E. COLI TOTAL MAXIMUM DAILY LOAD FOR WHITEWOOD CREEK

Topical Report RSI-2149

prepared for

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

August 2010

RESPEC
CONSULTING & SERVICES

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by

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Total Maximum Daily Load Summary Table	
Waterbody Name/Description	Whitewood Creek (from Deadwood Creek to Spruce Gulch)
Assessment Unit I.D.	SD-BF-R-WHITEWOOD_03
Size of Impaired Waterbody	Approximately 1.8 miles (2.9 kilometers) in length
Size of Watershed	105 square miles (273 square kilometers)
Location	Hydrologic Unit Codes (12-digit HUC): 101202020207 and 101202020208
Impaired Designated Use(s)	Immersion Recreation
Cause(s) of Impairment	*E. coli*
Cycle Most Recently Listed	2010
Total Maximum Daily Load End Points	Indicator Name: Fecal coliform bacteria Threshold Values: Maximum daily concentration of 400 colony-forming units per 100 milliliters (cfu/100 mL) and a geometric mean of at least five samples over a 30-day period 200 cfu/ 100 mL. These criteria apply from May through September.
Analytical Approach	Load Duration Curve, **Bacterial Indicator Tool** and **Hydrological Simulation Program – FORTRAN (HSPF)** modeling

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1.0 INTRODUCTION

The intent of this document is to clearly identify the components of a Total Maximum Daily Load (TMDL), support adequate public participation, and facilitate the U.S. Environmental Protection Agency (EPA) review. The TMDL was developed in accordance with Section 303(d) of the federal Clean Water Act and guidance developed by EPA. This TMDL document addresses the *E. coli* bacteria impairment on Whitewood Creek (SD-BF-R-WHITEWOOD_03), which was assigned an EPA assessment category of 5 (water is impaired or threatened and a TMDL is needed) in the 2010 impaired waterbodies list [South Dakota Department of Environment and Natural Resources, 2010a].

1.1 WATERSHED CHARACTERIZATION

The Whitewood Creek Watershed is approximately 105 square miles (273 square kilometers). The creek flows through both Lawrence and Meade Counties, with its headwaters located near the base of Deer Mountain. The creek flows to the Belle Fourche River near Vale, South Dakota. The watershed drains much of the central portion of Lawrence County in South Dakota, as shown in Figure 1-1. The impaired (Section 303(d) listed) segment of Whitewood Creek has a length of approximately 1.8 miles (2.9 kilometers), beginning at Deadwood Creek and ending at Spruce Gulch.

Average annual precipitation for Lead, South Dakota, and Deadwood, South Dakota, is 29 inches and 28 inches, respectively. Over 50 percent of the annual precipitation occurs between the months of April and June. The highest rainfall totals occur during May while the lowest rainfall totals occur during January. Snowmelt significantly contributes to flow during March, April, and May. Average annual snowfall in Lead and Deadwood is 169 inches and 112 inches, respectively [Carter, 2002].

Watershed land use above the TMDL endpoint is mainly forestland (71 percent) and grasslands (16 percent). Urban areas above the TMDL endpoint (5.6 percent of the study area) can be found near Lead, Central City, and Deadwood, South Dakota. The remaining portion of the study area consists of agricultural land, shrubs, and wetlands. Table 1-1 lists the land use in the Whitewood Creek Watershed above the TMDL endpoint. A majority of the impaired reach is located within the city of Deadwood.

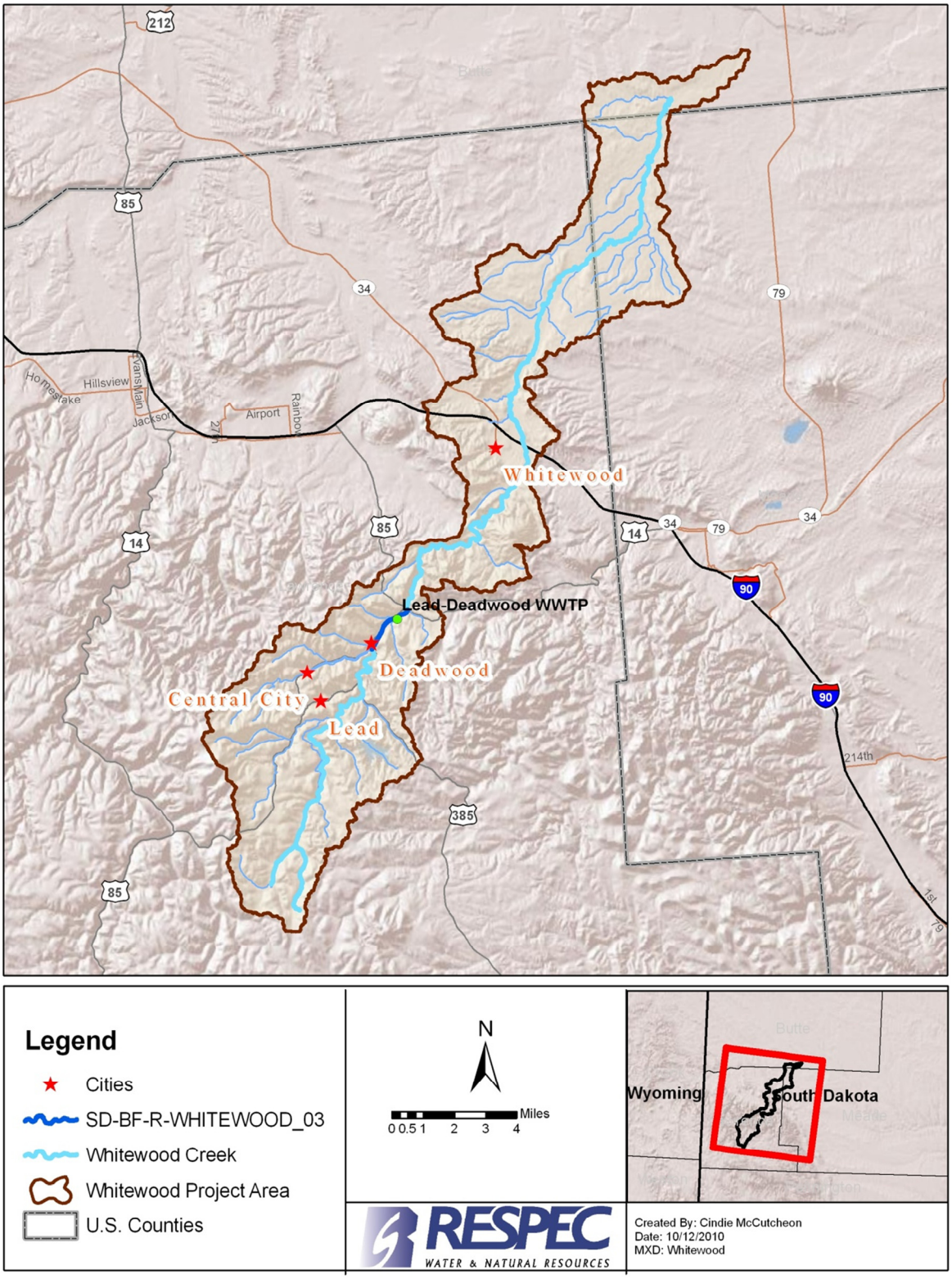

Figure 1-1. Whitewood Creek Study Area.

Table 1-1. Watershed Land Use in the Whitewood Creek Watershed Above the TMDL Reach Endpoint

Land Uses	Area (acres)	% of Area
Evergreen Forest	19,938	71.0%
Grassland/Herbaceous	4,532	16.1%
Shrub/Scrub	1,121	4.0%
Developed, Low Intensity	743	2.6%
Developed, Open Space	718	2.6%
Barren Land (Rock/Sand/Clay)	478	1.7%
Open Water	175	0.6%
Mixed Forest	134	0.5%
Deciduous Forest	124	0.4%
Developed, Medium Intensity	99	0.4%
Pasture/Hay	8	0.0%
Emergent Herbaceous Wetlands	3	0.0%
Woody Wetlands	1	0.0%
Total	28,074	100.0%

1.2 CLEAN WATER ACT SECTION 303(D) LISTING INFORMATION

Whitewood Creek was first listed in South Dakota's 2010 303(d) list [South Dakota Department of Environment and Natural Resources, 2010a] because of sample concentrations of *E. coli* bacteria that exceeded the criterion for the protection of the immersion recreation use. Because South Dakota did not adopt the *E. coli* criteria for the protection of the immersion recreation and limited contact uses until 2010, Segment SD-BF-R-WHITEWOOD_03 (from Deadwood Creek to Spruce Gulch) was not listed as impaired for *E. coli* until 2010. For a parameter to be included as a cause of impairment on the 303(d) impaired waterbodies list, greater than 10 percent of samples collected during the previous 5-year period must exceed water-quality criteria.

1.3 AVAILABLE WATER-QUALITY AND FLOW DATA

The South Dakota Department of Environment and Natural Resources (SD DENR) collected *E. coli* samples since 1998 at the Whitewood Creek ambient Water-Quality Monitoring (WQM) Station 123 near Deadwood and fecal coliform samples since 1991. *E. coli* bacteria concen-

tration data collected at WQM 123 (1998 through 2009) show that 14 out of 34 samples (41 percent) collected during the recreation season from May 1 to September 30 exceeded the acute *E. coli* bacteria criterion of 235 colony-forming units per 100 milliliters (cfu/100 mL). *E. coli* concentrations ranged from < 10 cfu/100 mL to 770 cfu/100 mL.

Bacteria sample data collected to date in Whitewood Creek near Deadwood at WQM 123 show a statistically significant correlation (Spearman $r_s = 0.71$; $p < 0.05$) between fecal coliform bacteria and *E. coli* concentrations. Because the two indicators are closely related, the paired fecal coliform and *E. coli* were used to develop a site-specific translator function ($r^2 = 0.55$) to convert fecal coliform loading estimates to *E. coli* loading estimates to address impairments to the immersion recreation impairment of Whitewood Creek. The mean ratio of *E. coli* to fecal coliform was calculated to be 1.21 cfu *E. coli*/cfu fecal coliform. Figure 1-2 shows the plot of *E. coli* versus fecal coliform. The translation requires the regression analysis equation (Equation 1-1) to convert fecal coliform concentration to *E. coli* concentrations:

$$E = 0.7681(F) + 74.592 \tag{1-1}$$

where:

E = E. *coli* concentration (cfu/100 mL)

F = fecal coliform concentration (cfu/100 mL).

Fecal coliform bacteria concentration data collected at WQM 123 and transformed to *E. coli* concentrations show that 67 out of 106 samples (63 percent) collected during the recreation season from May 1 to September 30 exceeded the acute *E. coli* bacteria criterion of 235 cfu/ 100 mL from 1991 through 2009. Calculated concentrations ranged from 76 cfu/100 mL to 5,221 cfu/100 mL.

Whitewood Creek flow data were available from U.S. Geological Survey (USGS) Station 06436170 at Deadwood, South Dakota, near WQM 123 from 1981 through 1995, while flow data were available from USGS Station 06436180 above Whitewood, South Dakota, from 1982 through 2009. Because recent flow data were required for construction of a load duration curve, a linear regression analysis was completed comparing historical flow (1982 through 1995) from the two stations; the equation of the linear regression analysis line ($r^2 = 0.88$) was used with the data from USGS Station 06436180 (1998 through 2009) to calculate more recent flow values for USGS Station 06436170. SD DENR WQM stations and USGS stations used for TMDL development are shown in Table 1-2 and Figure 1-3.

Boxplots shown in Figure 1-4 were constructed for the water-quality monitoring sites shown in Figure 1-5 using data which would have been used for the 2008 and 2010 integrated reports

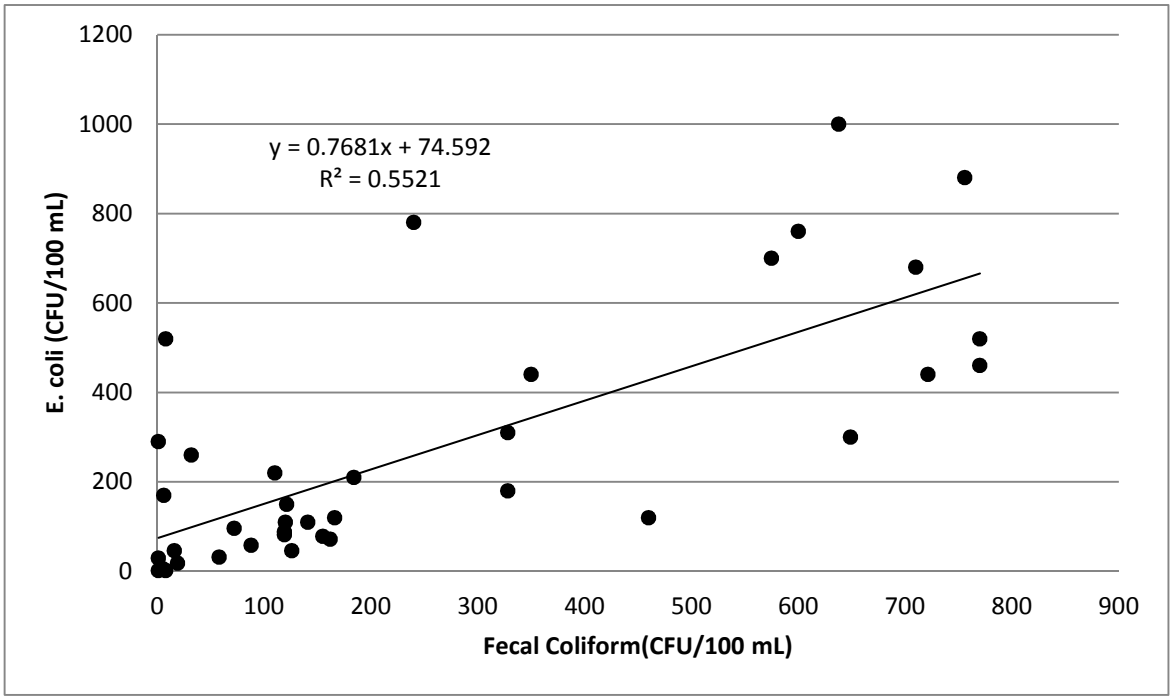

Figure 1-2. Plot of Fecal Coliform Versus *E. coli* for South Dakota Department of Environment and Natural Resources Water-Quality Monitoring Station WQM 123.

Table 1-2. Water-Quality Stations in the Whitewood Creek Watershed Used for Total Maximum Daily Load Development

Water Quality Stations	Period of Record	Calculated *E. coli* Samples	Actual *E. coli* Samples	Flow Samples
Whitewood Creek near Deadwood, SD (WQM 123)	1991–2009	106	39	0
Whitewood Creek at Deadwood, SD (USGS 06436170)	1981–1995	0	0	5,113
Whitewood Creek above Whitewood, SD (USGS 06436180)	1982–2009	2	0	9,719

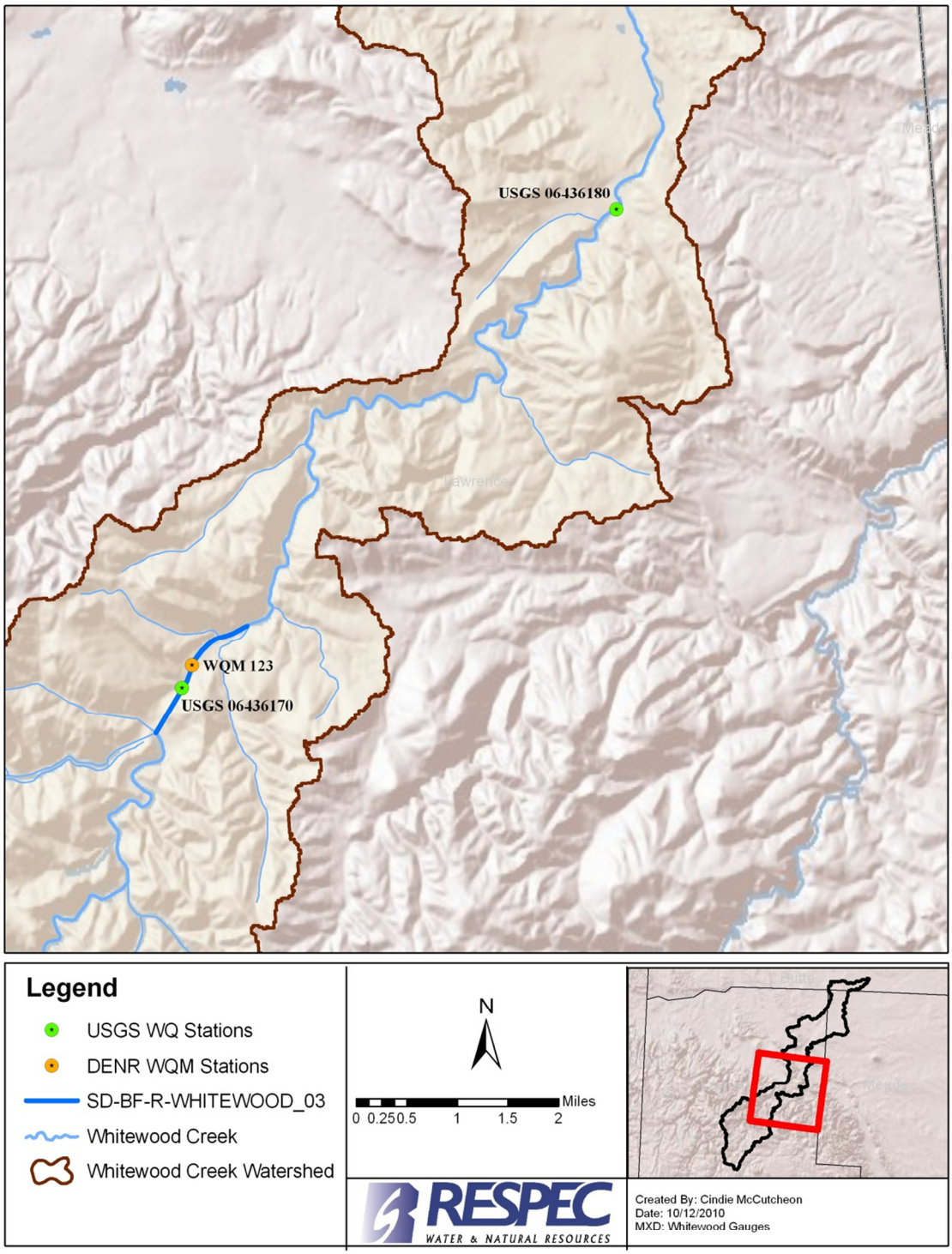

Figure 1-3. Water-Quality Stations in the Whitewood Creek Watershed Used for Total Maximum Daily Load Development.

