =	0
							No. of exceedances after reductions =	0

Flow weighted average chloride (mg/L) = (0.086 / 0.1199) / conversion = 8 mg/L

Average flow per unit area for winter =

Estimated drainage area for reach 10 =

Average flow for winter for reach 10 = 0.0260 * 136 =

Existing total chloride load for winter for reach 10

= 8 mg/L * 3.549 cms * conversions =

Sum of design flows for point sources for reach 10 =

Assumed effluent chloride concentration for point sources =

Existing point source chloride load for winter for reach 10 =

= 0.000 cms * 60 mg/L * conversions =

Existing NPS chloride load for winter for reach 10 = 2.70 - 0.00 =

0.0260 cms/mi²

136 mi²

3.549 cms

2.70 tons/day

0.000 cms

60 mg/L

0.00 tons/day

2.70 tons/day

Total allowable loading per unit area to meet stds (from Table J.1) =	1.19E-01 tons/day/mi2
Total allowable loading for reach 10 = 1.19E-1 * 136 mi2 =	16.23 tons/day
Explicit MOS for chloride for winter for reach 10 (10% * 16.23) =	1.62 tons/day
WLA for chloride for winter for reach 10 (same as existing load) =	0.00 tons/day
LA for chloride for winter for reach 10 = total - MOS - WLA =	14.61 tons/day

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Figure K.1. Winter Flow Duration Curve for USGS 07369680 Bayou Macon near Eudora

