TOTAL SUSPENDED SOLIDS TOTAL MAXIMUM DAILY LOAD FOR THE BIG SIOUX RIVER MINNEHAHA COUNTY, SOUTH DAKOTA

Topical Report RSI-2182

prepared for

South Dakota Department of Environment
and Natural Resources
523 East Capitol
Joe Foss Building
Pierre, South Dakota 57501

September 2012

RESPEC
CONSULTING & SERVICES

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by

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Total Maximum Daily Load Summary	
Waterbody Name/Description	Big Sioux River (S2, T104N, R49W to I-90)
Assessment Unit I.D.	SD-BS-R-BIG_SIOUX_08
Waterbody Type	River
Size of Impaired Waterbody	28.5 miles (45.8 kilometers)
Size of Watershed (Incremental)	79.0 square miles (204.7 square kilometers)
Location	12-digit Hydrologic Unit Code (HUC): 101702030604, 101702030605, and 101702031201
Impaired Designated Use(s)	Warm-Water Semipermanent Fish Life
303(d) Listing Parameter	Total Suspended Solids
Cycle Most Recently Listed	2010 South Dakota Integrated Report
TMDL Priority Ranking	1
Total Maximum Daily Load Criteria Threshold Values	Indicator Name: Total Suspended Solids Threshold Values: Maximum daily concentration of ≤158 milligrams per liter (mg/L) and a 30-day average of at least three consecutive grab or composite samples taken on separate weeks in a 30-day period of ≤90 mg/L.
Analytical Approach	Load duration curves and HSPF modeling
High Flow Zone LA	756.4 tons/day
High Flow Zone PS WLA	2.2 tons/day
High Flow Zone MS4 WLA	0 tons/day
High Flow Zone MOS	121.5 tons/day
High Flow Zone TMDL	880.1 tons/day

Total Maximum Daily Load Summary	
Waterbody Name/Description	Big Sioux River (I-90 to diversion return)
Assessment Unit I.D.	SD-BS-R-BIG_SIOUX_10
Waterbody Type	River
Size of Impaired Waterbody	15.8 miles (25.4 kilometers)
Size of Watershed (Incremental)	40.9 square miles (106.0 square kilometers)
Location	12-Digit Hydrologic Unit Code (HUC): 101702031203
Impaired Designated Use(s)	Warm-Water Semipermanent Fish Life
303(d) Listing Parameter	Total Suspended Solids
Cycle Most Recently Listed	2010 South Dakota Integrated Report
TMDL Priority Ranking	1
Total Maximum Daily Load Criteria Threshold Values	Indicator Name: Total Suspended Solids Threshold Values: Maximum daily concentration of ≤158 milligrams per liter (mg/L) and a 30-day average of at least three consecutive grab or composite samples taken on separate weeks in a 30-day period of ≤90 mg/L.
Analytical Approach	Load duration curves and HSPF modeling
High Flow Zone LA	170.3 tons/day
High Flow Zone PS WLA	0 tons/day
High Flow Zone MS4 WLA	16.9 tons/day
High Flow Zone MOS	39.3 tons/day
High Flow Zone TMDL	226.5 tons/day

Total Maximum Daily Load Summary	
Waterbody Name/Description	Big Sioux River (Diversion return to Sioux Falls Wastewater Treatment Plant)
Assessment Unit I.D.	SD-BS-R-BIG_SIOUX_11
Waterbody Type	River
Size of Impaired Waterbody	4.7 miles (7.5 kilometers)
Size of Watershed (Incremental)	49.0 square miles (127.0 square kilometers)
Location	12-digit Hydrologic Unit Code (HUC): 101702031705
Impaired Designated Use(s)	Warm-Water Semipermanent Fish Life
303(d) Listing Parameter	Total Suspended Solids
Cycle Most Recently Listed	2010 South Dakota Integrated Report
TMDL Priority Ranking	1
Total Maximum Daily Load Criteria Threshold Values	Indicator Name: Total Suspended Solids Threshold Values: Maximum daily concentration of ≤158 milligrams per liter (mg/L) and a 30-day average of at least three consecutive grab or composite samples taken on separate weeks in a 30-day period of ≤90 mg/L.
Analytical Approach	Load duration curves and HSPF modeling
High Flow Zone LA	891.5 tons/day
High Flow Zone PS WLA	0.6 tons/day
High Flow Zone MS4 WLA	37.1 tons/day
High Flow Zone MOS	200.1 tons/day
High Flow Zone TMDL	1,129.3 tons/day

Total Maximum Daily Load Summary	
Waterbody Name/Description	Big Sioux River (Sioux Falls Wastewater Treatment Plant to above Brandon)
Assessment Unit I.D.	SD-BS-R-BIG_SIOUX_12
Waterbody Type	River
Size of Impaired Waterbody	4.2 miles (6.8 kilometers)
Size of Watershed (Incremental)	45.3 square miles (117.4 square kilometers)
Location	12-digit Hydrologic Unit Code (HUC): 101702031705
Impaired Designated Use(s)	Warm-Water Semipermanent Fish Life
303(d) Listing Parameter	Total Suspended Solids
Cycle Most Recently Listed	2010 South Dakota Integrated Report
TMDL Priority Ranking	1
Total Maximum Daily Load Criteria Threshold Values	Indicator Name: Total Suspended Solids Threshold Values: Maximum daily concentration of ≤158 milligrams per liter (mg/L) and a 30-day average of at least three consecutive grab or composite samples taken on separate weeks in a 30-day period of ≤90 mg/L.
Analytical Approach	Load duration curves and HSPF modeling
High Flow Zone LA	944.1 tons/day
High Flow Zone PS WLA	3.6 tons/day
High Flow Zone MS4 WLA	0 tons/day
High Flow Zone MOS	208.4 tons/day
High Flow Zone TMDL	1156.1 tons/day

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1.0 INTRODUCTION

The intent of this document is to clearly identify the components of a Total Maximum Daily Load (TMDL), support adequate public participation, and facilitate the U.S. Environmental Protection Agency (EPA) review. The TMDL was developed in accordance with Section 303(d) of the federal Clean Water Act and guidance developed by the EPA. This TMDL document addresses total suspended solids (TSS) impairments on the reaches (SD-BS-R-BIG_SIOUX_08 [Reach 08], SD-BS-R-BIG_SIOUX_10 [Reach 10], SD-BS-R-BIG_SIOUX_11 [Reach 11], SD-BS-R-BIG_SIOUX_12 [Reach 12]) located in the Big Sioux River within the Lower Big Sioux River Watershed local to the city of Sioux Falls. These reaches were assigned to priority category 1 (high priority) in the 2010 Impaired Waterbodies List [South Dakota Department of Environment and Natural Resources, 2010]. From the 2008 to the 2010 cycle, South Dakota Department of Environment and Natural Resources (SD DENR) integrated SD-BS-R-BIG_SIOUX_09 (Reach 09) into the upstream and downstream reaches because of differences in beneficial use designations and TMDL development. None of the newly listed reaches were listed as impaired for TSS in the 2008 Impaired Waterbodies List [South Dakota Department of Environment and Natural Resources, 2008].

1.1 WATERSHED CHARACTERISTICS

The Lower Big Sioux River Watershed is located in eastern South Dakota and drains approximately 2,195 square miles in South Dakota and an additional 1,120 square miles in Minnesota and Iowa. The Sioux Falls TMDL Assessment project area lies within the Lower Big Sioux River Watershed, which includes the city of Sioux Falls, the state's largest city. The project area drains approximately 214 square miles within the state of South Dakota.

Figure 1-1 shows the impaired (Section 303(d) listed) reaches on the Lower Big Sioux River that are located within the project area [South Dakota Department of Environment and Natural Resources, 2010]. Reach 08 begins near Dell Rapids at the Moody/Minnehaha county line and ends at Interstate-90 (I-90). Before this assessment, the location of Reach 08 was defined as being from near Dell Rapids to below Baltic. During this assessment, Reach 08 was expanded to include the portion of Reach 09 above the diversion split or at I-90. The remainder of Reach 09below the diversion to Skunk Creek was incorporated into Reach 10. Reach 10 begins at I-90 and ends at the diversion return. Reach 11 begins at the diversion return and ends at the Sioux Falls Wastewater Treatment Plant (WWTP), and Reach 12 begins at the Sioux Falls WWTP and ends above Brandon, South Dakota. The Big Sioux River upstream of the project area and Skunk Creek are both project area influences. Skunk Creek currently has a warm-water marginal fish life beneficial use as opposed to the more stringent warm-water semipermanent fish life use of the project area. These TMDLs represent the contiguous Reach 08 through Reach 12.

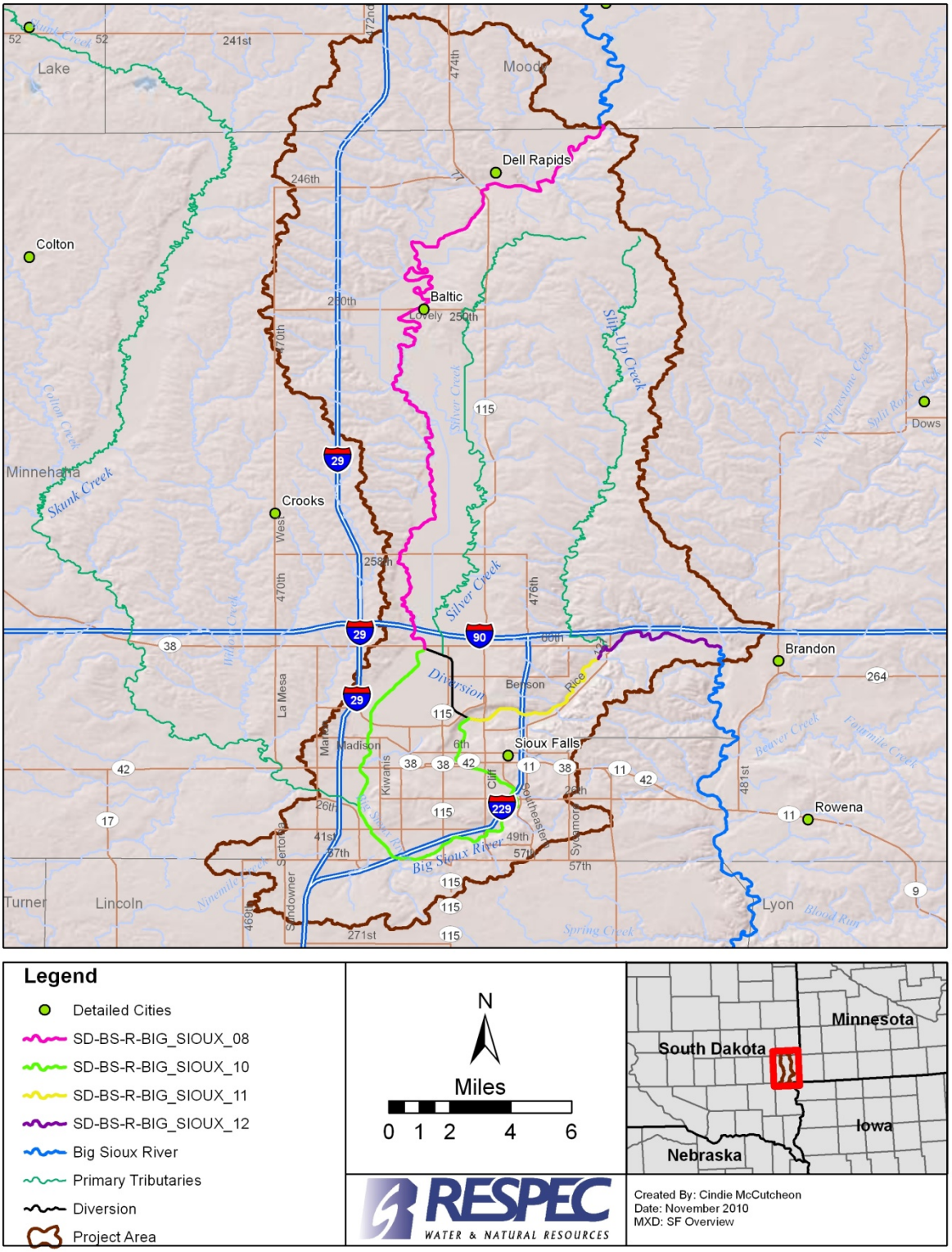

Figure 1-1. Project Area Watershed and Total Suspended Solids Impaired Reaches.

The Sioux Falls project area receives 73 percent of its average annual precipitation—24.7 inches—during the growing season of April through September [South Dakota State University, 2008]. The South Dakota precipitation normals and the Sioux Falls project area location (red box) is shown in Figure 1-2. Local storms with short durations often produce heavy rainfall events. These storms can elevate to severe thunderstorms and occasionally produce tornados. The average seasonal snowfall is 41.1 inches per year [U.S. Department of Commerce National Climatic Data Center, 2004]. Watershed land use is predominantly cropland and pasture. A complete list of watershed land uses and percent areas is provided in Table 1-1.

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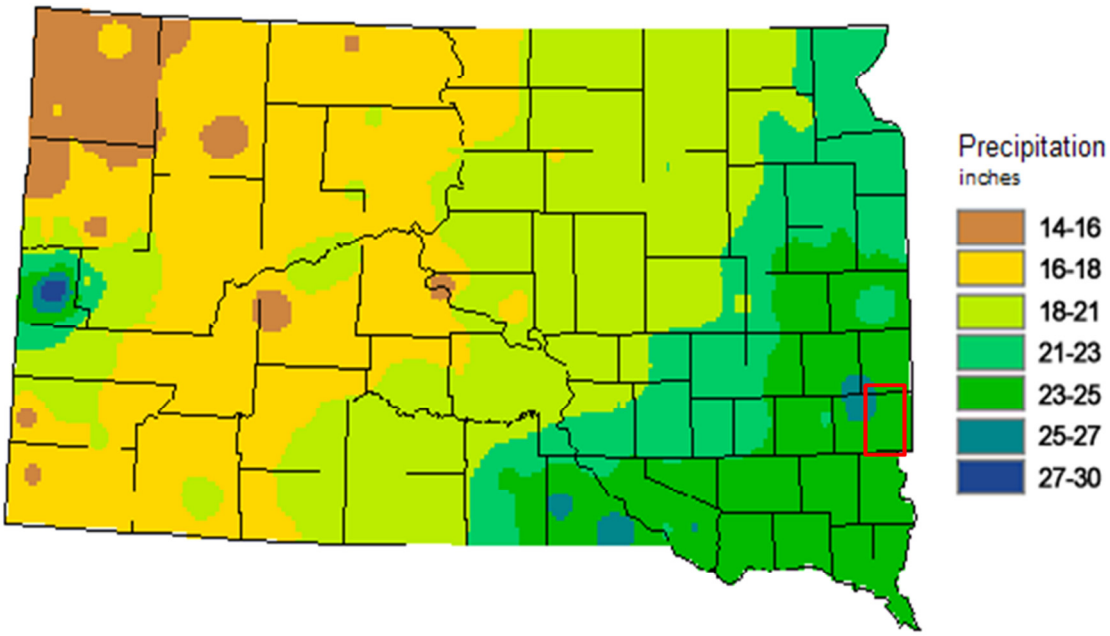


Figure 1-2. South Dakota Precipitation Normals for 1971–2002 [South Dakota State University, 2008].

1.2 CLEAN WATER ACT SECTION 303(D) LISTING INFORMATION

Four Big Sioux River reaches (08, 10, 11, and 12) within the project area were listed as impaired in South Dakota's 2010 303(d) list [South Dakota Department of Environment and Natural Resources, 2010] because of sample concentrations of TSS that exceeded the chronic criterion for protecting warm-water, semipermanent fish life propagation. The Big Sioux River reaches within the Sioux Falls project area were not listed as impaired in South Dakota before 2010 [South Dakota Department of Environment and Natural Resources, 2010].

Table 1-1. Land Use at Total Maximum Daily Load Reach Endpoints

Land Use	Reach 08 Land Use Drainage Area (mi^2)	Percent at TMDL Reach 08 Endpoint[a]	Reach 10 Land Use Drainage Area (mi^2)	Percent at TMDL Reach 10 Endpoint[a]	Reach 11 Land Use Drainage Area (mi^2)	Percent at TMDL Reach 11 Endpoint[a]	Reach 12 Land Use Drainage Area (mi^2)	Percent at TMDL Reach 12 Endpoint[a]
Cultivated Crops	1,668.7	61.1	2,053.9	61.2	2,075.7	61.0	2,099.4	61.0
Pasture/Hay	794.7	29.1	949.7	28.3	959.6	28.2	974.0	28.3
Developed, Open Space	–	0.0	–	0.0	–	0.0	–	0.0
Developed, Low Intensity	10.9	0.4	26.8	0.8	30.6	0.9	31.0	0.9
Developed, Medium Intensity	2.7	0.1	3.4	0.1	3.4	0.1	3.4	0.1
Grassland/Herbaceous	16.4	0.6	16.8	0.5	17.0	0.5	17.2	0.5
Deciduous Forest	54.6	2.0	60.4	1.8	61.3	1.8	62.0	1.8
Developed, High Intensity	10.9	0.4	20.1	0.6	23.8	0.7	24.1	0.7
Emergent Herbaceous Wetlands	95.6	3.5	117.5	3.5	115.7	3.4	117.0	3.4
Open Water	71.0	2.6	94.0	2.8	95.3	2.8	96.4	2.8
Barren Land	–	0.0	–	0.0	–	0.0	–	0.0
Woody Wetlands	–	0.0	3.4	0.1	3.4	0.1	3.4	0.1
Shrub/Scrub	5.5	0.2	10.1	0.3	10.2	0.3	10.3	0.3
Evergreen Forest	–	0.0	–	0.0	–	0.0	–	0.0
Total Drainage Area (mi^2)	**2,731.1**		**3,356.0**		**3,396**		**3,438.2**	

(a) See Figure 1-1; National Land Cover Data 2002 (Total Project Area = 214 mi^2).

1.3 AVAILABLE WATER-QUALITY AND WATER-QUANTITY DATA

The SD DENR and the United States Geological Service (USGS) TSS data were used from multiple sites within the project area dating back only to 2000. Earlier data were excluded because of the expansion of the city of Sioux Falls boundaries and the significant amount of data available after 2000. For the purposes of this TMDL summary, data were used from the stations listed in Table 1-2. Figure 1-3 shows the monitoring stations within the project area. Table 1-3 contains data collected from each project site (2000 to 2009) that was used to calculate the percent exceedance of the daily maximum, the 30-day average TSS criterion, and the TSS concentration ranges. All data, including Sioux Falls National Pollutant Discharge Elimination System (NPDES) data, were used in the watershed model development.

Table 1-2. Water-Quality Stations Total Suspended Solids Data Available in the Sioux Falls Project Area of the Lower Big Sioux River Watershed

Observed TSS Monitoring Stations	Site I.D.	Reach	Data Used	Number of Samples
Big Sioux River Minnehaha Co. line to below Baltic[(a)]	BSR010	SD-BS-R-BIG_SIOUX_08	01/25/2000-12/21/2009	133
Big Sioux River I-90 Bridge upstream of Sioux Falls	BSR020	SD-BS-R-BIG_SIOUX_08	01/31/2000-12/21/2009	473
Big Sioux River at Silver Creek[(a)]	BSR030	SD-BS-R-BIG_SIOUX_10	07/11/2000-10/09/2001	15
Big Sioux River at I-229 Bridge	BSR050	SD-BS-R-BIG_SIOUX_10	03/03/2009-10/27/2009	38
Big Sioux River near South Western Ave. Bridge at Sioux Falls	BSR060	SD-BS-R-BIG_SIOUX_10	01/31/2000-12/16/2009	154
Big Sioux River from Skunk Creek to diversion return	BSR070	SD-BS-R-BIG_SIOUX_10	07/11/2000-10/27/2009	52
Big Sioux River at North Cliff at Sioux Falls	BSR080	SD-BS-R-BIG_SIOUX_11	01/05/2000-12/16/2009	542
Big Sioux River at Bahnson Ave. Bridge	BSR090	SD-BS-R-BIG_SIOUX_11	01/05/2000-12/21/2009	576
Big Sioux River at bridge downstream of Slip-Up Creek	BSR100	SD-BS-R-BIG_SIOUX_12	01/31/2000-12/15/2009	174
Big Sioux River near Brandon[(a)]	BSR110	SD-BS-R-BIG_SIOUX_12	06/12/2000-10/20/2009	133

(a) Not used in the development of TMDL-observed tables.

Additional monitoring was completed in 2009 on three key tributaries (Skunk Creek, Slip-Up Creek, and Silver Creek); on the diversion canal, which sends flow around the Sioux Falls area; and at multiple sites along the Big Sioux River. A list of these sites is included in Table 1-4. This additional monitoring increased the understanding of the flows and associated TSS concentrations throughout the watershed and the flow being diverted around the city of Sioux Falls. The location of these sites is shown in Figure 1-4.

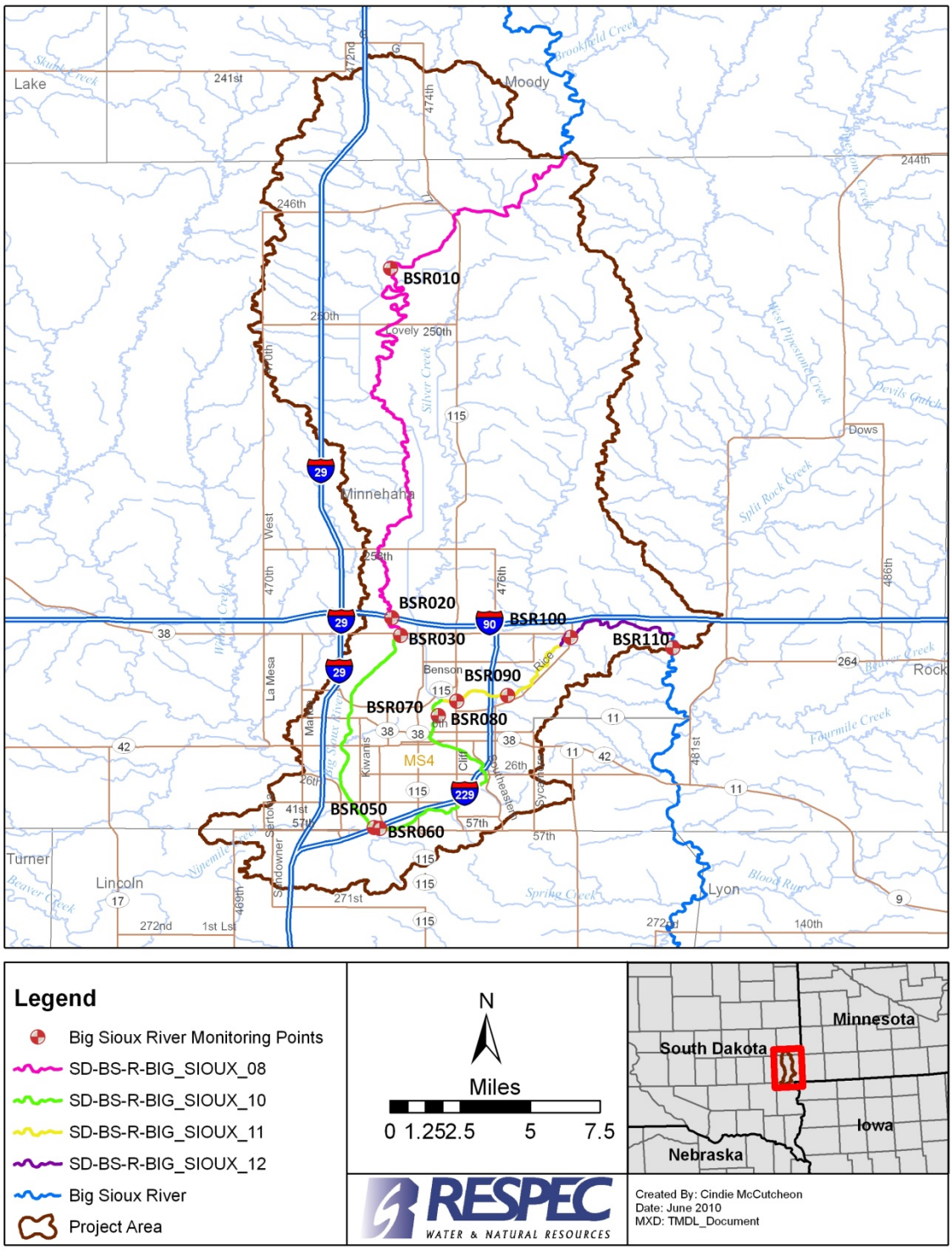


Figure 1-3. Monitoring Stations Within the Sioux Falls Project Area of the Lower Big Sioux River Watershed.

Table 1-3. Percent Exceedance of Total Suspended Solids Concentration Criteria and Ranges for Project Sites Within the Sioux Falls Project Area of the Lower Big Sioux River Watershed

Monitoring Stations	Site I.D.	Total Number of Samples	Daily Maximum Exceedances	Daily Maximum Percent Exceedance	Daily Maximum Concentration Range (158 mL)	30-Day Average Values[a]	30-Day Average Exceedances[a]	30-Day Average Percent Exceedance[a]	30-Day Average Concentration Range (mg/L)
Big Sioux River Minnehaha Co. line to below Baltic	BSR010	133	3	2%	3–474	17	11	65%	47.3–192.3
Big Sioux River I-90 Bridge upstream of Sioux Falls	BSR020	473	18	4%	3–450	741	187	25%	8.3–191.1
Big Sioux River at Silver Creek	BSR030	45	5	11%	8–703	2	2	100%	140.0–177
Big Sioux River at I-229 Bridge	BSR050	38	4	11%	5–595	62	14	23%	43.8–335.7
Big Sioux River near South Western Ave. Bridge at Sioux Falls	BSR060	154	8	5%	1–595	46	28	61%	40.9–270.8
Big Sioux River from Skunk Creek to diversion return	BSR070	52	7	13%	4–930	65	27	42%	14.3–390.7
Big Sioux River at North Cliff at Sioux Falls	BSR080	542	21	4%	1.9–772	904	140	15%	4.3–246.0
Big Sioux River at Bahnson Ave. Bridge	BSR090	576	33	6%	2.8–1116	965	165	17%	5.1–333.6
Big Sioux River at bridge downstream of Slip-Up Creek	BSR100	174	18	10%	4–710	98	52	53%	29.5–329.5
Big Sioux River near Brandon	BSR110	133	3	2%	19–1264	17	11	65%	174.0 - 246.7

(a) The running 30-day average concentration is calculated for each 30-day window. South Dakota criteria require a minimum of three consecutive grab or composite samples taken on separate weeks in a 30-day period for the 30-day average calculation.

Table 1-4. 2009 Mainstem and Large Tributary Monitoring Site List With Descriptions

Site I.D.	Name	Big Sioux River TMDL Reach	Type of Sampling
BSR020	Big Sioux River I-90 Bridge upstream of Sioux Falls	SD-BS-R-BIG_SIOUX_08	ISCO, Grab, Stage height
DIV010	Diversion Weir	N/A	Stage height
SKC030	Skunk Creek at Marion Road Bridge at Sioux Falls	N/A	ISCO, Grab, Stage height
BSR060	Big Sioux River near South Western Avenue Bridge at Sioux Falls	SD-BS-R-BIG_SIOUX_10	ISCO, Grab, Stage height
BSR070	Big Sioux River from Skunk Creek to diversion return	SD-BS-R-BIG_SIOUX_10	Grab
SVC010	Silver Creek 259 Street Bridge	N/A	ISCO, Grab
BSR080	Big Sioux River at North Cliff at Sioux Falls	SD-BS-R-BIG_SIOUX_11	ISCO, Grab, Stage height
SUC020	Slip-Up Creek upstream of Confluence with Big Sioux	N/A	ISCO, Grab, Stage height
BSR110	Big Sioux River near Brandon	SD-BS-R-BIG_SIOUX_12	ISCO, Grab, Stage height

Because the stormwater discharges that are regulated by the NPDES must be addressed by the municipal separate storm sewer system (MS4) portion of the wasteload allocation (WLA) component of this TMDL, additional urban stormwater monitoring was completed in 2009 within the storm drainage network for the Sioux Falls project area. A list of these sites is provided in Table 1-5 and the site locations are shown in Figure 1-5. Sample types occurring at each site, including integrated TSS samples, grab TSS samples, and stage-height measurements for flow, are also shown in Tables 1-4 and 1-5.

RESPEC grab sample data obtained during the 2009 monitoring effort (not including replicates) were used to create boxplots which show the range of TSS concentrations (mg/L) at each site during multiple flow conditions. Three boxplots are included from mainstem and large tributary sites. Figure 1-6 is a boxplot illustrating the base flow and storm flow combined, Figure 1-7 illustrates the base flow, and Figure 1-8 illustrates the storm flow. Three boxplots are also included from the stormwater sites. The base flow and storm flow combined are illustrated in Figure 1-9. The base flow is provided in Figure 1-10, and the storm flow is provided in Figure 1-11. Note that stormwater sites do not have a set TSS criteria.

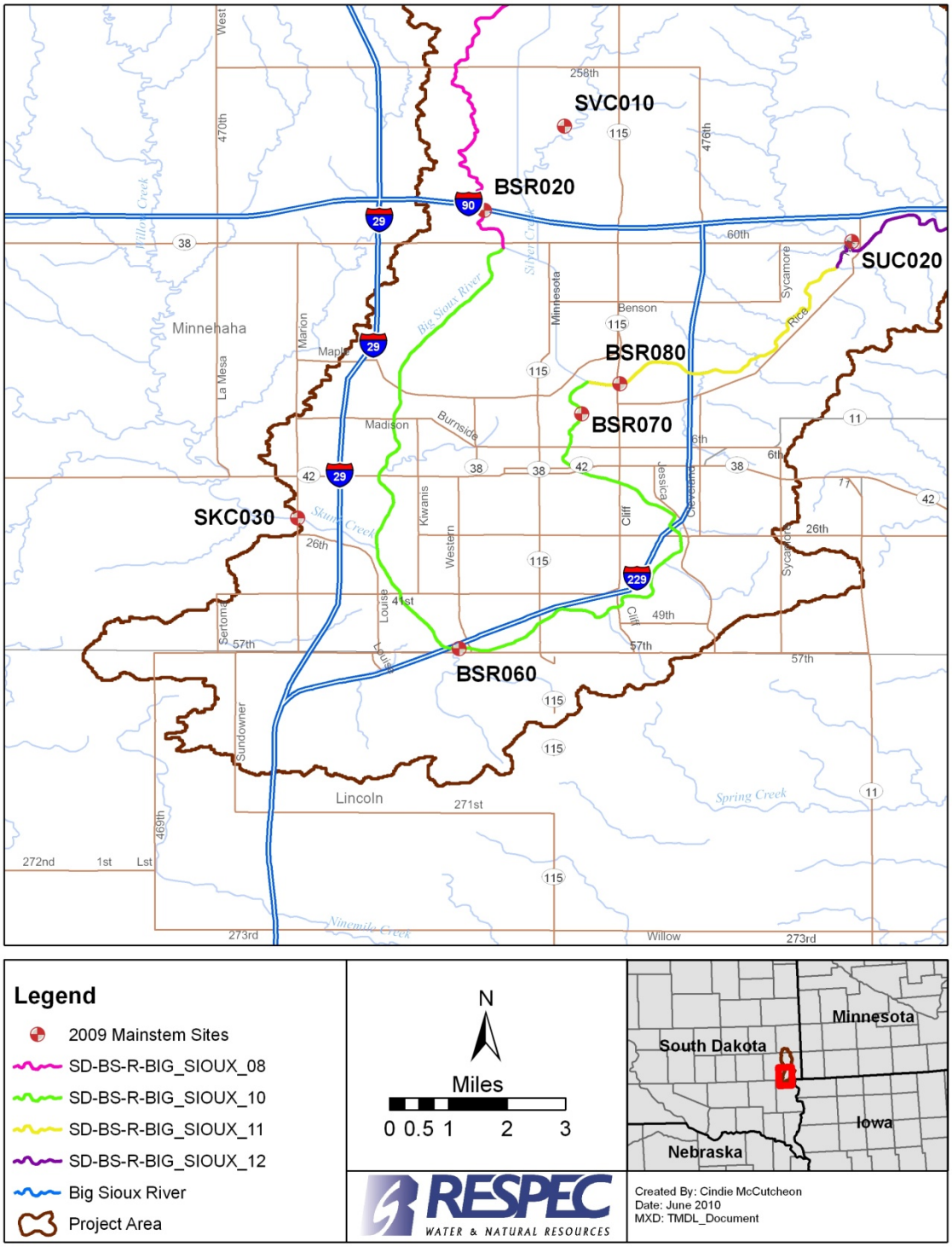


Figure 1-4. 2009 Mainstem and Large Tributary Monitoring Sites Within the Sioux Falls Project Area.

Table 1-5. 2009 Stormwater Monitoring Site List With Descriptions

Site I.D.	Name	Type of Sampling
STW010	Storm Drain near the Zoo	Grab
STW030	Urban Stream Channel near S. Dunham Circle	ISCO, Grab, Stage height
STW040	Stormwater Channel near W. Silver Valley Drive	ISCO, Grab, Stage height
STW049	Storm Drain near PetSmart upstream of Detention Structure	Grab, Stage height
STW050	Storm Drain near PetSmart	ISCO, Grab, Stage height
STW100	Urban Stream Channel near 57th St.	ISCO, Grab, Stage height
STW110	Storm Drain in Yankton Trail Park	ISCO, Grab, Stage height
STW140	Storm Drain along Beadle Greenway	ISCO, Grab, Stage height
STW150	Stormwater Channel near E. Benson Rd.	ISCO, Grab, Stage height
STW160	Storm Drain near John Morrell	Grab
STW170	Urban Stream Channel near E. Rice St.	ISCO, Grab, Stage height

BSR020 is the primary monitoring site located in Reach 08 and is the first mainstem site coming into the city. The boxplot of base flow and storm flow combined for this site shows the lowest percent exceedance of the daily maximum criteria (2.6 percent) of all sites. Exceedance of the chronic criteria at this site is 30 percent. However, the median concentration at this site is the fifth highest out of seven sites (70.6 mg/L).