(2003 through 2009). This dataset was used because requirements for stream listings state that data must be less than 5 years old. Boxplots are shown from upstream to downstream. A watershed schematic, as illustrated in Figure 1-6, shows median concentrations, percent exceedance, and number of samples at each water quality monitoring site from upstream to downstream for this time period. The only water-quality monitoring site within the impaired reach is Whitewood Creek below Deadwood (460123). West Strawberry Creek (460675), which flows into Reach SD-BF-R-WHITEWOOD_01 is impaired for fecal coliform with a median concentration of nearly two times that of Whitewood Creek below Deadwood. There is a TMDL document approved for West Strawberry Creek which suggests the bacteria load sources are approximately 43 percent human and 57 percent wildlife [South Dakota Department of Environment and Natural Resources, 2010b]. Whitewood Creek above Gold Run (460686), Gold Run Creek (460659), Whitewood Creek near Deadwood (460122), and Deadwood Creek (460127) are unimpaired. Using only data from 2003 through 2009, the impaired reach, SD-BF-R-WHITEWOOD_03, has 22 percent exceedance of the acute criteria and 50 percent exceedance of the geometric mean criteria. The Whitewood Creek near Deadwood site (460685) following the impaired reach actually exceeds the acute criteria 15 percent of the time. However, this site is not listed because it does not meet the sample requirements for impairment which state, "at least 20 samples for any one parameter are usually required at any site. The sample threshold was reduced to 10 samples if greater than 25 percent of samples exceed water standards [South Dakota Department Environment and Natural Resources, 2008]."

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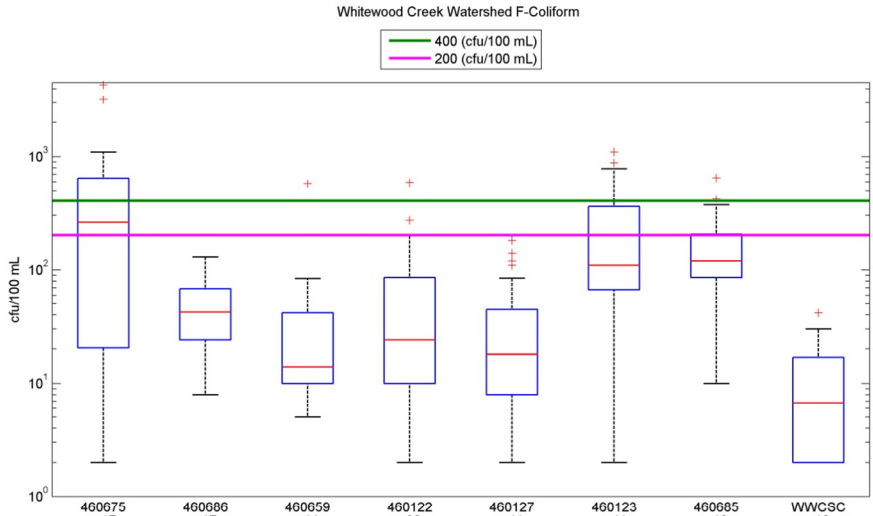

	460675	460686	460659	460122	460127	460123	460685	WWCSC
n	17	17	11	30	41	41	13	10
Min	2	8	5	2	2	2	10	2
Max	4350	130	580	590	180	1100	650	41.5
q1	20.5	24	10	10	8	67.25	86	2
Median	260	42	14	24	18	110	120	6.75
q3	642.5	68.5	41.5	86	44.5	357.5	205	17
Mean	716.9	49.4	73.7	68.9	34.9	251.8	182	12.2
90th%	2780	107	282	160	95	712	466	35.8
95th%	3948	123	555	270	129	825	615	41.5
% Exceeded	41	0	9.1	3.3	0	22	15	0
% Exceed30	59	0	0	NaN	0	50	NaN	0
n 30	17	17	12	0	22	22	0	10

Figure 1-4. Boxplots of 2003 Through 2009 Fecal Coliform Data for Sites Upstream, Within, and Downstream of the Impaired Reach.

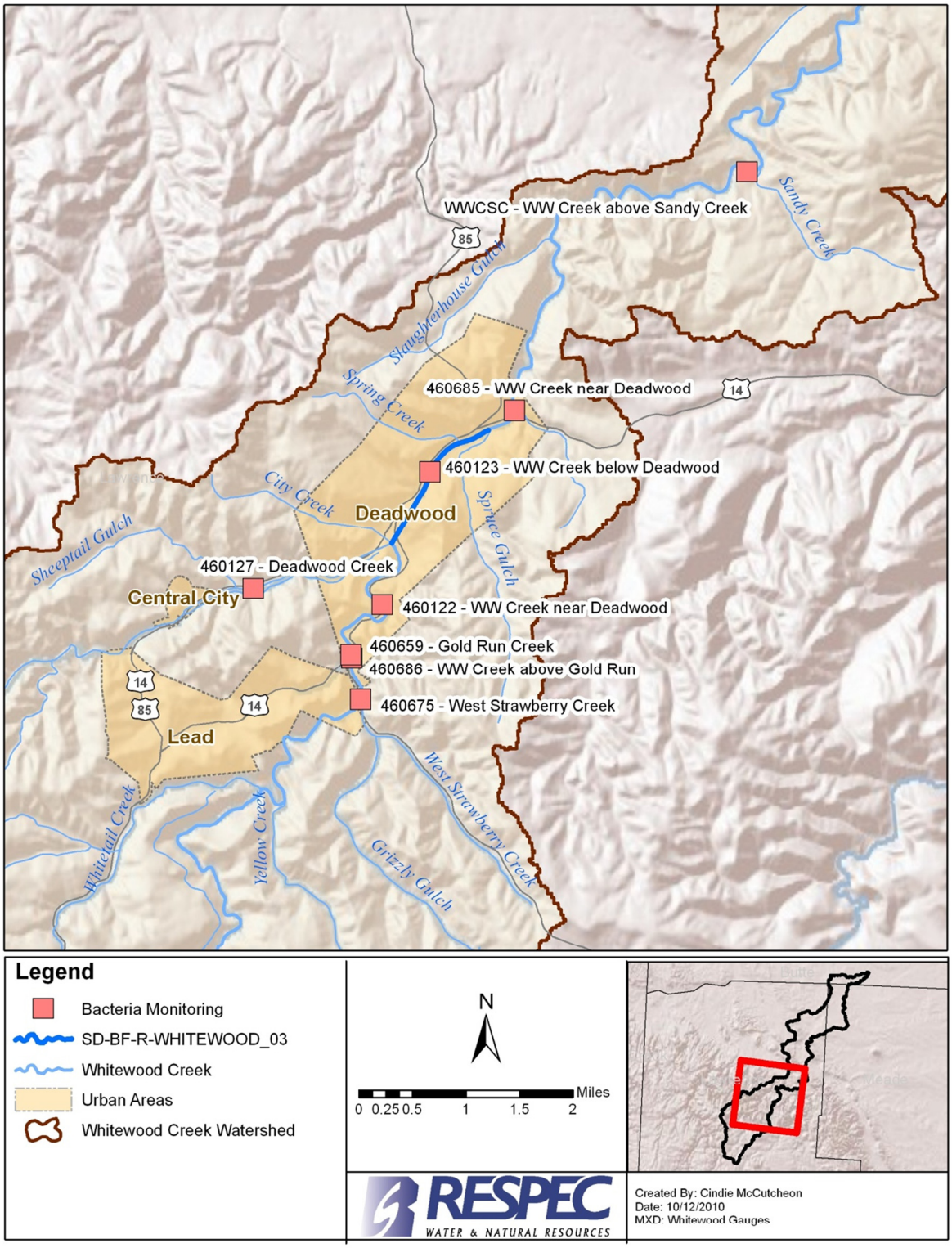

Figure 1-5. Whitewood Creek Monitoring Sites Upstream, Downstream, and Within Impaired Reach.

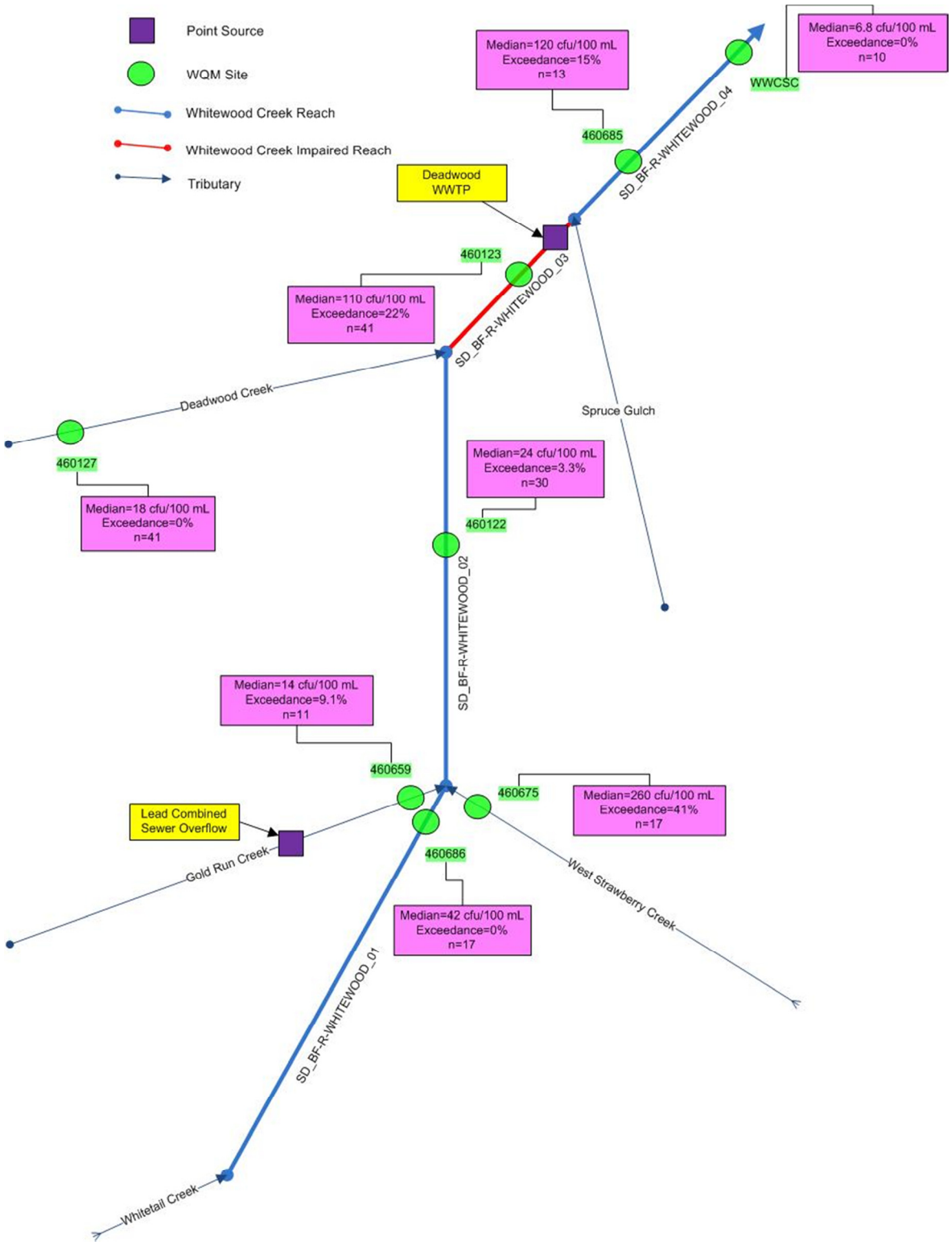

Figure 1-6. Whitewood Creek Watershed Schematic Showing Reaches Upstream and Downstream of Impaired Reach.

Although West Strawberry Creek is impaired for bacteria, there is zero exceedance at Whitewood Creek above Gold Run (460686) downstream of the confluence of West Strawberry Creek with Whitewood Creek. Even though some loading from West Strawberry Creek occurs, the overall contribution of West Strawberry Creek appears to be diluted by the time it gets to Whitewood Creek above Gold Run (460686). Besides West Strawberry Creek, none of the monitoring sites upstream of the impairment have consistently high bacteria concentrations, and the upstream contribution is relatively negligible compared to the Whitewood Creek site below Deadwood (460123). Deadwood sources could consist of sanitary sewer cross connections with the storm sewer, cracked or broken sanitary sewer lines draining into the storm sewer or directly to the stream, stormwater discharge from Deadwood or a combination of the above. An investigation should be completed upstream, within, and downstream of the impaired reach, throughout Deadwood and Lead, to pinpoint the bacterial sources. With implementation of Best Management Practices (BMPs) in Deadwood, such as reduction of on-site wastewater treatment system failures and leaking sewer lines and stormwater treatment programs, loads from the city of Deadwood downstream of the impaired reach in Whitewood Creek near Deadwood site 460685 would likely be reduced as well.

2.0 WATER-QUALITY STANDARDS AND TOTAL MAXIMUM DAILY LOAD TARGETS

South Dakota waterbodies are all assigned beneficial uses based on the regulations of the EPA Clean Water Act. All streams are designated with the use of fish and wildlife propagation, recreation, stock watering, and irrigation. Additional uses are assigned by the state based on a beneficial use analysis of each waterbody. Water-quality standards are defined in South Dakota state statutes in support of these uses. These standards consist of suites of criteria that provide physical and chemical benchmarks from which management decisions can be developed (Administrative Rules of South Dakota (ARSD) 74:51:01–74:51:03). Additional narrative standards that may apply can be found in the ARSD § 74:51:01:05, 06, 08, 09, and 12. These articles contain language that generally prohibit the presence of materials causing pollutants to form, visible pollutants, nuisance aquatic life, and pollutants impacting biological integrity.

Whitewood Creek Segment SD-BF-F-WHITEWOOD_03 was assigned the following beneficial uses: cold-water permanent fish life propagation, immersion recreation, limited contact recreation, fish and wildlife propagation, recreation and stock watering, and irrigation. Table 2-1 lists water-quality criteria that must be met to support the beneficial uses currently assigned to the Whitewood Creek.

South Dakota recently adopted *E. coli* criteria for the protection of the limited contact and immersion recreation uses. Current *E. coli* criteria for the immersion recreation and limited contact recreation use require that (1) no sample exceeds 235 cfu/100 mL and 1,178 cfu/100 mL, respectively, and (2) the geometric mean of a minimum of five samples collected during separate 24-hour periods for any 30-day period must not exceed 126 cfu/100 mL and 630 cfu/100 mL, respectively. Since only one or two water samples were collected during any 30-day period, compliance with the geometric mean criterion was evaluated using the **Hydrological Simulation Program – FORTRAN** (**HSPF**) model-predicted daily concentrations from a recalibrated version of a model created by Carter [2002]. The geometric mean, as defined in ARSD § 74:51:01:01, is the *n*th root of a product of *n* factors. The *E. coli* criteria are applicable from May 1 through September 30 (recreational season). A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still support its designated beneficial uses; it is the sum of allowable loads of a single pollutant from all contributing point and nonpoint sources. The numeric TMDL target established for Whitewood Creek's immersion recreation use impairment was determined for each of five flow conditions or zones and based on either the daily maximum (235 cfu/100 mL) or 30-day average (126 cfu/100 mL) *E. coli* bacteria criterion, depending on which criterion required the greatest load reduction.