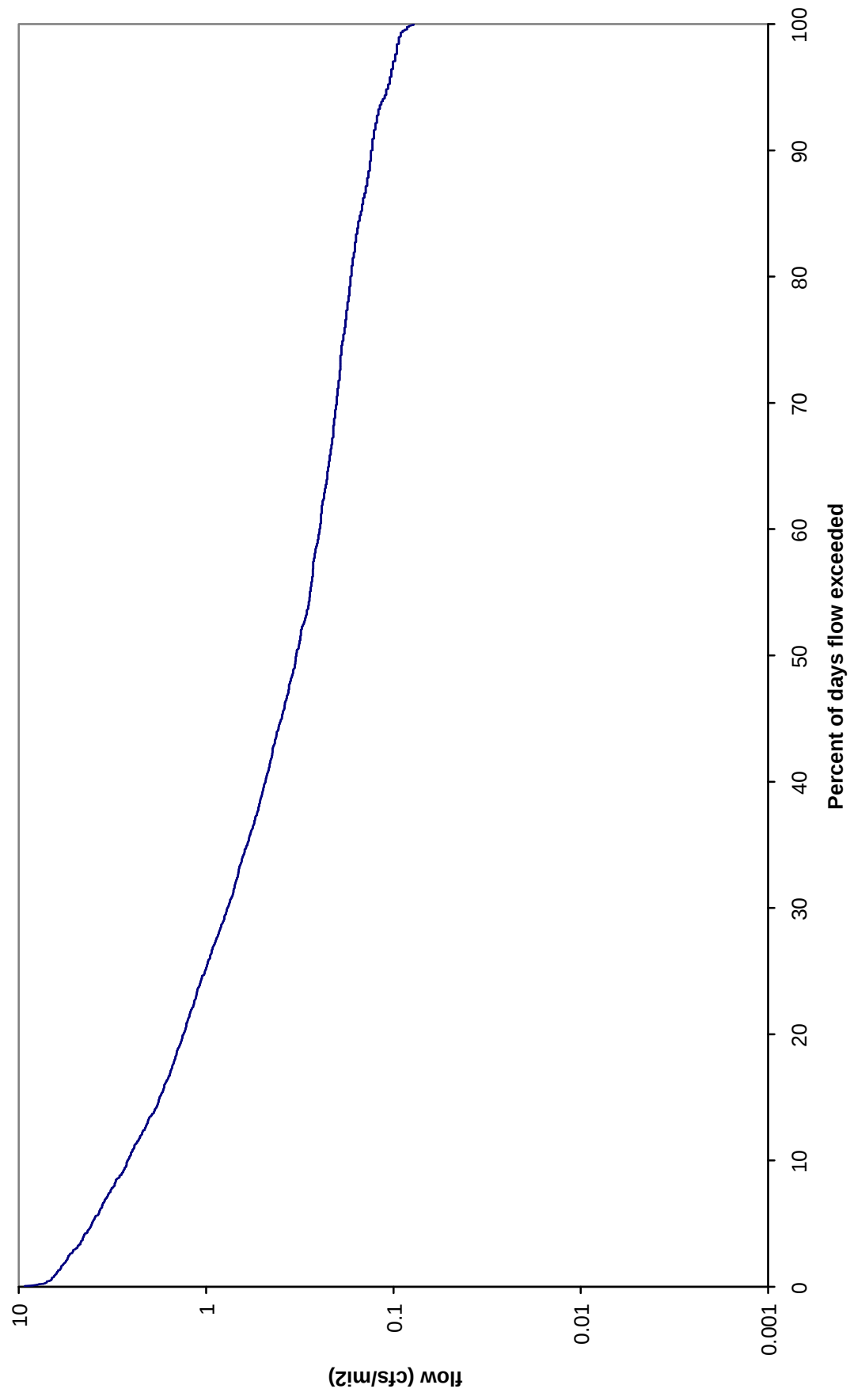


Figure K.2. Winter Chloride Load Duration Curve for Boeuf River at OUA0015A

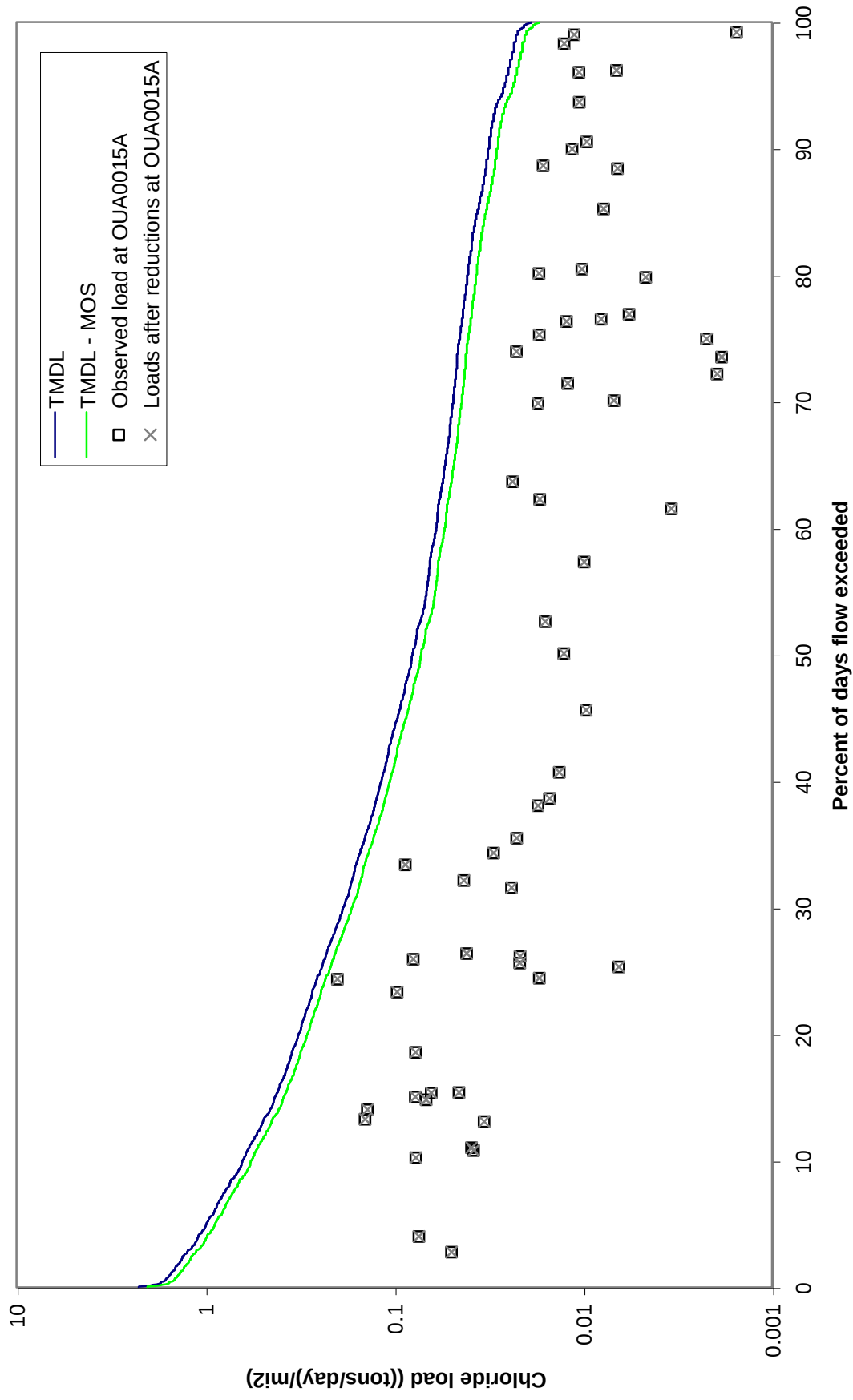


Figure K.3. Winter Chloride Load Duration Curve for Boeuf River at UWBFR01

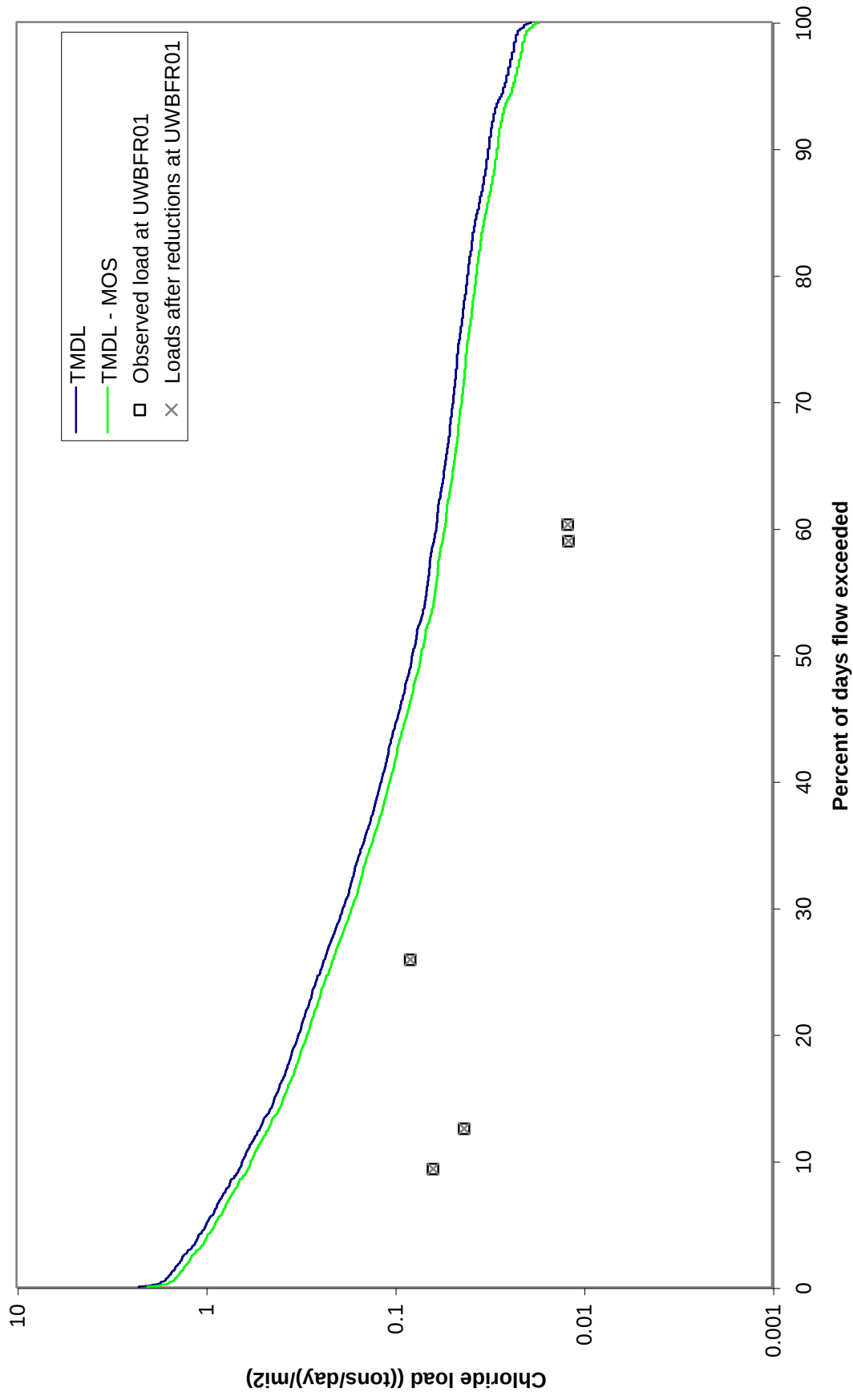


Figure K.4. Winter Chloride Load Duration Curve for Big Bayou at OUA0032

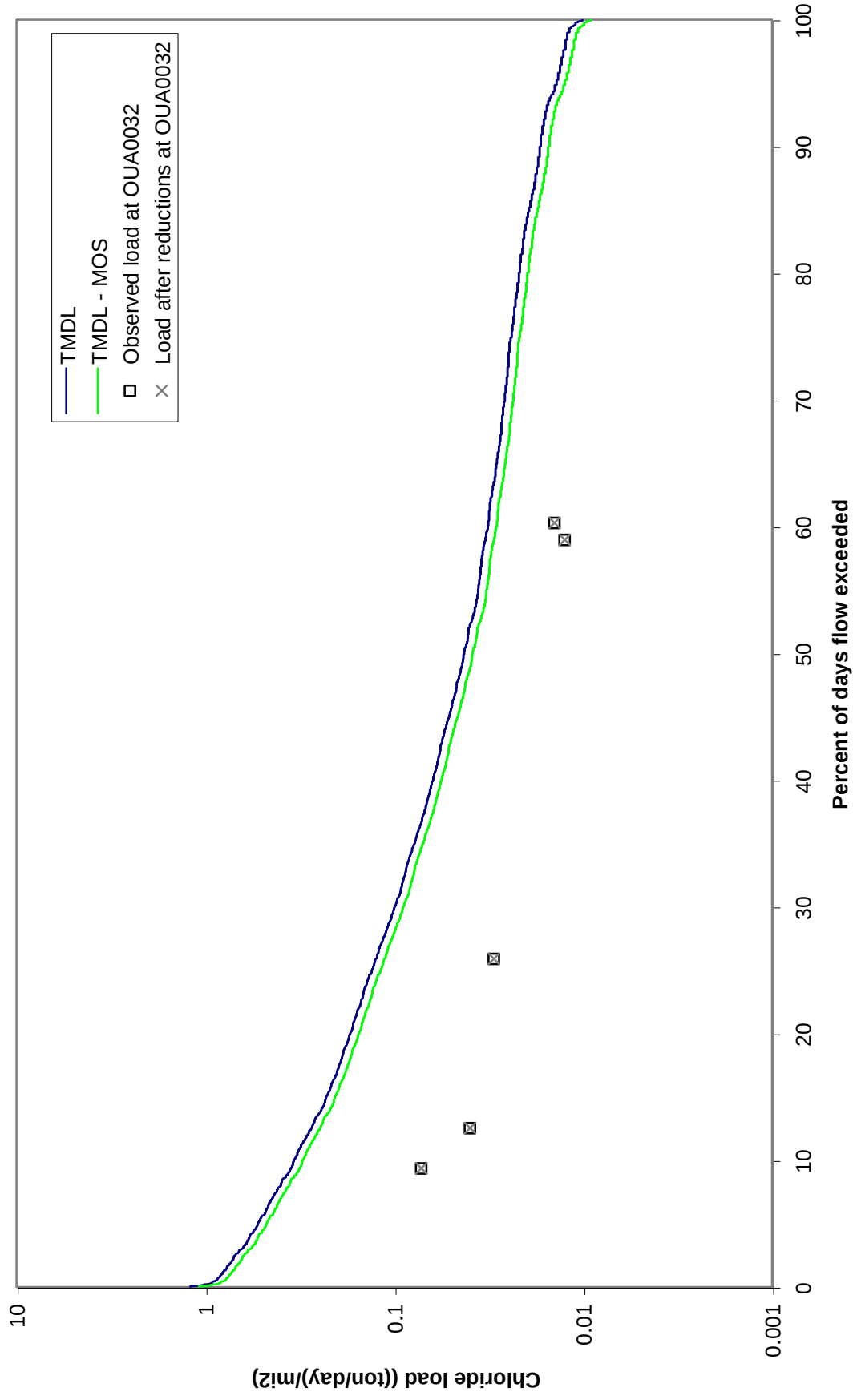


Figure K.5. Winter Chloride Load Duration Curve for Big Bayou at UWGB01

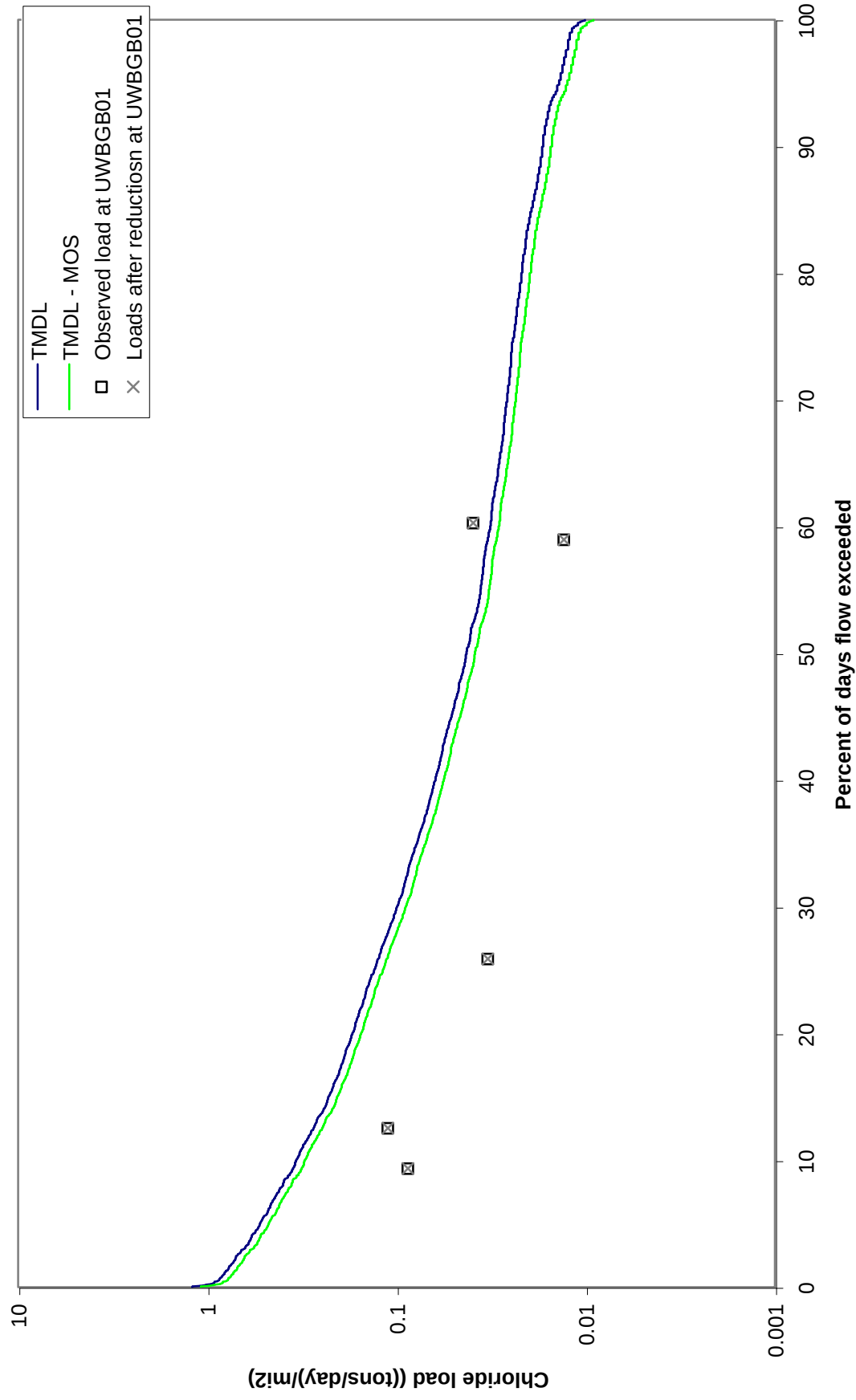
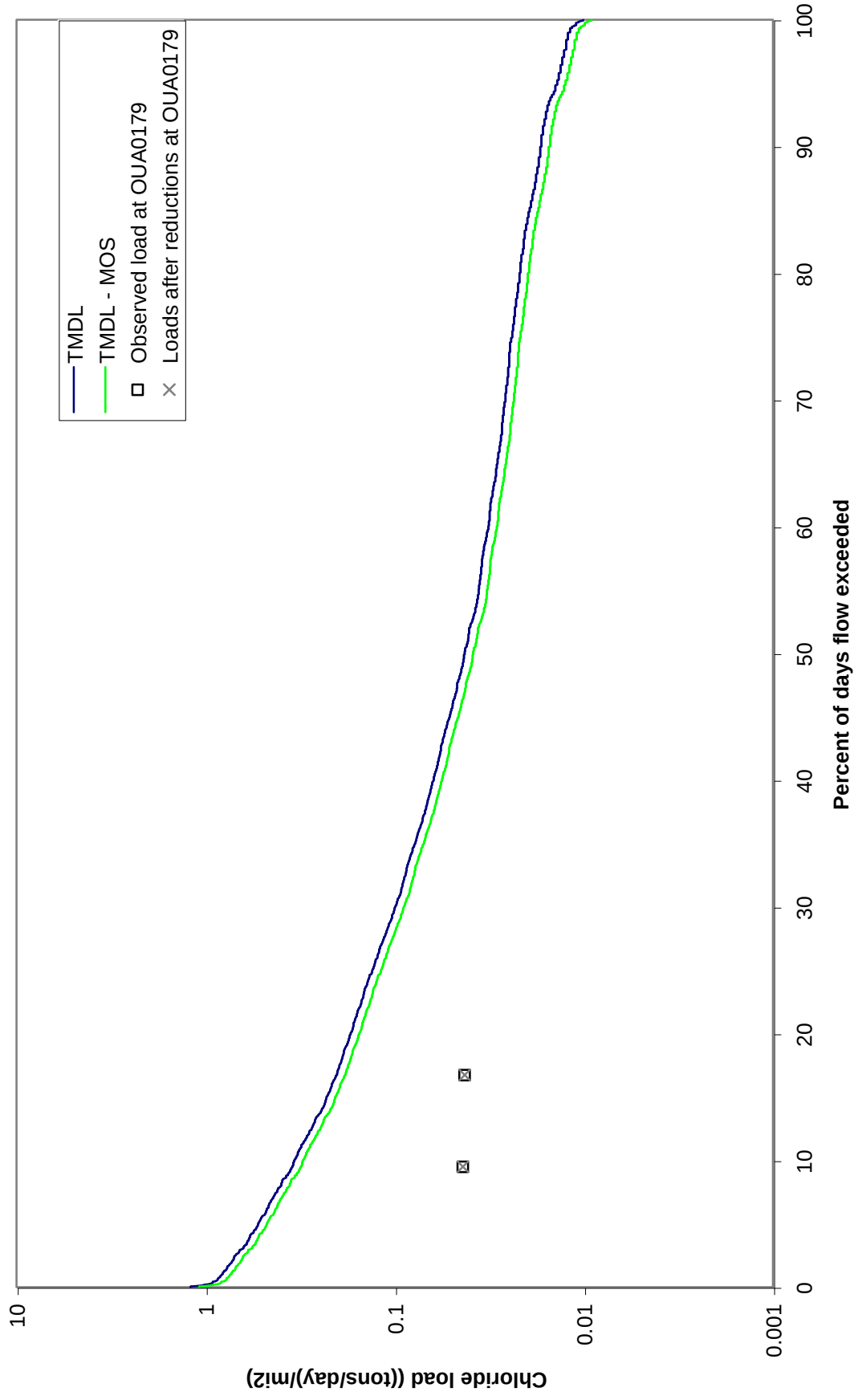


Figure K.6. Winter Chloride Load Duration Curve for Oak Bayou at OUA0179



APPENDIX L

Calculations for Summer TDS TMDL

TABLE L.1. CALCULATIONS FOR ALLOWABLE LOADS PER UNIT AREA FOR TDS DURING SUMMER

Percentage of total flow in basin represented by Bayou Macon:

USGS gage number and name		Avg. annual flow 1957-68 (cfs)	Drainage area (mi2)	Percent of combined flow
07367700	Boeuf River near AR/LA state line	875	785	65.2%
07369700	Bayou Macon near Kilbourne, LA	467	504	34.8%
		1,342	1,289	100.0%

Margin of Safety (MOS) = 10%

Observed flow at Eudora				Percent exceedance for observed flow	Adjusted flow for entire basin				"Width" for area under curves	TDS standard = 460 mg/L			Other Streams (Oak Log Bayou) TDS standard = 411 mg/L		
Season	Date	(cfs)		flow	cfs	cfs/mi2	cms/mi2	Allowable TDS load at this flow (tons/day)/mi2		Target TDS load at this flow (tons/day)/mi2	"Area under TMDL curve" (tons/day)/mi2	Allowable TDS load at this flow (tons/day)/mi2	Target TDS load at this flow (tons/day)/mi2	"Area under TMDL curve" (tons/day)/mi2	
A	B	C	D		E = C / 34.8%	F = E / 1289 mi2	G = E / 35.32	H = D1 - D2	I = G * 460 mg/L * conversion	J = I * (1 - MOS)	K = H * I	L = G * 411 mg/L * conversion	M = L * (1 - MOS)	N = H * L	
SUMMER	06/22/02	24	99.98%		69.0	0.054	0.0015	0.03%	0.07	0.06	2.07E-05	0.06	0.05	1.85E-05	
SUMMER	06/20/02	25	99.95%		71.8	0.056	0.0016	0.03%	0.07	0.06	2.15E-05	0.06	0.06	1.92E-05	
SUMMER	06/21/02	26	99.92%		74.7	0.058	0.0016	0.03%	0.07	0.06	2.24E-05	0.06	0.06	2.00E-05	
SUMMER	06/19/02	31	99.89%		89.1	0.069	0.0020	0.03%	0.09	0.08	2.67E-05	0.08	0.07	2.39E-05	
SUMMER	05/21/95	32	99.86%		92.0	0.071	0.0020	0.03%	0.09	0.08	2.76E-05	0.08	0.07	2.46E-05	
SUMMER	05/22/95	32	99.83%		92.0	0.071	0.0020	0.03%	0.09	0.08	2.76E-05	0.08	0.07	2.46E-05	
SUMMER	10/10/01	32	99.80%		92.0	0.071	0.0020	0.03%	0.09	0.08	2.76E-05	0.08	0.07	2.46E-05	
SUMMER	05/20/95	33	99.77%		94.8	0.074	0.0021	0.03%	0.09	0.08	2.84E-05	0.08	0.07	2.54E-05	

For brevity, most of the rows in this spreadsheet have been hidden (between the 99.77% and the 0.23% exceedances).

SUMMER	05/03/91	3110	0.23%	8936.8	6.933	0.1963	0.03%	8.60	7.74	2.68E-03	2.68E-03	7.68	6.92	2.39E-03
SUMMER	05/06/91	3110	0.20%	8936.8	6.933	0.1963	0.03%	8.60	7.74	2.68E-03	2.68E-03	7.68	6.92	2.39E-03
SUMMER	05/02/91	3130	0.17%	8994.3	6.978	0.1976	0.03%	8.66	7.79	2.70E-03	2.70E-03	7.73	6.96	2.41E-03
SUMMER	05/04/91	3130	0.14%	8994.3	6.978	0.1976	0.03%	8.66	7.79	2.70E-03	2.70E-03	7.73	6.96	2.41E-03
SUMMER	05/05/91	3130	0.11%	8994.3	6.978	0.1976	0.03%	8.66	7.79	2.70E-03	2.70E-03	7.73	6.96	2.41E-03
SUMMER	05/01/91	3170	0.08%	9109.2	7.067	0.2001	0.03%	8.77	7.89	2.73E-03	2.73E-03	7.83	7.05	2.44E-03
SUMMER	05/31/98	3250	0.05%	9339.1	7.245	0.2051	0.03%	8.99	8.09	2.80E-03	2.80E-03	8.03	7.23	2.50E-03
SUMMER	05/30/98	3270	0.02%	9396.6	7.290	0.2064	0.03%	9.04	8.14	2.82E-03	2.82E-03	8.08	7.27	2.52E-03

TOTALS = 100.00%

4.11E-01

4.60E-01

TABLE L.2. CALCULATIONS FOR TDS LOADS AND PERCENT REDUCTION FOR SUMMER FOR BOEUF RIVER AT OUA0015A (REACH 08050001-018)

WQ standard for TDS = 460 mg/L		Error check for reduction is / is not needed:		ok				
Percent reduction needed = 26%		Error check for less or more reduction needed:		ok				
Season	Date	Observed TDS at OUA0015A (mg/L)	Flow per unit area on sampling day (cms/mi2)	Percent exceedance for flow on sampling day	Current TDS load (tons/day)/mi2	Reduced TDS load (tons/day)/mi2	Allowable TDS load with MOS incorporated (tons/day)/mi2	Reduced load less than or equal to allow. load?
SUMMER	7/19/94	232	0.0802	1.6%	1.771	1.3107	3.1606	Yes
SUMMER	11/5/02	198	0.0434	3.3%	0.819	0.6060	1.7122	Yes
SUMMER	6/21/93	379	0.0323	4.6%	1.164	0.8615	1.2717	Yes
SUMMER	6/17/03	187	0.0304	5.0%	0.541	0.4001	1.1971	Yes
SUMMER	8/16/94	354	0.0242	6.2%	0.815	0.6031	0.9532	Yes
SUMMER	11/28/94	231	0.0241	6.2%	0.530	0.3925	0.9507	Yes
SUMMER	7/27/99	643	0.0210	8.7%	1.287	0.9525	0.8287	No
SUMMER	7/2/91	274	0.0193	9.7%	0.504	0.3730	0.7615	Yes
SUMMER	6/28/94	416	0.0191	9.9%	0.758	0.5607	0.7541	Yes
SUMMER	11/23/93	179	0.0175	11.1%	0.298	0.2206	0.6894	Yes
SUMMER	11/16/98	462	0.0158	12.4%	0.694	0.5138	0.6222	Yes
SUMMER	9/29/98	567	0.0151	12.9%	0.818	0.6053	0.5973	No
SUMMER	6/29/99	332	0.0145	13.9%	0.457	0.3382	0.5699	Yes
SUMMER	5/22/01	265.5	0.0138	14.4%	0.350	0.2586	0.5450	Yes
SUMMER	7/22/98	298	0.0104	19.6%	0.296	0.2187	0.4106	Yes
SUMMER	5/13/97	296	0.0090	23.7%	0.254	0.1883	0.3559	Yes
SUMMER	9/27/94	444	0.0090	24.1%	0.382	0.2824	0.3559	Yes
SUMMER	6/9/98	196	0.0090	24.3%	0.167	0.1238	0.3534	Yes
SUMMER	7/26/93	348	0.0086	26.3%	0.285	0.2105	0.3385	Yes
SUMMER	8/8/95	518	0.0085	26.9%	0.417	0.3088	0.3335	Yes
SUMMER	9/23/03	307	0.0084	27.1%	0.245	0.1816	0.3310	Yes
SUMMER	8/17/99	483.5	0.0083	27.5%	0.384	0.2839	0.3285	Yes
SUMMER	5/24/94	270	0.0083	27.6%	0.213	0.1573	0.3260	Yes
SUMMER	8/4/92	240	0.0081	28.3%	0.186	0.1377	0.3210	Yes
SUMMER	8/11/98	423	0.0080	28.8%	0.320	0.2371	0.3136	Yes
SUMMER	9/3/91	391	0.0078	29.5%	0.291	0.2157	0.3086	Yes
SUMMER	9/1/92	409	0.0076	30.9%	0.297	0.2201	0.3011	Yes
SUMMER	8/6/96	231	0.0074	32.5%	0.162	0.1202	0.2912	Yes

