FINAL

TMDLs for Total Dissolved Solids for the Saline River Basin, Arkansas

(HUC-reach 08040204-006, HUC-reach 08040203-010)

Prepared for:

United States Environmental Protection Agency, Region 6
Water Quality Protection Division
Permits, Oversight, and TMDL Team
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EXECUTIVE SUMMARY

Section 303(d) of the Clean Water Act and the U.S. Environmental Protection Agency's (EPA) Water Quality Planning and Management Regulations (at Title 40 of the *Code of Federal Regulations* [CFR] Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for impaired waterbodies. A TMDL establishes the amount of a pollutant that a waterbody can assimilate without exceeding its water quality standard for that pollutant. TMDLs provide the scientific basis for a state to establish water quality-based controls to reduce pollution from both point and nonpoint sources to restore and maintain the quality of the state's water resources (USEPA 1991).

A TMDL for a given pollutant and waterbody is composed of the sum of individual wasteload allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background levels. In addition, the TMDL must include an implicit or explicit margin of safety (MOS) to account for the lack of knowledge in the relationship between pollutant loads and the water quality of the receiving waterbody. The TMDL components are illustrated using the following equation:

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

The study area for this TMDL is the Saline River Basin, which is in central Arkansas in Planning Segment 2C. The Saline River is approximately 200 miles in length and begins in the foothills of the Ouachita Mountains in Saline and Garland counties in Arkansas. The headwaters of the river are the South Fork, Middle Fork, Alum Fork, and North Fork, which merge north of the city of Benton, Arkansas. After the four forks merge, the river travels through Saline, Grant, Dallas, Cleveland, Bradley, Ashley, and Drew counties. The river then flows into the Ouachita River in the Felsenthal National Wildlife Refuge just north of the Louisiana state border. Forest is the dominant land use in the Saline River Basin (> 80 percent). Urban areas in the watershed include the cities of Benton, Bryant, and Sheridan.

This document contains two stream segments in the Saline River Basin on the State's 2008 Section 303(d) list for various impairments (Table ES-1). The pollutants causing these impairments include total dissolved solids (TDS). The impaired designated use for the two segments is agriculture and industry water supply.

The numeric water quality criteria that apply to the impaired reaches in the Saline River Basin and were used to calculate the total allowable loads are presented in Table ES-2.

This TMDL was developed using the load duration curve methodology. This method illustrates allowable loading at a wide range of stream flow conditions. The steps for applying the methodology are as follows: (1) develop a flow duration curve; (2) convert the flow duration curve to load duration curves; (3) plot observed loads with load duration curves; and (4) calculate the TMDL, MOS, WLA, and LA. The TMDL was not developed for a particular season, and applies year-round.

Table ES-1. Section 303(d) and Integrated Report information for the Saline River Basin

HUC-reach number	HUC-reach name	Impaired use	Causes of impairment	Suspected sources of impairment
08040203-010	Saline River	Agriculture and industry water supply	TDS	Resource extraction
08040204-006	Saline River	Drinking water, agriculture and industry water supply	TDS	Unknown

Source: ADEQ 2005.

Table ES-2. Numeric water quality criteria for the listed segments

HUC-reach number	HUC-reach name	TDS[a] (mg/L)
08040203-010	Saline River	120
08040204-006	Saline River	120

Note: mg/L = milligrams per liter;
[a] These criteria shall apply to all surface waters of the state at all times except during periods when flows are less than the applicable critical flow. Streams with regulated flow will be addressed on a case-by-case basis to maintain designated instream uses. These standards apply outside the applicable mixing zone. Waters may, on occasion have natural background levels of certain substances outside the limits established by these criteria, in which case these criteria do not apply to the naturally occurring excursions. These criteria are not to be exceeded in more than one in ten samples collected over a period of not less than 30 days or more than 360 days.

In TMDL development, allowable loadings from all pollutant sources that cumulatively amount to no more than the TMDL must be established, thereby providing the basis for establishing water quality-based controls. WLAs were given to permitted point source discharges, including Phase II municipal separate storm sewer systems (MS4s). The LAs include background loadings, as well as human-induced nonpoint sources. An explicit MOS of 10 percent was included. A summary of the TMDLs for the segments addressed in this report is presented in Table ES-3.

Table ES-3. Summary of this TDS TMDL, MOS, WLAs, and LAs for the Saline River Basin

HUC-reach	Water quality station	Pollutant	Total allowable loading	Explicit MOS (10%)	Σ WLA	Σ LA
			lb/day			
08040203-010	OUA0026/ OUA0041	TDS	553,501	55,350	131,549	366,602
08040204-006	OUA0118	TDS	1,485,982	148,598	1,322	1,336,062

Note: Load allocations from segments 08040203-010 are included in 08040204-006.

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1 INTRODUCTION

Section 303(d) of the Clean Water Act and the U.S. Environmental Protection Agency's (EPA) Water Quality Planning and Management Regulations (at Title 40 of the *Code of Federal Regulations* [CFR] Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for waterbodies that are not supporting their designated uses even after pollutant sources have implemented technology-based controls. A TMDL establishes the maximum allowable load (mass per unit of time) of a pollutant that a waterbody is able to assimilate and still support its designated uses. The maximum allowable load is determined on the basis of the relationship between pollutant sources and in-stream water quality. A TMDL provides the scientific basis for a state to establish water quality-based controls to reduce pollution from both point and nonpoint sources to restore and maintain the quality of the state's water resources (USEPA 1991).

Monitoring data collected by the Arkansas Department of Environmental Quality (ADEQ) indicate that observed pollutant levels sometimes exceed water quality criteria in the Saline River Basin. The impaired designated use for these segments is agriculture and industry water supply. The pollutant causing this impairment is total dissolved solids (TDS). Table 1-1 presents information from Arkansas's 2004 Integrated Report (ADEQ 2005) for the two segments.

Table 1-1. 2004 Section 303(d) and Integrated Report information for the Saline River Basin

HUC-reach number	HUC-reach name	Impaired use	Causes of impairment	Suspected sources of impairment
08040203-010	Saline River	Agriculture and industry water supply	TDS	Resource extraction
08040204-006	Saline River	Drinking water, agriculture and industry water supply	TDS	Unknown

Source: ADEQ 2005.

2 BACKGROUND INFORMATION

2.1 General Description

The two stream segments addressed in this TMDL report are in central Arkansas (Figure 2-1) in portions of U.S. Geological Survey (USGS) hydrologic unit codes (HUC) 08040203 and 08040204. The Saline River is approximately 200 miles in length and begins in the foothills of the Ouachita Mountains in Saline and Garland counties, Arkansas. The headwaters of the river are the South Fork, Middle Fork, Alum Fork, and North Fork, which merge north of the city of Benton, Arkansas. After the four forks merge, the river travels through Saline, Grant, Dallas, Cleveland, Bradley, Drew, and Ashley counties. The river then flows into the Ouachita River in the Felsenthal National Wildlife Refuge just north of the Louisiana state border. Table 2-1 lists the counties in which the segments are located and the approximate drainage area of each segment.

Table 2-1. County and drainage area for each listed reach in the Saline River Basin

HUC-reach number	HUC-reach name	County	Total drainage area (acres)	Unique subwatershed Area (acres)
08040203-010	Saline River	Garland, Saline, Grant	439,774	439,774
08040204-006	Saline River	Saline, Grant, Jefferson, Cleveland	1,180,666	461,278

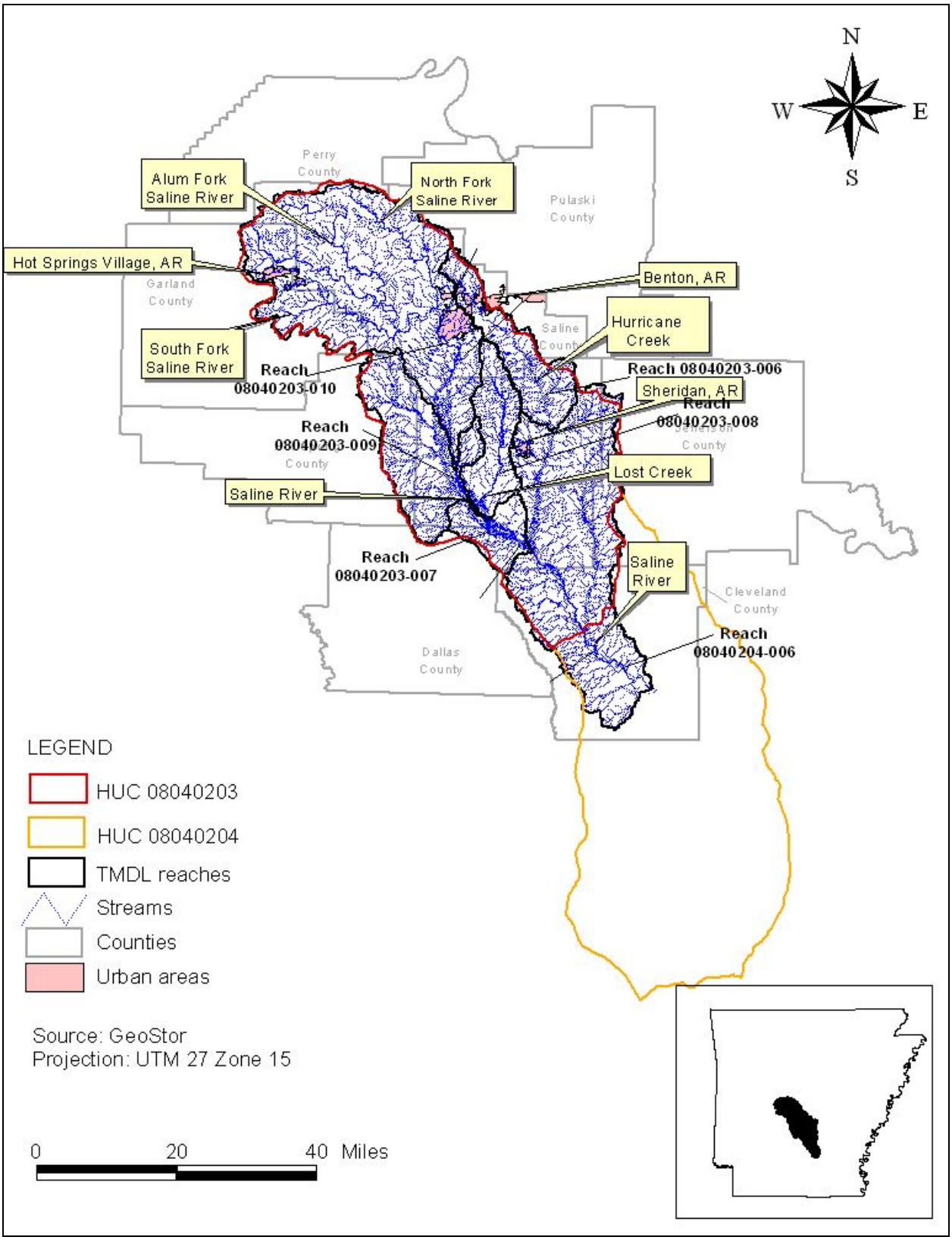

Figure 2-1. Location of the Saline River Basin.

2.2 Land Use

Land use data were obtained from the Center for Advanced Spatial Technologies (CAST) at the University of Arkansas in Fayetteville (2005). Table 2-2 and Figure 2-2 present the percentage of segment area covered by each land use and the land use coverage, respectively. Forest constitutes more than 80 percent of the land area in both of the listed below segments located within the Saline River Basin. Pasture/forage is the second largest land use in all the segments, covering at least 9 percent of the area in all segments. Segment 010 has the largest urban area (5.4 percent); portions of Hot Springs Village and the City of Benton are within the watershed.

Table 2-2. Land use by stream segment

	HUC-reach number			
	08040203-010		08040204-006	
Land use	Area (acres)	Percent coverage	Area (acres)	Percent coverage
Barren	523	0.1	3,168	0.3
Forest	368,060	83.7	1,018,234	86.3
Pasture/ forage	40,932	9.3	111,173	9.4
Urban	23,782	5.4	35,501	3.0
Water	6,313	1.5	12,065	1.0
TOTAL	**439,611**	**100.0**	**1,180,141**	**100.0**

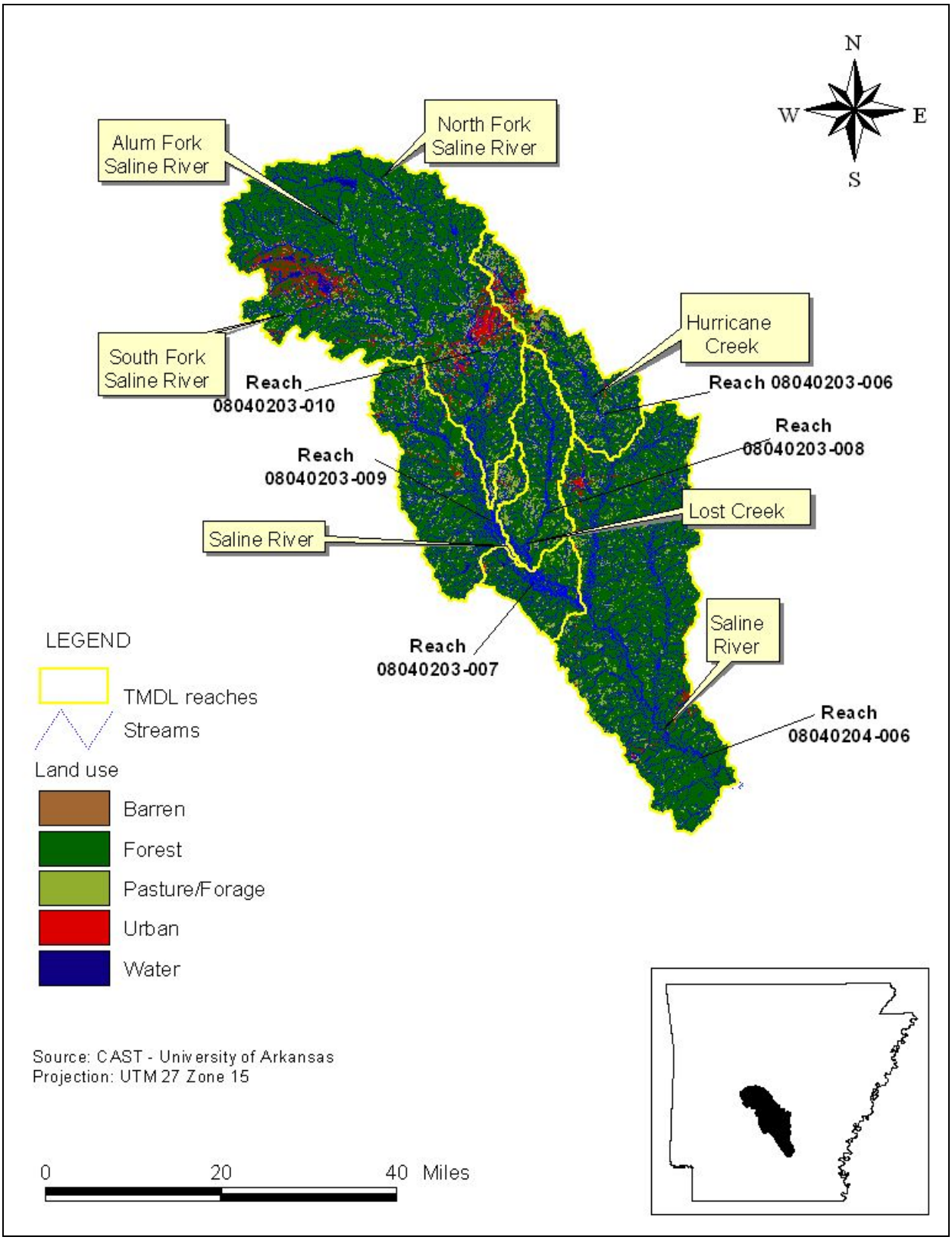

Figure 2-2. Land use in the Saline River Basin.

2.3 Flow Characteristics

USGS gauges 07363000 (Saline River at Benton) and 07363200 (Saline River near Sheridan) are the only gauges actually on the listed segments addressed in this report. There are no flow gauges on Lost Creek or reach 08040204-006 of the Saline River; however, there is a flow gauge just below reach 08040204-006 (07363500). Because there are only two active USGS flow-monitoring gauges in the listed segments, flow data are not available for all the segments in the Saline River Basin. Table 2-3 presents information for the flow gauges used in this TMDL.

Table 2-3. USGS flow gauge information for the Saline River Basin

Station number	Station name	Period of record	Drainage area (square miles)
07363500	Saline River near Rye	1937–present	2,102
07363200	Saline River near Sheridan	1971–82; 2001–06	1,123
07363000	Saline River at Benton	1951–79; 1983; 2001–06	550

USGS gauge 07363500 is on the Saline River, approximately 10 miles south of reach 08040204-006. USGS gauge 07363200 is on reach 08040203-007 of the Saline River, about 1.6 miles below the confluence with Lost Creek. USGS gauge 07363000 is on reach 0802043-010 of the Saline River in Benton, approximately 3 miles downstream of the confluence of the Saline River with the North Fork Saline River. Figure 2-3 shows the locations of the four USGS gauges.

The seasonal distribution of flow at each of the four flow gauging stations is shown in Figures 2-4 through 2-6. Low flow occurs in the summer and early fall, and high flow tends to occur in late winter and early spring.

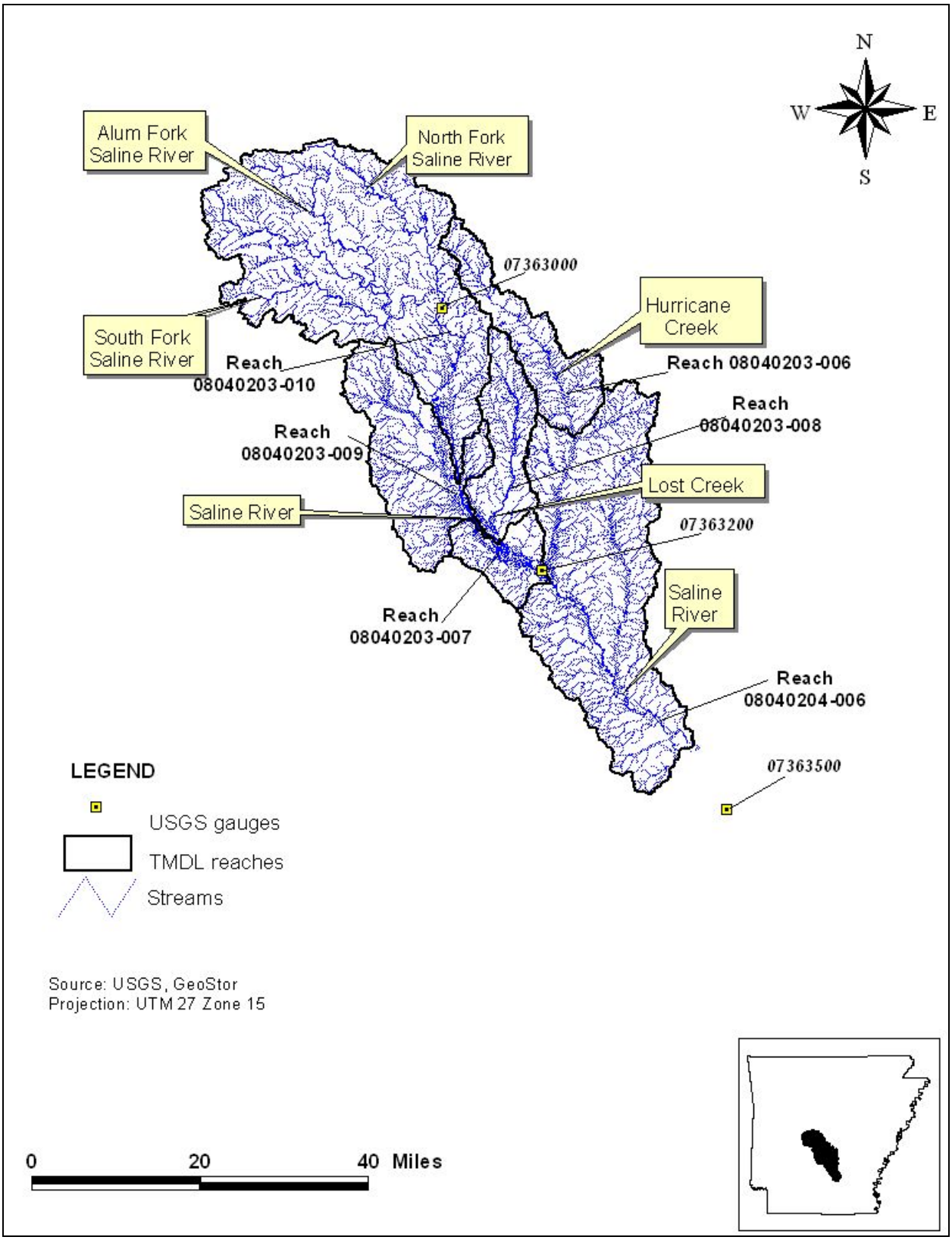

Figure 2-3. Location of USGS gauges assigned to the segments in the Saline River Basin.

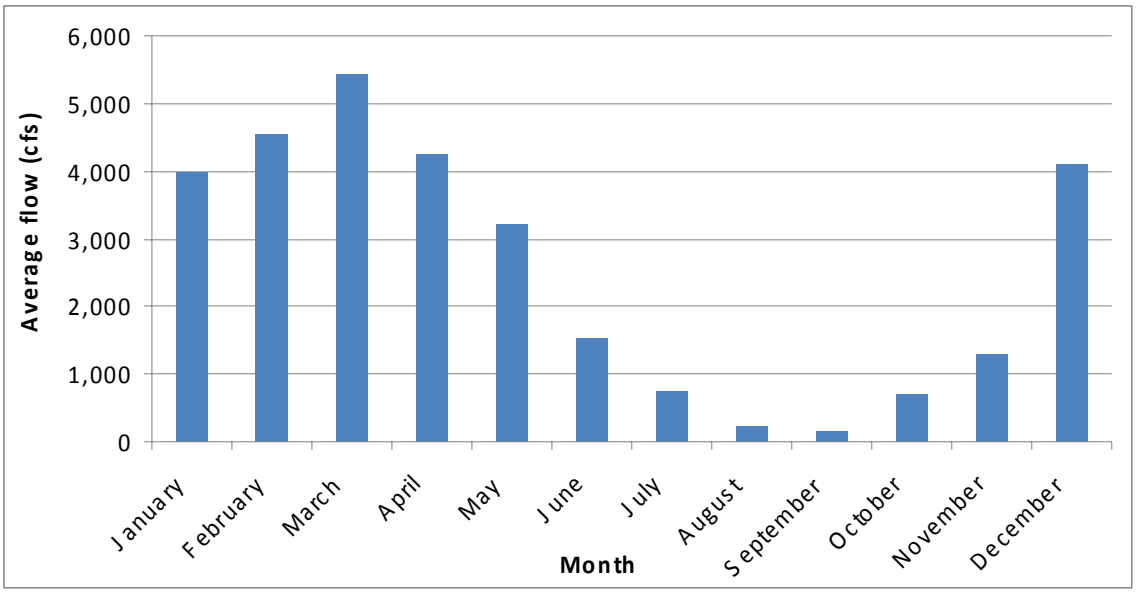

Figure 2-4. Seasonal distribution of flow at Saline River near Rye, Arkansas (USGS 07363500) for 1958 through 2002.

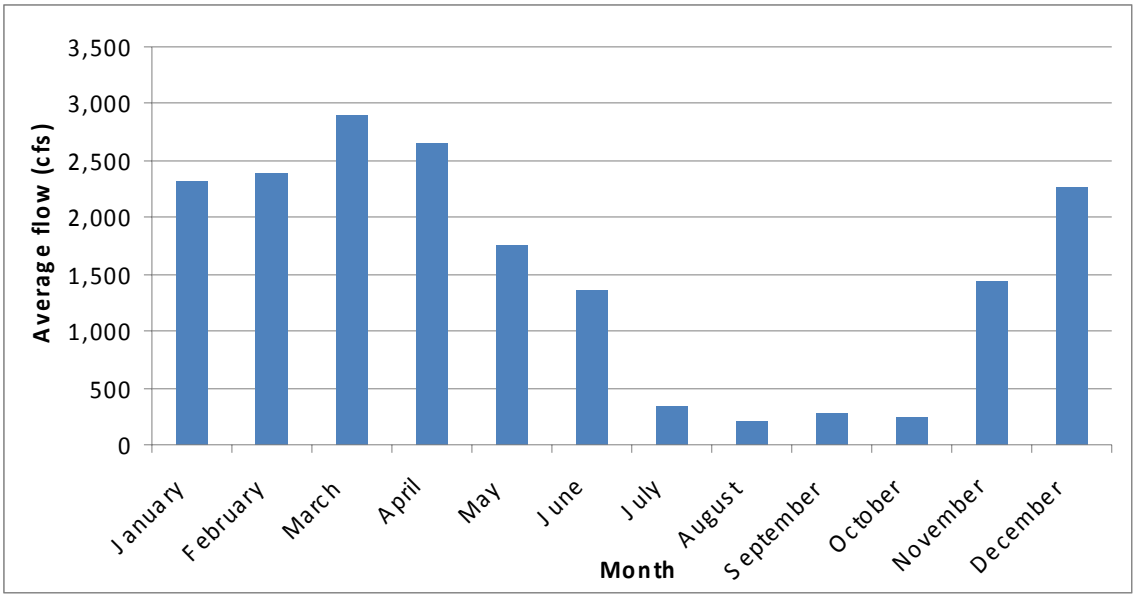

Figure 2-5. Seasonal distribution of flow at Saline River near Sheridan, Arkansas (USGS 07363200) for 1958 through 2002.

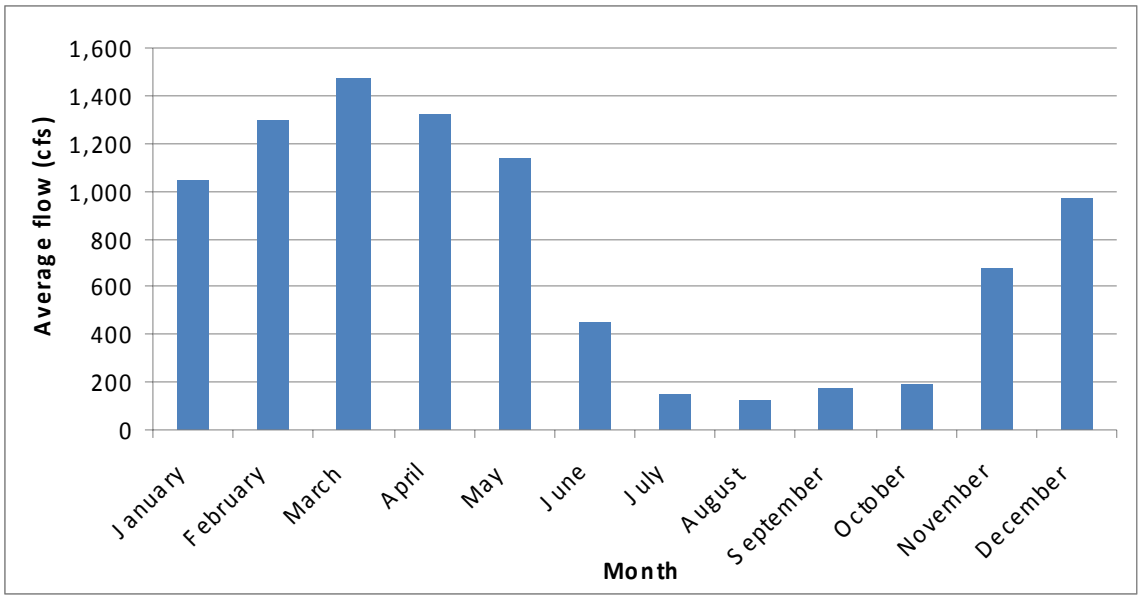

Figure 2-6. Seasonal distribution of flow at Saline River at Benton, Arkansas (USGS 07363000) for 1958 through 2002.

