ESCHERICHIA COLI TOTAL MAXIMUM DAILY LOAD (TMDL) FOR THE BIG SIOUX RIVER SEGMENT 1 CODINGTON, GRANT, DAY, AND ROBERTS COUNTIES, SOUTH DAKOTA

South Dakota Department of
Environment and Natural Resources

Protecting South Dakota's Tomorrow ... Today

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E. coli Total Maximum Daily Load Summary

Entity ID:	SD-BS-R-BIG_SIOUX_01
Location:	HUC Code: 10170201
Size of Watershed:	170,000 acres
Water body Type:	River/Stream
303(d) Listing Parameter:	*E. coli*
Initial Listing date:	2010 IR
TMDL Priority Ranking:	1
Listed Stream Miles:	31 miles
Designated Use of Concern:	Limited Contact Recreation
Analytical Approach:	Load Duration Curve Framework
Target:	Meet applicable water quality standards 74:51:01:51
Indicators:	*E. coli*
Target Value:	*E. coli* single sample maximum ≤ 1178 CFU/100mL and geometric mean concentration of ≤ 630 CFU/100mL
High Flow Zone LA:	$1.68E^{13}$ CFU/day
High Flow Zone WLA:	$4.28E^{10}$ CFU/day
High Flow Zone MOS:	$1.8E^{12}$ CFU/day
High Flow Zone TMDL:	$1.8E^{13}$ CFU/day

1.0 Objective

The intent of this document is to clearly identify the components of the TMDL, support adequate public participation and facilitate United States 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 EPA. This TMDL document addresses the *E. coli* impairment of the Big Sioux River, SD-BS-R-BIG_SIOUX_01. Segment 1 of the Big Sioux River is listed in the 2018 South Dakota Integrated Report (SDDENR 2018) as impaired for dissolved oxygen and *E. coli* bacteria. This document deals specifically with the *E. coli* impairment.

Segment 1 of the Big Sioux River was listed as impaired for E. coli during the 2010 reporting cycle based on routine monitoring data collected from 2001 to 2009. South Dakota criteria for determining support status states that if 20 or more samples are collected, the water body will be listed as impaired if more than 10% of the samples exceed the daily maximum criterion (SDDENR 2018). Additional sampling has confirmed the impairment, and the waterbody has remained listed for *E. coli* through the 2018 reporting cycle.

2.0 Watershed Characteristics

2.1 General

Segment 1 of the Big Sioux River drains approximately 170,000 acres of Codington, Grant, Day, and Roberts counties in South Dakota. This segment is defined as extending from Lake Kampeska at Watertown, SD upstream to Section 28, T121N, R52W in Grant County. Contributing drainage areas upstream constitute the headwaters of the river.
The boundary of the watershed is somewhat undefined as a result of rising water levels in previously closed drainages in Northeastern SD. Lakes that do not have a recorded history of discharging have reached elevations that are nearing or have begun to contribute to the upper reaches of the basin. For the purposes of this report, the USGS Hydrologic Unit Code (HUC) 12 boundaries (Figure 1) will be utilized to provide a reproducible level of consistency. The HUC 8 boundary includes an area of over 700,000 potential acres. The nature of the intermittent and incomplete hydrologic connection significantly limits this drainage areas contribution of water and pollutants to the river. Seven water quality monitoring sites were established within the segment (Figure 1). The site identification labels best depict each site's general location within the segment. Dots were also used to mark locations though considerable overlay makes it difficult to visualize the actual site location due to close proximity. Site KAMPESK07 overlaps with NCENBSRR24 and KAMPESK12 overlaps with NCENBRR25 though they are independent sites, respectively.

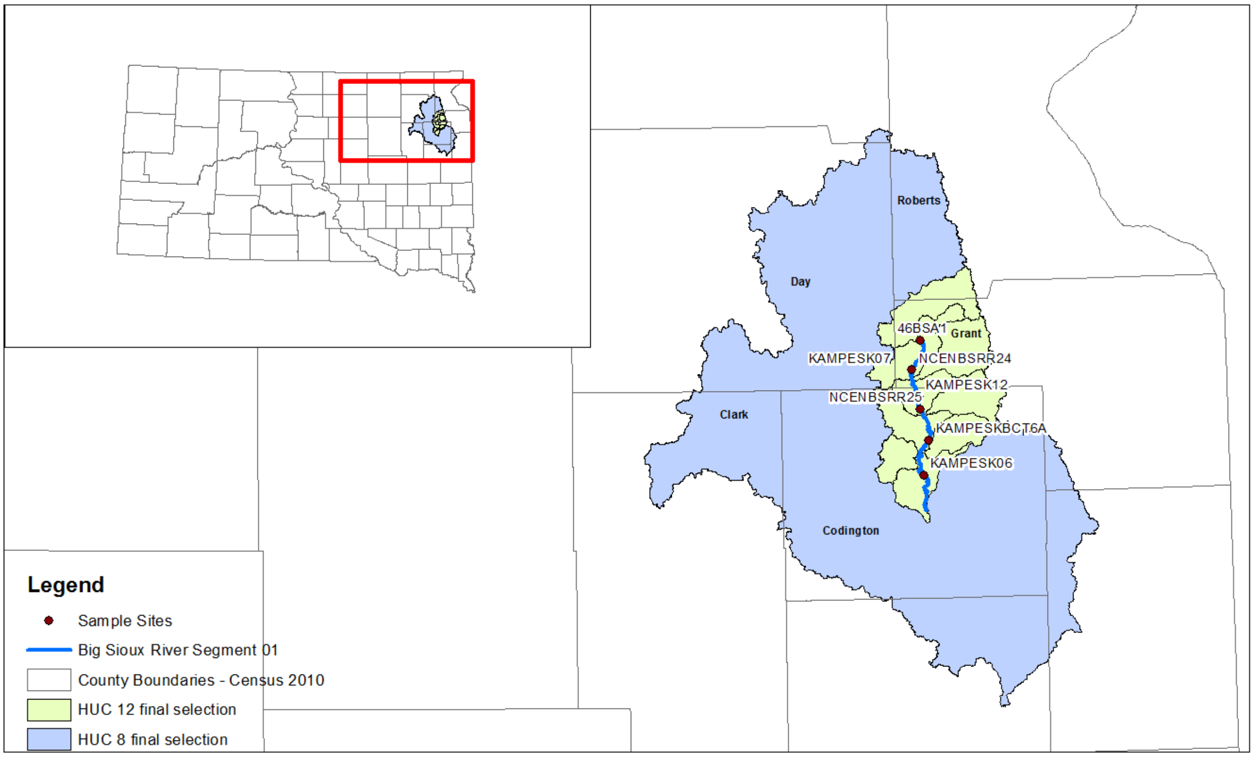

Figure 1. Upper Big Sioux Watershed Location in South Dakota and HUC Boundaries

Primary soil groups vary by county, however the most likely to be associated with bacterial contamination are those closest to the segment. Grant County soil associations of interest include the LaDelle-Doray-Playmoor and Renshaw-Fordville-Divide. These associations are most frequently located within the stream corridors or immediately adjacent terraces and uplands. Codington County soil associations found in a similar aspect on the landscape include the Estelline-Fordville-Renshaw and Lamoure-Rauville. (USDA 1977 and USDA 1966) Landuse in the watershed is primarily agricultural in nature. Based on 2011 NLCD data, row crops, small grain, and grazing are the dominant uses (Table 1). Agricultural practices such as grazing stream corridors, animal feeding operations, and manure applications are the most likely sources of bacterial contamination to the segment.

Table 1. Landuse Characteristics

Land use	Percentage
Cultivated Crop	49.2%
Grassland	42.3%
Developed	4.4%
Water/Wetlands	3.7%
Forest	0.4%

The watershed's climate may be characterized by extremes. Winter temperatures frequently fall to -20° F while summer heat may exceed 100° F. Precipitation averages 21 inches per year and may come as rain or snow; however 75% falls from April through September. Seasonal snowfall is 31 inches. Thunderstorms are frequently intense but short in duration occurring on average 36 days each year. (USDA, 1990)

3.0 Description of Applicable Water Quality Standards & Numeric TMDL Targets

3.1 South Dakota Water Quality Standards

Water quality standards are comprised of three main parts as defined in the Federal Clean Water Act (33 U.S.C. §1251 et seq.) and Administrative Rules of South Dakota (ARSD) Chapter 74:51:01:

- Beneficial Uses – Functions or activities that reflect waterbody management goals
- Criteria – Numeric concentrations or narrative statements that represent the level of water quality required to support beneficial uses
- Antidegredation – Additional policies that protect high quality waters

Each individual waterbody within South Dakota is designated one or more of the following beneficial uses:

(1) Domestic water supply
(2) Coldwater permanent fish life propagation
(3) Coldwater marginal fish life propagation
(4) Warmwater permanent fish life propagation
(5) Warmwater semipermanent fish life propagation
(6) Warmwater marginal fish life propagation
(7) Immersion recreation
(8) Limited contact recreation
(9) Fish and wildlife propagation, recreation, and stock watering
(10) Irrigation
(11) Commerce and industry

All waters (both lakes and streams) within South Dakota are designated the use of fish and wildlife propagation, recreation, and stock watering (9). All streams are designated the uses of (9), and (10) irrigation. Additional uses are designated by the state based on a beneficial use analysis of each waterbody.

Segment 1of the Big Sioux River (SD-BS-R-BIG_SIOUX_01) has been assigned the beneficial uses of: warmwater semi-permanent fish life propagation, irrigation waters, limited contact recreation, and fish and wildlife propagation, recreation, and stock watering. Table 2 lists the criteria that must be met to support the specified beneficial uses. When multiple criteria exist for a particular parameter, the most stringent criterion is used.

Table 2.South Dakota Water Quality Standards for Segment 1 of the Big Sioux River.

Parameters	Criteria	Unit of Measure	Beneficial Use Requiring this Standard
Total ammonia nitrogen as N	Equal to or less than the result from Equation 3 in Appendix A of Surface Water Quality Standards	mg/L 30 day average March 1 to October 31	Warmwater Semi-Permanent Fish Life Propagation
	Equal to or less than the result from Equation 4 in Appendix A of Surface Water Quality Standards	mg/L 30 day average November 1 to February 29	
	Equal to or less than the result from Equation c in Appendix A of Surface Water Quality Standards	mg/L Daily Maximum	
Dissolved Oxygen	≥5.0	mg/L	Warmwater Semi-Permanent Fish Life Propagation & Limited Contact Recreation
Total Suspended Solids	≤90 (mean) ≤158 (single sample)	mg/L	Warmwater Semi-Permanent Fish Life Propagation
Temperature	≤32	°C	Warmwater Semi-Permanent Fish Life Propagation
Escherichia coli Bacteria (May 1- Sept 30)	≤1178 (single sample) ≤ 630 (geomean)	count/100 mL	Limited Contact Recreation
Alkalinity ($CaCO_3$)	≤750 (mean) ≤1,313 (single sample)	mg/L	Fish and Wildlife Propagation, Recreation, and Stock Watering
Conductivity	≤2,500 (mean) ≤4,375 (single sample)	µmhos/cm @ 25° C	Irrigation Waters & fish and wildlife propagation, Recreation & stock watering
Nitrogen, nitrate as N	≤50 (mean) ≤88 (single sample)	mg/L	Fish and Wildlife Propagation, Recreation, and Stock Watering
pH (standard units)	≥6.5 to ≤9.0	units	Warmwater Semi-Permanent Fish Life Propagation & Fish and wildlife propagation, recreation & stock watering
Solids, total dissolved	≤2,500 (mean) ≤4,375 (single sample)	mg/L	Fish and Wildlife Propagation, Recreation, and Stock Watering
Total Petroleum Hydrocarbon	≤10	mg/L	Fish and Wildlife Propagation, Recreation, and Stock Watering
Oil and Grease	≤10		
Sodium Adsorption Ratio	<10	ratio	Irrigation Waters

3.2 *E. coli* Water Quality Standards

South Dakota has adopted numeric *E. coli* criteria for the protection of the immersion (7) and limited contact recreation uses (8). Immersion recreation waters are to be maintained suitable for activities such as swimming, bathing, water skiing and other similar activities with a high degree of water contact that make bodily exposure and ingestion more likely. Limited contact recreation waters are to be maintained suitable for boating, fishing, and other water-related recreation other than immersion recreation.

Through the 1970's and 1980's EPA epidemiological studies identified *E. coli* as a good predictor of gastrointestinal illnesses in fresh waters (USEPA, 1986). *E. coli* is a class of bacteria naturally found in the intestinal tract of humans and warm-blooded animals. The presence and concentration of *E. coli* in surface waters, typically measured in colony forming units (cfu) or counts (#) per

100ml, is used to identify fecal contamination and as an indicator for the likely presence of other pathogenic microorganisms. In 1986 EPA recommended states adopt *E. coli* criteria for immersion recreation based on a rate of 8 illnesses per 1,000 swimmers (USEPA, 1986). While it is generally understood that limited contact recreation is associated with a reduced illnesses risk and different routes of exposure, it is difficult to directly relate an illness rate to these activities from epidemiological studies based on immersion recreation. Therefore, to protect downstream uses and establish effluent limitations for limited contact recreation waters, EPA has suggested numeric criteria five times the immersion recreation values (USEPA, 2002). Because of the reduced risk, the multiplier was considered protective of the limited contact recreation use through the EPA and SDDENR water quality standards review and approval process.