Skunk Creek contributes a significant flow volume to the Big Sioux River and, sometimes, constitutes nearly the entire flow. The significant flow contribution from Skunk Creek is related to the diversion of much of the Big Sioux River around the city of Sioux Falls through a diversion canal (see Figure 1-1 for canal location). The percentage of flow volumes at the monitoring site directly downstream of the confluence of Skunk Creek with the Big Sioux River ranges from greater than 30 percent in February to approximately 85 percent in April as shown in Figure 1-12 (which is based on continuous data from 2005 through 2009). Although the TSS criteria are applicable year-round, higher flows, which often occur during the spring and summer months in South Dakota, generally increase TSS concentrations. Skunk Creek (SKC030) enters TMDL Reach 10 upstream of BSR060 and has a higher exceedance of the daily maximum criteria and the 30-day average criteria (18 percent and 48 percent, respectively) than the Big Sioux River site upstream of the confluence (BSR020) and the Big Sioux River

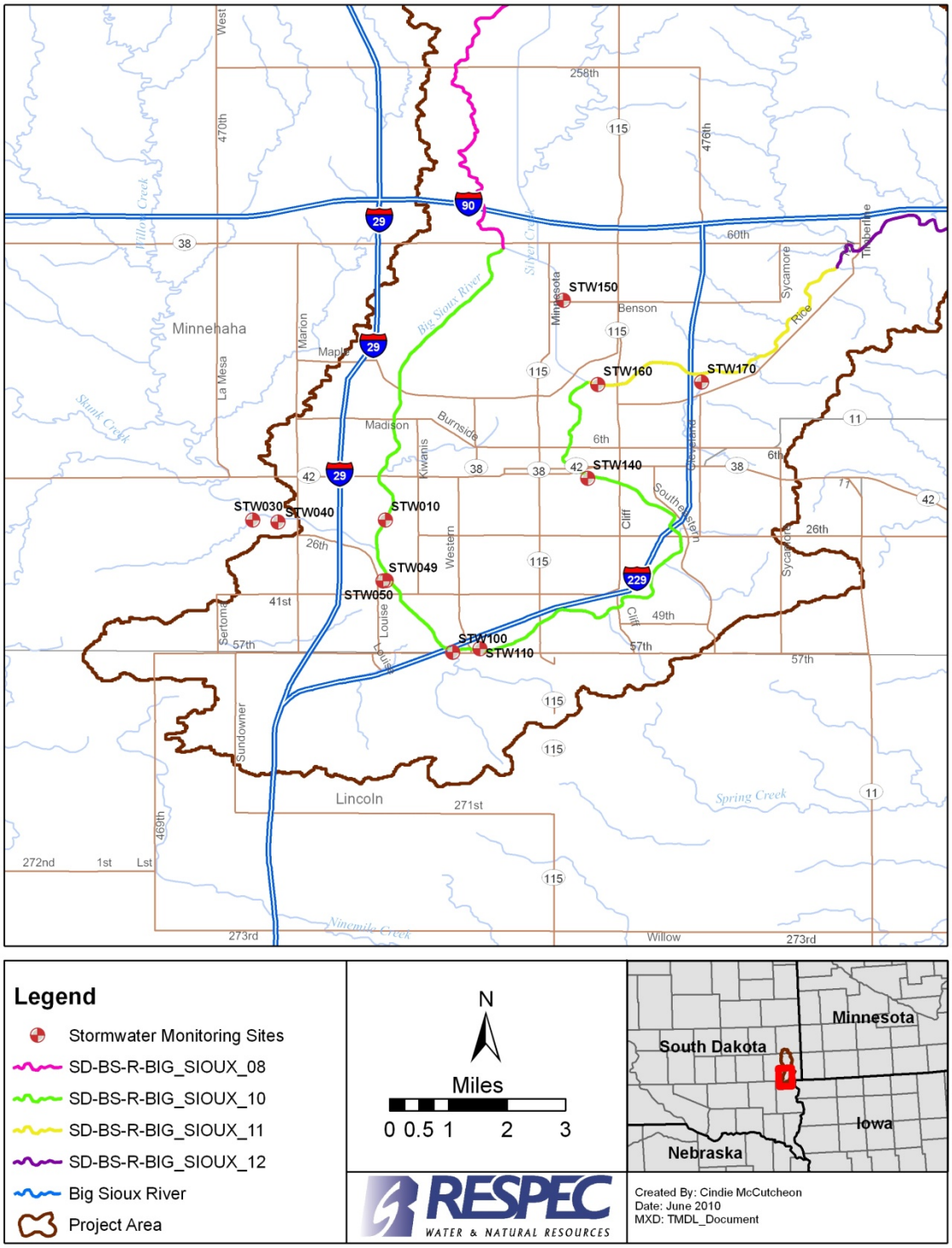
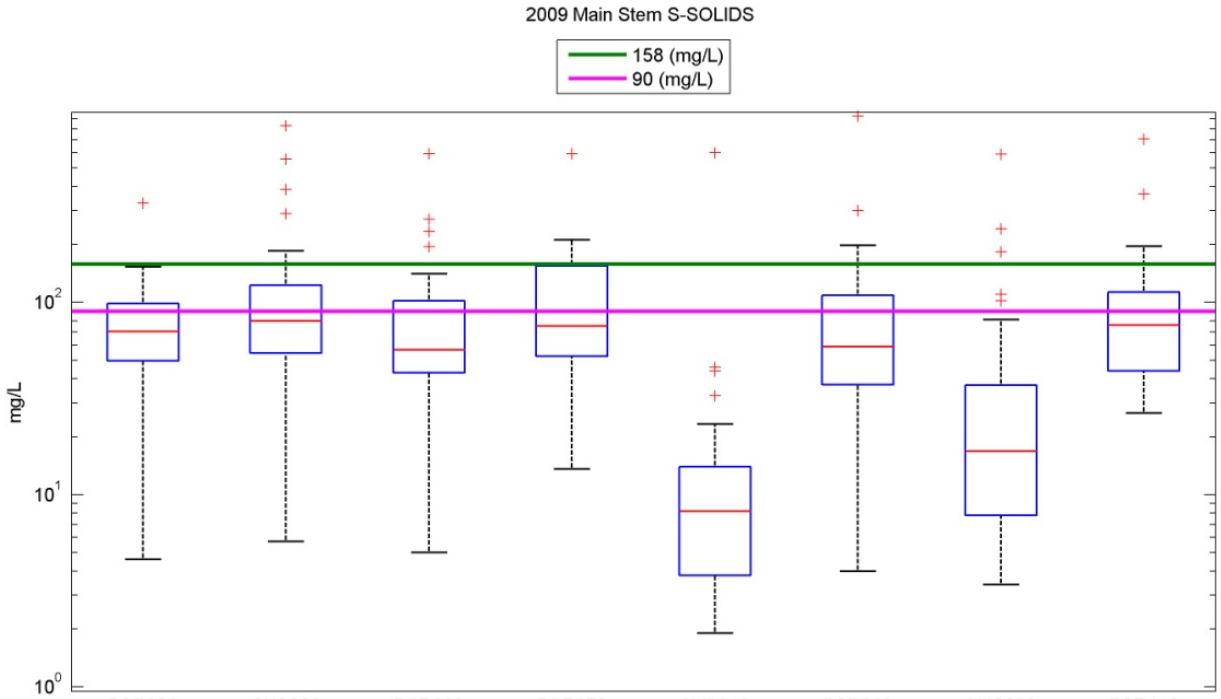
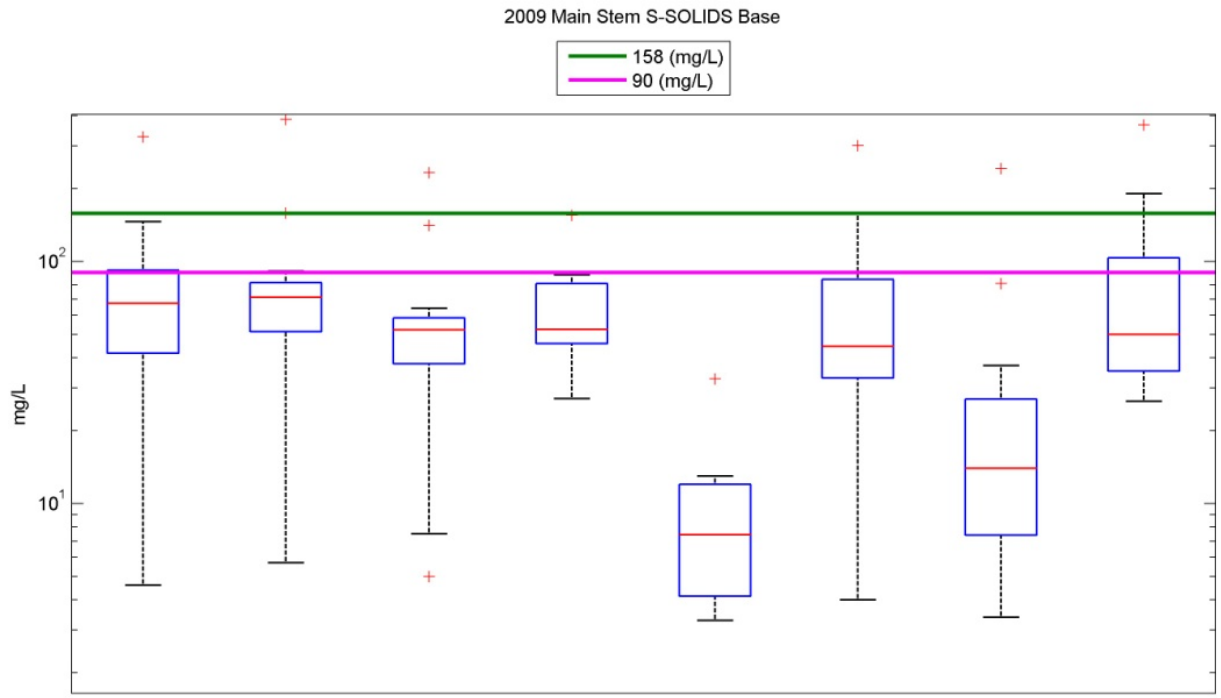


Figure 1-5. 2009 Stormwater Monitoring Sites Within the Sioux Falls Project Area.



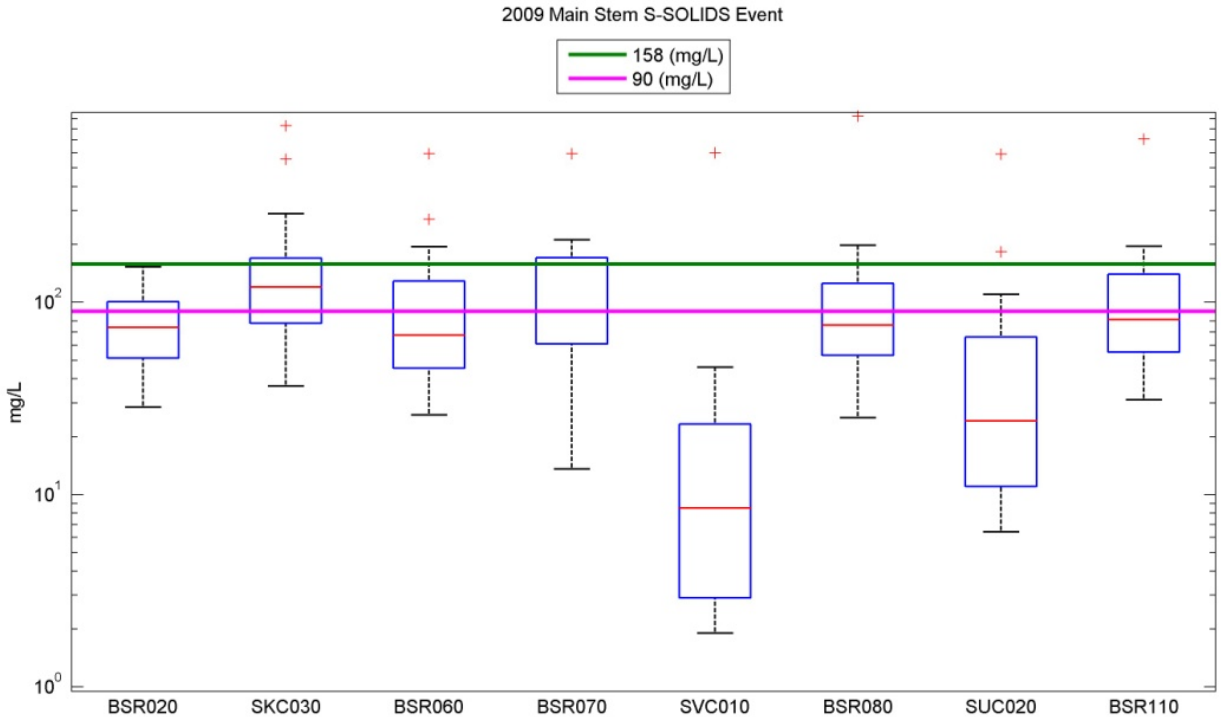
	BSR020	SKC030	BSR060	BSR070	SVC010	BSR080	SUC020	BSR110
n	38	39	38	22	26	37	38	38
Min	4.6	5.7	5	13.6	1.9	4	3.4	26.5
Max	328	832	595	595	600	930	590	710
q1	49.6	54.4	43	52.5	3.8	37.4	7.8	44
Median	70.6	80	56.6	75.5	8.2	59	16.8	76.2
q3	98.7	123	102	155	14	109	37.2	113
Mean	77.6	126	87.6	113	34.7	99.1	49.4	103
90th%	136	248	179	187	42.9	158	108	181
95th%	150	480	256	365	157	265	218	299
% Exceeded	2.6	18	11	23	3.8	8.1	7.9	11
% Exceed30	30	48	20	79	0	32	10	48
n 30	40	40	40	14	22	37	40	40

Figure 1-6. Total Suspended Solids Boxplots for Base Flow and Storm Flow Combined in 2009 From the Mainstem and Tributary Sampling Sites in the Sioux Falls Project Area of the Big Sioux River Watershed.



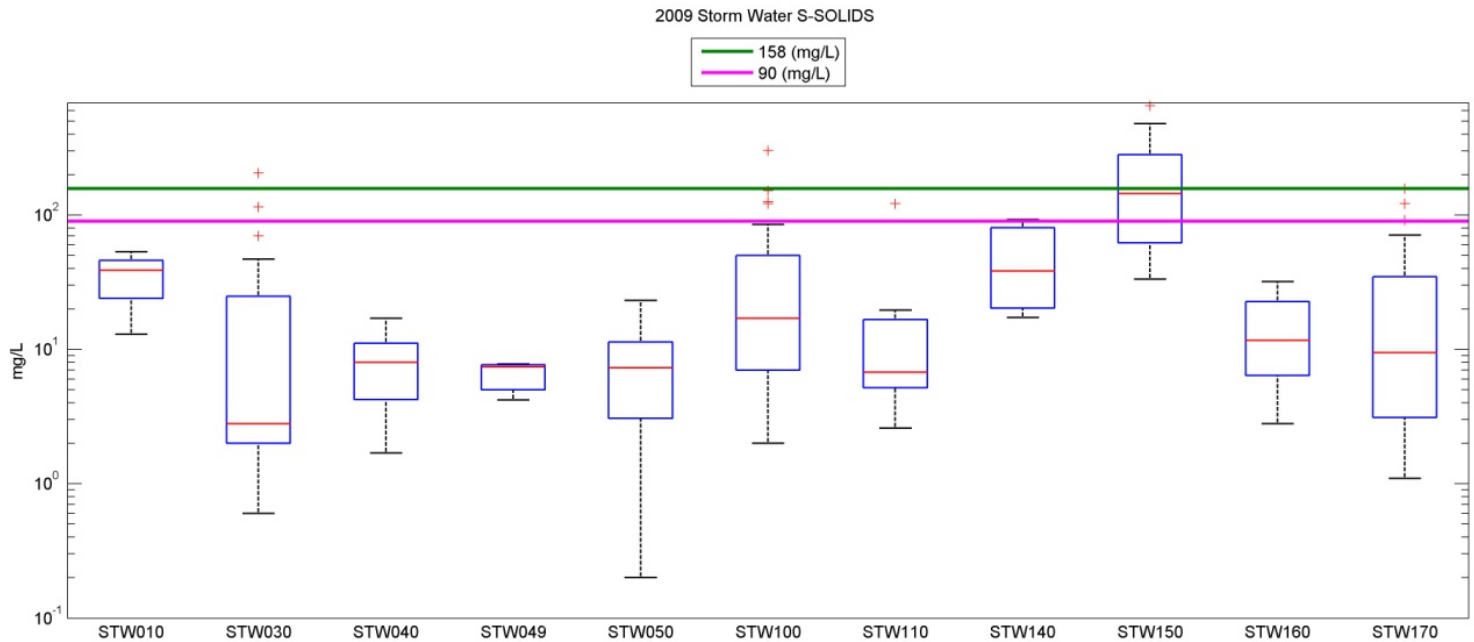
	BSR020	SKC030	BSR060	BSR070	SVC010	BSR080	SUC020	BSR110
n	21	21	20	9	12	20	20	20
Min	4.6	5.7	5	27.2	3.3	4	3.4	26.5
Max	328	387	233	155	32.7	301	242	367
q1	41.8	51.3	37.9	45.8	4.15	33	7.4	35.3
Median	67.2	71.2	52.3	52.5	7.45	44.6	14	50
q3	92	82	58.5	81.3	12	84.5	27	104
Mean	75.2	79.9	58.4	66.3	9.61	68.8	29.5	81.6
90th%	124	118	103	128	18.9	144	59.3	155
95th%	228	262	187	155	30.7	230	162	279
% Exceeded	4.8	9.5	5	0	0	5	5	10
% Exceed30	67	57	0	NaN	0	100	0	100
n 30	6	7	5	0	1	5	5	5

Figure 1-7. Total Suspended Solids Boxplots for Base Flow 2009 From the Mainstem and Tributary Sampling Sites in the Sioux Falls Project Area of the Big Sioux River Watershed.



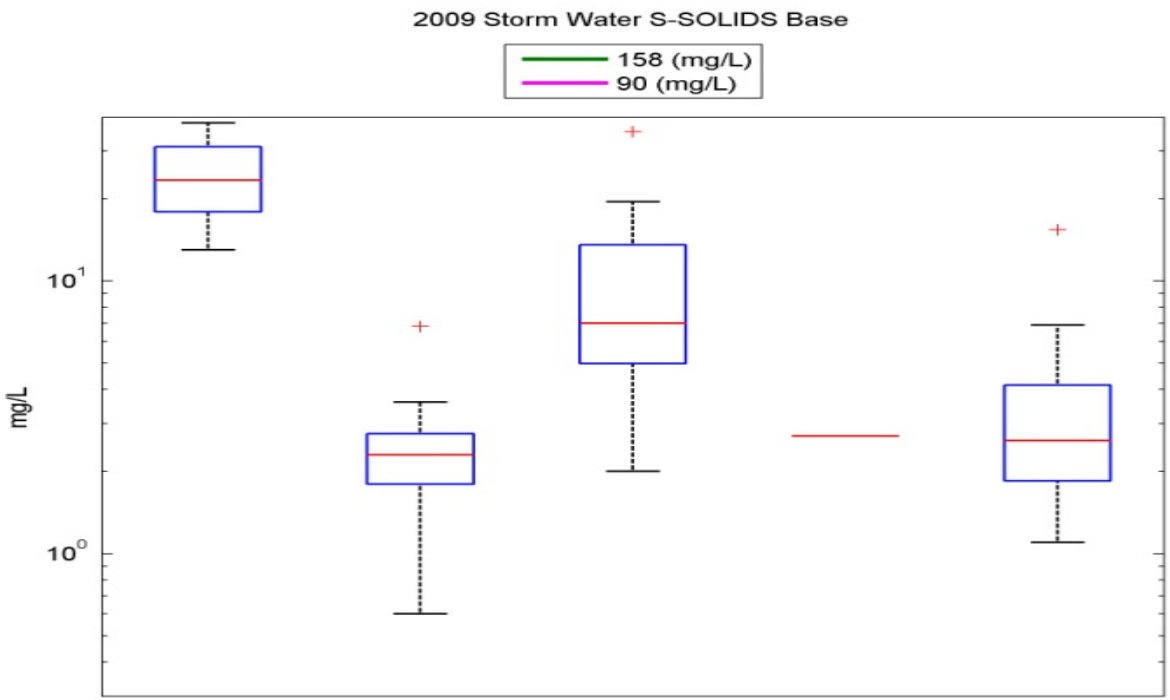
	BSR020	SKC030	BSR060	BSR070	SVC010	BSR080	SUC020	BSR110
n	17	18	18	13	14	17	18	18
Min	28.5	36.7	26	13.6	1.9	25.2	6.4	31.2
Max	153	832	595	595	600	930	590	710
q1	51.2	78	45.5	61	2.9	52.9	11	55
Median	74	121	67.4	90	8.5	76	24.2	81.3
q3	101	170	129	171	23.3	126	66	140
Mean	80.5	179	120	146	56.1	135	71.5	126
90th%	139	476	248	289	101	190	161	184
95th%	150	722	465	538	489	674	427	504
% Exceeded	0	28	17	38	7.1	12	11	11
% Exceed30	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
n 30	0	0	0	0	0	0	0	0

Figure 1-8. Total Suspended Solids Boxplots for Storm Flow 2009 From the Mainstem and Tributary Sampling Sites in the Sioux Falls Project Area of the Big Sioux River Watershed.



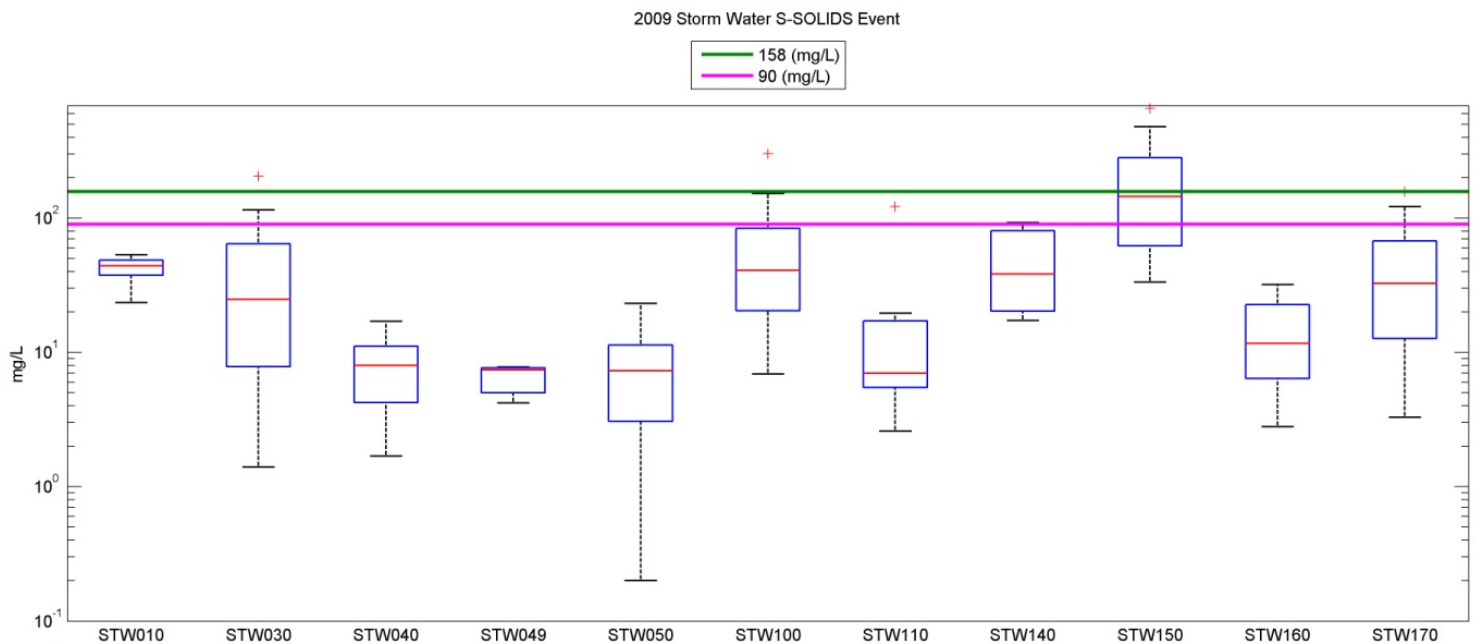
	STW010	STW030	STW040	STW049	STW050	STW100	STW110	STW140	STW150	STW160	STW170
n	14	30	13	3	15	34	16	9	15	4	29
Min	13	0.6	1.7	4.2	0.2	2	2.6	17.3	33.3	2.8	1.1
Max	53.3	206	17	7.8	23.2	302	122	93	655	32	158
q1	24	2	4.22	5	3.08	7	5.2	20.3	62	6.4	3.13
Median	39	2.8	8	7.4	7.3	17.1	6.75	38.5	145	11.7	9.5
q3	46	24.8	11.1	7.7	11.4	50	16.8	80.7	283	22.6	34.8
Mean	37	24.5	8.31	6.47	8.82	41	16.2	47.5	212	14.5	28
90th%	50.3	92.5	16.2	7.8	20.5	122	19.5	91.3	480	32	83.6
95th%	52.6	115	16.8	7.8	22.5	147	91.3	93	611	32	124
% Exceeded	0	3.3	0	0	0	2.9	0	0	47	0	0
% Exceed30	0	0	0	NaN	NaN	5.4	0	NaN	100	NaN	0
n 30	4	22	1	0	0	37	1	0	1	0	18

Figure 1-9. Total Suspended Solids Boxplots for Base Flow and Storm Flow Combined From the 2009 Urban Stormwater Sites in the Sioux Falls Project Area of the Big Sioux River Watershed.



	STW010	STW030	STW100	STW110	STW170
n	4	15	15	1	13
Min	13	0.6	2	2.7	1.1
Max	38	6.8	35.3	2.7	15.4
q1	17.9	1.8	4.98	2.7	1.85
Median	23.4	2.3	7	2.7	2.6
q3	31	2.75	13.5	2.7	4.15
Mean	24.5	2.48	9.85	2.7	3.95
90th%	38	3.6	19.5	2.7	8.6
95th%	38	6	31.3	2.7	14.1
% Exceeded	0	0	0	0	0
% Exceed30	NaN	NaN	NaN	NaN	NaN
n 30	0	0	0	0	0

Figure 1-10. Total Suspended Solids Boxplots for Base Flow From the 2009 Urban Stormwater Sites in the Sioux Falls Project Area of the Big Sioux River Watershed.



	STW010	STW030	STW040	STW049	STW050	STW100	STW110	STW140	STW150	STW160	STW170
n	10	15	13	3	15	19	15	9	15	4	16
Min	23.6	1.4	1.7	4.2	0.2	6.9	2.6	17.3	33.3	2.8	3.3
Max	53.3	206	17	7.8	23.2	302	122	93	655	32	158
q1	37.6	7.85	4.22	5	3.08	20.4	5.48	20.3	62	6.4	12.8
Median	44	24.8	8	7.4	7.3	40.8	7	38.5	145	11.7	32.7
q3	48.7	64.2	11.1	7.7	11.4	83.8	17.1	80.7	283	22.6	67.5
Mean	42	46.5	8.31	6.47	8.82	65.5	17.1	47.5	212	14.5	47.6
90th%	51.6	115	16.2	7.8	20.5	142	19.6	91.3	480	32	119
95th%	53.3	183	16.8	7.8	22.5	235	96.4	93	611	32	147
% Exceeded	0	6.7	0	0	0	5.3	0	0	47	0	0
% Exceed30	NaN	NaN	0	NaN	NaN	NaN	NaN	NaN	100	NaN	NaN
n 30	0	0	1	0	0	0	0	0	1	0	0

Figure 1-11. Total Suspended Solids Boxplots for Storm Flow From the 2009 Urban Stormwater Sites in the Sioux Falls Project Area of the Big Sioux River Watershed.

site downstream of the confluence (BSR060). The median concentration at SKC030 (80 mg/L) is approximately 10 mg/L higher than BSR020 and approximately 23 mg/L higher than BSR060. BSR060 exceeds the daily maximum criteria 11 percent of the time and the 30-day average criteria 20 percent of the time. The impairment at the second Big Sioux River (BSR) site (BSR070) following Skunk Creek increases to the highest of all mainstem and tributary sites (23 percent exceedance of the daily maximum criteria and 79 percent exceedance of the 30-day average criteria). The median concentration at BSR070 is 75.5 mg/L. The data for Reach 10 tends to be more skewed than in other reaches. This may be the result of altering the natural flow of water (hydromodification).

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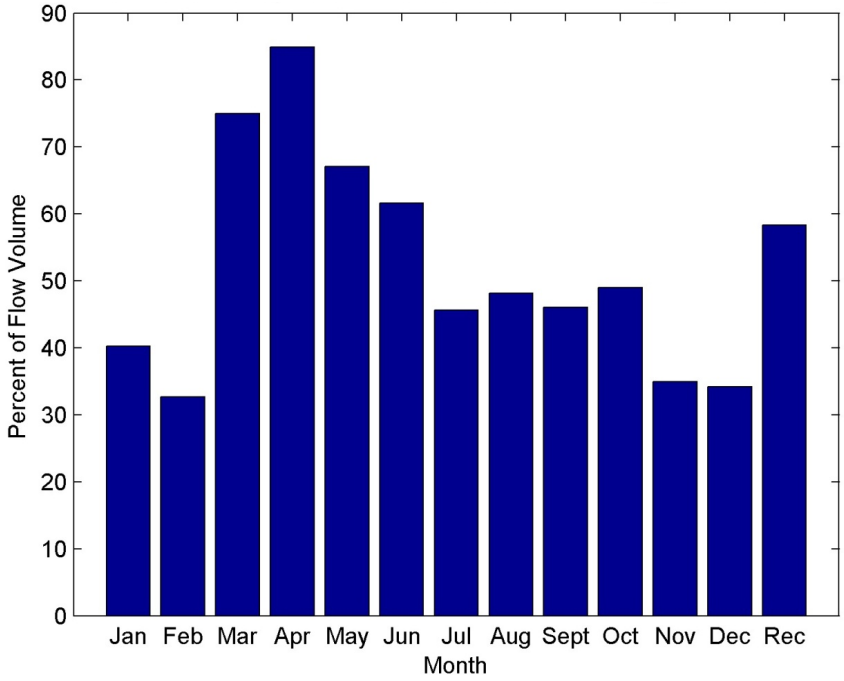

Figure 1-12. Skunk Creek Monthly Flow Volume Contribution Percentage to the Big Sioux River Directly Downstream of Skunk Creek.

The MS4 permit is a municipal stormwater discharge permit that authorizes the discharge of stormwater from the MS4. For the Sioux Falls TMDLs, it refers to stormwater runoff from the city of Sioux Falls into the Big Sioux River and its tributaries. The level of stormwater-quality control is defined in federal regulations in terms of maximum extent practicable (MEP). MEP considers the practicality and/or economics of trying to treat low-frequency, very large events and recognizes that the majority of stormwater loadings are generated by the frequent, smaller events.

All stormwater monitoring sites except STW150, STW160, and STW170 flow into Reach 10. The MS4 seems to have a minimal contribution to the impairment in Reach 10, because the

percent exceedance of the daily maximum criteria of the receiving Big Sioux River does not surpass 7 percent in any of the eight stormwater sites located within the reach. Median concentrations at the stormwater sites in the reach remain below 39 mg/L. The event data were insufficient at many of the stormwater sites for calculating chronic criteria exceedance.

The diversion reenters the Big Sioux River at the beginning of TMDL Reach 11. Silver Creek, which flows into the diversion, has low exceedance (3.8 percent of the daily maximum criteria and 0 percent of the 30-day average criteria) and the lowest median concentration (8.2 mg/L) of all sites. However, the increased flow from the diversion seems to slightly affect BSR080 of Reach 11 (8.1 percent exceedance of the daily maximum criteria, 32 percent exceedance of the chronic criteria, and a median concentration of 59 mg/L). Skunk Creek also contributes 19 percent of the flow to Reach 11. Based on the 2009 data collected at stormwater outfalls, the MS4 contributes minimal sediment loadings. However, one site that contributes to the diversion (STW150) has a 47 percent exceedance of the daily maximum criteria, a 100 percent exceedance of the 30-day average criteria, and a median concentration of 145 mg/L. The remaining two stormwater monitoring sites (STW160 and STW170) have 0 percent exceedance of the daily maximum criteria and median concentrations of 11.7 mg/L and 32.7 mg/L, respectively.

Reach 12, which is located below the Sioux Falls wastewater treatment facility, has a higher median concentration and percent exceedance than Reach 11 during base flows and storm flows combined. The highest overall mainstem median concentration (76.2 mg/L) occurs on this reach at site BSR110. The daily maximum criteria exceedance at BSR110 was 11 percent and the 30-day average criteria exceedance was 48 percent. Slip-Up Creek, which contributes to some sediment loading in Reach 12, had an 8 percent exceedance of the daily maximum criteria, a 10 percent exceedance of 30-day average criteria, and a median concentration of 17 mg/L during all base flows and storm flows combined.

Current Best Management Practices (BMPs) within the project area, such as detention ponds and constructed wetlands, appear to decrease the Big Sioux River TSS concentrations within the project area. At least three of the eleven stormwater sites (STW030, STW100, and STW170) are located downstream of current BMPs, and these three sites had no exceedances of the Big Sioux River daily maximum criteria during base flows and had less than 7 percent exceedances during storm flows. Not enough data were available from these sites to calculate 30-day average exceedance for base flows or storm flows separately. Median concentrations at these three sites were below the acute criteria of 158 mg/L on the Big Sioux River and ranged from 7 mg/L to 145 mg/L. Of the 11 sites, the median concentrations during storm flows at STW030, STW100, and STW170 rank the 6th, 9th, and 7th, respectively.

The USGS monitors long-term stream flow on the Big Sioux River at USGS 06481000 (Big Sioux River near Dell Rapids), USGS 06482000 (Big Sioux River at Sioux Falls), USGS 06482020 (Big Sioux River at Cliff Avenue at Sioux Falls), and Skunk Creek at USGS 06481500

(Skunk Creek at Sioux Falls). These stream flow gages are shown in Figure 1-13. Each of these stations provided an adequate stream flow dataset during the simulation period. Two additional stream flow gages also existed (BSR020 at the I-90 Bridge upstream of Sioux Falls and BSR110 near Brandon), but they did not have continuous flow data. These sites are illustrated in Figure 1-4. Additional flow data were collected as a part of the 2009 monitoring effort.

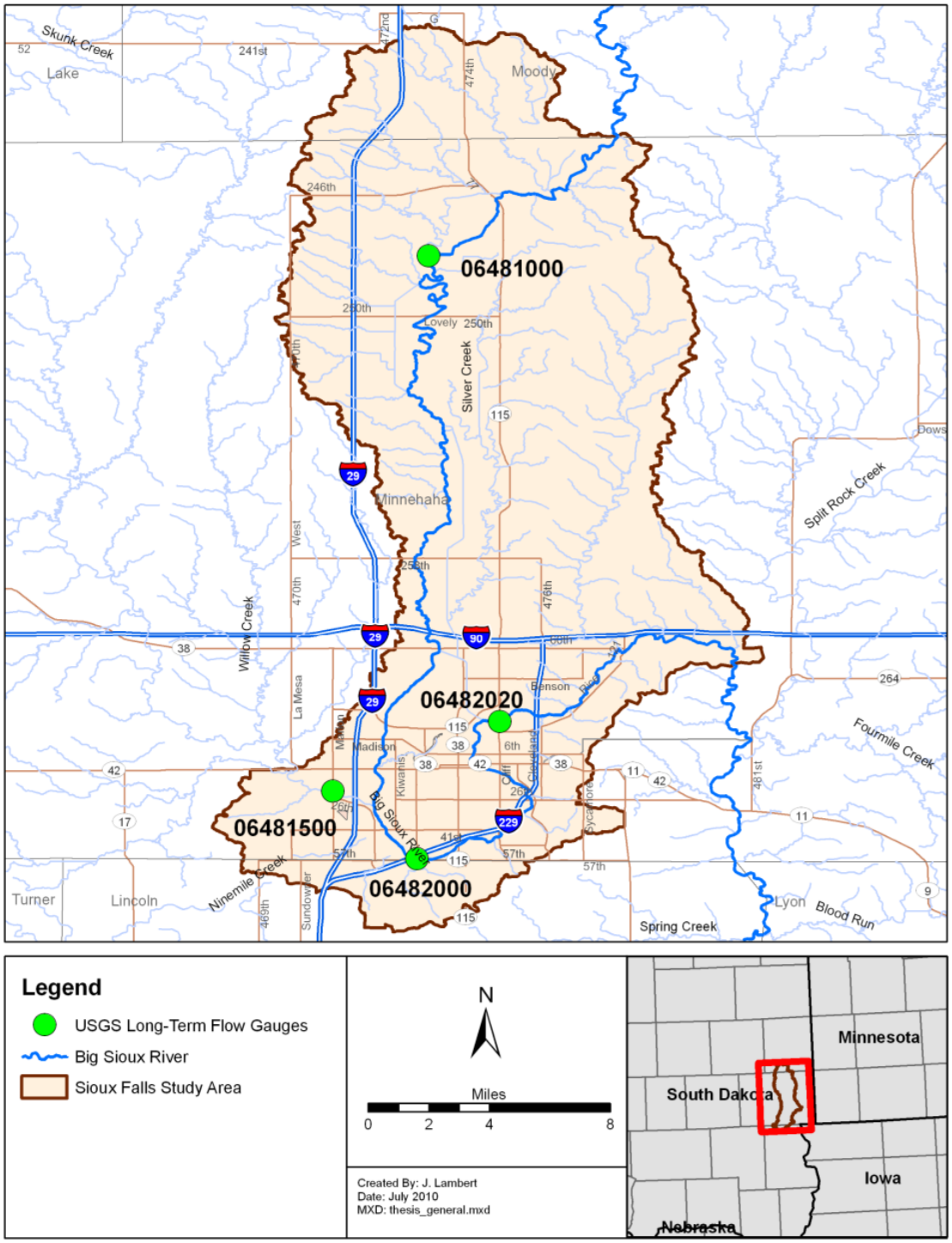

Figure 1-13. Long-Term U.S. Geological Survey Stream Flow Gages on the Big Sioux River and Skunk Creek.

2.0 WATER-QUALITY STANDARDS AND TOTAL MAXIMUM DAILY LOAD TARGETS

Each waterbody within South Dakota is assigned beneficial uses. All waters (both lakes and streams) are designated with the use of fish and wildlife propagation, recreation, and stock watering. All streams are assigned the use of irrigation. Additional uses may be assigned by the state based on a beneficial use analysis of each waterbody. Water-quality standards are defined in South Dakota state statutes to support these uses. These standards consist of suites of criteria that provide physical and chemical benchmarks from which management decisions can be developed (Administrative Rules of South Dakota (ARSD) 74:51:01–74:51:03) [Administrative Rules of South Dakota, 2010].

Additional "narrative" standards that may apply can be found in ARSD Articles 74:51:01:05; 06; 08; 09; and 12 [Administrative Rules of South Dakota, 2010]. These contain language that generally prohibits the presence of materials causing the formation of pollutants, visible pollutants, nuisance aquatic life, and pollutants that impact biological integrity.

The Big Sioux River Reach 08 and Reach 10 have been assigned the following beneficial uses: domestic water supply, fish and wildlife propagation, immersion recreation, irrigation waters, limited contact recreation, and warm-water semipermanent fish life. The Big Sioux River Reach 11 and Reach 12 were assigned the same beneficial uses with exception to domestic water supply, which is not a beneficial use in these downstream reaches. Table 2-1 lists water-quality criteria that must be met to support the beneficial uses currently assigned to the Big Sioux River within the city of Sioux Falls. Greater than 10 percent of the samples must exceed water-quality criteria for that parameter to be included as a cause of impairment on the 303(d) Impaired Waters List. Also, for a parameter to be considered representative of actual conditions, at least 20 samples of the parameter are required. The sample threshold is reduced to ten samples if three or more samples exceed daily maximum water-quality standards.

Current TSS criteria for the warm-water semipermanent fish life propagation beneficial use requires that (1) no sample exceeds 158 mg/L and (2) the 30-day average of at least three consecutive grab or composite samples taken on separate weeks in a 30-day period must not exceed 90 mg/L. According to ARSD Article 74:51:01:04, if pollutants are discharged into a reach and the criteria for that reach's designated beneficial use are not exceeded, but the waters flow into another reach whose designated beneficial use requires a more stringent parameter criterion, the pollutants may not cause the more stringent criterion to be exceeded.