2.4 Designated Uses and Water Quality Criteria

The designated uses for the Saline River are extraordinary resource waters (the entire river in the Ouachita Mountain Ecoregion and the Gulf Coastal Ecoregion, including the North, Alum, Middle, and South Forks); natural and scenic waterways (from the Grant/Saline County line to the mouth); ecologically sensitive waterbody (Lower Saline River in the Gulf Coastal Ecoregion and the Saline River including Alum, Middle, North, and South Forks, and Ten Mile Creek); primary contact recreation; secondary contact recreation; domestic, industrial, and agricultural water supply; and fisheries (APCEC 2007a). Arkansas's 2004 Integrated Report (ADEQ 2005) indicates that the impaired designated use for the two listed segments is agriculture and industry water supply. Agriculture water supply designates waters that will be protected for irrigation of crops and/or consumption by livestock (APCEC 2007a). Industrial water supply indicates waters that will be protected for use as process or cooling water (APCEC 2007a). Water quality criteria for the impaired segments are presented in Table 2-4; the designated use was presented in Table 1-1. The criteria apply at all times except during periods when flows are less than the applicable critical flow. The criteria are not to be exceeded in more than 1 in 10 samples collected over a period of not less than 30 days or more than 360 days.

Table 2-4. Numeric criteria for the segments of concern in the Saline River Basin

HUC-reach number	Stream reach name	TDS[a] (mg/L)
08040203-010	Saline River	120
08040204-006	Saline River	120

Note: mg/L = milligrams per liter;
[a] These criteria shall apply to all surface waters of the state at all times except during periods when flows are less than the applicable critical flow. Streams with regulated flow will be addressed on a case-by-case basis to maintain designated instream uses. These standards apply outside the applicable mixing zone. Waters may, on occasion have natural background levels of certain substances outside the limits established by these criteria, in which case these criteria do not apply to the naturally occurring excursions. These criteria are not to be exceeded in more than one in ten samples collected over a period of not less than 30 days or more than 360 days.

2.4.1 Antidegradation Policy

The Arkansas water quality standards also include an antidegradation policy (APCEC 2007a), which states that existing in-stream water uses and the level of water quality necessary to protect the existing uses must be maintained and protected.

State water exhibiting high water quality must be maintained and protected unless the state finds that allowing lower water quality is necessary to accommodate important economic or social development in the area in which the waters are located. In allowing such degradation or lower water quality, the state must ensure water quality adequate to protect the existing uses fully.

Those uses and water quality for which the outstanding resource waters were designated must be protected by (1) implementing water quality controls, (2) maintaining the natural flow regime, (3) protecting in-stream habitat, and (4) encouraging land management practices protective of the watershed.

In cases where potential water quality impairment associated with a thermal discharge is involved, the antidegradation policy and implementing method must be consistent with section 316 of the federal Clean Water Act.

2.5 Point Sources

Table 2-5 presents point source facilities that are in the Saline River Basin, in addition the last column in the table indicates whether the TMDL provides a WLA to be incorporated within the permit of a given facility. Note, by answering the question of ‘does the TMDL provide WLA’ with a yes indicates that a WLA will be provided; however, a no denotes that a WLA will not be provided within this TMDL. In addition figure 2-7 shows the locations of the NPDES facilities within the Saline River Basin.

Table 2-5. Point source discharges without dissolved mineral permit limits in the Saline River Basin

NPDES permit	Facility name	Location	Does the TMDL provide WLA?
HUC-reach 08040203-010			
AR0000582	Alcoa, Inc. - Bauxite	1401 Bauxite cur-off road	Yes, on the basis of past permit limits and effluent chemistry, effluent limits were based on water quality criteria. (See section 4.3.)
AR0036498	City of Benton MWVH	614 W Hazel	Yes, on the basis of the type of facility, effluent limits were based on median effluent concentrations of domestic wastewater facilities. (See section 4.3.)
AR0039284	Hot Springs Village-Cedar Ck	Ponce De Leon Dr @ Hwy 5	Yes, on the basis of the type of facility, effluent limits were based on median effluent concentrations of domestic wastewater facilities. (See section 4.3.)
AR0041416	Timber Ridge Ranch Neurorehabilitation Center	15000 Hwy 298; 10 miles NW of City	No. This permit contained limits for the following parameters: total ammonia nitrogen (as N), pH, TSS, $CBOD_5$, fecal coliform, and dissolved oxygen. This permit is not included in this TMDL.
AR0042277	Pawnee Village POA	Pawnee Village Dr	Yes, on the basis of the type of facility, effluent limits were based on median effluent concentrations of domestic wastewater facilities. (See section 4.3.)
AR0044423	Jessieville Public School	Beaudry Rd, NE of AR Hwy 7	Yes, on the basis of the type of facility, effluent limits were based on median effluent concentrations of domestic wastewater facilities. (See section 4.3.)
AR0044547	City of Haskell	620 S Taft - Haskell	Yes, on the basis of the type of facility, effluent limits were based on median effluent concentrations of domestic wastewater facilities. (See section 4.3.)
AR0045047	Village Square Shopping Center	4501 N Hwy 7	Yes, on the basis of the type of facility, effluent limits were based on median effluent concentrations of domestic wastewater facilities. (See section 4.3.)
AR0046141	Mountain Valley Retreat Center	1366 N Hwy 7	Yes, on the basis of the type of facility, effluent limits were based on median effluent concentrations of domestic wastewater facilities. (See section 4.3.)
AR0048194	N Garland County Boys & Girls Club	5050 N Hwy 7	Yes, on the basis of the type of facility, effluent limits were based on median effluent concentrations of domestic wastewater facilities. (See section 4.3.)
AR0049328	Saline Co.Prop. Improv Dist#37 - -East Gate Shopping Center	25255 Highway 5 @ East Gate	Yes, on the basis of the type of facility, effluent limits were based on median effluent concentrations of domestic wastewater facilities. (See section 4.3.)
AR0049506	Benton Packing Company	1837 Southland Cir	No. This permit contained limits for the following parameters: total ammonia nitrogen (as N), pH, TSS, $CBOD_5$, fecal coliform, dissolved oxygen, and oil and grease. This permit is not included in this TMDL.
AR0050202	Destined To Win/Family Outreach Ministry, Inc.	None	Yes, on the basis of the type of facility, effluent limits were based on median effluent concentrations of domestic wastewater facilities. (See section 4.3.)
AR0050326	Central Arkansas Utility Services	Jackman Trail	Yes, on the basis of the type of facility, effluent limits were based on median effluent concentrations of domestic wastewater facilities. (See section 4.3.)
AR0050563	Central Ark Utility-Crossroads Village	Crossroads Road	Yes, on the basis of the type of facility, effluent limits were based on median effluent concentrations of domestic wastewater facilities. (See section 4.3.)
ARG500018	Cobar Contracting-Elderidge	1613 Pool Road	No. This permit contained limits for the following parameters: pH, oil and grease, and TSS. This permit is not included in this TMDL.
ARG790084	Severns Enterprises-Shell #122	16824 Interstate 30	No. This permit contained limits for the following parameters: pH, benzene, benzene toluene xylenes, and total recoverable petroleum hydrocarbons. This permit is not included in this TMDL.

NPDES permit	Facility name	Location	Does the TMDL provide WLA?
HUC-reach 08040204-006			
AR0021695	City of Rison	Hwy 79, north of City	Yes, on the basis of the type of facility, effluent limits were based on median effluent concentrations of domestic wastewater facilities. (See section 4.3.)
AR0043672	City of Kingsland	Second & Larch; East of City Kingsland	Yes, on the basis of the type of facility, effluent limits were based on median effluent concentrations of domestic wastewater facilities. (See section 4.3.)

Phase I and II stormwater systems are another possible point source contributor in the Saline River Basin. Stormwater discharges are generated by runoff from urban land and impervious areas such as paved streets, parking lots, and rooftops during precipitation events. These discharges often contain high concentrations of pollutants that can eventually enter nearby waterbodies. Many stormwater discharges are considered point sources and require coverage by a National Pollutant Discharge Elimination System (NPDES) permit.

Under the NPDES stormwater program, operators of large, medium, and regulated small municipal separate storm sewer systems (MS4s) must obtain authorization to discharge pollutants. The Stormwater Phase I Rule (55 *Federal Register* 47990, November 16, 1990) requires all operators of medium and large MS4s to obtain an NPDES permit and develop a stormwater management program. Medium and large MS4s are defined by the size of the population within the MS4 area, not including the population served by combined sewer systems. A medium MS4 has a population of between 100,000 and 249,999. A large MS4 has a population of 250,000 or more.

Phase II requires a select subset of small MS4s to obtain an NPDES stormwater permit. A small MS4 is any MS4 not already covered by the Phase I program as a medium or large MS4. The Phase II Rule automatically covers all small MS4s in urban areas, as defined by the Bureau of the Census. It also includes small MS4s outside an urban area that are so designated by NPDES permitting authorities, case by case (USEPA 2000).

There are no Phase I MS4 permits in the Saline River Basin; however, there are four Phase II MS4 permits. Table 2-6 presents MS4 information by reach for the Saline River Basin.

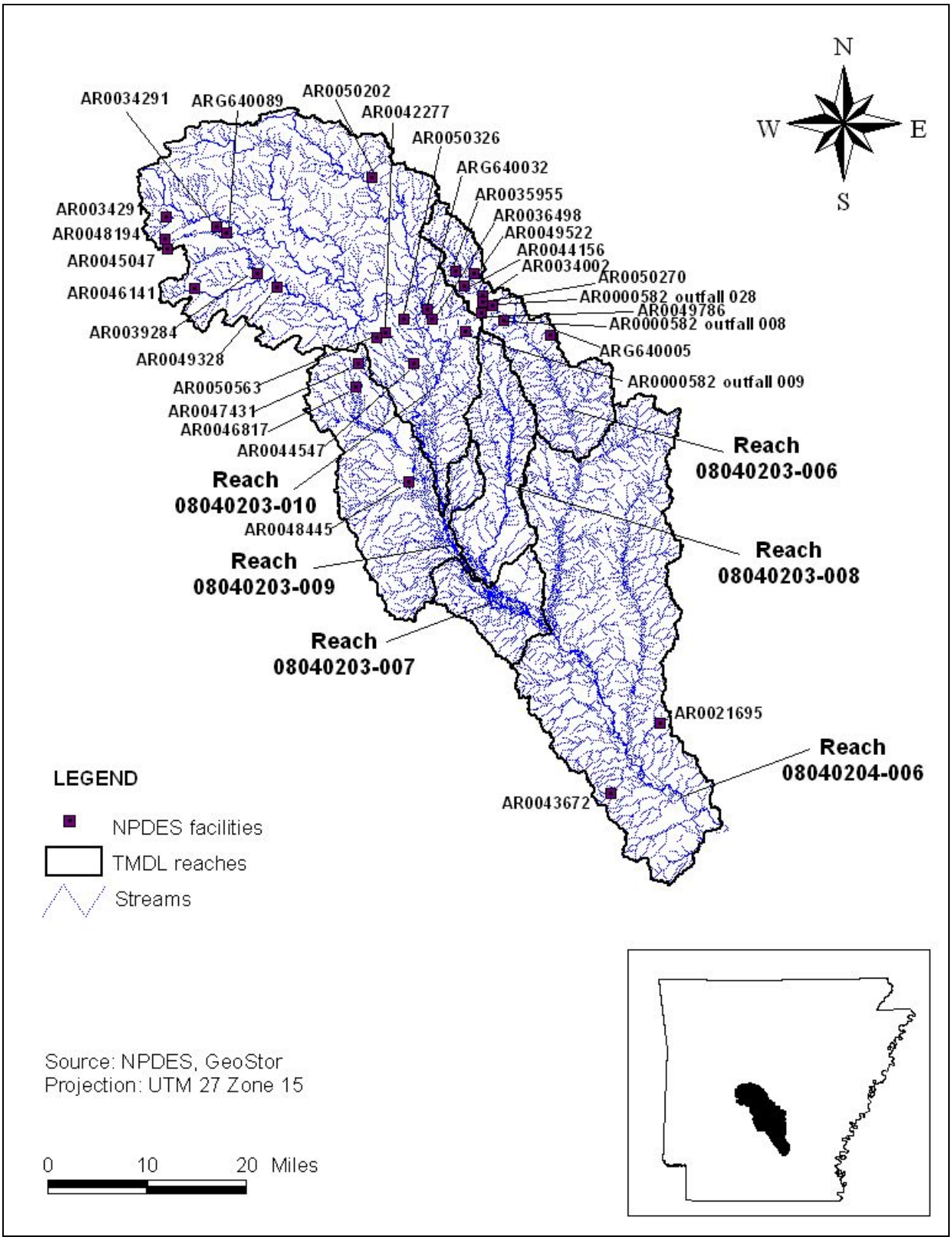

Figure 2-7. NPDES facilities in the Saline River Basin.

Table 2-6. MS4 information for the Saline River Basin

NPDES permit number	Authority	Discharge HUC-reach	Segment name	Urban area[a] (acres)
ARR040043	City of Benton	08040203-010	Saline River	10,083.0
ARR040014	Garland County	08040203-010	Saline River	7,196.0
ARR040003	Saline County	08040203-010	Saline River	10,872.8
ARR040012	Jefferson County	08040204-006	Saline River	243.8

[a] The urban area for the county permits includes the total urban area in each county based on the 2004 land use/land cover dataset from the Center for Advanced Spatial Technologies at the University of Arkansas.

2.6 Nonpoint Sources

According to Arkansas's 2004 section 305(b) report, mineral content (TDS) originates in the Saline River Basin from open-pit bauxite-mining activities (ADEQ 2004b), and a major reclamation project is under way in the area. Typically, sources of dissolved minerals include urban and agricultural runoff, forestry, and natural geology. TDS can originate from natural sources (e.g., mineral springs, carbonate deposits, salt deposits, seawater intrusion) and urban and agricultural runoff (Wilkes University 2005).

3 CHARACTERIZATION OF EXISTING WATER QUALITY

ADEQ has collected water quality data for TDS, and other parameters in the Saline River Basin at stations OUA0026, OUA0031, OUA0041, OUA0042, and OUA0118. Station OUA0026 (Saline River near Benton, Arkansas) is in reach 08040203-010 of the Saline River in the city of Benton. Station OUA0041 (Saline River downstream of Benton, Arkansas) is also in reach 08040203-010 of the Saline River, about 5 miles south of station OUA0026. And station OUA0118 (Saline River at Highway 79 bridge south of Rison) is on the Saline River in reach 08040204-006, about 19 miles downstream of station OUA0042. Figure 3-1 shows the location of these water quality monitoring stations.

3.1 Comparison of Observed Data to Criteria

3.1.1 Total Dissolved Solids

Station OUA0026 has 194 TDS observations from 1990 to 2007. Station OUA031 has 185 observations from 1990 to 2007, station OUA0041 has 184 TDS observations from 1990 to 2007, station OUA0042 has 194 TDS from 1990 to 2007, and station OUA0118 has 188 TDS observations from 1991 to 2007. Appendix B contains the original TDS water quality data.

None of the TDS observations at stations OUA0026 exceed the 120 mg/L TDS criterion for the Saline River. Thirty-six percent, 12 percent, and 20percent of the TDS observations exceed the 120 mg/L criterion at stations OUA0041, OUA0042, and OUA0118, respectively. Twenty percent of observations at OUA031 were above 500 mg/L.

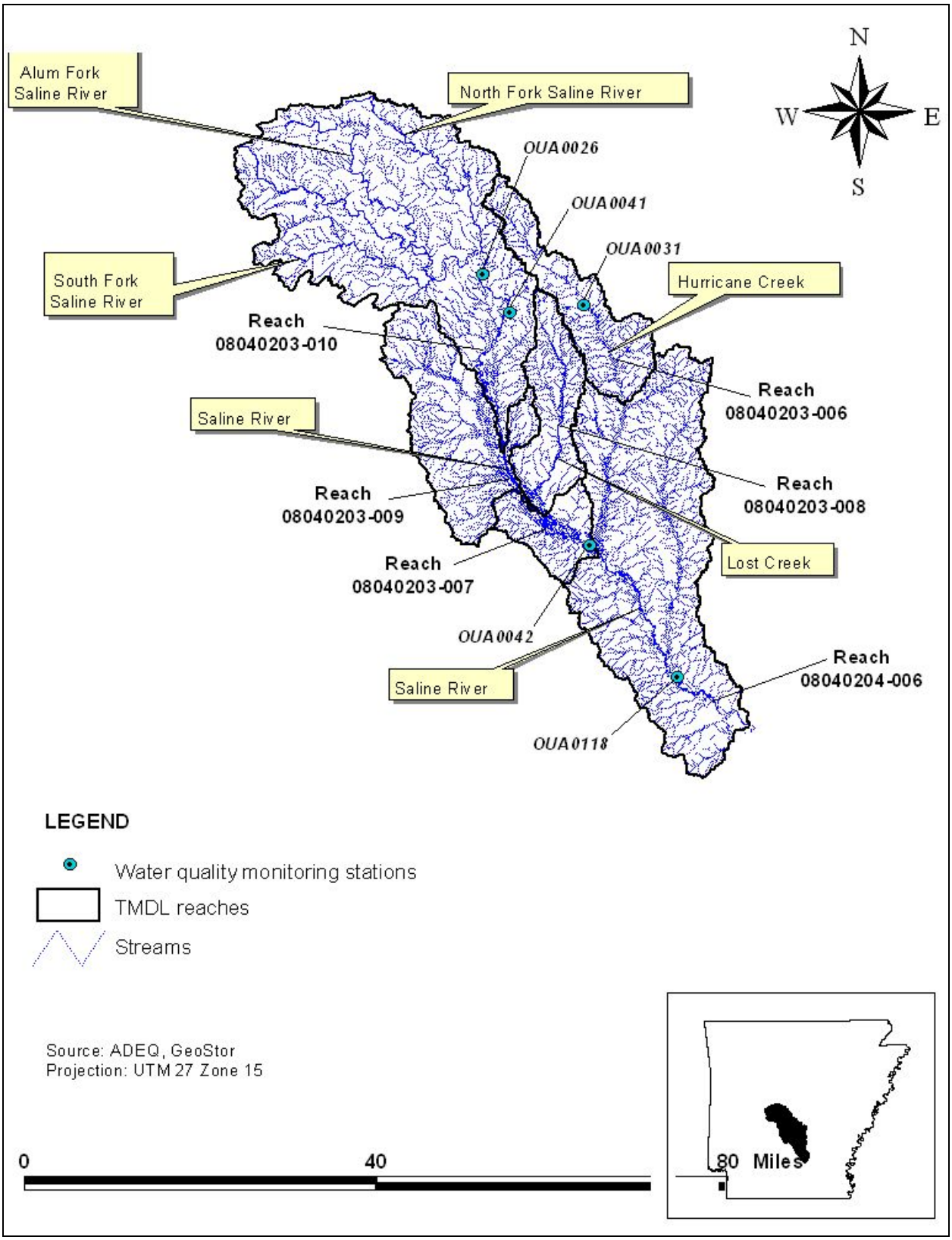

Figure 3-1. Location of water quality monitoring stations in the Saline River Basin.

3.2 Trends and Patterns in Observed Data

3.2.1 Total Dissolved Solids

The TDS observations at stations OUA0026, OUA0031, OUA0041, OUA0042, and OUA0118 do not show any strong seasonal trends or patterns. High TDS levels were observed during low flows at stations OUA0026, OUA0041, and OUA0042; however, not enough samples were collected during high flows to allow a valid comparison. High TDS levels were also observed during low flows at station OUA0118. Appendix C contains the TDS sampling results plotted over time and versus flow.

4 TMDL DEVELOPMENT

A TMDL is the total amount of a pollutant that can be assimilated by the receiving waterbody while still achieving water quality standards. In TMDL development, allowable loadings from all pollutant sources that cumulatively amount to no more than the TMDL must be established, thereby providing the basis for establishing water quality-based controls.

A TMDL for a given pollutant and waterbody is composed of the sum of individual wasteload allocations (WLAs) for point sources, and load allocations (LAs) for nonpoint sources and natural background levels. In addition, the TMDL must include an implicit or explicit margin of safety (MOS) to account for the lack of knowledge in the relationship between pollutant loads and the quality of the receiving waterbody. The TMDL components are illustrated using the following equation:

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

TMDLs are generally expressed on a mass loading basis (e.g., kilograms per day).

4.1 TMDL Analytical Approach

The methodology used to determine the TMDL for each impaired segment 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 a fixed, 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 for a wide range of flows. The steps for applying this methodology to develop the TMDLs in this report can be summarized as follows:

1. Develop a flow duration curve.
2. Convert the flow duration curve to load duration curves for each impairment.
3. Plot the observed loads with load duration curves.
4. Calculate the TMDL, MOS, WLA, and LA (see Section 4.2).
5. Calculate the loadings required to meet Arkansas's water quality standards.

4.1.1 Flow Duration Curve

A flow duration curve was developed for each USGS gauge for the TMDLs. Daily stream flow measurements from USGS gauges for each data set were sorted in increasing order, and the percentile ranking of each flow was calculated. The load duration curve methodology requires that the same flow period be used for both developing the flow duration and calculating observed loads from sampling data. For each season, the flows are then plotted against the corresponding percent flow that exceeds a specific flow to create the flow duration curves.

Figure 4-1 is an example of a flow duration curve. The plot shows the flow (e.g., cubic feet per second) on the Y axis. The X axis shows the percentage of days on which the plotted flow is exceeded. Points at the low end of the plot (0 through 10 percent) represent high-flow conditions,

where only 0 through 10 percent of the flow exceeds the plotted point. Conversely, points at the high end of the plot (90 to 100 percent) represent low-flow conditions.

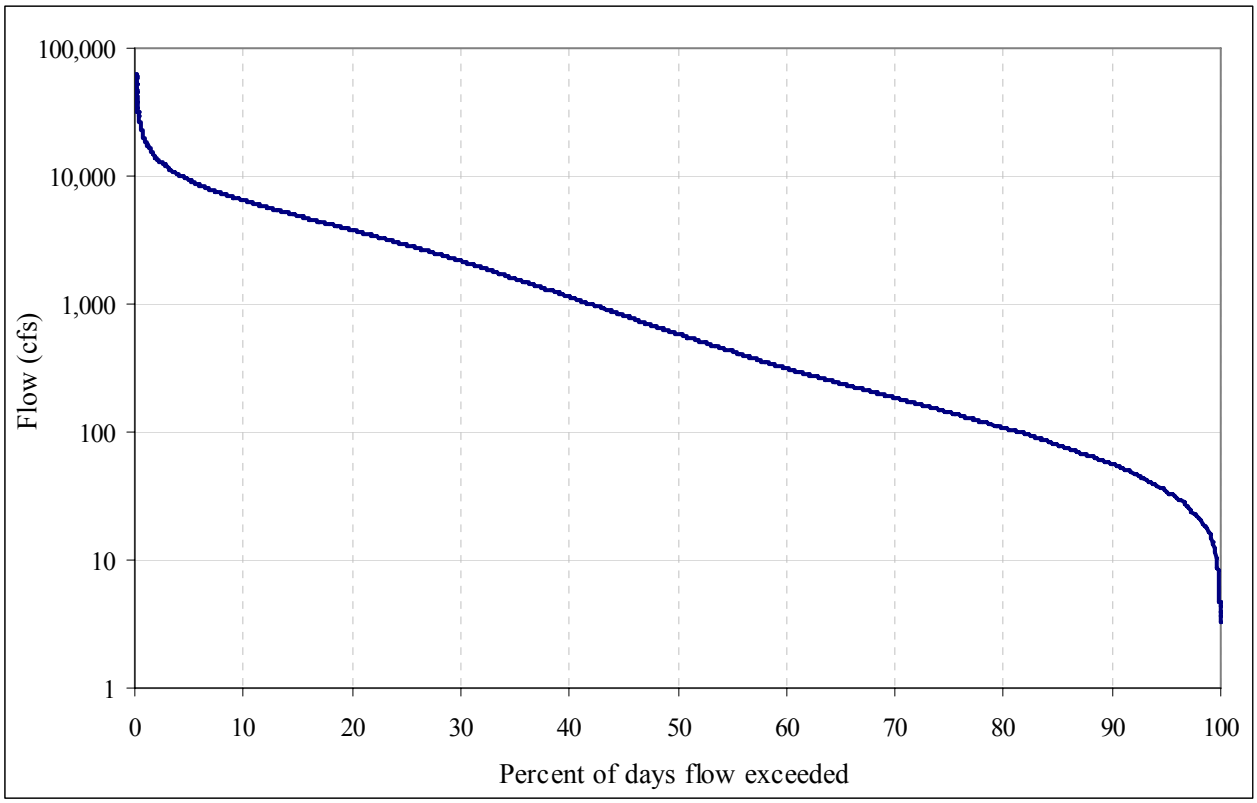

Figure 4-1. Example of a flow duration curve.

Four USGS gauges in the Saline River Basin were used in developing the TMDLs. Table 4-1 presents each USGS gauge in the basin, the period of record used in the TMDL analysis, and the segments represented.

Table 4-1. USGS flow gauges and represented reaches for the Saline River Basin

Station number	Station name	Drainage area (square miles)	Period of record used in TMDL development	HUC-reach represented
07363500	Saline River near Rye	2,102	1937–present	08040203-010, -009, -008, -007,-006, 08040204-006
07363200	Saline River near Sheridan	1,123	1971–1982; 2001–2006	Not used
07363000	Saline River at Benton	550	1951–1979; 1983; 2001–2006	Not used

For the TMDL calculations, the most recent flow data were used. Data from 1990 through 2006 were used for USGS gauge 07363500. USGS gauges 07363200 and 0736300, even though they are in impaired segments, were not used in these TMDLs. Flow data for these gauges are not available from 1983 through 2001. Many water quality observations occurred between 1990 and 2001, so USGS gauge 07363500 had to be used for these periods. To maintain consistency, this

gauge was used for the entire period. Because of the distance between USGS gauge 07363500 (Rye) and USGS gauges 07363200 (Sheridan) and 0736300 (Benton), an analysis was done comparing flows from the same dates. It was determined that there was a 4-day time-of-travel difference between the gauges at Rye and Benton and a 2-day time-of-travel difference between the gauges at Rye and Sheridan. The dates of the unit area flows were adjusted in the load duration curves to account for these differences so that the observed data would better match with the unit area flows.

Flows were area weighted for each stream segment and those flows were used to create a unique flow duration curve for each segment (Appendix D).

4.1.2 Load Duration Curve

For the TDS TMDL parameters, the flows from the flow duration curves were multiplied by the appropriate numeric criterion concentration (Tables 2-5 through 2-7) to compute an allowable load duration curve. Each load duration curve is a plot of mass per day versus the percent flow exceedance from the flow duration curves.

The load duration curve is beneficial when analyzing monitoring data with their corresponding flow information plotted as a load. This approach allows the monitoring data to be placed in relation to their position 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 approach will allow analysis of load cases in the future for different flow regimes.

4.1.3 Observed Loads

For each sampling station observed loads were calculated by multiplying the observed concentration of the parameter of concern by the flow on the sampling day. These observed loads were then plotted versus the percent flow exceedance of the flow on the sampling day and placed on the same plot as the load duration curve. Reductions were applied to the observed loads for each parameter until its water quality criteria and allowable percent exceedance were met to obtain an overall percent reduction for each reach. These plots are shown in the appendices to this report as follows:

Appendix E: Load Duration Calculations for all TMDLs (CD-ROM)
Appendix F: Load Duration Curve Summaries and Plots for Total Dissolved Solids

These plots provide visual comparisons between observed and allowable loads under different flow conditions. Observed loads that are plotted above the load duration curve represent conditions under which observed water quality concentrations exceed the numeric criterion concentrations. Observed loads plotted below the load duration curve represent conditions under which observed water quality concentrations are less than the numeric criterion concentrations (i.e., do not exceed the water quality standards).

4.2 TMDL

Reaches 08040203-010, and 08040204-006 were the only reaches with monitoring stations. TMDLs for these reaches were determined with load duration curves. TMDLs for the other reaches, which did not have water quality stations, were determined from the reaches with monitoring data and using a ratio of the total drainage area of each reaches. In addition, LAs from 08040203-010 are included in 08040204-006 because 08040204-006 is downstream of 08040203-010. Table 4-2 presents the TMDLs and allocations for the segments in this report.