The South Dakota *E. coli* criteria for the immersion recreation beneficial use requires that 1) no single sample exceed 235 cfu/100 ml and 2) during a 30-day period, the geometric mean of a minimum of 5 samples collected during separate 24-hr periods must not exceed 126 cfu/100 ml (ARSD 74:51:01:50). The *E. coli* criteria for the limited contact recreation beneficial use requires that 1) no single sample exceed 1,178 cfu/100 ml and 2) during a 30-day period, the geometric mean of a minimum of 5 samples collected during separate 24-hour periods must not exceed 630 cfu/100 ml (ARSD 74:51:01:51). As noted, these limited contact criteria are five times the corresponding immersion criteria. *E. coli* criteria apply from May 1 through September 30, which is considered the recreation season. The numeric *E. coli* criteria applicable to Big Sioux River Segment 1 are the limited contact recreation values listed in Table 2.

3.3 Numeric TMDL Targets

TMDLs are required to identify a numeric target to measure whether or not the applicable water quality standard is attained. A maximum allowable load, or TMDL, is ultimately calculated by multiplying this target with a flow value and a unit conversion factor. Generally, the pollutant causing the impairment and the parameter expressed as a numeric water quality criterion are the same. In these cases, selecting a TMDL target is as simple as applying the numeric criteria. Occasionally, an impairment is caused by narrative water quality criteria violations or by parameters that cannot be easily expressed as a load. When this occurs, the narrative criteria must be translated into a numeric TMDL target (e.g., nuisance aquatic life translated into a total phosphorus target) or a surrogate target established (e.g., a pH cause addressed through a total nitrogen target) and a demonstration should show how the chosen target is protective of water quality standards.

As seen from Table 2 there are two numeric *E. coli* criteria for TMDL target consideration. When multiple numeric criteria exist for a single parameter, the most stringent criterion is selected as the TMDL target. To judge whether one is more protective of the beneficial use, it is necessary to further elaborate how the criteria were derived.

South Dakota's *E. coli* criteria are based on EPA recommendations originally published in 1986 (USEPA, 1986). EPA issued slightly modified recommendations in 2012 that did not substantially change the underlying analysis or criteria values in South Dakota (USEPA, 2012). As recommended, SDDENR adopted *E. coli* criteria that contain two components: a geometric mean (GM) and a single sample maximum (SSM). The GM was established from epidemiological studies by comparing average summer exposure to an illness rate of 8:1,000. The SSM component was computed using the GM value and the corresponding variance observed in the epidemiological study dataset (i.e., log-standard deviation of 0.4). EPA provided four different SSM values corresponding to the 75th, 82nd, 90th, and 95th percentiles of the expected water quality sampling distribution around the GM to account for different recreational use intensities (Figure 2). South Dakota adopted the most stringent recommendation, the 75th percentile, into state water quality standard regulations as the SSM protective of designated beaches.

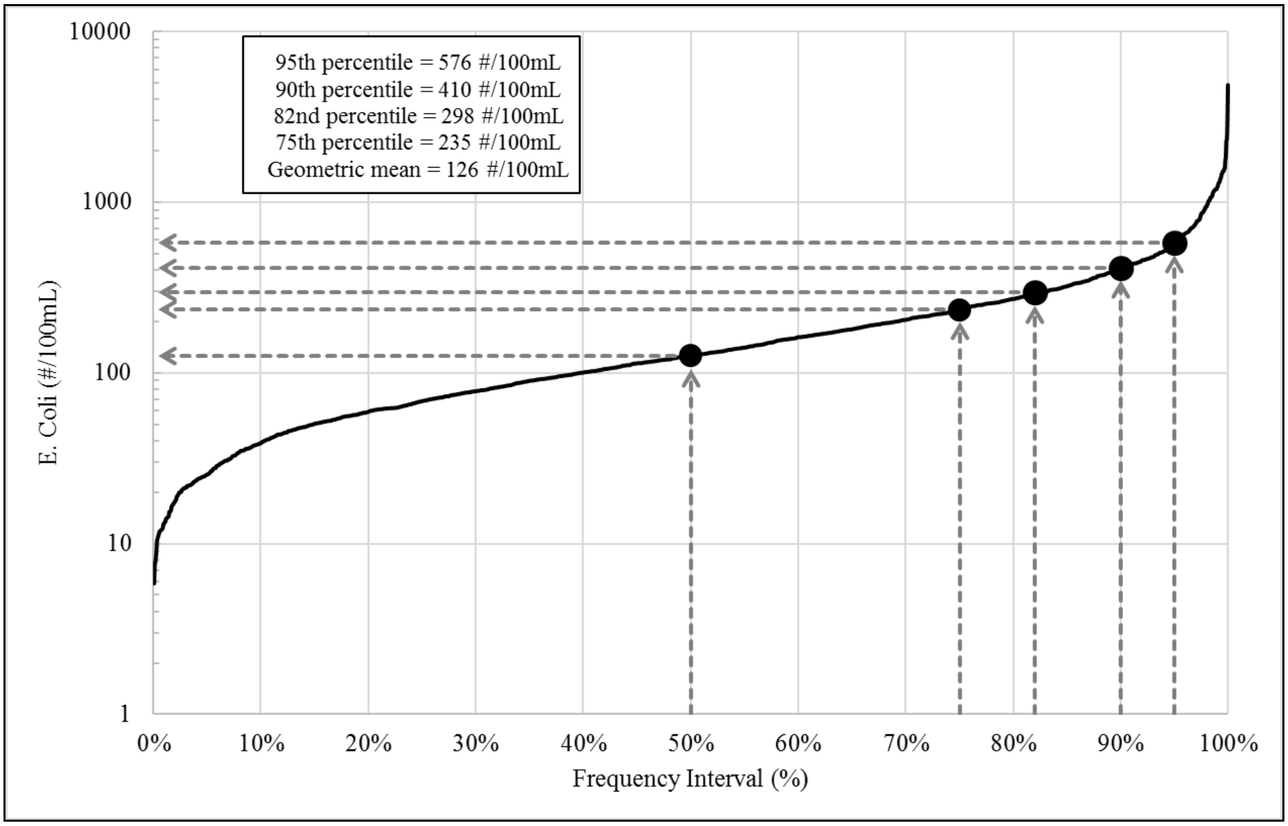

Figure 2. Log-Normal Frequency Distribution Used to Establish South Dakota's Immersion Recreation *E. coli* Criteria of 126 (GM) and 235 (SSM) #/100mL (EPA, 1986).

Dual criteria were established to balance the inherent variability of bacteria data and provide flexibility for handling different sampling routines. Together, the GM and SSM describe a water quality distribution expected to be protective of immersion contact recreation. The GM and SSM are equally protective of the beneficial use because they are based on the same illness rate and differ simply representing different statistical values and sampling timeframes. While this investigation has revealed the GM and SSM *E. coli* criteria to be equally protective of the immersion recreation use, a likewise conclusion can be made for the GM and SSM criteria associated with the limited contact recreation use since those values were simply derived as five times the immersion values.

As described in EPA's *Protocol for Developing Pathogen TMDLs*, the availability of data may dictate which criterion should be used as the TMDL target (EPA, 2001). When a geometric mean of the sampling dataset can be calculated as defined by South Dakota Administrative Rules (i.e., at least five samples separated by a minimum of 24-hours over a 30-day period) and compared to the GM criterion, SDDENR uses the GM criterion as the TMDL target. This establishes a smaller overall loading capacity and is considered a conservative approach to setting the TMDL.

When a proper GM cannot be calculated, as in this case for Segment 1 of the Big Sioux River (SD-BS-R-BIG_SIOUX_01), SDDENR uses the SSM as the TMDL target. This is permissible because the SSM is equally protective of the beneficial use as discussed above. Although this target selection leads to the establishment of a larger allowable load, in some respects it is more appropriate because timeframes align better (i.e., the SSM is associated with a single day and TMDLs establish daily loads, versus the 30-day GM). Additionally, certain aspects of SDDENR's *E. coli* assessment method, when combined with a SSM TMDL target, result in an expected dataset GM more protective than the GM criterion. SDDENR uses assessment methods to define how to interpret and apply water quality standards to 303(d) impairment decisions. These methods are further discussed in Section 3.4, however for this discussion, it is important to note that SDDENR allows a 10% exceedance frequency of both the SSM and GM. In other words, as long as the *E. coli* dataset meets other age and size requirements, a waterbody is considered impaired (i.e., not meeting water quality standards) when greater than 10% of samples exceed either the SSM or GM. Water quality standards are met if the exceedance frequency is 10% or less.

Returning to the original distribution used to establish South Dakota's Immersion Recreation *E. coli* criteria in Figure 2 remember that SDDENR chose to adopt a SSM concentration based on the most stringent recommendation (75^{th} percentile). According to assessment methods in South Dakota, however, the SSM concentration is treated as a 90^{th} percentile (i.e., 10% exceedance frequency). Step #1 in Figure 3 shows how doing so effectively moves the SSM point to the right. If the original log-normal frequency distribution with a log-standard deviation of 0.4 is subsequently re-fitted to this new 90^{th} percentile point at 235 #/100mL (red dotted line), the corresponding 50^{th} percentile (GM) is 72 #/100mL as shown in Step #2 of Figure 3

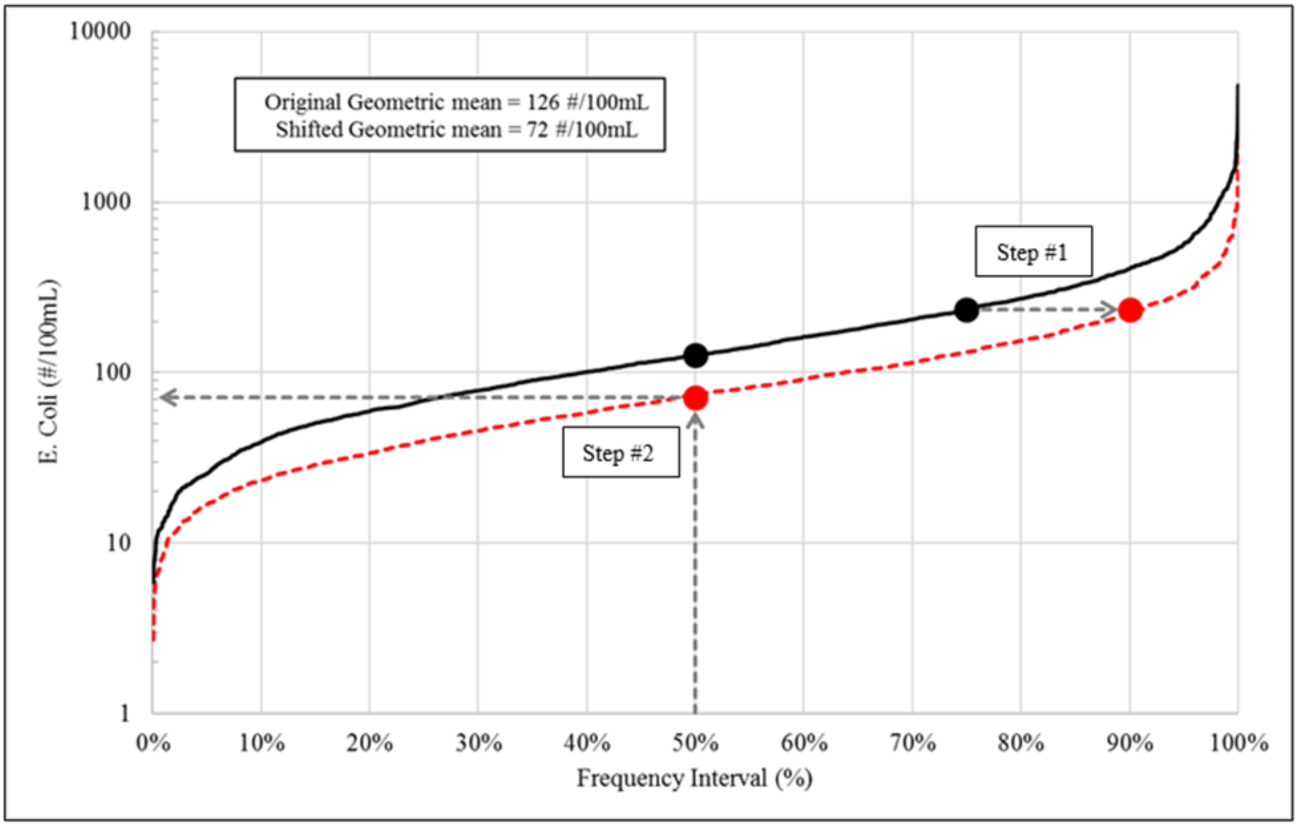

Figure 3. **The Effective Impact of South Dakota's *E. coli* Assessment Method on the Criteria's Original Log-Normal Frequency Distribution (Black line = original; red dotted line = shifted)**

The GM associated with this shifted distribution is more stringent than the GM of the original distribution (126 #/100mL), thus this demonstrates that attaining a maximum daily SSM target in a TMDL will also achieve the 30-day GM criterion when following South Dakota's assessment method. A similar conclusion was determined by EPA in *An Approach for Using Load Duration Curves in the Development of TMDLs* (USEPA, 2007) using Michigan criteria as an example. Once again this outcome holds true for South Dakota's limited contact recreation *E. coli* criteria since they were simply derived as five times the immersion values.