Table 2-1. State Surface Water-Quality Standards for the Big Sioux River in the City of Sioux Falls (Page 1 of 2)

Parameter	Criteria	Unit of Measure	Special Conditions
Total alkalinity as calcium carbonate[a]	≤ 750	mg/L	30-day average
	≤ 1,313	mg/L	Daily maximum
Total dissolved solids[a]	≤ 2,500	mg/L	30-day average
	≤ 4,375	mg/L	Daily maximum
Total dissolved solids[b]	≤ 1,000	mg/L	30-day average
	≤ 1,750	mg/L	Daily maximum
Total petroleum hydrocarbon[a]	≤ 10	mg/L	Daily maximum
Total petroleum hydrocarbon[b]	≤ 1.0	mg/L	Daily maximum
Oil and grease[a]	≤ 10	mg/L	Daily maximum
Nitrates as N[b]	≤ 10	mg/L	Daily maximum
Nitrates as N[a]	≤ 50	mg/L	30-day average
	≤ 88	mg/L	Daily maximum
Dissolved oxygen[c,d,e]	≥ 5.0	mg/L	Daily minimum
Total suspended solids[c]	≤ 90	mg/L	30-day average
	≤ 158	mg/L	Daily maximum
Temperature[c]	≤ 90	°F	Daily maximum
pH[a]	6.0 and ≤ 9.0	Standard units	
pH[b,c]	6.5 and ≤ 9.0	Standard units	
Undisassociated hydrogen sulfide[c]	≤ 0.002	mg/L	Daily maximum
Total ammonia nitrogen as N[c]	Equation-based limit	mg/L	30-day average
	Equation-based limit	mg/L	Daily maximum

Table 2-1. State Surface Water-Quality Standards for the Big Sioux River in the City of Sioux Falls (Page 2 of 2)

Parameter	Criteria	Unit of Measure	Special Conditions
Sodium adsorption ratio[d]	≤ 10		Daily maximum
Conductivity at 25°C[d]	≤ 2,500	micromhos/cm	30-day average
	≤ 4,375	micromhos/cm	Daily maximum
Fecal coliform[e]	< 200	cfu /100 mL	Geometric mean (May 1–Sep 30)
	< 400	cfu /100 mL	Daily maximum (May 1–Sep 30)
E. coli[e]	≤ 126	cfu /100 mL	Geometric mean (May 1–Sep 30)
	≤ 235	cfu /100 mL	Daily maximum (May 1–Sep 30)

(a) Criteria for fish and wildlife propagation, recreation, and stock watering use.
(b) Criteria for domestic water supply, which apply to TMDL Reach 10 and Reach 11.
(c) Criteria for warm-water semipermanent fish life propagation use.
(d) Criteria for irrigation use.
(e) Criteria for immersion recreation use.

Skunk Creek is currently assigned a warm-water marginal fish life propagation beneficial use that has less-stringent TSS criteria (30-day average criteria of 150 mg/L and daily maximum criteria of 263 mg/L) than the Big Sioux River's warm-water semipermanent fish life propagation beneficial use (30-day average criteria of 90 mg/L and daily maximum criteria of 158 mg/L). Because Skunk Creek is a relatively large contributor of flow to the Big Sioux River (as mentioned earlier), the discrepancy in water-quality standards is a concern. TSS concentrations in Skunk Creek have the potential to cause water-quality standard exceedances in the Big Sioux River without any urban load contribution from the city of Sioux Falls. This could make it more difficult for the Big Sioux River to support its assigned beneficial use in the urban and downstream reaches. The Skunk Creek Watershed is not part of the current TMDL assessment for the Big Sioux River through the city of Sioux Falls.

3.0 SIGNIFICANT SOURCES

3.1 POINT SOURCES

Multiple, permitted point-source discharges are located in the Big Sioux River Watershed project area. These permitted point sources, illustrated in Figure 3-1, include the Dell Rapids WWTP (wastewater treatment plant) in Reach 08, the Baltic WWTP in Reach 08, the Sioux Falls MS4 permit in Reaches 10 and 11, John Morrell & Company in Reach 11, and the Sioux Falls WWTP in Reach 12. The TSS daily maximum and 30-day average effluent limits for these facilities are listed in Table 3-1. The permit area covered by the MS4 permit includes "all areas within the corporate boundary of the city of Sioux Falls served by, or otherwise contributing, to discharges to state waters from municipal separate storm sewers owned or operated by the city of Sioux Falls and interstate highways operated by South Dakota Department of Transportation" [South Dakota Department of Environment and Natural Resources, 1999].

The Baltic WWTP and the Dell Rapids WWTP are lagoons. According to the Natural Resources Engineering Director of the SD DENR Surface Water Quality Program, the Baltic WWTP has not discharged in the last 5 years, and the Dell Rapids WWTP typically discharges in May and November each year [Buscher, 2010].

3.2 NONPOINT SOURCES

Nonpoint-source pollution generally comes from surface runoff, bed and bank erosion, cropland erosion, and construction erosion. Analysis of sediment loadings from north to south shows no obvious trends upstream to downstream, and the highest percent exceedance of both the daily maximum and the 30-day average criteria occurs at BSR070 (23 percent and 79 percent, respectively). TSS loadings for the model were estimated using the simulated hydrologic response of each modeled land use and the corresponding Event Mean Concentrations (EMCs) that were derived from 2009 sample data based on representative land use draining to particular sampling sites. For example, one sampling site was predominantly residential, so the concentrations observed from that site were used as the EMC for all residential land. There were multiple sampling sites, and each had a targeted representative land use. To account for spatial variability in the watershed and to align with downstream sampling measurements, the EMCs in some cases were adjusted through the calibration process within the range of concentrations that were observed for the land use.

3.3 SOURCE ASSESSMENT MODELING RESULTS

The watershed modeling package selected for this assessment was the EPA **HSPF (Hydrological Simulation Program-Fortran)** model. **HSPF** is a comprehensive watershed model of hydrology and

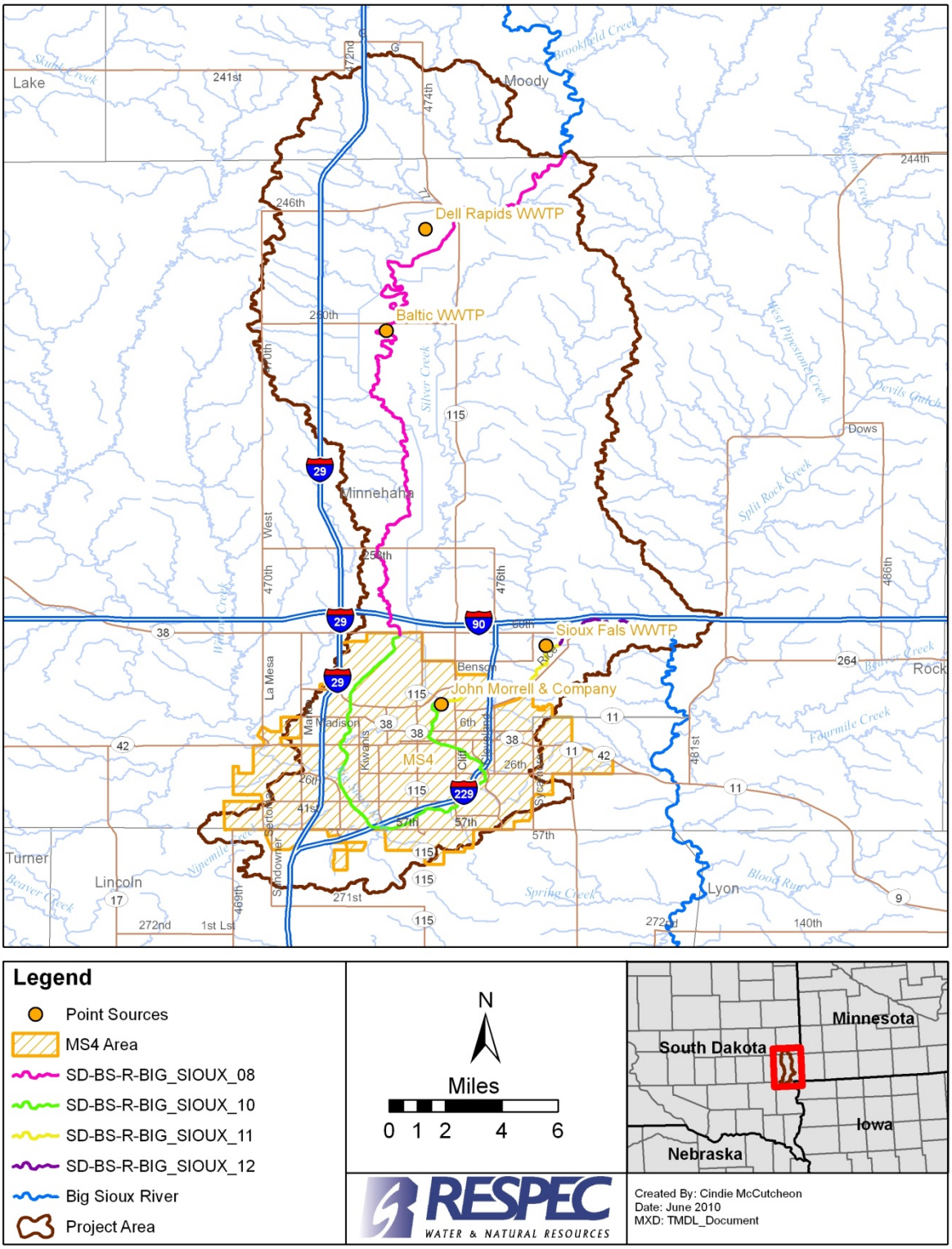

Figure 3-1. Point Sources Including the MS4 Within the Sioux Falls Project Area.

water quality that includes modeling of both land surface and subsurface hydrologic and water-quality processes that are linked and closely integrated with corresponding stream and reservoir processes. HSPF is considered a premier, high-level model among those currently available for comprehensive watershed assessments.

Table 3-1. Point-Source Discharge Statistics for the Lower Big Sioux River Watershed

Point Sources	Permit Number	Reach	TSS Daily Maximum Effluent Limits (mg/L)	TSS 30-Day Average Effluent Limits (mg/L)
Dell Rapids WWTP	SD-0022101	08	135	90
Baltic WWTP	SD-0022284	08	45	30
Sioux Falls NPDES MS4	SDS-000001	10, 11	N/A	N/A
John Morrell & Company[(a)]	SD-0000078	11	2,200 pounds per day	1,100 pounds per day
Sioux Falls WWTP	SD-0022128	12	45	30

(a) TSS effluent limits for John Morrell & Company are a load instead of a concentration. This was an option offered by the SD DENR.

The HSPF model was used to determine the contribution of TSS from identified sources in the Big Sioux River Watershed and to evaluate the implementation of BMPs to control these sources. The Big Sioux River drainage basin was represented in the model using 24 subwatersheds and two boundary conditions that represent Skunk Creek and the Big Sioux River at Dell Rapids. As mentioned earlier, nonpoint-source TSS loadings for HSPF were estimated using the EMCs for each land use, which were derived from sample data based on representative land uses draining to particular sampling sites. For example, one sampling site was predominantly residential, so the concentrations from that site were used as the EMCs for all residential land. EMCs were applied throughout the watershed.

Source assessment modeling results were summarized according to the following categories: nonpoint sources, MS4 (local), MS4 (upstream), Big Sioux River boundary conditions, Skunk Creek, Slip-Up Creek, and bed and bank (local and upstream). Figure 3-2 is a schematic of the sources listed above. The nonpoint-source category includes all areas north of the Sioux Falls MS4 except the Slip-Up Creek Watershed (local Big Sioux River from Reach 08) and Silver Creek. A time series of average daily loads by source occurring on each date from 2005 through 2009 was created. Pie charts, shown in Figure 3-3, were then produced for each of the four TMDL endpoints for each source. Note that the WLA percent contribution for the non-MS4 point sources was not included in Figure 3-3 because it was nearly insignificant (less than 0.1 percent of the overall load). Source contributions to Reach 08 included in the pie charts were from the Big Sioux River upstream of the boundary conditions and bed and bank. Reach 10 loads were primarily from Skunk Creek, local bed and bank, the Big Sioux River

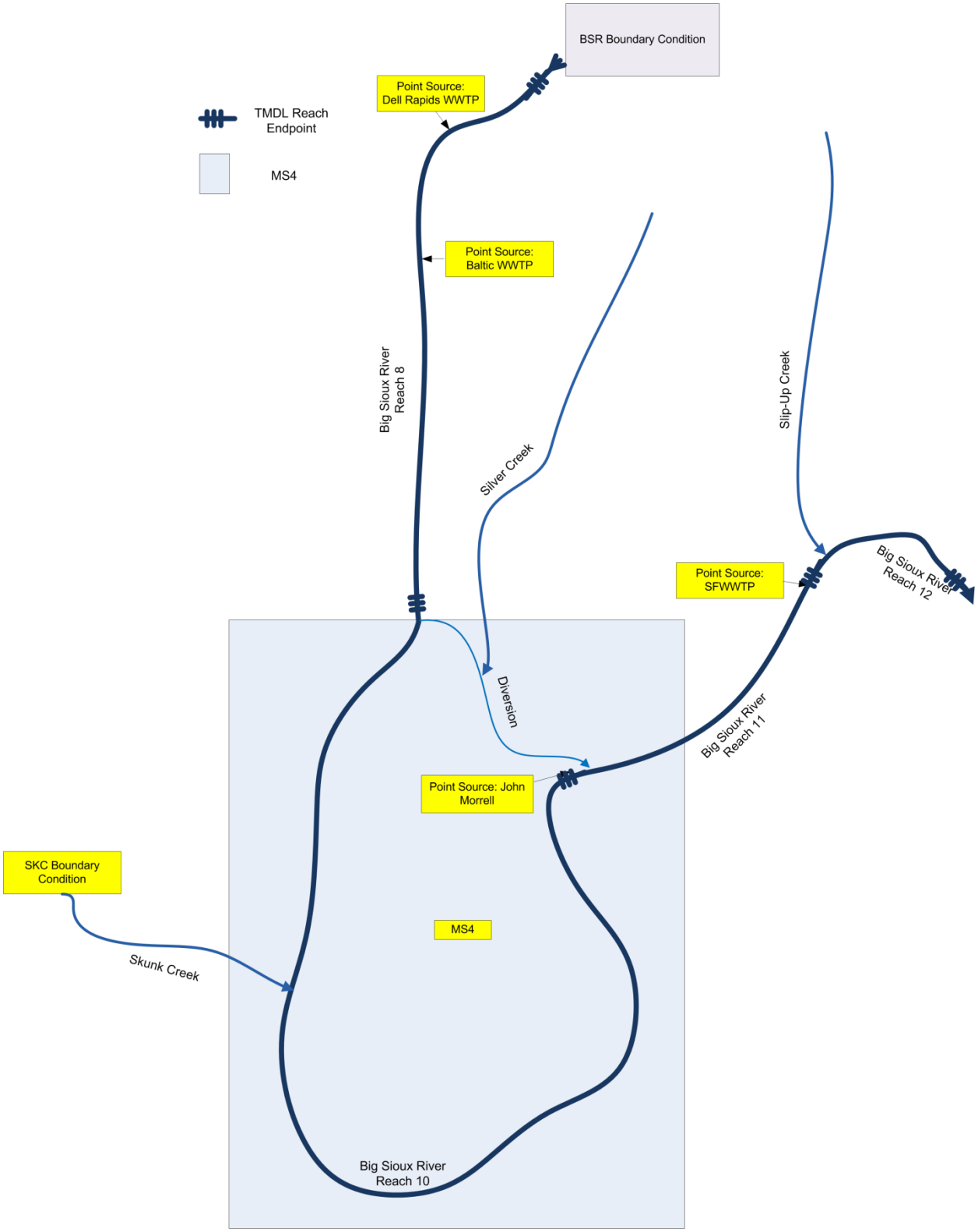

Figure 3-2. Diagram of Sources Used in Source Assessment Pie Charts.

upstream of the boundary conditions, and the local MS4. Reach 11 loads were primarily a combination of the Big Sioux River upstream of the boundary conditions, upstream bed and bank, local bed and bank, and Skunk Creek. Finally, Reach 12 loads were primarily attributed to the upstream bed and bank, the Big Sioux River upstream of the boundary conditions, local bed and bank, and Skunk Creek.

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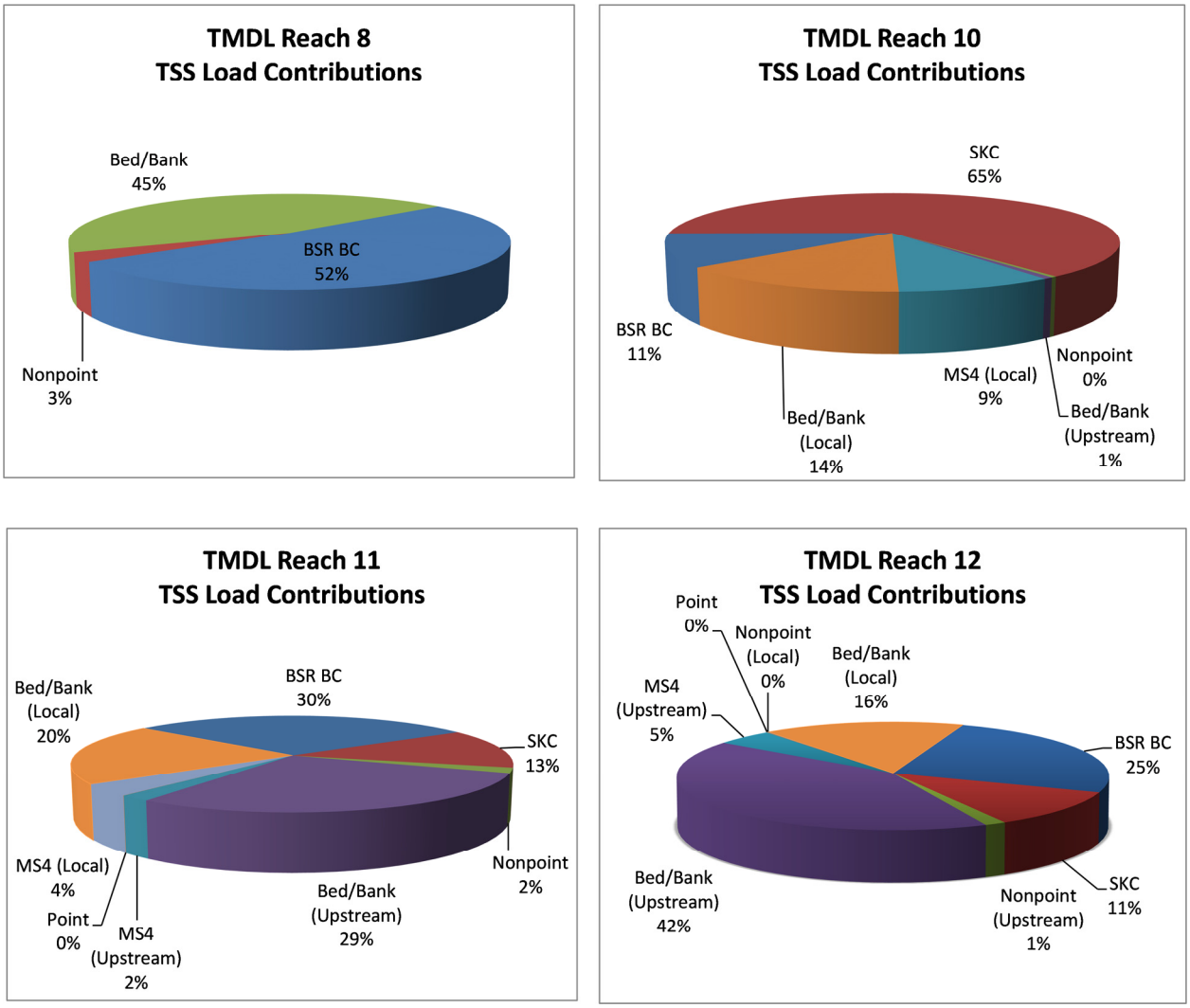

Figure 3-3. Source Assessment Modeling Results Within the Sioux Falls Project Area of the Lower Big Sioux River Watershed (Point Sources Indicated as 0 Percent Are Less Than 0.1 Percent of the Overall Load Contribution to the Reach).

4.0 TECHNICAL ANALYSES

The TMDL was developed using the load duration curve (LDC) approach, resulting in a flow-variable target that considers the entire flow regime. The LDC is a dynamic expression of the allowable daily load for any given flow. To aid in interpreting and implementing the TMDL, the LDC flow intervals were grouped into five flow zones: high flows (0–10 percent), moist conditions (10–40 percent), midrange flows (40–60 percent), dry conditions (60–90 percent), and low flows (90–100 percent) according to the U.S. Environmental Protection Agency [2007].

According to conclusions drawn from 2009 mainstem, tributary, and stormwater sites discussed in Section 1.3 and based on boxplots (Figures 1-6 through 1-11), TSS loads in the Big Sioux River Basin in Sioux Falls are a chronic issue. The dominant source of sediment appears to be from bed, bank, and, to some extent, riparian. In local nonpoint areas outside of the MS4, erosion is transport limited due to the relatively flat slopes and high infiltration; within the MS4, erosion appears to be limited based on 2009 stormwater outfall monitoring. The Big Sioux River appears to have both the transport capacity and supply of fine materials from bed and bank to routinely exceed the chronic standard during nonstorm events. A comparison of required daily maximum load reductions versus required 30-day average load reductions confirms this statement, because required 30-day average load reductions are far higher. For the purposes of this report, critical criteria were defined as the criteria (daily maximum or 30-day average) requiring the highest amount of reduction. Thus it was decided that the critical criteria for this TSS TMDL should be set to the 30-day average criteria, which are presented in the LDCs and the TMDL tables in this report. Daily maximum-based LDCs can be found in Appendix A.

TSS LDCs were constructed for each TSS-impaired reach of the Big Sioux River within the project area (Reaches 08, 10, 11, and 12) using the chronic criteria. The LDC for each reach includes two curves where the MS4 is applicable and one curve where the MS4 is not. The upper curve represents loading capacity within each reach and it was constructed using the product of simulated 30-day average flow at respective TMDL endpoints, the 30-day average TSS criteria, and a unit conversion factor. The lower curve represents the waste load allocation (WLA) and includes both permitted point-source loads and the MS4 load. The MS4 loads were included only within the two middle reaches (Reach 10 and Reach 11); thus, the WLA line, including the MS4, is not included on Reach 08 or Reach 12 LDCs. The dotted line across the lower portion of the LDC represents the point-source load for the reach. The MS4 is the only point-source load within Reach 10. The space between the WLA curve and the dotted line (point-source load) represents the NPDES MS4 load, which was calculated using the **HSPF** model application and the following assumptions:

1. The MS4 load component of the WLA will be flow variable.
2. Under the future TMDL, the MS4 will continue to have approximately the same contribution to the total load.

Thus the MS4 load was calculated as a percentage of the difference between the TMDL, the margin of safety (MOS), and the point-source load in each flow zone, and that percentage is estimated as the existing load shown in Figure 3-3. Points plotted within the LDC for each reach include observed loads that were calculated using observed 30-day average TSS and 30-day average flow data from monitoring stations. The LDCs also include boxplots of HSPF-simulated 30-day average loads for each flow zone that were calculated using simulated 30-day average TSS and flow data from reach endpoints. The locations of the water-quality monitoring sites that observed data were collected from on the Big Sioux River were shown in Figure 1-3. Observed TSS data and flow data collected between 2000 to 2009 were applied to the LDC of the reach in which they were collected. Water-quality monitoring sites and flow-monitoring sites used to develop the LDCs are shown in Table 4-1. Monitoring data from BSR010 were not used to develop the LDCs, because it is at the very upstream end of Reach 08 and is, therefore, not representative of the concentrations at the end of the reach. BSR030 monitoring data was not used to develop LDCs because it is located on the diversion, which is an artificial structure that is not within one of the Big Sioux River impaired reaches. Monitoring data from BSR110 was not used because it is below the endpoint of Reach 12.

Table 4-1. Water-Quality Monitoring Sites and Flow-Monitoring Sites Used for Developing Load Duration Curves

Reach	TSS Sites Used	Flow Sites Used
SD-BS-R-BIG_SIOUX_08	BSR020	Simulated Flow Only
SD-BS-R-BIG_SIOUX_10	BSR050	USGS 06482000 and Simulated Flow
	BSR060	
	BSR070	
SD-BS-R-BIG_SIOUX_11	BSR080	USGS 06482020
	BSR090	
SD-BS-R-BIG_SIOUX_12	BSR100	Simulated Flow Only

When the loads are plotted on the LDC, characteristics of the water-quality impairment are shown. Loads that plot above the solid curve are exceeding the water-quality criterion, while those below the curve are in compliance.

The 30-day average criterion-based LDC for Reach 08, shown in Figure 4-1, demonstrates that exceedance of the 30-day average criteria occurred during all but low flow conditions. Figure 4-2 shows that exceedance of the 30-day average criteria in Reach 10 occurred during moist, midrange, and dry flow conditions, and Figure 4-3 shows the exceedance of the 30-day average criteria in Reach 11 that occurred during all flow conditions. Figure 4-4 shows that the exceedance of the 30-day average criteria occurred during high and moist flows in Reach.

The LDCs shown in Figures 4-1 through 4-4 represent dynamic expressions of the TSS TMDLs for the Big Sioux River reaches that are based on the 30-day average TSS criterion. These LDCs result in unique loads that correspond to measured and simulated 30-day average flows.

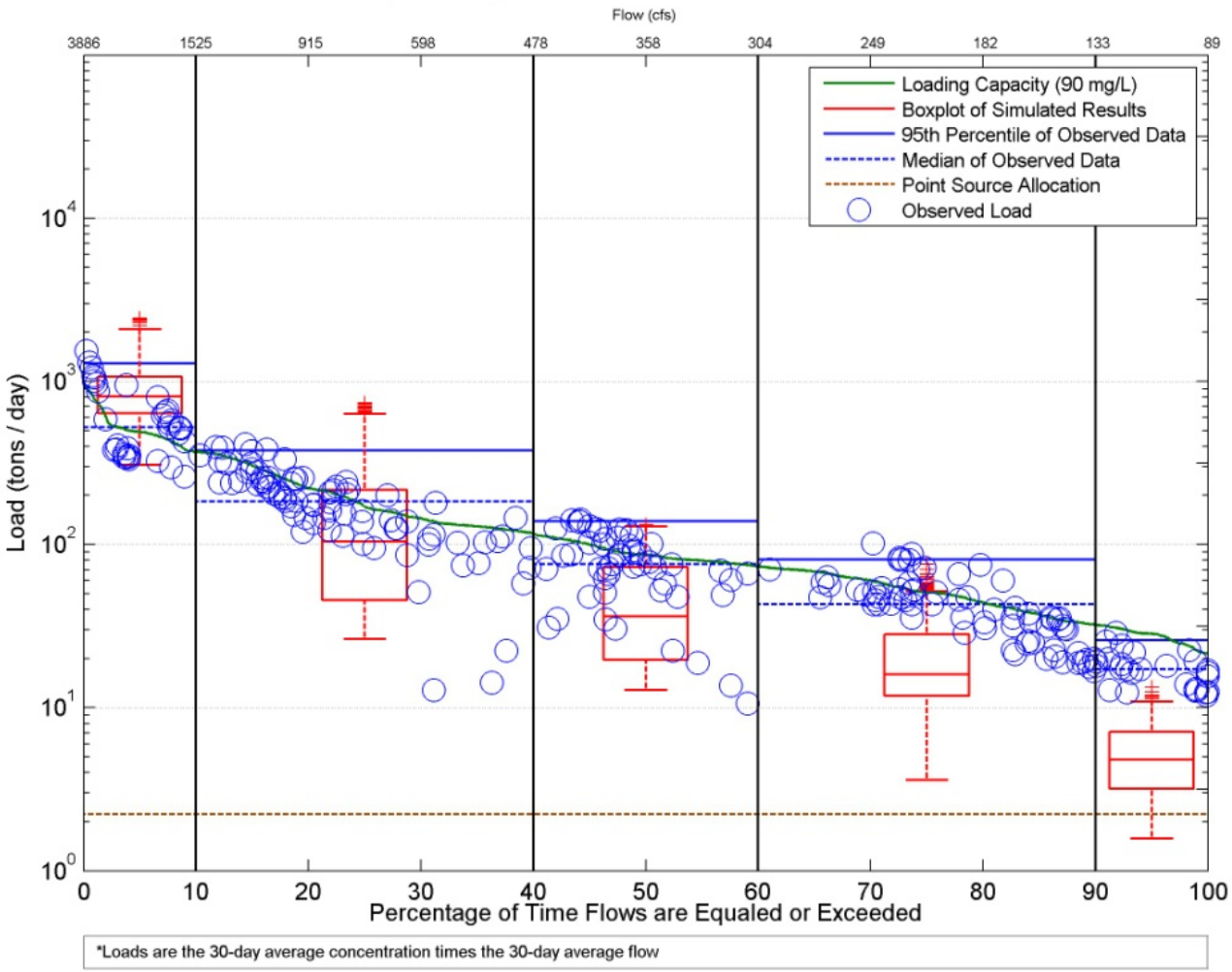

Figure 4-1. Reach SD-BS-R-BIG_SIOUX_08 Load Duration Curve Representing Allowable TSS Loads Based on 30-Day Average TSS Criteria.

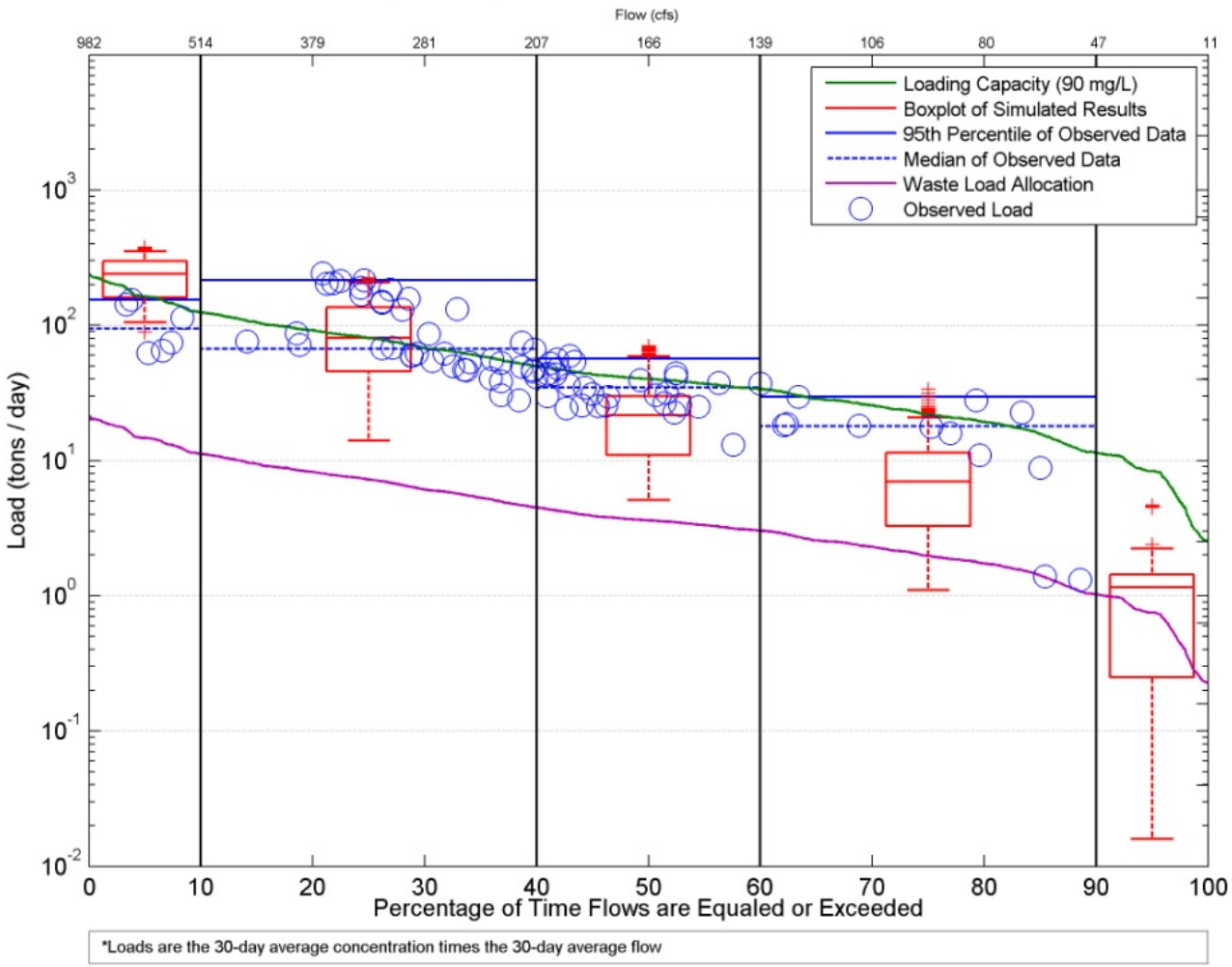

Figure 4-2. Reach SD-BS-R-BIG_SIOUX_10 Load Duration Curve Representing Allowable TSS Loads Based on 30-Day Average TSS Criteria.

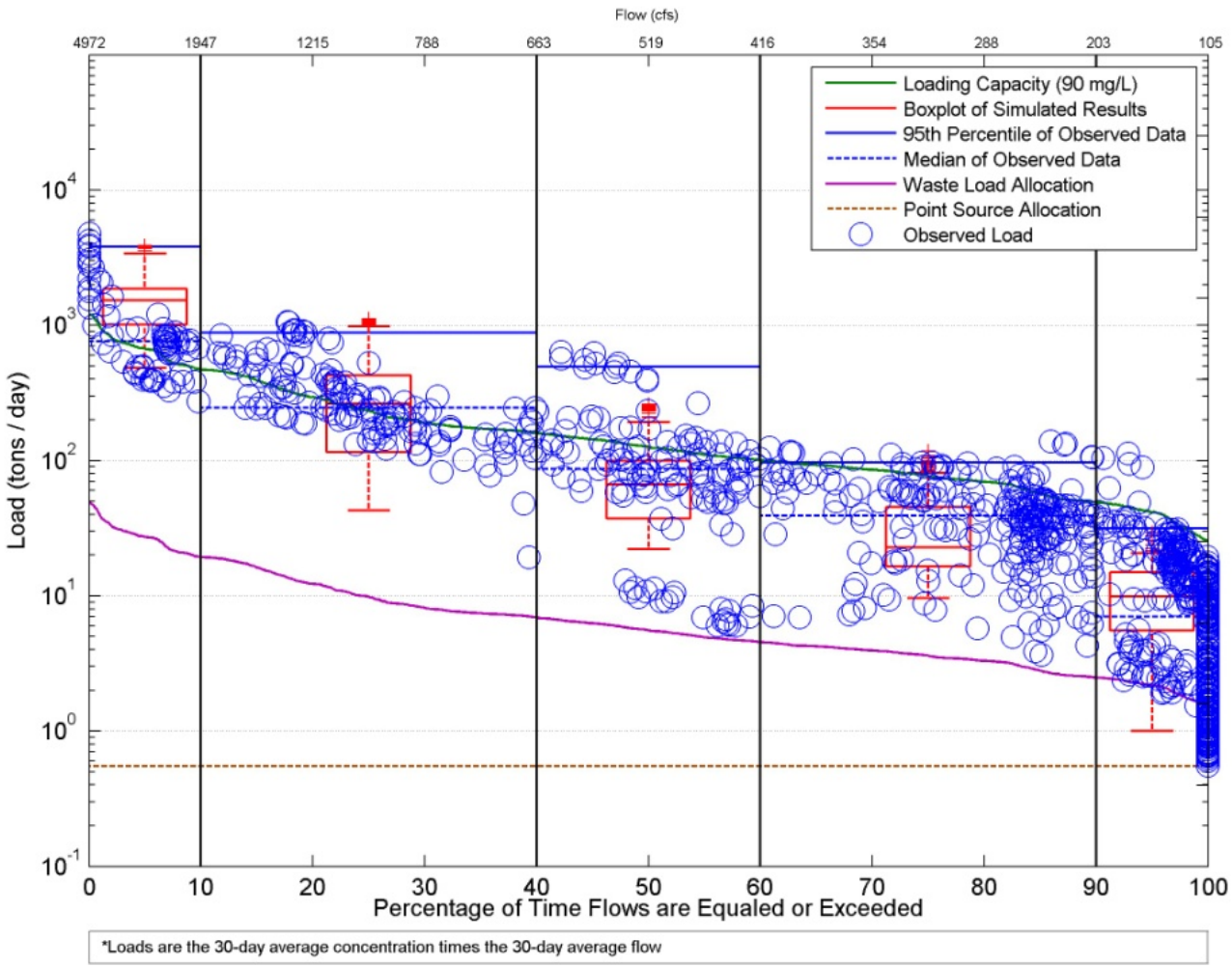

Figure 4-3. Reach SD-BS-R-BIG_SIOUX_11 Load Duration Curve Representing Allowable TSS Based on 30-Day Average TSS Criteria.