SUMMER	8/20/01	366	0.0073	32.8%	0.255	0.1889	0.2887	Yes
SUMMER	6/4/91	231	0.0073	33.1%	0.161	0.1192	0.2887	Yes
SUMMER	9/1/98	408	0.0070	35.7%	0.272	0.2015	0.2762	Yes
SUMMER	7/16/96	676	0.0068	38.0%	0.439	0.3248	0.2688	No
SUMMER	7/17/95	209	0.0068	38.1%	0.136	0.1004	0.2688	Yes
SUMMER	6/10/97	276	0.0067	39.5%	0.176	0.1301	0.2638	Yes
SUMMER	8/6/91	409	0.0066	40.9%	0.258	0.1910	0.2613	Yes
SUMMER	7/15/03	265	0.0064	42.2%	0.162	0.1202	0.2538	Yes
SUMMER	5/28/02	193	0.0064	42.3%	0.118	0.0876	0.2538	Yes
SUMMER	5/20/03	460	0.0063	43.3%	0.277	0.2046	0.2489	Yes
SUMMER	9/4/90	549	0.0063	44.2%	0.330	0.2442	0.2489	Yes
SUMMER	7/7/92	282	0.0062	45.2%	0.168	0.1242	0.2464	Yes
SUMMER	6/2/92	380	0.0062	46.0%	0.224	0.1657	0.2439	Yes
SUMMER	6/20/95	419	0.0061	47.4%	0.242	0.1789	0.2389	Yes
SUMMER	11/7/00	185	0.0058	50.9%	0.102	0.0757	0.2290	Yes
SUMMER	10/1/96	142	0.0058	51.0%	0.079	0.0581	0.2290	Yes
SUMMER	8/12/03	473	0.0056	53.6%	0.250	0.1852	0.2190	Yes
SUMMER	10/15/02	206	0.0055	54.3%	0.108	0.0797	0.2165	Yes
SUMMER	7/25/00	804	0.0054	55.2%	0.416	0.3076	0.2140	No
SUMMER	5/21/96	305	0.0053	56.8%	0.154	0.1140	0.2090	Yes
SUMMER	11/25/91	252	0.0053	57.0%	0.127	0.0942	0.2090	Yes
SUMMER	5/25/99	259	0.0052	57.4%	0.129	0.0956	0.2066	Yes
SUMMER	8/26/97	377	0.0052	58.6%	0.186	0.1375	0.2041	Yes
SUMMER	5/18/93	287	0.0052	58.8%	0.141	0.1047	0.2041	Yes
SUMMER	5/30/00	295	0.0050	59.9%	0.142	0.1050	0.1991	Yes
SUMMER	8/20/02	319	0.0050	60.6%	0.151	0.1121	0.1966	Yes
SUMMER	9/21/99	378	0.0049	61.5%	0.177	0.1312	0.1941	Yes
SUMMER	6/18/96	474	0.0049	61.7%	0.222	0.1645	0.1941	Yes
SUMMER	6/27/00	272	0.0049	62.4%	0.126	0.0932	0.1916	Yes
SUMMER	9/17/01	230.5	0.0048	63.7%	0.105	0.0779	0.1891	Yes
SUMMER	9/10/96	358	0.0048	64.1%	0.164	0.1210	0.1891	Yes
SUMMER	7/24/01	537	0.0045	68.3%	0.232	0.1720	0.1792	Yes
SUMMER	7/22/97	357	0.0045	68.6%	0.155	0.1143	0.1792	Yes
SUMMER	10/1/91	407	0.0045	69.1%	0.176	0.1304	0.1792	Yes
SUMMER	6/19/01	401	0.0044	70.8%	0.169	0.1249	0.1742	Yes
SUMMER	5/19/98	548	0.0044	72.3%	0.227	0.1682	0.1717	Yes
SUMMER	9/19/00	557	0.0042	73.6%	0.224	0.1660	0.1667	Yes
SUMMER	10/28/97	227	0.0042	73.8%	0.091	0.0677	0.1667	Yes
SUMMER	9/21/93	601	0.0040	77.1%	0.231	0.1711	0.1593	No

SUMMER	10/29/91	372	0.0040	77.2%	0.143	0.1059	0.1593	Yes
SUMMER	9/17/02	381	0.0040	77.6%	0.144	0.1068	0.1568	Yes
SUMMER	10/17/00	499	0.0039	80.4%	0.183	0.1354	0.1518	Yes
SUMMER	11/27/90	204	0.0039	81.1%	0.075	0.0554	0.1518	Yes
SUMMER	11/19/01	540	0.0038	81.7%	0.195	0.1441	0.1493	Yes
SUMMER	10/19/99	395.5	0.0038	82.1%	0.143	0.1056	0.1493	Yes
SUMMER	11/18/97	277	0.0038	82.7%	0.100	0.0739	0.1493	Yes
SUMMER	11/19/96	242	0.0038	82.8%	0.087	0.0646	0.1493	Yes
SUMMER	10/30/90	48	0.0036	86.0%	0.016	0.0122	0.1419	Yes
SUMMER	9/29/92	407	0.0035	88.7%	0.135	0.0996	0.1369	Yes
SUMMER	9/30/97	454	0.0034	89.2%	0.147	0.1091	0.1344	Yes
SUMMER	11/13/95	596	0.0033	90.9%	0.190	0.1405	0.1319	No
SUMMER	9/19/95	611	0.0033	91.0%	0.195	0.1441	0.1319	No
SUMMER	5/5/92	290	0.0033	91.5%	0.092	0.0684	0.1319	Yes
SUMMER	5/23/95	312	0.0033	92.4%	0.098	0.0722	0.1294	Yes
SUMMER	10/2/90	349	0.0033	92.6%	0.109	0.0807	0.1294	Yes
SUMMER	10/17/95	597	0.0032	93.3%	0.183	0.1354	0.1269	No
SUMMER	11/22/99	655	0.0030	95.0%	0.189	0.1399	0.1195	No
SUMMER	10/23/01	154	0.0028	96.9%	0.042	0.0308	0.1120	Yes
SUMMER	10/26/93	317	0.0025	98.4%	0.076	0.0564	0.0995	Yes

TOTALS =

0.7747

24.752

87

Total number of values =

10%

Allowable % of exceedances =

9

Allowable no. of exceedances =

20

No. of exceedances before reductions =

9

No. of exceedances after reductions =

Flow weighted average TDS (mg/L) = (24.752 / 0.7747) / conversion =

335 mg/L

Average flow per unit area for summer =

0.0105 cms/mi²

Estimated drainage area for reach 18 =

180 mi²

Average flow for summer for reach 18 = 0.0105 * 180 =

1.887 cms

Existing total TDS load for summer for reach 18

= 335 mg/L * 1.887 cms * conversions =

60.28 tons/day

Sum of design flows for point sources for reach 18 =

0.000 cms

Assumed effluent TDS concentration for point sources =

60 mg/L

Existing point source TDS load for summer for reach 18 =

= 0.000 cms * 60 mg/L * conversions =	0.00 tons/day
Existing NPS TDS load for summer for reach 18 = 60.28 - 0.00 =	60.28 tons/day
Total allowable loading per unit area to meet stds (from Table L.1) =	4.60E-01 tons/day/mi2
Total allowable loading for reach 18 = 4.60E-1 * 180 mi2 =	82.66 tons/day
Explicit MOS for TDS for summer for reach 18 (10% * 82.66) =	8.27 tons/day
WLA for TDS for summer for reach 18 (same as existing load) =	0.00 tons/day
LA for TDS for summer for reach 18 = total - MOS - WLA =	74.39 tons/day

FILE: R:\PROJECTS\2110-613\TECH\TMDL\REVISED\TMDL TDS-SUMMER.XLS

TABLE L.3. CALCULATIONS FOR TDS LOADS AND PERCENT REDUCTION
FOR SUMMER FOR OAK BAYOU AT OUA0179 (REACH 08050002-010)

WQ standard for TDS = 411 mg/L		Error check for reduction is / is not needed:		ok				
Percent reduction needed = 32%		Error check for less or more reduction needed:		ok				
<u>Season</u>	<u>Date</u>	Observed TDS at OUA0179 (mg/L)	Flow per unit area on sampling day (cms/mi2)	Percent exceedance for flow on sampling day	Current TDS load (tons/day)/mi2	Reduced TDS load (tons/day)/mi2	Allowable TDS load with MOS incorporated (tons/day)/mi2	Reduced load less than or equal to allow. load?
SUMMER	9/11/01	475	0.0071	34.8%	0.320	0.217	0.2490	Yes
SUMMER	7/16/01	525	0.0069	36.9%	0.344	0.234	0.2424	Yes
SUMMER	5/15/01	538	0.0049	61.3%	0.252	0.172	0.1734	Yes
SUMMER	11/7/00	888.5	0.0058	50.9%	0.491	0.334	0.2046	No
TOTALS =			0.0247		1.407		Total number of values = 4	4
							Allowable % of exceedances =	10%
							Allowable no. of exceedances =	1
							No. of exceedances before reductions =	4
							No. of exceedances after reductions =	1
Flow weighted average TDS (mg/L) = (1.407 / 0.0247) / conversion = 599 mg/L								
Average flow per unit area for summer = 0.0105 cms/mi2								
Estimated drainage area for reach 10 = 136 mi2								
Average flow for summer for reach 10 = 0.0105 * 136 = 1.430 cms								
Existing total TDS load for summer for reach 10 = 81.56 tons/day								
Sum of design flows for point sources for reach 10 = 0.000 cms								
Assumed effluent TDS concentration for point sources = 60 mg/L								
Existing point source TDS load for summer for reach 10 = 0.00 tons/day								
Existing NPS TDS load for summer for reach 10 = 81.56 tons/day								

Total allowable loading per unit area to meet stds (from Table L.1) =	
Total allowable loading for reach 10 = $4.11\text{E-}1 \times 136 \text{ mi}^2 =$	4.11E-01 tons/day/mi2 55.98 tons/day
Explicit MOS for TDS for summer for reach 10 ($10\% \times 55.98$) =	5.60 tons/day
WLA for TDS for summer for reach 10 (same as existing load) =	0.00 tons/day
LA for TDS for summer for reach 10 = total - MOS - WLA =	50.38 tons/day