Finally, while the SSM is associated with a single day of sampling and the GM is associated with 30 days of sampling, it is not technically appropriate to refer to them as "acute" and "chronic" criteria. Those terms distinguish timeframes over which harm-to-use impacts develop, not the sampling or averaging timeframe as with the SSM and GM. Acute refers to an effect that comes about rapidly over short periods of time. Chronic refers to an effect that can build up over longer periods, sometimes as long as the lifetime of a subject. In the case of *E. coli*, gastrointestinal illness develops within a matter of hours to days. Both the SSM and GM are derived from this same timeframe and based on the same underlying illness rate, thus treating the SSM as an acute criterion and assuming it to be less stringent is incorrect. EPA recommends states use the GM and SSM together, rather than just the GM or just the SSM, to judge whether water quality is protective of recreational uses. SDDENR follows these guidelines and only relies on one criterion when forced by data availability.

The limited contact recreation SSM *E. coli* criterion of 1,178 cfu/100mL was selected as the numeric TMDL target for Segment 1 of the Big Sioux River because a proper geometric mean could not be calculated from the available monitoring dataset. Refer to Section 4.0 for a thorough review of Big Sioux sampling and results.

3.4 Impairment Assessment Methods

Assessment methods document the decision-making process used to define whether water quality standards are met. SDDENR evaluates monitoring data following these established procedures to determine if: 1) one or more beneficial use is not supported, 2) the waterbody is impaired, and 3) it should be placed on the next 303(d) list. Waterbodies impaired by pollutants require TMDLs and these assessment methods are commonly used again in the process sometime after TMDLs have been established and restoration efforts have been implemented. In select cases, attainment is judged instead by comparing current conditions to TMDL loading limits. For example, when certain characteristics of the pollutant (e.g., bioaccumulative) or waterbody (e.g., a reservoir filling with sediment) prioritize loading concerns. Table 3 presents South Dakota's assessment method for *E. coli*, and describes what constitutes a minimum sample size and how an impairment decision is made.

Table 3. Assessment Methods for Determining Support Status for Section 303(d) (SDDENR 2018).

Description	Minimum Sample Size	Impairment Determination Approach
FOR CONVENTIONAL PARAMETERS (such as dissolved oxygen, TSS, *E. coli* bacteria, pH, water temperature, etc.)	STREAMS: a minimum of 10 samples for any one parameter are required within a waterbody reach. A minimum of two chronic (calculated) results are required for chronic criteria (30-day averages and geomeans). LAKES: at least two independent years of sample data and at least two sampling events per year.	STREAMS: >10% exceedance for daily maximum criteria (or 3 or more exceedances between 10 and 19 samples) or >10% exceedance for chronic criteria (or 2 or more exceedances between 2 and 19 samples) LAKES: >10% exceedance when 20 or more samples were available. If < 20 samples were available, 3 exceedances were considered impaired. See lakes listing methodology section for specifics on parameters associated with a vertical profile (i.e., dissolved oxygen, water temperature, pH, and specific conductance).

The assessment method mentions chronic and acute criteria. Although these terms do not directly relate to *E. coli* criteria for reasons previously discussed, the assessment method is organized together with other conventional parameters in the Integrated Report to show that a consistent approach is applied to many pollutants. In this limited definition, chronic refers to the GM and acute refers to the SSM *E. coli* criteria. Different assessment methods have been established for toxic parameters and mercury in fish tissue. In the next section, data collection activities are summarized and monitoring results are evaluated using this assessment method.

4.0 Data Collection and Results

4.1 Water Quality Data and Discharge Information

Daily flow values and paired *E. coli* concentrations are essential elements of TMDL development. *E. coli* data was obtained from seven monitoring stations within the impaired segment over the period 2001 to 2018 (Figure 1). The associated daily flows were obtained from long-term flow records available from a USGS gage station located within the impaired segment.

All data collection conducted during this project followed methods in accordance with the South Dakota *Standard Operating Procedures for Field Samplers* (https://denr.sd.gov/documents/SOP2016VolI.pdf) developed by the Watershed Protection Program. Water samples were sent to the State Health Laboratory in Pierre, SD for analysis. *E. coli* data collected during the recreation season was exclusively used to develop the TMDL. All water quality data and corresponding daily flow data used for TMDL development can be found in Appendix A.

4.2 Flow Analysis

Long term hydrologic records were available at two gauge stations within the impaired segment. USGS gage station 06479500 is located approximately 5 miles north of Watertown, SD. Flow data from this site was available from 1972 to 2018. A second USGS gage is located near Florence, SD on the Big Sioux River. This location is near the upstream end of the segment and the period of record is shorter than the Watertown site. The site at Watertown accounts for all discharges that are generated within the segment's drainage area. Therefore, discharge data from gage 06479500 was used to develop the load duration curve and TMDL.

4.3 Data Analysis

All applicable *E. coli* data collected within the impaired segment during the recreation season was used for TMDL development. *E. coli* data was obtained from multiple monitoring sites, many of which were established during past watershed assessment projects (Figure 1). Monitoring station WQM 46BSA1 is a long-term monitoring site established as part of SD DENR's ambient water quality monitoring network. This monitoring station will also provide a long-term dataset to evaluate compliance. Ambient monitoring site 460655 (WQM 55) is located in segment 2 immediately downstream of the boundary between the segments. Segment 2 is not impaired for bacteria indicating that the impairment is localized to segment 1.

Table 4. Sample Sites and Number of Samples For Each Site

Site Name	Associated Project	Number of Samples
46BSA1	Upper Big Sioux Assessment	65
KAMPESK06	Upper Big Sioux Assessment	45
KAMPESK07	Upper Big Sioux Assessment	35
KAMPESK12	Upper Big Sioux Assessment	31
KAMPESKBCT6A	Upper Big Sioux Assessment	20
NCENBSRR24	Central Big Sioux Assessment	18
NCENBSRR25	Central Big Sioux Assessment	26

A total of 240 *E. coli* samples were available for analysis within the listed segment. Multiple sites were sampled on the same day within the segment. To better represent the single sample maximum impairment, each point was treated as an independent sample. A descriptive statistical summary of *E. coli* concentrations for each site is depicted in Figure 4. Each site had multiple samples above the single sample maximum water quality standard (1178 cfu/ 100mL). *E. coli* sample collection was not conducted at the frequency required to calculate a monthly GM. As a result, impairment was solely based on the SSM standard.

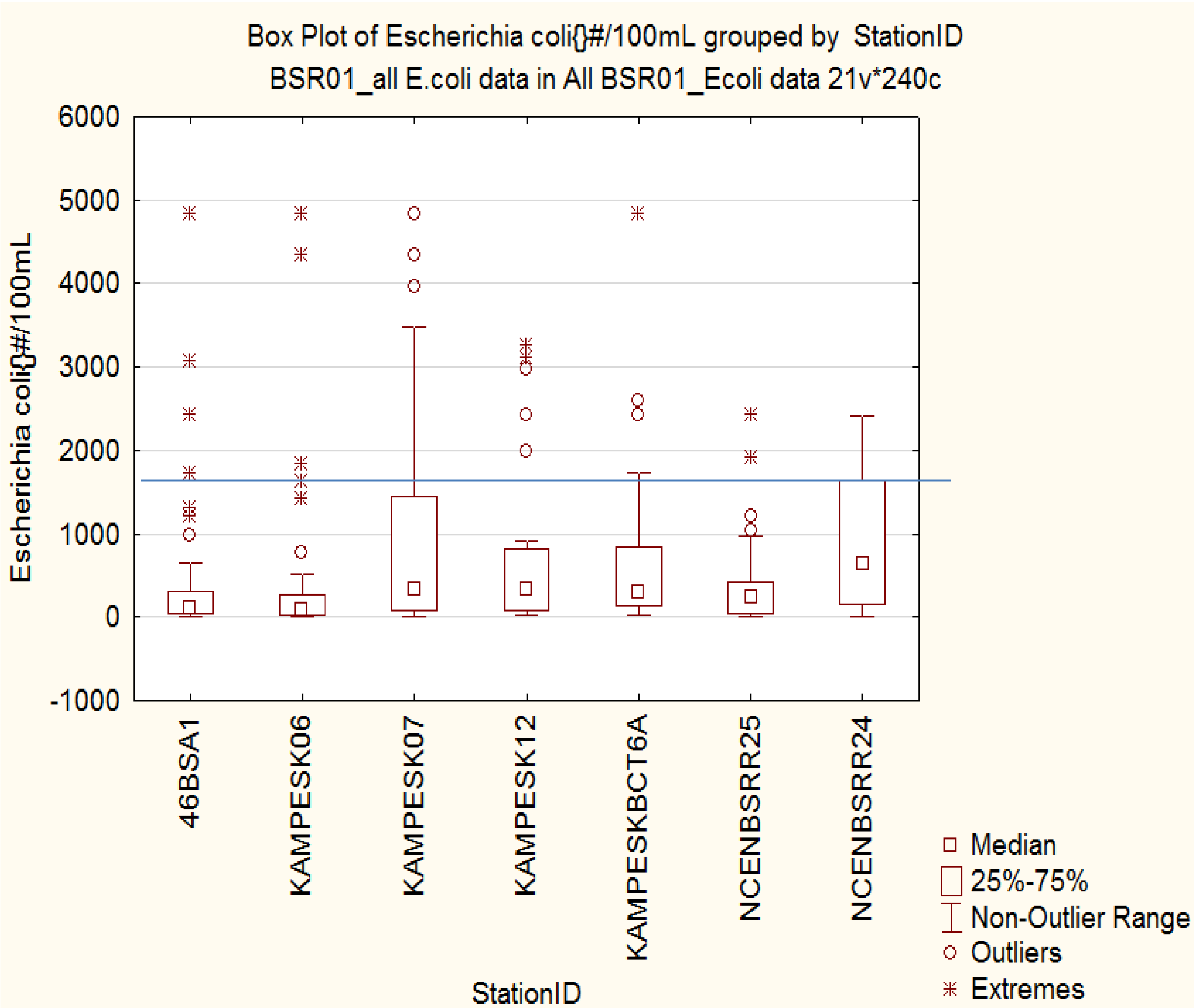

Figure 4. *E. coli* Concentration Distribution for Sites in Segment 1 of the Big Sioux River

The data in Figure 4 indicates that mitigation efforts should be focused on the entire reach of the Big Sioux River. Each site in Figure 4 had multiple exceedances of the SSM standard with some sites reaching almost 5,000 CFU/100mL. The three sites that have data points above the SSM standard that are not classified as an outlier or extreme are KAMPESK07, KAMPESKBCT6A, and NCENBSR24. Rather than addressing individual sites, the entire reach and segment of the

Big Sioux River should be looked at and remediation efforts should be put into place in order to bring the *E. coli* levels below the SSM standard.

5.0 Source Assessment and Allocation

5.1 Point Sources

There are several documented point sources within the Big Sioux River Segment 1 watershed. This includes 8 National Pollutant Discharge Elimination Permitted (NPDES) facilities that may directly contribute *E. coli* to the impaired segment of the Big Sioux River. These potential sources of *E. coli* bacteria are documented here to provide a watershed scale account of the entity's operational characteristics (discharge permits etc.), potential impact and Waste Load Allocation (WLA) consideration for the impaired segment of the Big Sioux River. There are also three CAFO's that are discussed below.

5.1.1 Wastewater Treatment Facilities

The town of Summit is in the Eastern part of South Dakota and has a small lagoon system that periodically discharges to an unnamed tributary of the Big Sioux River (NPDES Permit# SD0022811). This WWTF had two discharges in 2019, one in April and one in June. This facility was assigned a WLA value of 4.28E+10 per day for all zones except the dry flow zone, which was assigned a value of 2.59E+09. The WLA for this facility was calculated by using the facilities' *E. coli* permit effluent limit of 1,178 cfu/100mL, multiplied by the 80th percentile of daily maximum flow from Discharge Monitoring Reports (DMR's) of 0.96, and then multiplied by a unit conversion factor (37,854,120) in order to get cfu/day. For the dry flow zone, the WLA was adjusted to fit the flow range by splitting the allocations proportionately. Half of the load for the dry flow zone was given to the WLA and the remaining load was given to the LA, reserving 10% for the MOS. When permitted facilities are not discharging during the dry flow zone, the WLA is conceptually zero and the entire loading capacity can be attributed to the LA and the MOS.