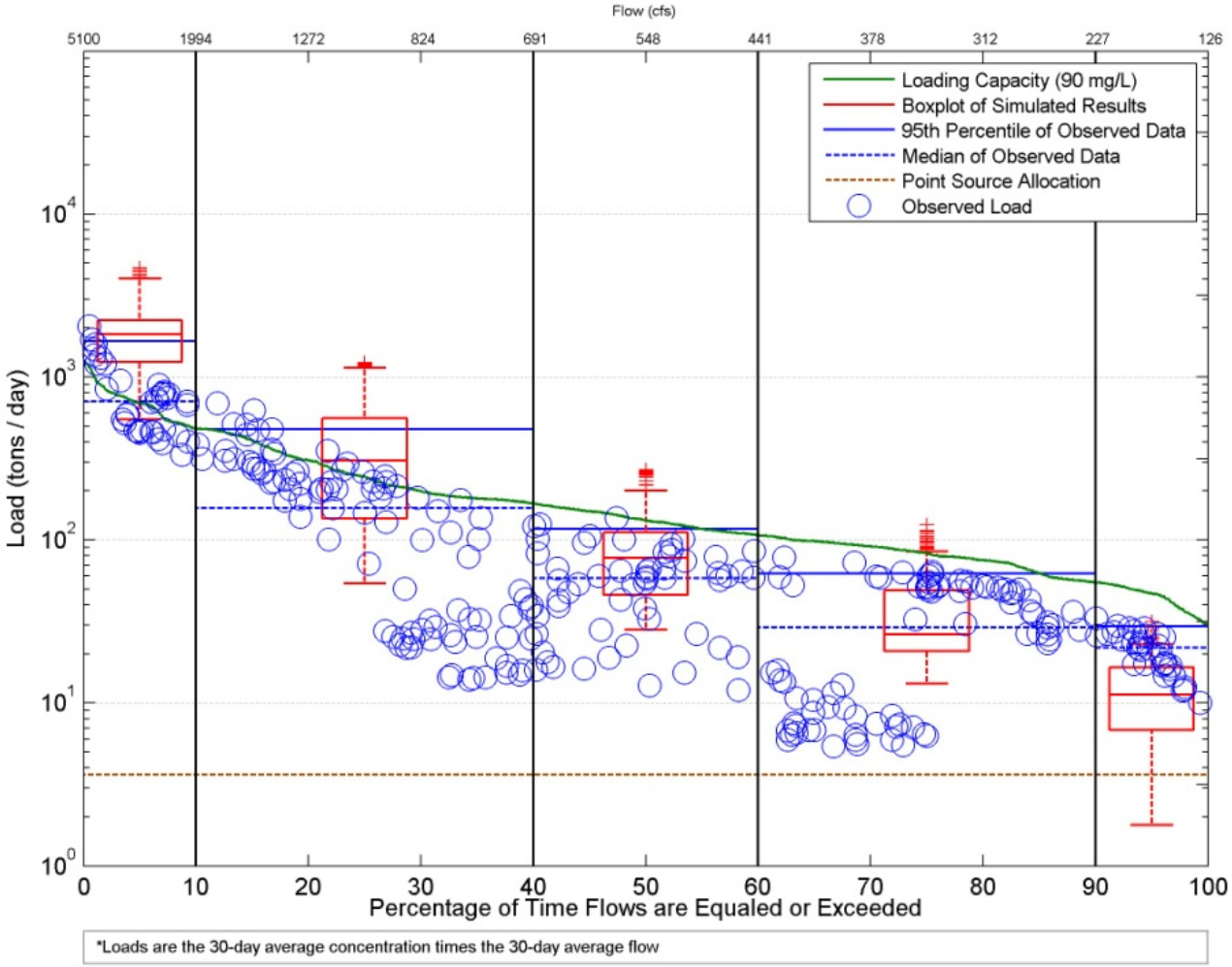

Figure 4-4. Reach SD-BS-R-BIG_SIOUX_12 Load Duration Curve Representing Allowable TSS Loads Based on 30-Day Average TSS Criteria.

5.0 TOTAL MAXIMUM DAILY LOAD AND ALLOCATIONS

To ensure that all applicable TSS criteria are met and to aid in the implementation of the TMDL, load allocations were calculated for each of the five flow zones using both the daily maximum and 30-day average criteria. As mentioned earlier, the critical criteria for this TMDL are 30-day average criteria, because TSS in the Big Sioux River Basin in the Sioux Falls area were shown to be a highly chronic problem. Thus the TMDL tables are focused on the chronic reduction required to meet 30-day average TSS criteria.

TMDL tables were constructed using simulated flows and TSS concentrations from water-quality monitoring stations within each reach. Methods used to calculate the TMDL allocations are discussed in detail in this chapter.

For each of the five flow zones, the 95th percentile of the range of loading capacities within a zone was set as the flow zone goal. TSS loads experienced during the largest stream flows (e.g., the top 5 percent) cannot be feasibly controlled by practical management practices. Thus setting the flow zone goal at the 95th percentile of the range of loading capacities will protect the warm-water semipermanent fish life propagation beneficial use and allow for the natural variability of the system.

5.1 LOAD ALLOCATION

The TMDL (loading capacity) is the sum of the load allocation (LA), the waste load allocation (WLA), and margin of safety (MOS). To develop the TSS LA for each of the four TMDL reaches, the loading capacity was first determined using the data sources specified. The daily maximum criterion (158 mg/L) was used to calculate the daily maximum loading capacities, and the 30-day average criterion (90 mg/L) was used to calculate the 30-day average loading capacities. The daily maximum and 30-day loading capacities for the Big Sioux River were calculated by multiplying the specified TSS criterion by the daily average and 30-day average simulated flow, respectively, at each reach endpoint. Portions of the loading capacity were allocated to nonpoint sources as an LA and an MOS to account for uncertainty in the calculations of these load allocations. The LA is calculated as the TMDL minus the WLA and the MOS.

5.2 WASTE LOAD ALLOCATION

Multiple point sources of TSS discharge directly to the impaired reaches of the Big Sioux River within the Sioux Falls project area. Point-source discharges also exist upstream of the impaired reaches. These discharges are indirectly accounted for through the use of boundary condition loads. TSS loads from these facilities probably do not have a large impact on the impaired reaches of the Big Sioux River because of relatively small facility loads. There are

13 permitted, concentrated animal feeding operations located in Minnehaha County. However, because of a biohazard concern, location information for these is unavailable. These permitted, concentrated animal feeding operations are not currently allowed to discharge within the watershed.

The WLA for the Sioux Falls TMDL is the sum of the point-source allocations (PSAs) within each reach and the MS4 loads, which the MS4 loads includes construction activities. Construction storm water activities are considered in compliance with provisions of the TMDL if they obtain a Construction General Permit under the NPDES program and properly select, install, and maintain all BMPs required under the permit, including any applicable additional BMPs required in Appendix A of the Construction General Permit for discharges to impaired waters, or they must meet local construction stormwater requirements if they are more restrictive than requirements of the State General Permit. The SD DENR has determined that the city of Sioux Falls has a Qualifying Local Program for stormwater management that includes a thorough Construction Site Management Program. Further detail on the MS4 loads was provided in Chapter 4.0. The PSAs, based on the acute and chronic criteria as well as the model-generated MS4 percentage, are shown in Table 5-1. The MS4 loads (tons/day) are not included in Table 5-1 because they vary by flow zone.

Table 5-1. Big Sioux River Total Suspended Solids Wasteload Allocations and the MS4 Percentage

Reach	PSA	PSA TMDL Table I.D.	TSS Acute PSA (tons/day)	TSS Chronic PSA (tons/day)	MS4 % of (TMDL–PSA)
SD-BS-R-BIG_SIOUX_08	Dell Rapids WWTP	PSA 1	2.47	1.64	0
SD-BS-R-BIG_SIOUX_08	Baltic WWTP	PSA 2	0.85	0.57	0
SD-BS-R-BIG_SIOUX_10	N/A	N/A	0	0	9
SD-BS-R-BIG_SIOUX_11	John Morrell & Company	PSA 3	1.10	0.55	4
SD-BS-R-BIG_SIOUX_12	Sioux Falls WWTP	PSA 4	5.43	3.62	0

5.3 MARGIN OF SAFETY

An explicit MOS, identified using a duration curve framework, is unallocated assimilative capacity intended to account for uncertainty (e.g., loads from tributary streams and effectiveness of controls). An explicit MOS was calculated as the difference between the loading capacity at the midpoint of each of the five flow zones and the loading capacity at the minimum flow in each zone. A substantial MOS is provided using this method, because the loading capacity is typically much less at the minimum flow of a zone than at the midpoint. Because

the allocations are a direct function of flow, accounting for potential flow variability is an appropriate method for addressing the MOS.

5.4 BASELINE CONDITIONS

Daily maximum-based loads, presented in Appendix B, were calculated and have a lower, overall reduction necessary to meet load requirements than 30-day average loads. Measured sample concentrations and flow data were used to estimate current daily loads (tons/day) by calculating the product of TSS sample concentrations from monitoring sites, the measured flow (cubic feet per second [cfs]) from monitoring sites, and a unit conversion factor (5.3938). The 95th percentile of the range of these estimates within each flow zone was defined as the baseline daily load. Daily maximum-based TMDL tables are in Appendix B.

To estimate current, 30-day average loads (tons/day), the product of the simulated 30-day average concentrations (mg/L) and simulated 30-day average stream flows (cfs) for reach endpoints was multiplied by a conversion factor (5.3938). The 95th percentile of the range of these estimates within each flow zone was defined as the baseline 30-day average load.

Tables 5-2 through 5-5 present load allocations based on the 30-day average criterion for each flow zone for Reaches 08, 10, 11, and 12.. The tables exhibit that load reductions are required for the high and moist flow zones in all reaches and the midrange flow zone for all reaches except Reach 12. High flows tend to lead to higher sediment because of resuspension and decreased bank stability.

The combined flow-weighted percent reductions required to meet the TMDL based on the acute water-quality criteria were 2 percent in Reach 08, 5 percent in Reach 10, 37 percent in Reach 11, and 12 percent in Reach 12 (observed acute data). The combined flow-weighted percent reductions required to meet the TMDL based on the chronic water-quality criteria were 46 percent in Reach 08, 35 percent in Reach 10, 56 percent in Reach 11, and 61 percent in Reach 12 (simulated chronic data). The chronic reductions are higher for all flow zones, which verifies the use of chronic TMDL reductions for this TMDL.

Table 5-2. Big Sioux River Total Suspended Solids Total Maximum Daily Load Based on the 30-Day Average Criterion for Reach SD-BS-R-BIG_SIOUX_08

TMDL Component (tons/day)		Flow Zone									
		High		Moist		Midrange		Dry		Low	
		> 1,525 cfs		1,525–478 cfs		478—304 cfs		304—133 cfs		< 133 cfs	
LA		756.4		306.5		97.6		50.9		23.0	
PSA 1	WLA	1.6	2.2	1.6	2.2	1.6	2.2	1.6	2.2	1.6	2.2
PSA 2		0.6		0.6		0.6		0.6		0.6	
MS4		0		0		0		0		0	
MOS		121.5		54.8		13.0		18.7		6.9	
TMDL		880.1		363.5		112.8		71.8		32.1	
Current Load[(a)]		2,085.3		630.4		129.4		51.7		10.9	
Load Reduction		1,205.2		266.9		16.6		0.0		0.0	
Load Reduction		58%		42%		13%		0%		0%	

(a) Current load is the 95th percentile of the simulated 30-day average TSS load for each flow zone.

Table 5-3. Big Sioux River Total Suspended Solids Total Maximum Daily Load Based on the 30-Day Average Criterion for Reach SD-BS-R-BIG_SIOUX_10

TMDL Component (tons/day)		Flow Zone									
		High		Moist		Midrange		Dry		Low	
		> 514 cfs		514—207 cfs		207–139 cfs		139–47 cfs		< 47 cfs	
LA		170.3		81.5		38.7		20.3		5.0	
No PSA	WLA	0	16.9	0	8.0	0	3.5	0	2.0	0	0.5
MS4		16.9		8.0		3.5		2.0		0.5	
MOS		39.3		30.7		6.5		10.5		5.8	
TMDL		226.5		120.2		48.7		32.8		11.3	
Current Load[(a)]		353.2		207.1		59.0		20.7		2.3	
Load Reduction		126.7		86.9		10.3		0.0		0.0	
Load Reduction		36%		42%		17%		0%		0%	

(a) Current load is the 95th percentile of the simulated 30-day average TSS load for each flow zone.

Table 5-4. Big Sioux River Total Suspended Solids Total Maximum Daily Load Based on the 30-Day Average Criterion for Reach SD-BS-R-BIG_SIOUX_11

TMDL Component (tons/day)		Flow Zone									
		High		Moist		Midrange		Dry		Low	
		> 1,947 cfs		1,947–663 cfs		663–416 cfs		416–203 cfs		< 203 cfs	
LA		891.5		374.6		126.5		67.1		31.0	
PSA 3	WLA	0.6	37.7	0.6	16.2	0.6	5.8	0.6	3.3	0.6	1.8
MS4		37.1		15.6		5.3		2.8		1.3	
MOS		200.1		72.1		25.0		28.1		16.2	
TMDL		1,129.3		462.9		157.3		98.5		49.0	
Current Load[(a)]		3,392.4		1,004.7		196.1		81.0		21.0	
Load Reduction		2,263.1		541.8		38.8		0.0		0.0	
Load Reduction		67%		54%		20%		0%		0%	

(a) Current Load is the 95th percentile of the simulated 30-day average TSS load for each flow zone.

Table 5-5. Big Sioux River Total Suspended Solids Total Maximum Daily Load Based on the 30-Day Average Criterion for Reach SD-BS-R-BIG_SIOUX_12

TMDL Component (tons/day)		Flow Zone									
		High		Moist		Midrange		Dry		Low	
		> 1,994 cfs		1994–691 cfs		691–441 cfs		441–227 cfs		< 227 cfs	
LA		944.1		395.0		134.0		73.2		34.7	
PSA 4	WLA	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
MS4		0		0		0		0		0	
MOS		208.4		77.2		25.8		28.1		16.4	
TMDL		1,156.1		475.8		163.4		104.9		54.7	
Current Load[(a)]		4,071.3		1,135.5		204.1		85.3		23.1	
Load Reduction		2,915.2		659.7		40.7		0.0		0.0	
Load Reduction		72%		58%		20%		0%		0%	

(a) Current Load is the 95th percentile of the simulated 30-day average TSS load for each flow zone.

6.0 SEASONALITY

Stream flows and TSS concentrations in the Big Sioux River displayed seasonal variation. The 2009 additional monitoring data were used to calculate monthly median TSS concentrations, shown in Figure 6-1, for five Big Sioux River project sites. This figure shows higher TSS concentrations occurring during the spring and summer months. Maximum and minimum average monthly flows included in Table 6-1 were calculated for three project sites. Flows were typically highest during spring and early summer and lowest during late summer and fall.

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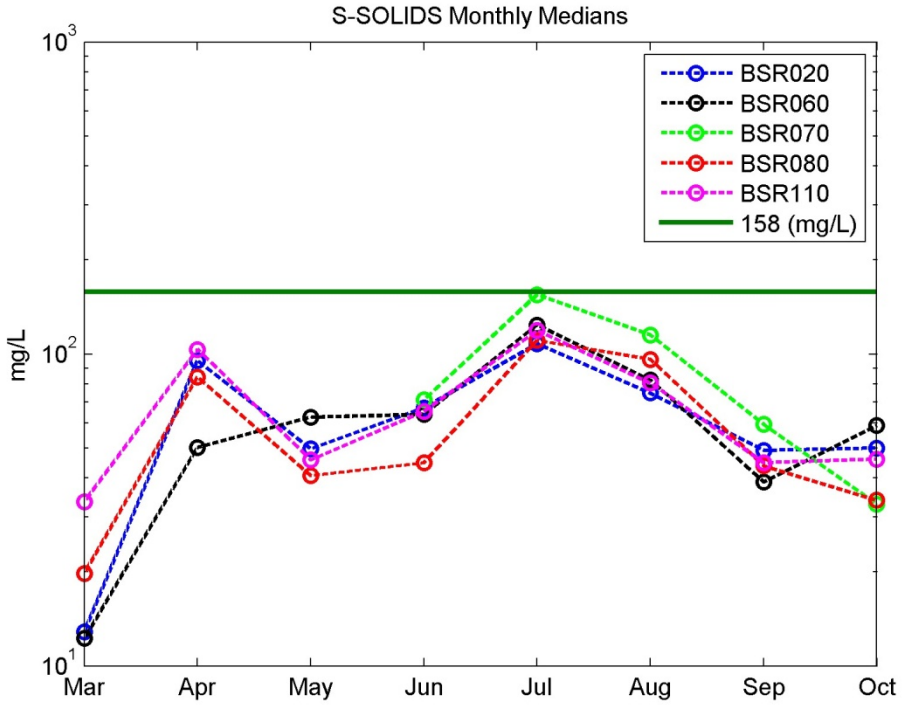

Figure 6-1. Monthly Median Total Suspended Solids Data From Additional 2009 RESPEC Data.

The highest TSS concentrations generally occur during the summer months of June and July. Short-duration, high-intensity rainstorms are common during these months. Localized summer storms can cause significant runoff, increased flows, and increased TSS concentrations for a relatively short period of time. Using the LDC approach to develop the TMDL allocations, seasonal variability in flow and TSS loads are taken into account, because stream flow and TSS delivery to the stream are related to seasonal changes in precipitation.

Table 6-1. Big Sioux River Maximum and Minimum Monthly Average Flows

Site I.D.	Maximum Monthly Average Flow	Minimum Monthly Average Flow
BSR010	2,792 cfs (April)	37 cfs (December)
BSR060	574 cfs (April)	76 cfs (August)
BSR080	4,187 cfs (April)	51 cfs (December)

Summer is also a critical time period because of seasonal differences in precipitation patterns and land uses. Typically, livestock are allowed to graze along the streams during the summer months, and this increases erosion potential. Also, construction is more likely to occur during spring and summer months because of South Dakota's harsh winter temperatures. Combined with the peak in TSS sources, high-intensity rainstorm events are common during the summer and produce a significant amount of TSS load that result from higher flows and washoff from cropland and construction zones.

7.0 PUBLIC PARTICIPATION

Efforts that focused on public education, review, and comment during the development of the Big Sioux River TSS TMDLs involved presentations on the findings of the assessment to local groups in the watershed and a 30-day public notice period for public review and comment. The findings from these public meetings and comments were considered in developing the TMDLs. The public notice was published in the *Sioux Falls Argus Leader* and the *Dell Rapids Tribune*. The document was also made available through the SD DENR's website.

Several meetings were held and presentations were provided for the Steering Committee: one in March 2009, one in April 2009 regarding Sioux Falls land use, one in November 2009 regarding monitoring, and one in October 2010 regarding modeling. Steering Committee members include Robert Kappel and Andy Berg (City of Sioux Falls), John Meyer (John Morrell and Co.), Deb Springman (East Dakota Water Development District [EDWDD]), and Rich Hanson and Kelli Buscher (SD DENR). Regular updates were provided for the Public Works Department, the city of Sioux Falls, EDWDD, John Morrell & Company, and the SD DENR. Two public meetings were held at the Kuehn Community Center in Sioux Falls (May 2009 and November 2009), and one public meeting was held at the Sioux Falls Main Public Library (November 2010). Additionally, presentations about different aspects of the project were provided at the annual Western South Dakota Hydrology Conference (WSDHC) and the Eastern South Dakota Water Conference (ESDWC). Scientists and engineers from the Midwest who work in the area of water quality and stream health regularly attend these conferences as well as many local stakeholders. These conferences allowed the project team to provide updates to the professional and stakeholder communities and receive feedback on the technical aspects of the project. A Sioux Falls TMDL website has been available since March 2009, and an EPA MS4 workshop was held in July 2009. A TMDL Public Education Video is also available (*www.siouxfalls.org/CityLink16/Programs/Feature_Programs/tmdl_project/video*). A timeline of all the events relating to this TMDL is shown in Figure 7-1.

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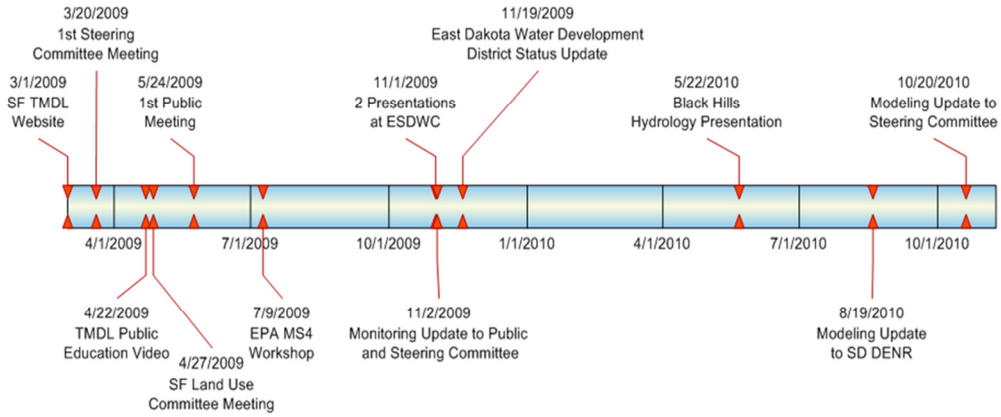

Figure 7-1. Timeline of Public Events.

8.0 MONITORING STRATEGY

During and after the implementation of management practices, monitoring will be necessary to ensure attainment of the TMDLs. Stream water-quality monitoring will be accomplished through SD DENR's ambient water-quality monitoring stations on the Big Sioux River, which are sampled on a monthly basis during the recreational season.

Additional monitoring and evaluation efforts regarding the effectiveness of implemented BMPs should be targeted. Monitoring locations should be based on the location and type of BMPs installed.

The SD DENR may adjust the load and/or wasteload allocations in this TMDL to account for new information or circumstances that develop during the implementation phase of the TMDL. New information generated during TMDL implementation may include monitoring data, BMP effectiveness information, and land use information. The SD DENR will propose adjustments only in the event that any adjusted LA or WLA will not result in a change to the loading capacity; the adjusted TMDL, including the WLAs and LAs, will be set at a level necessary to implement the applicable water-quality standards, and any adjusted WLA will be supported by a demonstration that load allocations are practical. The SD DENR will notify the EPA of any adjustments to this TMDL within 30 days of their adoption. Load and waste load allocation will only be adjusted after an opportunity for public participation.

9.0 RESTORATION STRATEGY

A variety of BMPs could be considered in the development of a water-quality management implementation plan for the South Dakota portion of the project area. While several types of control measures are available for reducing TSS loads, the practicable control measures listed and discussed below are recommended to address the identified sources in South Dakota. Based on water-quality monitoring and **HSPF** model results, there is reasonable assurance that the recommended control measures to be implemented in Sioux Falls are expected to reduce exceedances of the 30-day average TSS criteria from the current 18 percent to 1 percent in Reach 08, 24 percent to 0 percent in Reach 10, 31 percent to 5 percent in Reach 11, and 33 percent to 10 percent in Reach 12. These load reductions are conservative because they are based on model predictions that run continuously every hour over the 5-year modeling period. Also, note that model results indicate that implementing the management scenarios listed below resulted in exceedances of the acute TSS criterion 0 percent in Reach 08, 0 percent in Reach 10, 1 percent in Reach 11, and 2 percent in Reach 12.

The six management scenarios that were simulated for each TSS-impaired reach using the **HSPF** model include incorporating: (1) future land use, (2) the city's planned BMPs, (3) a 90 percent load reduction on agricultural land within the project area boundary north of Sioux Falls local to the Big Sioux River and Silver Creek, (4) Big Sioux River upstream of Dell Rapids compliance with the current warm-water semipermanent fish life and Skunk Creek compliance with the current warm-water marginal fish life propagation chronic water-quality standard, (5) Big Sioux River upstream of Dell Rapids and Skunk Creek compliance with the warm-water semipermanent fish life propagation chronic water-quality standard, (6) a 50 percent reduction in the amount of instream scour in the Big Sioux River and Skunk Creek within the project area. A seventh scenario that would have reduced TSS 50 percent on 100 percent of the MS4 was considered, but the model verified stormwater monitoring data in this potential management scenario had minimal impact (< 1 percent) on concentrations and loadings in all reaches, and was, therefore, not included as a viable, cost-effective management option. Modeled percent exceedance of the 30-day average criteria, individual load reduction results, and cumulative load reduction results are presented in the first, second, and third rows, respectively, of each reach's TMDL endpoint in Table 9-1.

Model results are discussed individually by scenario and show that implementing future Sioux Falls land use (Scenario 1) would result in a load reduction of 0 percent for Reach 08, 2 percent load increase for Reach 10, 0 percent load reduction for Reach 11, and 1 percent load increase in Reach 12. Model results indicated that implementing planned Sioux Falls BMPs (Scenario 2) would result in a load reduction of 0 percent in all reaches except Reach 10 where a 2 percent load reduction is predicted. A decrease in percent exceedance of the chronic criteria would not occur by implementing Scenarios 1 or 2.

Table 9-1. Big Sioux River Best Management Practice Modeled Percent Exceedance of the 30-Day Average Criterion and Best Management Practice Reduction (Scenarios 1–6)

	Baseline	Scenario 1 (Future Land Use)	Scenario 2 (Sioux Falls Planned BMPs)	Scenario 3 (90% Load Reduction on Agriculture Land[a])	Scenario 4 (Big Sioux River and Skunk Creek Boundaries at Current TSS Criteria (90 mg/L and 150 mg/L, respectively)	Scenario 5 (Big Sioux River and Skunk Creek Boundaries at Warm-Water Semipermanent Criteria (90 mgL)	Scenario 6 (50% Reduction of Instream Scour on Big Sioux River and Skunk Creek Within the Project Area)
Big Sioux River (TMDL Endpoint of Reach 08)							
Modeled % Exceedance (30-day average)[b]	18%	18%	18%	18%	11%	11%	1%
Individual BMP Percent Load Reduction[c]	–	0%	0%	0%	25%	0%	28%
Cumulative BMP Percent Load Reduction	–	0%	0%	0%	25%	25%	53%
Big Sioux River (TMDL Endpoint of Reach 10)							
Modeled % Exceedance (30-day average)[b]	24%	24%	24%	24%	2%	0%	0%
Individual BMP Percent Load Reduction[c]	–	-2%	2%	0%	45%	6%	16%
Cumulative BMP Percent Load Reduction	–	-2%	0%	0%	45%	51%	67%
Big Sioux River (TMDL Endpoint of Reach 11)							
Modeled % Exceedance (30-day average)[b]	31%	31%	31%	31%	18%	17%	5%
Individual BMP Percent Load Reduction[c]	–	0%	0%	0%	23%	1%	31%
Cumulative BMP Percent Load Reduction	–	0%	0%	0%	23%	24%	55%
Big Sioux River (TMDL Endpoint of Reach 12)							
Modeled % Exceedance (30-day average)[b]	33%	33%	33%	33%	22%	22%	10%
Individual BMP Percent Load Reduction[c]	–	-1%	0%	0%	19%	1%	34%
Cumulative BMP Percent Load Reduction	–	-1%	0%	0%	19%	20%	54%

(a) Agricultural BMPs for Scenario 3 were on lands within the project area boundary north of Sioux Falls local to the Big Sioux River and Silver Creek.
(b) Modeled percent exceedance represents the percent of samples that exceeded the 30-day average concentration based on the results of the HSPF model application.
(c) Individual load reduction is the reduction in average annual load from water year 2005–2009 that corresponds to a single BMP (not cumulative BMP effects).

Simulation of agricultural BMP implementation on lands within the project area boundary north of Sioux Falls local to the Big Sioux River and Silver Creek using a 90 percent load reduction on agricultural land (Scenario 3) resulted in a load reduction of 0 percent to all four TSS-impaired reaches in the Big Sioux River project area. The lack of load reduction probably occurred because agricultural lands in the project area that have low slopes, high infiltration, and low transport capacities currently have low TSS loads.

For Scenario 4, TSS concentrations were reduced at the Big Sioux River and Skunk Creek boundary conditions by multiplying each by a reduction factor (0.42 for the Big Sioux River and 0.27 for Skunk Creek) to ensure all concentrations were below the current 30-day average standards (warm-water semipermanent fish life propagation [90 mg/L]) for the Big Sioux River and warm-water marginal fish life propagation [150 mg/L] for Skunk Creek). The model shows that Scenario 4 would result in load reductions of 25 percent, 45 percent, 23 percent, and 19 percent for Reaches 08, 10, 11, and 12, respectively.

Currently, Skunk Creek has daily maximum and 30-day average TSS criteria of 263 mg/L and 150 mg/L, respectively, which are higher than the daily maximum criteria and 30-day average criteria of 158 mg/L and 90 mg/L in the impaired Big Sioux River reaches. Skunk Creek also contributes significant volume to Reaches 10, 11, and 12. This significantly influences water quality on the Big Sioux River, and the project team is working closely with SD DENR to determine if Skunk Creek should be reassigned a more stringent standard. For Scenario 5, TSS concentrations were reduced at the Big Sioux River and Skunk Creek boundary conditions by multiplying each by a reduction factor (0.42 for the Big Sioux River and 0.16 for Skunk Creek) to ensure all concentrations were below the warm-water semipermanent fish life propagation criteria (90 mg/L). The model shows that Scenario 5 would result in a reduction in average TSS loads of approximately 0 percent in Reach 08, 6 percent in Reach 10, and 1 percent in Reaches 11 and 12.

For Scenario 6, the instream bed and bank scour was reduced by 50 percent, which simulates streambank protection measures already being implemented within the project area. Implementation of Scenario 6 would result in a reduction in average TSS loads of approximately 28 percent, 16 percent, 31 percent, and 34 percent in Reaches 08, 10, 11, and 12, respectively.

Cumulatively, implementing all six scenarios would decrease 30-day average criterion percent exceedance from baseline conditions of 18 to 33 percent exceedance to 1 percent, 0 percent, 5 percent, and 10 percent exceedance in Reaches 08, 10, 11, and 12, respectively. Thus there is reasonable assurance that the cumulative implementation of Scenarios 1 through 6 would be an effective method for achieving maximum TSS reduction in the Big Sioux River throughout the project area.

Overall, there is reasonable assurance that TSS exceedances in the Big Sioux River project area can be reduced from a range of 18 to 33 percent to a range of 0 to 22 percent with proper

planning between state and local regulatory agencies, organizations, and stakeholders; BMP implementation; and access to adequate financial resources. Funds to implement watershed water-quality improvements can be obtained through SD DENR and the United States Department of Agriculture. Specifically, the SD DENR administers three major funding programs that provide low-interest loans and grants for projects that protect and improve water quality in South Dakota. These programs include Consolidated Water Facilities Construction Program, Clean Water State Revolving Fund Program, and the Section 319 Nonpoint Source Program. If the preferred concentrations cannot be met with the implementation of recommended BMPs, pollutant trading should be considered for the Sioux Falls Big Sioux River project area.

9.1 ADAPTIVE IMPLEMENTATION APPROACH

An adaptive implementation approach will be followed for implementing this TMDL. The EPA defines "adaptive implementation [as] an iterative implementation process that makes progress toward achieving water quality goals while using any new data and information to reduce uncertainty and adjust implementation activities" [U.S. Environmental Protection Agency, 2006]. Using an adaptive implementation approach for this TMDL is based on the uncertainty in developing the loading sources. The source assessment presented in Chapter 3.0 of this TMDL is based on relatively general sources of load contributions. To effectively achieve TSS reduction in the Big Sioux River, further understanding of specific sources of TSS to the impaired reaches is needed. To obtain a better understanding of the sources, a relatively intensive monitoring network, consisting of spatially distributed sampling locations, should be established within the project area. A possible benefit of this monitoring would be the ability to further isolate and investigate portions of the watershed with elevated suspended sediment levels for potential source areas and remedial actions. As noted in Chapter 8.0, SD DENR will notify EPA of any adjustments to this TMDL within 30 days of their adoption.

9.2 REASONABLE ASSURANCE

When a TMDL is developed for waters that are impaired by both point and nonpoint sources, and the WLA is based on an assumption that nonpoint-source load reductions will occur, the EPA states that the TMDL should provide reasonable assurances that nonpoint-source control measures will achieve expected load reductions.

The Big Sioux River Reaches 08, 10, 11, and 12 are impaired by nonpoint sources and permitted point sources (including the MS4). Therefore, the requirement to provide reasonable assurances applies to the TSS TMDLs for these reaches.

The WLAs for the non-MS4 point sources are calculated based on the effluent limits in the NPDES permits and the current discharge volumes for each point source. Modeling

demonstrates that at these WLAs, the non-MS4 point sources contribute less than 1 percent of the TSS load in these reaches. Therefore, further reductions in the WLAs for the non-MS4 point sources are not likely to have much effect on meeting the TSS water-quality criteria in these reaches.

The WLA for the MS4 is calculated based on the loading capacity that remains after accounting for the non-MS4 point sources and the MOS and assumes that the MS4 portion of the remaining loading capacity equals its current percent contribution of the total current load. HSPF modeling demonstrates that the MS4 contributes 4 percent to 9 percent of the total TSS loading in all four reaches, yet reductions of as much as 50 percent on 100 percent of the MS4 would have minimal impact (< 1 percent) on concentrations and loadings in all reaches. Therefore, further reductions in the WLAs for the MS4 point sources are also not likely to be effective in meeting the TSS water-quality criteria in these reaches.

The following elements provide assurances that nonpoint-source control measures can be feasibly designed to reduce the TSS loading in these reaches, that they are likely to be effective, and that they have a reasonably high probability of successful implementation in the Big Sioux River project area:

- Cooperation among stakeholders will facilitate implementation. The water-quality assessment work and the TMDL development for these reaches were performed as a cooperative project among the City of Sioux Falls, USGS, the EDWDD, RESPEC, and SD DENR. The cooperation among local stakeholders, state and local regulatory agencies, and organizations is expected to continue through the implementation phase and increase the probability of success.
- Conservative assumptions were used in the calculations of required load reductions.
  - The percent reductions in nonpoint-source loading required to meet the TMDL are the difference between the baseline loading and the TMDL. The baseline loading value chosen for the four reaches is the 95th percentile of the range of simulated 30-day average load (the product of the simulated 30-day average concentrations and simulated 30-day average flow for each reach endpoint) for each flow zone. This provides conservatism in the calculation of the necessary loading reductions.
  - A relatively large, explicit MOS is incorporated into the calculation of the LA for the nonpoint sources. The average MOS is 22 percent across all reaches and flow zones. This means that the TSS water-quality criterion could conceivably be met when the actual load reductions are, on average, 22 percent lower than the calculated required load reductions.
- Work on a TMDL implementation plan has commenced. Resources have been committed and work has commenced on developing a watershed-scale, decision support framework that is based on cost optimization that supports government and local

planning agencies in coordinating investments for achieving required load reductions. This decision support framework is the first step in the development of a TMDL implementation plan that outlines strategies with the best probability of a successful outcome and outlines milestones for implementation. The implementation plan will include a master plan with details concerning controls, schedule, and milestones to achieve the load allocations over time; monitoring to evaluate the progress toward achieving the load allocation, and discussing consequences and/or follow-up actions if adequate progress is not demonstrated (using the adaptive management approach).

10.0 REFERENCES

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APPENDIX A

ACUTE CRITERIA
LOAD DURATION CURVES

RSI-1827-10-051

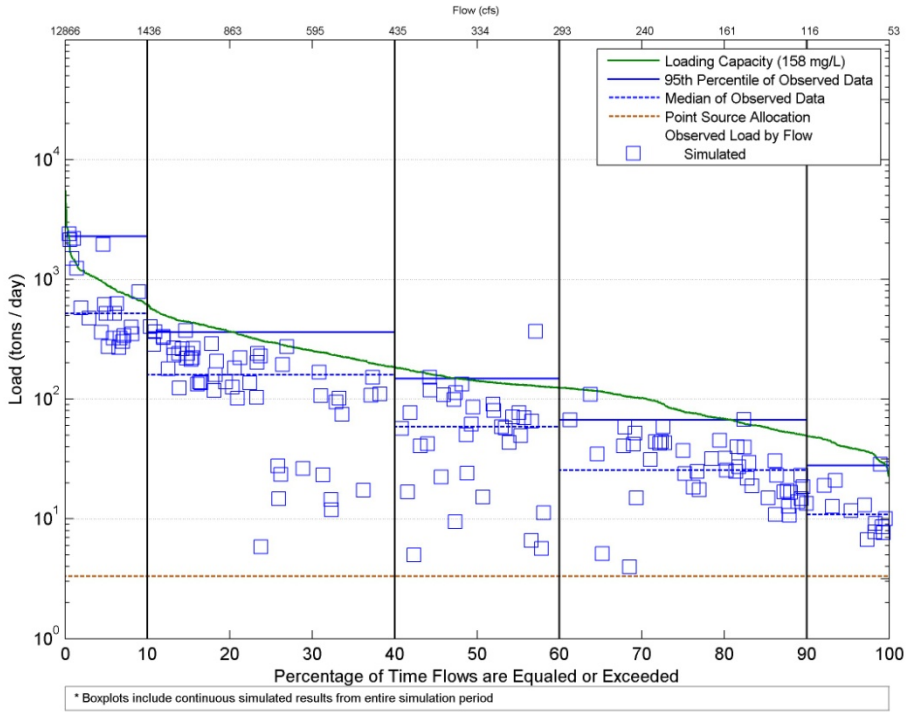

Figure A-1. Reach SD-BS-R-BIG_SIOUX_08 Acute Criteria Load Duration Curve.

