NEOSHO BASIN TOTAL MAXIMUM DAILY LOAD

Waterbody: Cottonwood River
Water Quality Impairment: Sulfate

1. INTRODUCTION AND PROBLEM IDENTIFICATION

Subbasin: Upper Cottonwood and Lower Cottonwood

County: Chase, Harvey, Marion, and Morris

HUC 8: 11070202 and 11070203

HUC 11 (HUC 14s): *11070202* **010** (010, 020 and 030)
020 (020 and 070)
030 (020 and 070)
040 (020 and 070)

11070203 **010** (010, 020, 030, and 040) (**Figure 2**)

Drainage Area: 622 square miles

Main Stem Segments: WQLS: 1, 2 and 3 in 11070202 and segment 2, 4 and 6 in 11070203 (Cottonwood River) starting at confluence with the Neosho River (in central Chase County) and traveling upstream to headwaters at confluence with Clear Creek south of the city of Marion (**Figure 1**).

Tributary Segments:
11070202 WQLS: Doyle Creek (21)
Clear Creek (4 and 5)
E. Branch Clear Creek (24)
S. Cottonwood River (17 and 18)
French Creek (16)

Designated Uses: Expected Aquatic Life Support (Special Aquatic Life Support for segments 2, 4 and 6 in 11070203), Primary Contact Recreation, Domestic Water Supply; Food Procurement; Ground Water Recharge; Industrial Water Supply Use; Irrigation Use; Livestock Watering Use for Main Stem Segments.

11070202 Expected Aquatic Life Support; Secondary Contact Recreation (Primary Contact Recreation for Tributary Segment 4); Domestic Water Supply; Food Procurement; Ground Water Recharge; Industrial Water Supply Use; Irrigation Use; Livestock Watering Use for Tributary Segments 21. 4, 5, 24, 17 and 18.

Expected Aquatic Life Support; Secondary Contact Recreation; Domestic Water Supply and Food Procurement on Tributary Segment 16.

1998 303(d) Listing: Table 1 - Predominant Non-point Source and Point Source Impacts and Table 3 - Predominant Natural Conditions Impact

Impaired Use: Domestic Water Supply (Potentially)

Water Quality Standard: Domestic Water Supply: 250 mg/L at any point of domestic water supply diversion (K.A.R.28-16-28e(c) (3) (A)

In stream segments where background concentrations of naturally occurring substances, including chlorides and sulfates, exceed the water quality criteria listed in Table 1a of KAR 28-16-28e(d), at ambient flow, the existing water quality shall be maintained, and the newly established numeric criteria shall be the background concentration, as defined in KAR 28-16-28b(e). Background concentrations shall be established using the methods outlined in the "Kansas implementation procedures: surface water quality standards," dated August 6, 2001. (KAR 28-16-28e(b)(9)).

Cottonwood River Watershed
Sulfate TMDL
HUC and Stream Segment Map

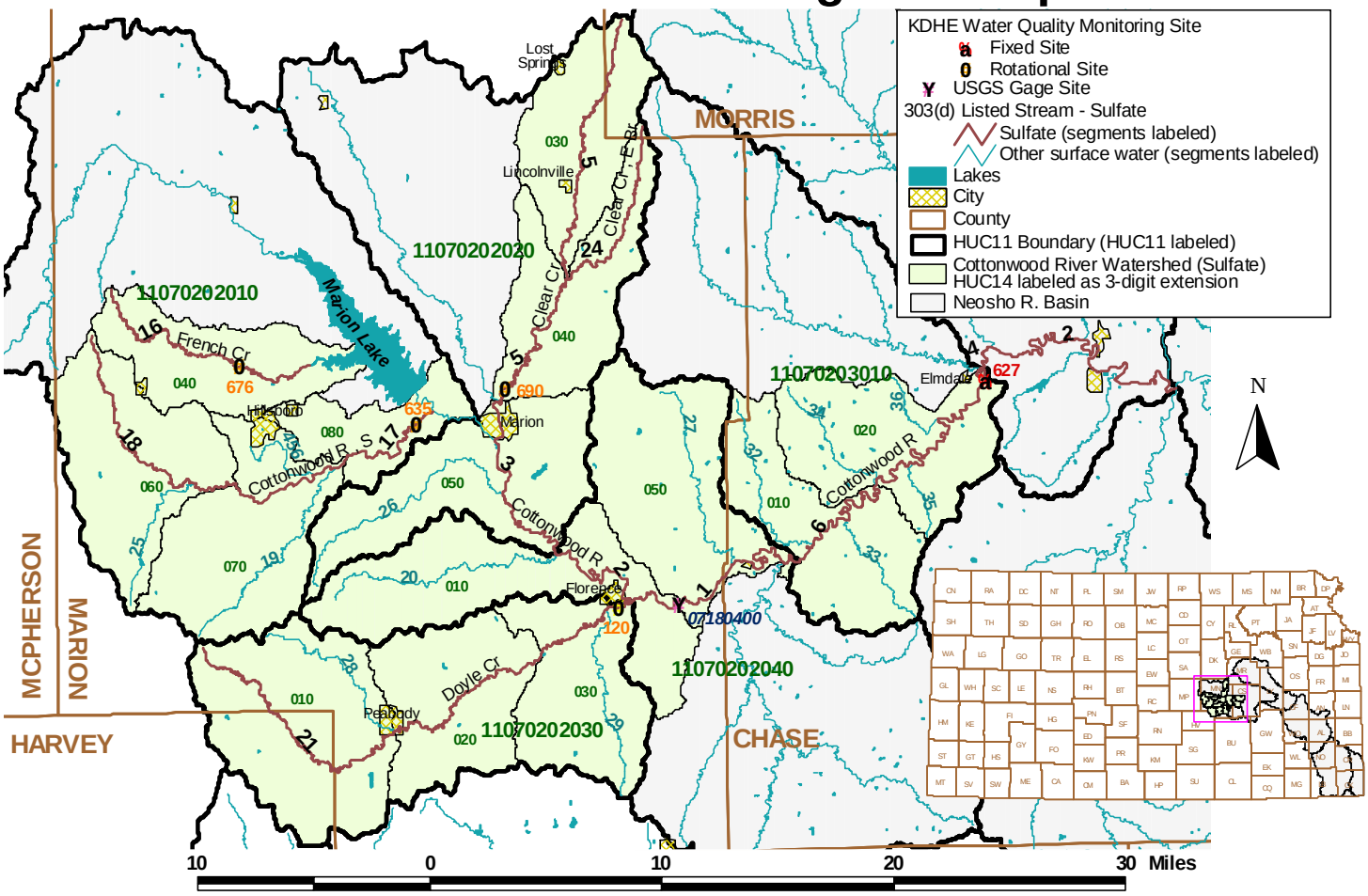

Figure 1

2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

Level of Support for Designated Use under 1998 303(d): Not Supporting Domestic Water Supply

Monitoring Sites: Station 627 near Elmdale (Cottonwood River); Station 120 near Florence (Doyle Creek); Station 690 near Marion (Clear Creek); Station 635 near Canada (S. Cottonwood River); and Station 676 near Hillsboro (French Creek) (**Figure 1**)

Period of Record Used: 1991-2000 for Station 627 (**Figure 2**); 1994, 1998-2000 for Station 102 (Kansas Biological Survey Data 1999-2000) (**Figure 3**); 1997 and 2001 for Station 690 (**Figure 4**); 1993, 1997, 1999-2001 for Station 635 (Kansas Biological Survey Data 1999-2000) (**Figure 5**); 1997, 1999-2001 for Station 676 (Kansas Biological Survey Data 1999-2000) (**Figure 6**).

Flow Record: Cottonwood River near Plymouth (USGS Station 07182250) for Site 627; Cedar Creek near Cedar Point (USGS Station 07180500) matched to South Cottonwood River near (USGS Station 07179850) for Site 635; Cedar Creek near Cedar Point (USGS Station 07180500) matched to area runoff for South Cottonwood River watershed and rescaled to respective watershed areas for Sites 120, 690 and 676.