Table 4-2. Summary of TDS TMDLs, MOS, WLAs, and LAs for the Saline River Basin

HUC/reach	Water quality station	Pollutant	Total allowable loading	Explicit MOS (10%)	Σ WLA	Σ LA
			lb/day			
08040203-010	OUA0026/ OUA0041	TDS	553,501	55,350	131,549	366,602
08040204-006	OUA0118	TDS	1,485,982	148,598	1,322	1,336,062

Note: Load allocations from segments 08040203-010 are included in 08040204-006.

Both section 303(d) of the Clean Water Act and the regulations at 40 CFR 130.7 require that TMDLs include an MOS to account for lack of knowledge in the 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 by using conservative assumptions in establishing the TMDL. For a more detailed discussion of the MOS, see section 4.5.

4.3 Wasteload Allocation

The WLA portion of the TMDL equation is the total loading of a pollutant that is assigned to point sources. The point sources in the Saline River Basin include industry, water supply, wastewater facilities, and MS4s.

WLAs are based on the current permit limits and discharge flow rates. No domestic wastewater facilities with permit limits for TDS were identified in the Saline River Basin, although it is possible that discharges from such facilities contain these constituents. Permit limits might not be assigned if a waterbody receiving the discharge is not listed and thus the discharge does not adversely affect water quality in the waterbody, or if the effluent from a facility does not contain a particular pollutant. For impaired waterbodies, permit limits are typically assigned. ADEQ designates permit limits during the permitting process on a case-by-case basis.

As noted above, because domestic wastewater facilities typically discharge TDS, facilities in this basin were assigned WLAs. The WLAs were based on facility flow in addition to the median effluent concentrations of domestic wastewater facilities (during the time that the TMDL was being developed) within the State of Arkansas as reported in the Permit Compliance System, a database operated by EPA. In the absence of actual data the median value of 324 mg/L was used for TDS, within the TMDL. Permit limits will be added during the next permit cycle, if required.

Alcoa Inc., permit AR0000582, discharges to Holly Creek in HUC-reach 08040203-010 and Hurricane Creek in HUC-reach 08040203-006. Outfall 009 operates under hydrologically controlled release; that is, the discharge volume is determined on the basis of the upstream Saline River flow rate, and TDS concentration. Discharge from Outfall 028 is limited by selenium concentrations and the amount of upstream flow of Hurricane Creek. Because of the nature of the operations at the facility, TDS WLAs were given to the facility's three outfalls, using the permitted flows for outfalls 008 and 009 and treatment design modeling for outfall 028. Because there are no permit limits for TDS, loadings were assigned. Outfalls 008 and 009 were given loadings on the basis of the water quality standards for the reaches into which they discharge (Hurricane Creek and Holly Creek, respectively). Effluent loadings for Outfall 028 were determined by a mass balance analysis.

WLAs for Outfall 028 from Alcoa, Inc. (permit AR0000582) were determined by a mass balance analysis for critical conditions. The outfall discharges to Hurricane Creek in HUC-reach 08040203-006. The upstream flow for the analysis was assumed to be zero, with all upstream dischargers discharging at maximum flow and concentrations. Effluent concentrations for Alcoa was adjusted so that after mixing, the stream reach would meet the water quality criteria in that reach. During this analysis, the hydrologically controlled release for Alcoa was also taken into account. TDS effluent concentrations were set 1,738 mg/L, for Alcoa Outfall 028

Table 4-3 lists the TDS WLAs for each point source in the Saline River Basin. There were no reductions to WLAs.

Table 4-3. TDS WLAs for the Saline River Basin

HUC-reach	NPDES permit	Outfall	Facility name	Discharge (mgd)	TDS (lb/d)
08040203-010	AR0000582	009	Alcoa, Inc.	6.1	81,451.17
08040203-010	AR0034291	001	Hot Springs Village POA – Mill Creek WWTP	1	2,703.91
08040203-010	AR0036498	001	Benton, City of MWVH	6.3	17,034.64
08040203-010	AR0039284	001	Hot Springs Village-Cedar Creek	1	2,703.91
08040203-010	AR0042277	001	Pawnee Village POA –Pawnee Village Subdivision	0.004	10.82
08040203-010	AR0044423	001	Jessieville Public School	0.018	48.67
08040203-010	AR0044547	001	Haskell, City of	0.6	1,622.35
08040203-010	AR0045047	001	Village Square Shopping Center	0.048	129.79
08040203-010	AR0046141	001	Mountain Valley Retreat Center	0.025	67.60
08040203-010	AR0048194	001	North Garland County Boys & Girls Club	0.01	27.04
08040203-010	AR0049328	001	Saline Co. Prop. Improv. Dist. #37-East Gate Shopping Center	0.035	94.64

HUC-reach	NPDES permit	Outfall	Facility name	Discharge (mgd)	TDS (lb/d)
08040203-010	AR0050202	001	Destined to Win/Family Outreach Ministry, Inc., D/B/A Second	0.015	40.56
08040203-010	AR0050326	001	Central Arkansas Utility Services D/B/A Reunion Subdivision	0.1	270.39
08040203-010	AR0050563	001	Central Ark Utility-Crossroads Village	0.1	270.39
08040204-006	AR0021695	001	Rison, City of	0.31	838.21
08040204-006	AR0043672	001	Kingsland, City of	0.06	162.23

EPA's stormwater permitting regulations require municipalities to obtain permit coverage for all stormwater discharges from MS4s. For the MS4 in the basin, a gross MS4 load was computed by multiplying the LA by the ratio of the MS4 area (which was based on the urban area in each segment) to the segment area in the Saline River Basin. Note that these values are estimates that can be refined in the future as more information about the MS4 and land-use-specific loadings information become available. Note also that the MS4 loads presented reflect only that portion of the MS4 in the reach. The computed MS4 load was subtracted from the LA and included as a WLA component of the TMDL because although MS4s are permitted dischargers, they function similarly to nonpoint sources through storm-driven processes. Table 4-4 lists the individual WLAs for the MS4 identified in section 2.5 (Table 2-9). EPA expects that the MS4 WLAs will be achieved through best management practices (BMPs) and adaptive management.

Table 4-4. TDS WLAs for MS4s in the Saline River Basin

HUC-reach	Urban Area	NPDES	TDS (lb/d)
08040203-010	Benton	ARR040043	8,980.2
	Garland County	ARR040014	6,409.0
	Saline County	ARR040003	9,683.8
08040204-006	Jefferson County	ARR040012	321.3

4.4 Load Allocation

The LA is the portion of the TMDL assigned to natural background loadings, as well as nonpoint sources like urban runoff that is not covered by MS4s, septic tanks (for TDS), and agricultural practices. For this TMDL, the LA was calculated by subtracting the WLA and MOS from the total TMDL. LAs were not allocated to separate nonpoint sources because there was a lack of available source characterization data. The LAs were presented in Table 4-2.

4.5 Margin of Safety

The MOS is the portion of the pollutant loading reserved to account for any lack of knowledge in the data. There are two ways to incorporate the MOS (USEPA 1991). One way is to implicitly incorporate it by using conservative model assumptions to develop the allocations. The other way is to explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations. In this analysis, for all pollutants, the MOS is explicit: 10 percent of each targeted TMDL was reserved as the MOS to account for any lack of knowledge in the TMDL. Using 10 percent of the TMDL load provides an additional level of protection to the designated use of the segments of concern.

4.6 Seasonality and Critical Conditions

The federal regulations at 40 CFR 130.7 require that TMDLs include seasonal variations and take into account critical conditions for stream flow, loading, and water quality parameters. The sampling results for all pollutants were plotted over time and reviewed for any seasonal patterns (see section 3.2).

By accounting for critical conditions, the TMDL makes sure that water quality standards are maintained for infrequent occurrences and not only for average conditions.

Because of the way the criteria are written (i.e., including critical and noncritical conditions), the TMDL for a pollutant of concern can be developed by reviewing pollutant loads at all flow conditions within applicable periods of the year and evaluating the percentage of values exceeding the criteria. The load duration curve, which determines the allowable loading at a wide range of flows, was chosen as the approach for these TMDLs (see section 4.1). Therefore, the TMDLs were calculated at all flows rather than at a single critical flow.

4.7 Future Growth

Compliance with this TDS TMDLs is based on keeping loadings in the stream below the assimilative capacity of the stream. Allocations between the WLA and LA may be re-evaluated if there is future growth of existing or new point sources discharging to the impaired reaches or their tributaries.

5 FUTURE WATERSHED ACTIVITIES

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, using appropriate sampling methods and procedures to ensure the quality of the data collected. Four of the locations where ADEQ will continue to monitor water quality are stations OUA0026, OUA0031, OUA0041, OUA0042, and OUA0118. The objectives of the surface water monitoring program are to determine the quality of the state's surface waters, to develop a long-term database for long-term trend analysis, and to monitor the effectiveness of pollution controls. The data obtained through the surface water monitoring program are used to develop the state's biennial 305(b) report and section 303(d) list of impaired waters, which were most recently published as the *State of Arkansas 2004 Integrated Water Quality Monitoring and Assessment Report* (ADEQ 2005).

6 PUBLIC PARTICIPATION

The federal regulations at 40 CFR 130.7(c)(1)(ii) specify that TMDLs "shall be subject to public review as defined in the State's CPP." These TMDLs were developed under contract to EPA, and EPA held a public review period seeking comments, information, and data from the public and any other interested parties. The notice for the public review period was published in the *Federal Register* on December 17, 2007, and the review period closed on January 16, 2008.

Audubon Arkansas submitted general comments for several TMDLs listed in the same public notice. Alcoa, Inc., and Almatis, Inc., submitted comments specific to this TMDL document. Comments and additional information submitted during the public comment period were used to inform or revise this TMDL document. The comments and responses to these TMDLs, along with comments on similar TMDLs with the same public review period, will be included in the document *EPA Responses to Comments for TMDLs in the Big Creek, Caddo River, Cornie Bayou, Bayou de L'Outre, Ouachita River, and Saline River Basins in Arkansas.*

EPA will submit the final TMDLs to ADEQ for implementation and incorporation into ADEQ's current water quality management plan.

7 REFERENCES

ADEQ (Arkansas Department of Environmental Quality). 2004. *Arkansas's 2004 List of Impaired Waterbodies.* Arkansas Department of Environmental Quality, Little Rock, AR.

ADEQ (Arkansas Department of Environmental Quality). 2005. *State of Arkansas 2004 Integrated Water Quality Monitoring and Assessment Report*. Arkansas Department of Environmental Quality, Little Rock, AR.

APCEC (Arkansas Pollution Control and Ecology Commission). 2007a. Regulation No. 2. Regulation Establishing Water Quality Standards for Surface Waters of the State of Arkansas. Adopted June 22, 2007. Arkansas Pollution Control and Ecology Commission, Little Rock, AR.

APCEC (Arkansas Pollution Control and Ecology Commission). 2007b. Regulation No. 2. Regulation Establishing Water Quality Standards for Surface Waters of the State of Arkansas. Adopted October 26, 2007. Arkansas Pollution Control and Ecology Commission, Little Rock, AR.

KDHE (Kansas Department of Health and Environment). 2003. *Kansas TMDL Curve Methodology*. Web site maintained by Kansas Department of Health and Environment. <http://www.kdheks.gov/tmdl/basic.htm>. September 29, 2003. Accessed June 13, 2005.

University of Florida. 2003. *Plant Management in Florida Waters: Chloride*. University of Florida, Center for Aquatic and Invasive Plants, and Florida Department of Environmental Protection, Bureau of Invasive Plant Management. <http:/aquat1.ifas.ufl.edu/guide/chlori.html>. Accessed July 20, 2005.

USEPA (U.S. Environmental Protection Agency). 1991. *Guidance for Water Quality-based Decisions: The TMDL Process*. EPA 440/-4-91-001. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

USEPA (U.S. Environmental Protection Agency). 2000. *Storm Water Phase II Final Rule.* (Fact sheet). EPA 833-F-00-002. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

Wilkes University. 2005. *Total Dissolved Solids*. Wilkes University, Center for Environmental Quality GeoEnvironmental Sciences and Engineering Department. <www.waterresearch.net/totaldissolvedsolids.htm>. Accessed July 20, 2005.

Appendix A
Summary of Water Quality Data

Table A-1. Summary of TDS data for the Saline River Basin

Station number	Station name	Period of record	Number of observations	Minimum	Maximum	Mean	Median	Number of observations above criterion[a]	% of observations above criterion[a]
				mg/L	mg/L	mg/L	mg/L		
OUA0026	Saline River near Benton, AR	9/18/90–4/3/07	194	47	101	73	73	0	0
OUA0031		10/2/90–7/17/07	185	3	1,615	299	215	36	20
OUA0041	Saline River downstream of Benton, AR	9/18/90–4/3/07	184	54	254	117	111	66	36
OUA0042	Saline River at Hwy 167, AR	9/4/90–4/24/07	194	49	227	98	92	24	12
OUA0118	Saline River at Hwy 79 bridge south of Rison, AR	1/2/91–4/24/07	188	53	224	102	95	38	20

[a] The water quality data were compared to the water quality criterion for TDS, which is 120 mg/L, except for station OUA0031, which were compared to a water quality criterion of 500 mg/L.

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Appendix B
Water Quality Data by Sampling Location

Table B-1. TDS data for station OUA0026

Sampling date	TDS (mg/L)
9/18/1990	78
10/16/1990	63
11/13/1990	84
12/11/1990	71
1/22/1991	60
2/19/1991	76
3/26/1991	78
4/16/1991	57
5/7/1991	63
6/4/1991	66
7/2/1991	75
7/30/1991	73
9/17/1991	64
10/8/1991	78
11/12/1991	69
12/10/1991	53
1/28/1992	70
2/25/1992	64
3/3/1992	62
4/7/1992	63
5/19/1992	78
6/22/1992	47
7/14/1992	74
8/11/1992	73
9/8/1992	69
10/6/1992	71
11/10/1992	81
11/23/1992	56
1/4/1993	72
1/5/1993	64
2/2/1993	59
3/2/1993	59
3/30/1993	61
5/4/1993	62
6/1/1993	77
7/13/1993	78
8/3/1993	86
9/7/1993	74
10/5/1993	54
11/2/1993	83
12/14/1993	60
2/1/1994	61
3/8/1994	55
4/5/1994	59
5/4/1994	72

Sampling date	TDS (mg/L)
6/21/1994	76
7/12/1994	75
8/23/1994	64
9/6/1994	84
10/4/1994	76
11/1/1994	
11/21/1994	69
1/24/1995	63
2/14/1995	72
3/28/1995	82
4/25/1995	59
5/23/1995	69
6/6/1995	61
7/11/1995	69
8/8/1995	76
9/5/1995	82
10/3/1995	84
10/31/1995	81
11/28/1995	81
1/9/1996	65
2/13/1996	77
3/12/1996	70
4/9/1996	69
5/7/1996	85
6/18/1996	75
7/23/1996	74
8/13/1996	83
9/10/1996	78
10/8/1996	73
11/5/1996	65
12/3/1996	56
1/21/1997	75
2/18/1997	65
3/11/1997	
4/15/1997	66
5/13/1997	71
6/17/1997	69
7/15/1997	85
8/26/1997	82
9/16/1997	78
10/28/1997	89
12/2/1997	82
12/30/1997	68
1/13/1998	62
2/10/1998	64

Sampling date	TDS (mg/L)
3/17/1998	55
4/14/1998	62
5/19/1998	
6/2/1998	88
6/30/1998	78
8/4/1998	54
9/1/1998	69
10/5/1998	83
11/3/1998	69
12/1/1998	83
1/5/1999	59
2/2/1999	53
3/2/1999	69.5
4/20/1999	66
5/11/1999	64.5
6/1/1999	82
7/6/1999	75
8/3/1999	78
9/7/1999	70
10/5/1999	73
11/17/1999	80
12/14/1999	59.5
1/18/2000	70.5
2/29/2000	68
3/27/2000	60
4/24/2000	67
5/16/2000	80.5
6/6/2000	73.5
7/18/2000	93.5
8/15/2000	80
9/5/2000	64.5
10/24/2000	86
10/31/2000	90.5
12/19/2000	67
1/15/2001	59
2/13/2001	63
3/6/2001	52.5
4/3/2001	65
5/8/2001	77
6/12/2001	69.5
7/3/2001	72.5
8/14/2001	92
9/25/2001	87
10/23/2001	82
11/13/2001	91.5
12/18/2001	51.5

Sampling date	TDS (mg/L)
1/22/2002	73
2/19/2002	64
3/19/2002	64
4/16/2002	56
5/14/2002	79
6/25/2002	
7/30/2002	83
8/27/2002	82
9/10/2002	89
10/15/2002	86
12/17/2002	61
1/21/2003	68
2/11/2003	79
3/11/2003	61
4/8/2003	78
5/13/2003	69.5
6/3/2003	69
6/30/2003	70
7/29/2003	101
9/9/2003	87
10/7/2003	90.5
11/4/2003	90.5
12/2/2003	70.5
1/27/2004	66.5
2/24/2004	53
3/30/2004	86.5
4/26/2004	89
5/4/2004	65.5
6/1/2004	77
7/20/2004	84
8/23/2004	75.5
9/28/2004	79.5
10/19/2004	74
11/2/2004	78.5
12/7/2004	86
1/4/2005	55.5
2/1/2005	78
3/15/2005	78.5
4/12/2005	58.5
5/10/2005	90
6/21/2005	91.5
7/19/2005	93
8/16/2005	93
9/13/2005	79.5
10/11/2005	87.5
11/1/2005	78.5

Sampling date	TDS (mg/L)
12/27/2005	88
2/21/2006	75.5
3/7/2006	84.5
4/18/2006	84.5
5/23/2006	73.5
6/6/2006	76
7/11/2006	88.5
8/1/2006	82
9/5/2006	87.5
10/3/2006	83
11/7/2006	68
12/5/2006	50.5
1/9/2007	57.5
2/6/2007	63.5
3/13/2007	74.5
4/3/2007	89

Table B-2. TDS data for station OUA0031

Sampling date	TDS (mg/L)
10/2/1990	852
10/30/1990	638
11/27/1990	79
1/22/1991	271
2/19/1991	268
3/26/1991	48
4/16/1991	183
5/7/1991	227
6/4/1991	594
7/2/1991	674
7/30/1991	754
9/17/1991	855
10/8/1991	994
11/12/1991	623
12/10/1991	286
1/28/1992	426
2/25/1992	384
3/3/1992	548
4/7/1992	338
5/19/1992	274
6/22/1992	624
7/14/1992	181

Sampling date	TDS (mg/L)
8/11/1992	477
9/8/1992	1345

Sampling date	TDS (mg/L)
10/6/1992	1615
11/10/1992	845
11/23/1992	42
1/4/1993	532
1/5/1993	147
2/2/1993	326
3/2/1993	186
3/30/1993	286
5/4/1993	212
6/1/1993	546
7/13/1993	223
8/3/1993	52
10/5/1993	1214
11/2/1993	85
12/14/1993	25
2/1/1994	26
3/8/1994	216
4/5/1994	3
5/4/1994	138
6/21/1994	49
7/12/1994	286
8/23/1994	532
9/6/1994	22
10/4/1994	68
11/21/1994	272
1/17/1995	46
2/21/1995	43
3/21/1995	32
4/11/1995	235
5/30/1995	36
6/27/1995	79
7/25/1995	815
9/11/1995	986
10/10/1995	378
11/7/1995	392
12/12/1995	611
1/16/1996	24
2/20/1996	298
3/26/1996	114
4/16/1996	726
4/30/1996	347
6/11/1996	429
7/9/1996	253
8/27/1996	1111
9/24/1996	119
10/15/1996	323

Sampling date	TDS (mg/L)
11/19/1996	384
12/10/1996	383
1/7/1997	343
2/4/1997	115
3/18/1997	255
4/22/1997	433
5/20/1997	156
6/10/1997	
7/8/1997	
8/5/1997	41
9/2/1997	176
9/30/1997	219
11/4/1997	399
12/9/1997	295
1/6/1998	146
2/3/1998	249
3/3/1998	166
3/31/1998	155
5/5/1998	352
6/23/1998	732
7/28/1998	649
8/25/1998	66
9/29/1998	52
10/20/1998	213
11/17/1998	289
12/21/1998	17
1/19/1999	277
2/9/1999	45.5
3/8/1999	164.5
4/13/1999	97
5/18/1999	237
6/1/1999	33
6/8/1999	653
7/6/1999	259
8/3/1999	414
12/14/1999	256
1/18/2000	181.5
2/29/2000	344.5
3/27/2000	3
4/24/2000	172.5
5/16/2000	195
6/5/2000	135
7/18/2000	154
12/19/2000	552.5
1/15/2001	136
2/13/2001	12

Sampling date	TDS (mg/L)
3/6/2001	11.5
4/3/2001	12
5/9/2001	181
6/12/2001	131.5
7/3/2001	293
8/14/2001	239
9/25/2001	173
10/23/2001	231
11/13/2001	181
1/22/2002	384
2/19/2002	29
3/19/2002	19.5
4/16/2002	137
5/14/2002	11
6/25/2002	
7/30/2002	738.5
8/27/2002	346
9/10/2002	933
10/15/2002	215
12/17/2002	153
1/21/2003	128
2/11/2003	127
3/11/2003	16
4/8/2003	132
5/13/2003	136
6/3/2003	191
6/30/2003	178
7/29/2003	188
9/9/2003	196
10/7/2003	88
11/4/2003	176
12/2/2003	138
1/27/2004	119
2/24/2004	137
3/30/2004	126
4/26/2004	13
5/4/2004	142
6/1/2004	145
7/20/2004	178
8/24/2004	127
9/28/2004	215
10/19/2004	118
12/7/2004	126
1/4/2005	112
2/1/2005	268
3/15/2005	34

Sampling date	TDS (mg/L)
4/12/2005	75.5
5/10/2005	24
6/21/2005	628
7/19/2005	243
8/16/2005	545
11/1/2005	134
12/27/2005	253
1/24/2006	152
2/21/2006	17
3/7/2006	584
4/18/2006	468
5/23/2006	312
6/6/2006	731
7/11/2006	956
8/1/2006	918
9/5/2006	67
10/3/2006	478
11/7/2006	516
12/5/2006	317
1/9/2007	179
2/6/2007	178
3/13/2007	357
4/3/2007	234
5/8/2007	433
6/19/2007	154
7/17/2007	555

Table B-3 TDS data for station OUA0041

Sampling date	TDS (mg/L)
9/18/90	131
10/16/90	179
11/13/90	133
12/11/90	133
1/22/91	97
1/22/91	128
2/19/91	100
3/26/91	121
4/16/91	95
5/7/91	95
6/4/91	110
7/2/91	110
7/30/91	123
9/17/91	116
10/8/91	126
11/12/91	137
1/28/92	119
2/25/92	111
3/3/92	117
4/7/92	141
5/19/92	127
6/22/92	54
7/14/92	106
8/11/92	138
9/8/92	105
10/6/92	123
11/10/92	118
11/23/92	106
1/4/93	139
2/2/93	87
3/30/93	149
5/4/93	64
6/1/93	91
7/13/93	86
8/3/93	89
9/7/93	84
10/5/93	74
11/2/93	137
12/14/93	70
2/1/94	79
3/8/94	93
4/5/94	106
5/4/94	125
6/21/94	111
7/12/94	117

Sampling date	TDS (mg/L)
8/23/94	69
9/6/94	91
10/4/94	145
11/1/94	
11/21/94	111
1/24/95	109
2/14/95	111
3/28/95	123
4/25/95	111
5/23/95	111
6/6/95	78
7/11/95	90
8/8/95	233
9/5/95	94
10/3/95	254
10/31/95	81
11/28/95	126
1/9/96	111
2/13/96	105
3/12/96	115
4/9/96	106
6/18/96	80
7/23/96	101
8/13/96	135
9/10/96	134
10/8/96	138
11/5/96	150
12/3/96	84
1/21/97	234
2/18/97	168
3/11/97	
4/15/97	209
5/13/97	250
7/15/97	127
8/26/97	147
9/16/97	129
10/28/97	239
12/2/97	236
12/30/97	160
2/10/98	219
4/14/98	204
5/19/98	
6/2/98	110
6/30/98	105
8/4/98	55

Sampling date	TDS (mg/L)
9/1/98	80
10/5/98	95
11/3/98	111
12/1/98	144
1/5/99	84
2/2/99	83
3/2/99	111.5
4/20/99	102
5/11/99	112.5
6/1/99	67
7/6/99	136
8/3/99	138
9/7/99	162
10/5/99	183
11/17/99	121
12/14/99	83
1/18/00	112.5
2/29/00	104
3/27/00	89
4/24/00	128
5/16/00	87
6/6/00	74.5
7/18/00	92
8/15/00	101
9/5/00	101
10/24/00	110
10/31/00	118
12/19/00	81.5
1/15/01	86
2/13/01	112
3/6/01	60.5
4/3/01	112
5/8/01	143
6/12/01	137
7/3/01	111
8/14/01	163
9/25/01	203
10/23/01	147
11/13/01	147
1/22/02	116
2/19/02	117
3/19/02	78
4/16/02	105
5/14/02	104
6/25/02	
7/30/02	105

Sampling date	TDS (mg/L)
8/27/02	130
9/10/02	150
10/15/02	106
12/17/02	108
1/21/03	98
2/11/03	106
3/11/03	111
4/8/03	118
5/13/03	119
6/3/03	140
6/30/03	134
7/29/03	152
9/9/03	147
10/7/03	168
11/4/03	121
12/2/03	126
1/27/04	122
2/24/04	103
3/30/04	122
4/26/04	112
5/4/04	119
6/1/04	123
7/20/04	105
8/24/04	95.5
9/28/04	106
12/7/04	85
2/1/05	106
3/15/05	102
4/12/05	71
5/10/05	115
6/21/05	128
7/19/05	89
8/16/05	104
9/13/05	101
10/11/05	126
11/1/05	114
12/27/05	112
2/21/06	105
3/7/06	124
4/18/06	99.5
5/23/06	105
6/6/06	79.5
7/11/06	88.5
8/1/06	106
9/5/06	93
10/3/06	95.5

Sampling date	TDS (mg/L)
11/7/06	74
12/5/06	60
1/9/07	60
2/6/07	103
3/13/07	98.5
4/3/07	108

Table B-4. TDS data for station OUA0042

Sampling date	TDS (mg/L)
9/4/90	102
10/2/90	112
10/30/90	116
11/27/90	106
1/2/91	62
2/12/91	81
3/12/91	110
4/2/91	78
5/14/91	83
6/18/91	91
7/9/91	97
8/6/91	120
9/3/91	96
10/15/91	88
10/29/91	84
11/25/91	71
1/7/92	80
2/18/92	96
3/17/92	81
4/21/92	95
5/5/92	122
6/9/92	109
7/28/92	92
8/25/92	101
9/22/92	106
10/20/92	119
11/17/92	100
12/14/92	106
1/19/93	94
2/16/93	181
3/16/93	81

Sampling date	TDS (mg/L)
4/20/93	86

Sampling date	TDS (mg/L)
5/18/93	67
6/14/93	92
6/21/93	131
7/27/93	67
8/24/93	79
9/21/93	80
10/12/93	88
11/16/93	76
12/21/93	82
1/11/94	113
2/22/94	73
3/1/94	75
4/12/94	103
5/17/94	92
7/5/94	92
8/2/94	76
8/30/94	72
10/11/94	77
11/8/94	78
12/6/94	112
2/21/95	77
3/21/95	73
4/11/95	75
5/30/95	92
6/27/95	94
7/25/95	81
8/22/95	85
9/11/95	107
10/10/95	78
11/7/95	108
12/12/95	102
1/16/96	90
2/20/96	93
3/26/96	91
4/16/96	112
4/30/96	104
6/11/96	74
7/9/96	76
8/27/96	132
9/24/96	112
10/15/96	155
11/19/96	174
12/10/96	86
1/7/97	143
2/4/97	89
3/18/97	73

Sampling date	TDS (mg/L)
4/22/97	150
5/20/97	183
6/10/97	
7/8/97	
8/5/97	170
9/2/97	209
9/30/97	115
11/4/97	195
12/9/97	161
1/6/98	108
2/3/98	106
3/3/98	83
3/31/98	113
5/5/98	227
6/23/98	115
7/28/98	80
8/25/98	78
9/29/98	75
10/20/98	74
11/17/98	94
12/21/98	104
1/19/99	87
2/9/99	90.5
3/8/99	105
4/13/99	82
5/18/99	88
6/8/99	85
7/13/99	121.5
8/17/99	126.5
9/14/99	91
10/19/99	164
11/22/99	125.5
12/20/99	89.5
1/25/00	94
2/15/00	102
3/14/00	77
4/11/00	96
5/30/00	100
6/27/00	73.5
7/31/00	
8/22/00	88
9/26/00	88
10/3/00	80
11/14/00	122.5
12/5/00	91
1/30/01	66