RSI-1827-10-052

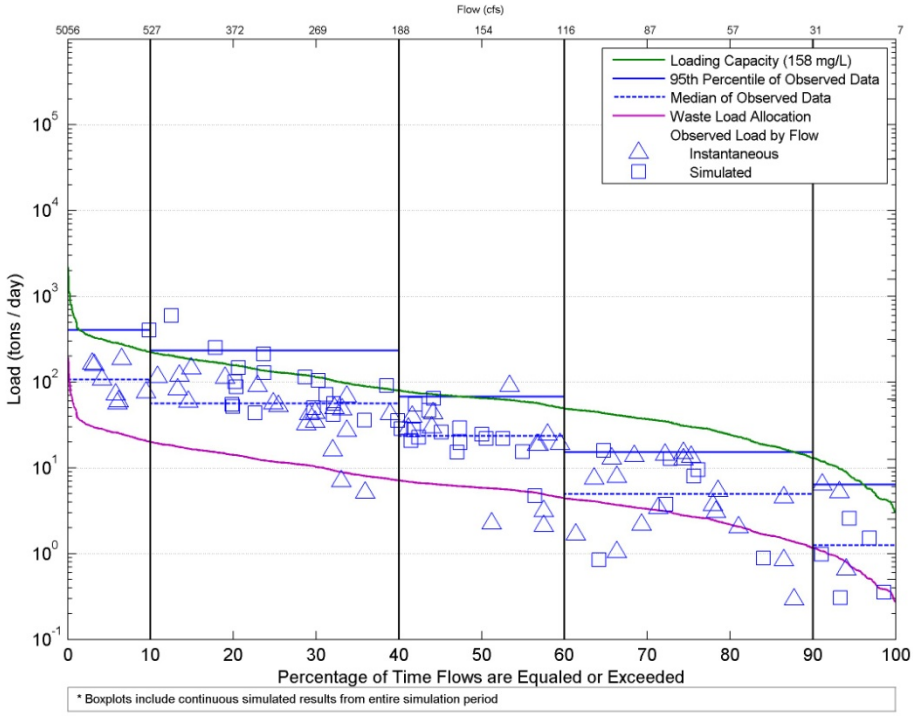

Figure A-2. Reach SD-BS-R-BIG_SIOUX_10 Acute Criteria Load Duration Curve.

RSI-1827-10-053

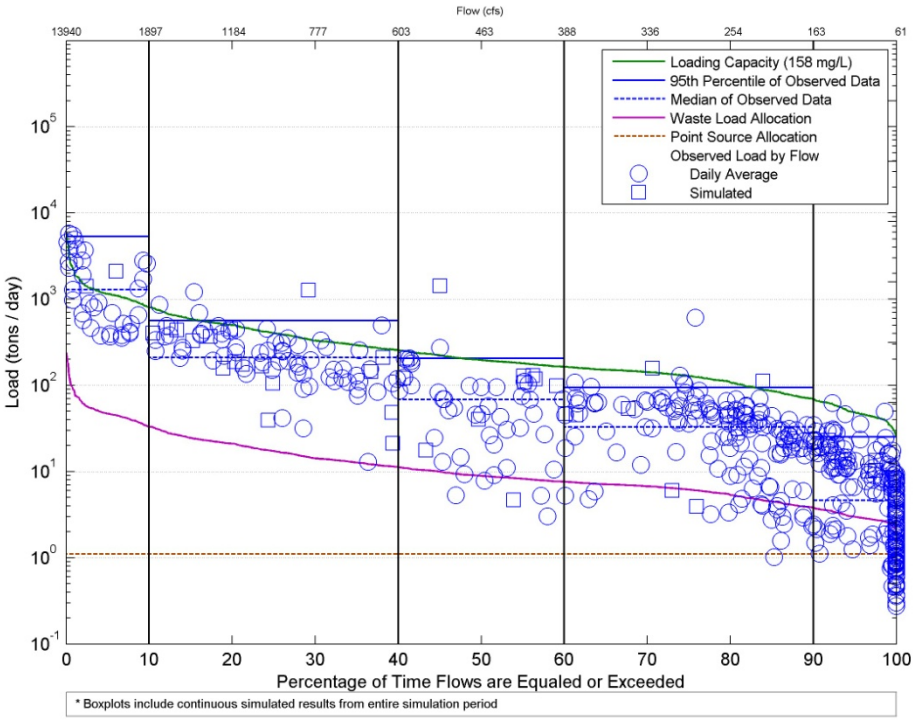

Figure A-3. Reach SD-BS-R-BIG_SIOUX_11 Acute Criteria Load Duration Curve.

RSI-1827-10-054

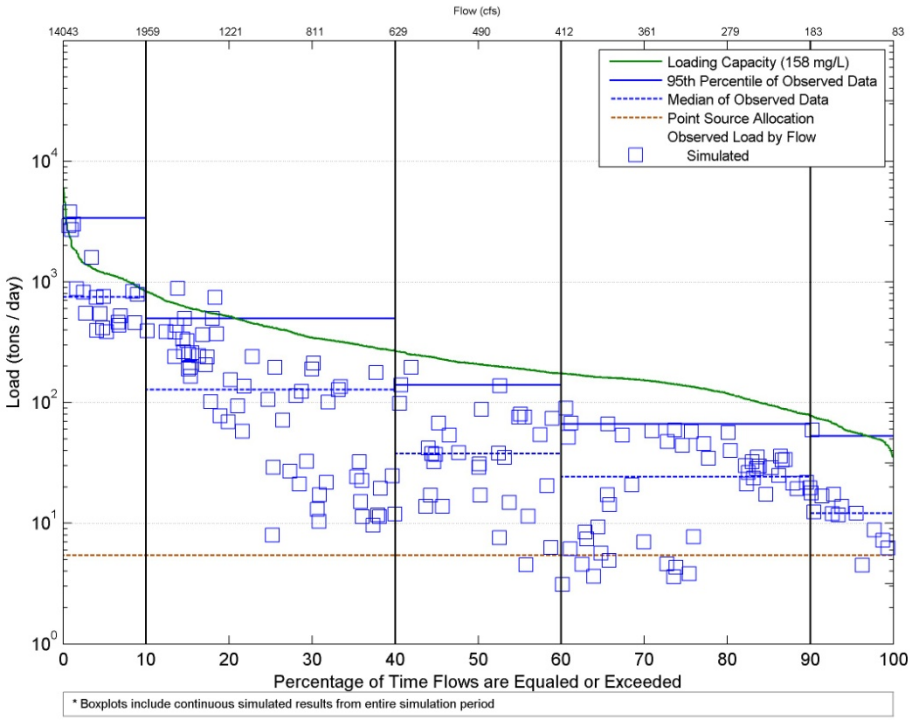

Figure A-4. Reach SD-BS-R-BIG_SIOUX_12 Acute Criteria Load Duration Curve.

APPENDIX B

ACUTE CRITERIA
TOTAL MAXIMUM DAILY LOAD TABLES

Table B-1. Reach SD-BS-R-BIG_SIOUX_08 Acute Criteria

TMDL Component (tons/day)		Flow Zone									
		High		Moist		Midrange		Dry		Low	
		> 1,436 cfs		1,436–435 cfs		435–293 cfs		293–116 cfs		< 116 cfs	
LA		1,913.2		403.5		159.3		90.0		28.6	
PSA 1	WLA	2.5	3.4	2.5	3.4	2.5	3.4	2.5	3.4	2.5	3.4
PSA 2		0.9		0.9		0.9		0.9		0.9	
MS4		0		0		0		0		0	
MOS		294.2		113.4		17.1		29.5		16.7	
TMDL		2,210.8		520.3		179.8		122.9		48.7	
Current Load[(a)]		2,279.4		360.8		148.9		67.1		27.9	
Load Reduction		68.6		0.0		0.0		0.0		0.0	
Load Reduction		3%		0%		0%		0%		0%	

(a) Current load is the 95th percentile of the observed daily maximum TSS load for each flow zone

Table B-2. Reach SD-BS-R-BIG_SIOUX_10 Acute Criteria

TMDL Component (tons/day)		Flow Zone									
		High		Moist		Midrange		Dry		Low	
		> 527 cfs		527–188 cfs		188–116 cfs		116–31 cfs		< 31 cfs	
LA		619.8		143.4		55.8		27.3		7.5	
No PSA	WLA	0.0	61.3	0.0	14.2	0.0	5.5	0.0	2.7	0.0	0.7
MS4		61.3		14.2		5.5		2.7		0.7	
MOS		74.5		51.3		16.2		17.4		4.4	
TMDL		755.6		208.9		77.5		47.4		12.6	
Current Load[(a)]		403.6		232.2		67.3		15.2		6.3	
Load Reduction		0.0		23.3		0.0		0.0		0.0	
Load Reduction		0%		10%		0%		0%		0%	

(a) Current load is the 95th percentile of the observed daily maximum TSS load for each flow zone.

Table B-3. Reach SD-BS-R-BIG_SIOUX_11 Acute Criteria

TMDL Component (tons/day)		Flow Zone									
		High		Moist		Midrange		Dry		Low	
		> 1,897 cfs		1,897–603 cfs		603–388 cfs		388–163 cfs		< 163 cfs	
LA		2,258.1		547.9		207.4		96.6		40.6	
PSA 3	WLA	1.1	95.2	1.1	23.9	1.1	9.7	1.1	5.1	1.1	2.8
MS4		94.1		22.8		8.6		4.0		1.7	
MOS		345.2		151.0		32.0		59.1		22.8	
TMDL		2,698.5		722.8		249.1		160.8		66.2	
Current Load[(a)]		5,085.4		394.4		57.3		28.7		4.6	
Load Reduction		2,386.9		0.0		0.0		0.0		0.0	
Load Reduction		47%		0%		0%		0%		0%	

(a) Current load is the 95th percentile of the observed daily maximum TSS load for each flow zone.

Table B-4. Reach SD-BS-R-BIG_SIOUX_12 Acute Criteria

TMDL Component (tons/day)		Flow Zone									
		High		Moist		Midrange		Dry		Low	
		> 1,959 cfs		1,959–629 cfs		629–412 cfs		412–183 cfs		< 183 cfs	
LA		2,400.1		594.3		223.7		106.5		48.2	
PSA 4	WLA	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
MS4		0		0		0		0		0	
MOS		340.6		153.2		33.3		60.0		21.8	
TMDL		2,746.1		752.9		262.4		171.9		75.4	
Current Load[(a)]		3,397.2		498.9		140.1		66.4		52.9	
Load Reduction		651.1		0.0		0.0		0.0		0.0	
Load Reduction		19%		0%		0%		0%		0%	

(a) Current load is the 95th percentile of the observed daily maximum TSS load for each flow zone.

EPA REGION 8 TMDL REVIEW

TMDL Document Info:

Document Name:	**Total Suspended Solids Total Maximum Daily Load for the Big Sioux River, Minnehaha County South Dakota**
Submitted by:	**South Dakota Department of Environment and Natural Resources**
Date Received:	**June 1, 2012**
Review Date:	**August 29, 2012**
Reviewer:	**Bonnie Lavelle, EPA Region 8**
Rough Draft / Public Notice / Final Draft?	**Public Notice Draft**
Notes:	

Reviewers Final Recommendation(s) to EPA Administrator (used for final draft review only):

- ☐ Approve
- ☐ Partial Approval
- ☐ Disapprove
- ☐ Insufficient Information

Approval Notes to Administrator:

This document provides a standard format for EPA Region 8 to provide comments to state TMDL programs on TMDL documents submitted to EPA for either formal or informal review. All TMDL documents are evaluated against the minimum submission requirements and TMDL elements identified in the following 8 sections:

1. Problem Description
   - 1.1.. TMDL Document Submittal Letter
   - 1.2. Identification of the Waterbody, Impairments, and Study Boundaries
   - 1.3. Water Quality Standards
2. Water Quality Target
3. Pollutant Source Analysis
4. TMDL Technical Analysis
   - 4.1. Data Set Description
   - 4.2. Waste Load Allocations (WLA)
   - 4.3. Load Allocations (LA)
   - 4.4. Margin of Safety (MOS)
   - 4.5. Seasonality and variations in assimilative capacity
5. Public Participation
6. Monitoring Strategy
7. Restoration Strategy
8. Daily Loading Expression

Under Section 303(d) of the Clean Water Act, waterbodies that are not attaining one or more water quality standard (WQS) are considered "impaired." When the cause of the impairment is determined to be a pollutant, a TMDL analysis is required to assess the appropriate maximum allowable pollutant loading rate. A TMDL document consists of a technical analysis conducted to: (1) assess the maximum pollutant loading rate that a waterbody is able to assimilate while maintaining water quality standards; and (2) allocate that assimilative capacity among the known sources of that pollutant**.** A well written TMDL document will describe a path forward that may be used by those who implement the TMDL recommendations to attain and maintain WQS.

Each of the following eight sections describes the factors that EPA Region 8 staff considers when reviewing TMDL documents. Also included in each section is a list of EPA's minimum submission requirements relative to that section, a brief summary of the EPA reviewer's findings, and the reviewer's comments and/or suggestions. Use of the verb "must" in the minimum submission requirements denotes information that is required to be submitted because it relates to elements of the TMDL required by the CWA and by regulation. Use of the term "should" below denotes information that is generally necessary for EPA to determine if a submitted TMDL is approvable.

This review template is intended to ensure compliance with the Clean Water Act and that the reviewed documents are technically sound and the conclusions are technically defensible.

1. Problem Description

A TMDL document needs to provide a clear explanation of the problem it is intended to address. Included in that description should be a definitive portrayal of the physical boundaries to which the TMDL applies, as well as a clear description of the impairments that the TMDL intends to address and the associated pollutant(s) causing those impairments. While the existence of one or more impairment and stressor may be known, it is important that a comprehensive evaluation of the water quality be conducted prior to development of the TMDL to ensure that all water quality problems and associated stressors are identified. Typically, this step is conducted prior to the 303(d) listing of a waterbody through the monitoring and assessment program. The designated uses and water quality criteria for the waterbody should be examined against available data to provide an evaluation of the water quality relative to all applicable water quality standards. If, as part of this exercise, additional WQS problems are discovered and additional stressor pollutants are identified, consideration should be given to concurrently evaluating TMDLs for those additional pollutants. If it is determined that insufficient data is available to make such an evaluation, this should be noted in the TMDL document.

1.1 TMDL Document Submittal Letter

When a TMDL document is submitted to EPA requesting formal comments or a final review and approval, the submittal package should include a letter identifying the document being submitted and the purpose of the submission.

Minimum Submission Requirements.

☒ A TMDL submittal letter should be included with each TMDL document submitted to EPA requesting a formal review.

☒ The submittal letter should specify whether the TMDL document is being submitted for initial review and comments, public review and comments, or final review and approval.

☐ Each TMDL document submitted to EPA for final review and approval should be accompanied by a submittal letter that explicitly states that the submittal is a final TMDL submitted under Section 303(d) of the Clean Water Act for EPA review and approval. This clearly establishes the State's/Tribe's intent to submit, and EPA's duty to review, the TMDL under the statute**.** The submittal letter should contain such identifying information as the name and location of the waterbody and the pollutant(s) of concern, which matches similar identifying information in the TMDL document for which a review is being requested.

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information ☐ N/A

Summary: *The document was transmitted to EPA by email on June 1, 2012. South Dakota Department of Environment and Natural Resources (SD DENR) requested formal review by EPA and stated that the document had been made available to the public for a 30-day period for review. The deadline for submitting public comments was July 1, 2012.*

Comments: *None.*

1.2 Identification of the Waterbody, Impairments, and Study Boundaries

The TMDL document should provide an unambiguous description of the waterbody to which the TMDL is intended to apply and the impairments the TMDL is intended to address. The document should also clearly delineate the physical boundaries of the waterbody and the geographical extent of the watershed area studied. Any additional information needed to tie the TMDL document back to a current 303(d) listing should also be included.

Minimum Submission Requirements:

☒ The TMDL document should clearly identify the pollutant and waterbody segment(s) for which the TMDL is being established. If the TMDL document is submitted to fulfill a TMDL development requirement for a waterbody on the state's current EPA approved 303(d) list, the TMDL document submittal should clearly identify the waterbody and associated impairment(s) as they appear on the State's/Tribe's current EPA approved 303(d) list, including a full waterbody description, assessment unit/waterbody ID, and the priority ranking of the waterbody. This information is necessary to ensure that the administrative record and the national TMDL tracking database properly link the TMDL document to the 303(d) listed waterbody and impairment(s).

☒ One or more maps should be included in the TMDL document showing the general location of the waterbody and, to the maximum extent practical, any other features necessary and/or relevant to the understanding of the TMDL analysis, including but not limited to: watershed boundaries, locations of major pollutant sources, major tributaries included in the analysis, location of sampling points, location of discharge gauges, land use patterns, and the location of nearby waterbodies used to provide surrogate information or reference conditions. Clear and concise descriptions of all key features and their relationship to the waterbody and water quality data should be provided for all key and/or relevant features not represented on the map

☒ If information is available, the waterbody segment to which the TMDL applies should be identified/geo-referenced using the National Hydrography Dataset (NHD). If the boundaries of the TMDL do not correspond to the Waterbody ID(s) (WBID), Entity_ID information or reach code (RCH_Code) information should be provided. If NHD data is not available for the waterbody, an alternative geographical referencing system that unambiguously identifies the physical boundaries to which the TMDL applies may be substituted.

Recommendation:
☐ Approve ☒ Partial Approval ☐ Disapprove ☐ Insufficient Information

Summary:

Pollutant and waterbody segment(s) for which the TMDL is being established:
The impaired segments of the Big Sioux River addressed by this TMDL document are located in south-eastern South Dakota, and are part of the larger Missouri River basin. The Big Sioux River segments included in this TMDL document have a total drainage area of approximately 137,088 acres in South Dakota.

The TMDLs address four (4) segments of the Big Sioux River (HUC 10170203) listed on the South Dakota 2010 303(d) list:
1) Big Sioux River from S2, T104N, R49W to Hwy I-90 (28.5 miles, SD-BS-R-BIG_SIOUX_08);
2) Big Sioux River from Hwy I-90 to the diversion return (15.8 miles, SD-BS-R-BIG_SIOUX_10);
3) Big Sioux River from diversion return to Sioux Falls wastewater treatment plant (WWTP) (4.7 miles, SD-BS-R-BIG_SIOUX_11); and
4) Big Sioux River from Sioux Falls wastewater treatment plant to above Brandon, South Dakota (4.2 miles, SD-BS-R-BIG_SIOUX_12).
All four segments are listed as high priority for TMDL development.

Prior to the development of these TMDLs, Segment SD-BS-R-BIG_SIOUX_08 was defined as being from near Dell Rapids to below Baltic. Segment SD-BS-R-BIG_SIOUX_08 has been expanded to include the portion of Segment SD-BS-R-BIG_SIOUX_09 above the diversion split at I-90. The portion of Segment SD-BS-R-

BIG_SIOUX_09 that lies below the diversion to Skunk Creek has been incorporated into Segment SD-BS-R-BIG_SIOUX_10.

The designated uses for these four Big Sioux River segments are:

- *warmwater semi-permanent fish life propagation waters,*
- *immersion recreation waters,*
- *limited contact recreation waters,*
- *irrigation waters,*
- *fish and wildlife propagation, recreation, and stock watering waters, and*
- *domestic water supply waters (segments 08 and 10 only).*

These segments were listed in 2010 for E. coli and fecal coliform bacteria which are impairing the immersion recreational uses, and for total suspended solids (TSS) which is impairing the warmwater semi permanent life fish propagation uses. The bacteria impairments in these segments are being addressed by SDDENR in a separate TMDL document. A fecal coliform TMDL for Big Sioux River segment 08 was approved by EPA in May 2008 and is expected to be withdrawn once the E. Coli TMDL for segment 08 is approved. The TMDLs in this document address the TSS impairments.

Section 1.0,"Introduction", and Section 2.0, "Water-Quality Targets and Total Maximum Daily Load Targets", identify the impairments to these segments as they appear on the State's 303(d) list in the 2010 South Dakota Integrated Report for Surface Water Quality Assessment. EPA approved the list on July 9, 2010.

Figure 1-1 is a map of the project area and the impaired segments that shows the general location of the Big Sioux River and major tributaries within the project area. Figure 3-1 is a map that shows the location of point sources including the MS4 within the project area. Figure 3-3 is a schematic of the impaired segments and locations of the major tributaries, the point sources and MS4 area within the overall project area.

The Lower Big Sioux River Watershed is located in eastern South Dakota and drains approximately 2,195 square miles in South Dakota and an additional 1,120 square miles in Minnesota and Iowa. The designated Sioux Falls TMDL Assessment Project Area is a sub-area of the Lower Big Sioux River Watershed and drains a much smaller area (approximately 214 square miles or 6.5% of the watershed) all of which is within South Dakota.

The TMDL document includes a breakdown of the land uses in the Big Sioux River watershed in Table 1-1. The predominant land use within the drainage areas of all four reaches is cultivated crops (61%). The second most prevalent land use is pasture /hay (28%). Less than 1% of the land within the total drainage area is high intensity development

***Impairment status**:*
The following impairment status information is an excerpt from the document "2010 South Dakota Integrated Report for Surface Water Quality Assessment" dated March 29, 2010 (2010 Integrated Report).

Reach	***Data Source***	***Impaired Use***	***Cause***	***Priority***
SD-BS-R-BIG_SIOUX_08	*DENR USGS*	*Warmwater Semi- permanent Fish Life*	*Total Suspended Solids*	*1*
SD-BS-R-BIG_SIOUX_10	*DENR USGS*	*Warmwater Semi- permanent Fish Life*	*Total Suspended Solids*	*1*
SD-BS-R-BIG_SIOUX_11	*DENR USGS*	*Warmwater Semi- permanent Fish Life*	*Total Suspended Solids*	*1*
SD-BS-R-BIG_SIOUX_12	*DENR*	*Warmwater Semi- permanent Fish Life*	*Total Suspended Solids*	*1*

The 303(d) list does not identify specific source categories for the total suspended solids impairments.

Skunk Creek is a tributary to Segment SD-BS-R-BIG_SIOUX_10. The designated beneficial uses for Skunk Creek are fish and wildlife propagation, recreation, and stock watering waters, irrigation waters, limited contact recreation waters, and warmwater marginal fish life propagation waters. Skunk Creek was listed as impaired for warmwater marginal fish life propagation waters due to elevated TSS in the 2012 South Dakota Integrated Report for Surface Water Quality Assessment (2012 IR). Therefore, Skunk Creek is not currently meeting the WQC for TSS for the warmwater marginal fish life propagation use which is a less stringent than the TSS WQC that applies to Segment SD-BS-R-BIG_SIOUX__10.

Comments:

Section 1.1, "Watershed Characteristics" (page 1) states:"The Big Sioux River upstream of the project area and Skunk Creek are both project area influences that have recently completed TMDLs". This statement is incorrect for TSS TMDLs. In both the 2010 and 2012 IRs, Big Sioux River segment 7 was identified as fully supporting its designated beneficial uses. In the 2010 IR, Big Sioux River segment 6 was identified as impaired for warm water semi-permanent fish life propagation use due to elevated TSS. However, in the 2012 IR, segment 6 was de-listed because the TSS WQS has been attained. The reason for this recovery is unspecified. In the 2012 IR, Skunk Creek was listed as impaired for warm water marginal fish life propagation waters due to elevated TSS. This was the first listing due to TSS impairment for Skunk Creek. No TMDL for TSS has been completed. EPA suggests that the phrase "that have recently completed TMDLs" be deleted from this section. Please also check the remainder of the TMDL document and correct any other references to completed TSS TMDLs for Skunk Creek and Big Sioux River segments upstream of the project area.

Response – this statement will be removed from the document.

1.3 Water Quality Standards

TMDL documents should provide a complete description of the water quality standards for the waterbodies addressed, including a listing of the designated uses and an indication of whether the uses are being met, not being met, or not assessed. If a designated use was not assessed as part of the TMDL analysis (or not otherwise recently assessed), the documents should provide a reason for the lack of assessment (e.g., sufficient data was not available at this time to assess whether or not this designated use was being met).

Water quality criteria (WQC) are established as a component of water quality standard at levels considered necessary to protect the designated uses assigned to that waterbody. WQC identify quantifiable targets and/or qualitative water quality goals which, if attained and maintained, are intended to ensure that the designated uses for the waterbody are protected. TMDLs result in maintaining and attaining water quality standards by determining the appropriate maximum pollutant loading rate to meet water quality criteria, either directly, or through a surrogate measurable target. The TMDL document should include a description of all applicable water quality criteria for the impaired designated uses and address whether or not the criteria are being attained, not attained, or not evaluated as part of the analysis. If the criteria were not evaluated as part of the analysis, a reason should be cited (e.g. insufficient data were available to determine if this water quality criterion is being attained).

Minimum Submission Requirements:

☒ The TMDL must include a description of the applicable State/Tribal water quality standard, including the designated use(s) of the waterbody, the applicable numeric or narrative water quality criterion, and the anti-degradation policy. (40 C.F.R. §130.7(c)(1)).

☒ The purpose of a TMDL analysis is to determine the assimilative capacity of the waterbody that corresponds to the existing water quality standards for that waterbody, and to allocate that assimilative capacity between the significant sources. Therefore, <u>all TMDL documents must be written to meet the existing water quality standards</u> for that waterbody (CWA §303(d)(1)(C)). *Note: In some circumstances, the load reductions determined to be necessary by the TMDL analysis may prove to be infeasible and may possibly indicate that the existing water quality standards and/or assessment methodologies may be erroneous. However, the TMDL must still be determined based on existing water quality standards. Adjustments to water quality standards and/or assessment methodologies may be evaluated separately, from the TMDL.*

☒ The TMDL document should describe the relationship between the pollutant of concern and the water quality standard the pollutant load is intended to meet. This information is necessary for EPA to evaluate whether or not attainment of the prescribed pollutant loadings will result in attainment of the water quality standard in question.

☒ If a standard includes multiple criteria for the pollutant of concern, the document should demonstrate that the TMDL value will result in attainment of all related criteria for the pollutant. For example, both acute and chronic values (if present in the WQS) should be addressed in the document, including consideration of magnitude, frequency and duration requirements.

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

<u>Summary</u>:
Summary tables included at the beginning of the document (pages i-iv) provide a description of the applicable water quality standards for each of the four segments of the Big Sioux River addressed in this TMDL. The description includes the designated uses assigned to each segment, and the applicable numeric water quality criteria (WQC).

The TSS WQC for the impaired designated uses for these reaches are as follows:

South Dakota DENR Surface Water Quality Criteria for TSS

Designated Use	***WQC (average)[1]***	***WQC (single sample)***	***Applicable Period***
Warmwater Semi permanent Fish Life	*≤ 90 mg/L*	*≤ 158 mg/L*	*Year round*

[1]Average of at least 3 grab or composite samples obtained during separate weeks for any 30-day period

Additionally, Section 2.0, Water Quality Standards and Total Maximum Daily Load Targets, provides a description of all designated uses (not just the impaired uses) that have been assigned to all four segments of the Big Sioux River included in the TMDL.

The designated uses are:

Big Sioux River Segment	*Designated Uses*
SD-BS-R-BIG_SIOUX_08	*Domestic water supply, fish and wildlife propagation, stock watering, immersion recreation, irrigation waters, limited contact recreation, and warmwater semi-permanent fish life*
SD-BS-R-BIG_SIOUX_10	*Domestic water supply, fish and wildlife propagation, stock watering, immersion recreation, irrigation waters, limited contact recreation, and warmwater semi-permanent fish life*
SD-BS-R-BIG_SIOUX_11	*Fish and wildlife propagation, stock watering, immersion recreation, irrigation waters, limited contact recreation, and warmwater semi-permanent fish life*
SD-BS-R-BIG_SIOUX_12	*Fish and wildlife propagation, stock watering, immersion recreation, irrigation waters, limited contact recreation, and warmwater semi-permanent fish life*

As described in Section 4.0, Technical Analysis, the TMDL was developed using the load duration curve (LDC) approach. Specific standards-related details of the LDCs are as follows:

- *The LDCs were developed for the entire flow regime.*
- *Separate LDCs were developed for each of the four impaired segments.*
- *The 30-day average WQC for total suspended solids (TSS) for warmwater semi permanent fish life use (90 mg/L) was chosen as the water quality target and this value was used to construct the upper curve, the loading capacity. The loading capacity is the product of the simulated 30-day average flow at respective TMDL endpoints, the 30-day average TSS criteria, and a unit conversion factor.*
- *Observed loads were plotted within the LDC for each reach. Observed loads were calculated using measured 30-day average TSS and 30-day average flow at designated monitoring stations.*
- *Box plots of model- simulated 30-day average loads were also plotted within the LDC for each reach.*
- *LDCs based on the daily maximum WQC for TSS for warmwater semi permanent fish life (158 mg/L) were also constructed and are included in Appendix A of the document for comparison. These LDCs support the conclusion that reductions in loadings necessary to achieve the 30-day average WQC for TSS will result in achieving the daily maximum WQC for TSS.*

Tables 5-2 through 5-5 present the TMDL for achieving the 30-day average WQC for TSS, the margin of safety (MOS), waste load allocations (WLAs), and load allocations (LAs) for all four impaired segments.

- *The TMDL for each flow zone for each segment is the loading capacity at the 95th percentile flow within each flow zone.*
- *The MOS is the difference between the loading capacity at the midpoint of the flow zone and the loading capacity at the minimum flow within each flow zone.*
- *The WLA for each non-MS4 point source is the product of the discharge of the point source and the current effluent limits specified in the NPDES permits for these facilities.*
- *The MS4 WLA was then calculated as a percentage of the loading capacity that remains after accounting for the WLAs and the MOS. The MS4 WLA was calculated assuming that the MS4 will continue to have approximately the same contribution to the total load as it does currently. The percent contribution to the total load was determined form the HSPF model. The MS4 WLA varies with flow.*
- *The nonpoint source LA is the loading capacity that remains after accounting for the MOS and the WLAs.*

Sufficient information is provided in the document to conclude that attainment of the prescribed pollutant loadings will result in attainment of the WQS.

Comments: *None.*

2. Water Quality Targets

TMDL analyses establish numeric targets that are used to determine whether water quality standards are being achieved. Quantified water quality targets or endpoints should be provided to evaluate each listed pollutant/water body combination addressed by the TMDL, and should represent achievement of applicable water quality standards and support of associated beneficial uses. For pollutants with numeric water quality standards, the numeric criteria are generally used as the water quality target. For pollutants with narrative standards, the narrative standard should be translated into a measurable value. At a minimum, one target is required for each pollutant/water body combination. It is generally desirable, however, to include several targets that represent achievement of the standard and support of beneficial uses (e.g., for a sediment impairment issue it may be appropriate to include a variety of targets representing water column sediment such as TSS, embeddedness, stream morphology, up-slope conditions and a measure of biota).

Minimum Submission Requirements:

☒ The TMDL should identify a numeric water quality target(s) for each waterbody pollutant combination. The TMDL target is a quantitative value used to measure whether or not the applicable water quality standard is attained. *Generally, the pollutant of concern and the numeric water quality target are, respectively, the chemical causing the impairment and the numeric criteria for that chemical (e.g., chromium) contained in the water quality standard. Occasionally, the pollutant of concern is different from the parameter that is the subject of the numeric water quality target (e.g., when the pollutant of concern is phosphorus and the numeric water quality target is expressed as a numerical dissolved oxygen criterion). In such cases, the TMDL should explain the linkage between the pollutant(s) of concern, and express the quantitative relationship between the TMDL target and pollutant of concern. In all cases, TMDL targets must represent the attainment of current water quality standards.*

☐ When a numeric TMDL target is established to ensure the attainment of a narrative water quality criterion, the numeric target, the methodology used to determine the numeric target, and the link between the pollutant of concern and the narrative water quality criterion should all be described in the TMDL document. Any additional information supporting the numeric target and linkage should also be included in the document.

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

Summary:

Numeric water quality target for each waterbody/pollutant combination:
The numeric TMDL targets established for the four impaired segments of the Big Sioux River are based on the 30-day average and daily maximum WQC for TSS established to protect the warmwater semi permanent fish life beneficial uses. The TSS targets for the four Big Sioux River segments are:

- *≤ 90 mg/L 30-day average; or*
- *≤ 158 mg/L daily maximum, depending on which criterion required the greatest load reduction.*

LDCs were constructed based on both the daily maximum TSS WQC and the 30-day average TSS WQC. The load reductions necessary to achieve the 30-day average TSS WQC are greater than the reductions necessary to achieve the daily maximum TSS WQC. Therefore, the final TMDL water quality target is the 30-day average TSS WQC of ≤ 90mg/L.

Comments: *None.*

3. Pollutant Source Analysis

A TMDL analysis is conducted when a pollutant load is known or suspected to be exceeding the loading capacity of the waterbody. Logically then, a TMDL analysis should consider all sources of the pollutant of concern in some manner. The detail provided in the source assessment step drives the rigor of the pollutant load allocation. In other words, it is only possible to specifically allocate quantifiable loads or load reductions to each significant source (or source category) when the relative load contribution from each source has been estimated. Therefore, the pollutant load from each significant source (or source category) should be identified and quantified to the maximum practical extent. This may be accomplished using site-specific monitoring data, modeling, or application of other assessment techniques. If insufficient time or resources are available to accomplish this step, a phased/adaptive management approach may be appropriate. The approach should be clearly defined in the document.

Minimum Submission Requirements:

☒ The TMDL should include an identification of all potentially significant point and nonpoint sources of the pollutant of concern, including the geographical location of the source(s) and the quantity of the loading, e.g., lbs/per day. This information is necessary for EPA to evaluate the WLA, LA and MOS components of the TMDL.

☒ The level of detail provided in the source assessment should be commensurate with the nature of the watershed and the nature of the pollutant being studied. Where it is possible to separate natural background from nonpoint sources, the TMDL should include a description of both the natural background loads and the nonpoint source loads.

☒ Natural background loads should not be assumed to be the difference between the sum of known and quantified anthropogenic sources and the existing *in situ* loads (e.g. measured in stream) unless it can be demonstrated that all significant anthropogenic sources of the pollutant of concern have been identified, characterized, and properly quantified.

☐ The sampling data relied upon to discover, characterize, and quantify the pollutant sources should be included in the document (e.g. a data appendix) along with a description of how the data were analyzed to characterize and quantify the pollutant sources. A discussion of the known deficiencies and/or gaps in the data set and their potential implications should also be included.

Recommendation:
☐ Approve ☒ Partial Approval ☐ Disapprove ☐ Insufficient Information

Summary:

The main TSS sources are a combination of point sources and nonpoint sources within and upstream of the impaired segments. A total of 5 permitted point sources are located within the drainage area of the four segments. The point sources are:

- *Dell Rapids Wastewater Treatment Plant (WWTP)(Reach 8)*
- *Baltic WWTP (Reach 8)*
- *Sioux Falls NPDES MS4 (Reach 10 and Reach 11)*
- *John Morrell & Company (Reach 11)*
- *Sioux Falls WWTP (Reach 12)*

Stormwater discharges from construction sites that disturb more than one acre are an additional source of loading accounted for the in Sioux Falls NPDES MS4 permit but not in Reach 8 and Reach 12 since the MS4 permit does not cover these areas.

There are several nonpoint sources that contribute loading of TSS. These include surface runoff, bed and bank erosion and cropland erosion.

The HSPF model was used to determine the contribution of TSS from identified sources in the project area and to evaluate the effectiveness of various management strategies to control these sources and achieve the load reductions necessary to meet the TSS WQC and TSS TMDL water quality target. Source assessment modeling results were summarized using the following categories:

- *nonpoint sources,*
- *MS4 (local (contributions from MS4 system located within the current reach boundaries)),*
- *MS4 (upstream (contributions from MS4 system located upstream of current reach boundaries)),*
- *Big Sioux River boundary conditions,*
- *Skunk Creek,*
- *Slip-Up Creek,*
- *local bed and bank erosion, and*
- *upstream bed and bank erosion.*

The contribution of the non-MS4 point sources to the total load was also evaluated in the model and found to be nearly insignificant i.e., less than 0.1 percent of the overall load.

EPA understands that all loading associated with stormwater discharges from construction sites that disturb more than one acre are covered under the MS4 portion of the WLA for each individual reach. The MS4 permit doesn't cover Segments 8 and 12.

There are 13 permitted concentrated animal feeding operations (CAFOs)located within the Sioux Falls area of the Lower Big Sioux River watershed. Although the exact locations of these facilities are not provided, the TMDLs address the loading from these facilities as follows:

- *The CAFOs are not permitted to discharge directly into adjacent streams. Therefore the HSPF model does not explicitly represent the CAFOs by including explicit loading estimates.*
- *The impact of CAFOs was accounted for in the HSPF model through use of the "Event Mean Concentration" (EMC) data. EMCs were derived for each land use category using 2009 sampling data. Each 2009 sampling site targeted a representative land use draining to the site. The resulting TSS concentrations were used in the model to represent that particular land use throughout the watershed. Any TSS impacts from CAFOs are captured in the EMC sampling data for agricultural land use.*

Flow and loading from Skunk Creek have significant influences on the Big Sioux River segments covered by this TMDL document. Skunk Creek is not achieving the less stringent TSS WQC for warmwater marginal fish life propagation. In the next five years, SD DENR plans to develop a TSS TMDL for Skunk Creek to address this impairment. However, successful attainment of the applicable WQC in Skunk Creek will result in Skunk Creek continuing to have a significant influence on TSS loading on the Big Sioux River segments covered by these TMDLs.