Table 2-1. State Surface Water-Quality Standards for Whitewood Creek From Deadwood Creek to Spruce Gulch (SD-BF-R-WHITEWOOD_03) [South Dakota Department of Environment and Natural Resources, 2008] (Page 1 of 2)

Parameter	Criteria	Unit of Measure	Special Conditions
Total alkalinity as calcium carbonate[a]	≤ 750	mg/L	30-day average
	≤ 1,313	mg/L	Daily maximum
Total dissolved solids[a]	≤ 2,500	mg/L	30-day average
	≤ 4,375	mg/L	Daily maximum
Total petroleum hydrocarbon[a]	≤ 10	mg/L	Daily maximum
Oil and grease[a]	≤ 10	mg/L	Daily maximum
Nitrogen, nitrates as N[a]	≤ 50	mg/L	30-day average
	≤ 88	mg/L	Daily maximum
Chloride[b]	≤ 100	mg/L	30-day average
	≤ 175	mg/L	Daily maximum
Chlorine, total residual[b]	≤ 0.011	mg/L	Chronic
	≤ 0.019	mg/L	Acute
Dissolved oxygen[c], [d]	≥ 5.0	mg/L	Daily minimum
Total suspended solids[b]	≤ 30	mg/L	30-day average
	≤ 53	mg/L	Daily maximum
Temperature[b]	≤ 65	°Φ	Daily maximum
pH[b]	6.6 and ≤ 8.6	Standard units	
Undisassociated hydrogen sulfide[b]	≤ 0.002	mg/L	Daily maximum
Total ammonia nitrogen as N[b]	Equation-based limit	mg/L	30-day average (March 1–October 31)
	Equation-based limit	mg/L	30-day average (November 1–February 29)
	Equation-based limit	mg/L	Daily maximum
Fecal coliform[d], [e]	< 200	cfu/100 mL	Geometric mean (May 1–September 30)
	< 400	cfu/100 mL	Daily maximum (May 1–September 30)
E. coli[d], [e]	< 126	cfu/100 mL	Geometric mean (May 1–September 30)
	< 235	cfu/100 mL	Daily maximum (May 1–September 30)

Table 2-1. State Surface Water-Quality Standards for Whitewood Creek From Deadwood Creek to Spruce Gulch (SD-BF-R-WHITEWOOD_03) [South Dakota Department of Environment and Natural Resources, 2008] (Page 2 of 2)

Parameter	Criteria	Unit of Measure	Special Conditions
Conductivity at 25°C[f]	< 2,500	micromhos/cm	30-day average
	< 4,375	micromhos/cm	Daily maximum
Sodium adsorption ratio[f]	< 10		Daily maximum

(a) Criteria for fish and wildlife propagation, recreation, and stock watering use.
(b) Criteria for cold-water permanent fish life propagation.
(c) Criteria for limited contact recreation use.
(d) Criteria for immersion recreation use.
(e) Geometric means must be based on a minimum of five samples obtained during separate 24-hour periods for any 30-day period.
(f) Criteria for irrigation use.

3.0 SIGNIFICANT SOURCES

3.1 POINT SOURCES

The permitted Lead/Deadwood wastewater treatment plant (WWTP) located in Deadwood discharges its effluent into Whitewood Creek. The monthly average discharge from 1997 to 2009 from the facility ranged from 0.8 million gallons per day (mgd) to 3.6 mgd. The mean monthly average discharge over this range was 1.4 mgd, and the median monthly average discharge was also 1.4 mgd. The Lead/Deadwood WWTP has been in operation since 1979. According to the WWTP, the geometric mean of the fecal coliform bacteria in the effluent for any 30-day period should not exceed 200 cfu/100 mL and the daily maximum should not exceed 400 cfu/100 mL. These fecal coliform criteria are the same as the criteria for Whitewood Creek. Thus as long as the WWTP meets the criteria of its discharge permit, it should not cause exceedances of the fecal coliform concentration criteria of Whitewood Creek [Carter, 2002]. However, using the translator function discussed in Section 1.3 to calculate *E. coli* loads from the WWTP effluent limits yields a 30-day average maximum *E. coli* concentration of 228 cfu/ 100 mL and a daily maximum *E. coli* concentration of 382 cfu/100 mL, surpassing the recently adopted *E. coli* standards. The current permit for the Lead/Deadwood WWTP is up for renewal, and an *E. coli* limit will be added to the renewed permit. The WWTP will have at least 1 year to meet the new limit, during which time, the fecal coliform limit will continue to be regulated [Buscher, 2010].

One combined sewer outfall (CSO) remains in the city of Lead. It was constructed in the late 1890s. When the sewer lines for the Lead/Deadwood Sanitation District were constructed, they collected sewage from all but two of the sewer outfalls that discharged to Whitewood Creek. The discharge that overflowed to Whitewood Creek near the Lead/Deadwood WWTP was eliminated from the sewer system in 2001; therefore, only one CSO remains in the city of Lead. Under normal conditions, a 10-inch weir located in the sewer keeps wastewater from flowing out of the combined sewer overflow in Lead. However, during some storm and snowmelt events, the flow in the combined sewer exceeds the capacity of the sewer line and overflows the weir. The wastes that flow over the weir travel down a concrete channel and flow into Gold Run Creek and eventually into Whitewood Creek. A collection container is anchored to the downstream side of the weir. If there is an overflow, some of the water is collected in the container; the container is checked daily to determine if there has been an overflow. The water in the container from the overflow is tested and the state is notified of the discharge. From 1991 to 1998, the geometric mean of the overflow concentrations of fecal coliform bacteria was 51,746 cfu/100 mL. The maximum concentration during this period was 2.1×10^6 cfu/100 mL. Overflows were reported in 44 of the 96 months from 1991 to 1998. The overflow that discharged to Whitewood Creek near the Lead/Deadwood WWTP only had discharges reported in 8 months from 1991 to 1998. The geometric mean of the concentrations of fecal coliform bacteria was 265,556 cfu/100 mL and the maximum was 721,000 cfu/100 mL [Carter, 2002].

When an overflow occurs, the city of Lead is required to contact SD DENR and to collect a sample of the overflow. Additionally, at the end of each month, the city of Lead submits a report to SD DENR including the geometric mean and maximum concentrations of fecal coliforms from the overflow samples. This information was obtained from SD DENR and used to estimate loadings from the combined sewer overflows. Because of the age of the data, the exact dates of the overflows were not available for this assessment. To determine when overflows likely occurred, the daily precipitation data for Lead was compared to the record of reported combined sewer overflows. It was assumed that each of the overflows was the result of a precipitation event. By comparing these two records, it was estimated that any storm event yielding over 0.33 inch of precipitation could cause the combined sewer to overflow. An "average" overflow resulting from approximately 1 inch of rain per hour likely results in an overflow of 250,000 gallons. Most overflows last for 2 hours or less [Carter, 2002].

3.2 NONPOINT SOURCES

Based on review of available information and communication with state and local authorities, the primary nonpoint sources of bacteria within the Whitewood Creek Watershed include livestock, wildlife, aging on-site wastewater treatment and sewer systems, and the CSO in Lead. Using the best-available information, loadings were estimated from each of these sources using the EPA's **Bacterial Indicator Tool (BIT)** based on the density and distribution of animals (livestock and wildlife) and failing on-site wastewater treatment systems in the watershed [U.S. Environmental Protection Agency, 2001a].

3.2.1 Agriculture

Manure from livestock is a potential source of bacteria to the stream. Livestock population densities in the watershed, shown in Table 3-1, were estimated using 1997 Census of Agriculture data [U.S. Department of Agriculture, 1997]. Livestock contribute bacteria loads to the Whitewood Creek by defecating directly into the stream while wading and defecating on rangelands that are washed off during precipitation events. Both the indirect and direct defecation bacteria loads from livestock were represented in the modeling applications.

3.2.2 Human

The bacterial source tracking tests identified the presence of human bacteria in Whitewood Creek. The watershed contains one centralized wastewater collection and treatment facility for Deadwood and Lead, South Dakota, as well as the CSO for Lead that is currently being eliminated. Besides the Deadwood/Lead WWTP, the watershed is mainly rural. Thus on-site wastewater treatment systems and leaks in sewer lines are also assumed to be human sources of bacteria loads to Whitewood Creek. Densities of on-site wastewater treatment systems in the watershed were derived from the 2000 U.S. Census statistics [Carter, 2002]. Discharge from

the Deadwood/Lead WWTP and the Lead CSO is considered a point source while any on-site wastewater treatment systems and leaks in sewer lines are considered nonpoint sources.

Table 3-1. Approximate Livestock Population Densities for Lawrence County

Species	Population Density (per mi^2)
Beef Cattle	6.68
Dairy Cattle	0.10
Hogs/Pigs	n/a
Sheep	1.53
Bison	n/a
Horses	0.84
Chickens	1.10

The retired director of the Environmental Health Office of Lawrence County, Mr. Roger Marshall, believes that less than 15 percent of the on-site wastewater treatment systems in the Lead and Deadwood areas are failing [Marshall, 2002]. SD DENR estimates that there are approximately 351 on-site wastewater treatment systems in use in the study area [Sawyer, 2002].

Because of leaks in sewer lines, raw sewage may bypass the wastewater treatment plant and flow directly into surface water or groundwater. Raw sewage could have high levels of pathogenic bacteria, protozoans, and viruses [U.S. Environmental Protection Agency, 2001b] in addition to elevated levels of fecal coliforms [Carter, 2002]. There are approximately 55 to 60 miles of sewer lines in Lead. Much of the existing sewer lines were constructed from clay tiles in the 1890s. Some of the clay tile sewer lines are in poor condition. Approximately 90 percent of the sewer lines in Deadwood have been replaced. The remaining 10 percent of the sewer lines that had not yet been replaced were constructed of clay tiles; however, the city of Deadwood plans to replace these remaining lines [Renner, 2002].

3.2.3 Natural Background/Wildlife

Wildlife within the watershed is a natural background source of bacteria. For watershed modeling purposes, wildlife population density estimates in Table 3-2 were obtained from the South Dakota Department of Game, Fish and Parks [1982]. Turkeys and whitetail deer were shown to be the most dense wildlife species in the Whitewood Creek Watershed. Avian species are a large source of bacterial counts at each watershed, throughout almost all types of flows. Through discussions at public meetings with ranchers in the area, it was determined that wild turkeys in the area were a probable source of bacteria. It was suggested that the number of

wild turkeys in the watershed is large and the turkeys use the riparian areas adjacent to the stream.

Table 3-2. Approximate Wildlife Population Densities for Lawrence County in 2001

Species	Population Density (per mi^2)
Whitetail Deer	12.55
Turkeys	11.29
Mule Deer	3.76
Raccoons	1.25
Beaver	0.76
Elk	n/a
Ducks	n/a
Canadian Geese	n/a
Grouse	n/a

3.3 BACTERIAL SOURCE TRACKING

Bacteria samples (*n* = 257) were collected and analyzed in 2003 on a weekly basis from May 29 through September 10 for bacterial source tracking to determine sources of fecal coliform bacteria within the watershed. A ribotyping test was used to link bacteria from samples to known sources. Ribotyping uses a DNA fingerprint of *E. coli* which shows differences among members of the same species of *E. coli* that have adapted to live in different host species. Because of differences in the intestinal environments of different species, these genes can be used to distinguish animal sources.

The source tracking assessment was completed at three separate locations: Whitewood Creek above Gold Run (WWC a GR), Gold Run Creek at the junction with Whitewood Creek (GRC), and Whitewood Creek below Deadwood (WWC b DWD). These locations are illustrated in Figure 3-1. Total fecal coliform values were highest at WWC b DWD. Categories used for the assessment include wild animals (avian, bear, deer/elk, rabbit, raccoon, rodent), domestic animals (canine and feline), livestock (bovine and horse), and human.

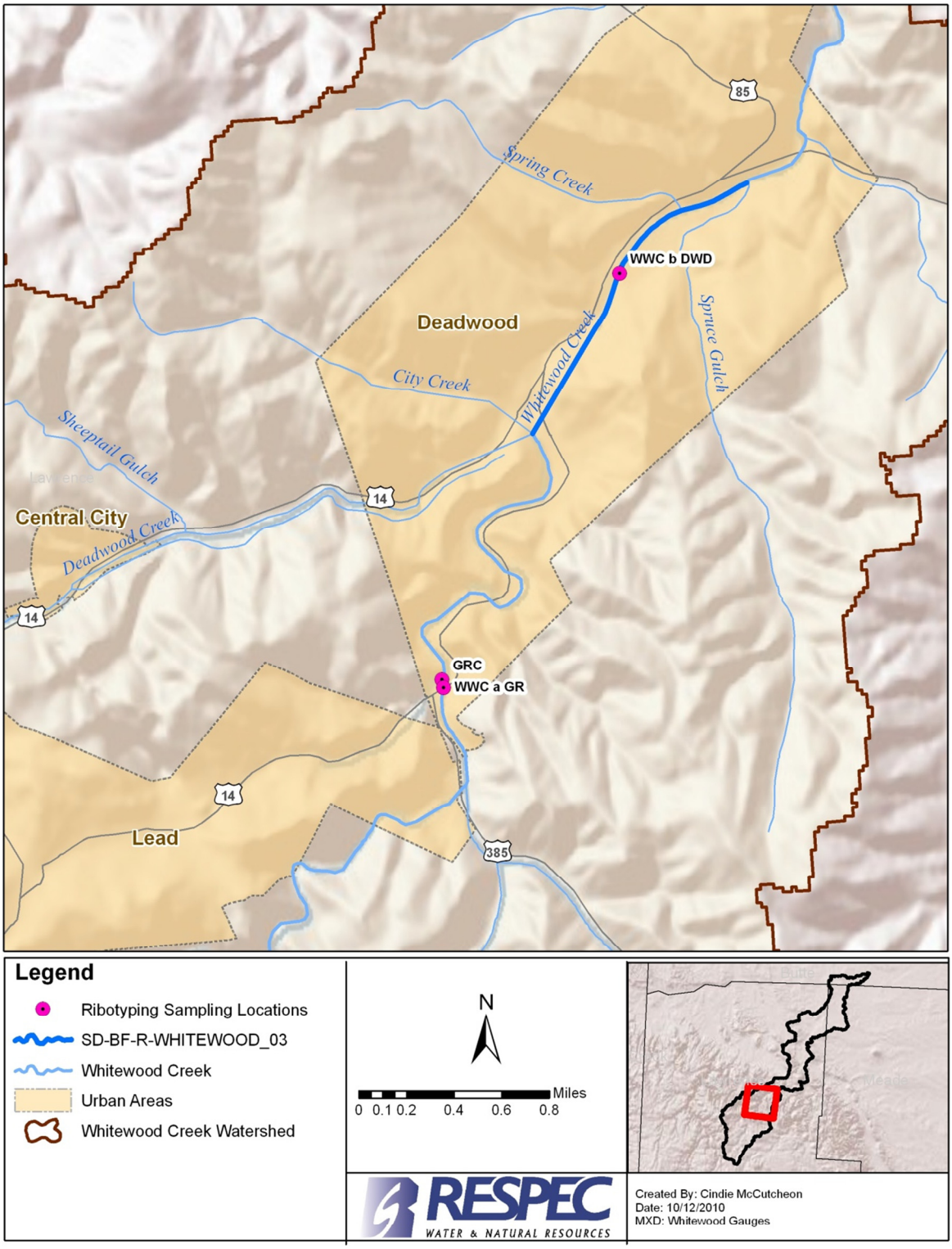

Figure 3-1. Ribotyping Locations.

Each of the three locations (Whitewood Creek above Gold Run, Whitewood Creek below Deadwood, and Gold Run Creek) were analyzed collectively and separately. Figure 3-2 shows the ribotyping results by category for all locations combined, and Table 3-3 shows the percent of contributions by source during all flows and high flows.