Long Term Flow Conditions: Median Flows = 286 cfs (Site 627); 10.2 cfs (Site 120); 5.7 cfs (Site 690); 8.4 cfs (Site 635); 2.6 cfs (Site 676)

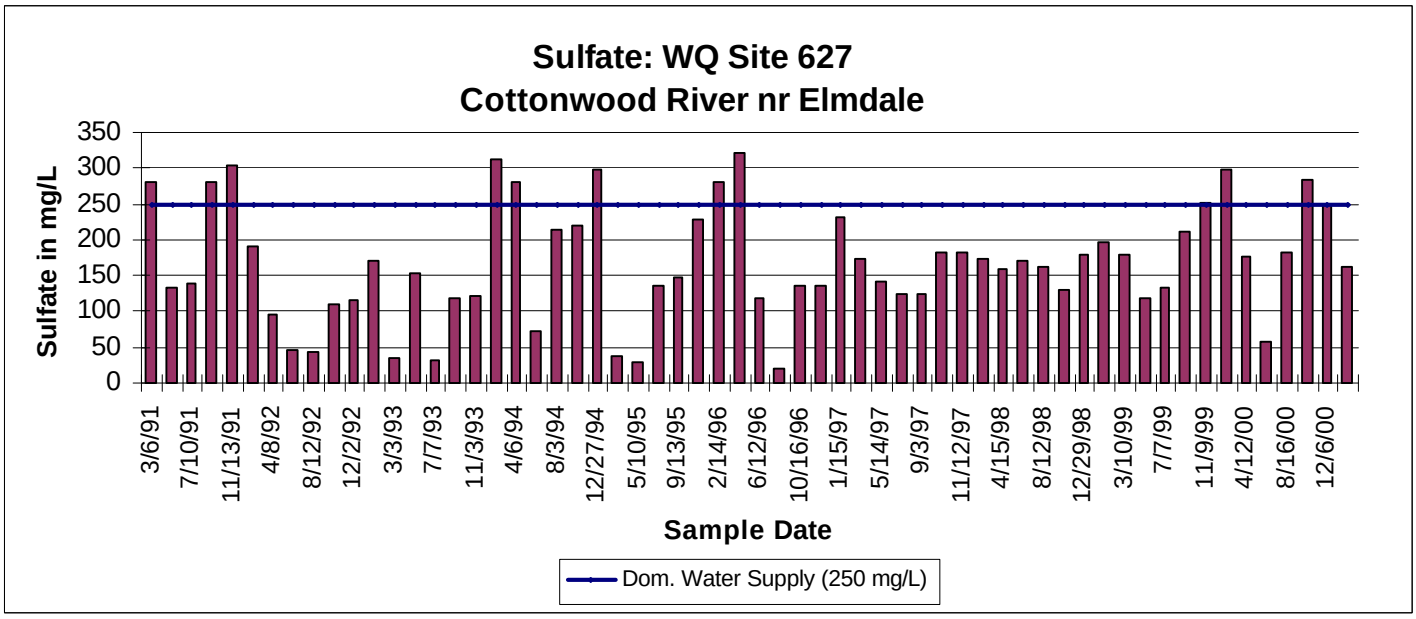

Figure 2

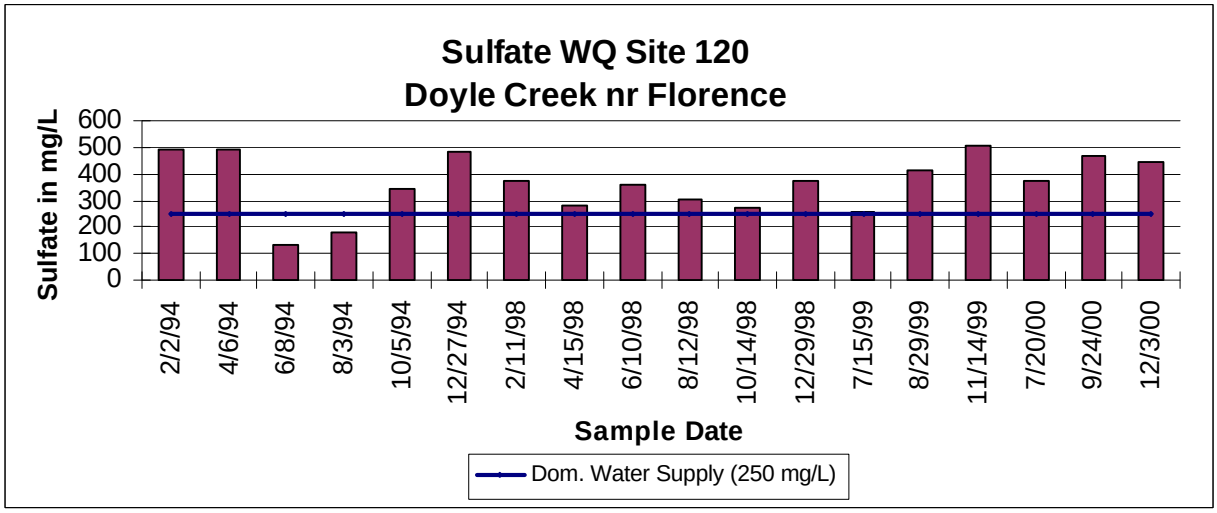

Figure 3

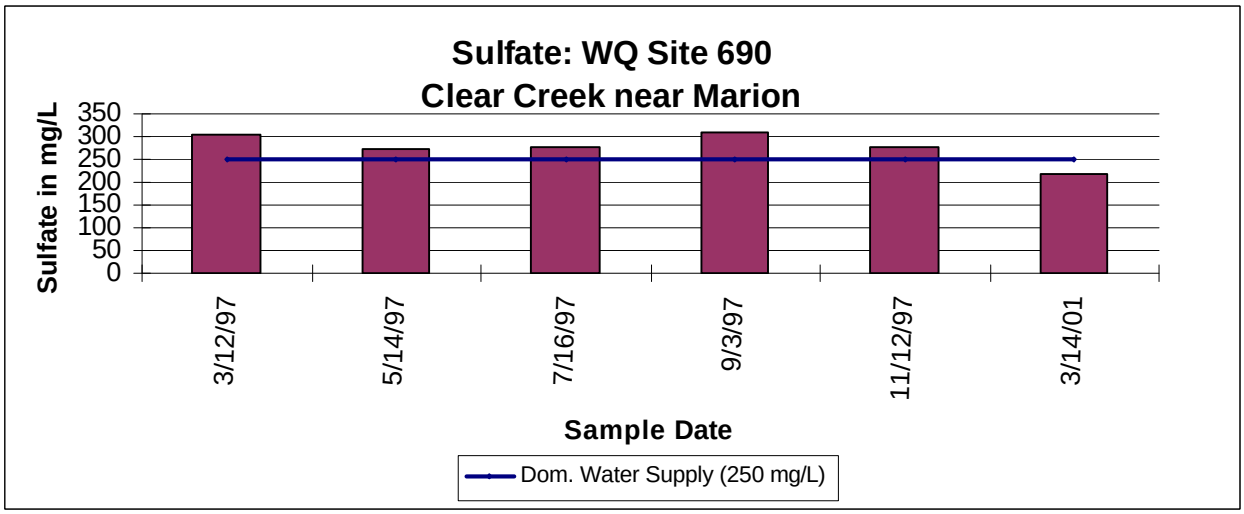

Figure 4

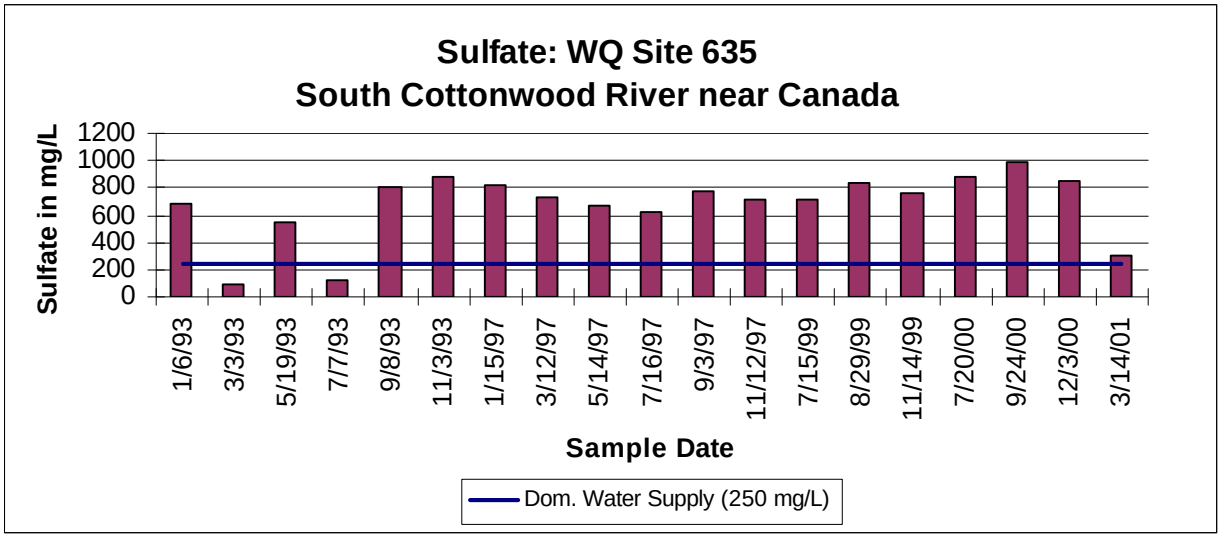

Figure 5

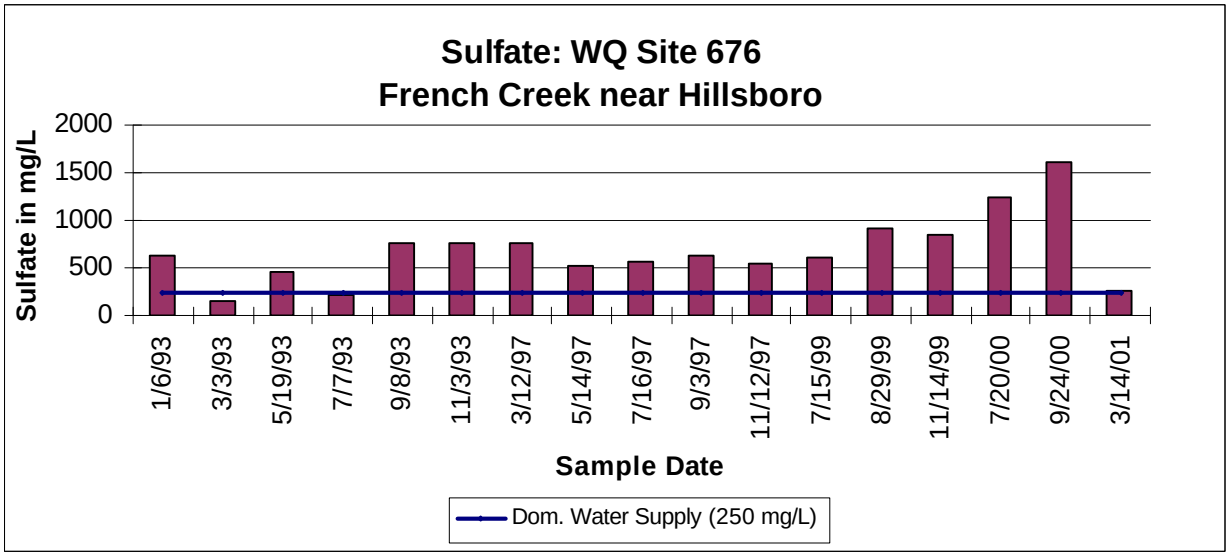

Figure 6

Current Conditions: Since loading capacity varies as a function of the flow present in the stream, this TMDL represents a continuum of desired loads over all flow conditions, rather than fixed at a single value. Sample data for the sampling sites were categorized for each of the three defined seasons: Spring (Apr-Jul), Summer-Fall (Aug-Oct) and Winter (Nov-Mar). High flows and runoff equate to lower flow durations; baseflow and point source influences generally occur in the 75-99% range. A Load curve was established for the Domestic Water Supply criterion by multiplying the flow values along the curve by the applicable water quality criterion and converting the units to derive a load duration curve of tons of sulfate per day. This load curves represent the TMDL since any point along the curve represents water quality for the standard at that flow. Historic excursions from the water quality standard are seen as plotted points above the load curve. Water quality standards are met for those points plotting below the load duration curve (**Figures 8, 9, 10, 11 and 12**).

Cottonwood River (Elmdale):Site 627: Excursions were seen in each of the three defined seasons and are outlined in **Table 1**. Ten percent of Spring samples and 13% of Summer-Fall samples were over the domestic supply criterion. Thirty percent of Winter samples were over the criterion. Overall, 19% of the samples were over the criteria. This would represent a baseline condition of partial-support of the impaired designated use.

Table 1
NUMBER OF SAMPLES OVER SULFATE STANDARD OF 250 mg/L BY FLOW AND SEASON

Station	Season	0 to 10%	10 to 25%	25 to 50%	50 to 75%	75 to 90%	90 to 100%	Cum Freq.
Cottonwood River near Elmdale (627)	Spring	0	0	0	0	2	0	2/20 = 10%
	Summer	0	0	0	1	0	1	2/15 = 13%
	Winter	0	0	0	3	2	1	7/23 = 30%