Sampling date	TDS (mg/L)
2/20/01	48.5
3/20/01	64
4/24/01	92
5/22/01	96
6/19/01	112
7/17/01	97.5
8/7/01	102
9/4/01	87
10/2/01	112.5
11/6/01	103.5
12/11/01	85
1/2/02	85
2/12/02	83
3/5/02	80.5
4/2/02	51.5
5/7/02	90
6/4/02	116
7/9/02	89.5
8/6/02	114
9/3/02	129
10/8/02	98.5
11/12/02	117
12/10/02	100
1/28/03	87
2/18/03	75
3/18/03	82
4/15/03	116
5/20/03	93
6/24/03	68
7/22/03	76.5
8/19/03	205
9/30/03	107
10/21/03	136
11/12/03	108
12/9/03	125
1/20/04	96
2/10/04	78.5
3/9/04	67
4/13/04	105
5/25/04	99
7/6/04	91.5
7/27/04	102
8/10/04	91
8/31/04	81
10/12/04	97.5
11/9/04	65.5

Sampling date	TDS (mg/L)
12/14/04	75
2/15/05	97.5
3/22/05	85
4/19/05	112
5/17/05	92.5
6/14/05	117
7/26/05	80
8/23/05	87
9/26/05	71.5
10/25/05	127
12/13/05	119
1/17/06	78.5
1/31/06	98.5
3/28/06	78
4/25/06	105
5/30/06	96
6/20/06	78
7/25/06	85
8/22/06	76
9/26/06	86.5
10/24/06	82.5
11/28/06	75
12/19/06	97.5
1/30/07	78
2/27/07	81
3/27/07	87.5
4/24/07	93

Table B-5. TDS data for station OUA0118

Sampling date	TDS (mg/L)
1/2/91	70
2/12/91	79
3/12/91	91
4/2/91	87
5/14/91	66
6/18/91	90
7/9/91	126
8/6/91	122
9/3/91	141
10/15/91	92
10/29/91	112
11/25/91	89

Sampling date	TDS (mg/L)
1/7/92	94
2/18/92	94
3/17/92	67
4/21/92	106
5/5/92	127
6/9/92	121
7/28/92	102
8/25/92	122
9/22/92	102
10/20/92	159
11/17/92	151
12/14/92	110
1/19/93	128
2/16/93	87
3/16/93	86
4/20/93	78
5/18/93	76
6/14/93	89
6/21/93	80
7/26/93	78
8/24/93	81
9/21/93	85
10/12/93	68
11/16/93	115
12/21/93	94
1/11/94	131
2/22/94	83
3/1/94	68
4/12/94	99
5/17/94	86
7/5/94	67
8/2/94	81
8/30/94	85
10/11/94	84
11/8/94	98
12/6/94	138
2/21/95	87
3/21/95	70
4/11/95	91
5/30/95	117
6/27/95	109
7/25/95	93
8/22/95	89
9/11/95	79
10/10/95	75
11/7/95	84

Sampling date	TDS (mg/L)
12/12/95	105
1/16/96	101
2/20/96	101
3/26/96	95
4/16/96	112
4/30/96	127
6/11/96	121
7/9/96	93
8/27/96	126
9/24/96	199
10/15/96	166
11/19/96	160
12/10/96	82
1/7/97	133
2/4/97	112
3/18/97	78
4/22/97	136
5/20/97	169
6/10/97	
7/8/97	
8/5/97	119
9/2/97	158
9/30/97	118
11/4/97	178
12/9/97	198
1/6/98	117
2/3/98	97
3/3/98	86
3/31/98	118
5/5/98	224
6/23/98	108
7/28/98	75
8/25/98	87
9/29/98	88
10/20/98	92
11/17/98	121
12/21/98	110
1/19/99	127
2/9/99	81
3/8/99	99
4/13/99	73
5/18/99	95
6/8/99	91
7/13/99	114.5
8/17/99	104
9/14/99	115.5

Sampling date	TDS (mg/L)
10/19/99	100
11/22/99	127
12/20/99	91.5
1/25/00	91.5
2/15/00	113
3/14/00	110
4/11/00	101
5/30/00	101.5
6/27/00	77.5
7/31/00	
8/22/00	84
9/26/00	72
10/3/00	82
11/14/00	126.5
12/5/00	99
1/30/01	68
2/20/01	61.5
3/20/01	61.5
4/24/01	84
5/22/01	97
6/19/01	112
7/17/01	116
8/7/01	124.5
9/4/01	103.5
10/2/01	92
11/6/01	110
12/11/01	92
1/2/02	85.5
2/12/02	91
3/5/02	86
4/2/02	52.5
5/7/02	84.5
6/4/02	91.5
7/9/02	130
8/6/02	127.5
9/3/02	213
10/8/02	144
11/12/02	123
1/28/03	92
2/18/03	79.5
3/18/03	82
4/15/03	106
5/20/03	85
6/24/03	65.5
7/22/03	109
8/19/03	97.5

Sampling date	TDS (mg/L)
9/30/03	97
10/21/03	101
11/12/03	104
12/9/03	140
1/20/04	108
2/10/04	79
3/9/04	69.5
4/13/04	77.5
5/25/04	102
7/6/04	85
7/27/04	90.5
8/10/04	89.5
8/31/04	82.5
10/12/04	92
11/9/04	76.5
12/14/04	67
2/15/05	87
3/22/05	94
4/19/05	96
5/17/05	100
6/14/05	108
7/26/05	81.5
8/23/05	73.5
9/26/05	69.5
10/25/05	91
12/13/05	148
1/17/06	148
1/31/06	112
3/28/06	73
4/25/06	99.5
5/30/06	77.5
6/20/06	83.5
8/22/06	86.5
9/26/06	123
10/24/06	119
11/28/06	88
12/19/06	103
1/30/07	77
2/27/07	97
3/27/07	100
4/24/07	98.5

Appendix C
Total Dissolved Solids Figures for the Saline River Basin

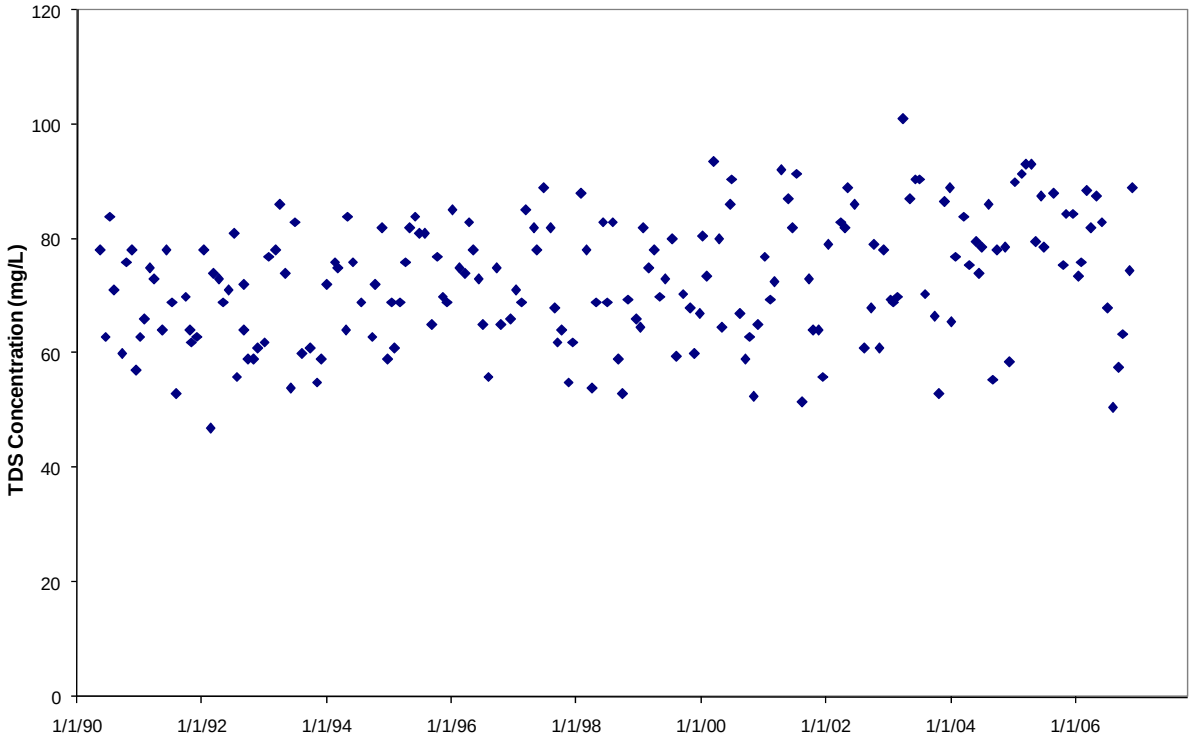

Figure C-1. Time series TDS observations at the Saline River near Benton, Arkansas (station OUA0026).

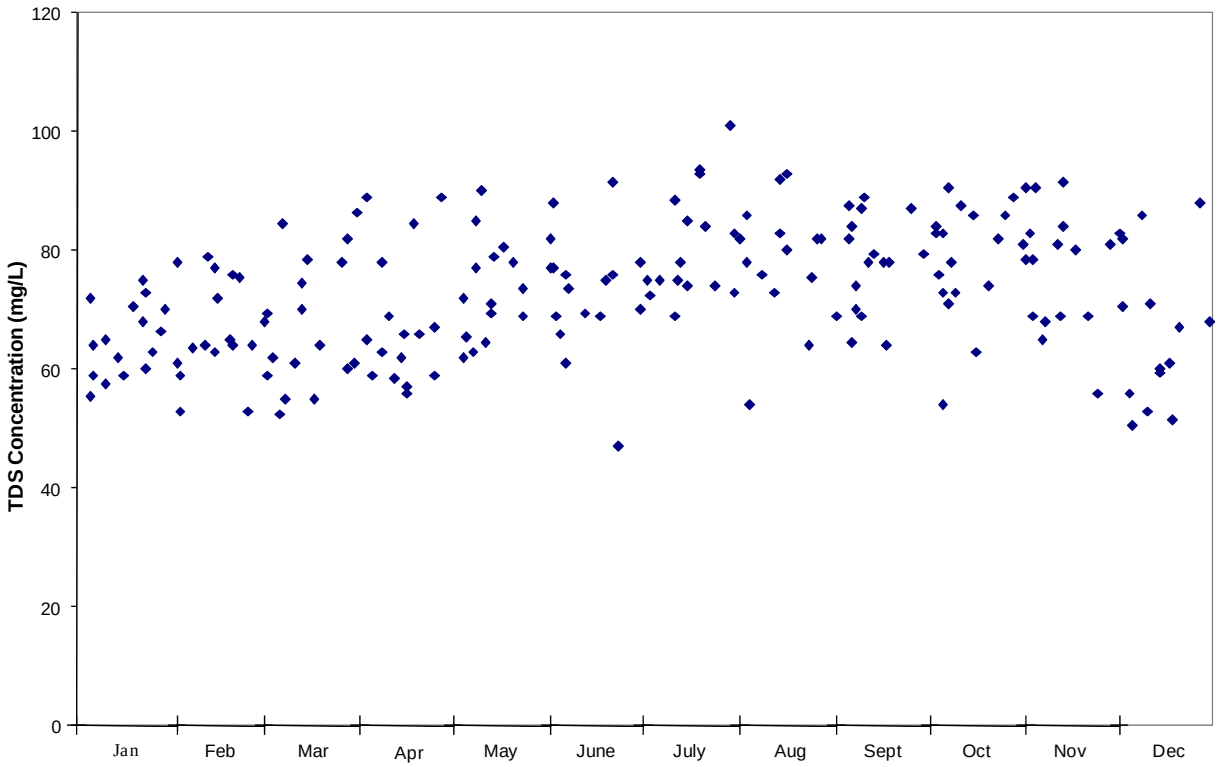

Figure C-2. Seasonal TDS observations at the Saline River near Benton, Arkansas (station OUA0026).

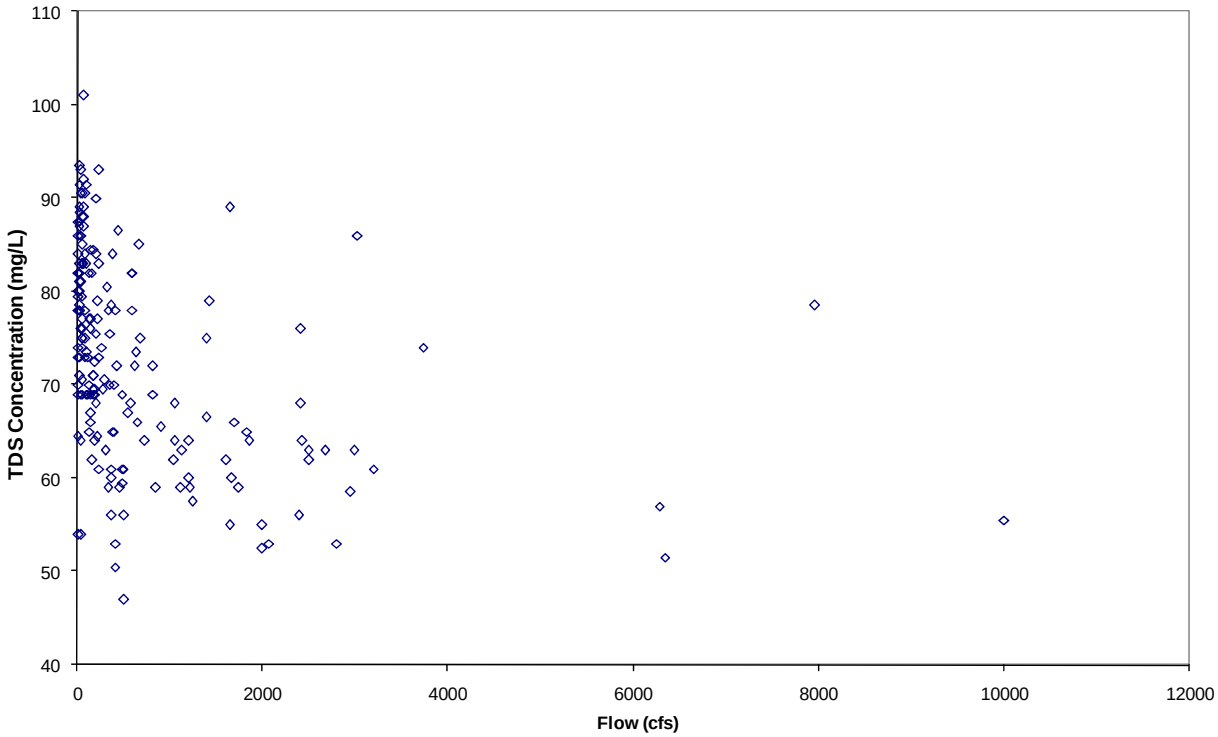

Figure C-3. TDS versus flow at the Saline River near Benton, Arkansas (station OUA0026).

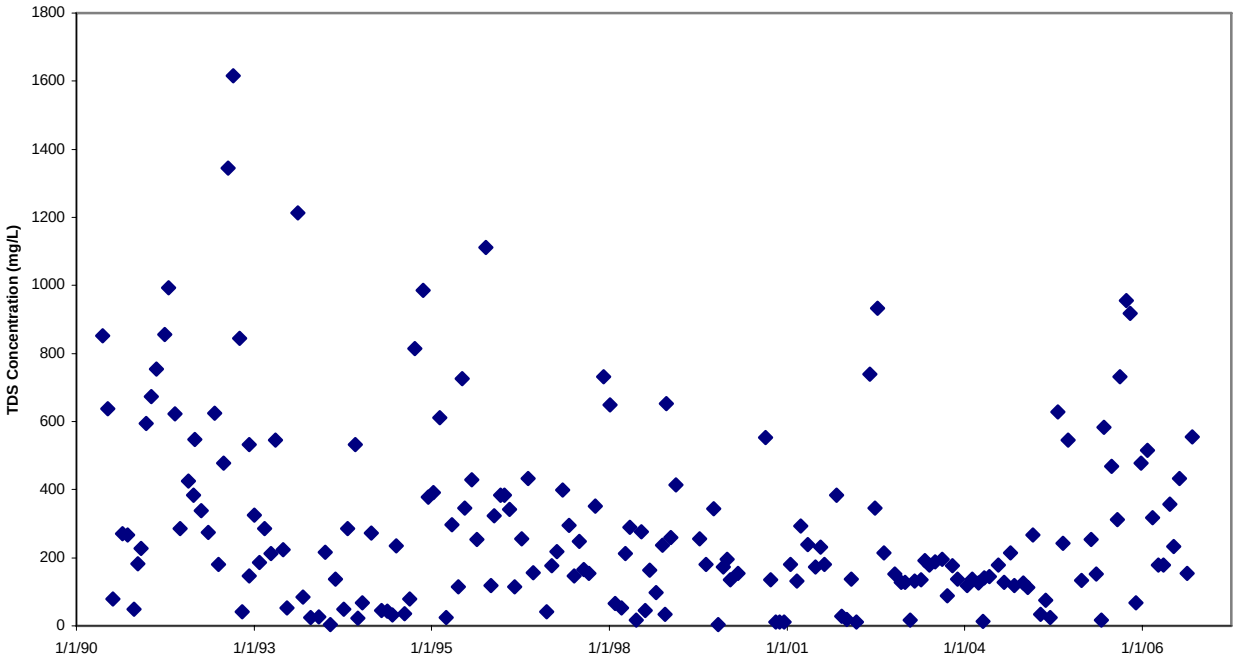

Figure C-4. Time series TDS observations at Hurricane Creek (station OUA0031).

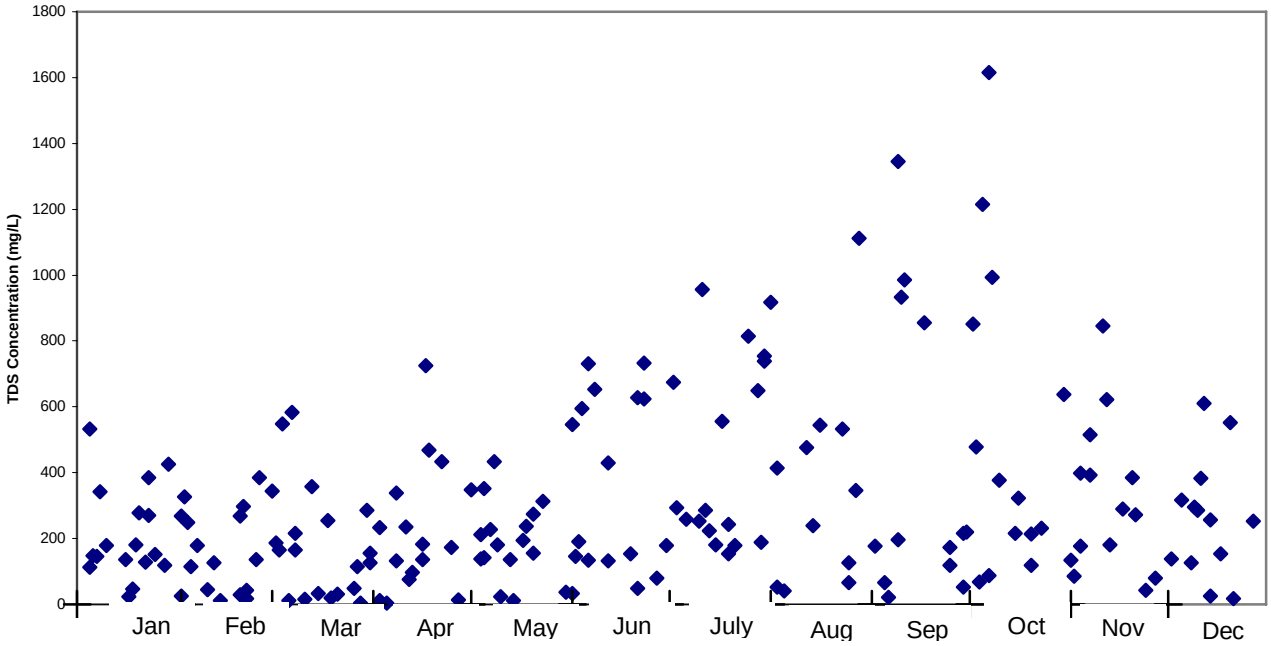

Figure C-5. Seasonal TDS observations at Hurricane Creek (station OUA0031).

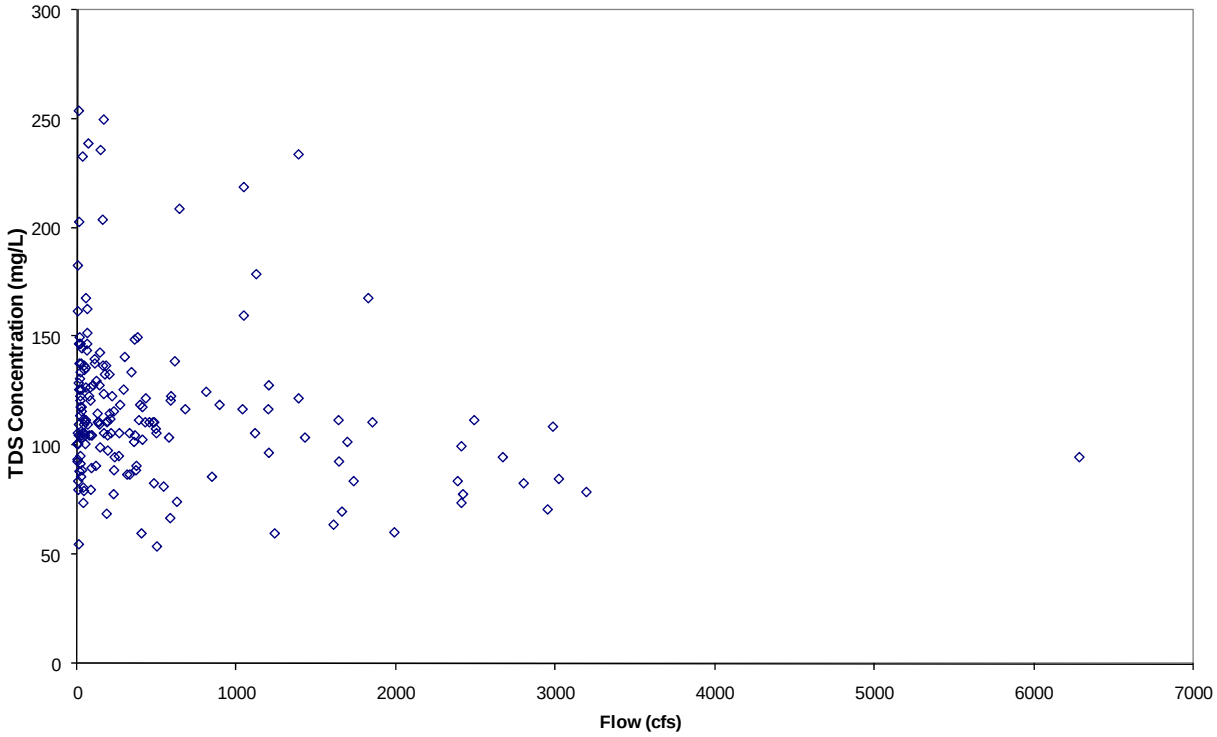

Figure C-6. TDS versus flow at Hurricane Creek (station OUA0031).

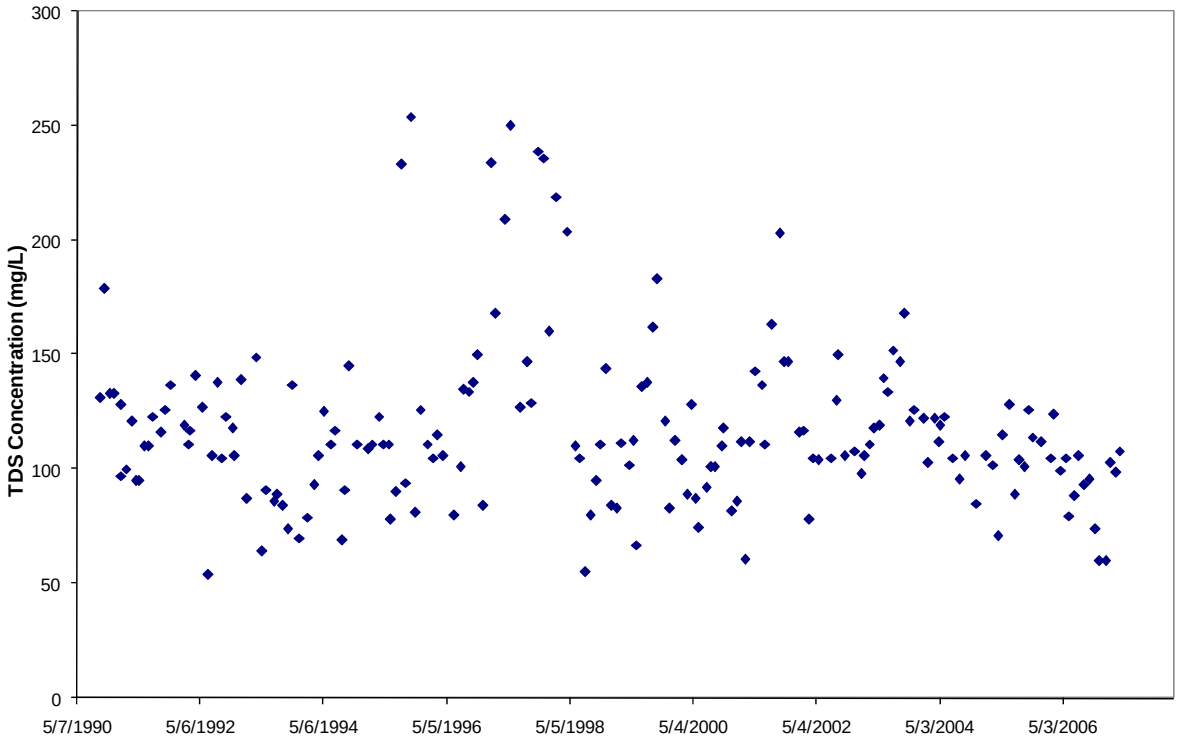

Figure C-7. Time series TDS observations at the Saline River downstream of Benton, Arkansas (station OUA0041).

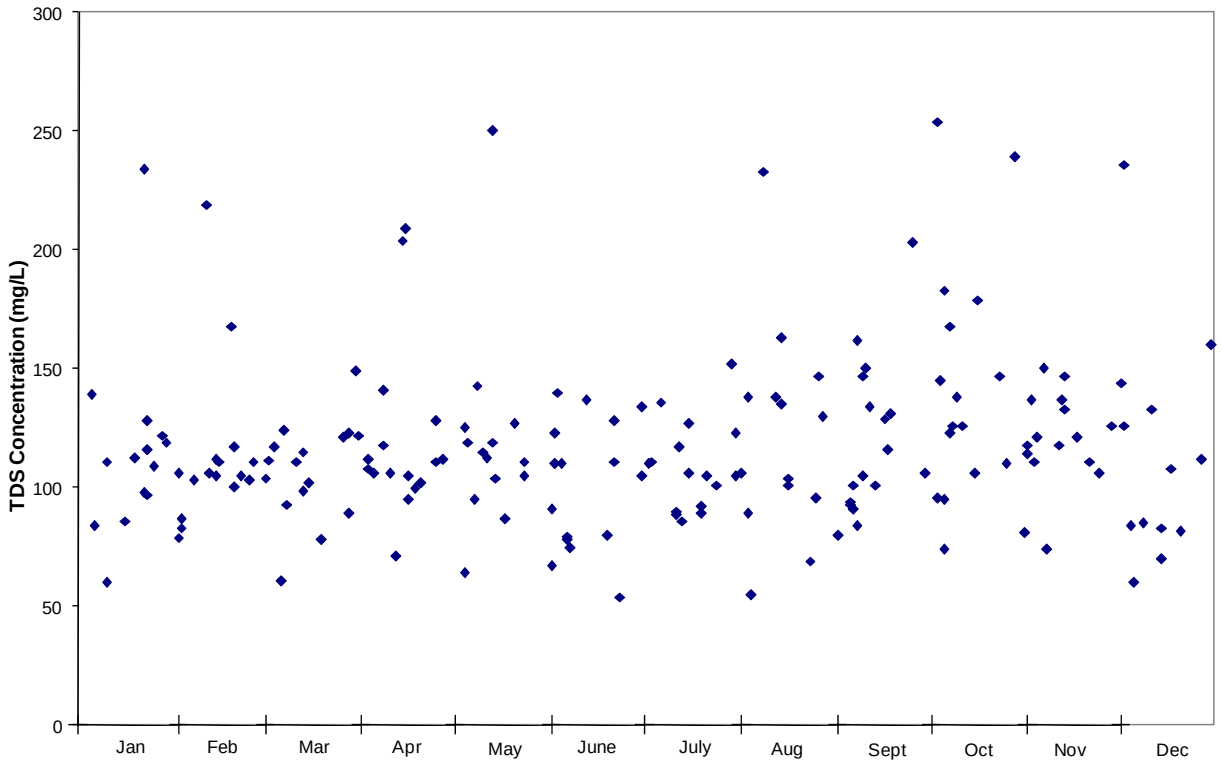

Figure C-8. Seasonal TDS observations at the Saline River downstream of Benton, Arkansas (station OUA0041).