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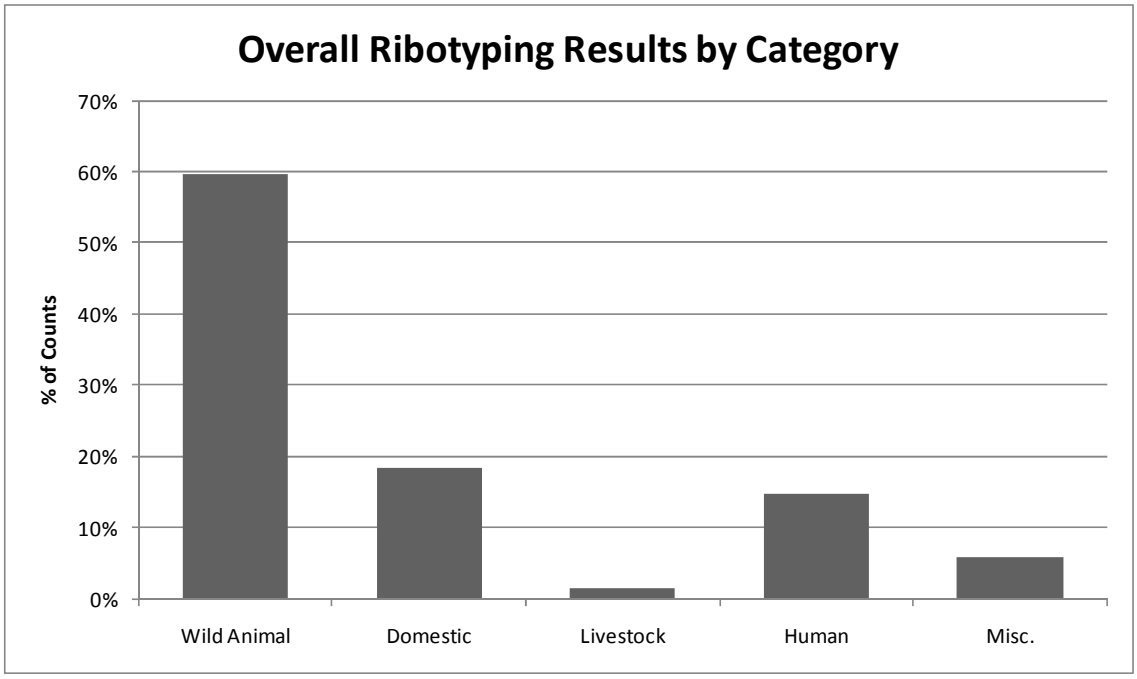

Figure 3-2. Ribotyping Results by Category for All Sampling Locations Combined.

Source tracking results from all flows and from high flows (Table 3-3) were fairly similar. Wild animals made up the majority of the bacterial counts, with numbers decreasing from upstream to downstream. Domestic animals and humans made up the second highest bacterial counts, with numbers increasing from upstream to downstream. Agricultural livestock made up the smallest percentages at all locations [Kenner, 2009]. These results seem logical, as population also increases from WWC a GR (the most upstream bacterial source tracking location), to GRC (influenced by Lead), to WWC b DWD (influenced by Deadwood).

Source tracking results during high flows at the WWC b DWD location, which is located within the impaired reach, had wild animals (avians, rodents, and a small amount of deer/elk) accounting for approximately half of the fecal coliform counts and domestic (canine) and human each accounting for a quarter of the counts [Kenner, 2009]. The percent of human counts from the site downstream of Lead and the site just above Lead were 10 and 20 percent lower, respectively, than counts from the site below Deadwood. The increase in human counts from the reach upstream of Lead to the reach downstream of Lead to the reach within and downstream of Deadwood may indicate that human sources in the impaired reach during high

flows are not only from the Lead CSO and sewer lines, but could also be from sanitary sewer cross connections with Deadwood storm sewers and/or stormwater discharge from Deadwood and/or washoff from overland flow.

Table 3-3. Total Fecal Coliform Contributions to Whitewood Creek From Each of Three Sampling Locations During All Flows and High Flows [Kenner, 2009]

Location	Source	Total Contribution (%) All Flows	Total Contribution (%) High Flows
Whitewood Creek above Gold Run	Agricultural livestock	2	0
	Domestic animals	15	19
	Wild animals	67	71
	Human	6	5
	Unknown	10	5
Gold Run Creek at the Junction with Whitewood Creek	Agricultural livestock	0	0
	Domestic animals	18	20
	Wild animals	63	65
	Human	13	15
	Unknown	5	0
Whitewood Creek below Deadwood	Agricultural livestock	3	0
	Domestic animals	20	24
	Wild animals	51	51
	Human	21	25
	Unknown	5	0

3.4 HYDROLOGIC MODEL

The HSPF model application, developed by Carter for the years of 1991 through 1998, was used to simulate the sources of loads in the watershed. Direct sources modeled include the Lead/Deadwood WWTP, the CSO, leaking sewers and septic systems, and wildlife/livestock direct defication. The permit for the CSOs does not have a set bacteria limit, and requires ultimate elimination of the CSO. Indirect sources modeled throughout the watershed that were represented include washoff from urban/built-up land, rangeland, forestland, and agricultural land.

The **HSPF** model application was also used to simulate the implementation of BMPs and evaluate their effectiveness in reducing bacteria loads in the Whitewood Watershed. The nonpoint sources in the study area were represented in **HSPF** with per-acre fecal coliform accumulation rates and maximum fecal coliform storage rates for each source estimated by the **BIT**. The buildup and washoff of fecal coliform was simulated based on these rates, precipitation, and predicted runoff. The **BIT** was also used to calculate fecal coliform bacteria loadings that represent livestock in streams and human sources, which were then used as inputs to the **HSPF** model.

It was determined that the wasteload allocation for the Lead/Deadwood WWTP be based on its discharge permit; the fecal coliform concentration, geometric mean is to be less than 200 cfu/100 mL and the daily maximum is not to exceed 400 cfu/100 mL. Carter's **HSPF** model application used a wasteload allocation for the Lead/Deadwood WWTP of approximately 1×10^{10} cfu/day [Carter, 2002].

One of the two combined sewer outfalls was removed in 2001. However, because the modeling period was from 1991 to 1998 (before removal occurred), point sources were modeled to represent both outfalls. A best management practice representing the removal of one outfall in 2001 was simulated to account for the removal of the outfall. Most overflows last 2 hours or less [Carter, 2002]. To create time series for both of the combined sewer outfalls, it was assumed that overflows only occurred in the months that they were reported. The precipitation records were reviewed and whenever the precipitation exceeded 0.33 inch in those months when overflows were reported, a discharge and fecal coliform load were added to the appropriate time series. When it was assumed that a discharge occurred, a daily flow of 0.39 cfs was added to the flow time series. This discharge rate represents an overflow of 250,000 gallons for that day. The fecal coliform loading for that day was assumed to be equal to the product of the discharge and the reported geometric mean of the fecal coliform samples collected and reported for that month. Based on these estimates, the CSO that discharges to Gold Run Creek overflowed 148 times from 1991 to 1998. The outfall that discharged to Whitewood Creek overflowed 39 times.

The fecal coliform model inputs were adjusted from Carter's initial estimates to match observed fecal coliform concentrations at five monitoring locations upstream of the TMDL endpoint. The inputs were classified as either indirect or direct sources and adjusted simultaneously within their respective classes. This method allowed for the original estimates to maintain their weight in their respective classes while also allowing flexibility to accurately represent indirect and direct sources. The model performance was evaluated visually using concentration duration curves which show the statistical distribution of the observed data compared to all simulated and paired simulated data, as shown in Figure 3-3 through Figure 3-7. The duration curves also show the water-quality standard which compares the observed and simulated exceedance percentages. Overall, the figures show the model performed very well and adequately represents direct and indirect sources accurately.

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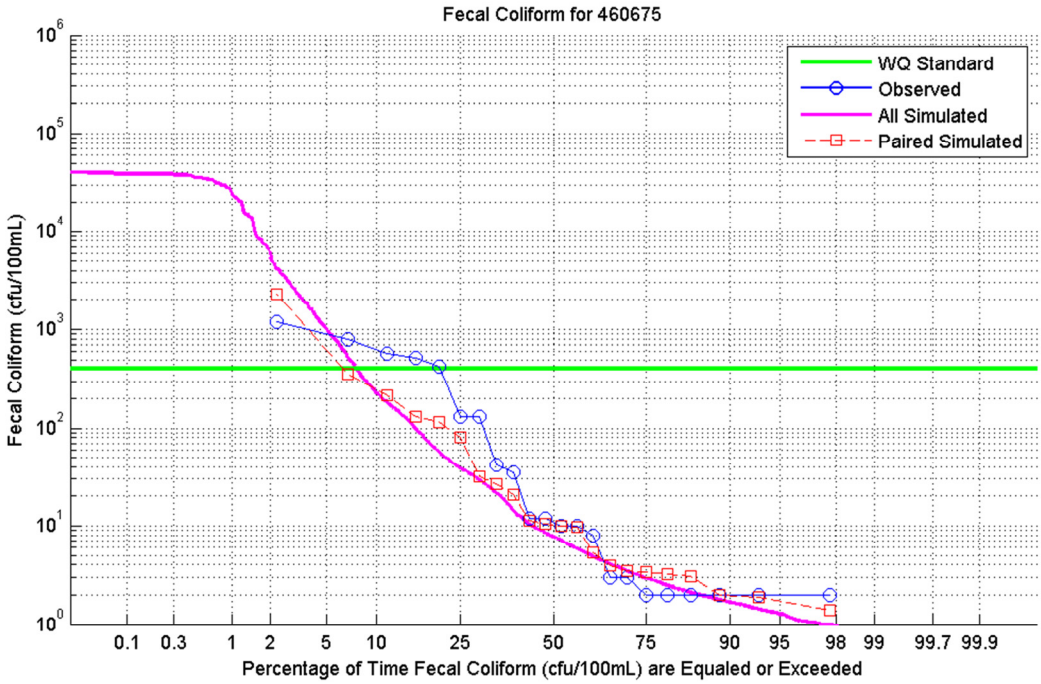

Figure 3-3. Concentration Duration Curve for West Strawberry Creek (460675).

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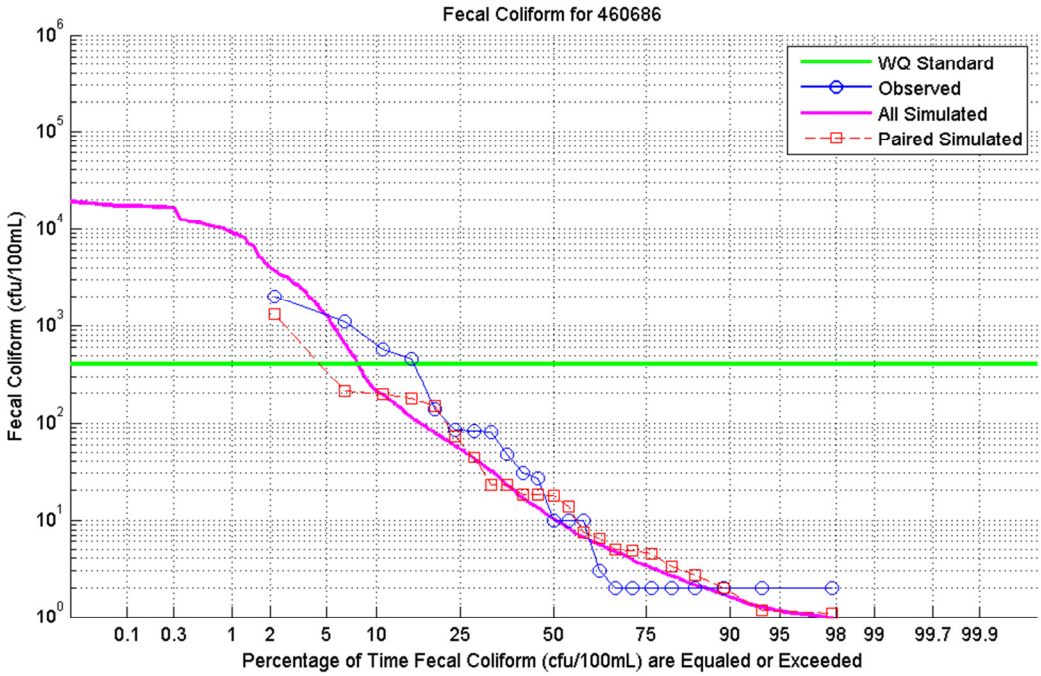

Figure 3-4. Concentration Duration Curve for Whitewood Creek Above Gold Run (460686).

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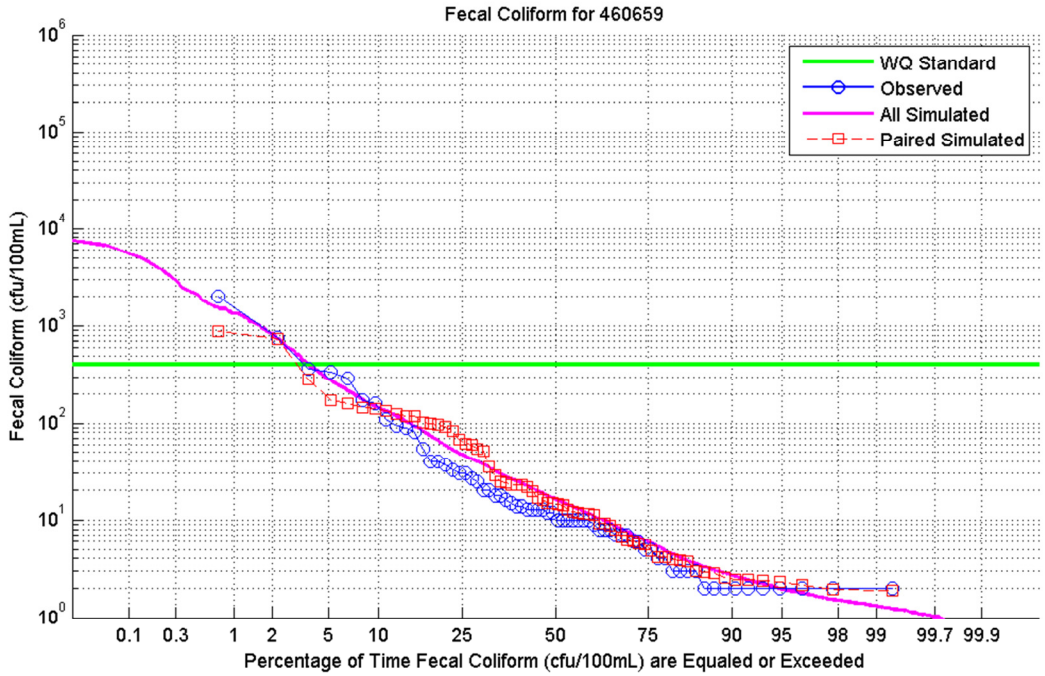

Figure 3-5. Concentration Duration Curve for Gold Run Creek (460659).

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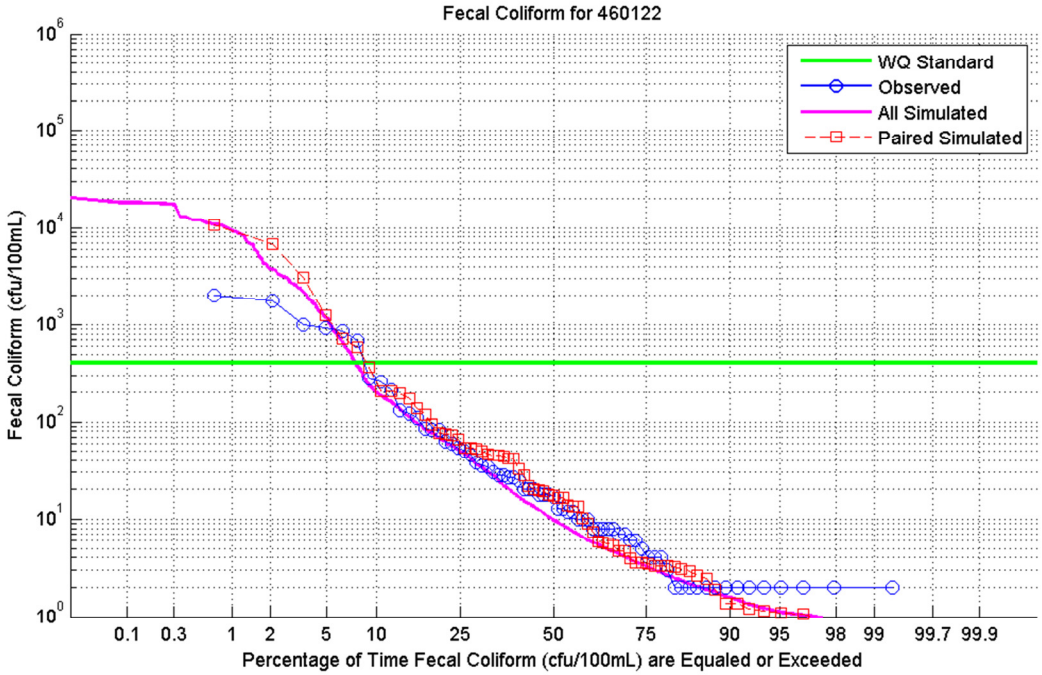

Figure 3-6. Concentration Duration Curve for Whitewood Creek Near Deadwood (460122).