Doyle Creek: Site 120: Excursions were seen in each of the three defined seasons and are outlined in **Table 2**. Eighty three of Spring samples and 83% of Summer-Fall samples were over the domestic supply criterion. All of the Winter samples were over the criterion. Overall, 89% of the samples were over the criteria. This would represent a baseline condition of non-support of the impaired designated use.

Table 2
NUMBER OF SAMPLES OVER SULFATE STANDARD OF 250 mg/L BY FLOW AND SEASON

Station	Season	0 to 10%	10 to 25%	25 to 50%	50 to 75%	75 to 90%	90 to 100%	Cum Freq.
Doyle Creek near Florence (120)	Spring	1	0	1	2	1	0	5/6 = 83%
	Summer	0	0	1	1	2	1	5/6 = 83%
	Winter	0	0	2	1	3	0	6/6 = 100%

Clear Creek: Site 690: Excursions were seen in each of the three defined seasons and are outlined in **Table 3**. Both of the of Spring samples and the single Summer-Fall sample were over the domestic supply criterion. Sixty seven percent of Winter samples were over the criterion. Overall, 83% of the samples were over the criteria. This would represent a baseline condition of non-support of the impaired designated use.

Table 3
NUMBER OF SAMPLES OVER SULFATE STANDARD OF 250 mg/L BY FLOW AND SEASON

Station	Season	0 to 10%	10 to 25%	25 to 50%	50 to 75%	75 to 90%	90 to 100%	Cum Freq.
Clear Creek near Marion (690)	Spring	0	0	2	0	0	0	2/2 = 100%
	Summer	0	0	1	0	0	0	1/1 = 100%
	Winter	0	1	1	0	0	0	2/3 = 67%

South Cottonwood River: Site 635: Excursions were seen in each of the three defined seasons and are outlined in **Table 2**. Eighty three of Spring samples and 100% of Summer-Fall samples were over the domestic supply criterion. Eighty eight percent of the Winter samples were over the criterion. Overall, 89% of the samples were over the criteria. This would represent a baseline condition of non-support of the impaired designated use.

Table 4
NUMBER OF SAMPLES OVER SULFATE STANDARD OF 250 mg/L BY FLOW AND SEASON

Station	Season	0 to 10%	10 to 25%	25 to 50%	50 to 75%	75 to 90%	90 to 100%	Cum Freq.
S. Cottonwood River near Canada (635)	Spring	1	0	2	2	0	0	5/6 = 83%
	Summer	0	0	2	0	2	0	4/4 = 100%
	Winter	0	2	4	0	1	0	7/8 = 88%

French Creek: Site 676: Excursions were seen in each of the three defined seasons and are outlined in **Table 2**. Eighty three of Spring samples and 100% of Summer-Fall samples were over the domestic supply criterion. Eighty six percent of the Winter samples were over the criterion. Overall, 88% of the samples were over the criteria. This would represent a baseline condition of non-support of the impaired designated use.