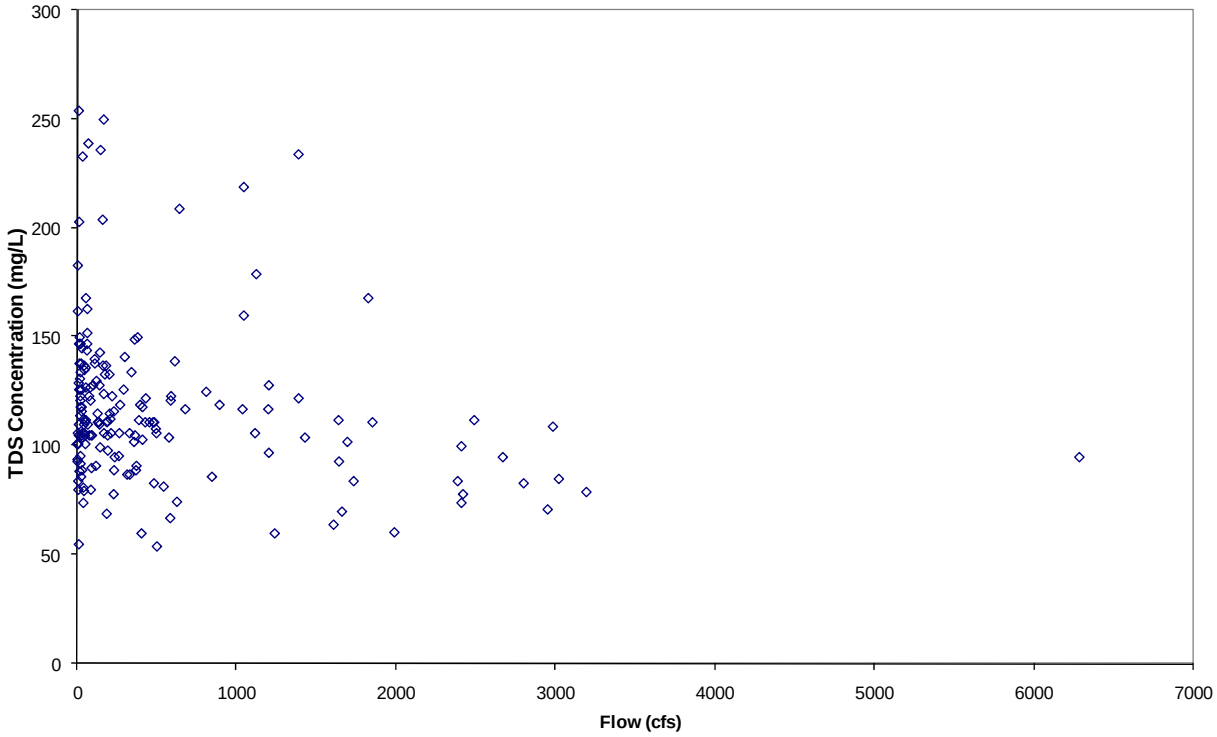

Figure C-9. TDS versus flow at the Saline River downstream of Benton, Arkansas (station OUA0041).

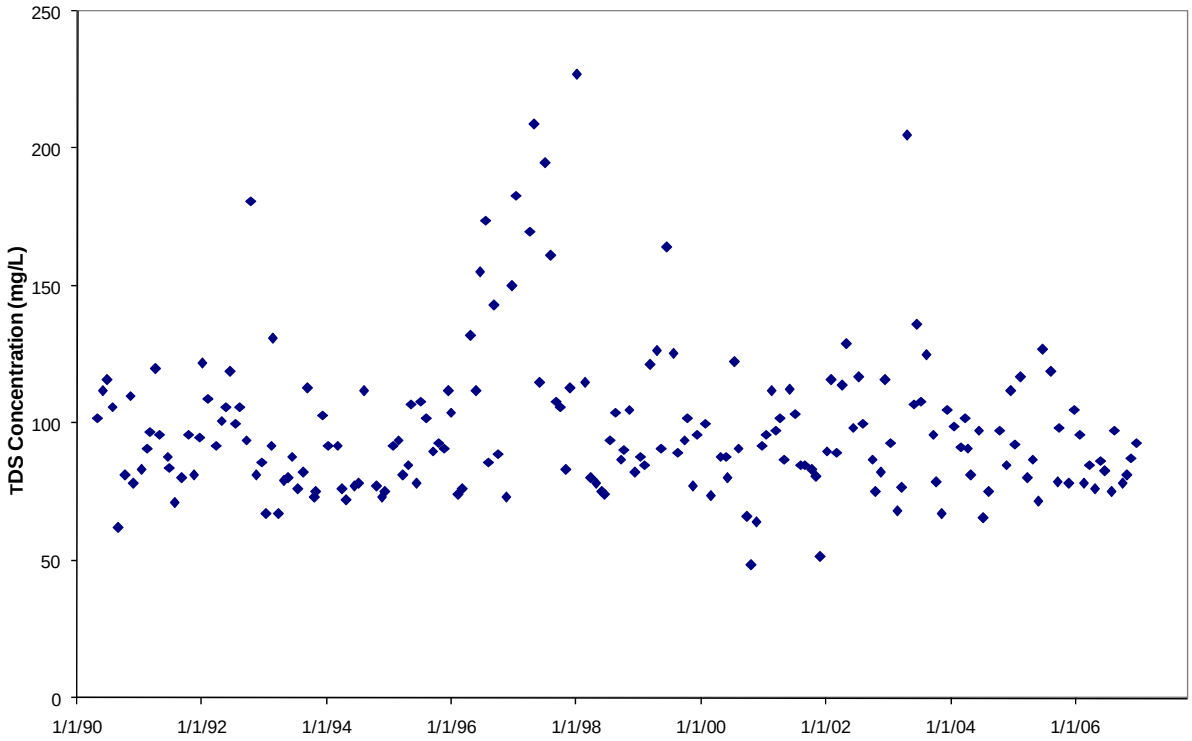

Figure C-10. Time series TDS observations at the Saline River at Highway 167, Arkansas (station OUA0042).

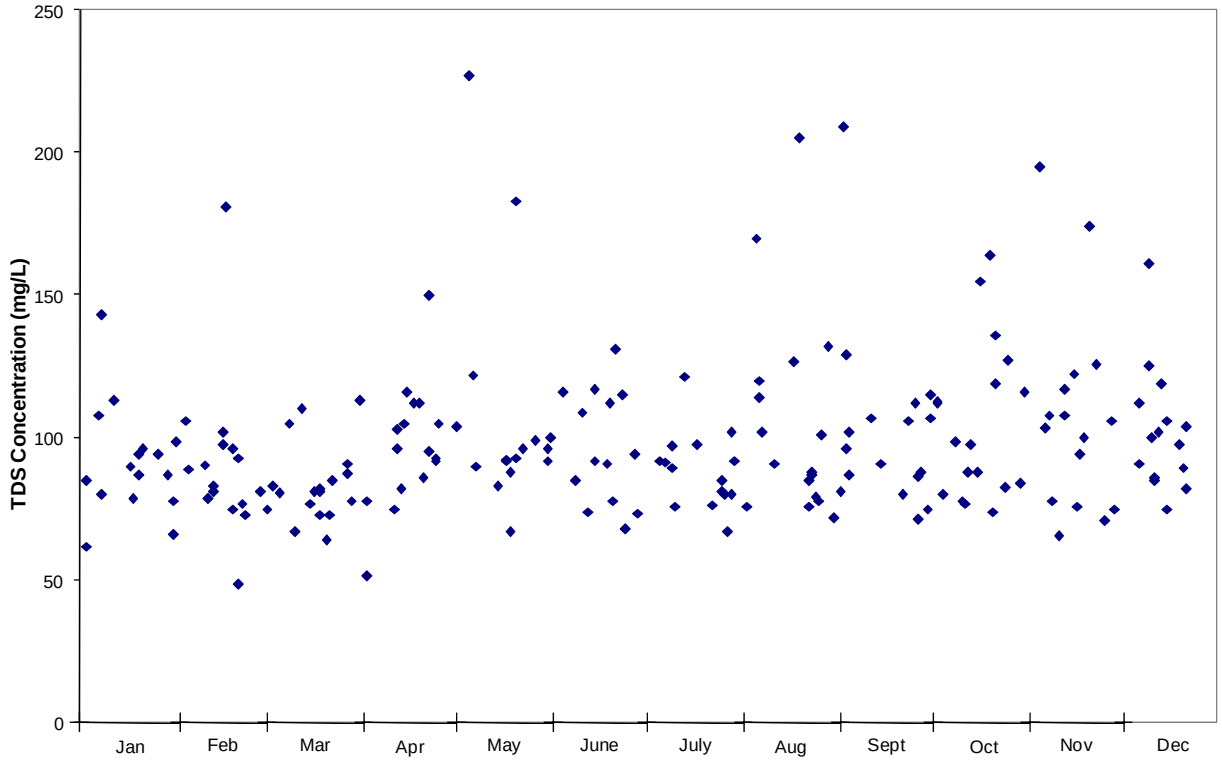

Figure C-11. Seasonal TDS observations at the Saline River at Highway 167, Arkansas (station OUA0042).

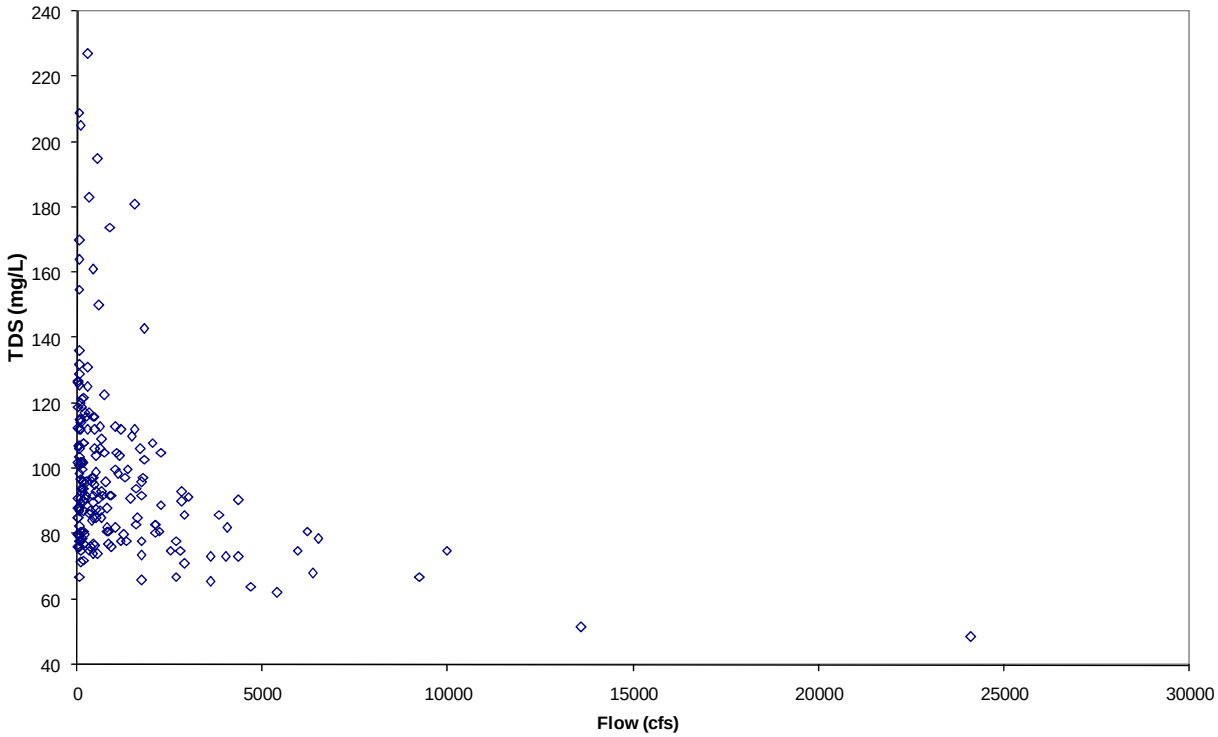

Figure C-12. TDS versus flow observations at the Saline River at Highway 167, Arkansas (station OUA0042).

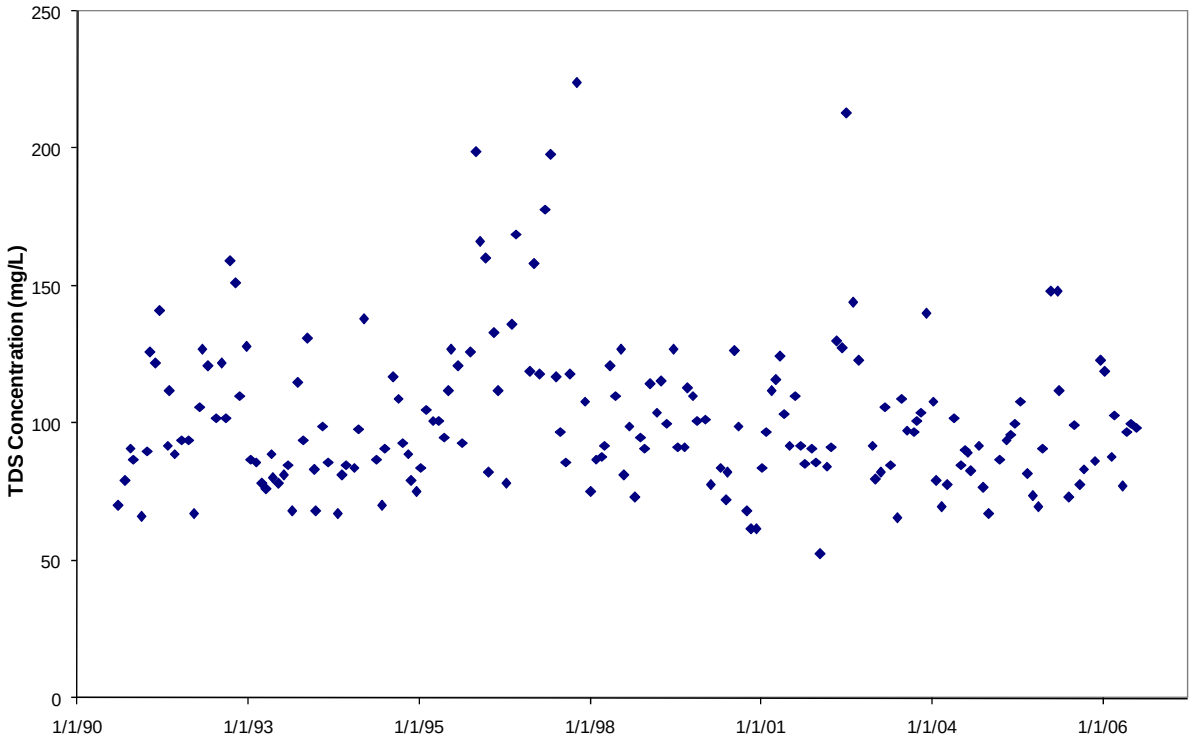

Figure C-13. Time series TDS observations at the Saline River at Highway 79 bridge south of Rison, Arkansas (station OUA0118).

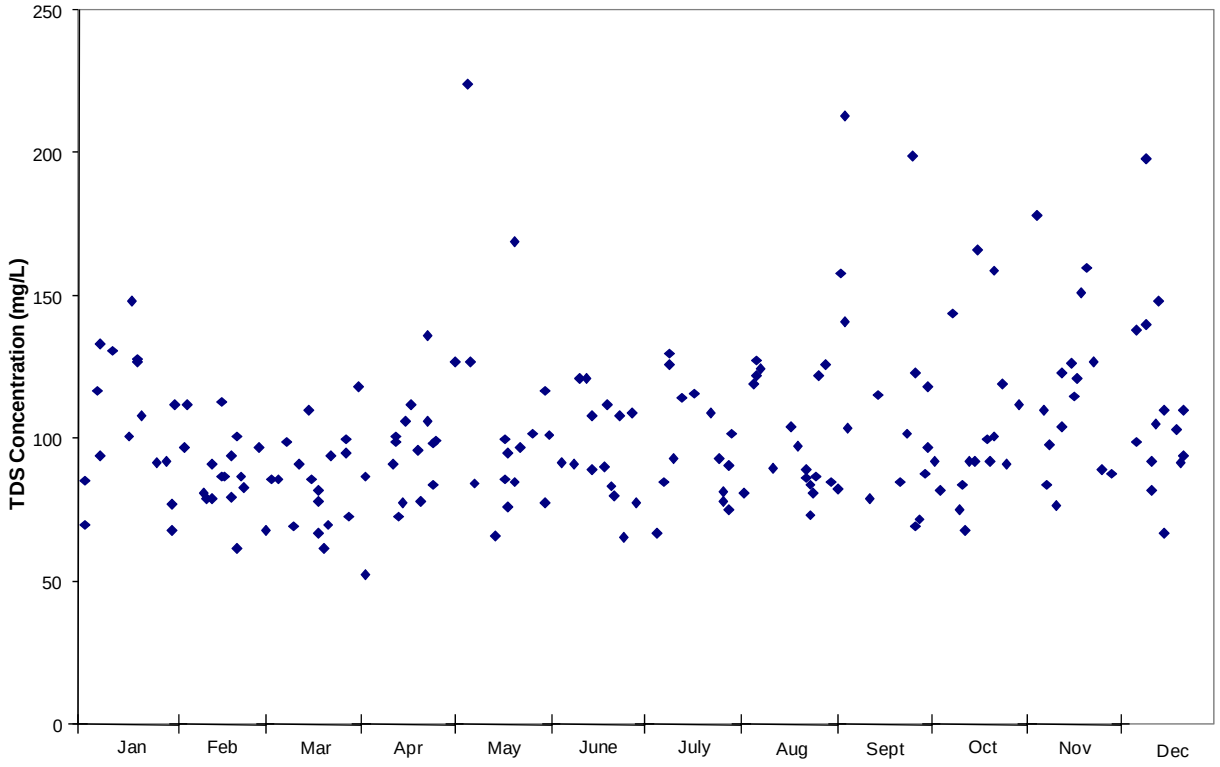

Figure C-14. Seasonal TDS observations at the Saline River at Highway 79 bridge south of Rison, Arkansas (station OUA0118).

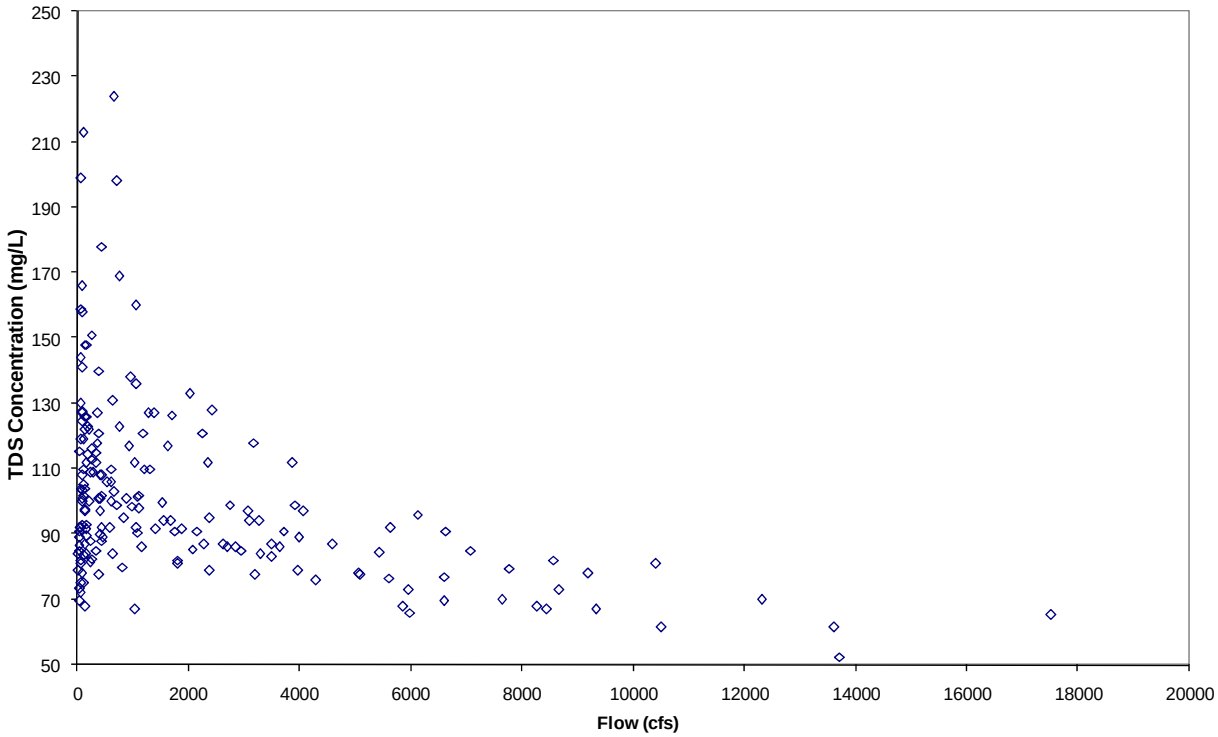

Figure C-15. TDS versus flow observations at the Saline River at Highway 79 bridge south of Rison, Arkansas (station OUA0118).

Appendix D
Flow Duration Curves for the Saline River Basin

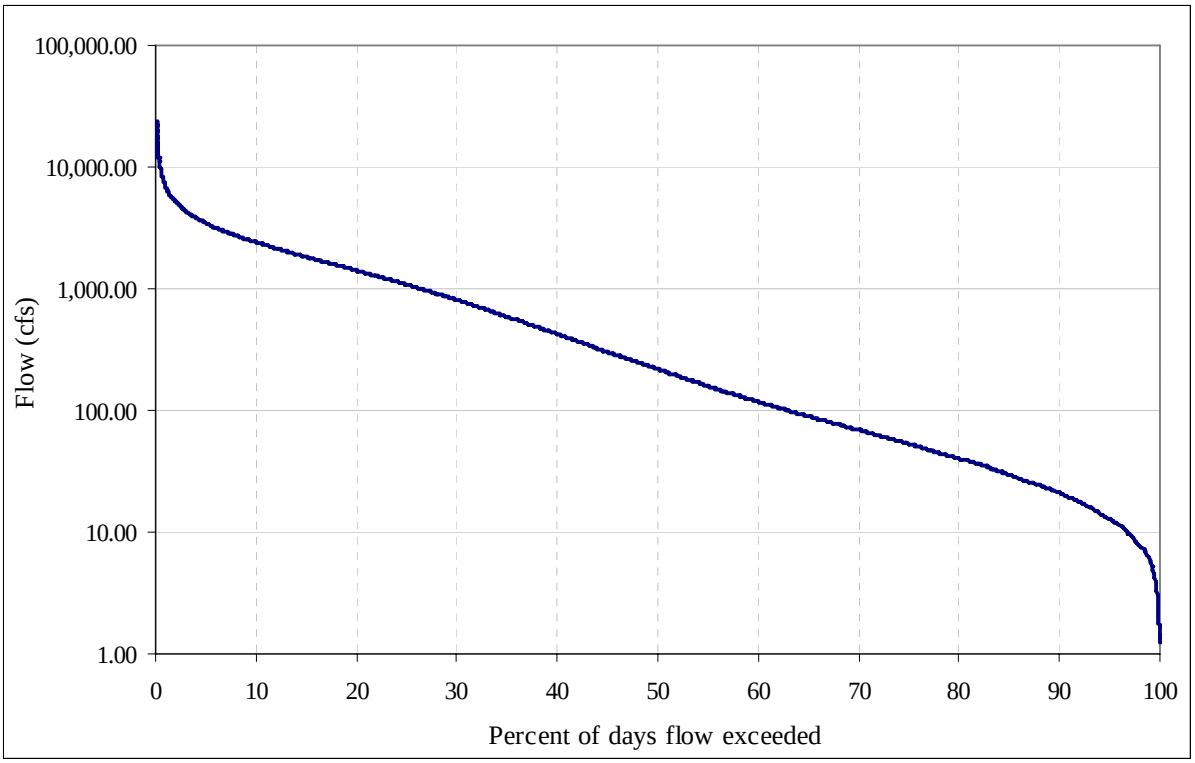

Figure D-1. Flow duration curve for HUC-reach 08040203-010 in the Saline River Basin.

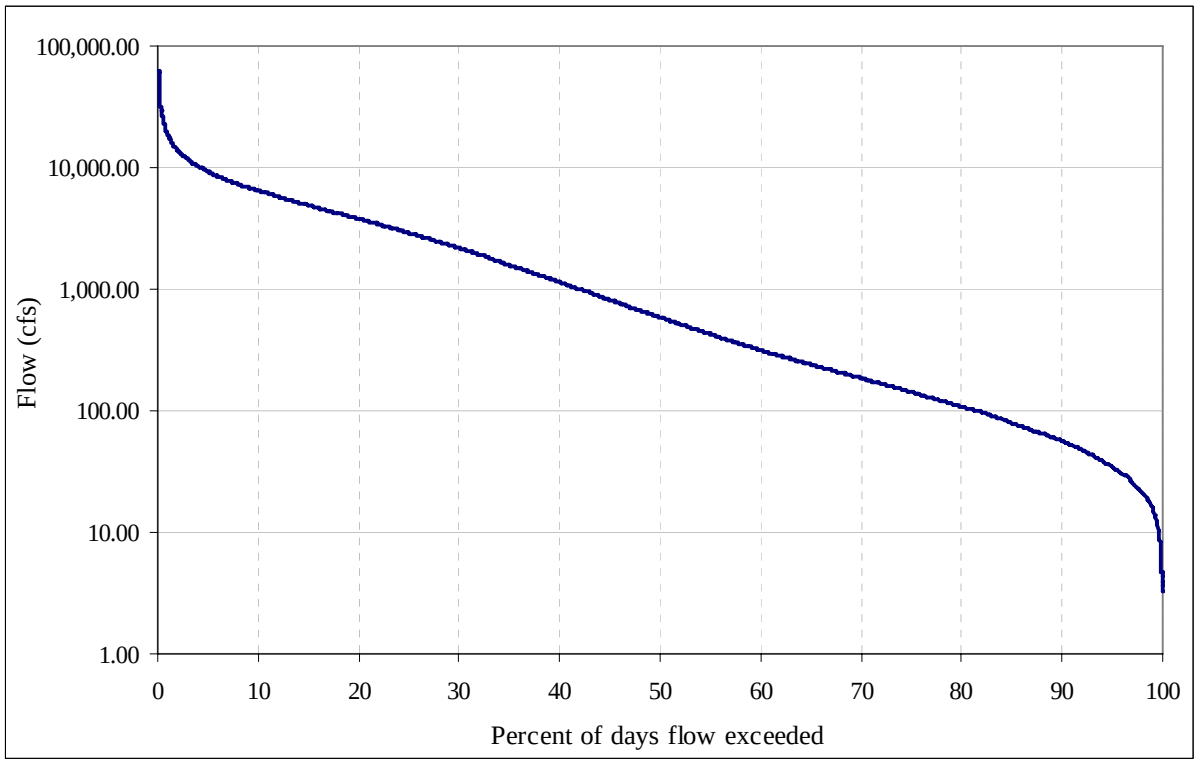

Figure D-2. Flow duration curve for HUC-reach 08040204-006 in the Saline River Basin.