Clark Kampeska RWS (NPDES Permit# SDG860066) is a Rural Water Supply that has TDS discharges into the Big Sioux River from backwashing filters. There are no discharges associated with *E. coli*, and as a result of this, a WLA of 0 was assigned for this specific RWS.

The Dakota Sioux Casino WWTF (NPDES Permit# SDG589801) is a no discharge facility. Considering this, the WLA for the Dakota Sioux Casino has been assigned a value of 0.

The City of Waubay, SD (NPDES Permit# SD0020125) is a WWTF that is on a compliance schedule to become a total retention facility. TMDL analysis determined that there is no hydrologic connection to segment 1 of the Big Sioux River. Considering this, a WLA of 0 was assigned to this WWTF.

The town of Florence, SD (NPDES Permit# SDG821598) is located in the Northeast of South Dakota and is a no discharge facility. Since this WWTF is a no discharge facility, the WLA has been assigned a value of 0.

Pickerel Lake Sanitary District (NPDES Permit# SDG827715) is located in the Northeast of South Dakota and is a no discharge facility. Since this WWTF is a no discharge facility, the WLA has been assigned a value of 0.

Enemy Swim Housing WWTP (NPDES Permit# SDG589808) is located in the Northeast of South Dakota and is a no discharge facility. Since this WWTF is a no discharge facility, the WLA has been assigned a value of 0.

Northern Con-Agg, INC (NPDES Permit# SD0026182) is a privately-owned facility for construction, sand and gravel. It is located in the Northeastern part of South Dakota and is a no discharge facility. Since this WWTF is a no discharge facility, the WLA has been assigned a value of 0.

There are three permitted CAFOs within the Big Sioux River Segment 1 watershed. All CAFO's are required to maintain compliance with provisions of the SD Water Pollution Control Act (SDCL 34A-2). SDCL 34A-2-36.2 requires each concentrated animal feeding operation, as defined by Title 40 Codified Federal Regulations Part 122.23 dated January1, 2007, to operate under a general or individual water pollution control permit issued pursuant to 34A-2-36. The general permit ensures that all CAFO's in SD have permit coverage regardless if they meet conditions for coverage under a NPDES permit. All 3 operations are covered under the 2003 *General Water Pollution Control Permit for Concentrated Animal Feeding Operations,* which requires housed lots to have no discharge of solid or liquid manure to waters of the state, and allows open lots to only have a discharge of manure or process wastewaters from properly designed, constructed, operated and maintained manure management systems in the event of 25-years, 24-hour or 100-year, 24-hour storm event if they meet the permit conditions. The general permit was reissued and became effective on April 15, 2017. All CAFO's with coverage under the 2003 general permit have a deadline to apply for coverage under the 2017 general permit. The 2017 general permit allows no discharge of manure or process wastewater from operations with state permit coverage or NPDES permit coverage for new source swine, poultry, and veal operations, and other housed lots with covered manure containment systems. Operations also have the option to apply for a state issued NPDES permit. Operations covered by the 2017 general permit or NPDES permit for open or housed lots with uncovered manure containment systems can only discharge manure or process wastewater from properly designed, constructed, operated and maintained manure management systems in the event of 25-year, 24-hour storm event if they meet the permit conditions. Both the 2003 and 2017 general permits have nutrient management planning requirements based on EPA's regulations and the South Dakota Natural Resources Conservation Services 590 Nutrient Management Technical Standard to ensure the nutrients are applied at agronomic rates with management practices to minimize the runoff of nutrients. Additionally, the general permits include design standards, operation, maintenance, inspection, record keeping, and reporting requirements. For more information about South Dakota's CAFO requirements and general permits visit: http://denr.sd.gov/des/fp/cafo.aspx.

As long as these facilities comply with the general CAFO permit requirements ensuring their discharges are unlikely and indirect loading events, the TMDL assumes their *E. coli* contribution is minimal, and unless found otherwise, no additional permit conditions are required by this TMDL.

Table 5. Description of CAFOs within the Big Sioux River Watershed

Name of Facility	Type of Operation	SD General Permit #
Norswiss Dairy	Dairy (housed lot)	SDG-0100005
Grant County Dairy, LLC	Dairy (housed lot)	SDG-0100498
Bronson Custom Farms, INC	Beef Cattle (open lot)	SDG-0100072

5.2 Non-Point Sources

Nonpoint sources of *E. coli* in segment 1 of the Big Sioux River come primarily from agricultural sources. Data from the 2010 National Agricultural Statistic Survey (USDA, 2010) and from the 2002 South Dakota Game Fish and Parks County Wildlife Assessment (Huxoll, 2002) were utilized for livestock and wildlife densities. Animal density information was used to estimate relative source contributions of bacteria loads and is summarized in Table 6. Production of *E. coli* bacteria in the watershed is estimated at 1.2E+15 colony forming units/acre/day.

Table 6. Big Sioux River *E. coli* Sources

Species	#/mile	#/acre	Bacteria/Animal/Day	Bacteria/Acre	Percent
Dairy cow	4.80	7.5E-03	4.46E+10	334725000	4.8%
Beef	80.00	1.3E-01	3.90E+10	4875000000	70.5%
Hog	17.19	2.7E-02	1.08E+10	290151818	4.2%
Sheep	22.11	3.5E-02	1.96E+10	677090909	9.8%
Horse	1.45	2.3E-03	5.15E+10	117000000	1.7%
Poultry1	466.36	7.3E-01	1.36E+08	99101287	1.4%
All Wildlife	Sum of all Wildlife			518989894	7.5%
Human	2.18	3.4E-03	1.95E+09	6647727	0.1%
Turkey (Wild)2	0.06	9.4E-05	1.10E+08	10313	
Goose3	1.43	2.2E-03	7.99E+08	1785266	
Deer3	4.57	7.1E-03	3.47E+08	2477797	
Beaver3	0.36	5.6E-04	2.00E+05	113	

Species	#/mile	#/acre	Bacteria/Animal/Day	Bacteria/Acre	Percent
Raccoon3	5.71	8.9E-03	5.00E+09	44609375	
Coyote/Fox4	1.15	1.8E-03	1.75E+09	3144531	
Muskrat2	34.24	5.4E-02	2.50E+07	1337500	
Opossom5	0.14	2.2E-04	5.00E+09	1093750	
Mink5	1.71	2.7E-03	5.00E+09	13359375	
Skunk5	3.99	6.2E-03	5.00E+09	31171875	
Badger5	0.26	4.1E-04	5.00E+09	2031250	
Jackrabbit5	3.57	5.6E-03	5.00E+09	27890625	
Cottontail5	28.53	4.5E-02	5.00E+09	222890625	
Squirrel5	21.4	3.3E-02	5.00E+09	167187500	
1 Regional Poultry Numbers used from 2002 census					
2 USEPA 2001					
3 Bacteria Indicator Tool Worksheet					
4 Best Professional Judgment based off of Dogs					
5 FC/Animal/Day copied from Raccoon to provide a more conservative estimate of background effects of wildlife					

5.2.1 Natural Background Sources

Wildlife within the watershed is a natural background source of *E. coli*. Wildlife population density estimates were obtained from the South Dakota Department of Game, Fish, and Parks. Best estimates suggest wildlife account for approximately 7.5% of the bacteria produced in the watershed.

5.2.2 Human Sources

Approximately 1500 people reside in the watershed (Census 2010). Septic systems are assumed to be the primary disposal source for residents in the watershed. Table 6 includes all human produced *E. coli* and does not include expected reductions as a result of delivery to a septic system. Human bacteria production may be estimated at 1.95E+9 (Yagow et al. 2001). When included as a total load in the table, the population produced loads accounting for about 0.1% of all bacteria in the watershed. These bacteria should all be delivered to a septic system, which if functioning correctly would result in no bacteria entering the segment.

5.2.3 Agricultural Sources

Manure from livestock is a potential source of *E. coli* to the river. Livestock in the basin are predominantly beef cattle. They may contribute *E. coli* directly by defecating while wading in the stream, or by defecating while grazing on rangelands or in feeding areas, which is then washed off during precipitation events. Table 7 allocates the sources of bacteria production in the watershed into three primary categories. The summary is based on the following assumptions; Feedlots numbers were calculated as the sum of all dairy, hog, and the NASS estimate of beef in feeding areas, while also considering the three CAFO's. All remaining livestock were assumed to be on grass and human contributions were excluded.

Table 7. ***E. coli*** **Source Allocation for Segment 1 Big Sioux River**

Source	Percentage
Feedlots	22.1%
Livestock on Grass	70.3%
Wildlife	7.5%

6.0 TMDL Load Duration Curve

The load duration curve generated for segment 1 of the Big Sioux River was separated into four distinctive flow zones (Figure 5). E. coli data is graphically represented as individual loadings calculated based on the flow frequency obtained from long-term records at the Watertown USGS gauge. The load frequency curve or TMDL was derived based on the SSM standard for E. coli (1,178 colony forming units/ 100mL), plus a unit conversion factor (Figure 5). Flow zones were defined according to the flow regime structure and distribution of the data following guidance recommended by EPA (USEPA, 2001). Sample data is heavily skewed to the higher flow regimes with a rapid decrease in frequency as flow rates decline. This corresponds to the seasonal flow of the river. Lower flows do occur during the recreation season, and periodic samples have been collected which provide a representation of these conditions.

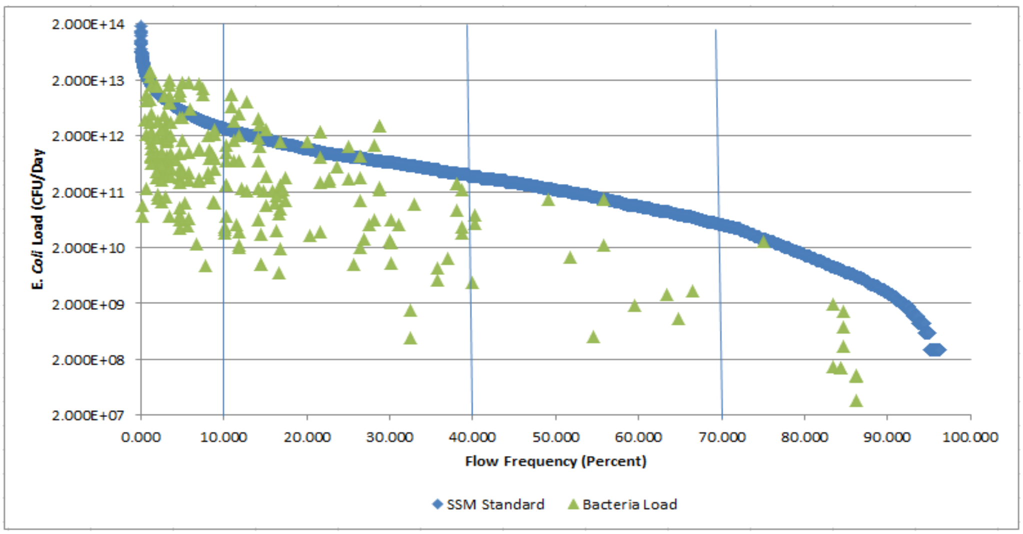

Figure 5. ***E. coli*** **Load Duration Curve for Segment 1 of the Big Sioux River**

6.1 TMDL Loading Analysis

Table 8 depicts the numeric TMDL calculations for each flow zone in Figure 5. Current loads were based off the 95th percentile flow and concentration for all flow zones, except the dry flow zone. The current load for the dry flow zone was calculated by multiplying the 95th percentile flow and maximum concentration. The max concentration was used due to the low density of samples available to represent this infrequent flow occurrence during the recreation season. To assure standard attainment with the limited dataset, reduction calculations were based on the single sample maximum value of 1178 cfu/ 100 mL. Point sources exist in the segment but are a small portion of the loading in the watershed (only one WWTF discharges into segment 1 of the Big Sioux River), requiring most reductions to come from nonpoint sources. A description for the margin of safety (MOS) used for the TMDL is provided in section 6.2.2.

Table 8. *E. coli* TMDL and Flow Zone Allocations for Segment 1 Big Sioux River

TMDL Component	Big Sioux River Segment 1 Flow Zones Expressed as (CFU/100ml)			
	High Flows	Moist Conditions	Mid-range Flows	Dry Conditions
	>112 cfs	>9.66 cfs	>1.00 cfs	<0.34 cfs
LA	**1.68E+13**	**2.50E+12**	**2.01E+11**	**2.60E+09**
WLA-Summit	**4.28E+10**	**4.28E+10**	**4.28E+10**	**2.59E+09**
MOS	**1.87E+12**	**2.82E+11**	**2.71E+10**	**5.76E+08**
TMDL @ 1178 #/ 100 mL	**1.87E+13**	**2.82E+12**	**2.71E+11**	**5.76E+09**
Current Load	**4.13E+13**	**7.93E+12**	**4.25E+11**	**1.21E+10**
Load Reduction	**55%**	**64%**	**36%**	**53%**

6.1.1 High Flows (0-10%)

The high flow zone represents the high flows in the Big Sioux River segment 01. The flow rate for this zone was variable with a range from 1470 cfs to 112 cfs. Flows represented in this zone occur at an infrequent basis and are characteristic of significant run-off events that are typical during the spring and early summer. High flows are commonly the product of spring snowmelt events but may also be generated by intense rain events. Bacteria sources across the watershed have the potential to be conveyed to the stream channel during high flow conditions. The 95th percentile bacteria concentration was calculated at 2,600 counts/100 ml. An *E. coli* load reduction of 55% is required to achieve compliance with the single sample maximum threshold.