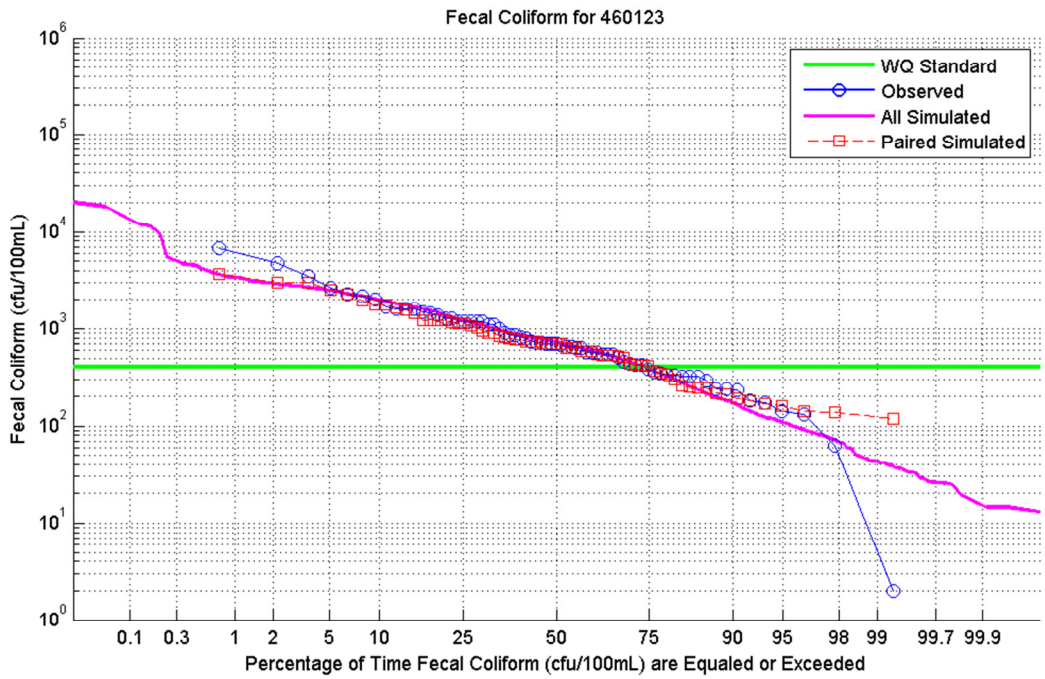

Figure 3-7. Concentration Duration Curve for Whitewood Creek Below Deadwood (460123).

Figure 3-8 shows boxplots of sites in the vicinity of the impaired reach from upstream to downstream which were constructed for water-quality monitoring sites using only data from the Carter's modeling period (1991 through 1998). The main difference between these boxplots and the 2003 through 2009 boxplots presented in Section 1.3 is a large increase at the West Strawberry Creek site. The West Strawberry Creek loads are likely negligible within the impaired reach because of decay and dilution. A pie chart of the load influences above Deadwood and at the TMDL reach endpoint, presented in Figure 3-9, shows that only 1 percent of the load in the impaired reach comes from upstream of the impaired reach. Three percent of the loads at the TMDL reach endpoint are from Deadwood Creek, and the remainder of the load at the TMDL endpoint is from the Deadwood Area. Flow contributions from upstream of the impaired reach are approximately 50 percent of the total flow, and flow contributions from the Deadwood area are approximately 30 percent of the total flow. Because the impaired reach receives over one third of the flow contribution from the Deadwood area, having observed concentrations of more than seven times any upstream observed concentrations, there is reasonable assurance that the Whitewood Creek model predictions, which show that 96 percent of the loads being from the Deadwood area, adequately represents BMP reductions.

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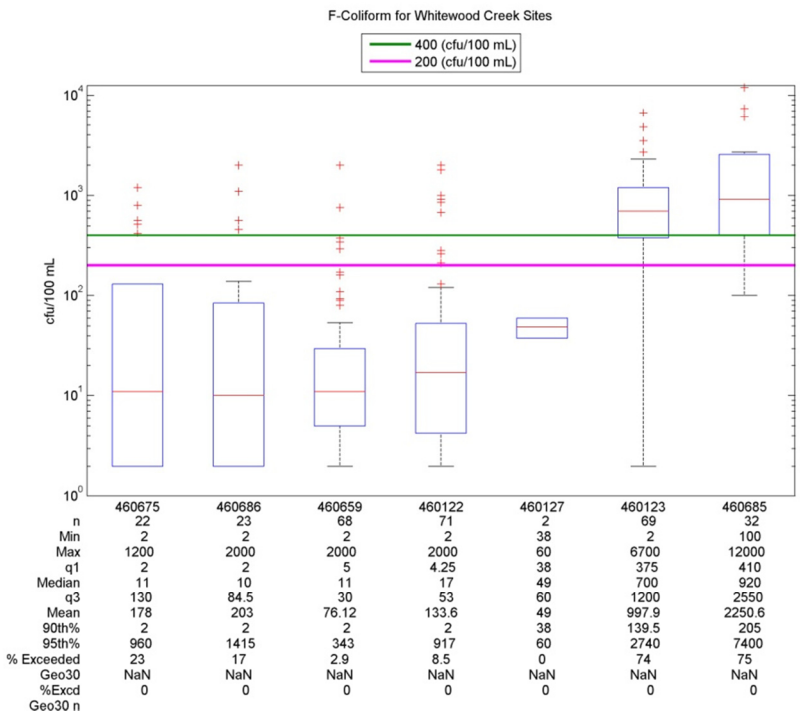

Figure 3-8. Boxplots of 1991 Through 1998 (Modeling Period) Fecal Coliform Data for Sites Upstream, Within, and Downstream of the Impaired Reach.

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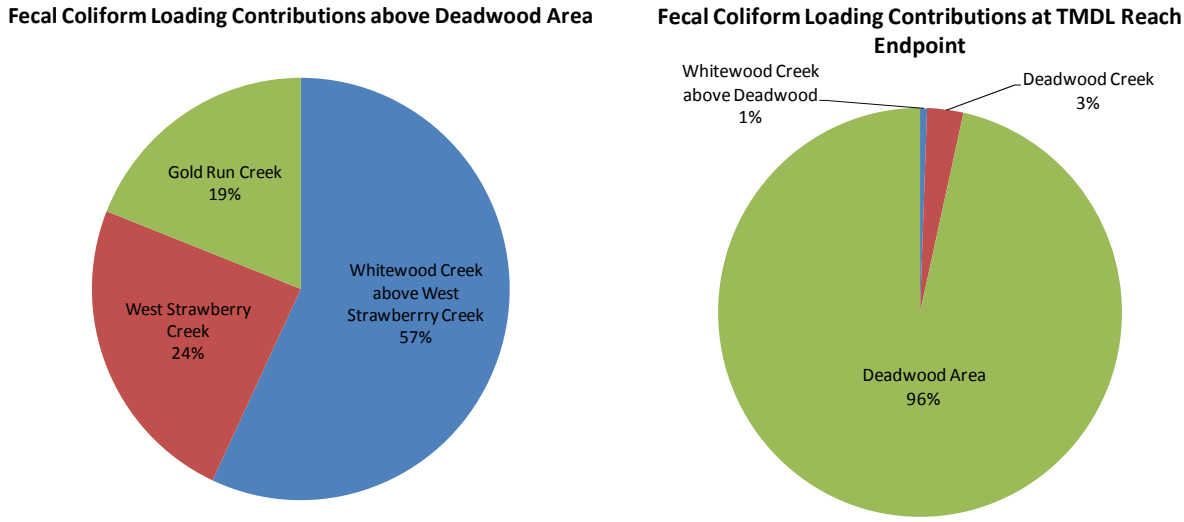

Figure 3-9. Pie Charts of Fecal Coliform Load Contributions Upstream of the Deadwood Area (Left) and at the Endpoint of the Impaired TMDL Reach (Right).

The city of Lead has already explored several options for treating the overflows from the combined sewer. To alleviate the problems associated with the combined sewer overflow, the city has decided to separate the sanitary and storm sewers. Approximately 40 percent of the sewer lines have already been separated [Thomas, 2010]. As the combined sewer is separated, the existing clay tile sewer lines will also be replaced [Carr, 2002]. During the separation process, urban stormwater-quality control measures should be implemented. Urban stormwater management systems such as storm sewers, ponds, and detention basins, are commonly used for pollutant reduction was well as flood control. To simulate this remediation effort, the point sources representing the combined sewer overflow in Lead were turned off in the model application, which resulted in a 17 percent load reduction.

To simulate the removal of failing on-site wastewater treatment systems and leaking sewer lines, it was assumed that approximately half of the failing on-site wastewater treatment systems and leaking sewer lines could be located and repaired or replaced. The removal of 50 percent of failing on-site wastewater treatment systems and leaking sewer lines resulted in a 38 percent load reduction.

It was assumed that a stormwater treatment program would be effective within the cities, so the effectiveness of these programs was only simulated for the urban land downstream of Gold Run Creek and Lead. To evaluate the effectiveness of these practices, the fecal coliform accumulation rates for the Commercial and Services, Mixed Urban or Built-up, and Residential land uses were reduced by 50 percent. The implementation of stormwater treatment in the model reduced loads by 6 percent.

The simulation of buffer/filter strips, avian control, direct defecation reduction, and overland load reduction from forest, pasture, and cropland was estimated to have a 50 percent efficiency on reducing bacteria loads from overland washoff and in-stream defecation. To simulate this BMP, the overland bacteria load and the load from in-stream defecation was reduced by 50 percent. The implementation of buffer/filter strips, avian control, direct defecation reduction, and overland load reduction from forest, pasture, and cropland in the model reduced the load by 2 percent.

4.0 LOAD DURATION CURVE ANALYSIS

This TMDL was developed using the Load Duration Curve (LDC) approach, resulting in a flow-variable target that considers the entire flow regime within the recreational season (May 1–September 30). The LDC is a dynamic expression of the allowable load for any given flow within the recreation season. To aid in interpretation and implementation of the TMDL, the LDC flow intervals were grouped into five flow zones: high flows (0–10 percent), moist conditions (10–40 percent), midrange flows (40–60 percent), dry conditions (60–90 percent), and low flows (90–100 percent) according to the U.S. Environmental Protection Agency [2007].

Instantaneous loads were calculated by multiplying the fecal coliform sample concentrations from SD DENR WQM 123 by the measured flow at the time the water sample was collected and by a unit conversion factor (0.0245) which converts the product of concentration and flow to a daily cfu load (product of flow (cubic feet per second (cfs)), concentration (cfu/100 mL), 86,400 seconds per day (sec/day), 28.32 liters per cubic feet (L/ft^3), and 1,000 milliliters per liter (mL/L). Recent flow data were not available for the closest USGS station (USGS 06436170); thus, a regression analysis was completed comparing flow at a downstream location (USGS 06436180). The analysis correlation between the two locations was determined to be significant (r^2 = 0.88 and p < 0.05) with no lag time between stations; therefore, discharge values from the downstream location were used with the regression equation (upstream station = downstream station × 0.8265 + 3.1156) to calculate the flow near Deadwood. These calculated discharge values for the upstream location were used for the upstream load calculation.

Two bacteria LDCs were constructed for the impaired reach using data from 1991 through 2009. The first LDC (constructed using the acute criteria), as shown in Figure 4-1, used observed bacteria data and observed flow data from within the reach. This plot includes observed loads calculated using observed instantaneous daily bacteria data and observed instantaneous daily flow data from monitoring stations. The second LDC (constructed using geometric mean criteria), shown in Figure 4-2) for the impaired reach used simulated geometric mean bacteria data and observed geometric mean flow data.

Loads that plot above the solid curve exceed the acute water-quality criterion while loads below the curve are in compliance. Both LDCs show *E. coli* samples collected from Whitewood Creek WQM 123 exceeding the criterion during high, moist, midrange, dry, and low flow conditions. Loads exceeding the criteria in the low flow zone indicate point source load contributions or sources near the stream, such as failing on-site wastewater treatment systems or livestock in the stream channel. Loads within the high flow and moist conditions commonly indicate potential nonpoint source contributions from stormwater runoff [U.S. Environmental Protection Agency, 2007]. The LDCs shown in Figures 4-1 and Figure 4-2 represent dynamic expressions of the *E. coli* bacteria TMDLs for the impaired reach of Whitewood Creek that are based on the acute and chronic *E. coli* criterion. These LDCs result in unique loads that correspond to average daily flows.

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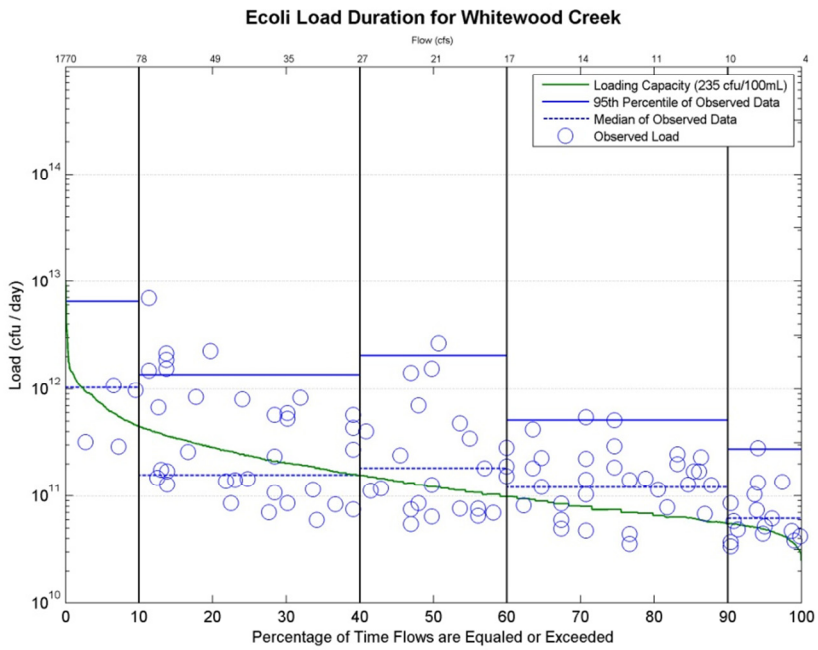

Figure 4-1. Load Duration Curve Representing Allowable Loads of Daily *E. coli* Based on Acute *E. coli* Criteria (≤ 235 cfu/100 mL) and Calculated Stream Flow From May to September.

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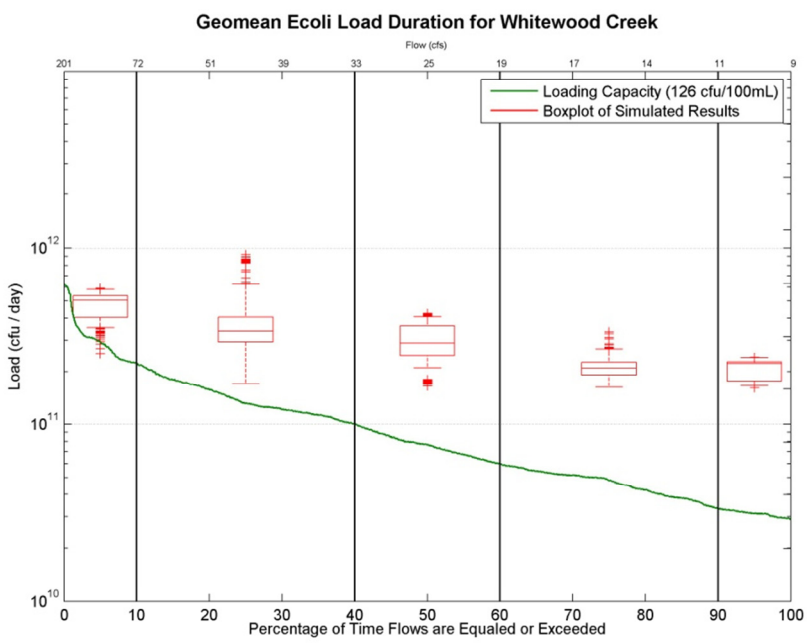

Figure 4-2. Load Duration Curve Representing Allowable Loads of Geometric Mean *E. coli* Based on Chronic *E. coli* Criteria (≤ 126 cfu/100 mL) and Calculated Stream Flow From May to September.

5.0 TOTAL MAXIMUM DAILY LOAD AND ALLOCATIONS

To ensure that all applicable *E. coli* criteria are met and aid in the implementation of the TMDL, load allocations were calculated for each of the five flow zones using both the acute and chronic criteria. The criterion requiring the greatest load reduction from baseline conditions, which varies by flow zone, was used to establish the TMDL allocations. Methods used to calculate the TMDL allocations are discussed in more detail below.

The TMDL is in effect from May 1 through September 30, as the *E. coli* criteria are applicable only during this period. In addition, only data from this time period were used to develop the TMDL allocations and load reduction goals.

5.1 LOAD ALLOCATION

To develop the *E. coli* bacteria load allocation (LA), the loading capacity was first determined. Both the acute criterion (235 cfu/100 mL) and the chronic criterion (126 cfu/ 100 mL) were used for the calculation of the loading capacity. The loading capacity for Whitewood Creek based on the acute criterion was calculated by multiplying the acute *E. coli* bacteria criterion by the calculated USGS daily average flow. The loading capacity based on the chronic criterion was calculated by multiplying the chronic criterion by the monthly average USGS flows.