Appendix E
Load Duration Curve Calculations for All TMDLs (CD-ROM)

This appendix contains extremely large files, which are included only on a CD-ROM. To obtain a copy of this appendix, please contact EPA.

Appendix F
Load Duration Curve Summaries and Plots for TDS

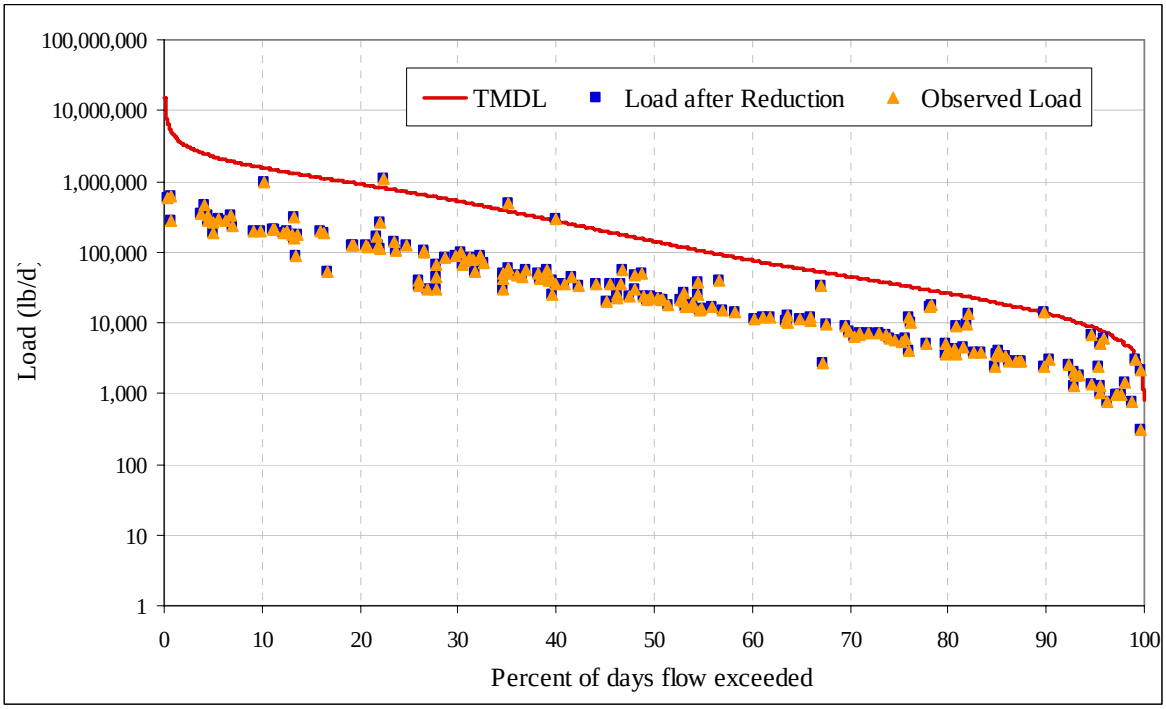

Figure F-1. TDS load duration curve for station OUA0026 for Saline River (HUC-reach 08040203-010)

Table F-1. Allowable TDS load for station OUA0026 for Saline River (HUC-reach 08040203-010)

Date	Observed flow (cfs)	Percent exceedance for observed flow	Adjusted flow for entire basin (cfs)	Width for area under curves (%)	Allowable load to meet standard (lb/day)	Area under TMDL curve (lb/day)
						553,500.5
9/12/1954	3.8	100.000	1.242	0.00	804.0380	0.00E+00
9/13/1954	3.8	100.000	1.242	0.00	804.0380	0.00E+00
9/16/1954	3.8	100.000	1.242	0.00	804.0380	0.00E+00
9/22/1954	3.8	100.000	1.242	0.00	804.0380	0.00E+00
9/23/1954	3.8	100.000	1.242	0.00	804.0380	0.00E+00
9/11/1954	4.1	100.000	1.340	0.00	867.5147	0.00E+00
9/14/1954	4.1	100.000	1.340	0.00	867.5147	0.00E+00
9/15/1954	4.1	100.000	1.340	0.00	867.5147	0.00E+00
9/17/1954	4.1	100.000	1.340	0.00	867.5147	0.00E+00
For brevity, most cells of this spreadsheet have been hidden						
1/28/1949	54800	0.100	17914.282	0.00	11595074.8671	0.00E+00
12/28/1987	59400	0.100	19418.035	0.00	12568384.0713	0.00E+00
5/2/1958	59600	0.100	19483.416	0.00	12610701.8628	0.00E+00
5/16/1968	59600	0.100	19483.416	0.00	12610701.8628	0.00E+00
12/26/1987	61500	0.100	20104.531	0.00	13012720.8819	0.00E+00
5/1/1958	65900	0.100	21542.904	0.00	13943712.2946	0.00E+00
12/27/1987	67000	0.100	21902.498	0.00	14176460.1477	0.00E+00
4/30/1958	68500	0.100	22392.852	0.00	14493843.5839	0.00E+00
4/29/1958	69500	0.100	22719.755	0.00	14705432.5413	0.00E+00
5/15/1968	71500	0.100	23373.561	0.10	15128610.4562	1.51E+04
5/14/1968	72500	0.000	23700.464	0.00	15340199.4136	0.00E+00

Table F-2. Existing load for TDS for station OUA0026 for Saline River (HUC-reach 08040203-010)

Date	Observed Concentration (mg/L)	Flow/unit area on sampling day (cfs)	Percent exceedance for flow on sampling day	Current load (lbs/day)	Reduced load (lbs/day)	Allowable load with MOS incorporated (lbs/day)	Reduced load less than or equal to allow load?
7/29/2003	101	21.902	75.9	1.193E+04	1.193E+04	1.276E+04	Yes
7/18/2000	93.5	7.955	85.2	4.012E+03	4.012E+03	4.634E+03	Yes
7/19/2005	93	76.495	56.7	3.837E+04	3.837E+04	4.456E+04	Yes
8/16/2005	93	12.095	95.8	6.067E+03	6.067E+03	7.046E+03	Yes
8/14/2001	92	21.902	63.4	1.087E+04	1.087E+04	1.276E+04	Yes
11/13/2001	91.5	4.904	84.7	2.420E+03	2.420E+03	2.856E+03	Yes
6/21/2005	91.5	33.671	78.2	1.662E+04	1.662E+04	1.961E+04	Yes
10/31/2000	90.5	10.461	95.6	5.106E+03	5.106E+03	6.094E+03	Yes
10/7/2003	90.5	18.960	81.9	9.255E+03	9.255E+03	1.104E+04	Yes
11/4/2003	90.5	28.441	89.8	1.388E+04	1.388E+04	1.657E+04	Yes
5/10/2005	90	67.669	67.1	3.285E+04	3.285E+04	3.942E+04	Yes
10/28/1997	89	23.950	64.9	1.150E+04	1.150E+04	1.395E+04	Yes
9/10/2002	89	6.211	99.1	2.982E+03	2.982E+03	3.618E+03	Yes
4/26/2004	89	536.121	22.1	2.574E+05	2.574E+05	3.123E+05	Yes
7/11/2006	88.5	5.884	87	2.809E+03	2.809E+03	3.428E+03	Yes
6/2/1998	88	22.838	65.9	1.084E+04	1.084E+04	1.330E+04	Yes
12/27/2005	88	18.960	80.8	9.000E+03	9.000E+03	1.104E+04	Yes
10/11/2005	87.5	5.230	92.3	2.469E+03	2.469E+03	3.047E+03	Yes
9/5/2006	87.5	1.635	96.3	7.714E+02	7.714E+02	9.522E+02	Yes
9/25/2001	87	5.230	95.4	2.454E+03	2.454E+03	3.047E+03	Yes
9/9/2003	87	21.576	76.1	1.012E+04	1.012E+04	1.257E+04	Yes
3/30/2004	86.5	141.549	30.4	6.604E+04	6.604E+04	8.246E+04	Yes
8/3/1993	86	10.949	79.8	5.079E+03	5.079E+03	6.378E+03	Yes
10/24/2000	86	4.577	99.6	2.123E+03	2.123E+03	2.666E+03	Yes
10/15/2002	86	11.769	75.2	5.459E+03	5.459E+03	6.855E+03	Yes
12/7/2004	86	987.247	4.2	4.579E+05	4.579E+05	5.751E+05	Yes
5/7/1996	85	216.406	30.2	9.922E+04	9.922E+04	1.261E+05	Yes
7/15/1997	85	18.989	69.5	8.706E+03	8.706E+03	1.106E+04	Yes
3/7/2006	84.5	55.574	39.6	2.533E+04	2.533E+04	3.237E+04	Yes
4/18/2006	84.5	48.055	46.2	2.190E+04	2.190E+04	2.799E+04	Yes
11/13/1990	84	67.146	48	3.042E+04	3.042E+04	3.911E+04	Yes
9/6/1994	84	122.316	39.1	5.542E+04	5.542E+04	7.125E+04	Yes
10/3/1995	84	4.448	92.9	2.015E+03	2.015E+03	2.591E+03	Yes
7/20/2004	84	25.825	65.9	1.170E+04	1.170E+04	1.504E+04	Yes
11/2/1993	83	15.311	73.7	6.854E+03	6.854E+03	8.919E+03	Yes
8/13/1996	83	15.995	72.9	7.161E+03	7.161E+03	9.318E+03	Yes
10/5/1998	83	77.838	45.6	3.485E+04	3.485E+04	4.534E+04	Yes
12/1/1998	83	21.042	67.5	9.420E+03	9.420E+03	1.226E+04	Yes
7/30/2002	83	29.748	82.1	1.332E+04	1.332E+04	1.733E+04	Yes
10/3/2006	83	7.846	79.7	3.512E+03	3.512E+03	4.570E+03	Yes
3/28/1995	82	193.311	32.2	8.550E+04	8.550E+04	1.126E+05	Yes
9/5/1995	82	1.711	98.8	7.566E+02	7.566E+02	9.965E+02	Yes
8/26/1997	82	8.040	85	3.556E+03	3.556E+03	4.684E+03	Yes
12/2/1997	82	48.927	52.7	2.164E+04	2.164E+04	2.850E+04	Yes
6/1/1999	82	191.601	32.3	8.474E+04	8.474E+04	1.116E+05	Yes
10/23/2001	82	6.211	67.2	2.747E+03	2.747E+03	3.618E+03	Yes
8/27/2002	82	40.536	78.4	1.793E+04	1.793E+04	2.361E+04	Yes
8/1/2006	82	2.288	95.6	1.012E+03	1.012E+03	1.333E+03	Yes
11/10/1992	81	8.040	85	3.513E+03	3.513E+03	4.684E+03	Yes
10/31/1995	81	13.771	75.7	6.017E+03	6.017E+03	8.022E+03	Yes
11/28/1995	81	10.093	81.5	4.410E+03	4.410E+03	5.880E+03	Yes
5/16/2000	80.5	103.499	41.6	4.494E+04	4.494E+04	6.029E+04	Yes
11/17/1999	80	7.613	85.8	3.285E+03	3.285E+03	4.435E+03	Yes
8/15/2000	80	2.224	97.7	9.596E+02	9.596E+02	1.296E+03	Yes
9/28/2004	79.5	15.691	94.7	6.729E+03	6.729E+03	9.141E+03	Yes
9/13/2005	79.5	3.269	98	1.402E+03	1.402E+03	1.904E+03	Yes
5/14/2002	79	467.471	15.9	1.992E+05	1.992E+05	2.723E+05	Yes
2/11/2003	79	70.284	27.8	2.995E+04	2.995E+04	4.094E+04	Yes
11/2/2004	78.5	2602.147	22.4	1.102E+06	1.102E+06	1.516E+06	Yes
3/15/2005	78.5	117.358	48.7	4.969E+04	4.969E+04	6.836E+04	Yes
11/1/2005	78.5	7.192	90.3	3.045E+03	3.045E+03	4.189E+03	Yes
9/18/1990	78	6.757	87.5	2.843E+03	2.843E+03	3.936E+03	Yes
3/26/1991	78	192.456	32.2	8.097E+04	8.097E+04	1.121E+05	Yes
10/8/1991	78	6.843	87.3	2.879E+03	2.879E+03	3.986E+03	Yes
5/19/1992	78	28.056	61.8	1.180E+04	1.180E+04	1.634E+04	Yes
7/13/1993	78	8.981	83.3	3.779E+03	3.779E+03	5.232E+03	Yes
9/10/1996	78	7.955	85.2	3.347E+03	3.347E+03	4.634E+03	Yes
9/16/1997	78	4.191	93.3	1.763E+03	1.763E+03	2.442E+03	Yes

Table F-2. (continued)

Date	Observed Concentration (mg/L)	Flow/unit area on sampling day (cfs)	Percent exceedance for flow on sampling day	Current load (lbs/day)	Reduced load (lbs/day)	Allowable load with MOS incorporated (lbs/day)	Reduced load less than or equal to allow load?
6/30/1998	78	4.277	93.1	1.799E+03	1.799E+03	2.491E+03	Yes
8/3/1999	78	5.731	89.8	2.411E+03	2.411E+03	3.338E+03	Yes
4/8/2003	78	134.684	46.8	5.666E+04	5.666E+04	7.846E+04	Yes
2/1/2005	78	108.205	27.8	4.552E+04	4.552E+04	6.303E+04	Yes
6/1/1993	77	39.518	56	1.641E+04	1.641E+04	2.302E+04	Yes
2/13/1996	77	16.851	71.9	6.998E+03	6.998E+03	9.816E+03	Yes
5/8/2001	77	47.728	45.1	1.982E+04	1.982E+04	2.780E+04	Yes
6/1/2004	77	72.572	34.6	3.014E+04	3.014E+04	4.228E+04	Yes
2/19/1991	76	787.786	6.8	3.229E+05	3.229E+05	4.589E+05	Yes
6/21/1994	76	45.420	53.9	1.862E+04	1.862E+04	2.646E+04	Yes
10/4/1994	76	10.521	80.6	4.313E+03	4.313E+03	6.129E+03	Yes
8/8/1995	76	12.232	77.8	5.014E+03	5.014E+03	7.125E+03	Yes
6/6/2006	76	15.038	70.5	6.164E+03	6.164E+03	8.760E+03	Yes
8/23/2004	75.5	114.089	48	4.646E+04	4.646E+04	6.646E+04	Yes
2/21/2006	75.5	63.419	53	2.583E+04	2.583E+04	3.694E+04	Yes
7/2/1991	75	14.969	74.1	6.055E+03	6.055E+03	8.720E+03	Yes
7/12/1994	75	222.394	29.8	8.997E+04	8.997E+04	1.296E+05	Yes
6/18/1996	75	28.997	61.2	1.173E+04	1.173E+04	1.689E+04	Yes
1/21/1997	75	454.196	16.3	1.837E+05	1.837E+05	2.646E+05	Yes
7/6/1999	75	18.647	69.9	7.543E+03	7.543E+03	1.086E+04	Yes
7/14/1992	74	87.247	44	3.482E+04	3.482E+04	5.082E+04	Yes
9/7/1993	74	3.250	95.6	1.297E+03	1.297E+03	1.893E+03	Yes
7/23/1996	74	17.791	70.9	7.101E+03	7.101E+03	1.036E+04	Yes
10/19/2004	74	1219.348	35.1	4.867E+05	4.867E+05	7.103E+05	Yes
6/6/2000	73.5	205.286	31.1	8.138E+04	8.138E+04	1.196E+05	Yes
5/23/2006	73.5	31.383	63.7	1.244E+04	1.244E+04	1.828E+04	Yes
7/30/1991	73	25.490	63.6	1.004E+04	1.004E+04	1.485E+04	Yes
8/11/1992	73	37.208	56.9	1.465E+04	1.465E+04	2.167E+04	Yes
10/8/1996	73	9.494	82.6	3.738E+03	3.738E+03	5.531E+03	Yes
10/5/1999	73	2.395	97.3	9.430E+02	9.430E+02	1.395E+03	Yes
1/22/2002	73	76.168	26.9	2.999E+04	2.999E+04	4.437E+04	Yes
7/3/2001	72.5	62.112	54.4	2.429E+04	2.429E+04	3.618E+04	Yes
1/4/1993	72	201.010	31.5	7.806E+04	7.806E+04	1.171E+05	Yes
5/4/1994	72	265.162	26.6	1.030E+05	1.030E+05	1.545E+05	Yes
2/14/1995	72	140.279	37	5.448E+04	5.448E+04	8.172E+04	Yes
12/11/1990	71	57.822	50.3	2.214E+04	2.214E+04	3.368E+04	Yes
10/6/1992	71	7.356	86.2	2.817E+03	2.817E+03	4.285E+03	Yes
5/13/1997	71	55.427	50.9	2.123E+04	2.123E+04	3.229E+04	Yes
1/18/2000	70.5	14.712	74.5	5.594E+03	5.594E+03	8.570E+03	Yes
12/2/2003	70.5	96.109	54.4	3.655E+04	3.655E+04	5.599E+04	Yes
1/28/1992	70	130.015	38.1	4.909E+04	4.909E+04	7.574E+04	Yes
3/12/1996	70	42.768	54.8	1.615E+04	1.615E+04	2.491E+04	Yes
9/7/1999	70	2.481	97.2	9.366E+02	9.366E+02	1.445E+03	Yes
6/30/2003	70	112.128	38.3	4.234E+04	4.234E+04	6.532E+04	Yes
3/2/1999	69.5	62.783	49	2.354E+04	2.354E+04	3.657E+04	Yes
6/12/2001	69.5	53.939	53.1	2.022E+04	2.022E+04	3.142E+04	Yes
5/13/2003	69.5	88.918	26	3.333E+04	3.333E+04	5.180E+04	Yes
11/12/1991	69	60.132	49.6	2.238E+04	2.238E+04	3.503E+04	Yes
9/8/1992	69	10.863	80	4.043E+03	4.043E+03	6.328E+03	Yes
11/21/1994	69	156.531	35.2	5.826E+04	5.826E+04	9.118E+04	Yes
5/23/1995	69	45.077	54	1.678E+04	1.678E+04	2.626E+04	Yes
7/11/1995	69	30.451	60.3	1.133E+04	1.133E+04	1.774E+04	Yes
4/9/1996	69	55.855	50.8	2.079E+04	2.079E+04	3.254E+04	Yes
6/17/1997	69	267.728	26.5	9.964E+04	9.964E+04	1.560E+05	Yes
9/1/1998	69	3.593	94.7	1.337E+03	1.337E+03	2.093E+03	Yes
11/3/1998	69	17.706	70.9	6.590E+03	6.590E+03	1.031E+04	Yes
6/3/2003	69	36.940	58.2	1.375E+04	1.375E+04	2.152E+04	Yes
12/30/1997	68	342.144	21.9	1.255E+05	1.255E+05	1.993E+05	Yes
2/29/2000	68	189.035	32.6	6.933E+04	6.933E+04	1.101E+05	Yes
1/21/2003	68	63.746	49.7	2.338E+04	2.338E+04	3.713E+04	Yes
11/7/2006	68	787.836	40	2.890E+05	2.890E+05	4.589E+05	Yes
4/24/2000	67	46.788	53.3	1.691E+04	1.691E+04	2.726E+04	Yes
12/19/2000	67	178.162	27.8	6.438E+04	6.438E+04	1.038E+05	Yes
1/27/2004	66.5	454.395	21.6	1.630E+05	1.630E+05	2.647E+05	Yes
6/4/1991	66	46.874	53.3	1.669E+04	1.669E+04	2.731E+04	Yes
4/15/1997	66	210.419	30.7	7.491E+04	7.491E+04	1.226E+05	Yes

Table F-2. (continued)

Date	Observed Concentration (mg/L)	Flow/unit area on sampling day (cfs)	Percent exceedance for flow on sampling day	Current load (lbs/day)	Reduced load (lbs/day)	Allowable load with MOS incorporated (lbs/day)	Reduced load less than or equal to allow load?
4/20/1999	66	554.273	12.6	1.973E+05	1.973E+05	3.229E+05	Yes
5/4/2004	65.5	292.578	23.7	1.034E+05	1.034E+05	1.704E+05	Yes
1/9/1996	65	43.281	54.7	1.517E+04	1.517E+04	2.521E+04	Yes
11/5/1996	65	124.883	38.8	4.378E+04	4.378E+04	7.275E+04	Yes
2/18/1997	65	597.041	11.3	2.093E+05	2.093E+05	3.478E+05	Yes
4/3/2001	65	127.492	36.5	4.470E+04	4.470E+04	7.427E+04	Yes
5/11/1999	64.5	69.028	47.5	2.401E+04	2.401E+04	4.021E+04	Yes
9/5/2000	64.5	0.855	99.7	2.976E+02	2.976E+02	4.983E+02	Yes
9/17/1991	64	10.435	80.8	3.602E+03	3.602E+03	6.079E+03	Yes
2/25/1992	64	605.595	11.1	2.091E+05	2.091E+05	3.528E+05	Yes
1/5/1993	64	237.790	28.6	8.209E+04	8.209E+04	1.385E+05	Yes
8/23/1994	64	61.415	49.2	2.120E+04	2.120E+04	3.578E+04	Yes
2/10/1998	64	342.144	21.9	1.181E+05	1.181E+05	1.993E+05	Yes
2/19/2002	64	392.284	23.4	1.354E+05	1.354E+05	2.285E+05	Yes
3/19/2002	64	791.105	0.8	2.731E+05	2.731E+05	4.608E+05	Yes
10/16/1990	63	367.805	20.6	1.250E+05	1.250E+05	2.143E+05	Yes
5/7/1991	63	872.467	5.5	2.965E+05	2.965E+05	5.082E+05	Yes
4/7/1992	63	98.366	42.3	3.343E+04	3.343E+04	5.730E+04	Yes
1/24/1995	63	975.110	4.4	3.314E+05	3.314E+05	5.680E+05	Yes
2/13/2001	63	813.988	4.5	2.766E+05	2.766E+05	4.742E+05	Yes
3/3/1992	62	339.578	22.1	1.136E+05	1.136E+05	1.978E+05	Yes
5/4/1993	62	526.046	13.6	1.759E+05	1.759E+05	3.064E+05	Yes
1/13/1998	62	816.869	6.3	2.732E+05	2.732E+05	4.758E+05	Yes
4/14/1998	62	53.374	51.5	1.785E+04	1.785E+04	3.109E+04	Yes
3/30/1993	61	118.895	39.6	3.912E+04	3.912E+04	6.926E+04	Yes
2/1/1994	61	1043.539	3.7	3.433E+05	3.433E+05	6.079E+05	Yes
6/6/1995	61	75.699	46.2	2.491E+04	2.491E+04	4.410E+04	Yes
12/17/2002	61	162.144	16.7	5.335E+04	5.335E+04	9.445E+04	Yes
3/11/2003	61	158.875	31.8	5.227E+04	5.227E+04	9.255E+04	Yes
1/22/1991	60	393.465	19.3	1.273E+05	1.273E+05	2.292E+05	Yes
12/14/1993	60	543.153	13	1.758E+05	1.758E+05	3.164E+05	Yes
3/27/2000	60	121.461	39.2	3.931E+04	3.931E+04	7.075E+04	Yes
12/14/1999	59.5	158.242	35.1	5.078E+04	5.078E+04	9.218E+04	Yes
2/2/1993	59	108.631	40.9	3.457E+04	3.457E+04	6.328E+04	Yes
3/2/1993	59	396.032	19.2	1.260E+05	1.260E+05	2.307E+05	Yes
4/5/1994	59	365.239	20.7	1.162E+05	1.162E+05	2.128E+05	Yes
4/25/1995	59	148.833	36.1	4.736E+04	4.736E+04	8.670E+04	Yes
1/5/1999	59	567.104	12.2	1.805E+05	1.805E+05	3.304E+05	Yes
1/15/2001	59	276.887	13.4	8.811E+04	8.811E+04	1.613E+05	Yes
4/12/2005	58.5	964.364	13.3	3.043E+05	3.043E+05	5.618E+05	Yes
1/9/2007	57.5	405.360	24.7	1.257E+05	1.257E+05	2.361E+05	Yes
4/16/1991	57	2052.863	0.8	6.311E+05	6.311E+05	1.196E+06	Yes
11/23/1992	56	163.374	34.6	4.935E+04	4.935E+04	9.517E+04	Yes
12/3/1996	56	780.088	6.9	2.356E+05	2.356E+05	4.544E+05	Yes
4/16/2002	56	119.320	40	3.604E+04	3.604E+04	6.951E+04	Yes
1/4/2005	55.5	3269.029	10.3	9.786E+05	9.786E+05	1.904E+06	Yes
3/8/1994	55	537.166	13.2	1.594E+05	1.594E+05	3.129E+05	Yes
3/17/1998	55	651.784	9.8	1.934E+05	1.934E+05	3.797E+05	Yes
10/5/1993	54	13.686	75.9	3.986E+03	3.986E+03	7.972E+03	Yes
8/4/1998	54	4.448	92.9	1.296E+03	1.296E+03	2.591E+03	Yes
12/10/1991	53	675.734	9.1	1.932E+05	1.932E+05	3.936E+05	Yes
2/2/1999	53	915.235	5.1	2.616E+05	2.616E+05	5.331E+05	Yes
2/24/2004	53	134.684	25.9	3.850E+04	3.850E+04	7.846E+04	Yes
3/6/2001	52.5	650.537	5	1.842E+05	1.842E+05	3.790E+05	Yes
12/18/2001	51.5	2072.565	0.4	5.757E+05	5.757E+05	1.207E+06	Yes
12/5/2006	50.5	132.723	46.6	3.615E+04	3.615E+04	7.731E+04	Yes
6/22/1992	47	164.229	34.6	4.163E+04	4.163E+04	9.567E+04	Yes

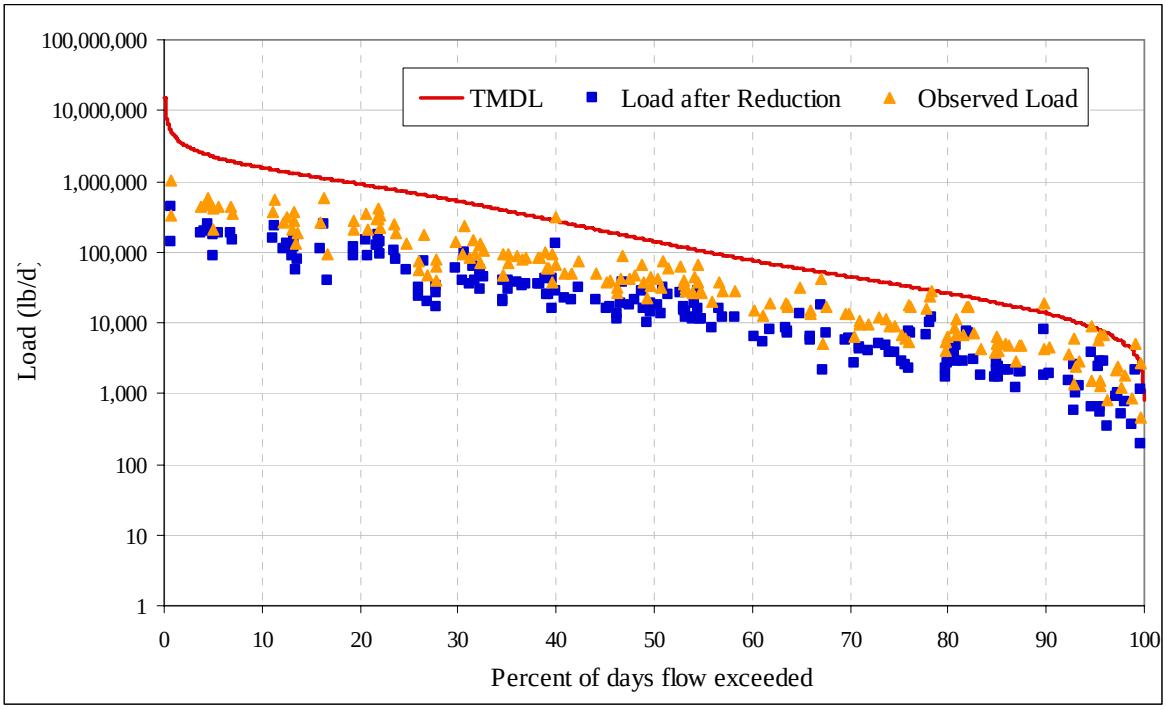

Figure F-2. TDS load duration curve for station OUA0041 for Saline River (HUC-reach 08040203-010)