Comments:

1. *Section 5.2," Waste Load Allocation" (page 32): This section states that there are 13 permitted CAFOs within the Sioux Falls area of the Lower Big Sioux River Watershed. However, because of biosecurity concerns, location information for the CAFOs is unavailable. EPA requests that, at a minimum, the document should identify the segments where the CAFOs are located.*

   Response - Thirteen CAFOs exist in Minnehaha County and given the predominance of agriculture (pasture land and cropland) it is likely that a CAFO exists in all of the segments of the Big Sioux River assessed for this TMDL document.

2. *Section 3.1,"Point Sources" (page 22): Please include the NPDES permit numbers for all five point sources shown in Table 3-1.*

   Response- NPDES permit numbers were added to the point sources shown in Table 3-1.

3. *The document should clearly identify the stormwater discharges from construction sites that disturb more than one acre as an additional source of loading that requires a WLA in those reaches where the MS4 doesn't apply.*

   Response – The following language has been added to section 5.2

   "Construction storm water activities are considered in compliance with provisions of the TMDL if they obtain a Construction General Permit under the NPDES program and properly select, install and maintain all BMPs required under the permit, including any applicable additional BMPs required in Appendix A of the Construction General Permit for discharges to impaired waters, or meet local construction stormwater requirements if they are more restrictive than requirements of the State General Permit."

4. TMDL Technical Analysis

TMDL determinations should be supported by a robust data set and an appropriate level of technical analysis**.** This applies to **all** of the components of a TMDL document. It is vitally important that the technical basis for **all** conclusions be articulated in a manner that is easily understandable and readily apparent to the reader.

A TMDL analysis determines the maximum pollutant loading rate that may be allowed to a waterbody without violating water quality standards. The TMDL analysis should demonstrate an understanding of the relationship between the rate of pollutant loading into the waterbody and the resultant water quality impacts. This stressor → response relationship between the pollutant and impairment and between the selected targets, sources, TMDLs, and load allocations needs to be clearly articulated and supported by an appropriate level of technical analysis. Every effort should be made to be as detailed as possible, and to base all conclusions on the best available scientific principles.

The pollutant loading allocation is at the heart of the TMDL analysis. TMDLs apportion responsibility for taking actions by allocating the available assimilative capacity among the various point, nonpoint, and natural pollutant sources. Allocations may be expressed in a variety of ways, such as by individual discharger, by tributary watershed, by source or land use category, by land parcel, or other appropriate scale or division of responsibility.

The pollutant loading allocation that will result in achievement of the water quality target is expressed in the form of the standard TMDL equation:

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

Where:

TMDL =		Total Pollutant Loading Capacity of the waterbody
LAs	=	Pollutant Load Allocations
WLAs	=	Pollutant Wasteload Allocations
MOS	=	The portion of the Load Capacity allocated to the Margin of safety.

Minimum Submission Requirements:

☒ A TMDL must identify the loading capacity of a waterbody for the applicable pollutant, taking into consideration temporal variations in that capacity. EPA regulations define loading capacity as the greatest amount of a pollutant that a water can receive without violating water quality standards (40 C.F.R. §130.2(f)).

☒ The total loading capacity of the waterbody should be clearly demonstrated to equate back to the pollutant load allocations through a balanced TMDL equation. In instances where numerous LA, WLA and seasonal TMDL capacities make expression in the form of an equation cumbersome, a table may be substituted as long as it is clear that the total TMDL capacity equates to the sum of the allocations.

☒ The TMDL document should describe the methodology and technical analysis used to establish and quantify the cause-and-effect relationship between the numeric target and the identified pollutant sources. In many instances, this method will be a water quality model.

☒ It is necessary for EPA staff to be aware of any assumptions used in the technical analysis to understand and evaluate the methodology used to derive the TMDL value and associated loading allocations. Therefore, the TMDL document should contain a description of any important assumptions (including the basis for those assumptions) made in developing the TMDL, including but not limited to:

(1) the spatial extent of the watershed in which the impaired waterbody is located and the spatial extent of the TMDL technical analysis;
(2) the distribution of land use in the watershed (e.g., urban, forested, agriculture);
(3) a presentation of relevant information affecting the characterization of the pollutant of concern and its allocation to sources such as population characteristics, wildlife resources, industrial activities etc…;
(4) present and future growth trends, if taken into consideration in determining the TMDL and preparing the TMDL document (e.g., the TMDL could include the design capacity of an existing or planned wastewater treatment facility);
(5) an explanation and analytical basis for expressing the TMDL through surrogate measures, if applicable. Surrogate measures are parameters such as percent fines and turbidity for sediment impairments; chlorophyll *a* and phosphorus loadings for excess algae; length of riparian buffer; or number of acres of best management practices.

☒ The TMDL document should contain documentation supporting the TMDL analysis, including an inventory of the data set used, a description of the methodology used to analyze the data, a discussion of strengths and weaknesses in the analytical process, and the results from any water quality modeling used. This information is necessary for EPA to review the loading capacity determination, and the associated load, wasteload, and margin of safety allocations.

☒	TMDLs must take critical conditions (e.g., steam flow, loading, and water quality parameters, seasonality, etc…) into account as part of the analysis of loading capacity (40 C.F.R. §130.7(c)(1)). TMDLs should define applicable critical conditions and describe the approach used to determine both point and nonpoint source loadings under such critical conditions. In particular, the document should discuss the approach used to compute and allocate nonpoint source loadings, e.g., meteorological conditions and land use distribution.
☐	Where both nonpoint sources and NPDES permitted point sources are included in the TMDL loading allocation, and attainment of the TMDL target depends on reductions in the nonpoint source loads, the TMDL document must include a demonstration that nonpoint source loading reductions needed to implement the load allocations are actually practicable [40 CFR 130.2(i) and 122.44(d)].

Recommendation:
☐ Approve ☒ Partial Approval ☐ Disapprove ☐ Insufficient Information

Summary:

A combination of HSPF modeling along with load duration curves were used in a weight of evidence technical analysis for the Big Sioux River TSS TMDLs. The HSPF model was used to determine the contribution of TSS from identified sources in the project area and to evaluate the effectiveness of alternative management strategies to control these sources. The evaluation of the management strategies was performed by comparing the predicted load reductions and the frequency percent exceedance of the WQC for each.

The Big Sioux River drainage basin was represented in the HSPF model using 24 sub watersheds and two boundary conditions which represent Skunk Creek and the Big Sioux River at Dell Rapids (the upstream endpoint of Reach 8). Nonpoint source TSS loadings for HSPF were estimated using the event mean concentrations (EMCs) for each land use, which were derived from sample data based on representative land uses draining to particular sampling sites. EMCs were applied throughout the watershed. The buildup and wash off of TSS was simulated based on the EMC values and precipitation.

The TMDL, WLAs, MOS, and LAs were derived using the load duration curve (LDC) approach that results in a flow-variable target that considers the entire flow regime. The LDC is a dynamic expression of the allowable load for any given day. The LDCs include the loading capacity or TMDL for each reach. The loading capacity was calculated as the product of simulated 30-day average flow (from the HSPF model) at the endpoint for each reach and the TSS 30-day average WQC and a unit conversion factor.

The LDCs for Reach 8, Reach 11, and Reach 12 include a WLA for the non-MS4 point sources. The WLA is the product of the daily discharge and the effluent limit specified in the NPDES permit for each source. For the Dell Rapids WWTP, the effluent limit is equal to the 30-day average TSS WQC of 90mg/L. The effluent limits for the Baltic WWTP and the Sioux Falls WWTP are 30 mg/L which is more stringent than the 30-day average TSS WQC. The effluent limit for John Morrell & Company is 1,100 pounds per day TSS as a 30-day average. Since the 13 permitted CAFOs in the project area are not permitted to discharge within the watershed, no WLA is provided for these facilities with the understanding that no discharge is permitted.

The LDCs for Reach 10 and Reach 11 include a WLA for the MS4, calculated using the HSPF model application. The MS4 component of the WLA is flow variable and was calculated assuming that in the future, the MS4 will continue to have approximately the same contribution to the total load as was estimated using current (2009) data.

Observed loads were plotted on the LDCs for each reach. Observed loads were calculated using observed 30-day average TSS concentrations from historical sampling events and the 30-day average flow data from monitoring stations. The LDCs also include box plots of HSPF-simulated 30-day average loads for each flow zone calculated using simulated 30-day average TSS and simulated flow at reach endpoints.

To aid in the interpretation of the TMDL, the LDC flow intervals were grouped into five flow zones: high flows (exceeded 0-10 percent of the time), moist conditions (exceeded 10-40 percent of the time), midrange flows (exceeded 40-60 percent of the time), dry conditions (exceeded 60-90 percent of the time) and low flows (exceeded 90-100 percent of the time).

Once the loading capacity was derived for each flow zone, the load allocations were calculated by subtracting the WLA and MOS. The calculated loads for each flow regime for all four segments are included in Tables 5-2, 5-3, 5-4 and 5-5 of the TMDL document.

<u>Comments:</u>

1. *Figure 3-3, "Source Assessment Modeling Results Within the Sioux Falls Study Area of the Lower Big Sioux River Watershed" (page 26): Please provide an explanation of the difference between the source categories "Bed/Bank" and "nonpoint". We assume that bed/bank erosion is one kind of nonpoint source of TSS. Why was it broken out in the figure? Also, the pie chart for reaches 11 and 12 indicates a WLA of 0%. We assume this was intended to be labeled as point source to indicate that the model predicts the contribution of the point sources to the total loading in these two reaches is negligible. However, this does not mean the WLA is 0. That would mean the point sources can no longer discharge. Please correct.*

Response– Nonpoint sources are considered to be from rainfall/runoff process originating from overland flow. Bed/bank erosion is a nonpoint source of TSS, but is more related to in-stream process. They are separated out due to the fact that they often require much different BMPs. The WLA will be relabeled as "point source" in the charts to avoid confusion.

The

2. *Section 4.0,"Technical Analyses":*
    a. *Table 4-1, "Water Quality Monitoring Sites and Flow Monitoring Sites from Which Data Were Used to Develop Load Duration Curves" (page 28): The heading for the second column in this table is "E. Coli Sites Used". Please correct.*

       Response – This will be corrected.

    b. *There are more 30-day average TSS concentrations for monitoring sites BSR020, BSR080, and BSR090 than individual sampling results at these stations. We would expect the number of average values to be less than the number of individual values. For example:*
        i. *Location BSR020: 473 individual sample results, 741 30-day average values*
        ii. *Location BSR 080: 542 individual sample results, 904 30-day average values*
        iii. *Location BSR090: 576 individual sample results, 965 30-day average values*

       Please explain how the 30-day average values were calculated and why there are so many more 30-day average values than individual results. This is important since we understand that the 95th percentile of the distribution of the observed loads is used to calculate the necessary load reductions. If the number of observed values is in error, the load reductions may need to be corrected.

       Response –The number of individual samples used in the TMDL calculations was verified as correct. The analysis performed calculates a 30-day average value for all 30 day periods surrounding that day with a unique set of individual samples and is not restricted to a given

month. In the hypothetical example below, there are 10 individual samples collected during the month of June while there are 19 30-day average values calculated during the same time period.

	Individual Samples	*30-day Average Values*
1-Jun	*1*	*1*
2-Jun	*0*	*0*
3-Jun	*0*	*1*
4-Jun	*1*	*0*
5-Jun	*0*	*1*
6-Jun	*0*	*0*
7-Jun	*0*	*1*
8-Jun	*1*	*0*
9-Jun	*0*	*1*
10-Jun	*0*	*1*
11-Jun	*1*	*0*
12-Jun	*0*	*1*
13-Jun	*0*	*1*
14-Jun	*0*	*1*
15-Jun	*1*	*0*
16-Jun	*0*	*1*
17-Jun	*0*	*0*
18-Jun	*1*	*0*
19-Jun	*0*	*1*
20-Jun	*0*	*1*
21-Jun	*0*	*1*
22-Jun	*1*	*0*
23-Jun	*0*	*1*
24-Jun	*1*	*1*
25-Jun	*0*	*1*
26-Jun	*1*	*0*
27-Jun	*0*	*1*
28-Jun	*0*	*1*
29-Jun	*1*	*0*
30-Jun	*0*	*1*
1-Jul	*0*	
2-Jul	*1*	
3-Jul	*0*	
4-Jul	*0*	
5-Jul	*0*	
6-Jul	*1*	

7-Jul	*0*	
8-Jul	*0*	
9-Jul	*1*	
10-Jul	*0*	
11-Jul	*0*	
12-Jul	*1*	
13-Jul	*1*	
14-Jul	*0*	
15-Jul	*0*	
16-Jul	*0*	
17-Jul	*0*	
18-Jul	*0*	
19-Jul	*1*	
20-Jul	*1*	
21-Jul	*0*	
22-Jul	*0*	
23-Jul	*1*	
24-Jul	*0*	
25-Jul	*0*	
26-Jul	*1*	
27-Jul	*1*	
28-Jul	*0*	
29-Jul	*1*	
30-Jul	*0*	

3. *Section 5.1, "Load Allocation" (page 32): The fourth sentence in this section states, "The loading capacities for Big Sioux River were calculated by multiplying the specified TSS criterion by the flow." Please clarify that the flow is simulated, not measured. We suggest that this sentence be modified as follows: "The loading capacities for Big Sioux River were calculated by multiplying the specified TSS criterion by the simulated flow at each reach endpoint."*

   Response – This sentence will be corrected to read "The daily maximum and 30-day loading capacities for Big Sioux River were calculated by multiplying the specified TSS criterion by the daily average and 30-day average simulated flow respectively at each reach endpoint."

4. *Section 5.2, "Waste Load Allocation" (page 33): This section contains the statement: "The WLA for the Sioux Falls TMDL is the sum of the point source allocations (PSAs) within each reach and MS4 loads, which includes construction activities." The MS4 doesn't cover Reach 8 or Reach 12 therefore, EPA is concerned that loading associated with stormwater discharges from construction sites has not been given an allocation in these reaches. We suggest that a portion of the WLA in Reach 8 and Reach 12 be given to construction activities using the same approach that was used to derive the MS4 WLA, i.e., the construction WLA can be calculated as a percentage of the difference between the TMDL, the MOS, and the WLA in each flow zone. The percentage is equal to the percent of the total load that is contributed by*

construction activities, as estimated by the HSPF model. If SD DENR prefers another approach to developing a WLA for stormwater discharges associated with construction sites, we are open to it.

Response – As stated above, the language below has been added to Section 5.2.

"Construction storm water activities are considered in compliance with provisions of the TMDL if they obtain a Construction General Permit under the NPDES program and properly select, install and maintain all BMPs required under the permit, including any applicable additional BMPs required in Appendix A of the Construction General Permit for discharges to impaired waters, or meet local construction stormwater requirements if they are more restrictive than requirements of the State General Permit."

5. *The modeled reduction scenarios presented in Section 9.0 predict that the chronic water quality standard for TSS may not be met within all reaches even after implementation of all five proposed management strategies. Since both nonpoint sources and NPDES permitted point sources are included in the TMDLs, and attainment of the TMDL target depends on reductions in the nonpoint source loads, information needs to be provided to demonstrate that the nonpoint source loading reductions needed to achieve the LA are practicable. The modeled reduction scenarios in Section 9.0 suggest that, while the strategies may be practicable, the necessary reductions may not be achieved in Reach 11 and Reach 12.*

   EPA understands that the reductions associated with the management scenarios are estimates based on the assumptions built into the HSPF model and these estimates include uncertainty. Also, the required reductions were calculated based on simulated flow and simulated TSS concentrations. Based on previous discussions with SD DENR, EPA also understands that the HSPF model predicts that some of the largest loadings come from the boundary conditions (Big Sioux River upstream of Reach 8 and Skunk Creek) and that recent work by RESPEC has determined there are other ways to characterize boundary conditions in the HSPF model that are more representative of anticipated restoration activities so the model predictions may underestimate the reductions that can be achieved. We recommend strengthening the discussion in Section 9 by including additional or alternative management strategies that could result in further nonpoint source loading reductions.

   Response – A sixth scenario was developed to represent bank stabilization. The scenario was simulated within the HSPF modeling application through incorporation of parameter changes that reduced instream scour in the Big Sioux River and Skunk Creek within the project boundary in a manner consistent with expected bank stabilization practices. Implementation of Scenario 6 would result in a reduction in average TSS loads of approximately 29 percent in Reach 8, 16 percent in Reach 10, 31 percent in Reach 11, and 34 percent in Reach 12. Cumulatively, implementation of all six scenarios would decrease 30-day average criterion percent exceedance from baseline conditions of 18 to 33 percent exceedance to 1, 0, 5, and 10 percent exceedance in Reaches 8, 10, 11, and 12 respectively. Adding this bank stabilization scenario provides reasonable assurance that there is an effective way to achieve TSS reductions that would bring the Big Sioux River into compliance with the TMDL.

6. *EPA guidance states that TMDLs should provide reasonable assurances that nonpoint source control measures will achieve expected load reductions in order for the TMDLs to be approvable. The TMDL document needs to include a more complete rationale of how reasonable assurance (RA) has been demonstrated. Reasonable assurance ensures that the TMDL's wasteload and load allocations are properly calibrated to meet the applicable water quality standards. Without such calibration, a TMDL's ability to serve as an effective guidepost for water quality improvement is significantly diminished. Permits that rely on those TMDLs without adequate RA may be vulnerable. The RA demonstration should include: 1) discussion of controls, schedule and milestones to achieve the load allocations over time; 2) discussion of the monitoring and tracking approach that will be used to evaluate progress in*

achieving the load allocations; and 3) discussion of consequences and/or follow-up actions if adequate progress is not demonstrated (using the adaptive management approach).

To address this concern, EPA recommends that a new Section 9.2, titled "Reasonable Assurance" be included in the TMDL document to summarize the demonstration of RA. The following is suggested language for the new section:

"When a TMDL is developed for waters impaired by both point and nonpoint sources, and the WLA is based on an assumption that nonpoint source load reductions will occur, EPA guidance states that the TMDL should provide reasonable assurances that nonpoint source control measures will achieve expected load reductions.

Big Sioux River segments SD-BS-R-BIG_SIOUX_08, SD-BS-R-BIG_SIOUX_10, SD-BS-R-BIG_SIOUX_11, and SD-BS-R-BIG_SIOUX_12 are impaired by nonpoint sources and permitted point sources (including MS4). Therefore, the requirement to provide reasonable assurances applies to the TSS TMDLs for these segments.

The WLAs for the non-MS4 point sources are calculated based on the effluent limits in the NPDES permits and the current discharge volumes for each point source. Modeling demonstrates that at these WLAs, the non-MS4 point sources contribute less than 1 percent of the TSS load in these segments. Therefore, further reductions in the WLAs for the non-MS4 point sources are not likely to have much effect on meeting the TSS water quality criteria in these segments.

The WLA for the MS4 is calculated based on the loading capacity that remains after accounting for the non-MS4 point sources and the margin of safety and assumes the MS4 portion of the remaining loading capacity equals its current percent contribution of the total current load. HSPF modeling demonstrates that the MS4 contributes 4% to 9% of the total TSS loading in all four reaches yet reductions of as much as 50% on 100 % of the MS4 would have minimal impact (<1%) on concentrations and loadings in all reaches. Therefore, further reductions in the WLAs for the MS4 point sources are also not likely to be effective in meeting the TSS water quality criteria in these segments.

The following elements provide assurances that nonpoint source control measures can feasibly be designed to reduce the TSS loading in these segments, that they are likely to be effective, and that they have a reasonably high probability of being implemented successfully in the Big Sioux River project area:

- *<u>Cooperation among stakeholders will facilitate implementation.</u> The water quality assessment work and the development of TMDLs for these segments were performed as a cooperative project among the City of Sioux Falls, USGS, the East Dakota Water Development District, RESPEC and SD DENR. The cooperation among local stakeholders, state and local regulatory agencies and organizations is expected to continue through the implementation phase, increasing the probability of success.*
- *<u>Conservative assumptions were used in the calculations of required load reductions.</u>*
    - *The percent reductions in nonpoint source loading required to meet the TMDL are the difference between the baseline loading and the TMDL. The baseline loading value chosen for the four segments is the 95th percentile of the range of simulated 30-day average load (the product of the simulated 30-day average concentrations and simulated 30-day average flow for each reach endpoint) for each flow zone. This provides conservatism in the calculation of the necessary loading reductions.*
    - *A relatively large explicit margin of safety is incorporated into the calculation of the LA for the nonpoint sources. The average margin of safety is 22% across all segments and flow zones. This means that the TSS water quality criterion could conceivably be met when the actual load reductions are, on average, 22% lower than the calculated required load reductions.*

- *<u>Work is underway on a TMDL implementation plan.</u> Resources have been committed and work is underway on the development of a watershed-scale decision support framework that is based on cost optimization to support government and local planning agencies to coordinate investments to achieve required load reductions. This decision support framework is the first step in the development of a TMDL implementation plan that outlines strategies with the best probability of being successful and milestones for implementation. It is expected that the implementation plan will include a master plan with details such as controls, schedule and milestones to achieve the load allocations over time, monitoring that will be used to evaluate progress in achieving the load allocation,; and discussion of consequences and/or follow-up actions if adequate progress is not demonstrated (using the adaptive management approach)."*

Response – The above language is accurate and will be included in the TMDL document.

7. *The wording in the TMDL document implies that the level of controls that the MS4 may be required to meet or implement (p 15 MEP) are bound by an older interpretation of the regulations. It should be noted that a court decision and EPA guidance have clarified this issue. Section 402(p)(3)(B) of the CWA provides that permits for discharges from municipal storm sewers "shall include a requirement to effectively prohibit non-stormwater discharges into the storm sewers; and shall require controls to reduce the discharge of pollutants to the maximum extent practicable, including management practices, control techniques and system, design and engineering methods, and such other provisions as the Administrator or State determines appropriate for the control of such pollutants." Under the provision […"such other provisions as the Administrator or State determines appropriate for the control of such pollutants."], the court found that the EPA [or State] has the authority to determine that ensuring strict compliance with state water-quality standards is necessary to control pollutants." Therefore EPA or the State has the discretion to require MS4 discharges to comply with water quality standards. We are not recommending any additional MS4 controls beyond those that are needed achieve the WLAs specified in the draft TMDL as written. However, if future data reveal that nonpoint source reductions are not occurring, it may be necessary to revisit and lower the MS4 WLA to ensure that the water quality standards are met.*

Response – This is noted.

4.1 Data Set Description

TMDL documents should include a thorough description and summary of all available water quality data that are relevant to the water quality assessment and TMDL analysis. An inventory of the data used for the TMDL analysis should be provided to document, for the record, the data used in decision making. This also provides the reader with the opportunity to independently review the data. The TMDL analysis should make use of all readily available data for the waterbody under analysis unless the TMDL writer determines that the data are not relevant or appropriate. For relevant data that were known but rejected, an explanation of why the data were not utilized should be provided (e.g., samples exceeded holding times, data collected prior to a specific date were not considered timely, etc…).

Minimum Submission Requirements:

☒ TMDL documents should include a thorough description and summary of all available water quality data that are relevant to the water quality assessment and TMDL analysis such that the water quality impairments are clearly defined and linked to the impaired beneficial uses and appropriate water quality criteria.

☐ The TMDL document submitted should be accompanied by the data set utilized during the TMDL analysis. If possible, it is preferred that the data set be provided in an electronic format and referenced in the document. If electronic submission of the data is not possible, the data set may be included as an appendix to the document.

Recommendation:
☐ Approve ☒ Partial Approval ☐ Disapprove ☐ Insufficient Information

Summary:

Description and summary of all available water quality data relevant to the water quality assessment and TMDL analysis: *The data description and summary for the four impaired segments of the Big Sioux River are included mainly in Section 1.3., Available Water-Quality Data, and are plotted on the load duration curves. Sampling was conducted on a temporal basis over the period from January 2000 to October 2009 and included 878 total samples analyzed for TSS.*

Although data are available from monitoring that occurred prior to the year 2000, only data collected during the period 2000-2009 were used the TMDL analysis. The earlier data were excluded because of the expansion of the City of Sioux Falls boundaries and the significant amount of data available after the year 2000. The data used in the TMDLs are representative of current conditions.

Comments:

1. *Summary tables of the data used in this TMDL are included but the complete data set is not. Please provide the complete data set in electronic format (Excel spreadsheet is preferred).*

   Response – We will work with the EPA to provide the entire dataset in the format requested.

2. *Table 1-2 contains a footnote that states the data from monitoring sites BSR010 and BSR110 were not used in the TMDL observed tables. Table 4-1 indicates that data from monitoring sites BSR030 and BSR050 were also excluded. Please add this information to Table 1-2 or correct Table 1-4. Also, provide an explanation for not including these sites.*

   Response – All sites indicated in Table 1-2 were used to calculate the TMDL observed tables with the exception of BSR010, BSR030, and BSR110. BSR010 was not used because it is at the very upstream end of Reach 8 and was therefore not deemed representative of the concentrations at the end of the reach. BSR030 was not used because it is located on the diversion, which is an artificial structure that is not technically within one of the Big Sioux River impaired reaches. BSR110 was not used because it is below the endpoint of Reach 12. All of these points were however used in model calibration. The tables and text will be corrected to reflect what is stated above.

3. *Table 6-1 on page 38 provides the range of monthly average flow for several monitoring sites. Site BSR040 is included. This is the first time this monitoring site is mentioned in the document. Please provide basic information such as its location and historic data. Were data from this location used in the development of the TMDL? How were they used?*

   Response – BSR040 is a discontinued USGS site located on the Big Sioux River just below the diversion north of the airport. It will be removed from the document as the data does not provide extra insight into the seasonality analysis.

4.2 Waste Load Allocations (WLA):

Waste Load Allocations represent point source pollutant loads to the waterbody. Point source loads are typically better understood and more easily monitored and quantified than nonpoint source loads. Whenever practical, each point source should be given a separate waste load allocation. All NPDES permitted dischargers that discharge the pollutant under analysis directly to the waterbody should be identified and given separate waste load allocations. The finalized WLAs are required to be incorporated into future NPDES permit renewals.

Minimum Submission Requirements:

☒ EPA regulations require that a TMDL include WLAs for all significant and/or NPDES permitted point sources of the pollutant. TMDLs must identify the portion of the loading capacity allocated to individual existing and/or future point source(s) (40 C.F.R. §130.2(h), 40 C.F.R. §130.2(i)). In some cases, WLAs may cover more than one discharger, e.g., if the source is contained within a general permit. If no allocations are to be made to point sources, then the TMDL should include a value of zero for the WLA.

☐ All NPDES permitted dischargers given WLA as part of the TMDL should be identified in the TMDL, including the specific NPDES permit numbers, their geographical locations, and their associated waste load allocations.

Recommendation:
☐ Approve ☒ Partial Approval ☐ Disapprove ☐ Insufficient Information

Summary:
The Big Sioux River TMDL document (see Table 3-1) mentions five point sources located directly on the one of the impaired stream segments, including the Sioux Falls MS4. WLAs for the Sioux Falls MS4 were derived for segments 10 and 11. Separate WLAs for the other four point sources were derived for segments 8, 11, and 12.

Comments:

The MS4 portion of the WLA doesn't cover Reach 8 or Reach 12 therefore, EPA is concerned that loading associated with stormwater discharge from construction sites has not been given an allocation in these reaches. We suggest that a portion of the WLA in Reach 8 and Reach 12 be given to construction activities using the same approach that was used to derive the MS4 WLA, i.e., the construction waste load allocation can be calculated as a percentage of the difference between the TMDL, the MOS, and the WLA in each flow zone. The percentage is equal to the percent of the total load that is contributed by construction activities, as estimated by the HSPF model. If SD DENR prefers an alternative approach to developing a WLA for stormwater discharges associated with construction sites, we are open to it.

Response – See above suggested approach for construction activities.

4.3 Load Allocations (LA):

Load allocations include the nonpoint source, natural, and background loads. These types of loads are typically more difficult to quantify than point source loads, and may include a significant degree of uncertainty. Often it is necessary to group these loads into larger categories and estimate the loading rates based on limited monitoring data and/or modeling results. The background load represents a composite of all upstream pollutant loads into the waterbody. In addition to the upstream nonpoint and upstream natural load, the background load often includes upstream point source loads that are not given specific waste load allocations in this particular TMDL analysis. In instances where nonpoint source loading rates are particularly difficult to quantify, a performance-based allocation approach, in which a detailed monitoring plan and adaptive management strategy are employed for the application of BMPs, may be appropriate.

Minimum Submission Requirements:

☒ EPA regulations require that TMDL expressions include LAs which identify the portion of the loading capacity attributed to nonpoint sources and to natural background. Load allocations may range from reasonably accurate estimates to gross allotments (40 C.F.R. §130.2(g)). Load allocations may be included for both existing and future nonpoint source loads. Where possible, load allocations should be described separately for natural background and nonpoint sources.

☒ Load allocations assigned to natural background loads should not be assumed to be the difference between the sum of known and quantified anthropogenic sources and the existing *in situ* loads (e.g., measured in stream) unless it can be demonstrated that all significant anthropogenic sources of the pollutant of concern have been identified and given proper load or waste load allocations.

Recommendation:

☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

Summary:

The Load Allocation section explains how the loading capacity and load allocation was derived. Tables 5-2, 5-3, 5-4 and 5-5 show the load allocations for each of the five flow regimes for each segment.

Comments:

None.

4.4 Margin of Safety (MOS):

Natural systems are inherently complex. Any mathematical relationship used to quantify the stressor → response relationship between pollutant loading rates and the resultant water quality impacts, no matter how rigorous, will include some level of uncertainty and error. To compensate for this uncertainty and ensure water quality standards will be attained, a margin of safety is required as a component of each TMDL. The MOS may take the form of a explicit load allocation (e.g., 10 lbs/day), or may be implicitly built into the TMDL analysis through the use of conservative assumptions and values for the various factors that determine the TMDL pollutant load → water quality effect relationship. Whether explicit or implicit, the MOS should be supported by an appropriate level of discussion that addresses the level of uncertainty in the various components of the TMDL technical analysis, the assumptions used in that analysis, and the relative effect of those assumptions on the final TMDL. The discussion should demonstrate that the MOS used is sufficient to ensure that the water quality standards would be attained if the TMDL pollutant loading rates are met. In cases where there is substantial uncertainty regarding the linkage between the proposed allocations and achievement of water quality standards, it may be necessary to employ a phased or adaptive management approach (e.g., establish a monitoring plan to determine if the proposed allocations are, in fact, leading to the desired water quality improvements).

Minimum Submission Requirements:

☒ TMDLs must include a margin of safety (MOS) to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality (CWA §303(d) (1) (C), 40 C.F.R. §130.7(c)(1)). EPA's 1991 TMDL Guidance explains that the MOS may be implicit (i.e., incorporated into the TMDL through conservative assumptions in the analysis) or explicit (i.e., expressed in the TMDL as loadings set aside for the MOS).

☐ If the MOS is implicit, the conservative assumptions in the analysis that account for the MOS should be identified and described. The document should discuss why the assumptions are considered conservative and the effect of the assumption on the final TMDL value determined.

☒ If the MOS is explicit, the loading set aside for the MOS should be identified. The document should discuss how the explicit MOS chosen is related to the uncertainty and/or potential error in the linkage analysis between the WQS, the TMDL target, and the TMDL loading rate.

☐ If, rather than an explicit or implicit MOS, the TMDL relies upon a phased approach to deal with large and/or unquantifiable uncertainties in the linkage analysis, the document should include a description of the planned phases for the TMDL as well as a monitoring plan and adaptive management strategy.

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

Summary:
The Big Sioux River TMDLs include explicit MOSs for each segment that were derived by calculating the difference between the loading capacity at the mid-point of each of the five flow zones and the loading capacity at the minimum flow in each zone. The explicit MOS values are included in Tables 5-2, 5-3, 5-4 and 5-5 of the TMDL document. The MOS varies from 11.5% to 32% with an average of 22% across all reaches and flow zones.

Comments*: None.*

4.5 Seasonality and variations in assimilative capacity:

The TMDL relationship is a factor of both the loading rate of the pollutant to the waterbody and the amount of pollutant the waterbody can assimilate and still attain water quality standards. Water quality standards often vary based on seasonal considerations. Therefore, it is appropriate that the TMDL analysis consider seasonal variations, such as critical flow periods (high flow, low flow), when establishing TMDLs, targets, and allocations.

Minimum Submission Requirements:

☒ The statute and regulations require that a TMDL be established with consideration of seasonal variations. The TMDL must describe the method chosen for including seasonal variability as a factor. (CWA §303(d)(1)(C), 40 C.F.R. §130.7(c)(1)).

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

Summary:
By using the load duration curve approach to develop the TMDL allocations seasonal variability in TSS loads are taken into account. Highest stream flows typically occur during late spring, and the lowest stream flows occur during the winter months.

Comments: *None.*

5. Public Participation

EPA regulations require that the establishment of TMDLs be conducted in a process open to the public, and that the public be afforded an opportunity to participate. To meaningfully participate in the TMDL process it is necessary that stakeholders, including members of the general public, be able to understand the problem and the proposed solution. TMDL documents should include language that explains the issues to the general public in understandable terms, as well as provides additional detailed technical information for the scientific community. Notifications or solicitations for comments regarding the TMDL should be made available to the general public, widely circulated, and clearly identify the product as a TMDL and the fact that it will be submitted to EPA for review. When the final TMDL is submitted to EPA for approval, a copy of the comments received by the state and the state responses to those comments should be included with the document.

Minimum Submission Requirements:

☒ The TMDL must include a description of the public participation process used during the development of the TMDL (40 C.F.R. §130.7(c)(1)(ii)).

☐ TMDLs submitted to EPA for review and approval should include a summary of significant comments and the State's/Tribe's responses to those comments.

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

Summary:
The Public Participation section of the TMDL document describes the public participation process that has occurred during the development of the TMDLs for the Big Sioux River. In particular, the State has encouraged participation through public meetings in the watershed, and a website was developed and maintained throughout the project. SD DENR provided an opportunity for the general public to comment on the draft TMDL during a 30-day public notice period prior to finalization.

Comments: *None*

6. Monitoring Strategy

TMDLs may have significant uncertainty associated with the selection of appropriate numeric targets and estimates of source loadings and assimilative capacity. In these cases, a phased TMDL approach may be necessary. For Phased TMDLs, it is EPA's expectation that a monitoring plan will be included as a component of the TMDL document to articulate the means by which the TMDL will be evaluated in the field, and to provide for future supplemental data that will address any uncertainties that may exist when the document is prepared.

Minimum Submission Requirements:

☒ When a TMDL involves both NPDES permitted point source(s) and nonpoint source(s) allocations, and attainment of the TMDL target depends on reductions in the nonpoint source loads, the TMDL document should include a monitoring plan that describes the additional data to be collected to determine if the load reductions provided for in the TMDL are occurring.

☐ Under certain circumstances, a phased TMDL approach may be utilized when limited existing data are relied upon to develop a TMDL, and the State believes that the use of additional data or data based on better analytical techniques would likely increase the accuracy of the TMDL load calculation and merit development of a second phase TMDL. EPA recommends that a phased TMDL document or its implementation plan include a monitoring plan and a scheduled timeframe for revision of the TMDL. These elements would not be an intrinsic part of the TMDL and would not be approved by EPA, but may be necessary to support a rationale for approving the TMDL. http://www.epa.gov/owow/tmdl/tmdl_clarification_letter.pdf

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

Summary:

The TMDLs include the recommendation that the Big Sioux River should continue to be monitored as part of DENR's ambient water quality monitoring at existing stations and by Sioux Falls as part of their stormwater permitting implementation. Additional post-TMDL implementation monitoring will also be necessary to assure the goals of the TMDLs have been reached and maintenance of the beneficial uses occurs. The adaptive implementation approach to this TMDL recognizes that further understanding of specific sources of TSS is necessary to effectively achieve the necessary loading reductions. A relatively intense monitoring network consisting of spatially distributed sampling locations will need to be established within the project area to characterize TSS loading at a more refined scale. Using the results of such a monitoring program, portions of the watershed with elevated TSS can be identified for priority implementation of management strategies to obtain the greatest loading reductions.

Comments: *None.*

7. Restoration Strategy

The overall purpose of the TMDL analysis is to determine what actions are necessary to ensure that the pollutant load in a waterbody does not result in water quality impairment. Adding additional detail regarding the proposed approach for the restoration of water quality is not currently a regulatory requirement, but is considered a value added component of a TMDL document. During the TMDL analytical process, information is often gained that may serve to point restoration efforts in the right direction and help ensure that resources are spent in the most efficient manner possible. For example, watershed models used to analyze the linkage between the pollutant loading rates and resultant water quality impacts might also be used to conduct "what if" scenarios to help direct BMP installations to locations that provide the greatest pollutant reductions. Once a TMDL has been written and approved, it is often the responsibility of other water quality programs to see that it is implemented. The level of quality and detail provided in the restoration strategy will greatly influence the future success in achieving the needed pollutant load reductions.