6.1.2 Moist Conditions (10-40%)

The mid-range flows represent the portion of the flow regime that occurs following moderate storm events. Flows in this zone varied from 111.9 cfs to 9.66 cfs. The flows in this zone occur in early to mid-summer near the peak of the recreation season, which provides for the optimal recreational opportunity. Bacteria sources from this zone are expected to be closer to the channel and easier to mitigate than that of the high flow zone. The 95th percentile bacteria concentration was calculated at 3,315 counts/100ml. An *E. coli* load reduction of 64% is required to achieve compliance with the single sample maximum threshold.

6.1.3 Mid-Range Flows (40-70%)

Dry conditions represent flow rates between 9.65 cfs and 0.35 cfs. Dry condition flows are best characterized as base flow conditions that are influenced by ground water sources. Bacteria sources from this zone likely originate in the stream channel during dry flow conditions. The 95th percentile bacteria concentration was calculated at 1,850 counts/100ml. An *E. coli* load reduction of 36% is required to achieve compliance with the single sample maximum threshold.

6.1.4 Dry Conditions (70-100%)

The dry flow zone represents rates that are less than 0.34 cfs. This zone is best characterized as a flow less than base flow conditions. Flows from this zone are during winter or drought conditions recorded over the last 50 years. Most frequently, they occur during the winter months. The 95^{th} percentile bacteria concentration was calculated at 2,480.5 counts/100ml. An *E. coli* load reduction of 53% is required to achieve compliance with the single sample maximum threshold.

6.2 TMDL Allocations

6.2.1 Load Allocations (LAs)

Approximately 92% of the bacteria in the watershed may be attributed to livestock. An additional 7.5% was attributed to wildlife as natural background sources. A very small amount of *E. coli*, less than 0.1%, was attributed to human sources. The high estimated percentage of livestock on grass suggests that grazing management may yield the greatest benefits.

A 55% reduction in *E. coli* from anthropogenic sources (livestock) is required in the high flow zone to fully attain the current water quality standards. The moist conditions zone requires a 64% reduction in bacteria. The mid-range flow zone requires a 36% reduction. The dry condition zone requires a 53% reduction in bacteria. Reducing bacteria concentrations below the SSM standard in each flow zone provides assurance that both the SSM and GM standards will be met. To achieve the specified reductions, primary focus should be placed on reducing bacteria inputs from livestock grazing and feeding areas.

6.2.2 Margin of Safety (MOS)

In accordance with regulations, a margin of safety was established to account for uncertainty in the data analyses. A margin of safety may be provided (1) by using conservative assumptions in the calculation of the loading capacity of the waterbody and (2) by establishing allocations that in total are lower than the defined loading capacity. In the case of segment 1 of the Big Sioux River, the latter approach was used to establish a safety margin or the *E. coli* TMDLs.

A 10% explicit MOS was calculated within the duration curve framework to account for uncertainty (e.g., loads from tributary streams, effectiveness of controls, etc.). This 10% explicit MOS was calculated from the TMDL within each flow zone and reserved as a reserved load. The remaining assimilative capacity was attributed to nonpoint sources (LA) or point sources (WLA).

6.2.3 Waste Load Allocations (WLAs)

Eight point sources are located in the Big Sioux River segment 1 watershed, but only one discharges into the segment (Town of Summit). Therefore, the WLA was assigned a value of 4.28E+10 #/day for all flow zones except the dry flow zone, which was assigned a WLA of 2.59E+09.

7.0 Seasonal Variation

Seasonality is important when considering bacteria contamination. Sample data was collected from May through September when the recreation standards apply. Seasonal variation is also a component of the load duration curve framework through the establishment of individual flow zones and associated TMDL load allocations. Daily bacteria loads exceed the single sample maximum (SSM) TMDL threshold consistently through the first two flow regimes (high flows and moist conditions). The implications of this pattern suggest bacteria contamination is mostly in the spring and early summer when it is watershed wide. Focusing on seasonal patterns is warranted to achieve attainment goals and reduce bacteria percentage.

8.0 Critical Conditions

Critical conditions occur within the basin during the spring and summer storm events. Typically, during severe thunderstorms, the largest concentrations are highest in the basin during the summer months. Combined with the peak in grazing, high-intensity rainstorm events, which are common during the spring and summer, can produce significant amounts of sheet and rill erosion from animal feeding area. The excessive flows can transport waste material throughout the Big Sioux River and impair the recreational beneficial use.

9.0 Adaptive Management and Monitoring Strategy

The Department (or EPA) may adjust the load and/or waste load allocations in this TMDL to account for new information or circumstances that are developed or come to light during the implementation of the TMDL and a review of the new information or circumstances indicate that such adjustments are appropriate. Adjustment of the load and waste load allocation will only be made following an opportunity for public participation. New information generated during TMDL implementation may include, among other things, monitoring data, BMP effectiveness information and land use information. The Department 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 its 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 practicable. The Department will follow EPA guidance for revising or withdrawing TMDLs in accordance with considerations documented in EPA's 2012 draft memo before taking action (http://www.epa.gov.sites.production/files/2015-10/documents/draft-tmdl 32212.pdf

During and after the implementation of management practices, monitoring will be necessary to assure attainment of the TMDL. Stream water quality monitoring will be accomplished through SD DENR's ambient water quality monitoring stations.

Additional monitoring and evaluation efforts will be targeted toward the effectiveness of implemented BMPs. Sample sites will be based on BMP site selection and parameters will be based on a product-specific basis.

10.0 Public Participation

STATE AGENCIES

South Dakota Department of the Environment and Natural Resources (SD DENR) was the primary state agency involved in the completion of this TMDL. Ambient water quality monitoring data in conjunction with additional sampling targeted in the reach were the sole sources of bacteria data.

A 30-day public comment period was issued for the original draft TMDL in April 2012. A public notice letter was published in the following local newspapers: Grant County Review, Webster Reporter and Watertown Public Opinion. The draft TMDL document and ability to comment was made available on DENRs One-Stop Public Notice Page at: https://denr.sd.gov/public/default.aspx. No public comments were received during the initial 30-day comment period. The original draft TMDL was not submitted to EPA for final approval following the initial comment period and a significant amount of time passed. This updated TMDL represents a second draft and incorporates significant revisions from the original version. A new 30-day public comment period (February 18, 2020 to March 23, 2020) was issued following the same public comment process described for the original draft TMDL (April 2012). Comments were received during the second public comment period. The comments and DENR's response to each comment is documented in Appendix B.

Segment 1 of the Big Sioux River flows through some Sisseton-Wahpeton trust lands that are just north of Lake Kampeska. South Dakota Department of the Environment and Natural Resources (SD DENR) and the Environmental Protection Agency (EPA) coordinated with the Sisseton-Wahpeton tribe during the TMDL process.

FEDERAL AGENCIES

Environmental Protection Agency (EPA) provided the primary source of funds for data analysis for this segment. Stream flow data was obtained from the United States Geologic Survey (USGS) which provided the sole source of water quantity data for this TMDL.

LOCAL GOVERNMENT, INDUSTRY, ENVIRONMENTAL, AND OTHER GROUPS AND PUBLIC AT LARGE

Local interest was shown from Watertown via the Upper Big Sioux Implementation Project, noting that people are concerned with water quality in the Upper Big Sioux Watershed. Public comments were received for this TMDL and were addressed and incorporated into the document (See Appendix B).

11.0 Implementation Strategy

Currently, there is an Upper Big Sioux implementation project targeting areas of sediment and bacterial sources within the Big Sioux River Watershed. Several types of BMPs have been considered in the development of a water quality management implementation plan for the impaired segments of the Big Sioux River Watershed. These were recommended to help reduce sediment, nutrients and bacteria loads entering the Big Sioux River from priority areas before attempting in-lake restoration activities such as sediment removal. The results shown in the Load Duration Curves indicate significant reductions are required in the higher two flow zones.

Because of the rural area and the lack of point sources (WWTF) most of the implementation measures should focus on the following:

- Livestock access to streams should be reduced, and livestock should be provided sources of water away from streams.
- Unstable stream banks should be protected by enhancing the riparian vegetation that provides erosion control and filters runoff of pollutants into the stream.
- Filter strips should be installed along the stream bordering cropland and pastureland.
- Animal confinement facilities should implement proper animal waste management systems.
- An assessment of progress will be part of every Section 319 implementation segment, and revisions to the plan will be made as appropriate, in cooperation with basin stakeholders.

12.0 Literature Cited

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Appendix A

Bacteria data used in the TMDL Development

Site	Date	E.coli (cfu)	Mean Daily Flow (cfs)
46BSA1	05/15/2001	58.1	317
46BSA1	06/11/2001	687	122
46BSA1	07/09/2001	130	64
46BSA1	08/13/2001	236	9.4
46BSA1	09/10/2001	140	1
46BSA1	05/04/2009	6.3	153
46BSA1	06/08/2009	90.7	56.3
46BSA1	07/13/2009	148	57.3
46BSA1	08/10/2009	31.2	42.8
46BSA1	09/08/2009	255	19
46BSA1	05/10/2010	10.6	188
46BSA1	06/15/2010	120	121
46BSA1	07/12/2010	47.1	114
46BSA1	09/13/2010	345	83.5
46BSA1	05/11/2011	133	449
46BSA1	05/26/2011	74.3	356
46BSA1	05/31/2011	1990	471
46BSA1	06/13/2011	365	309
46BSA1	06/16/2011	56.1	270
46BSA1	06/21/2011	2420	216
46BSA1	06/23/2011	1300	257
46BSA1	06/27/2011	88.2	294
46BSA1	07/05/2011	94.4	207
46BSA1	07/11/2011	133	231
46BSA1	07/14/2011	82	271
46BSA1	07/19/2011	152	251
46BSA1	07/25/2011	76.8	450
46BSA1	07/27/2011	59.8	450
46BSA1	08/03/2011	40.2	366
46BSA1	08/08/2011	41.8	308
46BSA1	08/08/2011	79.4	308
46BSA1	08/17/2011	68.2	215
46BSA1	08/23/2011	97.6	184
46BSA1	09/01/2011	313	144
46BSA1	09/08/2011	46.4	112
46BSA1	09/13/2011	291	97.8
46BSA1	09/20/2011	37.6	68
46BSA1	09/27/2011	14.5	53.6
46BSA1	05/08/2012	31	97.3
46BSA1	06/04/2012	74	27.8
46BSA1	05/06/2013	3.1	127

Site	Date	E.coli (cfu)	Mean Daily Flow (cfs)
46BSA1	06/10/2013	111	81.7
46BSA1	07/08/2013	96	21.5
46BSA1	08/05/2013	651	34.8
46BSA1	05/07/2014	24.2	85.9
46BSA1	06/09/2014	61	54.3
46BSA1	07/07/2014	108	76.6
46BSA1	08/04/2014	39.8	39.7
46BSA1	09/09/2014	166	52.5
46BSA1	05/04/2015	46.5	23.7
46BSA1	06/08/2015	108	23.2
46BSA1	07/06/2015	305	39.7
46BSA1	08/04/2015	41	12.7
46BSA1	09/01/2015	345	25.6
46BSA1	05/10/2016	41	28.6
46BSA1	06/07/2016	172	10.8
46BSA1	05/09/2017	7.4	2.86
46BSA1	06/12/2017	1300	4.6
46BSA1	07/11/2017	3080	0.34
46BSA1	08/02/2017	146	0.04
46BSA1	09/05/2017	93.2	1.24
46BSA1	05/14/2018	24.3	276
46BSA1	06/19/2018	143	125
46BSA1	07/11/2018	1220	51.4
46BSA1	08/14/2018	143	3.83
KAMPESK06	04/13/2005	13.5	30.2
KAMPESK06	06/08/2005	866	39.4
KAMPESK06	06/14/2005	1414	177
KAMPESK06	04/03/2006	12	253
KAMPESK06	03/21/2007	14.6	650
KAMPESK06	03/27/2007	25.6	198
KAMPESK06	04/07/2008	18.9	83.4
KAMPESK06	06/12/2008	2970	90.6
KAMPESK06	07/17/2008	384	25.8
KAMPESK06	03/23/2009	649	694
KAMPESK06	06/10/2009	76.8	61.1
KAMPESK06	10/07/2009	775	87.8
KAMPESK06	03/16/2010	187	830
KAMPESK06	05/19/2010	11.9	216
KAMPESK06	06/15/2010	263	121
KAMPESK06	09/16/2010	980	83.7
KAMPESK06	04/06/2011	2	1470