Table F-3. Allowable TDS load for station OUA0041 for Saline River (HUC-reach 08040203-010)

Date	Observed flow (cfs)	Percent exceedance for observed flow	Adjusted flow for entire basin (cfs)	Width for area under curves (%)	Allowable load to meet standard (lb/day)	Area under TMDL curve (lb/day)
						553,500.5
9/12/1954	3.8	100.000	1.242	0.00	804.0380	0.00E+00
9/13/1954	3.8	100.000	1.242	0.00	804.0380	0.00E+00
9/16/1954	3.8	100.000	1.242	0.00	804.0380	0.00E+00
9/22/1954	3.8	100.000	1.242	0.00	804.0380	0.00E+00
9/23/1954	3.8	100.000	1.242	0.00	804.0380	0.00E+00
9/11/1954	4.1	100.000	1.340	0.00	867.5147	0.00E+00
9/14/1954	4.1	100.000	1.340	0.00	867.5147	0.00E+00
9/15/1954	4.1	100.000	1.340	0.00	867.5147	0.00E+00
9/17/1954	4.1	100.000	1.340	0.00	867.5147	0.00E+00
For brevity, most cells of this spreadsheet have been hidden						
1/28/1949	54800	0.100	17914.282	0.00	11595074.8671	0.00E+00
12/28/1987	59400	0.100	19418.035	0.00	12568384.0713	0.00E+00
5/2/1958	59600	0.100	19483.416	0.00	12610701.8628	0.00E+00
5/16/1968	59600	0.100	19483.416	0.00	12610701.8628	0.00E+00
12/26/1987	61500	0.100	20104.531	0.00	13012720.8819	0.00E+00
5/1/1958	65900	0.100	21542.904	0.00	13943712.2946	0.00E+00
12/27/1987	67000	0.100	21902.498	0.00	14176460.1477	0.00E+00
4/30/1958	68500	0.100	22392.852	0.00	14493843.5839	0.00E+00
4/29/1958	69500	0.100	22719.755	0.00	14705432.5413	0.00E+00
5/15/1968	71500	0.100	23373.561	0.10	15128610.4562	1.51E+04
5/14/1968	72500	0.000	23700.464	0.00	15340199.4136	0.00E+00

Table F-4. Existing load for TDS for station OUA0041 for Saline River (HUC-reach 08040203-010)

Date	Observed Concentration (mg/L)	Flow/unit area on sampling day (cfs)	Percent exceedance for flow on sampling day	Current load (lbs/day)	Reduced load (lbs/day)	Allowable load with MOS incorporated (lbs/day)	Reduced load less than or equal to allow load?
10/3/1995	254	4.448	92.9	6.094E+03	2.591E+03	2.591E+03	Yes
5/13/1997	250	55.427	50.9	7.474E+04	3.178E+04	3.229E+04	Yes
10/28/1997	239	23.950	64.9	3.087E+04	1.313E+04	1.395E+04	Yes
12/2/1997	236	48.927	52.7	6.228E+04	2.648E+04	2.850E+04	Yes
1/21/1997	234	454.196	16.3	5.733E+05	2.437E+05	2.646E+05	Yes
8/8/1995	233	12.232	77.8	1.537E+04	6.536E+03	7.125E+03	Yes
2/10/1998	219	342.144	21.9	4.042E+05	1.718E+05	1.993E+05	Yes
4/15/1997	209	210.419	30.7	2.372E+05	1.009E+05	1.226E+05	Yes
4/14/1998	204	53.374	51.5	5.873E+04	2.497E+04	3.109E+04	Yes
9/25/2001	203	5.230	95.4	5.727E+03	2.435E+03	3.047E+03	Yes
10/5/1999	183	2.395	97.3	2.364E+03	1.005E+03	1.395E+03	Yes
10/16/1990	179	367.805	20.6	3.551E+05	1.510E+05	2.143E+05	Yes
2/18/1997	168	597.041	11.3	5.410E+05	2.300E+05	3.478E+05	Yes
10/7/2003	168	18.960	81.9	1.718E+04	7.305E+03	1.104E+04	Yes
8/14/2001	163	21.902	63.4	1.926E+04	8.188E+03	1.276E+04	Yes
9/7/1999	162	2.481	97.2	2.167E+03	9.216E+02	1.445E+03	Yes
12/30/1997	160	342.144	21.9	2.953E+05	1.255E+05	1.993E+05	Yes
7/29/2003	152	21.902	75.9	1.796E+04	7.635E+03	1.276E+04	Yes
11/5/1996	150	124.883	38.8	1.010E+05	4.296E+04	7.275E+04	Yes
9/10/2002	150	6.211	99.1	5.025E+03	2.137E+03	3.618E+03	Yes
3/30/1993	149	118.895	39.6	9.555E+04	4.063E+04	6.926E+04	Yes
8/26/1997	147	8.040	85	6.375E+03	2.711E+03	4.684E+03	Yes
10/23/2001	147	6.211	67.2	4.925E+03	2.094E+03	3.618E+03	Yes
11/13/2001	147	4.904	84.7	3.888E+03	1.653E+03	2.856E+03	Yes
9/9/2003	147	21.576	76.1	1.711E+04	7.274E+03	1.257E+04	Yes
10/4/1994	145	10.521	80.6	8.228E+03	3.499E+03	6.129E+03	Yes
12/1/1998	144	21.042	67.5	1.634E+04	6.949E+03	1.226E+04	Yes
5/8/2001	143	47.728	45.1	3.681E+04	1.565E+04	2.780E+04	Yes
4/7/1992	141	98.366	42.3	7.481E+04	3.181E+04	5.730E+04	Yes
6/3/2003	140	36.940	58.2	2.789E+04	1.186E+04	2.152E+04	Yes
1/4/1993	139	201.010	31.5	1.507E+05	6.408E+04	1.171E+05	Yes
8/11/1992	138	37.208	56.9	2.770E+04	1.178E+04	2.167E+04	Yes
10/8/1996	138	9.494	82.6	7.067E+03	3.005E+03	5.531E+03	Yes
8/3/1999	138	5.731	89.8	4.266E+03	1.814E+03	3.338E+03	Yes
11/12/1991	137	60.132	49.6	4.443E+04	1.889E+04	3.503E+04	Yes
11/2/1993	137	15.311	73.7	1.131E+04	4.811E+03	8.919E+03	Yes
6/12/2001	137	53.939	53.1	3.986E+04	1.695E+04	3.142E+04	Yes
7/6/1999	136	18.647	69.9	1.368E+04	5.816E+03	1.086E+04	Yes
8/13/1996	135	15.995	72.9	1.165E+04	4.952E+03	9.318E+03	Yes
9/10/1996	134	7.955	85.2	5.749E+03	2.445E+03	4.634E+03	Yes
6/30/2003	134	112.128	38.3	8.104E+04	3.446E+04	6.532E+04	Yes
11/13/1990	133	67.146	48	4.817E+04	2.048E+04	3.911E+04	Yes
12/11/1990	133	57.822	50.3	4.148E+04	1.764E+04	3.368E+04	Yes
9/18/1990	131	6.757	87.5	4.775E+03	2.030E+03	3.936E+03	Yes
8/27/2002	130	40.536	78.4	2.842E+04	1.209E+04	2.361E+04	Yes
9/16/1997	129	4.191	93.3	2.916E+03	1.240E+03	2.442E+03	Yes
1/22/1991	128	393.465	19.3	2.716E+05	1.155E+05	2.292E+05	Yes
4/24/2000	128	46.788	53.3	3.230E+04	1.374E+04	2.726E+04	Yes
6/21/2005	128	33.671	78.2	2.325E+04	9.884E+03	1.961E+04	Yes
5/19/1992	127	28.056	61.8	1.922E+04	8.172E+03	1.634E+04	Yes
7/15/1997	127	18.989	69.5	1.301E+04	5.531E+03	1.106E+04	Yes
10/8/1991	126	6.843	87.3	4.651E+03	1.977E+03	3.986E+03	Yes
11/28/1995	126	10.093	81.5	6.860E+03	2.917E+03	5.880E+03	Yes
12/2/2003	126	96.109	54.4	6.532E+04	2.777E+04	5.599E+04	Yes
10/11/2005	126	5.230	92.3	3.555E+03	1.511E+03	3.047E+03	Yes
5/4/1994	125	265.162	26.6	1.788E+05	7.602E+04	1.545E+05	Yes
3/7/2006	124	55.574	39.6	3.717E+04	1.580E+04	3.237E+04	Yes
7/30/1991	123	25.490	63.6	1.691E+04	7.190E+03	1.485E+04	Yes
10/6/1992	123	7.356	86.2	4.880E+03	2.075E+03	4.285E+03	Yes
3/28/1995	123	193.311	32.2	1.282E+05	5.453E+04	1.126E+05	Yes
6/1/2004	123	72.572	34.6	4.815E+04	2.047E+04	4.228E+04	Yes
1/27/2004	122	454.395	21.6	2.990E+05	1.271E+05	2.647E+05	Yes
3/30/2004	122	141.549	30.4	9.314E+04	3.960E+04	8.246E+04	Yes
3/26/1991	121	192.456	32.2	1.256E+05	5.341E+04	1.121E+05	Yes
11/17/1999	121	7.613	85.8	4.968E+03	2.113E+03	4.435E+03	Yes
11/4/2003	121	28.441	89.8	1.856E+04	7.892E+03	1.657E+04	Yes

Table F-4. (continued)

Date	Observed Concentration (mg/L)	Flow/unit area on sampling day (cfs)	Percent exceedance for flow on sampling day	Current load (lbs/day)	Reduced load (lbs/day)	Allowable load with MOS incorporated (lbs/day)	Reduced load less than or equal to allow load?
1/28/1992	119	130.015	38.1	8.345E+04	3.548E+04	7.574E+04	Yes
5/13/2003	119	88.918	26	5.707E+04	2.427E+04	5.180E+04	Yes
5/4/2004	119	292.578	23.7	1.878E+05	7.985E+04	1.704E+05	Yes
11/10/1992	118	8.040	85	5.117E+03	2.176E+03	4.684E+03	Yes
10/31/2000	118	10.461	95.6	6.658E+03	2.831E+03	6.094E+03	Yes
4/8/2003	118	134.684	46.8	8.572E+04	3.645E+04	7.846E+04	Yes
3/3/1992	117	339.578	22.1	2.143E+05	9.112E+04	1.978E+05	Yes
7/12/1994	117	222.394	29.8	1.403E+05	5.967E+04	1.296E+05	Yes
2/19/2002	117	392.284	23.4	2.476E+05	1.053E+05	2.285E+05	Yes
9/17/1991	116	10.435	80.8	6.529E+03	2.776E+03	6.079E+03	Yes
1/22/2002	116	76.168	26.9	4.766E+04	2.026E+04	4.437E+04	Yes
3/12/1996	115	42.768	54.8	2.653E+04	1.128E+04	2.491E+04	Yes
5/10/2005	115	67.669	67.1	4.197E+04	1.785E+04	3.942E+04	Yes
11/1/2005	114	7.192	90.3	4.422E+03	1.880E+03	4.189E+03	Yes
5/11/1999	112.5	69.028	47.5	4.189E+04	1.781E+04	4.021E+04	Yes
1/18/2000	112.5	14.712	74.5	8.927E+03	3.796E+03	8.570E+03	Yes
2/13/2001	112	813.988	4.5	4.917E+05	2.091E+05	4.742E+05	Yes
4/3/2001	112	127.492	36.5	7.702E+04	3.275E+04	7.427E+04	Yes
4/26/2004	112	536.121	22.1	3.239E+05	1.377E+05	3.123E+05	Yes
12/27/2005	112	18.960	80.8	1.145E+04	4.870E+03	1.104E+04	Yes
3/2/1999	111.5	62.783	49	3.776E+04	1.605E+04	3.657E+04	Yes
2/25/1992	111	605.595	11.1	3.626E+05	1.542E+05	3.528E+05	Yes
6/21/1994	111	45.420	53.9	2.719E+04	1.156E+04	2.646E+04	Yes
11/21/1994	111	156.531	35.2	9.372E+04	3.985E+04	9.118E+04	Yes
2/14/1995	111	140.279	37	8.399E+04	3.571E+04	8.172E+04	Yes
4/25/1995	111	148.833	36.1	8.911E+04	3.789E+04	8.670E+04	Yes
5/23/1995	111	45.077	54	2.699E+04	1.148E+04	2.626E+04	Yes
1/9/1996	111	43.281	54.7	2.591E+04	1.102E+04	2.521E+04	Yes
11/3/1998	111	17.706	70.9	1.060E+04	4.507E+03	1.031E+04	Yes
7/3/2001	111	62.112	54.4	3.719E+04	1.581E+04	3.618E+04	Yes
3/11/2003	111	158.875	31.8	9.512E+04	4.044E+04	9.255E+04	Yes
6/4/1991	110	46.874	53.3	2.781E+04	1.183E+04	2.731E+04	Yes
7/2/1991	110	14.969	74.1	8.881E+03	3.776E+03	8.720E+03	Yes
6/2/1998	110	22.838	65.9	1.355E+04	5.762E+03	1.330E+04	Yes
10/24/2000	110	4.577	99.6	2.715E+03	1.155E+03	2.666E+03	Yes
1/24/1995	109	975.110	4.4	5.733E+05	2.438E+05	5.680E+05	Yes
12/17/2002	108	162.144	16.7	9.445E+04	4.016E+04	9.445E+04	Yes
7/14/1992	106	87.247	44	4.988E+04	2.121E+04	5.082E+04	Yes
11/23/1992	106	163.374	34.6	9.341E+04	3.972E+04	9.517E+04	Yes
4/5/1994	106	365.239	20.7	2.088E+05	8.879E+04	2.128E+05	Yes
4/9/1996	106	55.855	50.8	3.193E+04	1.358E+04	3.254E+04	Yes
10/15/2002	106	11.769	75.2	6.729E+03	2.861E+03	6.855E+03	Yes
2/11/2003	106	70.284	27.8	4.018E+04	1.709E+04	4.094E+04	Yes
9/28/2004	106	15.691	94.7	8.971E+03	3.815E+03	9.141E+03	Yes
2/1/2005	106	108.205	27.8	6.187E+04	2.630E+04	6.303E+04	Yes
8/1/2006	106	2.288	95.6	1.308E+03	5.563E+02	1.333E+03	Yes
9/8/1992	105	10.863	80	6.152E+03	2.616E+03	6.328E+03	Yes
2/13/1996	105	16.851	71.9	9.543E+03	4.058E+03	9.816E+03	Yes
6/30/1998	105	4.277	93.1	2.422E+03	1.030E+03	2.491E+03	Yes
4/16/2002	105	119.320	40	6.758E+04	2.873E+04	6.951E+04	Yes
7/30/2002	105	29.748	82.1	1.685E+04	7.164E+03	1.733E+04	Yes
7/20/2004	105	25.825	65.9	1.463E+04	6.219E+03	1.504E+04	Yes
2/21/2006	105	63.419	53	3.592E+04	1.527E+04	3.694E+04	Yes
5/23/2006	105	31.383	63.7	1.777E+04	7.557E+03	1.828E+04	Yes
2/29/2000	104	189.035	32.6	1.060E+05	4.509E+04	1.101E+05	Yes
5/14/2002	104	467.471	15.9	2.622E+05	1.115E+05	2.723E+05	Yes
8/16/2005	104	12.095	95.8	6.785E+03	2.885E+03	7.046E+03	Yes
2/24/2004	103	134.684	25.9	7.482E+04	3.182E+04	7.846E+04	Yes
4/20/1999	102	554.273	12.6	3.049E+05	1.297E+05	3.229E+05	Yes
3/15/2005	102	117.358	48.7	6.457E+04	2.745E+04	6.836E+04	Yes
7/23/1996	101	17.791	70.9	9.692E+03	4.121E+03	1.036E+04	Yes
8/15/2000	101	2.224	97.7	1.212E+03	5.151E+02	1.296E+03	Yes
9/5/2000	101	0.855	99.7	4.660E+02	1.981E+02	4.983E+02	Yes
9/13/2005	101	3.269	98	1.781E+03	7.572E+02	1.904E+03	Yes
2/19/1991	100	787.786	6.8	4.249E+05	1.807E+05	4.589E+05	Yes
4/18/2006	99.5	48.055	46.2	2.579E+04	1.097E+04	2.799E+04	Yes
1/21/2003	98	63.746	49.7	3.370E+04	1.433E+04	3.713E+04	Yes

Table F-4. (continued)

Date	Observed Concentration (mg/L)	Flow/unit area on sampling day (cfs)	Percent exceedance for flow on sampling day	Current load (lbs/day)	Reduced load (lbs/day)	Allowable load with MOS incorporated (lbs/day)	Reduced load less than or equal to allow load?
1/22/1991	97	393.465	19.3	2.059E+05	8.753E+04	2.292E+05	Yes
8/24/2004	95.5	86.302	54.1	4.445E+04	1.890E+04	5.027E+04	Yes
10/3/2006	95.5	7.846	79.7	4.041E+03	1.718E+03	4.570E+03	Yes
4/16/1991	95	2052.863	0.8	1.052E+06	4.473E+05	1.196E+06	Yes
5/7/1991	95	872.467	5.5	4.471E+05	1.901E+05	5.082E+05	Yes
10/5/1998	95	77.838	45.6	3.988E+04	1.696E+04	4.534E+04	Yes
9/5/1995	94	1.711	98.8	8.674E+02	3.688E+02	9.965E+02	Yes
3/8/1994	93	537.166	13.2	2.695E+05	1.146E+05	3.129E+05	Yes
9/5/2006	93	1.635	96.3	8.199E+02	3.486E+02	9.522E+02	Yes
7/18/2000	92	7.955	85.2	3.947E+03	1.678E+03	4.634E+03	Yes
6/1/1993	91	39.518	56	1.940E+04	8.247E+03	2.302E+04	Yes
9/6/1994	91	122.316	39.1	6.004E+04	2.553E+04	7.125E+04	Yes
7/11/1995	90	30.451	60.3	1.478E+04	6.285E+03	1.774E+04	Yes
8/3/1993	89	10.949	79.8	5.256E+03	2.235E+03	6.378E+03	Yes
3/27/2000	89	121.461	39.2	5.831E+04	2.479E+04	7.075E+04	Yes
7/19/2005	89	76.495	56.7	3.672E+04	1.561E+04	4.456E+04	Yes
7/11/2006	88.5	5.884	87	2.809E+03	1.194E+03	3.428E+03	Yes
2/2/1993	87	108.631	40.9	5.098E+04	2.167E+04	6.328E+04	Yes
5/16/2000	87	103.499	41.6	4.857E+04	2.065E+04	6.029E+04	Yes
7/13/1993	86	8.981	83.3	4.166E+03	1.771E+03	5.232E+03	Yes
1/15/2001	86	276.887	13.4	1.284E+05	5.461E+04	1.613E+05	Yes
12/7/2004	85	987.247	4.2	4.526E+05	1.925E+05	5.751E+05	Yes
9/7/1993	84	3.250	95.6	1.473E+03	6.262E+02	1.893E+03	Yes
12/3/1996	84	780.088	6.9	3.534E+05	1.503E+05	4.544E+05	Yes
1/5/1999	84	567.104	12.2	2.569E+05	1.093E+05	3.304E+05	Yes
2/2/1999	83	915.235	5.1	4.097E+05	1.742E+05	5.331E+05	Yes
12/14/1999	83	158.242	35.1	7.084E+04	3.012E+04	9.218E+04	Yes
12/19/2000	81.5	178.162	27.8	7.832E+04	3.330E+04	1.038E+05	Yes
10/31/1995	81	13.771	75.7	6.017E+03	2.558E+03	8.022E+03	Yes
6/18/1996	80	28.997	61.2	1.251E+04	5.320E+03	1.689E+04	Yes
9/1/1998	80	3.593	94.7	1.550E+03	6.591E+02	2.093E+03	Yes
6/6/2006	79.5	15.038	70.5	6.448E+03	2.742E+03	8.760E+03	Yes
2/1/1994	79	1043.539	3.7	4.447E+05	1.891E+05	6.079E+05	Yes
6/6/1995	78	75.699	46.2	3.185E+04	1.354E+04	4.410E+04	Yes
3/19/2002	78	791.105	0.8	3.328E+05	1.415E+05	4.608E+05	Yes
6/6/2000	74.5	205.286	31.1	8.249E+04	3.508E+04	1.196E+05	Yes
10/5/1993	74	13.686	75.9	5.463E+03	2.323E+03	7.972E+03	Yes
11/7/2006	74	787.836	40	3.145E+05	1.337E+05	4.589E+05	Yes
4/12/2005	71	964.364	13.3	3.693E+05	1.570E+05	5.618E+05	Yes
12/14/1993	70	543.153	13	2.051E+05	8.720E+04	3.164E+05	Yes
8/23/1994	69	61.415	49.2	2.286E+04	9.719E+03	3.578E+04	Yes
6/1/1999	67	191.601	32.3	6.924E+04	2.944E+04	1.116E+05	Yes
5/4/1993	64	526.046	13.6	1.816E+05	7.721E+04	3.064E+05	Yes
3/6/2001	60.5	650.537	5	2.123E+05	9.026E+04	3.790E+05	Yes
12/5/2006	60	132.723	46.6	4.295E+04	1.826E+04	7.731E+04	Yes
1/9/2007	60	405.360	24.7	1.312E+05	5.578E+04	2.361E+05	Yes
8/4/1998	55	4.448	92.9	1.319E+03	5.610E+02	2.591E+03	Yes
6/22/1992	54	164.229	34.6	4.783E+04	2.034E+04	9.567E+04	Yes

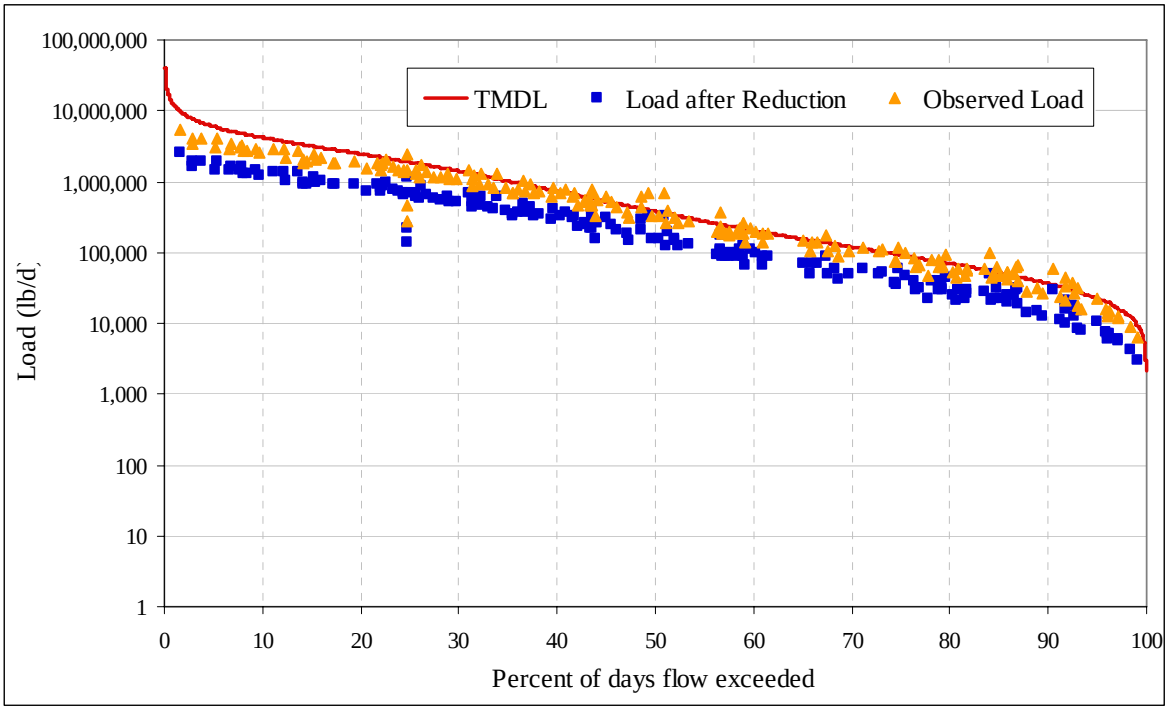

Figure F-3. TDS load duration curve for station OUA0118 for Saline River (HUC-reach 08040204-006)

Table F-5. Allowable TDS load for station OUA0118 for Saline River (HUC-reach 08040204-006)

Date	Observed flow (cfs)	Percent exceedance for observed flow	Adjusted flow for entire basin (cfs)	Width for area under curves (%)	Allowable load to meet standard (lb/day)	Area under TMDL curve (lb/day)
						1,485,981.5
9/16/1954	3.8	100.000	3.335	0.00	2158.5990	0.00E+00
9/17/1954	3.8	100.000	3.335	0.00	2158.5990	0.00E+00
9/20/1954	3.8	100.000	3.335	0.00	2158.5990	0.00E+00
9/26/1954	3.8	100.000	3.335	0.00	2158.5990	0.00E+00
9/27/1954	3.8	100.000	3.335	0.00	2158.5990	0.00E+00
9/15/1954	4.1	100.000	3.598	0.00	2329.0148	0.00E+00
9/18/1954	4.1	100.000	3.598	0.00	2329.0148	0.00E+00
9/19/1954	4.1	100.000	3.598	0.00	2329.0148	0.00E+00
9/21/1954	4.1	100.000	3.598	0.00	2329.0148	0.00E+00
For brevity, most cells in this spreadsheet have been hidden						
2/1/1949	54800	0.100	48094.430	0.00	31129270.4127	0.00E+00
1/1/1988	59400	0.100	52131.554	0.00	33742311.3597	0.00E+00
5/6/1958	59600	0.100	52307.081	0.00	33855921.8357	0.00E+00
5/20/1968	59600	0.100	52307.081	0.00	33855921.8357	0.00E+00
12/30/1987	61500	0.100	53974.588	0.00	34935221.3573	0.00E+00
5/5/1958	65900	0.100	57836.185	0.00	37434651.8284	0.00E+00
12/31/1987	67000	0.100	58801.584	0.00	38059509.4462	0.00E+00
5/4/1958	68500	0.100	60118.038	0.00	38911588.0159	0.00E+00
5/3/1958	69500	0.100	60995.673	0.00	39479640.3957	0.00E+00
5/19/1968	71500	0.100	62750.944	0.10	40615745.1552	4.06E+04
5/18/1968	72500	0.000	63628.580	0.00	41183797.5350	0.00E+00

Table F-6. Existing load for TDS for station OUA0118 for Saline River (HUC-reach 08040204-006) (OUA0118)