Table 5
NUMBER OF SAMPLES OVER SULFATE STANDARD OF 250 mg/L BY FLOW AND SEASON

Station	Season	0 to 10%	10 to 25%	25 to 50%	50 to 75%	75 to 90%	90 to 100%	Cum Freq.
French Creek near Hillsboro (676)	Spring	1	0	2	2	0	0	5/6 = 83%
	Summer	0	0	2	0	2	0	4/4 = 100%
	Winter	0	3	2	0	1	0	6/7 = 86%

Desired Endpoints of Water Quality (Implied Load Capacity) at Sites 627, 120, 690, 635 and 676 over 2007 - 2011

The ultimate endpoint for this TMDL will be to achieve the Kansas Water Quality Standards fully supporting Drinking Water Use. This TMDL will, however, be phased. The current standard of 250 mg/L of sulfate was used to establish the TMDL. However, the Cottonwood River system is subject to loading of sulfate from underlying Permian geologic formation and their high gypsum content in the watershed. As such, most of the watershed's tributaries in Marion County have elevated sulfate levels from this natural source. This natural background of sulfate, consistently above 250 mg/L, makes achievement of the Standard impossible for all but the highest flow conditions at Doyle Creek, Clear Creek, South Cottonwood River and French Creek (Sites 120, 690, 635 and 676). The average sulfate concentration on the Cottonwood River at Elmdale (Site 627) for flows greater and less than the median is not greater than the Phase One endpoint, therefore, the 250 mg/l endpoint will apply to all flows at the outlet of the watershed. At the other water quality sample sites (120, 690, 635 and 676), the Standard is not achievable because of natural contributions to the sulfate load, thus, an alternative endpoint is needed. Additionally, there has not been a point of diversion for potable water present on these streams on which to apply the domestic water criteria. Most public water supply use is from groundwater sources, Rural Water Districts or a Public Wholesale Water Supply District.

Kansas Implementation Procedures for Surface Water allow for a numerical criterion based on natural background to be established from flows less than median in-stream flow. The specific stream criteria to supplant the general standard will be developed concurrent with Phase One of this TMDL following the appropriate administrative and technical Water Quality Standards processes. Meanwhile, tentative endpoints have been developed from currently available information at water quality monitoring sites 120, 690, 635 and 676. The average sulfate concentration on Doyle Creek (Site 120) for flows less than the median flow is 371 mg/L which will be the tentative endpoint for this site. The average sulfate concentration on the South Cottonwood River (Site 635) for flows less than the median flow is 838 mg/L which will be the tentative endpoint for this site. The average sulfate concentration on French Creek (Site 676) for

flows less than the median flow is 1,044 mg/L which will be the tentative endpoint for this site. No data are available for Clear Creek (Site 690) for flows less than the median flow, however, since there appears to be no relation between sulfate and most flow conditions, the average sulfate concentration taken at the three lowest flows (288 mg/l) shall be the tentative endpoint for this site. The Phase Two TMDL will be based on these future standards applied to these contributing portions of the Cottonwood River watershed, while maintaining the 250 mg/l endpoint at Elmdale. Additionally, these endpoints are to be implemented upon initiation of use of these impaired streams for potable consumption, through a constructed point of diversion.

Seasonal variation has been incorporated in this TMDL through the documentation of the seasonal consistency of elevated sulfate levels. Achievement of the endpoints indicate loads are within the loading capacity of the stream, water quality standards are attained and full support of the designated uses of the stream has been restored.

3. SOURCE INVENTORY AND ASSESSMENT

Background Conditions: Permian bedrock underlies all of the Cottonwood River watershed except for the headwaters in easternmost McPherson and westernmost Marion counties where Cretaceous rock outcrops. The Permian bedrock contains varying amounts of gypsum (hydrated calcium sulfate) in the subsurface. The primary bedrock underlying the soil or outcropping at the surface in the central and western parts of the Cottonwood River watershed in Marion County is the lower part of the Wellington Formation. The Wellington bedrock in the watershed is predominantly shale with minor amounts of limestone, dolomite, gypsum, and anhydrite. The anhydrite (anhydrous calcium sulfate) occurs at a greater depth than the gypsum, where meteoric water has not yet penetrated sufficiently to hydrate it to gypsum. In some cases, the gypsum beds are near the surface or in outcrops of the Wellington. The gypsum is highly soluble and can result in ground waters containing a sulfate concentration up to 1,700 mg/L. The main area where sufficient gypsum is present at or near the land surface to substantially affect stream quality is just east of the outcrop line of the Carlton Limestone Member of the Wellington Formation whose outcrop approximately follows contours of land surface elevation; the trend of the outcrop location in the Cottonwood River watershed is a roughly north-south line that extends from just east of Walton in northeast Harvey County to north of Durham in northwest Marion County. This outcrop line passes a few miles west of Hillsboro. Tributaries to the Cottonwood River and the South Cottonwood River that cross the Wellington Formation east of the outcrop line of the Carlton Limestone Member have baseflows with sulfate concentrations that can often exceed 250 mg/L. Sulfate levels can reach as high as about 900 mg/L in some tributaries and the South Cottonwood River.

Although the Wellington Formation extends into parts of eastern Marion County, much of the area east of Marion is underlain by bedrock of the older Permian Chase Group, which is composed primarily of alternating limestones and shales. Thin beds and fracture fillings of gypsum occur in the subsurface in some of the limestones and shales. Although the amount of gypsum is much smaller than in the Wellington Formation, there are sufficient quantities to substantially raise the sulfate concentration of ground waters in some rocks of the Chase Group. Baseflows of streams crossing the Chase Group bedrock usually do not have sulfate concentrations that exceed 250 mg/L sulfate, but have enough sulfate that they do not dilute the Cottonwood River as rapidly as would fresher water. Thus, baseflows of the Cottonwood River downstream of the confluence with the South Cottonwood River to Elmdale can contain sulfate contents above 250 mg/L. The Cottonwood River below Marion Lake to the confluence with the South Cottonwood River

contains a sulfate concentration less than 250 mg/L during low flow because the freshwater runoff captured by the lake dilutes the mineralized baseflow entering the lake.

Irrigation Return Flows: Aggravation or impairment associated with irrigation return flows in this watershed is essentially non-existent. Irrigation reports from groundwater sources in 1998 indicate only 251 acre feet of irrigation use in the watershed. Return flows, if any, via groundwater discharge to tributaries or the main stem in the watershed from those diversions would be negligible at most.

NPDES: There are a total of 9 of municipal and industrial NPDES sites authorized to discharge upstream of the monitoring sites located within the watershed (**Table 6 and Figure 7**). There are also five non-discharging facilities located in the watershed (**Figure 7**). Any anthropogenic sulfate sources or hydrologic modifications increasing the sulfate concentration are minor in comparison with the natural sulfate source underlying the watershed in Marion County.

Table 6

NPDES Facility	Stream Reach	Riv Segm	Design Flow	Type
Hillsboro WTF	S. Cottonwood R	456	0.65 cfs	Mech.
Lehigh WTP	French Creek	16	0.046 cfs	Lagoon
Lincolnville WTF	Clear Creek	5	0.05 cfs	Lagoon
Marion WTF	Cottonwood River	3	0.835 cfs	Lagoon
Peabody WTF	Doyle Creek	21	0.325 cfs	Mech.
Harshman Const-Florence Qry	Cottonwood River	2		Quarry
Harshman Const-Starkey Qry	Cottonwood River	6		Quarry
Martin Mar-Sunflower Qry#382	Cottonwood River	2		Quarry
Martin Mar-Hett/N.Marion Qry	Clear Creek	5		Quarry

Since none of the municipal NPDES sites in the watershed are currently required to monitor for sulfate in their effluent, average sulfate concentrations for municipal sources were estimated based on the sulfate in their source waters. Where monitored, source water had an average sulfate concentration of 160 mg/l and a conservative 2:1 ratio was used to estimate the sulfate in those cities' effluent (325 mg/l). Lehigh discharges to French Creek and drains into Marion Lake where its effluent is diluted by the large volume of water held in storage behind the dam. Marion Lake averages 160-250 mg/l of sulfate.

The population of the municipalities in Marion County discharging to the impaired streams is projected to decline between the years 2000 and 2020, except for Hillsboro and Lehigh. Therefore, the expected effluent discharge from these municipalities is not expected to reach the design flow capacity of their treatment facilities.

The industrial NPDES sites (quarries) in the watershed have not reported any discharge since 1997 and are not presumed to contribute to the sulfate loading to the surface waters of the watershed.