Minimum Submission Requirements:

☒ EPA is not required to and does not approve TMDL implementation plans. However, in cases where a WLA is dependent upon the achievement of a LA, "reasonable assurance" is required to demonstrate the necessary LA called for in the document is practicable). A discussion of the BMPs (or other load reduction measures) that are to be relied upon to achieve the LA(s), and programs and funding sources that will be relied upon to implement the load reductions called for in the document, may be included in the implementation/restoration section of the TMDL document to support a demonstration of "reasonable assurance".

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

Summary:
Section 9.0, "Restoration Strategy" (page 41) describes a variety of BMPs that have been proposed for consideration during development of the implementation plan. Several types of control measures are available for reducing TSS loads, however the BMPs determined to be practicable by the stakeholders are recommended to address the identified sources of TSS loading in the Sioux Falls area.

Based on the water quality monitoring and HSPF model results, the recommended control measures are expected to reduce exceedances of the 30-day average TSS WQC from the current 18 percent to 11 percent in Reach SD-BS-R-BIG_SIOUX_08, from 24 percent to 0 percent in Reach SD-BS-R-BIG_ SIOUX_10, from 31 percent to 17 percent in Reach SD-BS-R-BIG_SIOUX_11, and from 33 percent to 22 percent in Reach SD-BS-R-BIG_SIOUX_12. These load reductions will assist in the attainment of the TMDL goal.

The six management scenarios that were simulated for each TSS-impaired reach using the HSPF model are:
(1) future land use,
(2) the city's planned BMPs,
(3) 90 percent load reduction on agricultural land within the project area boundary north of Sioux Falls local to the Big Sioux River and Silver Creek,
(4) a TSS reduction of 50 percent on 100 percent of the MS4,
(5) Big Sioux River upstream of Dell Rapids compliance with the current warmwater semi permanent fish life and Skunk Creek compliance with the current warmwater marginal fish life propagation chronic water quality standard, and
(6) Big Sioux River upstream of Dell Rapids and Skunk Creek compliance with the warmwater semi permanent fish life propagation chronic water quality standard.

Table 9-1 shows the modeled percent exceedance of the 30-day average TSS WQC, individual load reduction results, and cumulative load reduction results for each scenario considered in each of the four stream segments of the Big Sioux River.

An adaptive management approach will be taken in implementation of the TMDLs. Resources have been committed and work is underway on the development of a watershed-scale decision support framework that is based on cost optimization to support government and local planning agencies to coordinate investments to achieve required load reductions. This decision support framework is the first step in the development of a TMDL implementation plan that outlines strategies with the best probability of being successful and milestones for implementation. The implementation plan is expected to include procedures for reviewing key milestone progress and revising BMPs, if necessary, to meet the TMDL target loads and obtaining data to improve the understanding of the system, evaluate the appropriateness of the target, and to monitor whether the controls are effective towards meeting the target

Comments:
None

8. Daily Loading Expression

The goal of a TMDL analysis is to determine what actions are necessary to attain and maintain WQS. The appropriate averaging period that corresponds to this goal will vary depending on the pollutant and the nature of the waterbody under analysis. When selecting an appropriate averaging period for a TMDL analysis, primary concern should be given to the nature of the pollutant in question and the achievement of the underlying WQS. However, recent federal appeals court decisions have pointed out that the title TMDL implies a "daily" loading rate. While the most appropriate averaging period to be used for developing a TMDL analysis may vary according to the pollutant, a daily loading rate can provide a more practical indication of whether or not the overall needed load reductions are being achieved. When limited monitoring resources are available, a daily loading target that takes into account the natural variability of the system can serve as a useful indicator for whether or not the overall load reductions are likely to be met. Therefore, a daily expression of the required pollutant loading rate is a required element in all TMDLs, in addition to any other load averaging periods that may have been used to conduct the TMDL analysis. The level of effort spent to develop the daily load indicator should be based on the overall utility it can provide as an indicator for the total load reductions needed.

Minimum Submission Requirements:

☒ The document should include an expression of the TMDL in terms of a daily load. However, the TMDL may also be expressed in temporal terms other than daily (e.g., an annual or monthly load). If the document expresses the TMDL in additional "non-daily" terms the document should explain why it is appropriate or advantageous to express the TMDL in the additional unit of measurement chosen.

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

Summary:
The Big Sioux River TSS TMDLs include daily loads expressed in tons per day. The daily TMDL loads are included in the TMDL Allocations sections of the TMDL document.

Comments: *None.*

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8
1595 Wynkoop Street
DENVER, CO 80202-1129
Phone 800-227-8917
http://www.epa.gov/region08

DEC 06 2012

Ref: 8EPR-EP

Steven M. Pirner
Secretary
South Dakota Department of Environment & Natural Resources
Joe Foss Building
523 East Capitol
Pierre, SD 57501-3181

Re: TMDL Approval
Big Sioux River Segments 8, 10, 11, and 12
Total Suspended Solids
SD-BS-R-BIG_SIOUX_08
SD-BS-R-BIG_SIOUX_10
SD-BS-R-BIG_SIOUX_11
SD-BS-R-BIG_SIOUX_12

Dear Mr. Pirner:

We have completed our review of the total maximum daily loads as submitted by your office for the waterbodies listed in the enclosure to this letter. In accordance with the Clean Water Act (33 U.S.C. 1251 *et. seq.*), we approve all aspects of the TMDLs referenced above as developed for the water quality limited waterbodies as described in Section 303(d)(1). Based on our review, we feel the separate elements of the TMDL as listed in the enclosed table adequately address the pollutant of concern as given in the table, taking into consideration seasonal variation and a margin of safety.

Thank you for submitting the TMDL for our review and approval. If you have any questions, the most knowledgeable person on my staff is Bonnie Lavelle and she may be reached at 303-312-6579.

Sincerely,

Martin Hestmark
Assistant Regional Administrator
Office of Ecosystems Protection
and Remediation

Enclosures

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ENCLOSURE 1: APPROVED TMDLs

Total Suspended Solids Total Maximum Daily Load for the Big Sioux River, Minnehaha County, South Dakota (RESPEC for SD DENR, September 2012)

Submitted: 10/16/2012

4	Pollutant TMDLs completed.
4	Causes addressed from the 2012 303(d) list.
0	Determinations that no pollutant TMDL needed.

Segment: Big Sioux River from S2, T104N, R49W to Hwy I-90

303(d) ID: SD-BS-R-BIG SIOUX 08

Parameter/Pollutant (303(d) list cause): TOTAL SUSPENDED SOLIDS - 518

Water Quality Targets: < 90 mg/l as average of at least 3 grab or composite samples obtained during separate weeks in 30-day period

Allocation*	Value	Units	State Permits	Permits
WLA	0.6	TONS/DAY		SD-0022284
WLA	1.6	TONS/DAY		SD-0022101
MOS	121.5	TONS/DAY		
LA	756.4	TONS/DAY		
TMDL	880.1	TONS/DAY		

Notes: TMDLs were developed for five flow zones. This TMDL is based on high flow since the greatest reduction in loading is required in this zone to achieve the water quality target.

Segment: Big Sioux River from Hwy I-90 to Diversion Return (Sioux Falls)

303(d) ID: SD-BS-R-BIG SIOUX 10

Parameter/Pollutant (303(d) list cause): TOTAL SUSPENDED SOLIDS - 518

Water Quality Targets: < 90 mg/l as average of at least 3 grab or composite samples obtained during separate weeks in 30-day

Allocation*	Value	Units	State Permits	Permits
WLA	16.9	TONS/DAY		SDS-000001
MOS	39.3	TONS/DAY		
LA	170.3	TONS/DAY		
TMDL	226.5	TONS/DAY		

Notes: TMDLs were developed for five flow zones. This TMDL is based on high flow since the greatest reduction in loading is required in this zone to achieve the water quality target.

Segment: Big Sioux River from Diversion Return to Sioux Falls Wastewater Treatment Plant

303(d) ID: SD-BS-R-BIG SIOUX 11

Parameter/Pollutant (303(d) list cause): TOTAL SUSPENDED SOLIDS - 518

Water Quality Targets: < 90 mg/l as average of at least 3 grab or composite samples obtained during separate weeks in 30-day

Allocation*	Value	Units	State Permits	Permits
WLA	0.6	TONS/DAY		SD-0000078
WLA	37.1	TONS/DAY		SDS-000001
MOS	200.1	TONS/DAY		
LA	891.5	TONS/DAY		
TMDL	1129.3	TONS/DAY		

Notes: TMDLs were developed for five flow zones. This TMDL is based on high flow since the greatest reduction in loading is required in this zone to achieve the water quality target.

Date Submitted: 10/16/2012

Segment: Big Sioux River from Sioux Falls Wastewater Treatment Plant to above Brandon

303(d) ID: SD-BS-R-BIG SIOUX 12

Parameter/Pollutant (303(d) list cause): TOTAL SUSPENDED SOLIDS - 518

Water Quality Targets: < 90 mg/l as average of at least 3 grab or composite samples obtained during separate weeks in 30-day

Allocation*	Value	Units	State Permits	Permits
WLA	3.6	TONS/DAY		SD-0022128
MOS	208.4	TONS/DAY		
LA	944.1	TONS/DAY		
TMDL	1156.1	TONS/DAY		

Notes: TMDLs were developed for five flow zones. This TMDL is based on high flow since the greatest reduction in loading is required in this zone to achieve the water quality target.

* LA = Load Allocation, WLA = Wasteload Allocation, MOS = Margin of Safety, TMDL = sum(WLAs) + sum(LAs) + MOS

EPA REGION 8 TMDL REVIEW

TMDL Document Info:

Document Name:	**Total Suspended Solids Total Maximum Daily Load for the Big Sioux River, Minnehaha County South Dakota**
Submitted by:	**South Dakota Department of Environment and Natural Resources**
Date Received:	**October 16, 2012**
Review Date:	**November 14, 2012**
Reviewer:	**Bonnie Lavelle, EPA Region 8**
Rough Draft / Public Notice / Final Draft?	**Final**
Notes:	

Reviewers Final Recommendation(s) to EPA Administrator (used for final draft review only):

- ☒ Approve
- ☐ Partial Approval
- ☐ Disapprove
- ☐ Insufficient Information

Approval Notes to Administrator: Based on the review presented below, I recommend approval of the TMDLs submitted in this document.

This "EPA Region 8 TMDL Review" document provides a standard format for EPA Region 8 to provide comments to state TMDL programs on TMDL documents submitted to EPA for either formal or informal review. All TMDL documents are evaluated against the minimum submission requirements and TMDL elements identified in the following 8 sections:

1. Problem Description
   - 1.1... TMDL Document Submittal Letter
   - 1.2. Identification of the Waterbody, Impairments, and Study Boundaries
   - 1.3. Water Quality Standards
2. Water Quality Target
3. Pollutant Source Analysis
4. TMDL Technical Analysis
   - 4.1. Data Set Description
   - 4.2. Waste Load Allocations (WLA)
   - 4.3. Load Allocations (LA)
   - 4.4. Margin of Safety (MOS)
   - 4.5. Seasonality and variations in assimilative capacity
5. Public Participation
6. Monitoring Strategy
7. Restoration Strategy
8. Daily Loading Expression

Under Section 303(d) of the Clean Water Act, waterbodies that are not attaining one or more water quality standard (WQS) are considered "impaired." When the cause of the impairment is determined to be a pollutant, a TMDL analysis is required to assess the appropriate maximum allowable pollutant loading rate. A TMDL document consists of a technical analysis conducted to: (1) assess the maximum pollutant loading rate that a waterbody is able to assimilate while maintaining water quality standards; and (2) allocate that assimilative capacity among the known sources of that pollutant. A well written TMDL document will describe a path forward that may be used by those who implement the TMDL recommendations to attain and maintain WQS.

Each of the following eight sections describes the factors that EPA Region 8 staff considers when reviewing TMDL documents. Also included in each section is a list of EPA's minimum submission requirements relative to that section, a brief summary of the EPA reviewer's findings, and the reviewer's comments and/or suggestions. Use of the verb "must" in the minimum submission requirements denotes information that is required to be submitted because it relates to elements of the TMDL required by the CWA and by regulation. Use of the term "should" below denotes information that is generally necessary for EPA to determine if a submitted TMDL is approvable.

This review template is intended to ensure compliance with the Clean Water Act and that the reviewed documents are technically sound and the conclusions are technically defensible.

1. Problem Description

A TMDL document needs to provide a clear explanation of the problem it is intended to address. Included in that description should be a definitive portrayal of the physical boundaries to which the TMDL applies, as well as a clear description of the impairments that the TMDL intends to address and the associated pollutant(s) causing those impairments. While the existence of one or more impairment and stressor may be known, it is important that a comprehensive evaluation of the water quality be conducted prior to development of the TMDL to ensure that all water quality problems and associated stressors are identified. Typically, this step is conducted prior to the 303(d) listing of a waterbody through the monitoring and assessment program. The designated uses and water quality criteria for the waterbody should be examined against available data to provide an evaluation of the water quality relative to all applicable water quality standards. If, as part of this exercise, additional WQS problems are discovered and additional stressor pollutants are identified, consideration should be given to concurrently evaluating TMDLs for those additional pollutants. If it is determined that insufficient data is available to make such an evaluation, this should be noted in the TMDL document.

1.1 TMDL Document Submittal Letter

When a TMDL document is submitted to EPA requesting formal comments or a final review and approval, the submittal package should include a letter identifying the document being submitted and the purpose of the submission.

Minimum Submission Requirements.

- ☒ A TMDL submittal letter should be included with each TMDL document submitted to EPA requesting a formal review.
- ☒ The submittal letter should specify whether the TMDL document is being submitted for initial review and comments, public review and comments, or final review and approval.
- ☒ Each TMDL document submitted to EPA for final review and approval should be accompanied by a submittal letter that explicitly states that the submittal is a final TMDL submitted under Section 303(d) of the Clean Water Act for EPA review and approval. This clearly establishes the State's/Tribe's intent to submit, and EPA's duty to review, the TMDL under the statute. The submittal letter should contain such identifying information as the name and location of the waterbody and the pollutant(s) of concern, which matches similar identifying information in the TMDL document for which a review is being requested.

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information ☐ N/A

Summary: *The final version of the Total Suspended Solids(TSS)TMDLs for segments 8, 10, 11, and 12 of the Big Sioux River was transmitted to EPA by the South Dakota Department of Environment and Natural Resources (SD DENR) via email on October 16, 2012 with a letter requesting final EPA review and approval.*

Comments: *None.*

1.2 Identification of the Waterbody, Impairments, and Study Boundaries

The TMDL document should provide an unambiguous description of the waterbody to which the TMDL is intended to apply and the impairments the TMDL is intended to address. The document should also clearly delineate the physical boundaries of the waterbody and the geographical extent of the watershed area studied. Any additional information needed to tie the TMDL document back to a current 303(d) listing should also be included.

Minimum Submission Requirements:

☒ The TMDL document should clearly identify the pollutant and waterbody segment(s) for which the TMDL is being established. If the TMDL document is submitted to fulfill a TMDL development requirement for a waterbody on the state's current EPA approved 303(d) list, the TMDL document submittal should clearly identify the waterbody and associated impairment(s) as they appear on the State's/Tribe's current EPA approved 303(d) list, including a full waterbody description, assessment unit/waterbody ID, and the priority ranking of the waterbody. This information is necessary to ensure that the administrative record and the national TMDL tracking database properly link the TMDL document to the 303(d) listed waterbody and impairment(s).

☒ One or more maps should be included in the TMDL document showing the general location of the waterbody and, to the maximum extent practical, any other features necessary and/or relevant to the understanding of the TMDL analysis, including but not limited to: watershed boundaries, locations of major pollutant sources, major tributaries included in the analysis, location of sampling points, location of discharge gauges, land use patterns, and the location of nearby waterbodies used to provide surrogate information or reference conditions. Clear and concise descriptions of all key features and their relationship to the waterbody and water quality data should be provided for all key and/or relevant features not represented on the map

☒ If information is available, the waterbody segment to which the TMDL applies should be identified/geo-referenced using the National Hydrography Dataset (NHD). If the boundaries of the TMDL do not correspond to the Waterbody ID(s) (WBID), Entity_ID information or reach code (RCH_Code) information should be provided. If NHD data is not available for the waterbody, an alternative geographical referencing system that unambiguously identifies the physical boundaries to which the TMDL applies may be substituted.

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

Summary:

Pollutant and waterbody segment(s) for which the TMDL is being established:
The impaired segments of the Big Sioux River addressed by this TMDL document are located in south-eastern South Dakota, and are part of the larger Big Sioux River basin. The Big Sioux River segments included in this TMDL document have a total drainage area of approximately 214 square miles in South Dakota.

The TMDLs address four (4) segments of the Big Sioux River (HUC 10170203) listed on the EPA approved South Dakota 2012 303(d) list:
1) Big Sioux River from S2, T104N, R49W to Hwy I-90 (28.5 miles, SD-BS-R-BIG_SIOUX_08);
2) Big Sioux River from Hwy I-90 to the diversion return (15.8 miles, SD-BS-R-BIG_SIOUX_10);
3) Big Sioux River from diversion return to Sioux Falls wastewater treatment plant (WWTP) (4.7 miles, SD-BS-R-BIG_SIOUX_11); and
4) Big Sioux River from Sioux Falls wastewater treatment plant to above Brandon, South Dakota (4.2 miles, SD-BS-R-BIG_SIOUX_12).
All four segments are listed as priority 1 for TMDL development.

Prior to the development of these TMDLs, Segment SD-BS-R-BIG_SIOUX_08 was defined as being from near Dell Rapids to below Baltic. Segment SD-BS-R-BIG_SIOUX_08 has been expanded to include the portion of Segment SD-BS-R-BIG_SIOUX_09 above the diversion split at I-90. The portion of Segment SD-BS-R-

BIG_SIOUX_09 that lies below the diversion to Skunk Creek has been incorporated into Segment SD-BS-R-BIG_SIOUX_10.

The designated uses for these four Big Sioux River segments are:

- *warmwater semi-permanent fish life propagation waters,*
- *immersion recreation waters,*
- *limited contact recreation waters,*
- *irrigation waters,*
- *fish and wildlife propagation, recreation, and stock watering waters, and*
- *domestic water supply waters (segments 08 and 10 only).*

These segments were listed in 2010 and again in 2012 (most recent) for E. coli and fecal coliform bacteria which are impairing the immersion recreational uses, and for total suspended solids (TSS) which is impairing the warmwater semi permanent fish life propagation use. The bacteria impairments in these segments are being addressed by SD DENR in a separate TMDL document, approved by EPA in September 2012. A fecal coliform TMDL for Big Sioux River segment 08 was approved by EPA in May 2008 and is expected to be withdrawn now that the E. Coli TMDL for segment 08 is approved. The TMDLs in this document address the TSS impairments.

Section 1.0, "Introduction", and Section 2.0, "Water-Quality Targets and Total Maximum Daily Load Targets", identify the impairments to these segments as they appear on the State's 303(d) list in the EPA approved 2012 South Dakota Integrated Report for Surface Water Quality Assessment.

Figure 1-1 is a map of the project area and the impaired segments that shows the general location of the Big Sioux River and major tributaries within the project area. Figure 3-1 is a map that shows the location of NPDES permitted point sources including the City of Sioux Falls MS4 within the project area. Figure 3-3 is a schematic of the impaired segments and locations of the major tributaries, the point sources and MS4 area within the overall project area.

The Lower Big Sioux River Watershed is located in eastern South Dakota and drains approximately 2,195 square miles in South Dakota and an additional 1,120 square miles in Minnesota and Iowa. The designated Sioux Falls TMDL Assessment Project Area is a sub-area of the Lower Big Sioux River Watershed and drains a much smaller area (approximately 214 square miles or 6.5% of the watershed) all of which is within South Dakota.

The TMDL document includes a breakdown of the land uses in the Big Sioux River watershed in Table 1-1. The predominant land use within the drainage areas of all four reaches is cultivated crops (61%). The second most prevalent land use is pasture /hay (28%). Less than 1% of the land within the total drainage area is high intensity development.

Impairment status:
The following impairment status information is an excerpt from the document "2012 South Dakota Integrated Report for Surface Water Quality Assessment" (2012 IR).

Reach	***Data Source***	***Impaired Use***	***Cause***	***Priority***
SD-BS-R-BIG_SIOUX_08	*DENR USGS*	*Warmwater Semi- permanent Fish Life Propagation*	*Total Suspended Solids*	*1*
SD-BS-R-BIG_SIOUX_10	*DENR USGS*	*Warmwater Semi- permanent Fish Life Propagation*	*Total Suspended Solids*	*1*
SD-BS-R-BIG_SIOUX_11	*DENR USGS*	*Warmwater Semi- permanent Fish Life Propagation*	*Total Suspended Solids*	*1*
SD-BS-R-BIG_SIOUX_12	*DENR*	*Warmwater Semi- permanent Fish Life Propagation*	*Total Suspended Solids*	*1*

The 2012 Integrated Report does not identify specific source categories for the total suspended solids impairments.

Skunk Creek is a tributary to Segment SD-BS-R-BIG_SIOUX_10. The designated beneficial uses for Skunk Creek are fish and wildlife propagation, recreation, and stock watering waters, irrigation waters, limited contact recreation waters, and warmwater marginal fish life propagation waters. In the 2012 IR, Skunk Creek from Brandt Lake to the Big Sioux River was listed as impaired for warmwater marginal fish life propagation waters due to elevated TSS. Therefore, Skunk Creek is not currently meeting the water quality criteria (WQC) for TSS for the warmwater marginal fish life propagation use which is a less stringent WQC than the TSS WQC that applies to Segment SD-BS-R-BIG_SIOUX__10.

Comments: *None.*

1.3 Water Quality Standards

TMDL documents should provide a complete description of the water quality standards for the waterbodies addressed, including a listing of the designated uses and an indication of whether the uses are being met, not being met, or not assessed. If a designated use was not assessed as part of the TMDL analysis (or not otherwise recently assessed), the documents should provide a reason for the lack of assessment (e.g., sufficient data was not available at this time to assess whether or not this designated use was being met).

Water quality criteria (WQC) are established as a component of water quality standard at levels considered necessary to protect the designated uses assigned to that waterbody. WQC identify quantifiable targets and/or qualitative water quality goals which, if attained and maintained, are intended to ensure that the designated uses for the waterbody are protected. TMDLs result in maintaining and attaining water quality standards by determining the appropriate maximum pollutant loading rate to meet water quality criteria, either directly, or through a surrogate measurable target. The TMDL document should include a description of all applicable water quality criteria for the impaired designated uses and address whether or not the criteria are being attained, not attained, or not evaluated as part of the analysis. If the criteria were not evaluated as part of the analysis, a reason should be cited (e.g. insufficient data were available to determine if this water quality criterion is being attained).

Minimum Submission Requirements:

☒ The TMDL must include a description of the applicable State/Tribal water quality standard, including the designated use(s) of the waterbody, the applicable numeric or narrative water quality criterion, and the anti-degradation policy. (40 C.F.R. §130.7(c)(1)).

☒ The purpose of a TMDL analysis is to determine the assimilative capacity of the waterbody that corresponds to the existing water quality standards for that waterbody, and to allocate that assimilative capacity between the significant sources. Therefore, all TMDL documents must be written to meet the existing water quality standards for that waterbody (CWA §303(d)(1)(C)). *Note: In some circumstances, the load reductions determined to be necessary by the TMDL analysis may prove to be infeasible and may possibly indicate that the existing water quality standards and/or assessment methodologies may be erroneous. However, the TMDL must still be determined based on existing water quality standards. Adjustments to water quality standards and/or assessment methodologies may be evaluated separately, from the TMDL.*

☒ The TMDL document should describe the relationship between the pollutant of concern and the water quality standard the pollutant load is intended to meet. This information is necessary for EPA to evaluate whether or not attainment of the prescribed pollutant loadings will result in attainment of the water quality standard in question.

☒ If a standard includes multiple criteria for the pollutant of concern, the document should demonstrate that the TMDL value will result in attainment of all related criteria for the pollutant. For example, both acute and chronic values (if present in the WQS) should be addressed in the document, including consideration of magnitude, frequency and duration requirements.

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

Summary:
Summary tables included at the beginning of the document (pages i-iv) provide a description of the applicable water quality standards for each of the four segments of the Big Sioux River addressed by these TMDLs. The description includes the designated uses assigned to each segment, and the applicable numeric WQC.

The TSS WQC for the impaired designated uses for these reaches are as follows:

South Dakota DENR Surface Water Quality Criteria for TSS

Designated Use	*WQC (average)*[1]	*WQC (single sample)*	*Applicable Period*
Warmwater Semi permanent Fish Life Propagation	*≤ 90 mg/L*	*≤ 158 mg/L*	*Year round*

[1]*Average of at least 3 grab or composite samples obtained during separate weeks for any 30-day period*

Additionally, Section 2.0, "Water Quality Standards and Total Maximum Daily Load Targets", provides a description of all designated uses (not just the impaired uses) that have been assigned to all four segments of the Big Sioux River for which these TMDLs have been developed.

The designated uses are:

Big Sioux River Segment	*Designated Uses*
SD-BS-R-BIG_SIOUX_08	*Domestic water supply, fish and wildlife propagation, stock watering, immersion recreation, irrigation waters, limited contact recreation, and warmwater semi-permanent fish life propagation*
SD-BS-R-BIG_SIOUX_10	*Domestic water supply, fish and wildlife propagation, stock watering, immersion recreation, irrigation waters, limited contact recreation, and warmwater semi-permanent fish life propagation*
SD-BS-R-BIG_SIOUX_11	*Fish and wildlife propagation, stock watering, immersion recreation, irrigation waters, limited contact recreation, and warmwater semi-permanent fish life propagation*
SD-BS-R-BIG_SIOUX_12	*Fish and wildlife propagation, stock watering, immersion recreation, irrigation waters, limited contact recreation, and warmwater semi-permanent fish life propagation*

As described in Section 4.0, Technical Analysis, the TMDL was developed using the load duration curve (LDC) approach. Specific standards-related details of the LDCs are as follows:

- *The LDCs were developed for the entire flow regime.*
- *Separate LDCs were developed for each of the four impaired segments.*
- *The 30-day average WQC for TSS for warmwater semi permanent fish life propagation use (90 mg/L) was chosen as the water quality target and this value was used to construct the upper curve, the loading capacity. The loading capacity is the product of the simulated 30-day average flow at respective TMDL endpoints, the 30-day average TSS criteria, and a unit conversion factor.*
- *The lower curve represents the WLA and includes both permitted point source loads and, for segments 10 and 11, the City of Sioux Falls MS4 load which varies over the range of flow for these segments.*
- *Observed loads were plotted within the LDC for each reach. Observed loads were calculated using measured 30-day average TSS and 30-day average flow at designated monitoring stations.*
- *Box plots of HSPF model- simulated 30-day average loads were also plotted within the LDC for each segment. These were calculated using simulated 30-day average TSS and flow data from segments endpoints. The 95th percentile of the range of these estimates within each flow zone was selected as the baseline 30-day average load.*
- *LDCs based on the daily maximum WQC for TSS for warmwater semi permanent fish life propagation (158 mg/L) were also constructed using the procedures described above and are included in Appendix A of the document for comparison. These LDCs support the conclusion that reductions in loadings necessary to achieve the 30-day average WQC for TSS will also achieve the daily maximum WQC for TSS.*

Tables 5-2 through 5-5 present the TMDLs that will achieve the 30-day average WQC for TSS, the margin of safety (MOS), waste load allocations (WLAs), and load allocations (LAs) for all four impaired segments.

- *The TMDL for each flow zone for each segment is the loading capacity at the 95th percentile flow within each flow zone.*
- *The MOS is the difference between the loading capacity at the midpoint of the flow zone and the loading capacity at the minimum flow within each flow zone.*
- *The WLA for each non-MS4 point source is the product of the discharge of the point source and the current effluent limits specified in the NPDES permits for these facilities.*

- *The MS4 WLA was then calculated as a percentage of the loading capacity that remains after accounting for the WLAs and the MOS. The MS4 WLA was calculated assuming that the MS4 will continue to have approximately the same percent contribution to the total load as it does currently. The current percent contribution to the total load was determined using the HSPF model. The MS4 WLA varies with flow.*
- *The nonpoint source LA is the loading capacity that remains after accounting for the MOS and the WLAs.*

Sufficient information is provided in the document to conclude that attainment of the prescribed pollutant loadings will result in attainment of the WQS.

Comments: *None.*

2. Water Quality Targets

TMDL analyses establish numeric targets that are used to determine whether water quality standards are being achieved. Quantified water quality targets or endpoints should be provided to evaluate each listed pollutant/water body combination addressed by the TMDL, and should represent achievement of applicable water quality standards and support of associated beneficial uses. For pollutants with numeric water quality standards, the numeric criteria are generally used as the water quality target. For pollutants with narrative standards, the narrative standard should be translated into a measurable value. At a minimum, one target is required for each pollutant/water body combination. It is generally desirable, however, to include several targets that represent achievement of the standard and support of beneficial uses (e.g., for a sediment impairment issue it may be appropriate to include a variety of targets representing water column sediment such as TSS, embeddedness, stream morphology, up-slope conditions and a measure of biota).

Minimum Submission Requirements:

☒ The TMDL should identify a numeric water quality target(s) for each waterbody pollutant combination. The TMDL target is a quantitative value used to measure whether or not the applicable water quality standard is attained. *Generally, the pollutant of concern and the numeric water quality target are, respectively, the chemical causing the impairment and the numeric criteria for that chemical (e.g., chromium) contained in the water quality standard. Occasionally, the pollutant of concern is different from the parameter that is the subject of the numeric water quality target (e.g., when the pollutant of concern is phosphorus and the numeric water quality target is expressed as a numerical dissolved oxygen criterion). In such cases, the TMDL should explain the linkage between the pollutant(s) of concern, and express the quantitative relationship between the TMDL target and pollutant of concern. In all cases, TMDL targets must represent the attainment of current water quality standards.*

☐ When a numeric TMDL target is established to ensure the attainment of a narrative water quality criterion, the numeric target, the methodology used to determine the numeric target, and the link between the pollutant of concern and the narrative water quality criterion should all be described in the TMDL document. Any additional information supporting the numeric target and linkage should also be included in the document.

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

Summary:
Numeric water quality target for each waterbody/pollutant combination:
The numeric TMDL targets established for the four impaired segments of the Big Sioux River are based on the 30-day average and daily maximum WQC for TSS established to protect the warmwater semi permanent fish life propagation beneficial uses. The TSS targets for the four Big Sioux River segments are:

- *$\leq$ 90 mg/L 30-day average; or*
- *$\leq$ 158 mg/L daily maximum, depending on which criterion required the greatest load reduction.*

LDCs were constructed based on both the daily maximum TSS WQC and the 30-day average TSS WQC. The load reductions necessary to achieve the 30-day average TSS WQC are greater than the reductions necessary to

achieve the daily maximum TSS WQC. Therefore, the final TMDL water quality target is the 30-day average TSS WQC of ≤ 90mg/L.

Comments: *None.*

3. Pollutant Source Analysis

A TMDL analysis is conducted when a pollutant load is known or suspected to be exceeding the loading capacity of the waterbody. Logically then, a TMDL analysis should consider all sources of the pollutant of concern in some manner. The detail provided in the source assessment step drives the rigor of the pollutant load allocation. In other words, it is only possible to specifically allocate quantifiable loads or load reductions to each significant source (or source category) when the relative load contribution from each source has been estimated. Therefore, the pollutant load from each significant source (or source category) should be identified and quantified to the maximum practical extent. This may be accomplished using site-specific monitoring data, modeling, or application of other assessment techniques. If insufficient time or resources are available to accomplish this step, a phased/adaptive management approach may be appropriate. The approach should be clearly defined in the document.

Minimum Submission Requirements:

☒ The TMDL should include an identification of all potentially significant point and nonpoint sources of the pollutant of concern, including the geographical location of the source(s) and the quantity of the loading, e.g., lbs/per day. This information is necessary for EPA to evaluate the WLA, LA and MOS components of the TMDL.

☒ The level of detail provided in the source assessment should be commensurate with the nature of the watershed and the nature of the pollutant being studied. Where it is possible to separate natural background from nonpoint sources, the TMDL should include a description of both the natural background loads and the nonpoint source loads.

☒ Natural background loads should not be assumed to be the difference between the sum of known and quantified anthropogenic sources and the existing *in situ* loads (e.g. measured in stream) unless it can be demonstrated that all significant anthropogenic sources of the pollutant of concern have been identified, characterized, and properly quantified.

☒ The sampling data relied upon to discover, characterize, and quantify the pollutant sources should be included in the document (e.g. a data appendix) along with a description of how the data were analyzed to characterize and quantify the pollutant sources. A discussion of the known deficiencies and/or gaps in the data set and their potential implications should also be included.

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

Summary:
The main TSS sources are a combination of point sources and nonpoint sources within and upstream of the impaired segments. Five NPDES permitted point sources are located within the drainage area of the four segments. The five point sources are:

- *Permit number SD-0022101: Dell Rapids Wastewater Treatment Plant (WWTP)(Segment 8)*
- *Permit number SD-0022284: Baltic WWTP (Segment 8)*
- *Permit number SDS-000001: Sioux Falls NPDES MS4 (Segment 10 and Segment 11)*
- *Permit number SD-0000078: John Morrell & Company (Segment11)*
- *Permit number SD-0022128: Sioux Falls WWTP (Segment 12)*

Stormwater discharges from construction sites are another source of TSS loading. Section 402(p) of the Clean Water Act requires NPDES permit coverage for certain stormwater discharges. EPA's Stormwater Phase II Final Rule requires NPDES permit coverage for stormwater discharges from construction sites that disturb more than one acre.

For such discharges within segments 10 and 11, SD DENR has approved the City of Sioux Falls as a qualified local program for storm water discharges associated with construction sites within its jurisdiction. Compliance with the Sioux Falls requirements for control of stormwater discharges is deemed to be compliance with the SD General Permit for Storm Water Discharges Associated with Construction Activities. The Sioux Falls NPDES MS4 permit incorporates the requirements for control of stormwater discharges from construction sites. The TSS loading associated with stormwater discharges from construction sites that disturb more than one acre within Segments 10 and 11 is accounted for in the TSS TMDL by the MS4 WLAs for segments 10 and 11.

The Sioux Falls MS4 permit does not cover the segment 8 and segment 12 drainage areas however. Stormwater discharges associated with construction activities in these areas are covered by the SD General Permit for Storm Water Discharges Associated with Construction Activities. A separate WLA for stormwater discharges associated with construction activities is not considered necessary in these two segments for the following reasons:

- *Within segment 8 and segment 12, there are no stormwater outfalls. This means that the likelihood of stormwater discharges from construction sites directly into the Big Sioux River in these segments is low.*
- *Additionally, the HSPF model results indicate that the majority of the TSS loading in segment 8 is from Bed/Bank erosion (45%) and the boundary condition (52%). Within segment 12, the HSPF model results indicate that the majority of the TSS loading is from a combination of Bed/Bank erosion (16% local and 42% upstream), boundary conditions (25%) and Skunk Creek (11%). TSS loading from stormwater discharges associated with construction activities within these two segments is likely to be a relatively very small contribution to the overall loading from all sources.*
- *Another consideration is that that the Baltic WWTP in segment 8 discharges infrequently, e.g., it has not discharged within the last five years. Even though the discharge from this facility is infrequent, a WLA of 0.57 tons per day is allocated to this point source over all flow zones. Therefore, within this segment, when the facility is not discharging there is additional assimilative capacity for the possibility of stormwater discharges from construction sites.*

Given these facts, a separate WLA for stormwater discharges from construction sites that disturb more than one acre is considered to be unnecessary in segment 8 and segment 12. Compliance with the terms of the SD General Permit for Stormwater Discharges Associated with Construction Activities (permit number SDR100000) will be protective. As stated in Section 5.2 of the TMDL document, "Waste Load Allocation" (page 37), stormwater discharges associated with construction sites are considered to be in compliance with the TMDL if they are covered under the General Permit for Storm Water Discharges Associated with Construction Activities (Construction General Permit) issued by the SD DENR and the operator properly selects, installs, and maintains all required BMPs including any additional BMPs required for discharges to impaired waters pursuant to Section 6.13 of the Construction General Permit. If local construction stormwater requirements are more restrictive than the requirements of the SD DENR Construction General Permit, the operator must meet the local requirements.

There are several nonpoint sources that contribute loading of TSS. These include surface runoff, bed and bank erosion, and cropland erosion.

The HSPF model was used to determine the contribution of TSS from identified sources in the project area and to evaluate the effectiveness of various management strategies to control these sources and achieve the load reductions necessary to meet the TSS WQC and TSS TMDL water quality target. Source assessment modeling results were summarized using the following categories:

- *nonpoint sources,*
- *MS4 local (contributions from MS4 system located within the current reach boundaries),*
- *MS4 upstream (contributions from MS4 system located upstream of current reach boundaries),*
- *Non-MS4 point sources,*
- *Big Sioux River boundary conditions,*
- *Skunk Creek,*
- *Slip-Up Creek,*
- *local bed and bank erosion, and*
- *upstream bed and bank erosion.*

The contribution of the non-MS4 point sources to the total load was also evaluated in the HSPF model and found to be nearly insignificant i.e., less than 0.1 percent of the overall load.