Date	Observed Concentration (mg/L)	Flow/unit area on sampling day (cfs)	Percent exceedance for flow on sampling day	Current load (lbs/day)	Reduced load (lbs/day)	Allowable load with MOS incorporated (lbs/day)	Reduced load less than or equal to allow load?
5/5/1998	224	571.341	50.9	6.903E+05	3.328E+05	3.328E+05	Yes
9/3/2002	213	87.764	84.1	1.008E+05	4.861E+04	5.112E+04	Yes
9/24/1996	199	56.169	90.5	6.029E+04	2.907E+04	3.272E+04	Yes
12/9/1997	198	630.142	49.2	6.730E+05	3.245E+05	3.671E+05	Yes
11/4/1997	178	386.160	56.7	3.707E+05	1.788E+05	2.249E+05	Yes
5/20/1997	169	659.104	48.6	6.008E+05	2.897E+05	3.839E+05	Yes
10/15/1996	166	71.966	86.9	6.444E+04	3.107E+04	4.192E+04	Yes
11/19/1996	160	921.517	43.6	7.953E+05	3.834E+05	5.368E+05	Yes
10/20/1992	159	50.903	91.7	4.365E+04	2.105E+04	2.965E+04	Yes
9/2/1997	158	72.844	86.7	6.208E+04	2.993E+04	4.243E+04	Yes
11/17/1992	151	218.531	67.3	1.780E+05	8.581E+04	1.273E+05	Yes
12/13/2005	148	149.198	74.7	1.191E+05	5.742E+04	8.691E+04	Yes
1/17/2006	148	114.093	79.5	9.108E+04	4.391E+04	6.646E+04	Yes
10/8/2002	144	47.392	92.5	3.681E+04	1.775E+04	2.761E+04	Yes
9/3/1991	141	83.375	84.8	6.341E+04	3.057E+04	4.857E+04	Yes
12/9/2003	140	341.400	58.9	2.578E+05	1.243E+05	1.989E+05	Yes
12/6/1994	138	847.796	44.9	6.310E+05	3.043E+05	4.939E+05	Yes
4/22/1997	136	930.294	43.5	6.824E+05	3.290E+05	5.419E+05	Yes
1/7/1997	133	1772.824	33.9	1.272E+06	6.132E+05	1.033E+06	Yes
1/11/1994	131	561.687	51.2	3.969E+05	1.914E+05	3.272E+05	Yes
7/9/2002	130	43.882	93.1	3.077E+04	1.484E+04	2.556E+04	Yes
1/19/1993	128	2123.878	31	1.466E+06	7.070E+05	1.237E+06	Yes
8/6/2002	127.5	77.232	85.9	5.311E+04	2.561E+04	4.499E+04	Yes
5/5/1992	127	326.480	59.7	2.236E+05	1.078E+05	1.902E+05	Yes
4/30/1996	127	1114.597	40.9	7.635E+05	3.681E+05	6.493E+05	Yes
1/19/1999	127	1219.913	39.6	8.357E+05	4.029E+05	7.106E+05	Yes
11/22/1999	127	73.721	86.5	5.050E+04	2.435E+04	4.294E+04	Yes
11/14/2000	126.5	1483.204	36.6	1.012E+06	4.879E+05	8.640E+05	Yes
7/9/1991	126	143.055	75.5	9.722E+04	4.687E+04	8.333E+04	Yes
8/27/1996	126	118.481	78.8	8.052E+04	3.882E+04	6.902E+04	Yes
8/7/2001	124.5	78.110	85.8	5.245E+04	2.529E+04	4.550E+04	Yes
11/12/2002	123	660.860	48.5	4.384E+05	2.114E+05	3.850E+05	Yes
9/26/2006	123	162.363	73.1	1.077E+05	5.193E+04	9.458E+04	Yes
8/6/1991	122	180.793	71.1	1.190E+05	5.736E+04	1.053E+05	Yes
8/25/1992	122	121.991	78.2	8.028E+04	3.870E+04	7.106E+04	Yes
6/9/1992	121	1983.456	32.2	1.294E+06	6.241E+05	1.155E+06	Yes
6/11/1996	121	1044.386	41.7	6.816E+05	3.286E+05	6.084E+05	Yes
11/17/1998	121	344.033	58.6	2.245E+05	1.083E+05	2.004E+05	Yes
8/5/1997	119	91.274	83.5	5.859E+04	2.825E+04	5.317E+04	Yes
10/24/2006	119	50.903	91.7	3.267E+04	1.575E+04	2.965E+04	Yes
9/30/1997	118	312.438	60.3	1.989E+05	9.588E+04	1.820E+05	Yes
3/31/1998	118	2782.105	26.2	1.771E+06	8.537E+05	1.621E+06	Yes
5/30/1995	117	812.691	45.5	5.129E+05	2.473E+05	4.734E+05	Yes
1/6/1998	117	1421.770	37.3	8.972E+05	4.326E+05	8.282E+05	Yes
7/17/2001	116	227.308	66.4	1.422E+05	6.857E+04	1.324E+05	Yes
9/14/1999	115.5	35.983	95	2.242E+04	1.081E+04	2.096E+04	Yes
11/16/1993	115	296.641	61.4	1.840E+05	8.872E+04	1.728E+05	Yes
7/13/1999	114.5	164.995	72.7	1.019E+05	4.913E+04	9.611E+04	Yes
2/15/2000	113	233.451	65.9	1.423E+05	6.860E+04	1.360E+05	Yes
10/29/1991	112	136.034	76.4	8.218E+04	3.962E+04	7.924E+04	Yes
4/16/1996	112	2053.667	31.5	1.241E+06	5.982E+05	1.196E+06	Yes
2/4/1997	112	3396.450	22.5	2.052E+06	9.893E+05	1.979E+06	Yes
6/19/2001	112	302.784	60.9	1.829E+05	8.819E+04	1.764E+05	Yes
1/31/2006	112	895.188	44	5.408E+05	2.607E+05	5.215E+05	Yes
12/14/1992	110	1053.163	41.6	6.249E+05	3.013E+05	6.135E+05	Yes
12/21/1998	110	1149.703	40.4	6.821E+05	3.289E+05	6.697E+05	Yes
3/14/2000	110	533.602	51.9	3.166E+05	1.526E+05	3.108E+05	Yes
11/6/2001	110	101.806	81.8	6.040E+04	2.912E+04	5.930E+04	Yes
6/27/1995	109	208.877	68.2	1.228E+05	5.921E+04	1.217E+05	Yes
7/22/2003	109	243.983	65.1	1.434E+05	6.916E+04	1.421E+05	Yes
6/23/1998	108	80.742	85.2	4.703E+04	2.268E+04	4.703E+04	Yes
1/20/2004	108	352.810	58.4	2.055E+05	9.909E+04	2.055E+05	Yes
6/14/2005	108	390.548	56.6	2.275E+05	1.097E+05	2.275E+05	Yes

Table F-6. (continued)

Date	Observed Concentration (mg/L)	Flow/unit area on sampling day (cfs)	Percent exceedance for flow on sampling day	Current load (lbs/day)	Reduced load (lbs/day)	Allowable load with MOS incorporated (lbs/day)	Reduced load less than or equal to allow load?
4/21/1992	106	478.311	53.4	2.735E+05	1.319E+05	2.786E+05	Yes
4/15/2003	106	528.337	52	3.021E+05	1.456E+05	3.078E+05	Yes
12/12/1995	105	106.194	80.9	6.014E+04	2.900E+04	6.186E+04	Yes
8/17/1999	104	46.515	92.7	2.609E+04	1.258E+04	2.710E+04	Yes
11/12/2003	104	116.726	79.2	6.548E+04	3.157E+04	6.800E+04	Yes
9/4/2001	103.5	85.131	84.5	4.752E+04	2.291E+04	4.959E+04	Yes
12/19/2006	103	584.505	50.4	3.247E+05	1.566E+05	3.405E+05	Yes
7/28/1992	102	391.425	56.6	2.153E+05	1.038E+05	2.280E+05	Yes
9/22/1992	102	101.806	81.8	5.601E+04	2.700E+04	5.930E+04	Yes
5/25/2004	102	974.175	42.9	5.360E+05	2.584E+05	5.675E+05	Yes
5/30/2000	101.5	939.070	43.4	5.141E+05	2.479E+05	5.470E+05	Yes
1/16/1996	101	342.278	58.9	1.865E+05	8.990E+04	1.994E+05	Yes
2/20/1996	101	367.729	57.5	2.003E+05	9.659E+04	2.142E+05	Yes
4/11/2000	101	781.973	46	4.260E+05	2.054E+05	4.555E+05	Yes
10/21/2003	101	71.966	86.9	3.921E+04	1.890E+04	4.192E+04	Yes
10/19/1999	100	78.110	85.8	4.213E+04	2.031E+04	4.550E+04	Yes
5/17/2005	100	193.080	69.7	1.041E+05	5.021E+04	1.125E+05	Yes
3/27/2007	100	525.704	24.7	2.836E+05	1.367E+05	3.062E+05	Yes
4/25/2006	99.5	1334.006	38.1	7.159E+05	3.452E+05	7.771E+05	Yes
4/12/1994	99	2404.722	28.9	1.284E+06	6.191E+05	1.401E+06	Yes
3/8/1999	99	618.733	49.6	3.304E+05	1.593E+05	3.604E+05	Yes
12/5/2000	99	3440.331	22.3	1.837E+06	8.857E+05	2.004E+06	Yes
4/24/2007	98.5	858.328	24.7	4.560E+05	2.199E+05	5.000E+05	Yes
11/8/1994	98	974.175	42.9	5.149E+05	2.483E+05	5.675E+05	Yes
8/19/2003	97.5	116.726	79.2	6.139E+04	2.960E+04	6.800E+04	Yes
2/3/1998	97	3563.200	21.6	1.864E+06	8.988E+05	2.076E+06	Yes
5/22/2001	97	354.565	58.2	1.855E+05	8.944E+04	2.065E+05	Yes
9/30/2003	97	118.481	78.8	6.199E+04	2.989E+04	6.902E+04	Yes
2/27/2007	97	2694.341	24.7	1.410E+06	6.797E+05	1.570E+06	Yes
4/19/2005	96	5371.130	13.6	2.781E+06	1.341E+06	3.129E+06	Yes
3/26/1996	95	2079.996	31.4	1.066E+06	5.139E+05	1.212E+06	Yes
5/18/1999	95	732.826	47.1	3.755E+05	1.810E+05	4.269E+05	Yes
1/7/1992	94	1474.428	36.7	7.476E+05	3.604E+05	8.589E+05	Yes
2/18/1992	94	2711.894	26.7	1.375E+06	6.629E+05	1.580E+06	Yes
12/21/1993	94	2869.868	25.6	1.455E+06	7.015E+05	1.672E+06	Yes
3/22/2005	94	1369.112	37.7	6.942E+05	3.347E+05	7.975E+05	Yes
7/25/1995	93	151.831	74.4	7.616E+04	3.672E+04	8.845E+04	Yes
7/9/1996	93	86.886	84.3	4.358E+04	2.101E+04	5.061E+04	Yes
10/15/1991	92	63.190	88.9	3.136E+04	1.512E+04	3.681E+04	Yes
10/20/1998	92	375.628	57.2	1.864E+05	8.987E+04	2.188E+05	Yes
10/2/2001	92	25.451	97.2	1.263E+04	6.089E+03	1.483E+04	Yes
12/11/2001	92	4941.088	15.3	2.452E+06	1.182E+06	2.878E+06	Yes
1/28/2003	92	516.927	52.3	2.565E+05	1.237E+05	3.011E+05	Yes
10/12/2004	92	930.294	43.5	4.616E+05	2.226E+05	5.419E+05	Yes
12/20/1999	91.5	1649.955	34.8	8.143E+05	3.926E+05	9.611E+05	Yes
1/25/2000	91.5	133.401	76.8	6.584E+04	3.174E+04	7.771E+04	Yes
6/4/2002	91.5	1228.690	39.4	6.064E+05	2.924E+05	7.157E+05	Yes
3/12/1991	91	5818.724	12.2	2.856E+06	1.377E+06	3.390E+06	Yes
4/11/1995	91	1895.693	32.9	9.305E+05	4.486E+05	1.104E+06	Yes
6/8/1999	91	1535.862	36	7.539E+05	3.635E+05	8.947E+05	Yes
2/12/2002	91	3256.028	23.3	1.598E+06	7.705E+05	1.897E+06	Yes
10/25/2005	91	29.840	96.3	1.465E+04	7.062E+03	1.738E+04	Yes
7/27/2004	90.5	947.846	43.4	4.627E+05	2.231E+05	5.521E+05	Yes
6/18/1991	90	369.485	57.5	1.794E+05	8.648E+04	2.152E+05	Yes
8/10/2004	89.5	150.953	74.5	7.287E+04	3.513E+04	8.793E+04	Yes
11/25/1991	89	3492.990	22	1.677E+06	8.085E+05	2.035E+06	Yes
6/14/1993	89	397.569	56.3	1.909E+05	9.202E+04	2.316E+05	Yes
8/22/1995	89	32.473	95.8	1.559E+04	7.516E+03	1.892E+04	Yes
9/29/1998	88	215.021	67.6	1.021E+05	4.921E+04	1.253E+05	Yes
11/28/2006	88	385.282	56.8	1.829E+05	8.817E+04	2.244E+05	Yes
4/2/1991	87	3071.725	24.4	1.441E+06	6.950E+05	1.789E+06	Yes
2/16/1993	87	2299.405	29.7	1.079E+06	5.202E+05	1.339E+06	Yes
2/21/1995	87	1992.233	32.1	9.349E+05	4.507E+05	1.161E+06	Yes

Table F-6. (continued)

Date	Observed Concentration (mg/L)	Flow/unit area on sampling day (cfs)	Percent exceedance for flow on sampling day	Current load (lbs/day)	Reduced load (lbs/day)	Allowable load with MOS incorporated (lbs/day)	Reduced load less than or equal to allow load?
8/25/1998	87	109.704	80.3	5.148E+04	2.482E+04	6.391E+04	Yes
2/15/2005	87	4028.347	19.3	1.890E+06	9.114E+05	2.347E+06	Yes
8/22/2006	86.5	25.451	97.2	1.187E+04	5.725E+03	1.483E+04	Yes
3/16/1993	86	1018.057	42.1	4.722E+05	2.277E+05	5.930E+05	Yes
5/17/1994	86	2501.261	28.1	1.160E+06	5.594E+05	1.457E+06	Yes
3/3/1998	86	3185.817	23.8	1.478E+06	7.125E+05	1.856E+06	Yes
3/5/2002	86	2360.840	29.1	1.095E+06	5.280E+05	1.375E+06	Yes
1/2/2002	85.5	1816.706	33.6	8.378E+05	4.039E+05	1.058E+06	Yes
9/21/1993	85	31.595	96	1.449E+04	6.984E+03	1.840E+04	Yes
8/30/1994	85	301.907	60.9	1.384E+05	6.674E+04	1.759E+05	Yes
5/20/2003	85	2589.025	27.5	1.187E+06	5.723E+05	1.508E+06	Yes
7/6/2004	85	6204.884	11.2	2.845E+06	1.372E+06	3.615E+06	Yes
5/7/2002	84.5	4774.338	15.9	2.176E+06	1.049E+06	2.781E+06	Yes
10/11/1994	84	135.156	76.5	6.124E+04	2.952E+04	7.873E+04	Yes
11/7/1995	84	563.442	51.1	2.553E+05	1.231E+05	3.282E+05	Yes
8/22/2000	84	19.308	98.4	8.748E+03	4.218E+03	1.125E+04	Yes
4/24/2001	84	2878.645	25.6	1.304E+06	6.288E+05	1.677E+06	Yes
6/20/2006	83.5	103.561	81.5	4.664E+04	2.249E+04	6.033E+04	Yes
2/22/1994	83	3071.725	24.4	1.375E+06	6.630E+05	1.789E+06	Yes
8/31/2004	82.5	236.084	65.7	1.051E+05	5.065E+04	1.375E+05	Yes
12/10/1996	82	7512.561	7.9	3.323E+06	1.602E+06	4.376E+06	Yes
10/3/2000	82	52.658	91.3	2.329E+04	1.123E+04	3.067E+04	Yes
3/18/2003	82	1588.520	35.4	7.026E+05	3.387E+05	9.254E+05	Yes
7/26/2005	81.5	202.734	68.7	8.912E+04	4.297E+04	1.181E+05	Yes
8/24/1993	81	60.557	89.5	2.646E+04	1.276E+04	3.528E+04	Yes
8/2/1994	81	1579.744	35.5	6.902E+05	3.328E+05	9.202E+05	Yes
2/9/1999	81	9127.410	5.3	3.988E+06	1.923E+06	5.317E+06	Yes
6/21/1993	80	712.640	47.4	3.075E+05	1.483E+05	4.151E+05	Yes
2/18/2003	79.5	6819.228	9.4	2.924E+06	1.410E+06	3.972E+06	Yes
2/12/1991	79	2079.996	31.4	8.863E+05	4.273E+05	1.212E+06	Yes
9/11/1995	79	14.920	99.1	6.357E+03	3.065E+03	8.691E+03	Yes
2/10/2004	79	3475.437	22.1	1.481E+06	7.140E+05	2.025E+06	Yes
4/20/1993	78	4440.836	17.3	1.868E+06	9.008E+05	2.587E+06	Yes
7/26/1993	78	67.578	87.8	2.843E+04	1.371E+04	3.937E+04	Yes
3/18/1997	78	8065.471	6.8	3.393E+06	1.636E+06	4.698E+06	Yes
6/27/2000	77.5	2808.434	26	1.174E+06	5.660E+05	1.636E+06	Yes
4/13/2004	77.5	4458.389	17.2	1.864E+06	8.986E+05	2.597E+06	Yes
5/30/2006	77.5	335.257	59.1	1.401E+05	6.757E+04	1.953E+05	Yes
1/30/2007	77	5792.395	24.7	2.406E+06	1.160E+06	3.374E+06	Yes
11/9/2004	76.5	4923.536	15.4	2.032E+06	9.795E+05	2.868E+06	Yes
5/18/1993	76	3765.057	20.6	1.543E+06	7.441E+05	2.193E+06	Yes
10/10/1995	75	107.949	80.6	4.367E+04	2.105E+04	6.288E+04	Yes
7/28/1998	75	50.903	91.7	2.059E+04	9.928E+03	2.965E+04	Yes
8/23/2005	73.5	31.595	96	1.253E+04	6.039E+03	1.840E+04	Yes
4/13/1999	73	7600.324	7.7	2.993E+06	1.443E+06	4.427E+06	Yes
3/28/2006	73	5230.708	14.1	2.060E+06	9.930E+05	3.047E+06	Yes
9/26/2000	72	44.759	93.1	1.738E+04	8.381E+03	2.607E+04	Yes
1/2/1991	70	10794.918	3.7	4.076E+06	1.965E+06	6.288E+06	Yes
3/21/1995	70	6696.360	9.7	2.528E+06	1.219E+06	3.901E+06	Yes
3/9/2004	69.5	5783.619	12.4	2.168E+06	1.045E+06	3.369E+06	Yes
9/26/2005	69.5	43.004	93.3	1.612E+04	7.773E+03	2.505E+04	Yes
10/12/1993	68	126.380	77.7	4.635E+04	2.235E+04	7.362E+04	Yes
3/1/1994	68	7249.270	8.4	2.659E+06	1.282E+06	4.223E+06	Yes
1/30/2001	68	5134.168	14.5	1.883E+06	9.079E+05	2.991E+06	Yes
3/17/1992	67	8179.564	6.6	2.956E+06	1.425E+06	4.765E+06	Yes
7/5/1994	67	912.741	43.9	3.298E+05	1.590E+05	5.317E+05	Yes
12/14/2004	67	7407.244	8.1	2.677E+06	1.291E+06	4.315E+06	Yes
5/14/1991	66	5248.261	14.1	1.868E+06	9.008E+05	3.057E+06	Yes
6/24/2003	65.5	15358.623	1.6	5.426E+06	2.616E+06	8.947E+06	Yes
2/20/2001	61.5	11935.844	2.9	3.959E+06	1.909E+06	6.953E+06	Yes
3/20/2001	61.5	9215.174	5.2	3.057E+06	1.474E+06	5.368E+06	Yes
4/2/2002	52.5	12023.608	2.9	3.405E+06	1.642E+06	7.004E+06	Yes

EPA Responses to Comments for TMDLs in the Saline River Basin in Arkansas

Prepared for:

United States Environmental Protection Agency, Region 6
Water Quality Protection Division
Permits, Oversight, and TMDL Team
Dallas, TX

Prepared by:

Tetra Tech, Inc.
10306 Eaton Place, Suite 340
Fairfax, VA 22030

March 26, 2008

CONTENTS

PLEASE NOTE: Throughout this document there are references to other comments and responses. For brevity and the reader's convenience, hyperlinks to these other comments and responses are provided. The hyperlinks are *underlined and italicized*. By pressing "Control" and clicking a hyperlink, the reader can go directly to the cross-referenced comments. Comment numbers and request numbers start over in each letter. References to comment numbers are within the current letter unless otherwise noted.

SALINE WATERSHED COMMENTS AND RESPONSES

Alcoa Inc. – Bauxite Comments

January 16, 2008

Ms. Diane Smith
Water Quality Protection Division
U.S. EPA Region 6
1445 Ross Avenue
Dallas, TX 75202–2733

RE: Comments on draft TMDLs for chloride, sulfate, and TDS for the Saline River basin, Arkansas

Dear Ms. Smith:

Following are comments from Alcoa Inc. – Bauxite on the draft TMDLs referenced above.

The proposed wasteload allocation (WLA) for Alcoa Outfall 028 is based on effluent concentrations of 730 mg/L of sulfate and 1,210 mg/L of total dissolved solids (TDS). These concentrations are equal to the water quality standards in the receiving stream (Hurricane Creek). Due to the nature of the water being treated, Alcoa needs to discharge effluent through this outfall at concentrations above the water quality standards. This will not cause violations of water quality standards in Hurricane Creek because Outfall 028 is operated with a hydrograph controlled release (HCR), which means that the effluent flow rate is limited to certain percentages of the upstream flow.

The current permit consists of five (5) discharge tiers (48%, 37%, 30%, 26%, and 13%) for Outfall 028, which are based on selenium concentrations in the effluent. From time to time these HCR tiers will need to be modified through the NPDES application process to reflect the most recent effluent data. For example, Alcoa has submitted a new NPDES application with proposed discharge tiers of 111%, 67%, 48%, 30%, and 17% based on the most recent effluent data. The maximum measured sulfate concentration is 1,100 mg/L and calculated TDS concentration is approximately 2,200 mg/L. Alcoa requests that the WLA for Outfall 028 be based on actual effluent concentrations and not those associated with the Hurricane Creek water quality standards.

Calculations were developed that show conservatively high effluent concentrations of 1,400 mg/L sulfate and 2,200 mg/L TDS will not cause violations of water quality standards in Hurricane Creek under worst-case conditions with no ambient inflow upstream of Outfall 028. Instream concentrations of sulfate and TDS would normally be expected to be considerably lower than the values shown in the spreadsheet due to ambient inflow and conservative

1. EPA noticed the comments provided in reference to sulfates and chlorides, however the sulfate and chloride TMDL for the Saline River will be released at a later date and we will respond to those comments at that time.

assumptions in these calculations. One of the conservative assumptions is that Alcoa Outfall 008 was assumed to be discharging at a flow rate of 3.70 MGD and effluent concentrations equal to the water quality standards. Outfall 008 has been inactive for the past 3 years and will likely be operated in the future only during excessively wet periods. Another conservative assumption in these calculations is that the flow rate from Outfall 028 was calculated using 111%, at the existing treatment flow design, of the total upstream flow, even though the flow rate from this outfall could sometimes be limited to lower percentages of the upstream flow.

As long as these effluent concentrations for Alcoa Outfall 028 do not cause violations of water quality standards in Hurricane Creek, they should not cause violations of water quality standards in the Saline River downstream of Hurricane Creek. The standards for dissolved minerals in Hurricane Creek were set by ADEQ based on calculations that show that the dilution entering Hurricane Creek downstream of the Alcoa outfalls and the assimilative capacity of the Saline River at the confluence with Hurricane Creek are such that maintaining water quality standards in Hurricane Creek should allow water quality standards to be maintained in the Saline River downstream of Hurricane Creek. Ambient runoff drains into Hurricane Creek from a drainage area of approximately 236 square miles downstream of the Alcoa outfalls. The drainage area of the Saline River is 1,123 square miles immediately upstream of Hurricane Creek and 1,845 square miles at the downstream end of the impaired reach below Hurricane Creek (reach 08040204-006). The allowable loads for the Saline River reach 08040204-006 as calculated in the draft TMDL report are 495,327 lbs/day of sulfate and 1,485,982 lbs/day of TDS. These loads are very large in comparison to the requested effluent loading from Alcoa Outfall 028, which is about 32,000 lbs/day of sulfate and 50,000 lbs/day of TDS based on a flow rate of 2.74 MGD and effluent concentrations of 1,400 mg/L of sulfate and 2,200 mg/L of TDS.

Alcoa appreciates the opportunity to review these draft TMDLs and submit comments. If you have any questions or need any additional information concerning these comments, please feel free to contact me at 412-553-4303.

Sincerely,

Robyn Gross
Alcoa – Bauxite Site Manager

cc: Phil Hutchison, U.S. EPA Region 6

R:\PROJECTS\6012-250.O\TECH\NPDES\TMDL RESPONSE MEMO\ALCOA DRAFT COMMENTS ON SALINE RIVER TMDLS.DOC

EPA Response to Alcoa:

Upon performing a mass balance of all upstream and downstream contributors, the requested[1] TDS limits require slight reductions. The mass balance was performed assuming that all dischargers are discharging at their permit limits and

1. EPA noticed the comments provided in reference to sulfates and chlorides, however the sulfate and chloride TMDL for the Saline River will be released at a later date and we will respond to those comments at that time.

the stream is at the conditions (concentration and critical flow) identified in the *State of Arkansas Continuing Planning Process* document dated January 2000. These WLAs will be reflected in the final TMDL.

EPA was not able to recreate your calculations since they were not submitted with your comment package. In addition, the allowable load is for the entire watershed, including all point and nonpoint sources. The total loadings, as individual loadings from point sources, were determined so that effluents would not exceed water quality concentration criteria. So although loadings from your facility might seem small compared to the total allowable loadings, your limits were set so as not to exceed water quality concentration criteria based on facility flow.

1. EPA noticed the comments provided in reference to sulfates and chlorides, however the sulfate and chloride TMDL for the Saline River will be released at a later date and we will respond to those comments at that time.

Almatis, Inc. Comments

ALMATIS

Almatis, Inc.
4701 Alcoa Road
P O Box 300
Bauxite, AR 72011-0300 USA
www.almatis.com

January 16, 2008

Ms. Diane Smith
Water Quality Protection Division
U.S. EPA Region 6
1445 Ross Avenue
Dallas, TX 75202–2733

RE: Comments on draft TMDLs for chloride, sulfate, and TDS for the Saline River basin, Arkansas

Dear Ms. Smith:

Following are Almatis Inc. – Bauxite's (Permit No. AR0050270, AFIN 63-00010) comments on the draft TMDLs referenced above.

The draft Saline River TMDL does not allocate any sulfate or TDS wasteloads for the Almatis Inc. – Baxuite, Arkansas (Almatis) discharge. Almatis has an existing NPDES discharge permit that allows for discharges of minerals into Hurricane Creek. Almatis needs to discharge effluent through its outfall at concentrations at or above the water quality standards. This discharge should not cause violations of water quality standards in Hurricane Creek because of the upstream flow. The monthly maximum measured discharge concentrations are 744 mg/L for sulfate and 1,529 mg/L for TDS. The long-term average discharge concentrations are 557 mg/L for sulfate and 1,204 mg/L for TDS. Almatis requests a minerals allocation in the Saline River TMDL based on effluent concentrations of 1000 mg/L of sulfate and 2000 mg/L of TDS.

Calculations were developed that show average annual minerals waste loads for Hurricane Creek are not exceeding the water quality standards. As long as Almatis' Outfall 001 effluent concentrations do not cause violations of water quality standards in Hurricane Creek, they should not cause violations of water quality standards in the Saline River downstream of Hurricane Creek. The standards for dissolved minerals in Hurricane Creek were set by ADEQ based on calculations that show that the dilution entering Hurricane Creek downstream of the Almatis outfalls and the assimilative capacity of the Saline River at the confluence with Hurricane Creek are such that maintaining water quality standards in Hurricane Creek should allow water quality standards to be maintained in the Saline River downstream of Hurricane Creek.

Almatis appreciates the opportunity to review these draft TMDLs and submit comments. If you have any questions or need any additional information concerning these comments, please feel free to contact me at 501-776-4432.

Sincerely,

Michael Hoylman
Almatis Inc. – Environmental, Health, and Safety Manager

cc: Phil Hutchison, U.S. EPA Region 6

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1. EPA noticed the comments provided in reference to sulfates and chlorides, however the sulfate and chloride TMDL for the Saline River will be released at a later date and we will respond to those comments at that time.

EPA Response to Almatis:

Upon performing a mass balance of all upstream and downstream contributors, it was determined the[1] requested TDS limit required a slight reduction. The mass balance was performed assuming all dischargers are discharging at their permit limits and the stream is at the conditions (concentration and critical flow) identified in the *State of Arkansas Continuing Planning Process* document dated January 2000. These WLAs will be reflected in the final TMDL.

1. EPA noticed the comments provided in reference to sulfates and chlorides, however the sulfate and chloride TMDL for the Saline River will be released at a later date and we will respond to those comments at that time.