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

The TMDL (and loading capacity) is the sum of waste load allocation (WLA), LA, and margin of safety (MOS). Portions of the loading capacity were allocated to nonpoint sources as an LA, a WLA, and an MOS to account for uncertainty in the calculations of these load allocations. The method used to calculate the MOS is discussed in Section 6.1. The WLA for the Lead/Deadwood WWTP was based on its discharge permit and was, therefore, determined by multiplying the WWTP average design flow by 126 cfu/100 mL for the geometric mean TMDL and by 235 cfu/100 mL for the daily maximum TMDL and converting this value to cfu/day with a conversion factor. The overall LA was determined by subtracting the WLA and MOS from the loading capacity. Because the CSO permit requires ultimate elimination and does not have a permitted discharge, its WLA was set to zero.

5.2 BASELINE CONDITIONS

Measured sample concentrations and flow data were used to compute current daily loads (cfu × 10^9/day) by calculating the product of calculated *E. coli* sample concentrations (cfu/100 mL) from SD DENR WQM 123, the calculated average daily flow (cfs), and a unit conversion factor (0.0245). Observed load estimates were calculated for WQM 123 from 1991 through 2009. The 95th percentile of the range of these estimates within each flow zone was defined as the baseline daily load.

Baseline conditions for the 30-day geometric mean period were calculated similarly to the daily averaging period. The monthly *E. coli* geometric mean loads (cfu × 10^9/month) were estimated by calculating the products of the geometric mean-simulated calculated *E. coli* concentrations (cfu/100 mL), the calculated geometric mean of average daily stream flows (cfs), and a unit conversion factor (0.0245). The 95th percentile of the range of these estimates within each flow zone was defined as the baseline geometric mean load.

Table 5-1 presents allocations and load reductions required based on the acute criterion for each flow zone, showing that load reductions are required for every flow zone except the high flow zone to meet the acute criterion. Table 5-2 lists monthly allocations based on the chronic criterion, showing that load reductions of the monthly mean loads are required for every flow zone except the high flow zone to meet the chronic criterion. The moist and midrange flow zone allocations based on the acute criterion require slightly greater reductions than the allocations based on the chronic criterion, while the dry and low flow zone allocations based on the chronic criterion require greater reductions than the allocations based on the acute criterion. Thus the allocations listed for the moist and midrange flow zones in Table 5-1 (acute criterion) and the allocations listed for high, dry, and low flow zones in Table 5-2 (chronic criterion) represent the TMDL goals to attain compliance with water-quality standards.

5.3 WASTE LOAD ALLOCATION

One point source (Deadwood WWTP) of *E. coli* bacteria discharges directly to the impaired segment of Whitewood Creek, so the WLA was assigned values 2.22 × 10^{10} cfu/day for the daily maximum TMDL value and 1.19 × 10^{10} cfu/day for the geometric mean TMDL value, which was calculated using the maximum permitted daily maximum and geometric mean concentrations from the point source during the effective criterion period. The Lead/Deadwood WWTP has reported flows of 2.5 mgd. The WLA for the Lead/Deadwood WWTP was based on its discharge permit and was therefore determined by multiplying the WWTP-reported flows by 126 cfu/ 100 mL for the geometric mean TMDL and by 235 cfu/100 mL for the daily maximum TMDL and converting this value to cfu/day with a conversion factor. A WLA for the Lead CSO was set to zero because the Lead CSO permit requires its elimination. No permitted concentrated animal feeding operations currently exist within the Whitewood Creek Watershed.

Table 5-1. Whitewood Creek *E. coli* Bacteria Total Maximum Daily Load Based on the Acute Criterion

TMDL Component	Flow Zone (expressed as cfu × 10^9/day)				
	High	**Moist**	**Midrange**	**Dry**	**Low**
	> 78 cfs	**77–27 cfs**	**26–17 cfs**	**16–10 cfs**	**9–4 cfs**
LA	1,439	305	107	52	9
WLA	22	22	22	22	22
MOS	267	80	22	19	24
TMDL	1,729	408	151	94	55
Current Load[(a)]	1,088	2,247	1,953	512	237
Load Reduction	0	1,840	1,802	418	182
Load Reduction	0%	82%	92%	82%	77%

(a) Current load is the 95th percentile of the observed fecal coliform bacteria load for each flow zone.

Table 5-2. Whitewood Creek *E. coli* Bacteria Total Maximum Daily Load Based on the Chronic Criterion

TMDL Component	Flow Zone (expressed as cfu × 10^9/day)				
	High	**Moist**	**Midrange**	**Dry**	**Low**
	>73 cfs	**71–33 cfs**	**31–19 cfs**	**18–11 cfs**	**9–9 cfs**
LA	516	163	67	31	19
WLA	12	12	12	12	12
MOS	70	31	17	15	2
TMDL	597	206	96	58	33
Current Load[(a)]	590	638	544	402	243
Load Reduction	0	432	448	344	210
Load Reduction	0%	68%	82%	86%	86%

(a) Current load is the 95th percentile of the simulated geometric mean fecal coliform bacteria load for each flow zone.

6.0 MARGIN OF SAFETY AND SEASONALITY

6.1 MARGIN OF SAFETY

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

6.2 SEASONALITY

Stream flows, as well as actual and calculated *E. coli* concentrations in Whitewood Creek, displayed seasonal variation. Available recreational season daily (actual and calculated) flow, actual *E. coli* concentrations, and calculated *E. coli* concentrations were used to calculate the maximum and minimum average monthly flows and bacteria concentrations for the impaired reach (see Table 6-1). Monthly average stream flows ranged considerably, with the lowest monthly average stream flow occurring in September (14 cfs) and the highest monthly average stream flow occurring in May (84 cfs). A large range of calculated and actual *E. coli* concentrations also occurred. The lowest monthly average recreational season actual and calculated *E. coli* concentration occurred in May (129 and 395 cfu/100 mL, respectively). The highest recreational season monthly average actual *E. coli* concentration occurred in August (442 cfu/100 mL), and the highest monthly average calculated *E. coli* concentration occurred in July (950 cfu/100 mL).

Table 6-1. Whitewood Creek Average Monthly Recreational Season Flows and *E. coli* Concentrations

Month	Average Actual Monthly *E. coli* Concentration (cfu/100mL)	Average Calculated Monthly *E. coli* Concentration (cfu/100mL)	Average Monthly Flow (cfs)
May	128.6	395.4	83.7
June	92.8	554.9	52.1
July	347.1	950.1	21.3
August	442.3	642.5	15.9
September	320.9	495.7	13.7

The highest bacteria concentrations generally occur during the midsummer months. Short-duration, high-intensity rainstorms are common during the summer months. These localized summer storms can cause significant runoff and increased bacteria concentrations for a relatively short period of time while only slightly increasing stream flows. However, by using the LDC approach to develop TMDL allocations, seasonal variability in flow and *E. coli* loads is taken into account, as stream flow and bacteria delivery to the stream is related to seasonal changes in precipitation.

In addition, this *E. coli* bacteria TMDL is seasonal, as it is effective only during the period of May 1 through September 30. Since the criteria for *E. coli* bacteria concentrations are in effect from May 1 through September 30, the TMDL is also applicable only during this time period.

Critical conditions occur during the midrange flow conditions as the greatest load reductions are required during this flow regime. Summer is also a critical time period because of seasonal differences in precipitation patterns and land uses. Typically, livestock are allowed to graze along the streams during the summer months. Also, Black Hills tourism peaks during the summer months. Combined with the peak in bacteria sources, high-intensity rainstorm events are common during the summer and produce a significant amount of *E. coli* load because of bacterial washoff from the watershed. Similarly, loads from the CSO would be at their peak during summer months.

7.0 PUBLIC PARTICIPATION

Efforts taken to gain public education, review, and comment during development of the Whitewood Creek fecal coliform bacteria TMDL involved presentations to local groups in the watershed on the findings of the assessment and a 30-day public notice period for public review and comment. The findings from these public meetings and comments were taken into consideration in development of the TMDL. The public notice was published in the *Meade County Times-Tribune*, the *Rapid City Journal*, and the *Lawrence County Journal*. The document was made available through the SD DENR's website.

It was desired to hold informational meetings, provide news releases on a quarterly basis for the public, and inform the involved parties of progress on the study. Public meetings were held at Herford, Sturgis, Belle Fourche, Newell, Vale, and Spearfish in 2002. In addition, the project information and results were presented at various conservation district meetings (Butte, Lawrence, and Elk Creek). A special stakeholders meeting was also held to discuss the number of cattle below Lead and Deadwood.

8.0 MONITORING STRATEGY

During and after the implementation of management practices, monitoring will be necessary to ensure attainment of the TMDL. Stream water-quality monitoring will be accomplished through SD DENR's WQM 123 on Whitewood Creek, which is sampled on a monthly basis during the effective criteria period.

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

SD DENR may adjust the load and/or wasteload allocations in this TMDL to account for new information or circumstances that develop during the implementation phase of the TMDL. New information generated during TMDL implementation may include monitoring data, BMP effectiveness information, and land use information. SD DENR will propose adjustments only in the event that any adjusted LA or WLA will not result in a change to the loading capacity. The adjusted TMDL, including 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. SD DENR will notify EPA of any adjustments to this TMDL within 30 days of their adoption. Adjustment of the LA and WLA will only be made following an opportunity for public participation.

9.0 RESTORATION STRATEGY

A variety of BMPs could be considered in the development of a water-quality management implementation plan for the impaired portion of the Whitewood Creek Watershed. While several types of control measures are available for reducing *E. coli* bacteria loads, the practicable control measures listed and discussed below are recommended to address the identified sources. Based on water-quality monitoring, bacterial source tracking, and **HSPF** model results, there is reasonable assurance that the recommended control measures to be implemented in South Dakota will achieve the required load reductions and attain the TMDL goal.

The combined flow-weighted percent reductions required to meet the TMDL based on acute and chronic water-quality criterion were 60 and 59 percent, respectively. Required percent reductions for the five flow zones, either acute or chronic, ranged from 0 percent for the acute high flow zone to 92 percent for the acute midrange flow zone (Table 5-1 and 5-2). In addition to the TMDL prepared, the following BMPs were simulated within the **HSPF** model framework:

- Complete replacement of the CSO system in Lead, South Dakota.
- Reduction of on-site wastewater treatment system failures and leaking sewer lines.
- Stormwater treatment programs for urban areas.
- Riparian buffers and filter strips, avian management practices, reduction of direct defecation, and reduction of overland load from forest, pasture, and cropland.

The combination of these BMPs showed a 63 percent reduction of the daily load. Therefore, there is reasonable assurance that the TMDL can be attained considering inherent modeling error and the applied MOS. Implementation progress to date includes 40 percent replacement of the CSO system in Lead, South Dakota [Thomas, 2010] and replacement of over 90 percent of sewer lines in Deadwood [Renner, 2002]. Completion of the CSO replacement project is a part of a ten year plan [Thomas, 2010].

The calibration results of the **HSPF** model application showed higher *E. coli* concentrations in low flows which indicates an influence from direct sources. Direct sources contribute to the bacteria loading similarly at all flows causing higher concentrations during low flows. The direct sources in the Whitewood Creek Watershed above the TMDL endpoint primarily include, septic system failures and leaking sewer lines. Indirect sources require high runoff to influence in-stream *E. coli* loads. High amounts of runoff also cause higher stream flows which result in lower concentrations. The indirect sources in the Whitewood Creek Watershed include landscape *E. coli* accumulation and washoff from wildlife and livestock. The model BMP simulation indicates that complete removal of the CSO, reduction of on-site wastewater treatment facilities and leaking sewer lines, and a Deadwood stormwater treatment/urban litter control program should be the primary target for future BMP implementation. It is

recommended that an in-depth BMP scenario analysis be performed before developing a future BMP implementation plan.

There is reasonable assurance that the goals of this TMDL established for Whitewood Creek can be met with proper planning between state and local regulatory agencies, organizations and stakeholders, BMP implementation, and access to adequate financial resources. Funds to implement watershed water-quality improvements can be obtained through the SD DENR. SD DENR administers three major funding programs that provide low interest loans and grants for projects that protect and improve water quality in South Dakota, including Consolidated Water Facilities Construction program, Clean Water State Revolving Fund (SRF) program, and the Section 319 Nonpoint Source program.

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APPENDIX A

U.S. ENVIRONMENTAL PROTECTION AGENCY REGION VIII TOTAL MAXIMUM DAILY LOAD REVIEW

EPA REGION VIII TMDL REVIEW

TMDL Document Info:

Document Name:	**E. coli Total Maximum Daily Load for Whitewood Creek, Lawrence County, South Dakota**
Submitted by:	**Cheryl Saunders, SD DENR**
Date Received:	**August 25, 2010**
Review Date:	**September 9, 2010**
Reviewer:	**Vern Berry, EPA**
Rough Draft / Public Notice / Final?	**Public Notice Draft**
Notes:	

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

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

Approval Notes to Administrator:

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

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

Under Section 303(d) of the Clean Water Act, waterbodies that are not attaining one or more water quality standard (WQS) are considered "impaired." When the cause of the impairment is determined to be a pollutant, a TMDL analysis is required to assess the appropriate maximum allowable pollutant loading rate. A TMDL document consists of a technical analysis conducted to: (1) assess the maximum pollutant loading rate that a waterbody is able to assimilate while maintaining water quality standards; and (2) allocate that

assimilative capacity among the known sources of that pollutant. A well written TMDL document will describe a path forward that may be used by those who implement the TMDL recommendations to attain and maintain WQS.

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

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

1. Problem Description

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

1.1 TMDL Document Submittal Letter

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

Minimum Submission Requirements.

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

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

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

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

SUMMARY: The Whitewood Creek *E. coli* TMDL was submitted to EPA for review during the public notice period via an email from Cheryl Saunders, SD DENR on August 25, 2010. The email included the draft TMDL document and a public notice announcement requesting review and comment.

COMMENTS: None

1.2 Identification of the Waterbody, Impairments, and Study Boundaries

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

Minimum Submission Requirements:

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

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

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

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

SUMMARY: The Whitewood Creek is a stream located in the Black Hills of western South Dakota. Its headwaters are located near the base of Deer Mountain and it ends at the confluence with the Belle Fourche River near Vale, SD. Whitewood Creek has a contributing drainage area of approximately 105 square miles. It flows to the Belle Fourche River from the Lower Belle Fourche sub-basin (HUC 10120202). The impaired segment of Whitewood Creek begins at Deadwood Creek and ends at Spruce Gulch (1.8 miles; SD-BF-R-WHITEWOOD_03), and is listed as a medium priority for TMDL development.

This segment is identified on the 2010 South Dakota 303(d) waterbody list as impaired due to elevated *E. coli* and fecal coliform concentrations. The fecal coliform impairment will be addressed in a separate TMDL document.

The designated uses for the listed segment of Whitewood Creek include: coldwater permanent fish life propagation waters, immersion recreation waters, limited-contact recreation waters, irrigation waters, fish and wildlife propagation, recreation, and stock watering.

COMMENTS: None.

SD DENR Comments: Watershed and inches of rain presented in Section 1.1 was rounded to the nearest square mile and inch, respectively. A land use discussion and percent land use table was changed from the entire watershed to the watershed above the TMDL endpoint. The phrase "A majority of the impaired reach is located within the City of Deadwood" was added to the last paragraph of the watershed characterization.

1.3 Water Quality Standards

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

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

Minimum Submission Requirements:

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

☒ The purpose of a TMDL analysis is to determine the assimilative capacity of the waterbody that corresponds to the existing water quality standards for that waterbody, and to allocate that assimilative capacity between the significant sources. Therefore, <u>all TMDL documents must be written to meet the existing water quality standards</u> for that waterbody (CWA §303(d)(1)(C)).

Note: In some circumstances, the load reductions determined to be necessary by the TMDL analysis may prove to be infeasible and may possibly indicate that the existing water quality standards and/or assessment methodologies may be erroneous. However, the TMDL must still be determined based on existing water quality standards. Adjustments to water quality standards and/or assessment methodologies may be evaluated separately, from the TMDL.

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

☒ If a standard includes multiple criteria for the pollutant of concern, the document should demonstrate that the TMDL value will result in attainment of all related criteria for the pollutant. For example, both acute and chronic

values (if present in the WQS) should be addressed in the document, including consideration of magnitude, frequency and duration requirements.

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

SUMMARY: The Whitewood Creek segment addressed by this TMDL is impaired based on *E. coli* concentrations that are impacting the immersion recreation beneficial uses. South Dakota has applicable numeric standards for *E. coli* that may be applied to this river segment. The numeric standards being implemented in this TMDL are: a daily maximum value of *E. coli* of 235 cfu/100mL in any one sample, and a maximum geometric mean of 126 cfu/100mL during a 30-day period. The standards for *E. coli* are applicable from May 1 to September 30. Discussion of additional applicable water quality standards for Whitewood Creek can be found on pages 8 - 10 of the TMDL document.

COMMENTS: None.

2. Water Quality Targets

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

Minimum Submission Requirements:

☒ The TMDL should identify a numeric water quality target(s) for each waterbody pollutant combination. The TMDL target is a quantitative value used to measure whether or not the applicable water quality standard is attained.