FILE: R:\PROJECTS\2110-613\TECH\TMDL\REVISED\TMDL TDS-SUMMER.XLS

Figure L.1. Summer Flow Duration Curve for USGS 07369680 Bayou Macon near Eudora

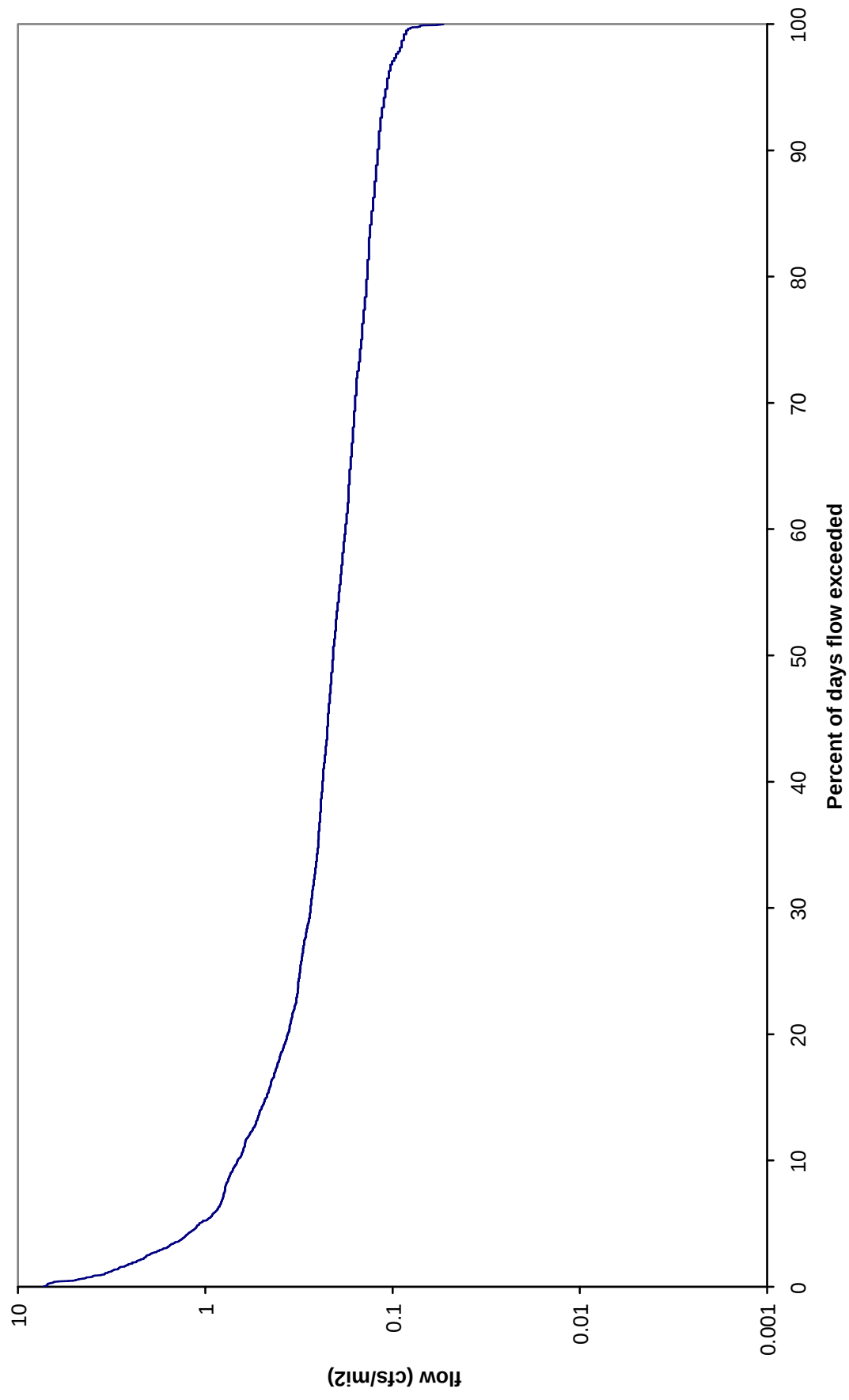


Figure L.2. Summer TDS Load Duration Curve for Boeuf River at OUA0015A

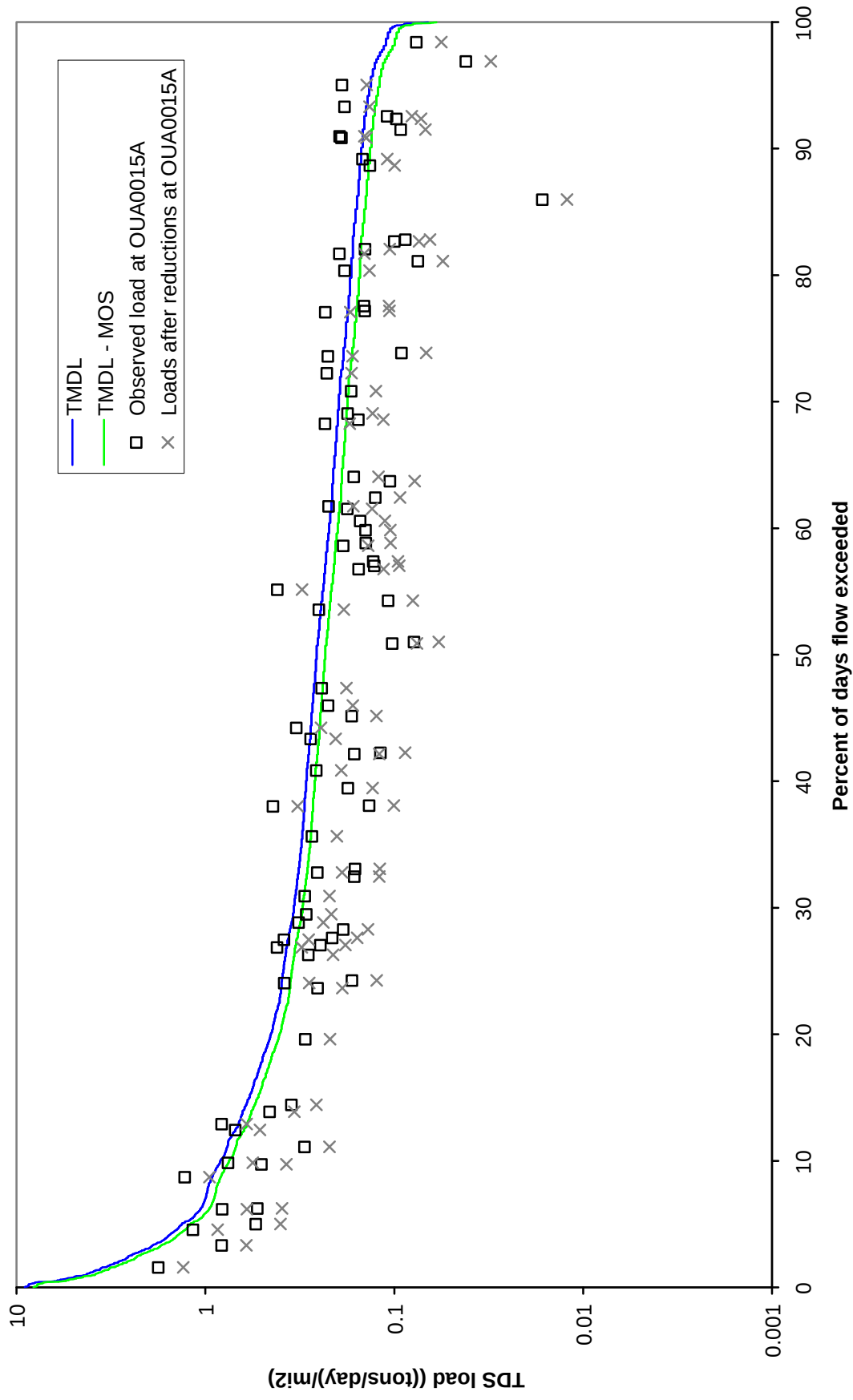
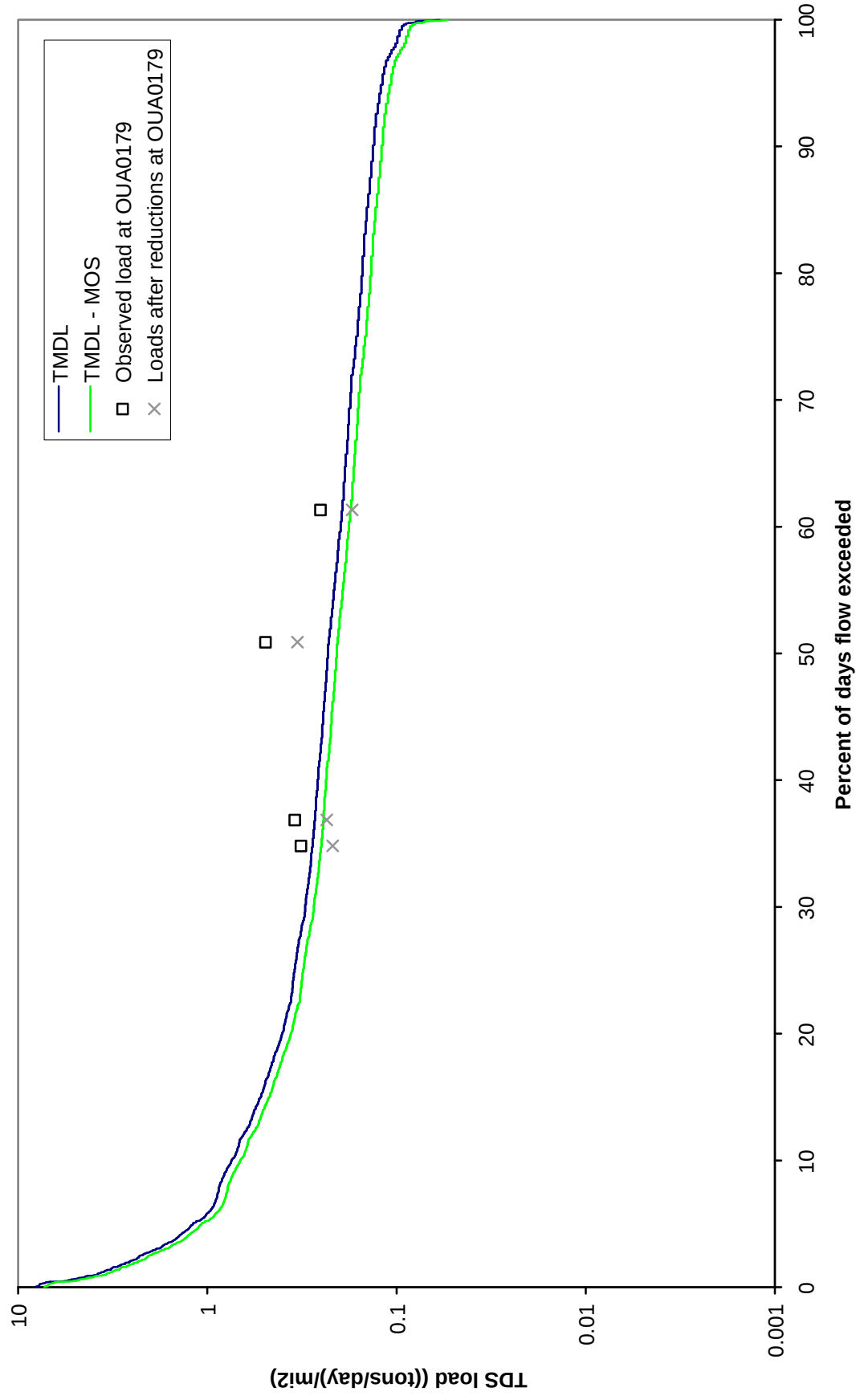


Figure L.3. Summer TDS Load Duration Curve for Oak Bayou at OUA0179



APPENDIX M

Calculations for Winter TDS TMDL

TABLE M.1. CALCULATIONS FOR ALLOWABLE LOADS PER UNIT AREA FOR TDS DURING WINTER

Percentage of total flow in basin represented by Bayou Macon:

Avg. annual flow 1958-67 (cfs)	Drainage area (mi ²)	Percent of combined flow
875	785	65.2%
467	504	34.8%
1,342	1,289	100.0%

USGS gage number and name

07367700 Boeuf River near AR/LA state line
07369700 Bayou Macon near Kilbourne, LA

	Boeuf	Others
TMDL =	11.98071406	10.70450757 (gm/sec)/mi ²
Total allowable load =	1.141039631	1.019494105 (tons/day)/mi ²

Margin of Safety (MOS) = 10%

										Boeuf River				Other Streams			
										TDS standard = 460 mg/L				TDS standard = 411 mg/L			
										Allowable TDS load at this flow (tons/day)/mi ²		Target TDS load at this flow (tons/day)/mi ²		Allowable TDS load at this flow (tons/day)/mi ²		Target TDS load at this flow (tons/day)/mi ²	
Season	Date	B	C	D	Percent exceedance for observed flow	Observed flow at Eudora (cfs)	Adjusted flow for entire basin			"Width" for area under curves		I = G * 460 mg/L		J = I * (1 - MOS)		K = H * I	
A							E = C / 34.8%	cfs	F = E / 1289 mi ²	G = E / 35.32	H = D1 - D2	I = G * 460 mg/L		J = I * (1 - MOS)		K = H * I	
										L = G * 411 mg/L		MOS		N = H * L			
WINTER	02/22/00		35	99.98%		100.6	0.078	0.0022	0.04%	0.10	0.09	4.27E-05	0.08	3.81E-05	0.08	3.81E-05	0.08
WINTER	02/23/00		35	99.93%		100.6	0.078	0.0022	0.04%	0.10	0.09	4.27E-05	0.08	3.81E-05	0.08	3.81E-05	0.08
WINTER	02/21/00		36	99.89%		103.4	0.080	0.0023	0.04%	0.10	0.09	4.39E-05	0.08	3.92E-05	0.08	3.92E-05	0.08
WINTER	02/20/00		37	99.85%		106.3	0.082	0.0023	0.04%	0.10	0.09	4.51E-05	0.08	4.03E-05	0.08	4.03E-05	0.08
WINTER	02/24/00		37	99.80%		106.3	0.082	0.0023	0.04%	0.10	0.09	4.51E-05	0.08	4.03E-05	0.08	4.03E-05	0.08
WINTER	03/05/00		38	99.76%		109.2	0.085	0.0024	0.04%	0.11	0.09	4.63E-05	0.08	4.14E-05	0.08	4.14E-05	0.08
WINTER	03/06/00		38	99.71%		109.2	0.085	0.0024	0.04%	0.11	0.09	4.63E-05	0.08	4.14E-05	0.08	4.14E-05	0.08
WINTER	03/07/00		38	99.67%		109.2	0.085	0.0024	0.04%	0.11	0.09	4.63E-05	0.08	4.14E-05	0.08	4.14E-05	0.08
For brevity, most of the rows in this spreadsheet have been hidden (between the 99.67% and the 0.33% exceedances).																	
WINTER	04/30/91		3200	0.33%		9195.4	7.134	0.2020	0.04%	8.85	7.96	3.90E-03	7.12	3.49E-03	7.12	3.49E-03	7.12
WINTER	04/26/95		3250	0.29%		9339.1	7.245	0.2051	0.04%	8.99	8.09	3.96E-03	7.23	3.54E-03	7.23	3.54E-03	7.23
WINTER	02/01/99		3310	0.24%		9511.5	7.379	0.2089	0.04%	9.15	8.24	4.04E-03	7.36	3.61E-03	7.36	3.61E-03	7.36
WINTER	01/30/99		3500	0.20%		10057.5	7.803	0.2209	0.04%	9.68	8.71	4.27E-03	7.78	3.81E-03	7.78	3.81E-03	7.78
WINTER	01/31/99		3560	0.15%		10229.9	7.936	0.2247	0.04%	9.84	8.86	4.34E-03	7.92	3.88E-03	7.92	3.88E-03	7.92
WINTER	04/25/95		3790	0.11%		10890.8	8.449	0.2392	0.04%	10.48	9.43	4.62E-03	8.43	4.13E-03	8.43	4.13E-03	8.43
WINTER	04/24/95		4150	0.07%		11925.3	9.252	0.2619	0.04%	11.48	10.33	5.06E-03	9.23	4.52E-03	9.23	4.52E-03	9.23
WINTER	04/23/95		4170	0.02%		11982.8	9.296	0.2632	0.04%	11.53	10.38	5.08E-03	9.27	4.54E-03	9.27	4.54E-03	9.27
										TOTALS = 100.00%				1.14E+00			
										TOTALS = 1.02E+00							

FILE: R:\PROJECTS\2110-613\TECH\TMDL\REVISED\TMDL TDS-WINTER.XLS

TABLE M.2. CALCULATIONS FOR TDS LOADS AND PERCENT REDUCTION FOR
WINTER FOR BOEUF RIVER AT OUA0015A (REACH 08050001-018)

WQ standard for TDS = 460 mg/L		Error check for reduction is / is not needed:		ok				
Percent reduction needed = 0%		Error check for less or more reduction needed:		ok				
Season	Date	Observed TDS at OUA0015A (mg/L)	Flow per unit area on sampling day (cms/mi2)	Percent exceedance for flow on sampling day	Current TDS load (tons/day)/mi2	Reduced TDS load (tons/day)/mi2	Allowable TDS load with MOS incorporated (tons/day)/mi2	Reduced load less than or equal to allow. load?
WINTER	2/15/94	92	0.14517	2.8%	1.272	1.2720	6.35994	Yes
WINTER	4/23/96	308	0.12687	4.0%	3.721	3.7215	5.55803	Yes
WINTER	1/2/91	238	0.07259	10.3%	1.645	1.6453	3.17997	Yes
WINTER	2/17/98	134	0.06817	11.0%	0.870	0.8700	2.98641	Yes
WINTER	2/25/03	199	0.05782	13.1%	1.096	1.0958	2.53291	Yes
WINTER	12/17/96	191	0.05725	13.3%	1.041	1.0414	2.50803	Yes
WINTER	12/11/01	200	0.05302	14.0%	1.010	1.0099	2.32276	Yes
WINTER	1/26/99	225	0.05049	14.8%	1.082	1.0820	2.21215	Yes
WINTER	2/5/91	192	0.04065	18.6%	0.743	0.7433	1.78078	Yes
WINTER	1/18/94	306	0.03781	19.9%	1.102	1.1018	1.65635	Yes
WINTER	12/22/98	189	0.03168	23.3%	0.570	0.5703	1.38813	Yes
WINTER	12/18/95	291	0.02998	24.4%	0.831	0.8309	1.31347	Yes
WINTER	4/13/93	198	0.02985	24.4%	0.563	0.5630	1.30793	Yes
WINTER	3/12/91	60	0.02809	25.3%	0.161	0.1605	1.23051	Yes
WINTER	2/25/97	263	0.02777	25.6%	0.696	0.6956	1.21668	Yes
WINTER	3/17/98	185	0.02714	25.9%	0.478	0.4782	1.18903	Yes
WINTER	3/26/02	217	0.01995	31.6%	0.412	0.4122	0.87380	Yes
WINTER	3/27/00	238	0.01950	32.2%	0.442	0.4421	0.85444	Yes
WINTER	1/30/01	277	0.01856	33.4%	0.490	0.4895	0.81297	Yes
WINTER	12/19/00	175.5	0.01767	34.3%	0.295	0.2954	0.77425	Yes
WINTER	1/20/98	196	0.01666	35.5%	0.311	0.3110	0.73001	Yes
WINTER	12/19/94	178	0.01477	38.1%	0.250	0.2504	0.64705	Yes
WINTER	4/17/01	235	0.01445	38.6%	0.323	0.3235	0.63323	Yes
WINTER	1/12/93	101	0.01389	39.7%	0.134	0.1336	0.60834	Yes
WINTER	3/15/94	205	0.01325	40.7%	0.259	0.2588	0.58069	Yes
WINTER	2/26/02	226	0.00846	52.6%	0.182	0.1820	0.37054	Yes