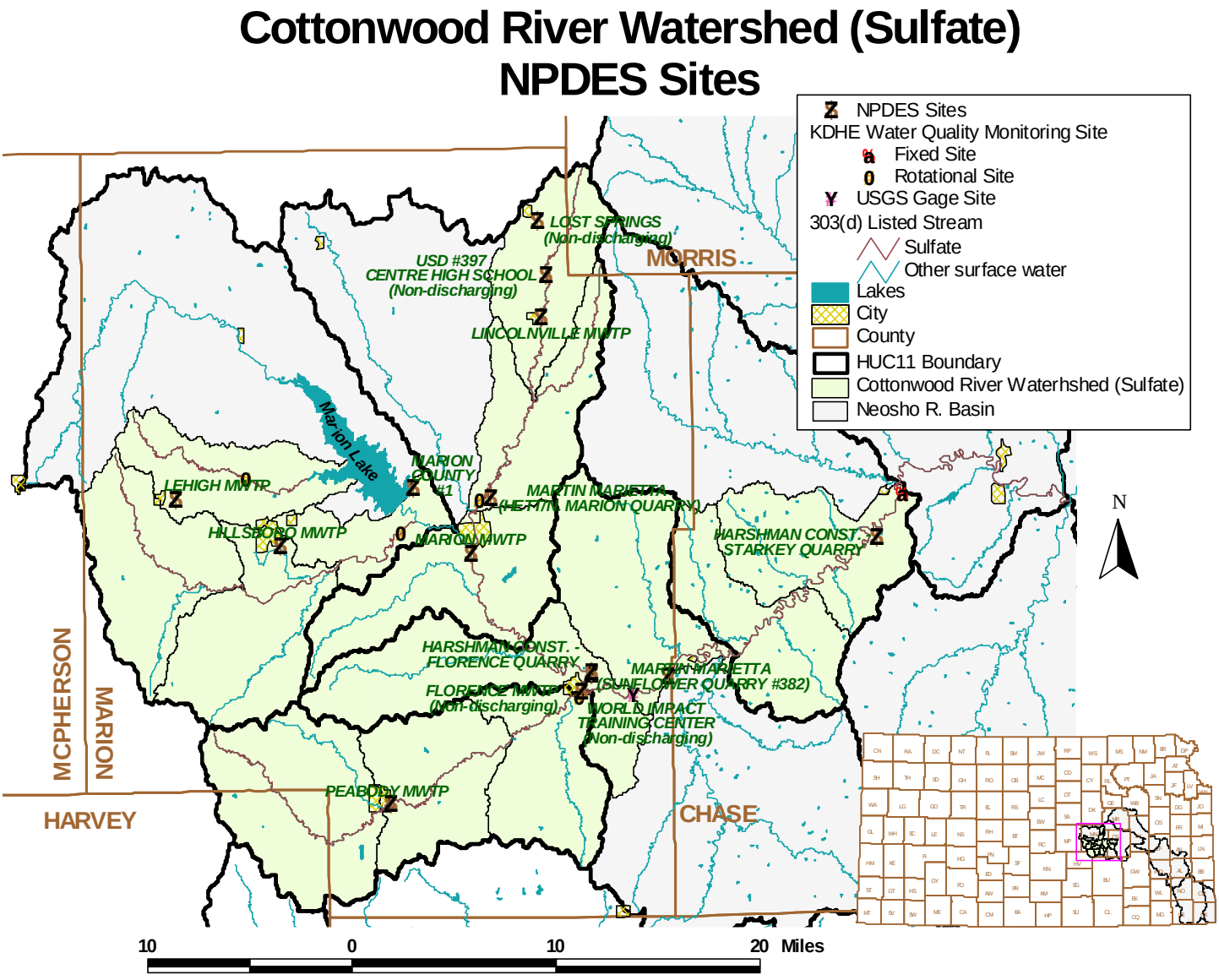

Figure 7

4. ALLOCATION OF POLLUTION REDUCTION RESPONSIBILITY

The source assessment has ascertained that natural sulfate loading within the watershed is

overwhelmingly responsible for the excursions seen at the monitoring sites located within the Cottonwood River watershed. An analysis was made at two of the lowest flow conditions where sulfate levels exceeded 250 mg/l at Elmdale. These two conditions were in March and November of 1991, in the midst of a drought, and representing steady state flow conditions. Estimates of flows at Elmdale were made from recorded flow at the downstream station at Plymouth. Calculations are given in the Appendix. Table 7 shows the relative contributions of loading from point and non-point sources in these conditions and the impact of reducing assumed point source concentrations to 250 mg/l. The analysis indicates very minor impact from imposing controls on the point sources, even at design flows, which will not likely be attained in the next 20 years.

Table 7. Loading Analysis of Cottonwood River at Elmdale at 2 Lowest Sampled Flows

March 91	Actual Flow (cfs)	Conc (mg/l)	Load (T/D)	Flow (cfs)	Conc (mg/l)	Load (T/D)
Elmdale	36	**305**	29.6	36	**303**	29.4
Pt. Sources	**0.9**	325	0.8	0.9	**250**	0.6
Chase Co.	11.1	20	0.6	11.1	20	0.6
Marion Co.	24.0	436	28.2	24.0	436	28.2
Novmber 91	Actual Flow (cfs)	Conc (mg/l)	Load (T/D)	Flow (cfs)	Conc (mg/l)	Load (T/D)
Elmdale	8.6	**280**	6.5	8.6	**273**	6.3
Pt. Sources	**0.9**	325	0.8	0.9	**250**	0.6
Chase Co.	1.5	20	0.1	1.5	20	0.1
Marion Co.	6.2	337	5.6	6.2	337	5.6
March 91	Design Flow (cfs)	Conc (mg/l)	Load (T/D)	Flow (cfs)	Conc (mg/l)	Load (T/D)
Elmdale	37	**305**	30.4	37	**302**	30.1
Pt. Sources	**1.9**	325	1.6	1.9	**250**	1.3
Novmber 91	Design Flow (cfs)	Conc (mg/l)	Load (T/D)	Flow (cfs)	Conc (mg/l)	Load (T/D)
Elmdale	9.6	**285**	7.3	9.6	**270**	7.0
Pt. Sources	**1.9**	325	1.6	1.9	**250**	1.3

Point Sources: The following Wasteload Allocations shall only apply upon initiation of the use of these surface waters for potable supply through a constructed point of diversion.

Cottonwood River at Elmdale: Site 627: Based on an estimated discharge volume from all point sources contributing to site 627 of 1.9 cfs, a Wasteload Allocation of 1.6 tons sulfate per day will be established by this TMDL, assuming an average effluent concentration of 325 mg/l (**Figure 8**). This includes a wasteload allocation of 0.73 tons per day discharged by Marion directly into the Cottonwood River.

Doyle Creek: Site 120: Based on an estimated discharge volume from Peabody contributing to site 120 (0.325 cfs), a Wasteload Allocation of 0.28 tons per day will be established by this TMDL, using an effluent concentration of 325 mg/l. (**Figure 9**).

Clear Creek: Site 690: Based on an estimated discharge volume from Lincolnville contributing to site 690 (0.05 cfs), a WLA of up to 0.04 tons per day will be established by this TMDL, using an effluent concentration of 325 mg/l. (**Figure 10**).

South Cottonwood River: Site 635: Based on an estimated discharge volume from Hillsboro contributing to site 635 (0.65 cfs), a WLA of up to 0.57 tons per day will be established by this TMDL, using an effluent concentration of 325 mg/l. (**Figure 11**).

French Creek: Site 676: Based on an estimated discharge volume from Lehigh contributing to site 676 (0.046 cfs), a WLA of up to 0.04 tons per day will be established by this TMDL using an effluent concentration of 325 mg/l. (**Figure 12**).

Non-Point Sources: The elevated sulfate concentrations predominately stem from background geologic sources underlying Marion County.

Cottonwood River at Elmdale: Site 627: The Load Allocation based on the existing standard of 250 mg/L across all flow conditions is shown in **Figure 8** and is 191.3 tons sulfate per day at median flow (286 cfs).

Doyle Creek: Site 120: The Load Allocation based on the existing standard of 250 mg/L across all flow conditions is shown in **Figure 9** and is 6.7 tons per day at median flow (10.2 cfs). The LA using a background sulfate concentration of 371 mg/L is 9.9 tons per day at median flow for this site.

Clear Creek: Site 690: The Load Allocation based on the existing standard of 250 mg/L across all flow conditions is shown in **Figure 10** and is 3.82 tons per day at median flow (5.7 cfs). The LA using an estimated background sulfate concentration of 288 mg/L is 4.43 tons per day at median flow for this site.

South Cottonwood River: Site 635: The Load Allocation based on the existing standard of 250 mg/L across all flow conditions is shown in **Figure 11** and is 5.23 tons per day at median flow (8.4 cfs). The LA using a background sulfate concentration of 838 mg/L is 17.5 tons per day at median flow for this site.