Generally, the pollutant of concern and the numeric water quality target are, respectively, the chemical causing the impairment and the numeric criteria for that chemical (e.g., chromium) contained in the water quality standard. Occasionally, the pollutant of concern is different from the parameter that is the subject of the numeric water quality target (e.g., when the pollutant of concern is phosphorus and the numeric water quality target is expressed as a numerical dissolved oxygen criterion). In such cases, the TMDL should explain the linkage between the pollutant(s) of concern, and express the quantitative relationship between the TMDL target and pollutant of concern. In all cases, TMDL targets must represent the attainment of current water quality standards.

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

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

SUMMARY: The water quality targets for this TMDL are based on the numeric water quality standards for *E. coli* established to protect the immersion recreation beneficial uses for the impaired segment of Whitewood

Creek. The *E. coli* targets are: daily maximum of ≤ 235 cfu/100mL in any one sample, and maximum geometric mean of ≤ 126 cfu/100mL during a 30-day period. The *E. coli* standards are applicable from May 1 to September 30.

COMMENTS: None.

3. Pollutant Source Analysis

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

Minimum Submission Requirements:

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

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

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

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

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

SUMMARY: The TMDL document identifies the land uses in the watershed as a mixture of predominately evergreen forest and grasses with a small amount of cropland and other uses. The specific landuse breakdown for the watershed is included in Table 1-1 excerpted from the TMDL below.

Table 1-1. Watershed Land Use in the Whitewood Creek Watershed

Land Uses	Area (acres)	% of Area
Evergreen Forest	30,131	45.1
Grassland/Herbaceous	21,304	31.9
Cultivated Crops	4,915	7.4
Shrub/Scrub	3,977	5.9
Woody Wetlands	2,118	3.2
Developed, Open Space	1,232	1.8
Developed, Low Intensity	1,162	1.7
Barren Land (Rock/Sand/Clay)	513	0.8
Pasture/Hay	432	0.6
Deciduous Forest	321	0.5
Open Water	223	0.3
Emergent Herbaceous Wetlands	208	0.3
Developed, Medium Intensity	173	0.3
Mixed Forest	137	0.2
Developed, High Intensity	9	0.0
Total	**66,855**	**100**

One point source, the permitted Lead/Deadwood wastewater treatment plant located in Deadwood, discharges effluent containing *E. coli* bacteria directly into the impaired segment of Whitewood Creek. No permitted concentrated animal feeding operations currently exist within the Whitewood Creek watershed.

One combined sewer outfall (CSO) remains in the city of Lead. A 10-inch weir located in the sewer keeps wastewater from flowing out of the CSO in Lead under normal conditions. However, during some storm and snowmelt events, the flow in the combined sewer exceeds the capacity of the sewer line and overflows the weir. The waste that passes over the weir from the overflow travels down a concrete channel and flows into Gold Run Creek and eventually into Whitewood Creek. An average overflow, resulting from approximately 1 inch of rain per hour, likely results in an overflow of 250,000 gallons.

Based on review of available information and communication with state and local authorities, the primary nonpoint sources of bacteria within the Whitewood Creek watershed include livestock, wildlife, aging onsite wastewater treatment and sewer systems, and the CSO in Lead. Using the best-available information, loadings were estimated from each of these sources using the EPA's Bacterial Indicator Tool (BIT) based on the density and distribution of animals (livestock and wildlife) and failing onsite wastewater treatment systems in the watershed.

Manure from livestock is a potential source of *E. coli* to the stream. Livestock population densities in the watershed were estimated using Census of Agriculture data. Livestock contribute bacteria loads to the Whitewood Creek by defecating directly into the stream while wading and indirectly by defecating on

rangelands that are washed off during precipitation events. Both the indirect and direct sources of bacteria loads from livestock were represented in the modeling applications.

COMMENTS: On page 12 of the TMDL document it mentions using livestock density populations in the modeling. However, the TMDL does not include a table showing the livestock population densities in the watershed. We recommend adding a table that includes livestock population densities for the Whitewood Creek watershed similar to the table provided for wildlife population densities.

SD DENR Comments: A table of livestock densities was added to Section 3.2.1

This segment is very small and appears to begin in the City of Deadwood and extend to approximately the WWTP. The TMDL does not include specific details on the sub-watershed drainage area for this segment. It may be helpful to review and discuss the water quality data in the segment directly above and below the listed segment for additional clues on what may be causing the bacteria problems in this segment. It seems odd that the segments above and below the listed segment are not impaired for pathogens, yet they also receive loads from many of the same sources (i.e., Lead's CSO, WWTP, failing septic systems, wildlife, livestock). Because the TMDL segment is almost entirely along Main Street in Deadwood we wonder if the source(s) may be more localized. We also wonder how much wildlife (i.e., turkeys or other avian species) or livestock are / are not concentrated in the Deadwood vicinity or immediate drainage area. If wildlife and livestock are not present in significant quantities in the localized drainage area then the sources could be related to sanitary sewer cross connections with the storm sewer, cracked or broken sanitary sewer lines draining into the storm sewer or directly to the stream, stormwater discharge from Deadwood or a combination of the above. We recommend adding information about potential localized sources and plans to investigate additional local sources during the restoration phase.

SD DENR Comments: An analysis of bacteria concentrations from upstream to downstream and information about potential localized sources and plans to investigate additional local sources was added to Section 1.3. Also, detail on on-site wastewater treatment systems, leaks in sewer lines, and the CSO was added to section 3.2.2. Further information on potential localized sources was also added to the ribotyping section discussing bacterial sources. A column showing ribotyping results during high flows was added to Table 3-3. An error was noticed in the mapped ribotyping location WWC b DWD and the map was updated accordingly.

We also recommend checking the location of the WWTP in relation to the listed segment. The TMDL mentions that the WWTP "…discharges directly to the impaired segment of Whitewood Creek…" However, EPA's Enviromapper shows that the WWTP may be in the segment below the listed segment.

SD DENR Comments: The WWTP was added to the map of Whitewood Creek Watershed (Figure 1-1). The location was checked, and the WWTP is located within the impaired segment.

4. TMDL Technical Analysis

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

A TMDL analysis determines the maximum pollutant loading rate that may be allowed to a waterbody without violating water quality standards. The TMDL analysis should demonstrate an understanding of the relationship between the rate of pollutant loading into the waterbody and the resultant water quality impacts. This stressor → response relationship between the pollutant and impairment and between the selected targets,

sources, TMDLs, and load allocations needs to be clearly articulated and supported by an appropriate level of technical analysis. Every effort should be made to be as detailed as possible, and to base all conclusions on the best available scientific principles.

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

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

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

Where:

TMDL = Total Pollutant Loading Capacity of the waterbody

LAs = Pollutant Load Allocations

WLAs = Pollutant Wasteload Allocations

MOS = The portion of the Load Capacity allocated to the Margin of safety.

Minimum Submission Requirements:

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

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

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

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

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

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

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

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

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

SUMMARY: The technical analysis should describe the cause and effect relationship between the identified pollutant sources, the numeric targets, and achievement of water quality standards. It should also include a description of the analytical processes used, results from water quality modeling, assumptions and other pertinent information. The technical analysis for the Whitewood Creek TMDL describes how the *E. coli* loads were derived in order to meet the applicable water quality standards for the 303(d) impaired stream segment.

The South Dakota Department of Environment and Natural Resources (SD DENR) collected bacteria samples at the Whitewood Creek ambient water-quality monitoring (WQM) station 123 near Deadwood since 1991. Historical data collected from May 1 to September 30 (applicable dates for the *E. coli* water quality standards) from WQM 123 monitoring station were used in the TMDL technical analysis. Whitewood Creek flow data were available from U.S. Geological Survey (USGS) Station 06436170 at Deadwood, South Dakota, near WQM 123 from 1981 through 1995, and flow data were available from USGS Station 06436180 above Whitewood, South Dakota, from 1982 through 2009. Because recent flow data were required for construction of a load duration curve, a linear regression analysis was completed comparing historical flow (1982 through 1995) from the two stations to calculate more recent flow values for USGS Station 06436170.

The Hydrological Simulation Program – FORTRAN (HSPF) model was established to simulate flows within the Whitewood Creek Watershed and the point and nonpoint sources in the watershed. Loadings were estimated from each of the nonpoint sources using the EPA's Bacterial Indicator Tool (BIT) based on the density and distribution of animals (livestock and wildlife) and failing onsite wastewater treatment systems in the watershed.

The TMDLs were developed using the Load Duration Curve (LDC) approach, resulting in a flow-variable target that considers the entire flow regime within the recreational season (May 1st – September 30th). The LDC is a dynamic expression of the allowable load for any given day within the recreation season. To aid in interpretation and implementation of the TMDL, the LDC flow intervals were grouped into five flow zones: high flows (0–10%), moist conditions (10–40%), mid-range flows (40–60%), dry conditions (60–90%), and low flows (90–100%) according to EPA's LDC guidance.

The LDCs shown in Figures 4-1 and 4-2 in the TMDL document represent dynamic expressions of parameter-specific TMDLs for the impaired segment of the Whitewood Creek that are based on the daily

maximum and 30-day geometric mean *E. coli* criteria, resulting in unique loads that correspond to measured and simulated average daily flows.

Two bacteria LDCs were constructed for the bacteria-impaired reach of Whitewood Creek. The curve, which represents loading capacity, within the first LDC was constructed using the product of simulated flow data, the daily maximum bacteria criteria, and a unit conversion factor. Box plots in the second LDC represent the simulated geometric mean bacteria data and simulated geometric mean flow data.

To ensure that all applicable water quality standards are met, TMDL loads were set according to the criterion (either acute or chronic) that required the greatest load reduction percentage by flow zone. The TMDL loading capacities are included in Tables 5-1 and 5-2 of the TMDL document. These loads, when met, will attain compliance with all applicable water quality standards for *E. coli* in the listed segment of Whitewood Creek.

COMMENTS: The TMDL mentions use of the BIT, but does not include a discussion of the results of the loading estimates derived from its use. Also, the Model Results section mentions how the HSPF model was used, but doesn't discuss the results of the modeling. Further, Carter's lack of analysis of Lead's CSO discharge and loading estimates is not sufficient justification for excluding this existing loading source from the technical analysis in the TMDL. The load should not be assumed to be zero until the CSO separation is complete. Carter's thesis was completed in 2002 – what progress has been made in CSO separation since 2002? When is it scheduled to be completed? Is it possible to estimate a WLA, using existing information, to include in the TMDL?

As mentioned in the comments to the Restoration Strategy below, it appears that the TMDL document includes mention that the necessary nonpoint source reductions are achievable or practicable. However, we recommend including more information to address reasonable assurance.

SD DENR Comments: Carter's original watershed model was re-calibrated and concentration curves for the impaired reach as well as for upstream reaches are included in the Hydrologic Model section. A discussion the model results which used loading estimates derived from the BIT was added to Section 3.4. Model results and further detail regarding the CSO, on-site wastewater treatment systems, litter control, buffer zones and filter strips, and leaking sewer lines were also added to Section 3.4. More detail was added to this section regarding the CSO loading assumptions and methods used to model the CSO. The CSO was only assumed zero for the purposes of BMPs. Information was added in Section 9.0 on progress made in CSO separation and plans. Because the CSO permit requires ultimate elimination and does not have a permitted discharge, its WLA was set to zero. A brief explanation was added to the ends of sections 5.1 and 5.3 describing why the WLA was set to zero (because the CSO permit requires its elimination). The recalibration of the model altered the simulated geometric mean TMDL values slightly, and any relating text was updated. Updated model results were added to Section 9.0, and reasonable assurance was addressed in Section 3.4 and 9.0.

4.1 Data Set Description

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

Minimum Submission Requirements:

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

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

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

SUMMARY: The Whitewood Creek TMDL data description and summary are included mostly in the Available Data section and in tables throughout the document. The full data set is in not included in the TMDL. The South Dakota Department of Environment and Natural Resources (SD DENR) collected bacteria samples at the Whitewood Creek ambient water-quality monitoring (WQM) station 123 near Deadwood since 1991. A total of 34 *E. coli* samples were collected at WQM 123 during the recreation season from May 1 to September 30. Fecal coliform bacteria concentration data was also collected at WQM 123, and includes a total of 95 samples collected during the recreation season. Bacteria sample data collected to date in Whitewood Creek near Deadwood at WQM 123 show a statistically significant correlation between fecal coliform bacteria and *E. coli* concentrations. Because the two indicators are closely related, the paired fecal coliform and *E. coli* were used to develop a site-specific translator function to convert fecal coliform loading estimates to *E. coli* loading estimates to address impairments to the immersion recreation impairment of Whitewood Creek. The mean ratio of *E. coli* to fecal coliform was calculated to be 1.21 cfu *E. coli* / cfu fecal coliform. The data set also includes the flow record on Whitewood Creek that was used to create the load duration curves for the listed segment included in the TMDL document.

COMMENTS: None.

SD DENR Comments: Eleven additional fecal coliform samples from 2003 SDSMT sampling efforts were brought to our attention and added to the analysis. Numbers changed by less than 2 percent in section 1.3 and by less than 1 percent in the actual TMDL tables. The r^2 value of the flow regression analysis was added in the Section 1.3 for detail. Table 1-3 was removed as it added nothing to the document about the impaired reach.

4.2 Waste Load Allocations (WLA):

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

Minimum Submission Requirements:

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

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

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

SUMMARY: One point source, the permitted Lead/Deadwood wastewater treatment plant located in Deadwood, discharges effluent containing *E. coli* bacteria directly into the impaired segment of Whitewood Creek. The WLA for the Lead/Deadwood WWTP was based on its discharge permit and was determined by multiplying the WWTP reported flows by 126 cfu/100 mL for the geometric mean TMDL and by 235 cfu/100 mL for the daily maximum TMDL and converting this value to cfu/day with a conversion factor. The WLA was assigned values 2.22×10^{10} cfu/day for the daily maximum TMDL value and 1.19×10^{10} cfu/day for the geometric mean TMDL value.

No permitted concentrated animal feeding operations currently exist within the Whitewood Creek watershed.

One combined sewer outfall (CSO) remains in the city of Lead. During some storm and snowmelt events, the flow in the combined sewer exceeds the capacity of the sewer line and overflows the weir. The waste that passes over the weir from the overflow travels down a concrete channel and flows into Gold Run Creek and eventually into Whitewood Creek. An average overflow, resulting from approximately 1 inch of rain per hour, likely results in an overflow of 250,000 gallons.

COMMENTS: As mentioned above in the comments to the Technical Analysis, the CSO discharges from Lead will remain a potential source of *E. coli* loading to the impaired segment of Whitewood Creek until the separation project is complete. Typically, if a point source is not accounted for in an upstream boundary condition or provided a specific WLA, then the discharge is assumed to have a zero WLA which should be reflected in the permit as no discharge of that pollutant. We recommend analyzing the discharges from the Lead CSO and providing accounting for that load in the TMDL document.

SD DENR Comments: Information on CSO separation and discharges was added to sections 3.4. A CSO WLA was set to zero in the TMDL document because the CSO permit requires its eventual elimination and a permitted concentration does not exist. The following statement was added to Section 5.1: Because the CSO permit requires ultimate elimination and does not have a permitted discharge, its WLA was set to zero. The following statement was added to Section 5.3: A WLA for the Lead CSO was set to zero because the Lead CSO permit requires its elimination.

4.3 Load Allocations (LA):

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

Minimum Submission Requirements:

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

nonpoint source loads. Where possible, load allocations should be described separately for natural background and nonpoint sources.

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

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

SUMMARY: To develop the *E. coli* bacteria load allocation (LA), the loading capacity was first determined using the data sources specified. The daily maximum criterion (235 cfu/100 mL) was used in the calculation of the daily maximum loading capacities, and the geometric mean criterion (126 cfu/100 mL) was used for the calculation of the geometric mean loading capacities. The loading capacities for Whitewood Creek were calculated by multiplying the specified *E. coli* bacteria criterion by the specified flow data. For each of the flow zones, the 95th percentile of the range of loading capacities within a zone was set as the flow zone goal. Bacteria loads experienced during the largest stream flows (e.g., top 5 percent) cannot be feasibly controlled by practical management practices. Thus setting the flow zone goal at the 95th percentile of the range of loading capacities will protect the immersion recreation beneficial use and allow for the natural variability of the system. The TMDL (and loading capacity) is the sum of the waste load allocation (WLA), the LA, and margin of safety (MOS). Portions of the loading capacity were allocated to nonpoint sources as an LA and an MOS to account for uncertainty in the calculations of these load allocations. The method used to calculate the MOS is discussed below. The overall LA was determined by subtracting the WLA and MOS from the loading capacity. The resulting LA was allocated to the various nonpoint sources identified in the watershed.

COMMENTS: None.

4.4 Margin of Safety (MOS):

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

Minimum Submission Requirements:

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

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

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

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

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

SUMMARY: The Whitewood Creek TMDL includes an explicit MOS derived by calculating the difference between the loading capacity at the mid-point of each of the flow zones and the loading capacity at the minimum flow in each zone. The explicit MOS values are included in Tables 5-1, and 5-2 of the TMDL.