WINTER	4/2/91	279	0.00757	57.3%	0.201	0.2013	0.33182	Yes
WINTER	4/7/92	104	0.00682	61.5%	0.068	0.0675	0.29864	Yes
WINTER	1/14/02	208	0.00669	62.3%	0.133	0.1325	0.29311	Yes
WINTER	3/26/01	219	0.00644	63.7%	0.134	0.1343	0.28205	Yes
WINTER	4/23/02	230.5	0.00568	69.9%	0.125	0.1247	0.24887	Yes
WINTER	3/23/99	220	0.00568	70.1%	0.119	0.1190	0.24887	Yes
WINTER	3/28/95	197	0.00555	71.5%	0.104	0.1042	0.24334	Yes
WINTER	3/9/93	95	0.00549	72.2%	0.050	0.0497	0.24057	Yes
WINTER	1/7/92	86	0.00543	73.5%	0.044	0.0445	0.23781	Yes
WINTER	2/23/99	228	0.00536	74.0%	0.116	0.1165	0.23504	Yes
WINTER	4/27/99	214	0.00524	75.0%	0.107	0.1068	0.22951	Yes
WINTER	2/14/95	251	0.00524	75.3%	0.125	0.1252	0.22951	Yes
WINTER	1/30/96	423	0.00511	76.3%	0.206	0.2060	0.22398	Yes
WINTER	2/4/92	203	0.00511	76.5%	0.099	0.0988	0.22398	Yes
WINTER	4/15/97	230	0.00505	76.9%	0.111	0.1106	0.22122	Yes
WINTER	3/3/92	214	0.00480	79.8%	0.098	0.0978	0.21015	Yes
WINTER	4/24/00	225	0.00473	80.1%	0.101	0.1014	0.20739	Yes
WINTER	2/9/93	223	0.00473	80.5%	0.101	0.1005	0.20739	Yes
WINTER	3/25/03	214	0.00417	85.3%	0.085	0.0849	0.18250	Yes
WINTER	4/15/03	243	0.00379	88.4%	0.088	0.0876	0.16591	Yes
WINTER	4/14/98	243	0.00379	88.6%	0.088	0.0876	0.16591	Yes
WINTER	12/1/92	248	0.00372	90.0%	0.088	0.0880	0.16315	Yes
WINTER	2/20/96	225	0.00366	90.5%	0.078	0.0784	0.16038	Yes
WINTER	12/20/99	225	0.00328	93.7%	0.070	0.0703	0.14379	Yes
WINTER	1/21/03	259	0.00290	96.1%	0.072	0.0716	0.12720	Yes
WINTER	2/29/00	344.5	0.00290	96.2%	0.095	0.0953	0.12720	Yes
WINTER	3/12/96	260	0.00271	98.3%	0.067	0.0672	0.11890	Yes
WINTER	12/3/02	209	0.00259	99.0%	0.052	0.0515	0.11337	Yes
WINTER	1/25/00	83.5	0.00259	99.2%	0.021	0.0206	0.11337	Yes
			1.1783		22.824	Total number of values =	55	
						Allowable % of exceedances =	10%	
						Allowable no. of exceedances =	6	
						No. of exceedances before reductions =	0	
						No. of exceedances after reductions =	0	
Flow weighted average TDS (mg/L) = (22.824 / 1.1783) / conversion =				203 mg/L				

Average flow per unit area for winter =	0.0260 cms/mi ²
Estimated drainage area for reach 18 =	180 mi ²
Average flow for winter for reach 18 = 0.0260 * 180 =	4.682 cms
Existing total TDS load for winter for reach 18 = 203 mg/L * 4.682 cms * conversions =	90.69 tons/day
Sum of design flows for point sources for reach 18 =	0.000 cms
Assumed effluent TDS concentration for point sources =	60 mg/L
Existing point source TDS load for winter for reach 18 = = 0.000 cms * 60 mg/L * conversions =	0.00 tons/day
Existing NPS TDS load for winter for reach 18 = 90.69 - 0.00 =	90.69 tons/day
Total allowable loading per unit area to meet stds (from Table M.1) =	1.14E+00 tons/day/mi ²
Total allowable loading for reach 18 = 1.14E0 * 180 mi ² =	205.12 tons/day
Explicit MOS for TDS for winter for reach 18 (10% * 205.12) =	20.51 tons/day
WLA for TDS for winter for reach 18 (same as existing load) =	0.00 tons/day
LA for TDS for winter for reach 18 = total - MOS - WLA =	184.61 tons/day

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TABLE M.3. CALCULATIONS FOR EXISTING TDS LOADS AND PERCENT REDUCTION
FOR WINTER FOR OAK BAYOU OUA0179 (REACH 08050002-010)

WQ standard for TDS = 411 mg/L		Error check for reduction is / is not needed: ok						
Percent reduction = 0%		Error check for less or more reduction needed: ok						
<u>Season</u>	<u>Date</u>	<u>Observed TDS at OUA179 (mg/L)</u>	<u>Flow per unit area on sampling day (cms/mi2)</u>	<u>Percent exceedance for flow on sampling day</u>	<u>Current TDS load (tons/day)/mi2</u>	<u>Reduced TDS load (tons/day)/mi2</u>	<u>Allowable TDS load with MOS incorporated (tons/day)/mi2</u>	<u>Reduced load less than or equal to allow. load?</u>
WINTER	3/5/01	203.5	0.0757	9.5%	1.468	1.4680	2.66829	Yes
WINTER	1/23/01	235.0	0.0442	16.7%	0.989	0.9889	1.55650	Yes
TOTALS =		0.1199		2.457		Total number of values = 2		
						Allowable % of exceedances = 10%		
						Allowable no. of exceedances = 1		
						No. of exceedances before reductions = 0		
						No. of exceedances after reductions = 0		
Flow weighted average TDS (mg/L) = (2.457 / 0.1199) / conversion =						215 mg/L		
Average flow per unit area for winter =						0.0260 cms/mi2		
Estimated drainage area for reach 10 =						136 mi2		
Average flow for winter for reach 10 = 0.0260 * 136 =						3.549 cms		
Existing total TDS load for winter for reach 10						72.71 tons/day		
= 215 mg/L * 3.549 cms * conversions =								
Sum of design flows for point sources for reach 10 =						0.000 cms		
Assumed effluent TDS concentration for point sources =						60 mg/L		
Existing point source TDS load for winter for reach 10 =						0.00 tons/day		
= 0.000 cms * 60 mg/L * conversions =								
Existing NPS TDS load for winter for reach 10 = 72.71 - 0.00 =						72.71 tons/day		

Total allowable loading per unit area to meet stds (from Table M.1) =	1.02E+00 tons/day/mi2
Total allowable loading for reach 10 = $1.02E0 * 136 \text{ mi}^2 =$	138.93 tons/day
Explicit MOS for TDS for winter for reach 10 ($10\% * 138.93$) =	13.89 tons/day
WLA for TDS for winter for reach 10 (same as existing load) =	0.00 tons/day
LA for TDS for winter for reach 10 = total - MOS - WLA =	125.04 tons/day

FILE: R:\PROJECTS\2110-613\TECH\TMDL\REVISED\TMDL TDS-WINTER.XLS

Figure M.1. Winter Flow Duration Curve for USGS 07369680 Bayou Macon near Eudora

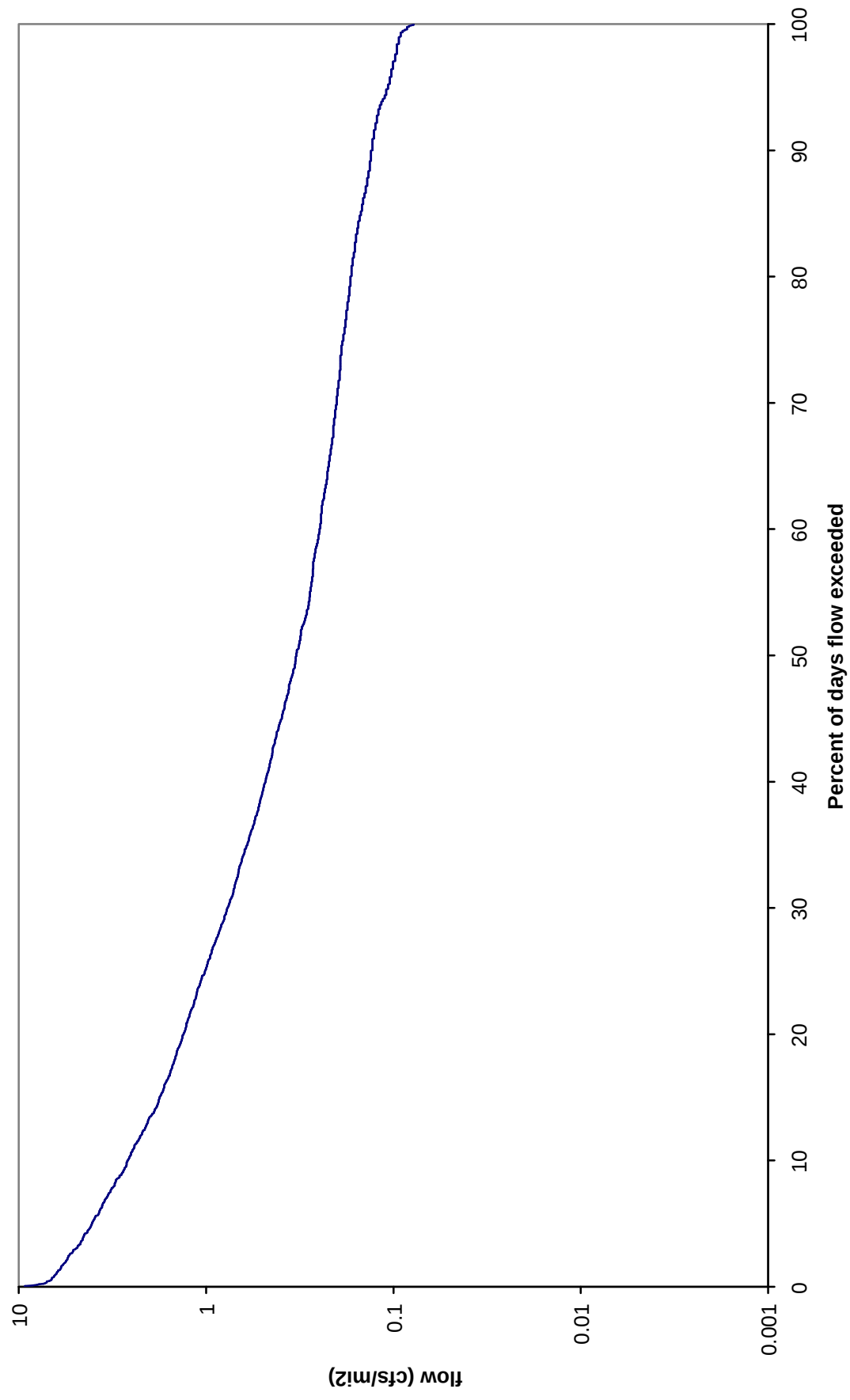


Figure M.2. Winter TDS Load Duration Curve for Boeuf River at OUA0015A

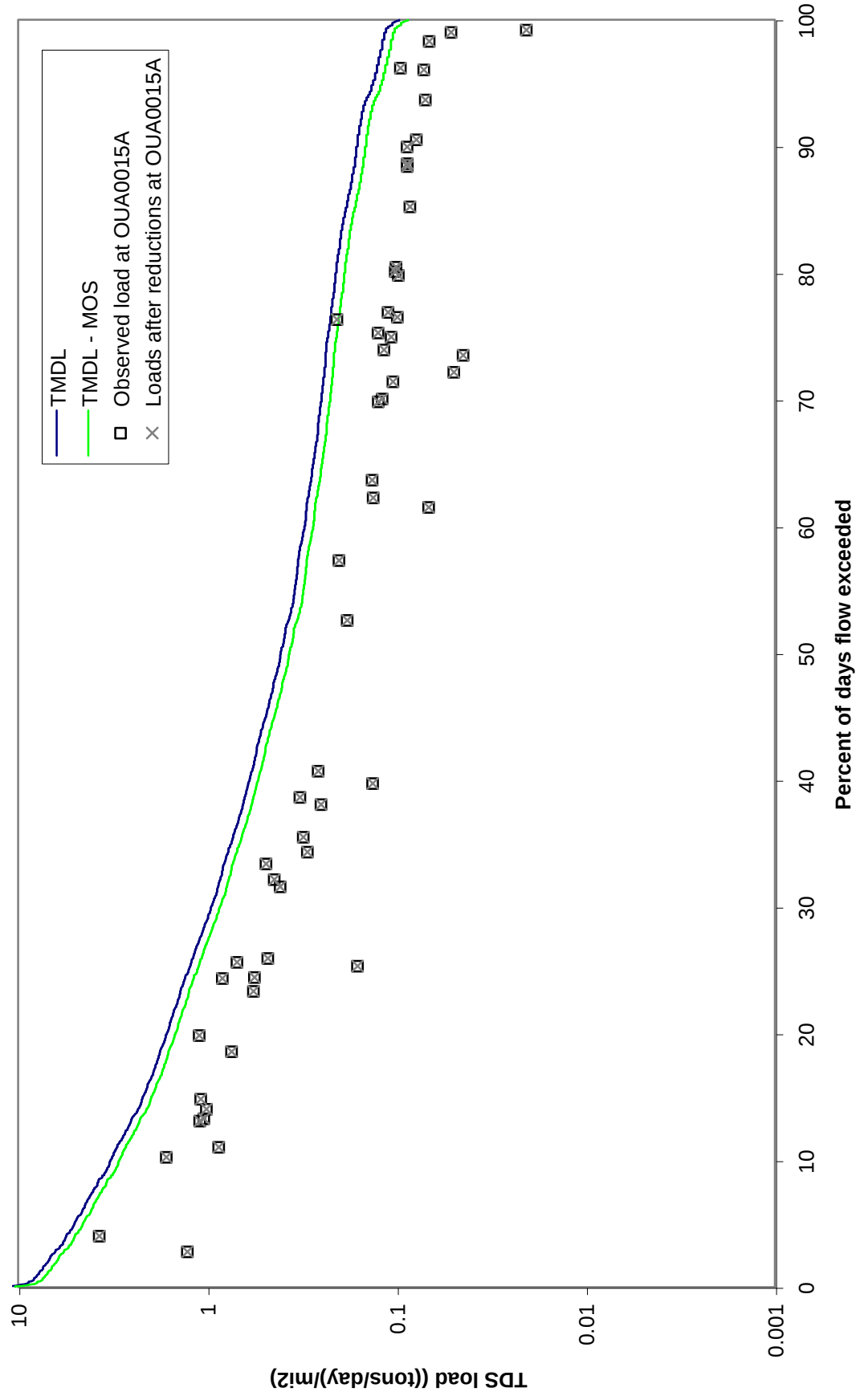
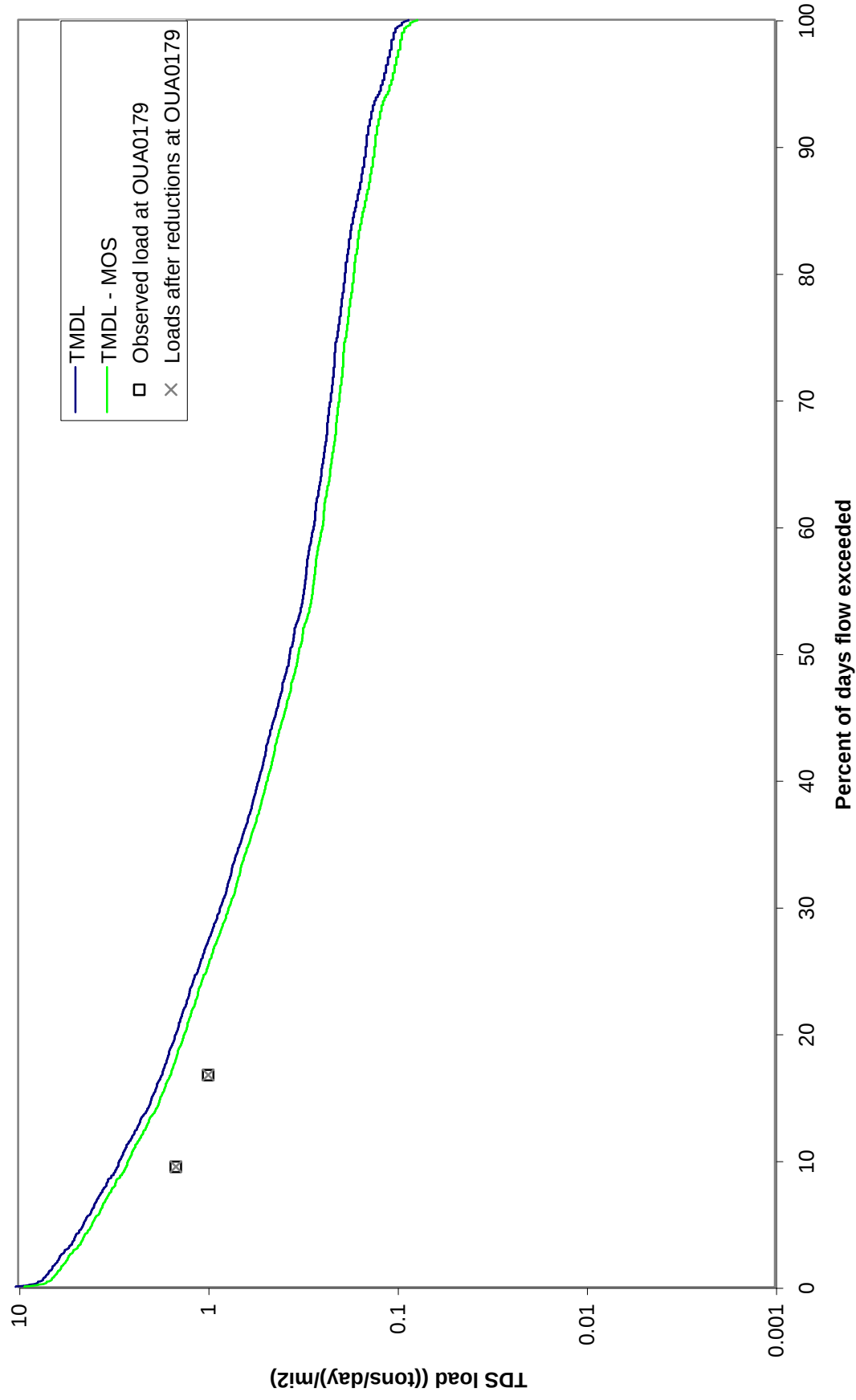