Site	Date	E.coli (cfu)	Mean Daily Flow (cfs)
KAMPESK06	05/26/2011	81.6	356
KAMPESK06	05/31/2011	308	471
KAMPESK06	06/16/2011	236	270
KAMPESK06	06/21/2011	178	216
KAMPESK06	06/23/2011	1630	257
KAMPESK06	06/27/2011	275	294
KAMPESK06	07/05/2011	87.4	207
KAMPESK06	07/14/2011	104	271
KAMPESK06	07/19/2011	61.4	251
KAMPESK06	07/25/2011	104	450
KAMPESK06	07/25/2011	75.8	450
KAMPESK06	07/27/2011	77.6	450
KAMPESK06	08/03/2011	1840	366
KAMPESK06	08/08/2011	17.2	308
KAMPESK06	08/17/2011	8.2	215
KAMPESK06	08/23/2011	14.8	184
KAMPESK06	09/01/2011	97.8	144
KAMPESK06	09/08/2011	187	112
KAMPESK06	09/13/2011	110	97.8
KAMPESK06	09/20/2011	134	68
KAMPESK06	09/27/2011	72.8	53.6
KAMPESK06	03/19/2012	6.2	65.1
KAMPESK06	04/29/2013	49.6	371
KAMPESK06	10/17/2013	4350	76.2
KAMPESK06	05/22/2014	18.7	99.2
KAMPESK06	06/23/2014	331	117
KAMPESK06	03/19/2015	5.2	54.9
KAMPESK06	04/11/2017	20.1	9.66
KAMPESK07	04/07/2008	10.9	83.4
KAMPESK07	06/12/2008	4840	90.6
KAMPESK07	07/17/2008	4840	25.8
KAMPESK07	03/23/2009	122	694
KAMPESK07	06/10/2009	1730	61.1
KAMPESK07	10/07/2009	335	87.8
KAMPESK07	05/19/2010	95.9	216
KAMPESK07	06/15/2010	384	121
KAMPESK07	09/16/2010	2420	83.7
KAMPESK07	04/06/2011	3.1	1470
KAMPESK07	05/26/2011	411	356
KAMPESK07	05/31/2011	2420	471
KAMPESK07	06/16/2011	131	270

Site	Date	E.coli (cfu)	Mean Daily Flow (cfs)
KAMPESK07	06/21/2011	1990	216
KAMPESK07	06/23/2011	1200	257
KAMPESK07	06/27/2011	1450	294
KAMPESK07	07/05/2011	3470	207
KAMPESK07	07/14/2011	258	271
KAMPESK07	07/19/2011	87	251
KAMPESK07	07/25/2011	192	450
KAMPESK07	07/25/2011	163	450
KAMPESK07	07/27/2011	1450	450
KAMPESK07	08/03/2011	203	366
KAMPESK07	08/08/2011	88.6	308
KAMPESK07	08/17/2011	14.8	215
KAMPESK07	08/23/2011	3970	184
KAMPESK07	09/01/2011	4840	144
KAMPESK07	09/08/2011	770	112
KAMPESK07	09/13/2011	411	97.8
KAMPESK07	09/20/2011	1120	68
KAMPESK07	09/27/2011	1200	53.6
KAMPESK07	03/19/2012	6.2	65.1
KAMPESK07	04/30/2013	19.9	359
KAMPESK07	05/22/2014	14.6	99.2
KAMPESK07	05/31/2018	4350	134
KAMPESK12	04/07/2008	9.7	83.4
KAMPESK12	06/12/2008	4840	90.6
KAMPESK12	07/17/2008	4840	25.8
KAMPESK12	03/23/2009	488	694
KAMPESK12	06/10/2009	248	61.1
KAMPESK12	10/07/2009	1730	87.8
KAMPESK12	05/26/2011	210	356
KAMPESK12	05/31/2011	770	471
KAMPESK12	06/16/2011	517	270
KAMPESK12	06/21/2011	2420	216
KAMPESK12	06/23/2011	3100	257
KAMPESK12	06/27/2011	651	294
KAMPESK12	07/05/2011	821	207
KAMPESK12	07/14/2011	334	271
KAMPESK12	07/19/2011	570	251
KAMPESK12	07/25/2011	198	450
KAMPESK12	07/25/2011	450	450
KAMPESK12	07/27/2011	81.6	450
KAMPESK12	08/03/2011	107	366

Site	Date	E.coli (cfu)	Mean Daily Flow (cfs)
KAMPESK12	08/08/2011	335	308
KAMPESK12	08/17/2011	54.4	215
KAMPESK12	08/23/2011	224	184
KAMPESK12	09/01/2011	336	144
KAMPESK12	09/08/2011	921	112
KAMPESK12	09/13/2011	579	97.8
KAMPESK12	09/20/2011	2420	68
KAMPESK12	09/27/2011	196	53.6
KAMPESK12	03/19/2012	21.6	65.1
KAMPESK12	04/30/2013	17.3	359
KAMPESK12	05/22/2014	17.1	99.2
KAMPESK12	05/31/2018	3260	134
KAMPESKBCT6A	05/26/2011	102	356
KAMPESKBCT6A	05/31/2011	2420	471
KAMPESKBCT6A	06/16/2011	249	270
KAMPESKBCT6A	06/21/2011	816	216
KAMPESKBCT6A	06/23/2011	2600	257
KAMPESKBCT6A	06/27/2011	387	294
KAMPESKBCT6A	07/05/2011	334	207
KAMPESKBCT6A	07/14/2011	293	271
KAMPESKBCT6A	07/19/2011	323	251
KAMPESKBCT6A	07/25/2011	186	450
KAMPESKBCT6A	07/27/2011	209	450
KAMPESKBCT6A	08/03/2011	1730	366
KAMPESKBCT6A	08/08/2011	136	308
KAMPESKBCT6A	08/17/2011	19.2	215
KAMPESKBCT6A	08/23/2011	72.6	184
KAMPESKBCT6A	09/01/2011	87.4	144
KAMPESKBCT6A	09/08/2011	291	112
KAMPESKBCT6A	09/13/2011	109	97.8
KAMPESKBCT6A	09/20/2011	435	68
KAMPESKBCT6A	09/27/2011	152	53.6
NCENBSRR24	05/05/2015	42.8	23.1
NCENBSRR24	05/19/2015	30	55.1
NCENBSRR24	06/02/2015	1630	32
NCENBSRR24	06/16/2015	488	29.2
NCENBSRR24	06/30/2015	798	66.7
NCENBSRR24	07/14/2015	2100	26.4
NCENBSRR24	07/28/2015	379	36.5
NCENBSRR24	08/11/2015	1030	11.2
NCENBSRR24	08/25/2015	288	51.2

Site	Date	E.coli (cfu)	Mean Daily Flow (cfs)
NCENBSRR24	04/12/2016	3.1	19.9
NCENBSRR24	04/26/2016	2420	39.6
NCENBSRR24	05/11/2016	192	29.5
NCENBSRR24	05/24/2016	23.8	14.5
NCENBSRR24	06/07/2016	823	10.8
NCENBSRR24	06/21/2016	2400	2.49
NCENBSRR24	07/19/2016	1990	0.03
NCENBSRR24	08/31/2016	153	0.01
NCENBSRR24	10/18/2016	1120	0.07
NCENBSRR25	05/05/2015	18.5	23.1
NCENBSRR25	05/19/2015	122	55.1
NCENBSRR25	06/02/2015	429	32
NCENBSRR25	06/16/2015	1203	29.2
NCENBSRR25	06/30/2015	1920	66.7
NCENBSRR25	07/14/2015	98	26.4
NCENBSRR25	07/28/2015	350	36.5
NCENBSRR25	08/11/2015	345	11.2
NCENBSRR25	08/25/2015	110	51.2
NCENBSRR25	09/09/2015	980	11.4
NCENBSRR25	09/22/2015	325	9.47
NCENBSRR25	04/12/2016	1	19.9
NCENBSRR25	04/26/2016	2420	39.6
NCENBSRR25	05/11/2016	27.2	29.5
NCENBSRR25	05/24/2016	14.5	14.5
NCENBSRR25	06/07/2016	137	10.8
NCENBSRR25	06/21/2016	364	2.49
NCENBSRR25	07/19/2016	1050	0.03
NCENBSRR25	08/02/2016	461	0.03
NCENBSRR25	08/17/2016	145	0.04
NCENBSRR25	08/31/2016	50.4	0.01
NCENBSRR25	09/14/2016	428	0.01
NCENBSRR25	09/27/2016	411	0.01
NCENBSRR25	10/18/2016	83.9	0.07
NCENBSRR25	11/01/2016	41.9	1.02
NCENBSRR25	11/15/2016	39.7	1.86

APPENDIX B

Public Comments

EAST DAKOTA
WATER
DEVELOPMENT
DISTRICT

March 5, 2020

Joshua Strobel
SD DENR - Watershed Protection Program
523 East Capitol Avenue
Pierre, South Dakota 57501-3181

Dear Mr. Strobel:

I am writing to offer comments on behalf of the East Dakota Water Development District on the DRAFT *Esherichia Coli* Total maximum Daily Load (TMDL) for the Big Sioux River Segment 1, Codington, Grant, Day and Roberts Counties, South Dakota (DRAFT TMDL). For each I have included a page reference from the DRAFT document.

1. Page 2, Section 1.0 Objective, second paragraph. I would suggest re-writing the final sentence to read, "Additional sampling has confirmed the impairment, and the waterbody has remained listed for *E. coli* through the 2018 reporting cycle." I read the current language to suggest that the listing only occurred in the 2010 IR and then the 2018 IR, but not the 2012, 2014 and 2016 cycles.

2. Page 3, Figure 1. There are five (5) sample sites (red dots) shown on the map. However, there are seven (7) sample IDs on the map. I suspect that the reality is that for two of the sites, there are multiple Ids. This should be clarified.

3. Page 5, Table 2. The fourth column on the table, labeled Beneficial Use Requiring this Standard, is incomplete, in that it lists only a single beneficial use for several parameters when in fact some of them apply to multiple uses.

   Dissolved oxygen is assessed when evaluating both warmwater semi-permanent fish life propagation <u>and limited contact recreation</u>.

   Conductivity is assessed when evaluating both irrigation waters <u>and fish and wildlife propagation, recreation & stock watering</u>.

   pH is assessed when evaluating both warmwater semi-permanent fish life propagation <u>and fish and wildlife propagation, recreation & stock watering</u>.

   The table should be updated.

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4. Page 14, last paragraph. The first sentence should read, "There are three permitted CAFOs within the Big Sioux River (Segment 1) ~~W~~watershed." There are way more than three permitted CAFOs in the whole of the Big Sioux River watershed. Also, watershed in this case would be lower case.

5. Page 24-30, Appendix A. As noted in comment 2 above, the actual location of several of the listed sites (KAMPESK06, KAMPESK12, NCENBSRR24 & NECNBSRR25) is uncertain.

Thank you for your consideration of these comments. If you have any questions about the points that I have raised, please do not hesitate to contact me.

Sincerely,

Jay P. Gilbertson
Manager/Treasurer

DENR Responses

1. Page 2, Section 1.0 Objective, second paragraph. I would suggest re-writing the final sentence to read "Additional sampling has confirmed the impairment, and the waterbody has remained listed for *E. Coli* through the 2018 reporting cycle." I read the current language to suggest that the listing only occurred in the 2010 IR and then the 2018 IR, but not the 2012, 2014 and 2016 cycles.

   DENR Response: The suggested sentence was incorporated into the second paragraph on Page 2, Section 1.0 Objective.

2. Page 3, Figure 1. There are five sample sites (red dots) shown on the map. However, there are seven sample ID's on the map. I suspect that the reality is that for two of the sites, there are multiple ID's. This should be clarified.

   DENR Response: On the map, the sites all have their own ID, but KAMPESK07 and NCENBSRR24 are so close to each other that they look like the same dot on the map. The same happens for KAMPESK12 and NCENBSRR25. This was clarified at the bottom of the last paragraph on page 2, Section 2.0 Watershed Characteristics.

3. Page 5, Table 2. The fourth column on the table, labeled Beneficial Use Requiring this Standard is incomplete, in that it lists only a single beneficial use for several parameters when in fact some of them apply to multiple uses.

   DENR Response: Table 2 was updated based on the recommendation in the comment above by adding uses to dissolved oxygen, conductivity, and pH.

4. Page 14, last paragraph. The first sentence should read, "There are three permitted CAFOs within the Big Sioux River Segment 1 watershed." There are way more than three permitted CAFOs in the whole of the Big Sioux River watershed.

   DENR Response: The first sentence in the last paragraph of page 14 was changed based on the recommendation above.

5. Page 24-30 Appendix A, As noted in comment 2 above, the actual location of several of the listed sites (KAMPESK06, KAMPESK12, NCENBSRR24 & NCENBSRR25) is uncertain.

   DENR Response: The location of the sites was clarified and addressed in comment 2 above.