French Creek: Site 676: The Load Allocation based on the existing standard of 250 mg/L across

all flow conditions is shown in **Figure 12** and is 1.73 tons per day at median flow (2.6 cfs). The LA using a background sulfate concentration of 1,044 mg/L is 7.2 tons per day at median flow for this site.

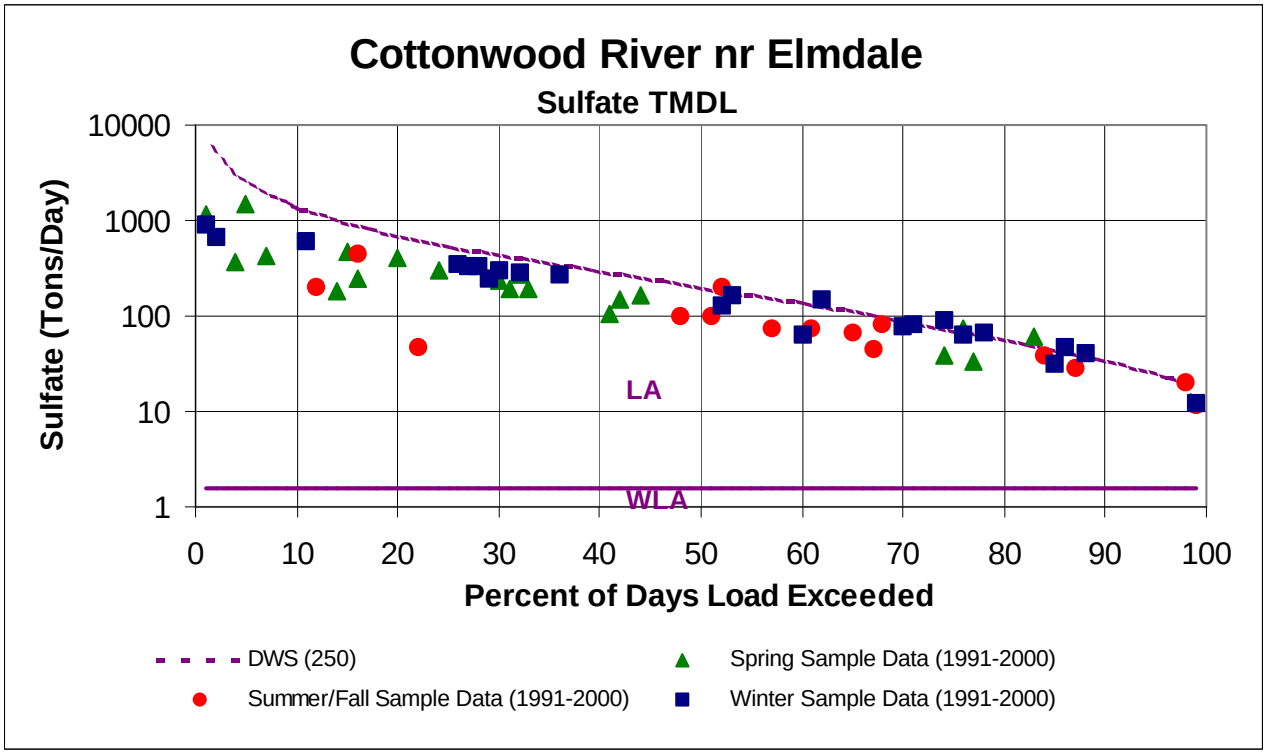

Figure 8

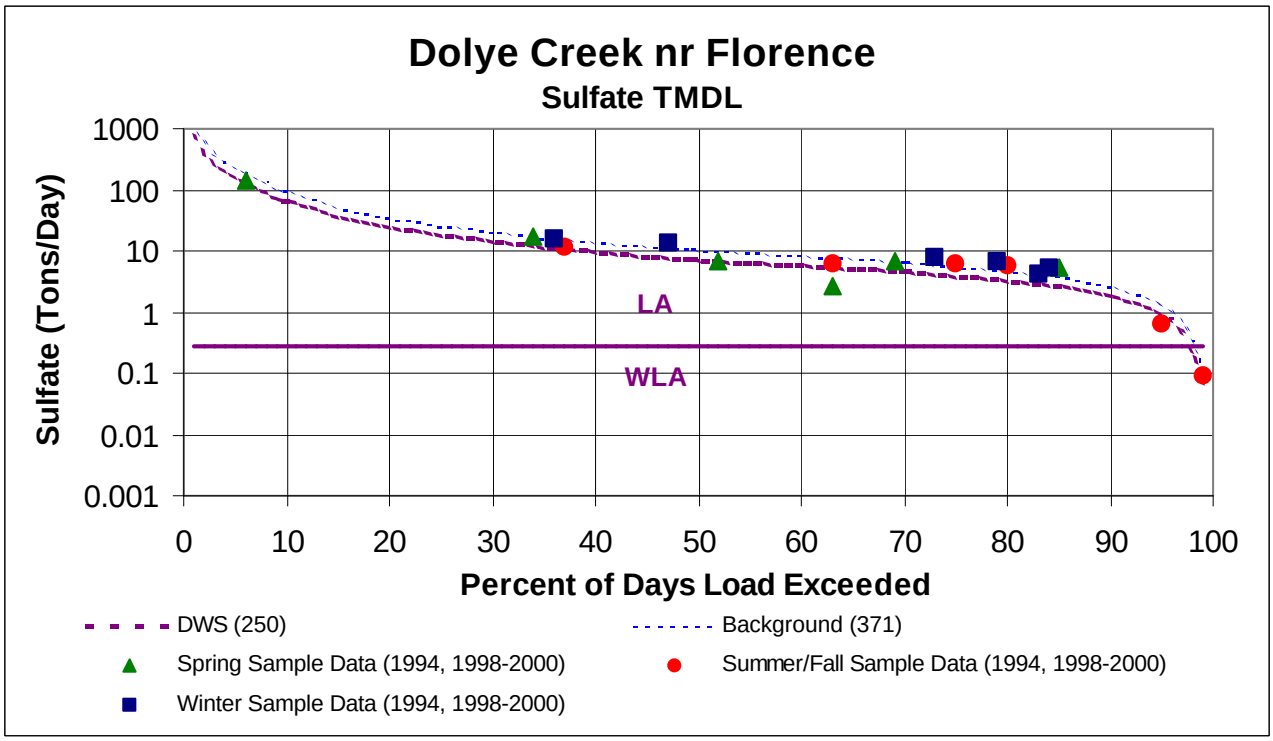

Figure 9

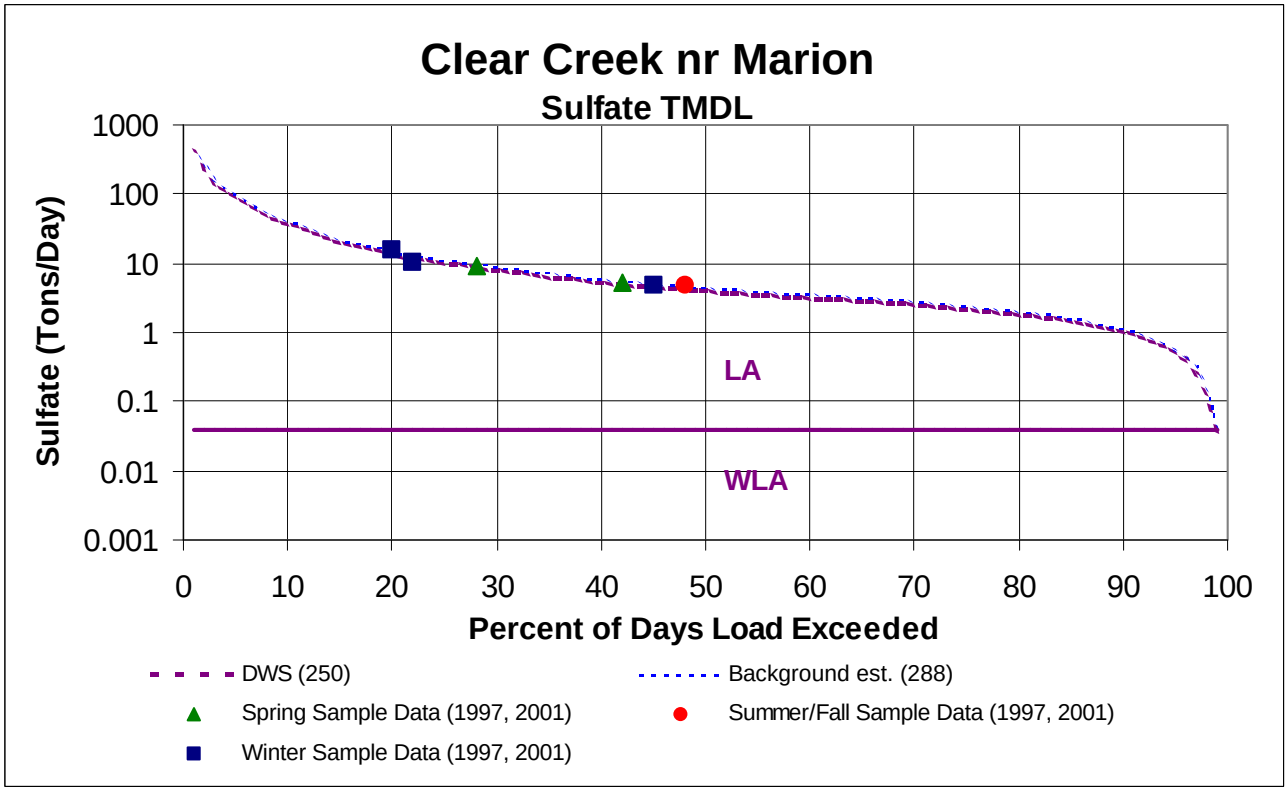

Figure 10

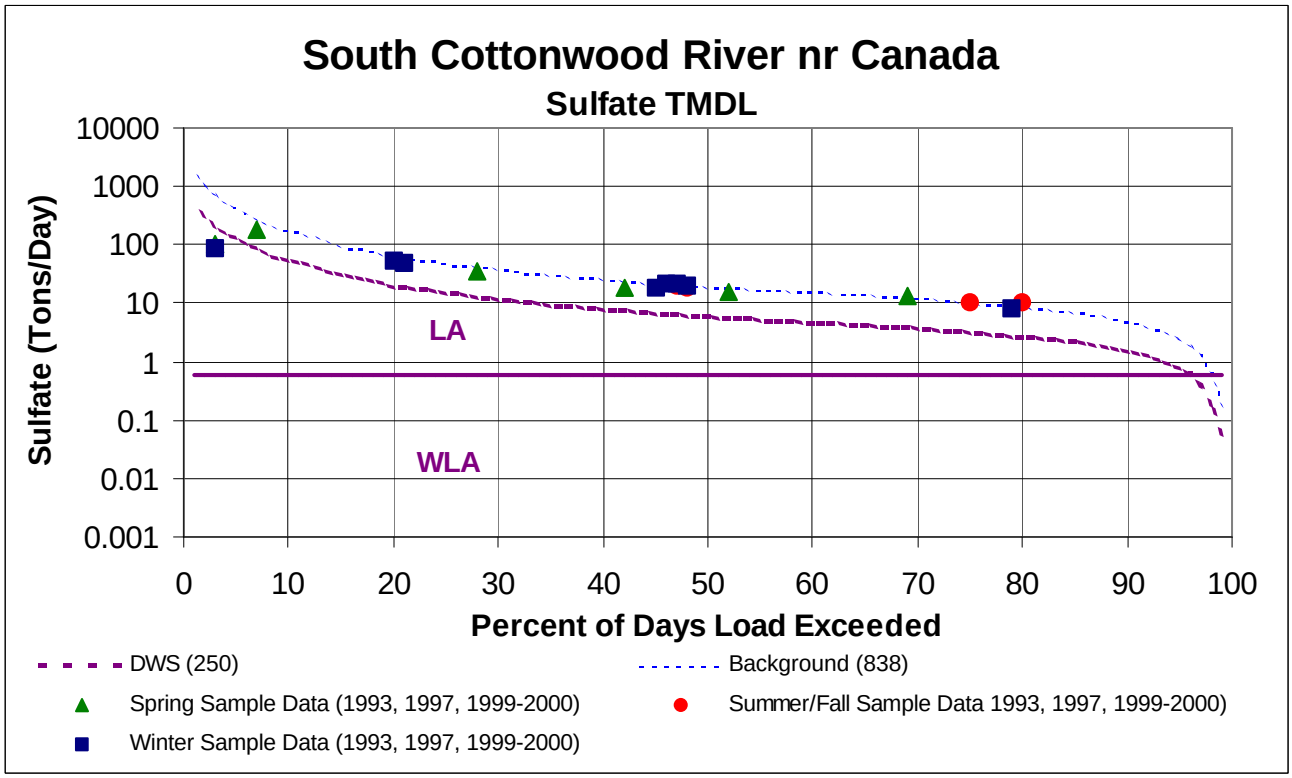

Figure 11

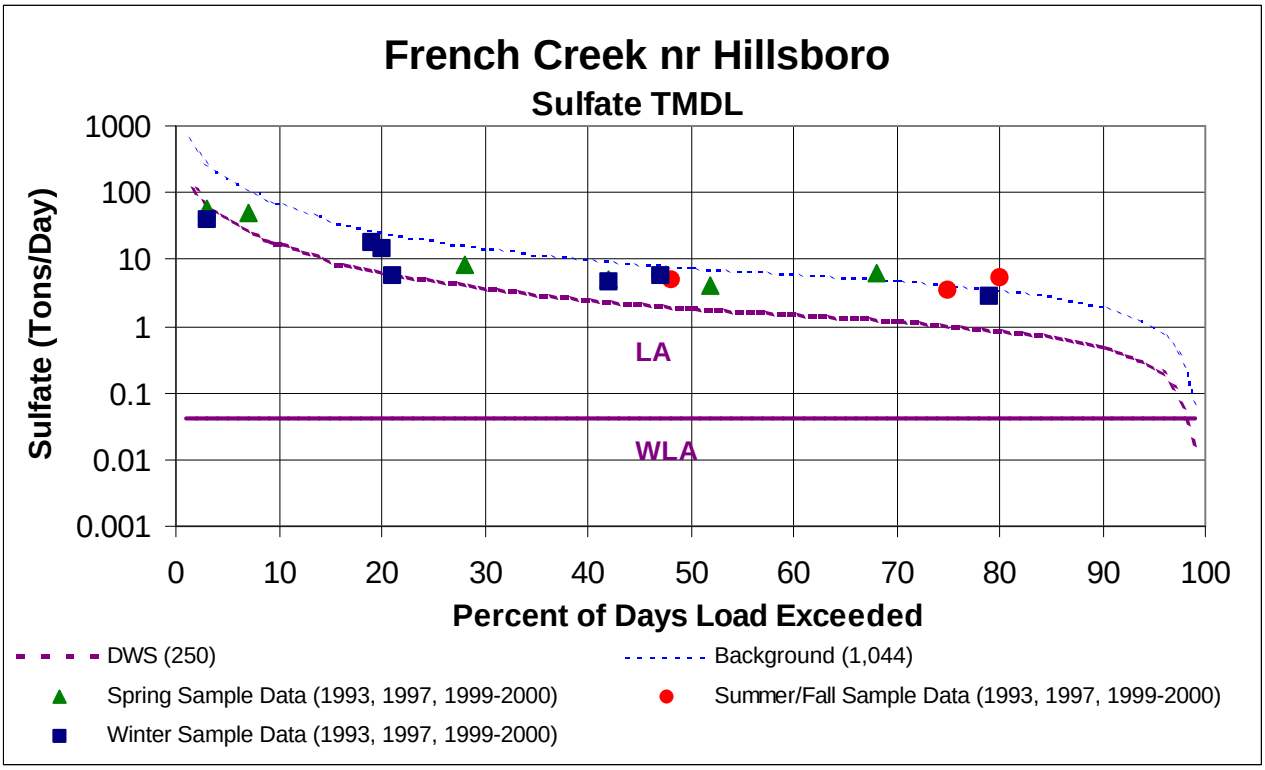

Figure 12

Defined Margin of Safety: The Margin of Safety is established by holding the point sources to their estimated current concentration of sulfate within their effluent. This will have the impact of reducing the sulfate concentration of the current background flows in the tributaries of the Cottonwood River in Marion County. The estimated sulfate concentration in their effluent of 325 mg/l is a conservative estimate based on assumed concentrating the sulfate content of their source water. Furthermore, population projections for the municipal dischargers in Marion County, indicate population declines in all but Lehigh and Hillsboro, indicating the use of design flows is a conservative assumption of potential loading by each of the municipalities. By not allowing effluent concentrations to match background concentrations in the tributaries, this TMDL and its Margin of Safety will ensure that the desired endpoint of maintaining 250 mg/l at Elmdale (Station 627) will be met by the Wasteload Allocations assigned to each of the municipalities.