Figure M.3. Winter TDS Load Duration Curve for Oak Bayou at OUA0179



APPENDIX N

WLAs for Individual Point Sources

TABLE N.1. CALCULATIONS FOR ALLOWABLE LOADS PER UNIT AREA FOR SULFATE DURING SUMMER

Percentage of total flow in basin represented by Bayou Macon:

<u>USGS gage number and name</u>		Avg. annual flow 1958-67 (cfs)	Drainage area (mi ²)	Percent of combined flow
07367700	Boeuf River near AR/LA state line	875	785	65.2%
07369700	Bayou Macon near Kilbourne, LA	467	504	34.8%
		1,342	1,289	100.0%

Margin of Safety (MOS) = 10%

Sulfate standard = 30 mg/L									
Season	Date	Observed flow at Eudora (cfs)	Percent exceedance for observed flow	Adjusted flow for entire basin			"Width" for area under curves	Allowable	
				cfs	cfs/mi ²	cms/mi ²		Sulfates load to meet standard (tons/day)/mi ²	Target Sulfates load with MOS incorporated (tons/day)/mi ²
A	B	C	D	E = C / 34.8%	F = E / 1289 mi ²	G = E / 35.32	H = D1 - D2	I = G * 30 mg/L * conversion	J = I * (1 - MOS)
SUMMER	06/22/02	24	99.98%	69.0	0.054	0.0015	0.03%	0.004	0.004
SUMMER	06/20/02	25	99.95%	71.8	0.056	0.0016	0.03%	0.005	0.004
SUMMER	06/21/02	26	99.92%	74.7	0.058	0.0016	0.03%	0.005	0.004
SUMMER	06/19/02	31	99.89%	89.1	0.069	0.0020	0.03%	0.006	0.005
SUMMER	05/21/95	32	99.86%	92.0	0.071	0.0020	0.03%	0.006	0.005
SUMMER	05/22/95	32	99.83%	92.0	0.071	0.0020	0.03%	0.006	0.005
SUMMER	10/10/01	32	99.80%	92.0	0.071	0.0020	0.03%	0.006	0.005
SUMMER	05/20/95	33	99.77%	94.8	0.074	0.0021	0.03%	0.006	0.005
									K = H * I
									1.35E-06
									1.40E-06
									1.46E-06
									1.74E-06
									1.80E-06
									1.80E-06
									1.80E-06
									1.85E-06

For brevity, most of the rows in this spreadsheet have been hidden (between the 99.77% and the 0.23% exceedances).

SUMMER	05/03/91	3110	0.23%	8936.8	6.933	0.1963	0.03%	0.561	0.505	1.75E-04
SUMMER	05/06/91	3110	0.20%	8936.8	6.933	0.1963	0.03%	0.561	0.505	1.75E-04
SUMMER	05/02/91	3130	0.17%	8994.3	6.978	0.1976	0.03%	0.564	0.508	1.76E-04
SUMMER	05/04/91	3130	0.14%	8994.3	6.978	0.1976	0.03%	0.564	0.508	1.76E-04
SUMMER	05/05/91	3130	0.11%	8994.3	6.978	0.1976	0.03%	0.564	0.508	1.76E-04
SUMMER	05/01/91	3170	0.08%	9109.2	7.067	0.2001	0.03%	0.572	0.515	1.78E-04
SUMMER	05/31/98	3250	0.05%	9339.1	7.245	0.2051	0.03%	0.586	0.527	1.83E-04
SUMMER	05/30/98	3270	0.02%	9396.6	7.290	0.2064	0.03%	0.590	0.531	1.84E-04

TOTALS = 100.00%

3.00E-02

TABLE N.2. CALCULATIONS FOR SULFATE LOADS AND PERCENT REDUCTION
FOR SUMMER FOR BOEUF RIVER AT OUA0015A (REACH 08050001-018)

WQ standard for Sulfate = 30 mg/L		Error check for reduction is / is not needed:		ok				
Percent reduction = 59%		Error check for less or more reduction needed:		ok				
Season	Date	Observed Sulfates at OUA0179 (mg/L)	Flow per unit area on sampling day (cms/mi2)	Percent exceedance for flow on sampling day	Current Sulfates load (tons/day)/mi2	Reduced Sulfates load (tons/day)/mi2	Allowable Sulfate load with MOS incorporated (tons/day)/mi2	Reduced load less than or equal to allow. load?
SUMMER	7/19/94	13.5	0.0802	1.6%	0.103	0.0423	0.2061	Yes
SUMMER	11/5/02	15.0	0.0434	3.3%	0.062	0.0254	0.1117	Yes
SUMMER	6/21/93	36.0	0.0323	4.6%	0.111	0.0453	0.0829	Yes
SUMMER	6/17/03	12.8	0.0304	5.0%	0.037	0.0152	0.0781	Yes
SUMMER	8/16/94	24.9	0.0242	6.2%	0.057	0.0235	0.0622	Yes
SUMMER	11/28/94	21.9	0.0241	6.2%	0.050	0.0206	0.0620	Yes
SUMMER	7/27/99	76.8	0.0210	8.7%	0.154	0.0630	0.0540	No
SUMMER	7/2/91	33.0	0.0193	9.7%	0.061	0.0249	0.0497	Yes
SUMMER	6/28/94	47.5	0.0191	9.9%	0.087	0.0355	0.0492	Yes
SUMMER	11/23/93	13.0	0.0175	11.1%	0.022	0.0089	0.0450	Yes
SUMMER	11/16/98	43.0	0.0158	12.4%	0.065	0.0265	0.0406	Yes
SUMMER	9/29/98	46.3	0.0151	12.9%	0.067	0.0274	0.0390	Yes
SUMMER	6/29/99	23.9	0.0145	13.9%	0.033	0.0135	0.0372	Yes
SUMMER	5/22/01	22.0	0.0138	14.4%	0.029	0.0119	0.0355	Yes
SUMMER	7/22/98	21.3	0.0104	19.6%	0.021	0.0087	0.0268	Yes
SUMMER	5/13/97	13.6	0.0090	23.7%	0.012	0.0048	0.0232	Yes
SUMMER	9/27/94	39.8	0.0090	24.1%	0.034	0.0140	0.0232	Yes
SUMMER	6/9/98	14.6	0.0090	24.3%	0.012	0.0051	0.0230	Yes
SUMMER	7/26/93	36.9	0.0086	26.3%	0.030	0.0124	0.0221	Yes
SUMMER	8/8/95	42.3	0.0085	26.9%	0.034	0.0140	0.0217	Yes
SUMMER	9/23/03	26.7	0.0084	27.1%	0.021	0.0088	0.0216	Yes
SUMMER	8/17/99	45.6	0.0083	27.5%	0.036	0.0148	0.0214	Yes
SUMMER	5/24/94	26.4	0.0083	27.6%	0.021	0.0085	0.0213	Yes
SUMMER	8/4/92	18.3	0.0081	28.3%	0.014	0.0058	0.0209	Yes
SUMMER	8/11/98	28.1	0.0080	28.8%	0.021	0.0087	0.0205	Yes
SUMMER	9/1/92	28.8	0.0076	30.9%	0.021	0.0086	0.0196	Yes

SUMMER	8/6/96	17.5	0.0074	32.5%	0.012	0.0050	0.0190	Yes
SUMMER	8/20/01	24.1	0.0073	32.8%	0.017	0.0069	0.0188	Yes
SUMMER	6/4/91	14.0	0.0073	33.1%	0.010	0.0040	0.0188	Yes
SUMMER	9/1/98	30.0	0.0070	35.7%	0.020	0.0082	0.0180	Yes
SUMMER	7/16/96	98.6	0.0068	38.0%	0.064	0.0262	0.0175	No
SUMMER	7/17/95	18.4	0.0068	38.1%	0.012	0.0049	0.0175	Yes
SUMMER	6/10/97	18.1	0.0067	39.5%	0.012	0.0047	0.0172	Yes
SUMMER	8/6/91	47.0	0.0066	40.9%	0.030	0.0122	0.0170	Yes
SUMMER	7/15/03	21.9	0.0064	42.2%	0.013	0.0055	0.0166	Yes
SUMMER	5/28/02	9.4	0.0064	42.3%	0.006	0.0024	0.0166	Yes
SUMMER	5/20/03	10.0	0.0063	43.3%	0.006	0.0025	0.0162	Yes
SUMMER	9/4/90	38.0	0.0063	44.2%	0.023	0.0094	0.0162	Yes
SUMMER	7/7/92	25.4	0.0062	45.2%	0.015	0.0062	0.0161	Yes
SUMMER	6/2/92	50.0	0.0062	46.0%	0.029	0.0121	0.0159	Yes
SUMMER	6/20/95	52.4	0.0061	47.4%	0.030	0.0124	0.0156	Yes
SUMMER	11/7/00	8.8	0.0058	50.9%	0.005	0.0020	0.0149	Yes
SUMMER	10/1/96	12.2	0.0058	51.0%	0.007	0.0028	0.0149	Yes
SUMMER	8/12/03	39.1	0.0056	53.6%	0.021	0.0085	0.0143	Yes
SUMMER	10/15/02	5.7	0.0055	54.3%	0.003	0.0012	0.0141	Yes
SUMMER	7/25/00	91.4	0.0054	55.2%	0.047	0.0194	0.0140	No
SUMMER	5/21/96	32.5	0.0053	56.8%	0.016	0.0067	0.0136	Yes
SUMMER	11/25/91	11.6	0.0053	57.0%	0.006	0.0024	0.0136	Yes
SUMMER	5/25/99	23.2	0.0052	57.4%	0.012	0.0047	0.0135	Yes
SUMMER	8/26/97	21.3	0.0052	58.6%	0.011	0.0043	0.0133	Yes
SUMMER	5/18/93	20.2	0.0052	58.8%	0.010	0.0041	0.0133	Yes
SUMMER	5/30/00	24.1	0.0050	59.9%	0.012	0.0048	0.0130	Yes
SUMMER	8/20/02	23.1	0.0050	60.6%	0.011	0.0045	0.0128	Yes
SUMMER	9/21/99	42.7	0.0049	61.5%	0.020	0.0082	0.0127	Yes
SUMMER	6/18/96	71.8	0.0049	61.7%	0.034	0.0138	0.0127	No
SUMMER	6/27/00	30.9	0.0049	62.4%	0.014	0.0059	0.0125	Yes
SUMMER	9/17/01	13.9	0.0048	63.7%	0.006	0.0026	0.0123	Yes
SUMMER	9/10/96	29.8	0.0048	64.1%	0.014	0.0056	0.0123	Yes
SUMMER	7/24/01	65.7	0.0045	68.3%	0.028	0.0117	0.0117	Yes
SUMMER	7/22/97	31.4	0.0045	68.6%	0.014	0.0056	0.0117	Yes
SUMMER	6/19/01	57.7	0.0044	70.8%	0.024	0.0099	0.0114	Yes
SUMMER	5/19/98	76.6	0.0044	72.3%	0.032	0.0130	0.0112	No
SUMMER	9/19/00	49.9	0.0042	73.6%	0.020	0.0082	0.0109	Yes