APPENDIX C

EPA Approval letter and Decision Document

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

Ref: 8WD-CWS

Mr. Hunter Roberts
Secretary
South Dakota Department of Environment & Natural Resources
Joe Foss Building
523 East Capitol Ave
Pierre, South Dakota 57501-3181

Re: Approval of *Escherichia coli* Bacteria Total Maximum Daily Load Evaluation for the Big Sioux River Segment 1

Dear Mr. Roberts,

The U.S. Environmental Protection Agency (EPA) has completed review of the total maximum daily load (TMDL) submitted by your office on April 7, 2020. In accordance with the Clean Water Act (33 U.S.C. §1251 *et. seq*.) and the EPA's implementing regulations at 40 C.F.R Part 130, the EPA hereby approves South Dakota's TMDL for segment 1 of the Big Sioux River. The EPA has determined that the separate elements of the TMDL listed in the enclosure adequately address the pollutant of concern, are designed to attain and maintain applicable water quality standards, consider seasonal variation and includes a margin of safety. The EPA's rationale for this action is contained in the enclosure.

The EPA's approval of South Dakota's submitted TMDL extends to waterbodies in South Dakota with the exception of those waters that are within Indian country, as defined in 18 U.S.C. Section 1151. The EPA is taking no action to approve or disapprove the State's TMDLs with respect to those waters at this time. EPA, or eligible Indian tribes, as appropriate, will retain responsibilities under Section 303(d) for those waters.

Thank you for submitting this TMDL for our review and approval. If you have any questions, please contact Peter Brumm on my staff at (406) 457-5029.

Sincerely,

JUDY BLOOM
Digitally signed by JUDY BLOOM
Date: 2020.04.23 15:15:29 -06'00'

Judy Bloom, Manager
Clean Water Branch

Enclosure
Big Sioux River Segment 1 *E. coli* TMDL EPA Review Summary

EPA TOTAL MAXIMUM DAILY LOAD (TMDL) REVIEW SUMMARY

TMDL: *E. coli* Total Maximum Daily Load Evaluation for the Big Sioux River Segment 1

ATTAINS TMDL ID: R8-SD-2020-02

LOCATION: Codington, Grand, Day and Roberts Counties, South Dakota

IMPAIRMENTS/POLLUTANTS: The TMDL document addresses one river segment whose limited contact recreation use is impaired due to high concentrations of *E. coli* bacteria.

Waterbody/Pollutant Addressed in this TMDL Action

Assessment Unit ID	Waterbody Description	Pollutants Addressed
SD-BS-R-BIG_SIOUX_01	Big Sioux River (S28, T121N, R52W to Lake Kampeska)	Escherichia coli (*E. coli*)

BACKGROUND: The South Dakota Department of Environment and Natural Resources (DENR) submitted to EPA the final *E. coli* TMDL for segment 1 of the Big Sioux River with a letter requesting review and approval dated March 27, 2020. DENR sent an updated version of the TMDL document on April 7, 2020 that incorporated inadvertently omitted public comments and requested EPA act on the newer version, which EPA agreed to do.

The submittal included:

- Letter requesting EPA's review and approval of the TMDL
- Final TMDL report

APPROVAL RECOMMENDATIONS: Based on the review presented below, the reviewer recommends approval of the final Big Sioux River *E. coli* TMDL. All the required elements of an approvable TMDL have been met.

TMDL Approval Summary	
Number of TMDLs Approved:	1
Number of Causes Addressed by TMDLs:	1

REVIEWERS: Peter Brumm, EPA

The following review summary explains how the TMDL submission meets the statutory and regulatory requirements of TMDLs in accordance with Section 303(d) of the Clean Water Act (CWA), and EPA's implementing regulations in 40 C.F.R. Part 130.

EPA TMDL REVIEW FOR BIG SIOUX RIVER SEGMENT 1 E. COLI TMDL

This TMDL review document includes EPA's guidelines that summarize the currently effective statutory and regulatory requirements relating to TMDLs (CWA Section 303(d) and 40 C.F.R. Part 130). These TMDL review guidelines are not themselves regulations. Any differences between these guidelines and EPA's regulations should be resolved in favor of the regulations themselves. The italicized sections of this document describe the information generally necessary for EPA to determine if a TMDL submittal fulfills the legal requirements for approval. The sections in regular type reflect EPA's analysis of the state's compliance with these requirements. Use of the verb "must" below denotes information that is required to be submitted because it relates to elements of the TMDL required by the CWA and by regulation.

1. Identification of Waterbody, Pollutant of Concern, Pollutant Sources, and Priority Ranking

The TMDL submittal must clearly identify (40 C.F.R. §130.7(c)(1)):

- *the waterbody as it appears on the State's/Tribe's 303(d) list;*
- *the pollutant for which the TMDL is being established; and*
- *the priority ranking of the waterbody.*

The TMDL submittal must include (40 C.F.R. §130.7(c)(1); 40 C.F.R. §130.2):

- *an identification of the point and nonpoint sources of the pollutant of concern, including location of the source(s) and the quantity of the loading (e.g., lbs. per day);*
- *facility names and NPDES permit numbers for point sources within the watershed; and*
- *a description of the natural background sources, and the magnitude and location of the sources, where it is possible to separate natural background from nonpoint sources.*

This information is necessary for EPA's review of the load and wasteload allocations, which are required by regulation.

The TMDL submittal should also contain a description of any important assumptions made in developing the TMDL, such as:

- *the spatial extent of the watershed in which the impaired waterbody is located;*
- *the assumed distribution of land use in the watershed (e.g., urban, forested, agriculture);*
- *population characteristics, wildlife resources, and other relevant information affecting the characterization of the pollutant of concern and its allocation to sources;*
- *present and future growth trends, if taken into consideration in preparing the TMDL (e.g., the TMDL could include the design capacity of a wastewater treatment facility); and*
- *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.*

Segment 1 of the Big Sioux River is located in north-eastern South Dakota and is part of the larger Missouri River basin. The impaired waterbody segment subject to this TMDL extends upstream from Lake Kampeska to S28, T121N, R52W in Grant County and is identified as SD-BS-R-BIG_SIOUX_01. Figure 1 displays the general location of the upper Big Sioux Watershed, the impaired segment, and monitoring stations where data was collected to support TMDL development.

This segment was first listed as impaired by *E. coli* on South Dakota's 2010 303(d) List and was assigned a high priority (i.e., 1) for TMDL development on the most recent 303(d) list in 2020. This priority ranking information is contained on page 1. Dissolved oxygen (DO) has been identified as causing impairments to the warmwater semipermanent fish life propagation use and the limited contact recreation use on this segment, but the DO impairment is not addressed in this *E. coli* TMDL report nor have any previous TMDLs have been established for this segment.

Table 1 summarizes the land use distribution draining into the impaired segment and Section 5.2 characterizes nonpoint sources into categories of agriculture, septic systems, and natural background (i.e., wildlife). DENR quantified *E. coli* production from these sources using human and animal population estimates from various sources. Traditional point sources are identified and described in Section 5.1.1 by facility name, permit number and discharge characteristics. Permitted Concentrated Animal Feeding Operations (CAFOs) are identified by name, operation type and general permit number in Table 5.

Assessment: EPA concludes that DENR adequately identified the impaired waterbody, the pollutant of concern, the priority ranking, the identification, location and magnitude of the pollutant sources, and the important assumptions and information used to develop the TMDL.

2. Description of the Applicable Water Quality Standards and Numeric Water Quality Target

The TMDL submittal 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 antidegradation policy (40 C.F.R. §130.7(c)(1)); and*
- *a numeric water quality target for each TMDL. If the TMDL is based on a target other than a numeric water quality criterion, then a numeric expression must be developed from a narrative criterion and a description of the process used to derive the target must be included in the submittal (40 C.F.R. §130.2(i)).*

EPA needs this information to review the loading capacity determination, and load and wasteload allocations, which are required by regulation.

Section 3.0 (Description of the Applicable Water Quality Standards and Numeric Water Quality Target) describes the water quality standards applicable to the impaired segment with citations to relevant South Dakota regulations. SD-BS-R-BIG_SIOUX_01 is designated for the following beneficial uses:

- warmwater marginal fish life propagation,
- limited contact recreation,
- irrigation,
- fish and wildlife propagation, recreation, and stock watering.

All numeric criteria applicable to these uses are presented in Table 2. DENR determined that *E. coli* is preventing the river's limited contact recreation use from being supported. The numeric *E. coli* criteria for limited contact recreation waters are applied directly as water quality targets for the TMDL and are comprised of a 30-day geometric mean criterion (≤ 630 cfu/100mL) and a single sample maximum criterion (≤ 1,178 cfu/100mL). These criteria are seasonally applicable from May 1 to September 30.

The TMDL and allocations were developed using the single sample maximum criterion because geometric means could not be calculated from the monitoring dataset in accordance with South Dakota water quality standard regulations (i.e., minimum five samples separated by at least 24-hours within a 30-day period). DENR demonstrates in Section 3.3 (Numeric TMDL Targets) that attaining the single sample maximum target will also achieve the geometric mean criterion.

Assessment: EPA concludes that DENR adequately described the applicable water quality standards and numeric water quality target for this TMDL.

3. Loading Capacity - Linking Water Quality and Pollutant Sources

The TMDL submittal must include the loading capacity for each waterbody and pollutant of concern. 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 TMDL submittal must:

- *describe the method used to establish 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;*
- *contain documentation supporting the TMDL analysis, including the basis for any assumptions; a discussion of strengths and weaknesses in the analytical process; and results from any water quality modeling; and*
- *include a description and summary of the water quality data used for the TMDL analysis.*

EPA needs this information to review the loading capacity determination, and load and wasteload allocations, which are required by regulation (40 C.F.R. §130.2).

The full water quality dataset should be made available as an appendix to the TMDL or as a separate electronic file. Other datasets used (e.g., land use, flow), if not included within the TMDL submittal, should be referenced by source and year. The TMDL analysis should make use of all readily available data for the waterbody unless the TMDL writer determines that the data are not relevant or appropriate.

The pollutant loadings may be expressed as either mass-per-time, toxicity or other appropriate measure (40 C.F.R. §130.2(i)). Most TMDLs should be expressed as daily loads (USEPA. 2006a). If the TMDL is expressed in terms other than a daily load (e.g., annual load), the submittal should explain why it is appropriate to express the TMDL in the unit of measurement chosen.

The TMDL submittal must describe the critical conditions and related physical conditions in the waterbody as part of the analysis of loading capacity (40 C.F.R. §130.7(c)(1)). The critical condition can be thought of as the "worst case" scenario of environmental conditions (e.g., stream flow, temperature, loads) in the waterbody in which the loading expressed in the TMDL for the pollutant of concern will continue to meet water quality standards. TMDLs should define the applicable critical conditions and describe the approach used to estimate both point and nonpoint source loads under such critical conditions.

DENR relied on the load duration curve approach to define the *E. coli* loading capacity for segment 1 of the Big Sioux River. A load duration curve is a graphic representation of pollutant loads across various flows. The approach helps correlate water quality conditions to stream flow and provides insight into the variability of source contributions. EPA has published guidance on the use of duration curves for TMDL development (USEPA. 2007) and the practice is well established. Using this approach, DENR set the TMDL equivalent to the loading capacity and expressed the TMDL in colony forming units (CFU) per day at four different flow zones (i.e., high, moist, mid-range, dry), as listed in Table 8. The load duration curve, and TMDL based on the curve, is shown visually in Figure 5 with instantaneous loads calculated from the monitoring dataset.

All ambient water quality data used in the analysis is contained in Appendix A (Bacteria Data Used in the TMDL Development). All samples were originally analyzed for *E. coli* so there was no need to convert fecal coliform data into *E. coli*.

While the loading capacity is defined for multiple stream flow conditions, DENR determined critical conditions occur during spring and summer storm events when the in-stream concentrations of *E. coli* are the highest.

Assessment: EPA concludes that the loading capacity was calculated using an acceptable approach, used a water quality target consistent with water quality criteria, and has been appropriately set at a level necessary to attain and maintain the applicable water quality standards. The pollutant loads have been expressed as daily loads. The critical conditions were described and factored into the calculations and were based on a reasonable approach to establish the relationship between the target and pollutant sources.

4. Load Allocation

The TMDL submittal must include load allocations (LAs). EPA regulations define LAs as the portion of a receiving water's loading capacity that is attributed either to one of its existing or future nonpoint sources of pollution and to natural background sources. Load allocations may range from reasonably accurate estimates to gross allotments (40 C.F.R. §130.2(g)). Where possible, separate LAs should be provided for natural background and for nonpoint sources.

In the rare instance that a TMDL concludes that there are no nonpoint sources or natural background for a pollutant, the load allocation must be expressed as zero and the TMDL should include a discussion of the reasoning behind this decision.

As described in Section 6.2 (TMDL Allocations), DENR established a single LA as the allowable load remaining after the WLA and explicit MOS have been accounted for (i.e., LA = TMDL – WLA – MOS). Table 8 presents the LA across the TMDLs four flow zones. This composite LA represents all nonpoint source contributions, both human and natural, as one allocation, however, individual nonpoint source categories were characterized in greater depth in Section 5.2 (Nonpoint Sources).