There are 13 permitted concentrated animal feeding operations (CAFOs) located within Minnehaha County. These permitted CAFOs are not currently allowed to discharge. Although the exact locations of these facilities are not provided due to concerns about biosecurity, given the predominance of pasture land and crop land, it's likely that CAFOs exist in all four impaired segments. The TMDLs address the loading from these facilities as follows:

- *The CAFOs are not permitted to discharge directly into adjacent streams. Therefore the HSPF model does not explicitly represent the CAFOs by including explicit loading estimates.*
- *The impact of CAFOs was accounted for in the HSPF model through use of the "Event Mean Concentration" (EMC) data. EMCs were derived for each land use category using 2009 sampling data. Each 2009 sampling site targeted a representative land use draining to the site. The resulting TSS concentrations were used in the model to represent that particular land use throughout the watershed. Any TSS impacts from CAFOs are captured in the EMC sampling data for agricultural land use.*

Flow and loading from Skunk Creek have significant influences on all three Big Sioux River segments (10, 11, and 12) covered by this TMDL document. The HSPF model estimates that Skunk Creek contributes 65% of the TSS loading in segment 10, 13% of the TSS loading in segment 11 and 11% of the TSS loading segment12. The designated beneficial use for Skunk Creek is warmwater marginal fish life propagation. Skunk Creek is listed on the 2012 EPA approved 303(d) list for South Dakota as impaired due to elevated TSS. In the next five years, SD DENR plans to develop a TSS TMDL for Skunk Creek to address this impairment. However, successful attainment of the applicable WQC in Skunk Creek will result in Skunk Creek continuing to have a significant influence on TSS loading on the Big Sioux River segments covered by these TMDLs since the TSS WQC for warmwater marginal fish life propagation is less stringent than the TSS WQC for warmwater semi permanent fish life propagation.

Comments: *None.*

4. TMDL Technical Analysis

TMDL determinations should be supported by a robust data set and an appropriate level of technical analysis. This applies to **all** of the components of a TMDL document. It is vitally important that the technical basis for **all** conclusions be articulated in a manner that is easily understandable and readily apparent to the reader.

A TMDL analysis determines the maximum pollutant loading rate that may be allowed to a waterbody without violating water quality standards. The TMDL analysis should demonstrate an understanding of the relationship between the rate of pollutant loading into the waterbody and the resultant water quality impacts. This stressor → response relationship between the pollutant and impairment and between the selected targets, sources, TMDLs, and load allocations needs to be clearly articulated and supported by an appropriate level of technical analysis. Every effort should be made to be as detailed as possible, and to base all conclusions on the best available scientific principles.

The pollutant loading allocation is at the heart of the TMDL analysis. TMDLs apportion responsibility for taking actions by allocating the available assimilative capacity among the various point, nonpoint, and natural pollutant sources. Allocations may be expressed in a variety of ways, such as by individual discharger, by tributary watershed, by source or land use category, by land parcel, or other appropriate scale or division of responsibility.

The pollutant loading allocation that will result in achievement of the water quality target is expressed in the form of the standard TMDL equation:

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

Where:

TMDL =		Total Pollutant Loading Capacity of the waterbody
LAs	=	Pollutant Load Allocations
WLAs	=	Pollutant Wasteload Allocations
MOS	=	The portion of the Load Capacity allocated to the Margin of safety.

Minimum Submission Requirements:

- ☒ A TMDL must identify the loading capacity of a waterbody for the applicable pollutant, taking into consideration temporal variations in that capacity. EPA regulations define loading capacity as the greatest amount of a pollutant that a water can receive without violating water quality standards (40 C.F.R. §130.2(f)).
- ☒ The total loading capacity of the waterbody should be clearly demonstrated to equate back to the pollutant load allocations through a balanced TMDL equation. In instances where numerous LA, WLA and seasonal TMDL capacities make expression in the form of an equation cumbersome, a table may be substituted as long as it is clear that the total TMDL capacity equates to the sum of the allocations.
- ☒ The TMDL document should describe the methodology and technical analysis used to establish and quantify the cause-and-effect relationship between the numeric target and the identified pollutant sources. In many instances, this method will be a water quality model.
- ☒ It is necessary for EPA staff to be aware of any assumptions used in the technical analysis to understand and evaluate the methodology used to derive the TMDL value and associated loading allocations. Therefore, the TMDL document should contain a description of any important assumptions (including the basis for those assumptions) made in developing the TMDL, including but not limited to:

(1) the spatial extent of the watershed in which the impaired waterbody is located and the spatial extent of the TMDL technical analysis;
(2) the distribution of land use in the watershed (e.g., urban, forested, agriculture);
(3) a presentation of relevant information affecting the characterization of the pollutant of concern and its allocation to sources such as population characteristics, wildlife resources, industrial activities etc…;
(4) present and future growth trends, if taken into consideration in determining the TMDL and preparing the TMDL document (e.g., the TMDL could include the design capacity of an existing or planned wastewater treatment facility);
(5) an explanation and analytical basis for expressing the TMDL through surrogate measures, if applicable. Surrogate measures are parameters such as percent fines and turbidity for sediment impairments; chlorophyll *a* and phosphorus loadings for excess algae; length of riparian buffer; or number of acres of best management practices.

☒ The TMDL document should contain documentation supporting the TMDL analysis, including an inventory of the data set used, a description of the methodology used to analyze the data, a discussion of strengths and weaknesses in the analytical process, and the results from any water quality modeling used. This information is necessary for EPA to review the loading capacity determination, and the associated load, wasteload, and margin of safety allocations.

☒ TMDLs must take critical conditions (e.g., steam flow, loading, and water quality parameters, seasonality, etc…) into account as part of the analysis of loading capacity (40 C.F.R. §130.7(c)(1)). TMDLs should define applicable critical conditions and describe the approach used to determine both point and nonpoint source loadings under such critical conditions. In particular, the document should discuss the approach used to compute and allocate nonpoint source loadings, e.g., meteorological conditions and land use distribution.

☒ Where both nonpoint sources and NPDES permitted point sources are included in the TMDL loading allocation, and attainment of the TMDL target depends on reductions in the nonpoint source loads, the TMDL document must include a demonstration that nonpoint source loading reductions needed to implement the load allocations are actually practicable [40 CFR 130.2(i) and 122.44(d)].

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

Summary:
A combination of HSPF modeling along with load duration curves were used in a weight of evidence technical analysis for the Big Sioux River TSS TMDLs. The HSPF model was used to determine the contribution of TSS from identified sources in the project area and to evaluate the effectiveness of alternative management strategies to control these sources. The evaluation of the management strategies was performed by comparing the predicted load reductions and the frequency percent exceedance of the WQC expected to result from the implementation of each management strategy and the cumulative effects of implementing all strategies.

The Big Sioux River drainage basin was represented in the HSPF model using 24 sub watersheds and two boundary conditions which represent Skunk Creek (a significant tributary) and the Big Sioux River at Dell Rapids (the upstream endpoint of Reach 8). Nonpoint source TSS loadings for HSPF were estimated using the event mean concentrations (EMCs) for each land use, which were derived from sample data based on representative land uses draining to particular sampling sites. EMCs were applied throughout the watershed. The buildup and wash off of TSS was simulated based on the EMC values and precipitation. The HSPF model calculated the average daily TSS load to the impaired Big Sioux River segments for each date from 2005 – 2009.

The TMDL, WLAs, MOS, and LAs were derived using the load duration curve (LDC) approach that results in a flow-variable target that considers the entire flow regime. The LDC is a dynamic expression of the allowable load for any given day. The LDCs include the loading capacity or TMDL for each reach. The loading capacity was calculated as the product of simulated 30-day average flow (from the HSPF model) at the endpoint for each reach and the TSS 30-day average WQC and a unit conversion factor.

The LDCs for Reach 8, Reach 11, and Reach 12 include a WLA for the non-MS4 point sources. The WLA is the product of the daily discharge and the effluent limit specified in the NPDES permit for each source. For the Dell Rapids WWTP, the effluent limit is equal to the 30-day average TSS WQC of 90mg/L. The effluent limits for the Baltic WWTP and the Sioux Falls WWTP are 30 mg/L which is more stringent than the 30-day average TSS WQC. The effluent limit for John Morrell & Company is 1,100 pounds per day TSS as a 30-day average. Since the 13 permitted CAFOs in the project area are not permitted to discharge within the watershed, no WLA is provided for these facilities with the understanding that no discharge is permitted.

The LDCs for Reach 10 and Reach 11 include a WLA for the MS4, calculated using the HSPF model application. The MS4 component of the WLA is flow variable and was calculated assuming that in the future, the MS4 will continue to have approximately the same contribution to the total load as was estimated using current (2009) data.

Observed loads were plotted on the LDCs for each reach. Observed loads were calculated using observed 30-day average TSS concentrations from historical sampling events and the 30-day average flow data from monitoring stations. The LDCs also include box plots of HSPF-simulated 30-day average loads for each flow zone calculated using simulated 30-day average TSS and simulated flow at reach endpoints.

To aid in the interpretation of the TMDL, the LDC flow intervals were grouped into five flow zones: high flows (exceeded 0-10 percent of the time), moist conditions (exceeded 10-40 percent of the time), midrange flows (exceeded 40-60 percent of the time), dry conditions (exceeded 60-90 percent of the time) and low flows (exceeded 90-100 percent of the time).

Once the loading capacity was derived for each flow zone, the load allocations were calculated by subtracting the WLA and MOS. The calculated loads for each flow regime for all four segments are included in Tables 5-2, 5-3, 5-4 and 5-5 of the TMDL document.

Tables 5-2 through 5-5 present the TMDL for achieving the 30-day average WQC for TSS, the MOS, WLAs, and LAs for all four impaired segments.

- *The TMDL for each flow zone for each segment is the loading capacity at the 95th percentile flow within each flow zone.*
- *The MOS is the difference between the loading capacity at the midpoint of the flow zone and the loading capacity at the minimum flow within each flow zone.*
- *The WLA for each non-MS4 point source is the product of the discharge of the point source and the current effluent limits specified in the NPDES permits for these facilities.*
- *The MS4 WLA was then calculated as a percentage of the loading capacity that remains after accounting for the WLAs and the MOS. The MS4 WLA was calculated assuming that the MS4 will continue to have approximately the same contribution to the total load as it does currently. The percent contribution to the total load was determined form the HSPF model. The MS4 WLA varies with flow.*
- *The nonpoint source LA is the loading capacity that remains after accounting for the MOS and the WLAs.*

Comments: *None.*

4.1 Data Set Description

TMDL documents should include a thorough description and summary of all available water quality data that are relevant to the water quality assessment and TMDL analysis. An inventory of the data used for the TMDL analysis should be provided to document, for the record, the data used in decision making. This also provides the reader with the opportunity to independently review the data. The TMDL analysis should make use of all readily available data for the waterbody under analysis unless the TMDL writer determines that the data are not relevant or appropriate. For relevant data that were known but rejected, an explanation of why the data were not utilized should be provided (e.g., samples exceeded holding times, data collected prior to a specific date were not considered timely, etc…).

Minimum Submission Requirements:

☒ TMDL documents should include a thorough description and summary of all available water quality data that are relevant to the water quality assessment and TMDL analysis such that the water quality impairments are clearly defined and linked to the impaired beneficial uses and appropriate water quality criteria.

☒ The TMDL document submitted should be accompanied by the data set utilized during the TMDL analysis. If possible, it is preferred that the data set be provided in an electronic format and referenced in the document. If electronic submission of the data is not possible, the data set may be included as an appendix to the document.

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

Summary:

Description and summary of all available water quality data relevant to the water quality assessment and TMDL analysis: *The data used to support the TMDLs consist of SD DENR and USGS TSS and flow data collected from 10 sites within the project area. The data description and summary for the four impaired segments of the Big Sioux River are included mainly in Section 1.3., "Available Water-Quality Data", and are plotted on the load duration curves. Sampling was conducted at these 10 monitoring sites on a temporal basis over the period from January 2000 to October 2009 and included 878 total samples analyzed for TSS. The ranges of TSS concentrations measured at each of the 10 monitoring sites is provided in Table 1-3, along with the number of times the daily maximum TSS WQC and the 30-day average TSS WQC were exceeded at each. The frequency of sampling at each site is not provided however.*

Although data are available from monitoring that occurred prior to the year 2000, only data collected during the period 2000-2009 were used the TMDL analysis. The earlier data were excluded because of the expansion of the City of Sioux Falls boundaries and the significant amount of data available after the year 2000. The data used in the TMDLs are representative of current conditions.

Additional monitoring of flow and TSS was completed in 2009 specifically to support the development of these TMDLs. This monitoring was performed on three key tributaries (Skunk Creek, Slip-Up Creek, and Silver Creek), on the diversion canal, and at five sites along the Big Sioux River. The program also included urban stormwater monitoring at 11 locations within the storm drainage network for the City of Sioux Falls (this area is covered by the NPDES MS4 permit). Details of the 2009 sampling are described in the document "Standard Operating Procedure for Field Operations for the 2009 Sioux Falls Total Maximum Daily Load Assessment" prepared by RESPEC for SD DENR. Descriptive statistics such as minimum, maximum, median, mean, 90th percentile, 95th percentile and frequency of exceedance of the TSS WQC are provided for each of the 2009 sampling sites, including the urban stormwater sites.

The data historically collected by SD DENR and USGS is available on public websites. An electronic copy of the data collected in 2009 to support these TMDLs is provided in a separate submittal.

Comments: *None.*

4.2 Waste Load Allocations (WLA):

Waste Load Allocations represent point source pollutant loads to the waterbody. Point source loads are typically better understood and more easily monitored and quantified than nonpoint source loads. Whenever practical, each point source should be given a separate waste load allocation. All NPDES permitted dischargers that discharge the pollutant under analysis directly to the waterbody should be identified and given separate waste load allocations. The finalized WLAs are required to be incorporated into future NPDES permit renewals.

Minimum Submission Requirements:

☒ EPA regulations require that a TMDL include WLAs for all significant and/or NPDES permitted point sources of the pollutant. TMDLs must identify the portion of the loading capacity allocated to individual existing and/or future point source(s) (40 C.F.R. §130.2(h), 40 C.F.R. §130.2(i)). In some cases, WLAs may cover more than one discharger, e.g., if the source is contained within a general permit. If no allocations are to be made to point sources, then the TMDL should include a value of zero for the WLA.

☒ All NPDES permitted dischargers given WLA as part of the TMDL should be identified in the TMDL, including the specific NPDES permit numbers, their geographical locations, and their associated waste load allocations.

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

Summary:
The Big Sioux River TMDL document (see Table 3-1) identifies five point sources that discharge directly to the four impaired stream segments, including the Sioux Falls MS4. WLAs for the Sioux Falls MS4 were derived for segments 10 and 11 and these WLAs are flow variable. The MS4 WLAs for each flow zone within segments 10 and 11 are provided in Tables 5-3 and 5-4 and are summarized in the following table:

MS4 TSS WLAs in tons/day

Segment	*High Flow Zone*		*Moist Flow Zone*		*Midrange Flow Zone*		*Dry Flow Zone*		*Low Flow Zone*	
	Flow cfs	*MS4 WLA tons/day*	*Flow cfs*	*MS4 WLA tons/day*	*Flow cfs*	*MS4 WLA tons/day*	*Flow cfs*	*MS4 WLA tons/day*	*Flow cfs*	*MS4 WLA tons/day*
SD-BS-R-BIG_SIOUX_10	*>514*	*16.9*	*207-514*	*8.0*	*139-207*	*3.5*	*47-139*	*2.0*	*<47*	*0.5*
SD-BS-R-BIG_SIOUX 11	*>1947*	*37.1*	*663-1947*	*15.6*	*416-663*	*5.3*	*203-416*	*2.8*	*<203*	*1.3*

Separate WLAs for the other four point sources were derived for segments 8, 11, and 12. These WLAs are not flow variable. These WLAs are summarized in the following table.

Segment	***Point Source***	***WLA (tons/day)***
SD-BS-R-BIG_SIOUX_08	*Dell Rapids WWTP*	*1.6*
	Baltic WWTP	*0.6*
SD-BS-R-BIG_SIOUX_11	*John Morrell & Co.*	*0.6*
SD-BS-R-BIG_SIOUX_12	*Sioux Falls WWTP*	*3.6*

Stormwater discharges from construction sites are another source of TSS loading. EPA's Stormwater Phase II Final Rule requires NPDES permit coverage for stormwater discharges from construction sites that disturb more than one acre.

For stormwater discharges from construction sites that disturb more than one acre, within segments 10 and 11, SD DENR has approved the City of Sioux Falls as a qualified local program for storm water discharges associated with construction sites within its jurisdiction. Compliance with the Sioux Falls requirements for control of stormwater discharges is deemed to be compliance with the SD General Permit for Storm Water Discharges Associated with Construction Activities. The Sioux Falls NPDES MS4 permit incorporates the requirements for control of stormwater discharges from construction sites. The TSS loading associated with stormwater discharges from construction sites that disturb more than one acre within Segments 10 and 11 is accounted for in the TSS TMDL by the MS4 WLAs for segments 10 and 11.

The Sioux Falls MS4 permit does not cover the segment 8 and segment 12 drainage areas however. Stormwater discharges associated with construction activities in these areas are covered by the SD General Permit for Storm Water Discharges Associated with Construction Activities. A separate WLA for stormwater discharges associated with construction activities is not considered necessary in these two segments for the following reasons:

- *Within segment 8 and segment 12, there are no stormwater outfalls. This means that the likelihood of stormwater discharges from construction sites directly into the Big Sioux River in these segments is low.*
- *Additionally, the HSPF model results indicate that the majority of the TSS loading in segment 8 is from Bed/Bank erosion (45%) and the boundary condition (52%). Within segment 12, the HSPF model results indicate that the majority of the TSS loading is from a combination of Bed/Bank erosion (16% local and 42% upstream), boundary conditions (25%) and Skunk Creek (11%). TSS loading from stormwater discharges associated with construction activities within these two segments is likely to be a relatively very small contribution to the overall loading from all sources.*
- *Another consideration is that that the Baltic WWTP in segment 8 discharges infrequently, e.g., it has not discharged within the last five years. Even though the discharge from this facility is infrequent, a WLA of 0.57 tons per day is allocated to this point source over all flow zones. Therefore, within this segment, when the facility is not discharging there is additional assimilative capacity for the possibility of stormwater discharges from construction sites.*

Given these facts, a separate WLA for stormwater discharges from construction sites that disturb more than one acre is considered to be unnecessary in segment 8 and segment 12. Compliance with the terms of the SD General Permit for Stormwater Discharges Associated with Construction Activities will be protective. As stated in Section 5.2 of the TMDL document, "Waste Load Allocation" (page 37), stormwater discharges associated with construction sites are considered to be in compliance with the TMDL if they are covered under the General Permit for Storm Water Discharges Associated with Construction Activities (Construction General Permit) issued by the SD DENR and the operator properly selects, installs, and maintains all required BMPs including any additional BMPs required for discharges to impaired waters pursuant to Section 6.13 of the Construction

General Permit. If local construction stormwater requirements are more restrictive than the requirements of the SD DENR Construction General Permit, the operator must meet the local requirements.

***Comments**: None.*

4.3 Load Allocations (LA):

Load allocations include the nonpoint source, natural, and background loads. These types of loads are typically more difficult to quantify than point source loads, and may include a significant degree of uncertainty. Often it is necessary to group these loads into larger categories and estimate the loading rates based on limited monitoring data and/or modeling results. The background load represents a composite of all upstream pollutant loads into the waterbody. In addition to the upstream nonpoint and upstream natural load, the background load often includes upstream point source loads that are not given specific waste load allocations in this particular TMDL analysis. In instances where nonpoint source loading rates are particularly difficult to quantify, a performance-based allocation approach, in which a detailed monitoring plan and adaptive management strategy are employed for the application of BMPs, may be appropriate.

Minimum Submission Requirements:

☒ EPA regulations require that TMDL expressions include LAs which identify the portion of the loading capacity attributed to nonpoint sources and to natural background. Load allocations may range from reasonably accurate estimates to gross allotments (40 C.F.R. §130.2(g)). Load allocations may be included for both existing and future nonpoint source loads. Where possible, load allocations should be described separately for natural background and nonpoint sources.

☒ Load allocations assigned to natural background loads should not be assumed to be the difference between the sum of known and quantified anthropogenic sources and the existing *in situ* loads (e.g., measured in stream) unless it can be demonstrated that all significant anthropogenic sources of the pollutant of concern have been identified and given proper load or waste load allocations.

Recommendation:

☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

***Summary**:*

Tables 5-2 through 5-5 present the TMDL for achieving the 30-day average WQC for TSS, the MOS, WLAs, and LAs for all four impaired segments.

- *The TMDL for each flow zone for each segment is the loading capacity at the 95th percentile flow within each flow zone.*
- *The MOS is the difference between the loading capacity at the midpoint of the flow zone and the loading capacity at the minimum flow within each flow zone.*
- *The WLA for each non-MS4 point source is the product of the discharge of the point source and the current effluent limits specified in the NPDES permits for these facilities.*
- *The MS4 WLA was then calculated as a percentage of the loading capacity that remains after accounting for the WLAs and the MOS. The MS4 WLA was calculated assuming that the MS4 will continue to have approximately the same contribution to the total load as it does currently. The percent contribution to the total load was determined form the HSPF model. The MS4 WLA varies with flow.*
- *The nonpoint source LA is the loading capacity that remains after accounting for the MOS and the WLAs.*

Section 5.1, "Load Allocation" explains how the loading capacity and load allocation was derived. Tables 5-2, 5-3, 5-4 and 5-5 show the load allocations for each of the five flow regimes for each segment.

The following table summarizes the LA for each segment for each flow zone.

TSS LAs in tons/day

Segment	*High Flow Zone*		*Moist Flow Zone*		*Midrange Flow Zone*		*Dry Flow Zone*		*Low Flow Zone*	
	Flow cfs	*LA tons/day*	*Flow cfs*	*LA tons/day*	*Flow cfs*	*LA tons/day*	*Flow cfs*	*LA tons/day*	*Flow cfs*	*LA tons/day*
SD-BS-R-BIG_SIOUX_8	*>1525*	*756.4*	*478-1525*	*306.5*	*304-478*	*97.6*	*133-304*	*50.9*	*<133*	*23.0*
SD-BS-R-BIG_SIOUX_10	*>514*	*170.3*	*207-514*	*81.5*	*139-207*	*38.7*	*47-139*	*20.3*	*<47*	*5*
SD-BS-R-BIG_SIOUX 11	*>1947*	*891.5*	*663-1947*	*374.6*	*416-663*	*126.5*	*203-416*	*67.1*	*<203*	*31.0*
SD-BS-R-BIG_SIOUX 12	*>1994*	*944.1*	*691-1994*	*395*	*441-691*	*134*	*227-441*	*73.2*	*<227*	*34.7*

Comments: None.

4.4 Margin of Safety (MOS):

Natural systems are inherently complex. Any mathematical relationship used to quantify the stressor → response relationship between pollutant loading rates and the resultant water quality impacts, no matter how rigorous, will include some level of uncertainty and error. To compensate for this uncertainty and ensure water quality standards will be attained, a margin of safety is required as a component of each TMDL. The MOS may take the form of a explicit load allocation (e.g., 10 lbs/day), or may be implicitly built into the TMDL analysis through the use of conservative assumptions and values for the various factors that determine the TMDL pollutant load → water quality effect relationship. Whether explicit or implicit, the MOS should be supported by an appropriate level of discussion that addresses the level of uncertainty in the various components of the TMDL technical analysis, the assumptions used in that analysis, and the relative effect of those assumptions on the final TMDL. The discussion should demonstrate that the MOS used is sufficient to ensure that the water quality standards would be attained if the TMDL pollutant loading rates are met. In cases where there is substantial uncertainty regarding the linkage between the proposed allocations and achievement of water quality standards, it may be necessary to employ a phased or adaptive management approach (e.g., establish a monitoring plan to determine if the proposed allocations are, in fact, leading to the desired water quality improvements).

Minimum Submission Requirements:

☒ TMDLs must include a margin of safety (MOS) to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality (CWA §303(d) (1) (C), 40 C.F.R. §130.7(c)(1)). EPA's 1991 TMDL Guidance explains that the MOS may be implicit (i.e., incorporated into the TMDL through conservative assumptions in the analysis) or explicit (i.e., expressed in the TMDL as loadings set aside for the MOS).

☐ If the MOS is implicit, the conservative assumptions in the analysis that account for the MOS should be identified and described. The document should discuss why the assumptions are considered conservative and the effect of the assumption on the final TMDL value determined.

☒ If the MOS is explicit, the loading set aside for the MOS should be identified. The document should discuss how the explicit MOS chosen is related to the uncertainty and/or potential error in the linkage analysis between the WQS, the TMDL target, and the TMDL loading rate.

☐ If, rather than an explicit or implicit MOS, the TMDL relies upon a phased approach to deal with large and/or unquantifiable uncertainties in the linkage analysis, the document should include a description of the planned phases for the TMDL as well as a monitoring plan and adaptive management strategy.

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

Summary:
The Big Sioux River TMDLs include explicit MOSs for each segment that were derived by calculating the difference between the loading capacity at the mid-point of each of the five flow zones and the loading capacity at the minimum flow in each zone. The explicit MOS values are included in Tables 5-2, 5-3, 5-4 and 5-5 of the TMDL document. The MOS varies from 11.5% to 32% with an average of 22% across all reaches and flow zones.

The following table summarizes the MOS for each segment for each flow zone.

TSS Margin of Safety in tons/day

Segment	***High Flow Zone***		***Moist Flow Zone***		***Midrange Flow Zone***		***Dry Flow Zone***		***Low Flow Zone***	
	Flow cfs	***MOS tons/day***	***Flow cfs***	***MOS tons/day***	***Flow cfs***	***MOS tons/day***	***Flow cfs***	***MOS tons/day***	***Flow cfs***	***MOS tons/day***
SD-BS-R-BIG_SIOUX_8	*>1525*	*121.5*	*478-1525*	*54.8*	*304-478*	*13.0*	*133-304*	*18.7*	*<133*	*6.9*
SD-BS-R-BIG_SIOUX_10	*>514*	*39.3*	*207-514*	*30.7*	*139-207*	*6.5*	*47-139*	*10.5*	*<47*	*5.8*
SD-BS-R-BIG_SIOUX 11	*>1947*	*200.1*	*663-1947*	*72.1*	*416-663*	*25.0*	*203-416*	*28.1*	*<203*	*16.2*
SD-BS-R-BIG_SIOUX 12	*>1994*	*208.4*	*691-1994*	*77.2*	*441-691*	*25.8*	*227-441*	*28.1*	*<227*	*16.4*

Comments: None.

4.5 Seasonality and variations in assimilative capacity:

The TMDL relationship is a factor of both the loading rate of the pollutant to the waterbody and the amount of pollutant the waterbody can assimilate and still attain water quality standards. Water quality standards often vary based on seasonal considerations. Therefore, it is appropriate that the TMDL analysis consider seasonal variations, such as critical flow periods (high flow, low flow), when establishing TMDLs, targets, and allocations.

Minimum Submission Requirements:

☒ The statute and regulations require that a TMDL be established with consideration of seasonal variations. The TMDL must describe the method chosen for including seasonal variability as a factor. (CWA §303(d)(1)(C), 40 C.F.R. §130.7(c)(1)).

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

Summary:
By using the load duration curve approach to develop the TMDL allocations seasonal variability in TSS loads are taken into account. Highest stream flows typically occur during late spring, and the lowest stream flows occur during the winter months. For any given flow condition, Tables 5-2 through 5-5 provide the TMDL, WLA, MOS and LA for each of the four impaired segments.

Comments: None.

5. Public Participation

EPA regulations require that the establishment of TMDLs be conducted in a process open to the public, and that the public be afforded an opportunity to participate. To meaningfully participate in the TMDL process it is necessary that stakeholders, including members of the general public, be able to understand the problem and the proposed solution. TMDL documents should include language that explains the issues to the general public in understandable terms, as well as provides additional detailed technical information for the scientific community. Notifications or solicitations for comments regarding the TMDL should be made available to the general public, widely circulated, and clearly identify the product as a TMDL and the fact that it will be submitted to EPA for review. When the final TMDL is submitted to EPA for approval, a copy of the comments received by the state and the state responses to those comments should be included with the document.

Minimum Submission Requirements:

☒ The TMDL must include a description of the public participation process used during the development of the TMDL (40 C.F.R. §130.7(c)(1)(ii)).

☒ TMDLs submitted to EPA for review and approval should include a summary of significant comments and the State's/Tribe's responses to those comments.

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

Summary:
The Public Participation section of the TMDL document describes the public participation process that has occurred during the development of the TMDLs for the Big Sioux River. In particular, the State has encouraged participation through public meetings in the watershed, and a website was developed and maintained throughout the project. SD DENR provided an opportunity for the general public to comment on the draft TMDL during a 30-day public notice period prior to finalization. During this 30-day public notice period, SD DENR received no public comments on the draft TMDL.

Comments: *None*

6. Monitoring Strategy

TMDLs may have significant uncertainty associated with the selection of appropriate numeric targets and estimates of source loadings and assimilative capacity. In these cases, a phased TMDL approach may be necessary. For Phased TMDLs, it is EPA's expectation that a monitoring plan will be included as a component of the TMDL document to articulate the means by which the TMDL will be evaluated in the field, and to provide for future supplemental data that will address any uncertainties that may exist when the document is prepared.

Minimum Submission Requirements:

☒ When a TMDL involves both NPDES permitted point source(s) and nonpoint source(s) allocations, and attainment of the TMDL target depends on reductions in the nonpoint source loads, the TMDL document should include a monitoring plan that describes the additional data to be collected to determine if the load reductions provided for in the TMDL are occurring.

☐ Under certain circumstances, a phased TMDL approach may be utilized when limited existing data are relied upon to develop a TMDL, and the State believes that the use of additional data or data based on better analytical techniques would likely increase the accuracy of the TMDL load calculation and merit development of a second phase TMDL. EPA recommends that a phased TMDL document or its implementation plan include a monitoring plan and a scheduled timeframe for revision of the TMDL. These elements would not be an intrinsic part of the TMDL and would not be approved by EPA, but may be necessary to support a rationale for approving the TMDL. http://www.epa.gov/owow/tmdl/tmdl_clarification_letter.pdf

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

Summary:

The TMDLs include the recommendation that the Big Sioux River should continue to be monitored as part of DENR's ambient water quality monitoring at existing stations and by Sioux Falls as part of their stormwater permitting implementation. Additional post-TMDL implementation monitoring will also be necessary to assure the goals of the TMDLs have been reached and maintenance of the beneficial uses occurs. The adaptive implementation approach to this TMDL recognizes that further understanding of specific sources of TSS is necessary to effectively achieve the necessary loading reductions. A relatively intense monitoring network consisting of spatially distributed sampling locations will need to be established within the project area to characterize TSS loading at a more refined scale. Using the results of such a monitoring program, portions of the watershed with elevated TSS can be identified for priority implementation of management strategies to obtain the greatest loading reductions.

Comments: *None.*

7. Restoration Strategy

The overall purpose of the TMDL analysis is to determine what actions are necessary to ensure that the pollutant load in a waterbody does not result in water quality impairment. Adding additional detail regarding the proposed approach for the restoration of water quality is not currently a regulatory requirement, but is considered a value added component of a TMDL document. During the TMDL analytical process, information is often gained that may serve to point restoration efforts in the right direction and help ensure that resources are spent in the most efficient manner possible. For example, watershed models used to analyze the linkage between the pollutant loading rates and resultant water quality impacts might also be used to conduct "what if" scenarios to help direct BMP installations to locations that provide the greatest pollutant reductions. Once a TMDL has been written and approved, it is often the responsibility of other water quality programs to see that it is implemented. The level of quality and detail provided in the restoration strategy will greatly influence the future success in achieving the needed pollutant load reductions.

Minimum Submission Requirements:

☒ EPA is not required to and does not approve TMDL implementation plans. However, in cases where a WLA is dependent upon the achievement of a LA, "reasonable assurance" is required to demonstrate the necessary LA called for in the document is practicable). A discussion of the BMPs (or other load reduction measures) that are to be relied upon to achieve the LA(s), and programs and funding sources that will be relied upon to implement the load reductions called for in the document, may be included in the implementation/restoration section of the TMDL document to support a demonstration of "reasonable assurance".

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

Summary:
Section 9.0, "Restoration Strategy" (page 46) describes a variety of BMPs that have been proposed for consideration during development of the implementation plan. Several types of control measures are available for reducing TSS loads, however the BMPs determined to be practicable by the stakeholders are recommended to address the identified sources of TSS loading in the Sioux Falls area.

Based on the water quality monitoring and HSPF model results, the recommended control measures are expected to reduce exceedances of the 30-day average TSS WQC from the current 18 percent to 1 percent in Reach SD-BS-R-BIG_SIOUX_08, from 24 percent to 0 percent in Reach SD-BS-R-BIG_ SIOUX_10, from 31 percent to 5 percent in Reach SD-BS-R-BIG_SIOUX_11, and from 33 percent to 10 percent in Reach SD-BS-R-BIG_SIOUX_12. These load reductions will assist in the attainment of the TMDL goal.

The six management scenarios that were simulated for each TSS-impaired reach using the HSPF model are:
(1) future land use,
(2) the city's planned BMPs,
(3) 90 percent load reduction on agricultural land within the project area boundary north of Sioux Falls local to the Big Sioux River and Silver Creek,
(4) Big Sioux River upstream of Dell Rapids compliance with the current warmwater semi permanent fish life propagation and Skunk Creek compliance with the current warmwater marginal fish life propagation chronic water quality standard,
(5) Big Sioux River upstream of Dell Rapids and Skunk Creek compliance with the warmwater semi permanent fish life propagation chronic water quality standard, and
(6) a 50% reduction in the amount of in stream scour in the Big Sioux River and Skunk Creek within the project area.

Table 9-1 (page 47) shows the modeled percent exceedance of the 30-day average TSS WQC, individual load reduction results, and cumulative load reduction results for each scenario considered in each of the four stream segments of the Big Sioux River.

An adaptive management approach will be taken in implementation of the TMDLs. Resources have been committed and work is underway on the development of a watershed-scale decision support framework that is based on cost optimization to support government and local planning agencies to coordinate investments to achieve required load reductions. This decision support framework is the first step in the development of a TMDL implementation plan that outlines strategies with the highest probability of success and milestones for implementation. The implementation plan is expected to include procedures for reviewing key milestone progress and revising BMPs, if necessary, to meet the TMDL target loads and obtaining data to improve the understanding of the system, evaluate the appropriateness of the target, and to monitor whether the controls are effective towards meeting the target

Comments: *None*

8. Daily Loading Expression

The goal of a TMDL analysis is to determine what actions are necessary to attain and maintain WQS. The appropriate averaging period that corresponds to this goal will vary depending on the pollutant and the nature of the waterbody under analysis. When selecting an appropriate averaging period for a TMDL analysis, primary concern should be given to the nature of the pollutant in question and the achievement of the underlying WQS. However, recent federal appeals court decisions have pointed out that the title TMDL implies a "daily" loading rate. While the most appropriate averaging period to be used for developing a TMDL analysis may vary according to the pollutant, a daily loading rate can provide a more practical indication of whether or not the overall needed load reductions are being achieved. When limited monitoring resources are available, a daily loading target that takes into account the natural variability of the system can serve as a useful indicator for whether or not the overall load reductions are likely to be met. Therefore, a daily expression of the required pollutant loading rate is a required element in all TMDLs, in addition to any other load averaging periods that may have been used to conduct the TMDL analysis. The level of effort spent to develop the daily load indicator should be based on the overall utility it can provide as an indicator for the total load reductions needed.

Minimum Submission Requirements:

☒ The document should include an expression of the TMDL in terms of a daily load. However, the TMDL may also be expressed in temporal terms other than daily (e.g., an annual or monthly load). If the document expresses the TMDL in additional "non-daily" terms the document should explain why it is appropriate or advantageous to express the TMDL in the additional unit of measurement chosen.

Recommendation:
☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

Summary:
The Big Sioux River TSS TMDLs include daily loads expressed in tons per day. The daily TMDL loads are included in the TMDL Allocations sections of the TMDL document. The following table summarizes the TMDL for each segment for each flow zone.

TSS Total Maximum Daily Loads in tons/day

Segment	*High Flow Zone*		*Moist Flow Zone*		*Midrange Flow Zone*		*Dry Flow Zone*		*Low Flow Zone*	
	Flow cfs	*TMDL tons/day*	*Flow cfs*	*TMDL tons/day*	*Flow cfs*	*TMDL tons/day*	*Flow Cfs*	*TMDL tons/day*	*Flow cfs*	*TMDL tons/day*
SD-BS-R-BIG_SIOUX_8	*>1525*	*880.1*	*478-1525*	*363.5*	*304-478*	*112.8*	*133-304*	*71.8*	*<133*	*32.1*
SD-BS-R-BIG_SIOUX_10	*>514*	*226.5*	*207-514*	*120.3*	*139-207*	*48.7*	*47-139*	*32.8*	*<47*	*11.3*
SD-BS-R-BIG_SIOUX 11	*>1947*	*1129.3*	*663-1947*	*462.9*	*416-663*	*157.3*	*203-416*	*98.5*	*<203*	*49.0*
SD-BS-R-BIG_SIOUX 12	*>1994*	*1156.1*	*691-1994*	*475.8*	*441-691*	*163.4*	*227-441*	*104.9*	*<227*	*54.7*

Comments: *None.*