SUMMER	10/28/97	19.8	0.0042	73.8%	0.008	0.0033	0.0109	Yes
SUMMER	6/25/02	108.4	0.0041	75.2%	0.042	0.0174	0.0105	No
SUMMER	9/21/93	45.0	0.0040	77.1%	0.017	0.0071	0.0104	Yes
SUMMER	9/17/02	26.9	0.0040	77.6%	0.010	0.0042	0.0102	Yes
SUMMER	10/17/00	53.6	0.0039	80.4%	0.020	0.0081	0.0099	Yes
SUMMER	11/27/90	26.0	0.0039	81.1%	0.010	0.0039	0.0099	Yes
SUMMER	11/19/01	72.0	0.0038	81.7%	0.026	0.0107	0.0097	No
SUMMER	10/19/99	37.5	0.0038	82.1%	0.014	0.0055	0.0097	Yes
SUMMER	11/18/97	21.8	0.0038	82.7%	0.008	0.0032	0.0097	Yes
SUMMER	11/19/96	18.3	0.0038	82.8%	0.007	0.0027	0.0097	Yes
SUMMER	10/30/90	25.0	0.0036	86.0%	0.009	0.0035	0.0093	Yes
SUMMER	9/29/92	35.9	0.0035	88.7%	0.012	0.0049	0.0089	Yes
SUMMER	9/30/97	26.5	0.0034	89.2%	0.009	0.0035	0.0088	Yes
SUMMER	11/13/95	65.4	0.0033	90.9%	0.021	0.0085	0.0086	Yes
SUMMER	9/19/95	63.4	0.0033	91.0%	0.020	0.0083	0.0086	Yes
SUMMER	5/5/92	36.7	0.0033	91.5%	0.012	0.0048	0.0086	Yes
SUMMER	5/23/95	41.3	0.0033	92.4%	0.013	0.0053	0.0084	Yes
SUMMER	10/17/95	61.7	0.0032	93.3%	0.019	0.0078	0.0083	Yes
SUMMER	11/22/99	92.4	0.0030	95.0%	0.027	0.0109	0.0078	No
SUMMER	10/23/01	10.4	0.0028	96.9%	0.003	0.0011	0.0073	Yes
SUMMER	10/26/93	28.5	0.0025	98.4%	0.007	0.0028	0.0065	Yes

TOTALS = 0.7591

2.190
Total number of values = 84
Allowable % of exceedances = 10%
Allowable no. of exceedances = 9
No. of exceedances before reductions = 38
No. of exceedances after reductions = 8

Flow weighted average Sulfates (mg/L) = (2.190 / 0.7591) / conversion = 30 mg/L

Average flow per unit area for summer =

Estimated drainage area for reach 18 =

Average flow for summer for reach 18 = 0.0105 * 180 =

0.0105 cms/mi2
180 mi2
1.887 cms

Existing total Sulfates load for summer for reach 18

= 30 mg/L * 1.887 cms * conversions =

5.39 tons/day

Sum of design flows for point sources for reach 18 =	0.000 cms
Assumed effluent Sulfates concentration for point sources =	60 mg/L
Existing point source Sulfates load for summer for reach 18 = = 0.000 cms * 60 mg/L * conversions =	0.00 tons/day
Existing NPS Sulfates load for summer for reach 18 = 5.39 - 0.00 =	5.39 tons/day
Total allowable loading per unit area to meet sSulfates (from Table N.1) =	3.00E-02 tons/day/mi2
Total allowable loading for reach 18 = 3.00E-2 * 180 mi2 =	5.39 tons/day
Explicit MOS for Sulfates for summer for reach 18 (10% * 5.39) =	0.54 tons/day
WLA for Sulfates for summer for reach 18 (same as existing load) =	0.00 tons/day
LA for Sulfates for summer for reach 18 = total - MOS - WLA =	4.85 tons/day

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Figure N.1. Summer Flow Duration Curve for USGS 07369680 Bayou Macon near Eudora

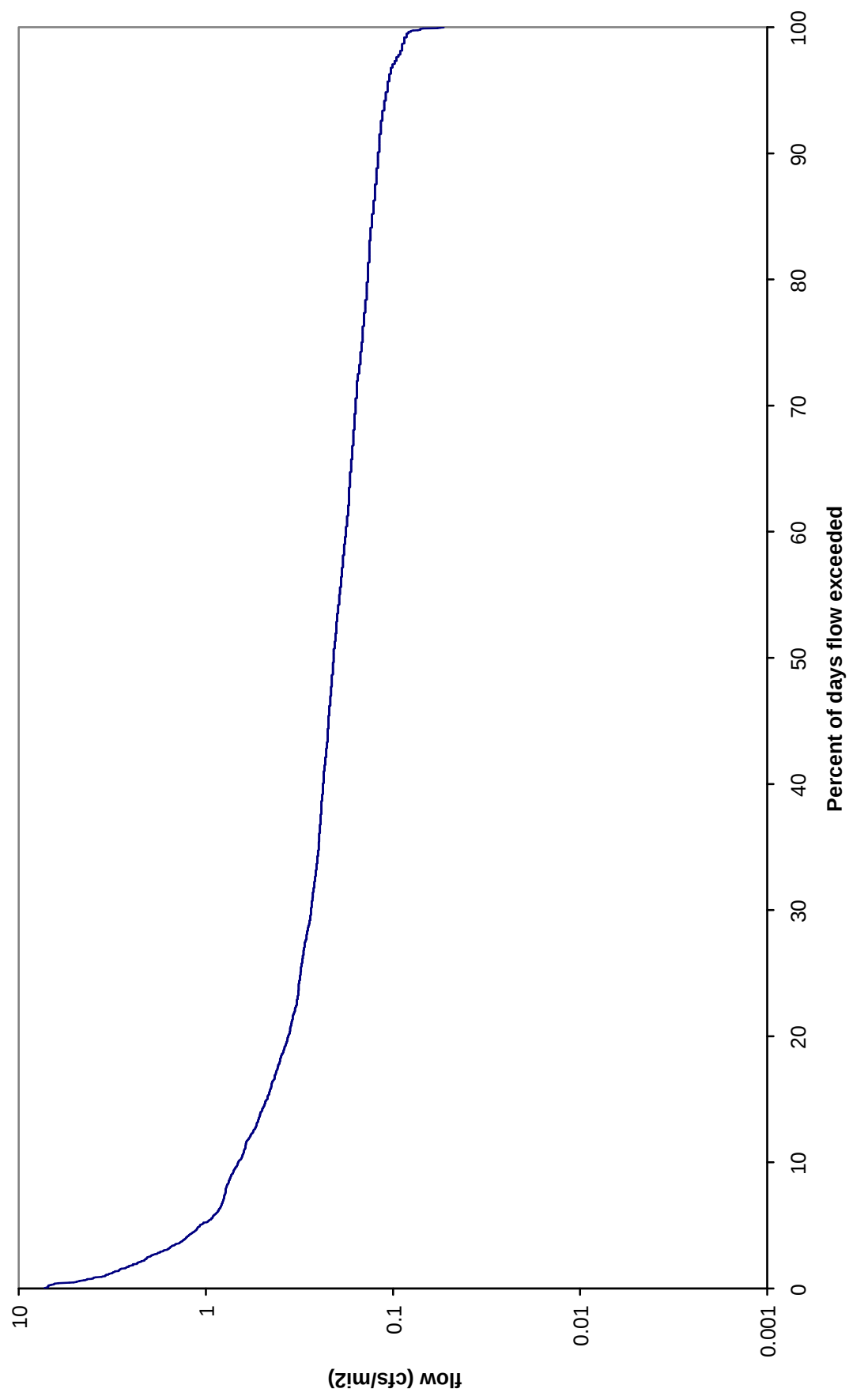
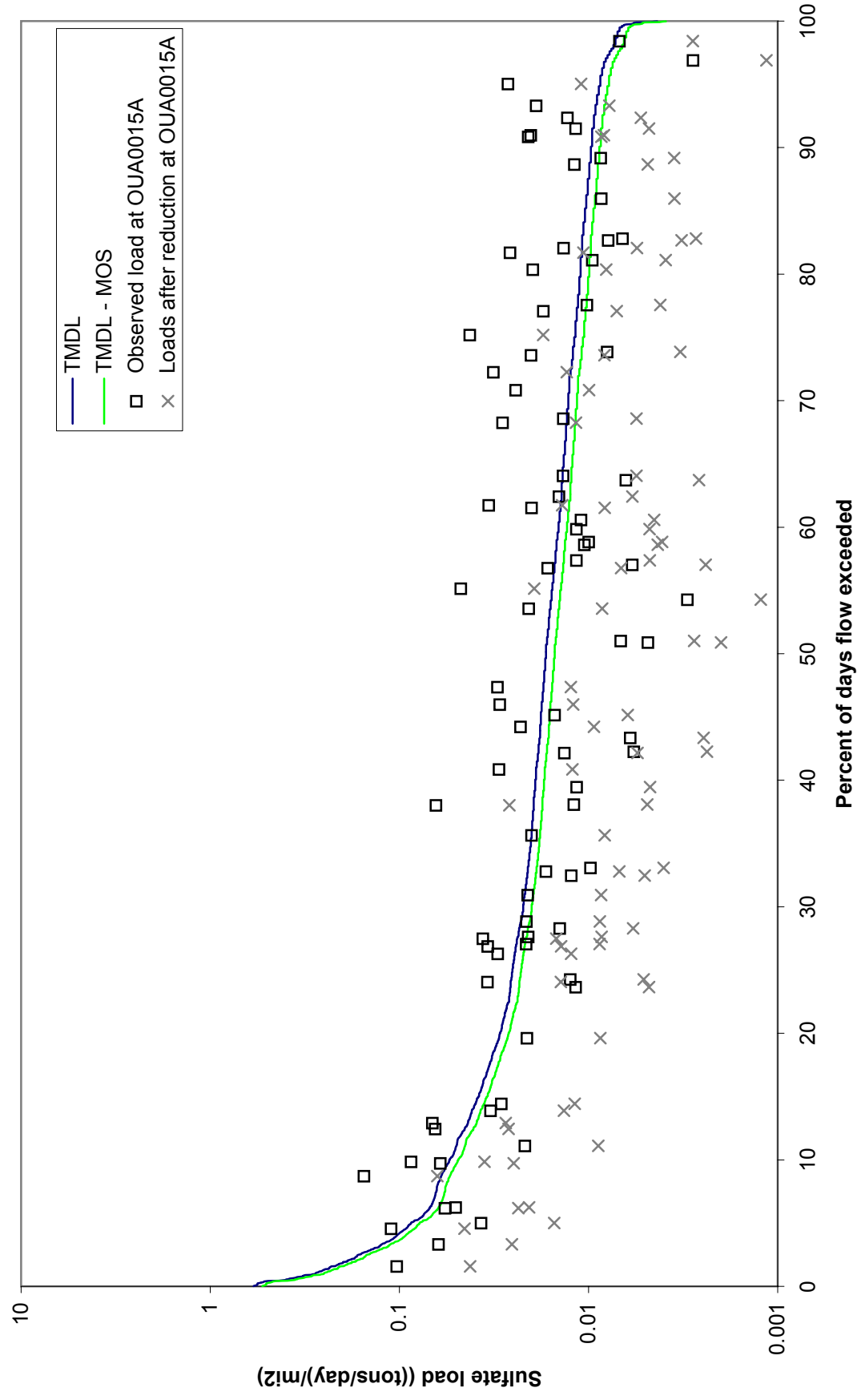


Figure N.2. Summer Sulfate Load Duration Curve for Boeuf River at OUA0015A



APPENDIX O

Calculations for Winter Sulfate TMDL

TABLE O.1. CALCULATIONS FOR ALLOWABLE LOADS PER UNIT AREA FOR SULFATE DURING WINTER

Percentage of total flow in basin represented by Bayou Macon:

USGS gage number and name	Avg. annual flow 1958-67 (cfs)	Drainage area (mi ²)	Percent of combined flow
07367700 Boeuf River near AR/LA state line	875	785	65.2%
07369700 Bayou Macon near Kilbourne, LA	467	504	34.8%
	1,342	1,289	100.0%

Margin of Safety (MOS) = 10%

Sulfate standard = 30 mg/L											
Season	Date	Observed flow at Eudora (cfs)	Percent exceedance for observed flow	Adjusted flow for entire basin				"Width" for area under curves	Allowable		"Area under curve" (tons/day)/mi2
				cfs	E = C / 34.8%	F = E / 1289 mi2	G = E / 35.32		chloride load at this flow (tons/day)/mi2	Target Sulfates load at this flow (tons/day)/mi2	
A	B	C	D					H = D1 - D2	I = G * 30 mg/L	J = I * (1 - MOS)	K = H * I
WINTER	02/22/00	35	99.98%	100.6	0.078	0.0022	0.04%	0.01	0.01	0.01	2.78E-06
WINTER	02/23/00	35	99.93%	100.6	0.078	0.0022	0.04%	0.01	0.01	0.01	2.78E-06
WINTER	02/21/00	36	99.89%	103.4	0.080	0.0023	0.04%	0.01	0.01	0.01	2.86E-06
WINTER	02/20/00	37	99.85%	106.3	0.082	0.0023	0.04%	0.01	0.01	0.01	2.94E-06
WINTER	02/24/00	37	99.80%	106.3	0.082	0.0023	0.04%	0.01	0.01	0.01	2.94E-06
WINTER	03/05/00	38	99.76%	109.2	0.085	0.0024	0.04%	0.01	0.01	0.01	3.02E-06
WINTER	03/06/00	38	99.71%	109.2	0.085	0.0024	0.04%	0.01	0.01	0.01	3.02E-06
WINTER	03/07/00	38	99.67%	109.2	0.085	0.0024	0.04%	0.01	0.01	0.01	3.02E-06

For brevity, most of the rows in this spreadsheet have been hidden (between the 99.67% and the 0.33% exceedances).

WINTER	04/30/91	3200	0.33%	9195.4	7.134	0.2020	0.04%	0.58	0.52	2.54E-04
WINTER	04/26/95	3250	0.29%	9339.1	7.245	0.2051	0.04%	0.59	0.53	2.58E-04
WINTER	02/01/99	3310	0.24%	9511.5	7.379	0.2089	0.04%	0.60	0.54	2.63E-04
WINTER	01/30/99	3500	0.20%	10057.5	7.803	0.2209	0.04%	0.63	0.57	2.78E-04
WINTER	01/31/99	3560	0.15%	10229.9	7.936	0.2247	0.04%	0.64	0.58	2.83E-04
WINTER	04/25/95	3790	0.11%	10890.8	8.449	0.2392	0.04%	0.68	0.62	3.01E-04
WINTER	04/24/95	4150	0.07%	11925.3	9.252	0.2619	0.04%	0.75	0.67	3.30E-04
WINTER	04/23/95	4170	0.02%	11982.8	9.296	0.2632	0.04%	0.75	0.68	3.32E-04

TOTALS = 100.00%

7.44E-02

TABLE O.2. CALCULATIONS FOR SULFATE LOADS AND PERCENT REDUCTION
FOR WINTER FOR BOEUF RIVER AT OUA0015A (REACH 08050001-018)