State Water Plan Implementation Priority: Because it appears this watershed's sulfate load is predominately from natural geologic sources, this TMDL will be a Low Priority for implementation.

Unified Watershed Assessment Priority Ranking: This watershed lies across the Upper Cottonwood Basin (HUC 8: 11070202) with a priority ranking of 36 (Medium Priority for restoration work) and the Lower Cottonwood Basin (HUC 8: 11070203) with a priority ranking of 43 (Medium Priority for restoration work)

Priority HUC 11s and Stream Segments: Because of the natural geologic contribution of this impairment, no priority subwatersheds or stream segments will be identified.

5. IMPLEMENTATION

Desired Implementation Activities

1. Monitor any anthropogenic contributions of sulfate loading to river.
2. Establish alternative background criterion.
3. Assess likelihood of river being used for domestic uses.

Implementation Programs Guidance

NPDES and State Permits - KDHE

a. Municipal and industrial permits for facilities in the watershed will be renewed after 2004 with sulfate monitoring and any appropriate permit limits which protects the domestic water supply criteria at any emerging point of diversion on these streams.

Non-Point Source Pollution Technical Assistance - KDHE

a. Evaluate any potential anthropogenic activities which might contribute sulfate to the river as part of an overall Watershed Restoration and Protection Strategy.

Water Quality Standards and Assessment - KDHE

a. Establish background levels of sulfate for the river and tributaries.

Use Attainability Analysis - KDHE

a. Consult with Division of Water Resources on locating existing or future domestic points of diversion on the Walnut River for drinking water purposes.

Timeframe for Implementation: Development of a background level-based water quality standard should be accomplished with the 2002 water quality standards revision.

Targeted Participants: Primary participants for implementation will be KDHE.

Milestone for 2007: The year 2007 marks the mid-point of the ten year implementation window for the watershed. At that point in time, additional monitoring data from Cottonwood River watershed will be reexamined to confirm the impaired status of the river and the suggested background concentration. Should the case of impairment remain, source assessment, allocation and implementation activities will ensue.

Delivery Agents: The primary delivery agents for program participation will be the Kansas Department of Health and Environment.

Reasonable Assurances:

Authorities: The following authorities may be used to direct activities in the watershed to reduce pollution.

1. K.S.A. 65-164 and 165 empowers the Secretary of KDHE to regulate the discharge of sewage into the waters of the state.

2. K.S.A. 65-171d empowers the Secretary of KDHE to prevent water pollution and to protect the beneficial uses of the waters of the state through required treatment of sewage and established water quality standards and to require permits by persons having a potential to discharge pollutants into the waters of the state.

3. K.S.A. 82a-901, et seq. empowers the Kansas Water Office to develop a state water plan directing the protection and maintenance of surface water quality for the waters of the state.

4. K.S.A. 82a-951 creates the State Water Plan Fund to finance the implementation of the *Kansas Water Plan.*

5. The *Kansas Water Plan* and the Lower Arkansas Basin Plan provide the guidance to state agencies to coordinate programs intent on protecting water quality and to target those programs to geographic areas of the state for high priority in implementation.

Funding: The State Water Plan Fund, annually generates $16-18 million and is the primary funding mechanism for implementing water quality protection and pollution reduction activities in the state through the *Kansas Water Plan*. The state water planning process, overseen by the Kansas Water Office, coordinates and directs programs and funding toward watersheds and water resources of highest priority. Typically, the state allocates at least 50% of the fund to programs supporting water quality protection. This watershed and its TMDL are a Low Priority consideration and should not receive funding.

Effectiveness: Minimal control can be exerted on natural contributions to loading.

6. MONITORING

KDHE will continue to collect bimonthly samples at Station 627 and rotational data every four years at Stations 120, 690, 635 and 676, including sulfate samples, in each of the three defined seasons. Based on that sampling, the priority status will be evaluated in 2006 including application of numeric criterion based on background concentrations. Should impaired status remain, the desired endpoints under this TMDL will be refined and direct more intensive sampling will need to be conducted under specified seasonal flow conditions over the period 2007-2011.

Monitoring of sulfate levels in effluent will be a condition of NPDES and state permits for facilities. This monitoring will continually assess the functionality of the systems in reducing sulfate levels in the effluent released to the streams.

7. FEEDBACK

Public Meetings: Public meetings to discuss TMDLs in the Neosho Basin were held January 9, 2002 in Burlington and March 4, 2002 in Council Grove. An active Internet Web site was established at http://www.kdhe.state.ks.us/tmdl/ to convey information to the public on the general establishment of TMDLs and specific TMDLs for the Neosho Basin.

Public Hearing: Public Hearings on the TMDLs of the Neosho Basin were held in Burlington and Parsons on June 3, 2002.

Basin Advisory Committee: The Neosho Basin Advisory Committee met to discuss the TMDLs in the basin on October 2, 2001, January 9 and March 4, 2002.

Milestone Evaluation: In 2007, evaluation will be made as to the degree of implementation which has occurred within the watershed and current condition of the Cottonwood River watershed. Subsequent decisions will be made regarding the implementation approach and follow up of additional implementation in the watershed.

Consideration for 303(d) Delisting: The creek will be evaluated for delisting under Section 303(d), based on the monitoring data over the period 2007-2011. Therefore, the decision for delisting will come about in the preparation of the 2012 303(d) list. Should modifications be made to the applicable water quality criteria during the ten year implementation period, consideration for delisting, desired endpoints of this TMDL and implementation activities may be adjusted accordingly.

Incorporation into Continuing Planning Process, Water Quality Management Plan and the Kansas Water Planning Process: Under the current version of the Continuing Planning Process, the next anticipated revision will come in 2003 which will emphasize implementation of TMDLs. At that time, incorporation of this TMDL will be made into both documents. Recommendations of this TMDL will be considered in *Kansas Water Plan* implementation decisions under the State Water Planning Process for Fiscal Years 2003-2007.

Appendix: Load Analysis of Upper Cottonwood River during 1991, when exceedance over 250 mg/l SO4 were seen at Elmdale and flows were at their lowest level.

calibration to actual flows and concentrations

	march 6, 1991				November 13, 1991		
source	flow (cfs)	so4	mass	source	flow (cfs)	so4	mass
wla	0.9	325	0.78975	wla	0.9	325	0.78975
cedar crk	11.1	20	0.5994	cedar crk	1.5	20	0.081
mar trib	24	436	28.2528	mar trib	6.2	337	5.64138
elmdale	36	304.9583	29.64195	elmdale	8.6	280.4535	6.51213
	36	305			8.6	280	

estimated flow at elmdale based on Plymouth flow and concentration

elmdale	36	305	elmdale	8.6	280
chase trib	17	20	chase trib	7.4	20
plymouth	53	213.5849	plymouth	16	159.75

point source controls

	march 6, 1991				November 13, 1991		
source	flow (cfs)	so4	mass	source	flow (cfs)	so4	mass
wla	0.9	250	0.6075	wla	0.9	250	0.6075
cedar crk	11.1	20	0.5994	cedar crk	1.5	20	0.081
mar trib	24	436	28.2528	mar trib	6.2	337	5.64138
elmdale	36	303.0833	29.4597	elmdale	8.6	272.6047	6.32988
	36	305			8.6	280	

nonreduced design flow

	march 6, 1991				November 13, 1991		
source	flow (cfs)	so4	mass	source	flow (cfs)	so4	mass
wla	1.86	325	1.63215	wla	1.86	325	1.63215
cedar crk	11.1	20	0.5994	cedar crk	1.5	20	0.081
mar trib	24	436	28.2528	mar trib	6.2	337	5.64138
elmdale	36.96	305.4789	30.48435	elmdale	9.56	284.9268	7.35453
	36	305			8.6	280	

reduced design flow

	march 6, 1991				November 13, 1991		
source	flow (cfs)	so4	mass	source	flow (cfs)	so4	mass
wla	1.86	250	1.2555	wla	1.86	250	1.2555
cedar crk	11.1	20	0.5994	cedar crk	1.5	20	0.081
mar trib	24	436	28.2528	mar trib	6.2	337	5.64138
elmdale	36.96	301.7045	30.1077	elmdale	9.56	270.3347	6.97788
	36	305			8.6	280	