Assessment: EPA concludes that the LA provided in the TMDL is reasonable and will result in attainment of the water quality standards.

5. Wasteload Allocations

The TMDL submittal must include wasteload allocations (WLAs). EPA regulations define WLAs as the portion of a receiving water's loading capacity that is allocated to existing and future point sources (40 C.F.R. §130.2(h)). If no point sources are present or if the TMDL recommends a zero WLA for point sources, the WLA must be expressed as zero. If the TMDL recommends a zero WLA after considering all pollutant sources, there must be a discussion of the reasoning behind this decision, since a zero WLA implies an allocation only to *nonpoint sources and natural background will result in attainment of the applicable water quality standards, and all point sources have no measurable contribution.*

The individual WLAs may take the form of uniform percentage reductions or individual mass based limitations for dischargers where it can be shown that this solution meets WQSs and does not result in localized impairments. In some cases, WLAs may cover more than one discharger (e.g., if the source is contained within a general permit).

Section 5.1.1 (Point Sources) identifies and describes the eleven point sources located within the drainage area that are permitted under the National Pollutant Discharge Elimination System (NPDES) program. These are the wastewater treatment facilities for the towns of Summit (Permit #SD0022811) and Florence (#SDG821598); the City of Waubay (#SD0020125); the Pickerel Lake Sanitary District (#SDG827715); the Enemy Swin Housing Authority (#SDG589808); the Dakota Sioux Casino (#SDG589801); the Northern Con-Agg, Inc. construction, sand and gravel facility (#SD0026182) and the Clark Kampeska Rural Water Supply (#SDG860066). There are also three permitted CAFOs running dairy and beef cattle operations within the drainage area (#SDG-0100005, #SDG-0100498, and #SDG-0100072).

After reviewing the specifics of each facility, DENR established one WLA for the Town of Summit. No other point source was given a TMDL allocation (i.e., all others were assigned a WLA of zero) because the wastewater treatment facilities are designed and permitted to be non-discharging facilities and DENR determined that discharges from the rural water supply system and sand and gravel facility were unlikely to contain *E. coli* based the characteristics of their operations. CAFOs were similarly assigned WLAs of zero with the understanding that as long as they comply with the existing general CAFO permit requirements, DENR considers CAFO discharges to be unlikely and inconsequential.

For the high, moist, and mid-range flow zones, the Town of Summit WLA was calculated using the single sample maximum criterion of 1,178 cfu/100mL, the facility's 80th percentile daily maximum flow (0.96 cfs) as recorded in Discharge Monitoring Reports (DMRs), and a unit conversion factor (37,854,120) to produce an allowable load in units of cfu per day. Calculations in the dry flow zone were adjusted to account for the reduced loading capacity of the river during those conditions. The dry flow WLA was calculated by evenly splitting the allowable load between the WLA and the LA after accounting for the 10% explicit MOS (i.e., WLA = (TMDL – MOS) / 2). Table 8 presents the WLAs for each flow zone

EPA notes that despite the TMDL reporting on page 13 that the Town of Summit WLA "was calculated by using the facilities' [sic] *E. coli* permit effluent limit of 1,178 cfu/100mL…", the current permit has been administratively continued since 2013 and has fecal coliform monitoring requirements but no bacteria effluent limits. 40 C.F.R. § 122.44(d)(vii) requires DENR to ensure that permits it issues include water quality based effluent limits that are derived from and comply with all applicable water quality standards and are consistent with WLAs established in EPA-approved TMDLs. DENR should consider updating the permit to incorporate South Dakota's current water quality criteria established to protect recreational uses, which changed from fecal coliform to *E. coli* in 2017 (USEPA. 2017a), and also consider whether *E. coli* effluent limits are necessary to ensure consistency with the TMDL.

Assessment: EPA concludes that the WLA provided in the TMDL is reasonable, will result in the attainment of the water quality standards and will not cause localized impairments. The TMDL accounts for all point sources contributing loads to the impaired segment.

6. Margin of Safety

*The TMDL submittal must include a margin of safety (MOS) to account for any lack of knowledge concerning the relationship between load allocations, wasteload allocations and water quality (CWA §303(d)(1)(C), 40 C.F.R. §130.7(c)(1)). The MOS may be **implicit** or **explicit**.*

*If the MOS is **implicit**, the conservative assumptions in the analysis that account for the MOS must be described. If the MOS is **explicit**, the loading set aside for the MOS must be identified.*

The segment 1 Big Sioux River *E. coli* TMDL includes an explicit MOS derived as 10% of the TMDL. The explicit MOS is included in Table 8 and varies by flow zone.

Assessment: EPA concludes that the TMDL incorporates an adequate explicit margin of safety.

7. Seasonal Variation

The TMDL submittal must be established with consideration of seasonal variations. The method chosen for including seasonal variations in the TMDL must be described (CWA §303(d)(1)(C), 40 C.F.R. §130.7(c)(1)).

The load duration curve method used to establish the TMDL incorporates variations in stream flow, which in turn, is influenced by other climatic and human factors that change throughout the year. To account for these variations, DENR developed the TMDL at four different flow zones (i.e., high, moist, mid-range, dry) as listed in Table 8.

The variability of measured stream flows and monitored *E. coli* concentrations are summarized in Section 7.0 (Seasonal Variation). Typically, the highest *E. coli* concentrations and loads are observed during the high and moist flow zones and are associated with spring snowmelt or intense rainfall events. This pattern suggests the spring and early summer periods as important timeframes to focus water quality attainment goals.

Assessment: EPA concludes that seasonal variations were adequately described and considered to ensure the TMDL allocations will be protective of the applicable water quality standards throughout any given year.

8. Reasonable Assurances

When a TMDL is developed for waters impaired by both point and nonpoint sources, EPA guidance (USEPA. 1991) and court decisions say that the TMDL must provide reasonable assurances that nonpoint source control measures will achieve expected load reductions in order for the TMDL to be approvable. This information is necessary for EPA to determine that the TMDL, including the load and wasteload allocations, has been established at a level necessary to implement the applicable water quality standards (CWA §303(d)(1)(C), 40 C.F.R. §130.7(c)(1)).

EPA guidance (USEPA. 1997) also directs Regions to work with States to achieve TMDL load allocations in waters impaired only by nonpoint sources. However, EPA cannot disapprove a TMDL for nonpoint source-only impaired waters, which do not have a demonstration of reasonable assurance that LAs will be achieved, because such a showing is not required by current regulations.

As verified through the TMDL analysis, segment 1 of the Big Sioux River is impaired by both point and nonpoint sources of *E. coli* therefore DENR provided reasonable assurances that source control measures will be achieved.

The WLA was established based on the Summit wastewater treatment facility meeting *E. coli* water quality criteria in their effluent (i.e., criteria end-of-pipe). Reasonable assurances are addressed for point sources through NPDES permits, which require these facilities to have effluent limits consistent with the assumptions and requirements of WLAs.

Nonregulatory, voluntary-based reasonable assurances are provided for the LA where the submittal discusses DENR's adaptive management approach to the TMDL process, the monitoring strategy that will be used to gage TMDL effectiveness in the future, and the core aspects of a TMDL implementation strategy. These assurances include the more detailed characterization of nonpoint sources that will guide restoration planning beyond what is summarized in the composite LA representing all nonpoint source categories and the recommendation of specific activities to focus implementation. The submittal also mentions one implementation project addressing bacteria already underway (i.e., the Upper Big Sioux Implementation Project).

Assessment: EPA considered the reasonable assurances contained in the TMDL submittal and concludes that they are adequate to meet the load reductions.

9. Monitoring Plan

The TMDL submittal should include a monitoring plan for all:

- *Phased TMDLs; and*
- *TMDLs with both WLA(s) and LA(s) where reasonable assurances are provided.*

Under certain circumstances, a phased TMDL should be developed when there is significant uncertainty associated with the selection of appropriate numeric targets, estimates of source loadings, assimilative capacity, allocations or when limited existing data are relied upon to develop a TMDL. EPA guidance (USEPA. 2006b) recommends that a phased TMDL submittal, or a separate document (e.g., implementation plan), include a monitoring plan, an explanation of how the supplemental data will be used to address any uncertainties that may exist when the phased TMDL is prepared and a scheduled timeframe for revision of the TMDL.

For TMDLs that need to provide reasonable assurances, the monitoring plan should describe the additional data to be collected to determine if the load reductions included in the TMDL are occurring and leading to attainment of water quality standards.

EPA guidance (USEPA. 1991) recommends post-implementation monitoring for all TMDLs to determine the success of the implementation efforts. Monitoring plans are not a required part of the TMDL and are not approved by EPA but may be necessary to support the decision rationale for approval of the TMDL.

In Section 9.0 (Adaptive Management and Monitoring Strategy) DENR commits to supporting future ambient water quality monitoring activities to judge progress towards achieving the goals outlined in the TMDL. DENR also maintains the ability to modify the TMDL and allocations as new data becomes available using an adaptive management approach in accordance with the TMDL revision process previously recommended by EPA.

Assessment: Monitoring plans are not a required element of EPA's TMDL review and decision-making process. The TMDL submitted by DENR includes a commitment to monitor progress toward attainment of water quality standards. EPA is taking no action on the monitoring strategy included in the TMDL submittal.

10. Implementation

EPA policy (USEPA. 1997) encourages Regions to work in partnership with States/Tribes to achieve nonpoint source load allocations established for 303(d)-listed waters impaired by nonpoint sources. Regions may assist States/Tribes in developing implementation plans that include reasonable assurances that nonpoint source LAs established in TMDLs for waters impaired solely or primarily by nonpoint sources will in fact be achieved. The policy recognizes that other relevant watershed management processes may be used in the TMDL process. EPA is not required to and does not approve TMDL implementation plans.

EPA encourages States/Tribes to include restoration recommendations (e.g., framework) in all TMDLs for stakeholder and public use to guide future implementation planning. This could include identification of a range of potential management measures and practices that might be feasible for addressing the main loading sources in the watershed (see USEPA. 2008b, Chapter 10). Implementation plans are not a required part of the TMDL and are not approved by EPA but may be necessary to support the decision rationale for approval of the TMDL.

In Section 11.0 (Implementation Strategy) DENR encourages, based on the makeup and contribution of pollutant sources within the watershed, that future implementation activities focus on:

- Limiting livestock access to streams and providing alternative water sources.
- Protecting stream banks by enhancing riparian vegetation to provide erosion control and filter runoff of pollutants before entering the stream.
- Installing filter strips along the stream bordering cropland and pastureland.
- Implementing proper waste management systems at animal confinement facilities.
- Assessing the impact of CWA Section 319 projects and revising plans in cooperation with basin stakeholders whenever necessary.

Assessment: Although not a required element of the TMDL approval, DENR discussed how information derived from the TMDL analysis process can be used to support implementation of the TMDL. EPA is taking no action on the implementation portion of the TMDL submittal.

11. Public Participation

EPA policy is that there must be full and meaningful public participation in the TMDL development process. Each State/Tribe must, therefore, provide for public participation consistent with its own continuing planning process and public participation requirements (40 C.F.R. §25.3 and §130.7(c)(1)(ii)). *The final TMDL submittal must describe the State/Tribe's public participation process, including a summary of significant comments and the State/Tribe's responses to those comments (40 C.F.R. §25.3 and §25.8). Inadequate public participation could be a basis for disapproving a TMDL; however, where EPA determines that a State/Tribe has not provided adequate public participation, EPA may defer its approval action until adequate public participation has been provided for, either by the State/Tribe or by EPA.*

Section 10.0 (Public Participation) explains the public engagement process DENR followed during development of the TMDL. A draft TMDL report was initially released for public comment in April 2012. No public comments were submitted during that time. Following additional data collection and significant revisions to the document, the TMDL report was public noticed again from February 18, 2020 to March 23, 2020. Both opportunities for public review and comment were posted on DENR's website and announced in three area newspapers: the Grant County Review, the Webster Reporter, and the Watertown Public Opinion. DENR received one set of comments in 2020. Appendix B (Public Comments) presents the comment letter and DENR's response to each comment.

Assessment: EPA has reviewed DENR's public participation process and concludes that DENR involved the public during the development of the TMDL and provided adequate opportunities for the public to comment on the draft report.

12. Submittal Letter

The final TMDL submittal must 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 (40 C.F.R. §130.7(d)(1)). The final submittal letter should contain such identifying information as the waterbody name, location, assessment unit number and the pollutant(s) of concern.

A transmittal letter with the appropriate information was included with the final TMDL report submission from DENR, dated March 27, 2020 and signed by Paul Lorenzen, Environmental Scientist Manager 1, Water Protection Program. DENR sent an updated version of the TMDL document on April 7, 2020 that incorporated inadvertently omitted public comments and requested EPA act on the newer version, which EPA agreed to do.

Assessment: EPA concludes that the state's submittal package clearly and unambiguously requested EPA to act on the TMDL in accordance with the Clean Water Act and the submittal contained all necessary supporting information.

References

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