WQ standard for Sulfates = 30 mg/L		Error check for reduction is / is not needed:				ok		
Percent reduction = 0%		Error check for less or more reduction needed:				ok		
Season	Date	Observed Sulfates at OUA0015A (mg/L)	Flow per unit area on sampling day (cms/mi2)	Percent exceedance for flow on sampling day	Allowable			
					Current Sulfates load (tons/day)/mi2	Reduced Sulfates load (tons/day)/mi2	Sulfates load with MOS incorporated (tons/day)/mi2	Reduced load less than or equal to allow. load?
WINTER	1/2/91	11.0	0.0726	10.3%	0.076	0.0760	0.1867	Yes
WINTER	2/5/91	14.0	0.0406	18.6%	0.054	0.0542	0.1045	Yes
WINTER	3/12/91	4.0	0.0281	25.3%	0.011	0.0107	0.0722	Yes
WINTER	4/2/91	12.0	0.0076	57.3%	0.009	0.0087	0.0195	Yes
WINTER	1/7/92	9.3	0.0054	73.5%	0.005	0.0048	0.0140	Yes
WINTER	2/4/92	15.3	0.0051	76.5%	0.007	0.0074	0.0131	Yes
WINTER	3/3/92	16.3	0.0048	79.8%	0.007	0.0074	0.0123	Yes
WINTER	4/7/92	9.7	0.0068	61.5%	0.006	0.0063	0.0175	Yes
WINTER	12/1/92	21.0	0.0037	90.0%	0.007	0.0074	0.0096	Yes
WINTER	1/12/93	10.1	0.0139	39.7%	0.013	0.0134	0.0357	Yes
WINTER	2/9/93	18.3	0.0047	80.5%	0.008	0.0083	0.0122	Yes
WINTER	3/9/93	7.8	0.0055	72.2%	0.004	0.0041	0.0141	Yes
WINTER	4/13/93	11.8	0.0299	24.4%	0.034	0.0336	0.0768	Yes
WINTER	12/20/93	14.1	0.0035	92.6%	0.005	0.0047	0.0089	Yes
WINTER	1/18/94	14.8	0.0378	19.9%	0.053	0.0533	0.0972	Yes
WINTER	2/15/94	7.5	0.1452	2.8%	0.104	0.1040	0.3733	Yes
WINTER	3/15/94	9.0	0.0133	40.7%	0.011	0.0114	0.0341	Yes
WINTER	4/19/94	15.0	0.0483	15.4%	0.069	0.0690	0.1242	Yes
WINTER	12/19/94	7.9	0.0148	38.1%	0.011	0.0111	0.0380	Yes
WINTER	2/14/95	17.7	0.0052	75.3%	0.009	0.0088	0.0135	Yes
WINTER	3/28/95	13.1	0.0056	71.5%	0.007	0.0069	0.0143	Yes
WINTER	12/18/95	31.6	0.0300	24.4%	0.090	0.0902	0.0771	No
WINTER	1/30/96	24.3	0.0051	76.3%	0.012	0.0118	0.0131	Yes
WINTER	2/20/96	16.3	0.0037	90.5%	0.006	0.0057	0.0094	Yes
WINTER	3/12/96	18.2	0.0027	98.3%	0.005	0.0047	0.0070	Yes
WINTER	4/23/96	19.2	0.1269	4.0%	0.232	0.2320	0.3262	Yes

WINTER	12/17/96	16.9	0.0572	13.3%	0.092	0.0921	0.1472	Yes
WINTER	2/25/97	4.9	0.0278	25.6%	0.013	0.0130	0.0714	Yes
WINTER	3/11/97	12.4	0.0265	26.4%	0.031	0.0313	0.0682	Yes
WINTER	4/15/97	14.5	0.0050	76.9%	0.007	0.0070	0.0130	Yes
WINTER	1/20/98	4.4	0.0167	35.5%	0.007	0.0070	0.0428	Yes
WINTER	2/17/98	3.7	0.0682	11.0%	0.024	0.0243	0.1753	Yes
WINTER	3/17/98	8.8	0.0271	25.9%	0.023	0.0227	0.0698	Yes
WINTER	4/14/98	21.1	0.0038	88.6%	0.008	0.0076	0.0097	Yes
WINTER	12/22/98	14.1	0.0317	23.3%	0.043	0.0425	0.0815	Yes
WINTER	1/26/99	6.6	0.0505	14.8%	0.032	0.0319	0.1298	Yes
WINTER	2/23/99	11.6	0.0054	74.0%	0.006	0.0059	0.0138	Yes
WINTER	3/23/99	8.6	0.0057	70.1%	0.005	0.0046	0.0146	Yes
WINTER	12/20/99	16.4	0.0033	93.7%	0.005	0.0051	0.0084	Yes
WINTER	1/25/00	7.3	0.0026	99.2%	0.002	0.0018	0.0067	Yes
WINTER	2/29/00	13.0	0.0029	96.2%	0.004	0.0036	0.0075	Yes
WINTER	3/27/00	9.9	0.0195	32.2%	0.018	0.0185	0.0502	Yes
WINTER	4/24/00	12.6	0.0047	80.1%	0.006	0.0057	0.0122	Yes
WINTER	12/19/00	9.0	0.0177	34.3%	0.015	0.0151	0.0454	Yes
WINTER	1/30/01	10.6	0.0186	33.4%	0.019	0.0188	0.0477	Yes
WINTER	2/27/01	5.6	0.0487	15.4%	0.026	0.0259	0.1253	Yes
WINTER	3/26/01	9.7	0.0064	63.7%	0.006	0.0059	0.0166	Yes
WINTER	4/17/01	12.3	0.0145	38.6%	0.017	0.0169	0.0372	Yes
WINTER	12/11/01	10.0	0.0530	14.0%	0.050	0.0505	0.1363	Yes
WINTER	1/14/02	8.2	0.0067	62.3%	0.005	0.0052	0.0172	Yes
WINTER	2/26/02	6.1	0.0085	52.6%	0.005	0.0049	0.0217	Yes
WINTER	3/26/02	6.5	0.0199	31.6%	0.012	0.0123	0.0513	Yes
WINTER	4/23/02	11.2	0.0057	69.9%	0.006	0.0060	0.0146	Yes
WINTER	12/3/02	18.9	0.0026	99.0%	0.005	0.0047	0.0067	Yes
WINTER	1/21/03	13.4	0.0029	96.1%	0.004	0.0037	0.0075	Yes
WINTER	2/25/03	5.0	0.0578	13.1%	0.027	0.0274	0.1487	Yes
WINTER	3/25/03	8.5	0.0042	85.3%	0.003	0.0034	0.0107	Yes
WINTER	4/15/03	15.1	0.0038	88.4%	0.005	0.0054	0.0097	Yes
TOTALS =		1.3001			1.387	Total number of values =	58	
						Allowable % of exceedances =	10%	
						Allowable no. of exceedances =	6	
						No. of exceedances before reductions =	1	
						No. of exceedances after reductions =	1	

Flow weighted average Sulfate (mg/L) = (1.387 / 1.3001) / conversion =	11 mg/L
Average flow per unit area for winter =	0.0260 cms/mi2
Estimated drainage area for reach 18 =	180 mi2
Average flow for winter for reach 18 = 0.0260 * 180 =	4.682 cms
Existing total Sulfates load for winter for reach 18 = 11 mg/L * 4.682 cms * conversions =	4.99 tons/day
Sum of design flows for point sources for reach 18 =	0.000 cms
Assumed effluent Sulfates concentration for point sources =	60 mg/L
Existing point source Sulfates load for winter for reach 18 = = 0.000 cms * 60 mg/L * conversions =	0.00 tons/day
Existing NPS Sulfates load for winter for reach 18 = 4.99 - 0.00 =	4.99 tons/day
Total allowable loading per unit area to meet Sulfates (from Table O.1) =	7.44E-02 tons/day/mi2
Total allowable loading for reach 18 = 7.44E-2 * 180 mi2 =	13.38 tons/day
Explicit MOS for Sulfates for winter for reach 18 (10% * 13.38) =	1.34 tons/day
WLA for Sulfates for winter for reach 18 (same as existing load) =	0.00 tons/day
LA for Sulfates for winter for reach 18 = total - MOS - WLA =	12.04 tons/day

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Figure O.1. Winter Flow Duration Curve for USGS 07369680 Bayou Macon near Eudora

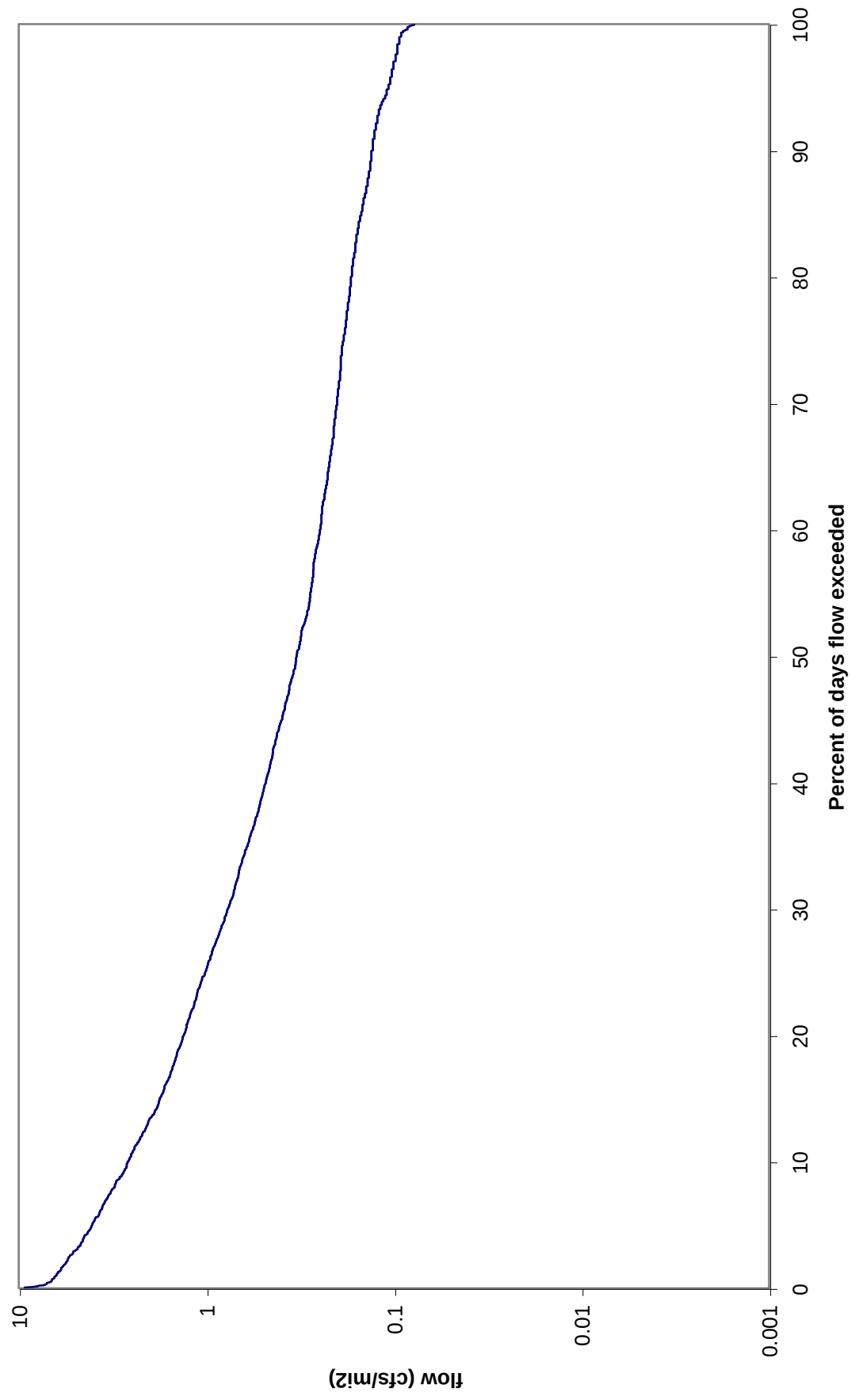
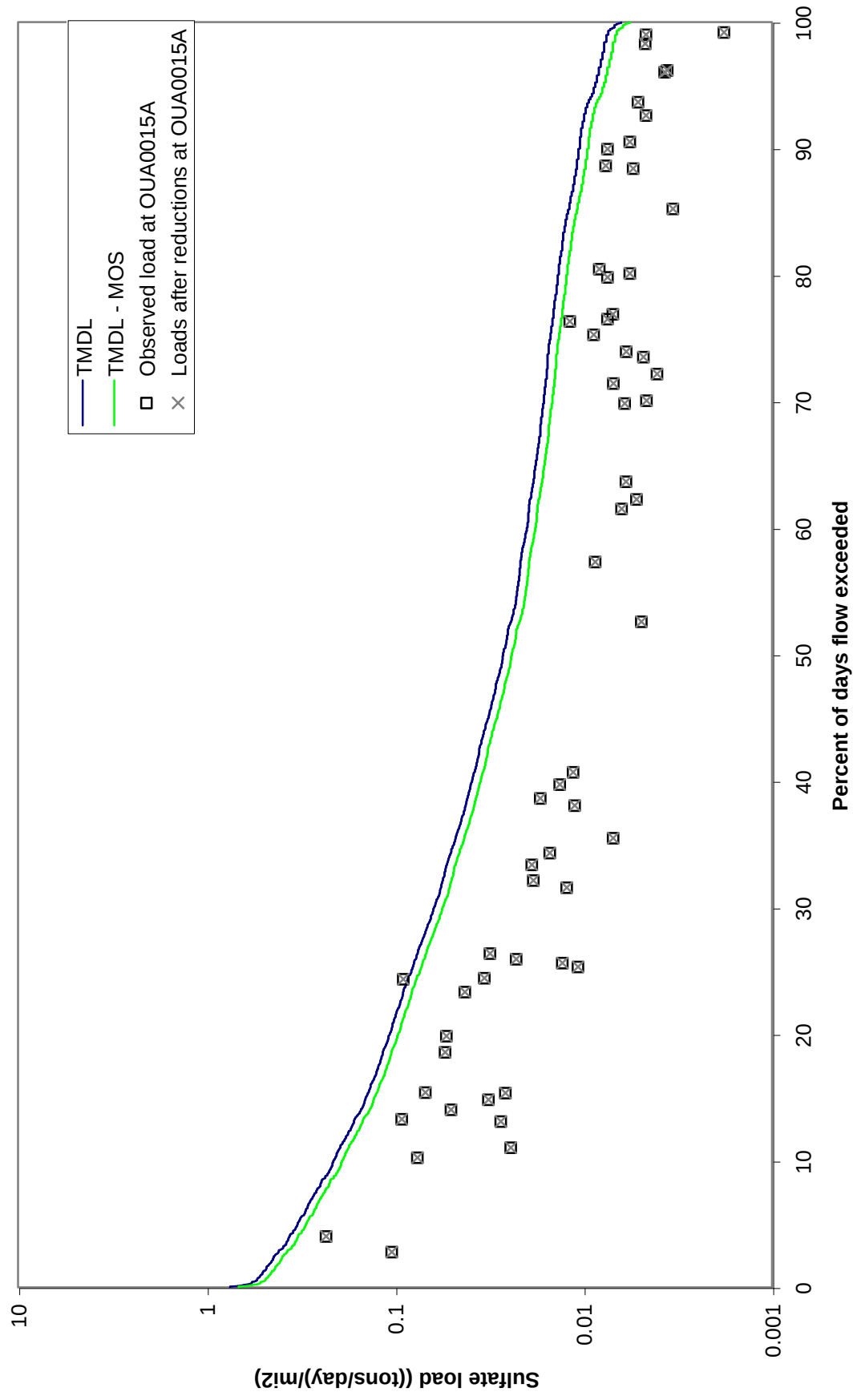


Figure O.2. Winter Sulfate Load Duration Curve for Boeuf River at OUA0015A



APPENDIX P

WLAs for Individual Point Sources

Table P.1 Summary of WLAs for individual point sources.

Reach ID	Stream Name	Parameter	Permit Number	Facility Name	Design flow rate (MGD)	Assumed effluent conc. (mg/L)	Wasteload allocation (lbs/day)	Future Growth (50% of WLA) (lbs/day)	Reduction required?
08050001-022	Big Bayou	Chloride	AR0022071	City of McGehee	0.6	60	300.4	150.2	NO
			AR0022250	City of Dermott-South Pond	1.2	60	600.9	300.4	NO
			AR0041297	City of Montrose	0.1	60	50.1	25.0	NO
				TOTAL	1.9		951.4	475.7	
08050001-018	Boeuf River	Chloride	None						
		TDS	None						
		Sulfate	None						
08050001-019	Boeuf River	Chloride	AR0033707	City of Tillar	0.0900	60	45.1	22.5	NO
			AR0046507	AR Hwy Dept-McGehee HQ	0.0005	60	0.3	1.25E-04	NO
				TOTAL	0.0905		45.3	22.7	
08050002-010	Oak Bayou	Chloride	None						
		TDS	None						

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