COMMENTS: None.

4.5 Seasonality and variations in assimilative capacity:

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

Minimum Submission Requirements:

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

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

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

COMMENTS: None.

5. Public Participation

EPA regulations require that the establishment of TMDLs be conducted in a process open to the public, and that the public be afforded an opportunity to participate. To meaningfully participate in the TMDL process it is necessary that stakeholders, including members of the general public, be able to understand the problem and the proposed solution. TMDL documents should include language that explains the issues to the general public in understandable terms, as well as provides additional detailed technical information for the scientific

community. Notifications or solicitations for comments regarding the TMDL should be made available to the general public, widely circulated, and clearly identify the product as a TMDL and the fact that it will be submitted to EPA for review. When the final TMDL is submitted to EPA for approval, a copy of the comments received by the state and the state responses to those comments should be included with the document.

Minimum Submission Requirements:

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

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

Recommendation:

☐ Approve ☒ Partial Approval ☐ Disapprove ☐ Insufficient Information

SUMMARY: The State's submittal includes a summary of the public participation process that has occurred which describes the ways the public has been given an opportunity to be involved in the TMDL development process so far. In particular, the State has encouraged participation through public meetings in the watershed, and a website was developed and maintained throughout the project. The TMDL has been available for a 30-day public notice period prior to finalization.

COMMENTS: The Public Participation section (Section 7.0) generally mentions presentations to "local groups in the watershed." Additional detail on the number of presentations given and the types of stakeholder groups in attendance would provide a more complete description of the public participation process for this TMDL. It would also be helpful to state whether the public notice was published in local newspapers and if it was available on the SD DENR's web site.

SD DENR Comments: Information regarding the number of presentations given, the types of stakeholder groups in attendance, and publishing of public notice was added to Chapter 7.0.

6. Monitoring Strategy

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

Minimum Submission Requirements:

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

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

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

SUMMARY: The impaired segment of Whitewood Creek will continue to be monitored through SD DENR's ambient water quality monitoring stations in the Whitewood Creek watershed. Stream water-quality monitoring will be accomplished through SD DENR's ambient water-quality monitoring stations which are sampled on a monthly basis during the recreational season. During the recreation season bacterial monitoring should be increased to collect at least 5 samples per month to assess the geometric mean criterion. Additional monitoring and evaluation efforts should be targeted toward designed BMPs to document the effectiveness of implemented BMPs. Post-implementation monitoring will be necessary to assure the TMDL has been reached and maintenance of the beneficial use occurs.

COMMENTS: None.

7. Restoration Strategy

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

Minimum Submission Requirements:

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

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

SUMMARY: The Restoration Strategy section of the TMDL document says that a variety of BMPs could be considered in the development of a water-quality management implementation plan for the impaired segment of the Whitewood Creek watershed. Several types of control measures are available for reducing *E. coli* bacteria loads, and recommendations to address the identified sources are included in the TMDL document. Based on water-quality monitoring, bacterial source tracking, and HSPF model results, the recommended control measures to be implemented are expected to achieve the required load reductions and attain the TMDL goals. The model results indicate that direct sources should be the primary target for future BMP implementation. It is recommended that an in-depth BMP scenario analysis be performed before developing

a future BMP implementation plan. Funds to implement watershed water quality improvements can be obtained through the SD DENR.

COMMENTS: The EPA is working on an updated and expanded reasonable assurance policy for all TMDLs. Until the policy is finalized we are asking that all TMDLs that include both point and nonpoint sources address reasonable assurance to the extent possible. It appears that components of reasonable assurance already exist in the Whitewood Creek TMDL document (e.g., mention of analysis that shows that implementation of a combination of BMPs would reduce the loading to the ranges needed to meet the water quality standards). We recommend including a few paragraphs that use the words "reasonable assurance" and also include general implementation progress to date and any proposed future schedule for NPS implementation.

SD DENR Comments: The words "reasonable assurance" were used in multiple paragraphs, and general implementation progress to date and any proposed future schedule for NPS implementation was included in Chapter 9.0.

8. Daily Loading Expression

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

Minimum Submission Requirements:

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

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

SUMMARY: The Whitewood Creek *E. coli* TMDL includes daily loads expressed as colonies forming units (cfu) per day. The daily TMDL loads are included in TMDL Section of the document.

COMMENTS: None.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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RECEIVED
AUG 8 2011
DEPT. OF ENVIRONMENT AND NATURAL RESOURCES, SECRETARY'S OFFICE

JUL 28 2011

Ref: 8EPR-EP

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

Re: TMDL Approvals
Whitewood Creek, Segment 3; E. Coli;
SD-BF-R-WHITEWOOD_03

Dear Mr. Pirner:

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

Thank you for submitting these TMDLs for our review and approval. If you have any questions, the most knowledgeable person on my staff is Vern Berry and he may be reached at 303-312-6234.

Sincerely,

Carol L. Campbell
Assistant Regional Administrator
Office of Ecosystems Protection
and Remediation

Enclosures

Printed on Recycled Paper

ENCLOSURE 1: APPROVED TMDLs

E. Coli Total Maximum Daily Load for Whitewood Creek (RESPEC for SDDENR, August 2010)

Submitted: 5/25/2011

1	Pollutant TMDLs completed.
1	Causes addressed from the 2010 303(d) list.
0	Determinations that no pollutant TMDL needed.

Segment: Whitewood Creek - from Deadwood Creek to Spruce Gulch

303(d) ID: SD-BF-R-WHITEWOOD 03

Parameter/Pollutant (303(d) list cause): E. COLI - 227

Water Quality Targets: <= 126 cfu/100 mL 30-day geometric mean; <= 235 cfu/100mL single sample maximum

Allocation*	Value	Units	Permits
WLA	2.2E+10	CFU/DAY	SD0020796
LA	3.05E+11	CFU/DAY	
TMDL	4.08E+11	CFU/DAY	
MOS	8.0E+10	CFU/DAY	

Notes: The loads shown represent the loads during the moist flow regime as defined by the load duration curve for Whitewood Creek, segment 03 (see Figure 4-1 of the TMDL). The moist range flows are when significant differences occur between the existing loads and the target loads, and represent the flow regime that is most likely to be targeted for BMP implementation.

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

ENCLOSURE 2

EPA REGION VIII TMDL REVIEW

TMDL Document Info:

Document Name:	**E. coli Total Maximum Daily Load for Whitewood Creek, Lawrence County, South Dakota**
Submitted by:	**Cheryl Saunders, SD DENR**
Date Received:	**May 25, 2011**
Review Date:	**July 12, 2011**
Reviewer:	**Vern Berry, EPA**
Rough Draft / Public Notice / Final?	**Final**
Notes:	

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

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

Approval Notes to Administrator:

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

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

Under Section 303(d) of the Clean Water Act, waterbodies that are not attaining one or more water quality standard (WQS) are considered "impaired." When the cause of the impairment is determined to be a pollutant, a TMDL analysis is required to assess the appropriate maximum allowable pollutant loading rate. A TMDL document consists of a technical analysis conducted to: (1) assess the maximum pollutant loading

rate that a waterbody is able to assimilate while maintaining water quality standards; and (2) allocate that assimilative capacity among the known sources of that pollutant. A well written TMDL document will describe a path forward that may be used by those who implement the TMDL recommendations to attain and maintain WQS.

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

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

1. Problem Description

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

1.1 TMDL Document Submittal Letter

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

Minimum Submission Requirements.

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

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

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

Recommendation:

☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

SUMMARY: The Whitewood Creek *E. coli* TMDL was submitted to EPA review and approval via an email from Cheryl Saunders, SD DENR on May 25, 2011. The email included the final TMDL document and a letter requesting approval of the TMDL.

COMMENTS: None

1.2 Identification of the Waterbody, Impairments, and Study Boundaries

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

Minimum Submission Requirements:

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

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

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

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

SUMMARY: Whitewood Creek is a stream located in the Black Hills of western South Dakota. Its headwaters are located near the base of Deer Mountain and it ends at the confluence with the Belle Fourche River near Vale, SD. Whitewood Creek has a contributing drainage area of approximately 105 square miles. It flows to the Belle Fourche River from the Lower Belle Fourche sub-basin (HUC 10120202). The impaired segment of Whitewood Creek begins at Deadwood Creek and ends at Spruce Gulch (1.8 miles; SD-BF-R-WHITEWOOD_03), and is listed as a medium priority for TMDL development.

This segment is identified on the 2010 South Dakota 303(d) waterbody list as impaired due to elevated *E. coli* and fecal coliform concentrations. The fecal coliform impairment will be addressed in a separate TMDL document.

The designated uses for the listed segment of Whitewood Creek include: coldwater permanent fish life propagation waters, immersion recreation waters, limited-contact recreation waters, irrigation waters, fish and wildlife propagation, recreation, and stock watering.

COMMENTS: None.

1.3 Water Quality Standards

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

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

Minimum Submission Requirements:

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

☒ The purpose of a TMDL analysis is to determine the assimilative capacity of the waterbody that corresponds to the existing water quality standards for that waterbody, and to allocate that assimilative capacity between the significant sources. Therefore, <u>all TMDL documents must be written to meet the existing water quality standards</u> for that waterbody (CWA §303(d)(1)(C)).

Note: In some circumstances, the load reductions determined to be necessary by the TMDL analysis may prove to be infeasible and may possibly indicate that the existing water quality standards and/or assessment methodologies may be erroneous. However, the TMDL must still be determined based on existing water quality standards. Adjustments to water quality standards and/or assessment methodologies may be evaluated separately, from the TMDL.

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

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

Recommendation:

☒ Approve ☐ Partial Approval ☐ Disapprove ☐ Insufficient Information

SUMMARY: The Whitewood Creek segment addressed by this TMDL is impaired based on *E. coli* concentrations that are impacting the immersion recreation beneficial uses. South Dakota has applicable numeric standards for *E. coli* that may be applied to this river segment. The numeric standards being implemented in this TMDL are: a daily maximum value of *E. coli* of 235 cfu/100mL in any one sample, and a maximum geometric mean of 126 cfu/100mL during a 30-day period. The standards for *E. coli* are applicable from May 1 to September 30. Discussion of additional applicable water quality standards for Whitewood Creek can be found on pages 11 - 13 of the TMDL document.

COMMENTS: None.

2. Water Quality Targets

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

Minimum Submission Requirements:

☒ The TMDL should identify a numeric water quality target(s) for each waterbody pollutant combination. The TMDL target is a quantitative value used to measure whether or not the applicable water quality standard is attained.

Generally, the pollutant of concern and the numeric water quality target are, respectively, the chemical causing the impairment and the numeric criteria for that chemical (e.g., chromium) contained in the water quality standard. Occasionally, the pollutant of concern is different from the parameter that is the subject of the numeric water quality target (e.g., when the pollutant of concern is phosphorus and the numeric water quality target is expressed as a numerical dissolved oxygen criterion). In such cases, the TMDL should explain the linkage between the pollutant(s) of concern, and express the quantitative relationship between the TMDL target and pollutant of concern. In all cases, TMDL targets must represent the attainment of current water quality standards.

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

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

SUMMARY: The water quality targets for this TMDL are based on the numeric water quality standards for *E. coli* established to protect the immersion recreation beneficial uses for the impaired segment of Whitewood Creek. The *E. coli* targets are: daily maximum of $\leq$ 235 cfu/100mL in any one sample, and maximum geometric mean of $\leq$ 126 cfu/100mL during a 30-day period. The *E. coli* standards are applicable from May 1 to September 30.

COMMENTS: None.

3. Pollutant Source Analysis

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

Minimum Submission Requirements:

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

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

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

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

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

SUMMARY: The TMDL document identifies the land uses in the watershed as a mixture of predominately evergreen forest and grasses with a small amount of cropland and other uses. The specific landuse breakdown for the watershed is included in Table 1-1 excerpted from the TMDL below.

Table 1-1. Watershed Land Use in the Whitewood Creek Watershed Above the TMDL Reach Endpoint

Land Uses	Area (acres)	% of Area
Evergreen Forest	19,938	71.0%
Grassland/Herbaceous	4,532	16.1%
Shrub/Scrub	1,121	4.0%
Developed, Low Intensity	743	2.6%
Developed, Open Space	718	2.6%
Barren Land (Rock/Sand/Clay)	478	1.7%
Open Water	175	0.6%
Mixed Forest	134	0.5%
Deciduous Forest	124	0.4%
Developed, Medium Intensity	99	0.4%
Pasture/Hay	8	0.0%
Emergent Herbaceous Wetlands	3	0.0%
Woody Wetlands	1	0.0%
Total	28,074	100.0%

One point source, the permitted Lead/Deadwood wastewater treatment plant (permit number SD0020796) located in Deadwood, discharges effluent containing *E. coli* bacteria directly into the impaired segment of Whitewood Creek. No permitted concentrated animal feeding operations currently exist within the Whitewood Creek watershed.

One combined sewer outfall (CSO) remains in the city of Lead. A 10-inch weir located in the sewer keeps wastewater from flowing out of the CSO in Lead under normal conditions. However, during some storm and snowmelt events, the flow in the combined sewer exceeds the capacity of the sewer line and overflows the weir. The waste that passes over the weir from the overflow travels down a concrete channel and flows into Gold Run Creek and eventually into Whitewood Creek. An average overflow, resulting from approximately 1 inch of rain per hour, likely results in an overflow of 250,000 gallons. Potential Deadwood sources include sanitary sewer cross connections with the storm sewer, cracked or broken sanitary sewer lines draining into the storm sewer or directly to the stream, stormwater discharge from Deadwood or a combination of the above. An investigation should be completed upstream, within, and downstream of the impaired reach, and within Deadwood and Lead, to pinpoint the bacterial sources. Approximately 90 percent of the sewer lines in Deadwood have been replaced. The remaining 10 percent of the sewer lines that have not yet been replaced were constructed of clay tiles; however, the city of Deadwood plans to replace these remaining lines.

Based on review of available information and communication with state and local authorities, the primary nonpoint sources of bacteria within the Whitewood Creek watershed include livestock, wildlife, aging onsite wastewater treatment and sewer systems, and the CSO in Lead. Using the best-available information, loadings were estimated from each of these sources using the EPA's Bacterial Indicator Tool (BIT) based on

the density and distribution of animals (livestock and wildlife) and failing onsite wastewater treatment systems in the watershed.

Manure from livestock is a potential source of *E. coli* to the stream. Livestock population densities in the watershed were estimated using Census of Agriculture data. Human sources include leaks in sewer lines and discharges from the CSO. Raw sewage may bypass the wastewater treatment plant and flow directly into surface water or groundwater. Through discussions at public meetings with ranchers in the area, it was determined that wild turkeys in the area were a probable source of *E. coli*. It was suggested that the number of wild turkeys in the watershed is large and the turkeys use the riparian areas adjacent to the stream.

COMMENTS: None.

4. TMDL Technical Analysis

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

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

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

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

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

Where:

TMDL = Total Pollutant Loading Capacity of the waterbody

LAs = Pollutant Load Allocations

WLAs = Pollutant Wasteload Allocations

MOS = The portion of the Load Capacity allocated to the Margin of safety.

Minimum Submission Requirements:

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

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

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

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

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

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

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

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

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

SUMMARY: The technical analysis should describe the cause and effect relationship between the identified pollutant sources, the numeric targets, and achievement of water quality standards. It should also include a description of the analytical processes used, results from water quality modeling, assumptions and other pertinent information. The technical analysis for the Whitewood Creek TMDL describes how the *E. coli* loads were derived in order to meet the applicable water quality standards for the 303(d) impaired stream segment.

The South Dakota Department of Environment and Natural Resources (SD DENR) collected bacteria samples at the Whitewood Creek ambient water-quality monitoring (WQM) station 123 near Deadwood since 1991. Historical data collected from May 1 to September 30 (applicable dates for the *E. coli* water quality standards) from WQM 123 monitoring station were used in the TMDL technical analysis. Whitewood Creek flow data were available from U.S. Geological Survey (USGS) Station 06436170 at

Deadwood, South Dakota, near WQM 123 from 1981 through 1995, and flow data were available from USGS Station 06436180 above Whitewood, South Dakota, from 1982 through 2009. Because recent flow data were required for construction of a load duration curve, a linear regression analysis was completed comparing historical flow (1982 through 1995) from the two stations to calculate more recent flow values for USGS Station 06436170.

The Hydrological Simulation Program – FORTRAN (HSPF) model was established to simulate flows within the Whitewood Creek Watershed and the point and nonpoint sources in the watershed. Loadings were estimated from each of the nonpoint sources using the EPA's Bacterial Indicator Tool (BIT) based on the density and distribution of animals (livestock and wildlife) and failing onsite wastewater treatment systems in the watershed.

The TMDLs were developed using the Load Duration Curve (LDC) approach, resulting in a flow-variable target that considers the entire flow regime within the recreational season (May 1st – September 30th). The LDC is a dynamic expression of the allowable load for any given day within the recreation season. To aid in interpretation and implementation of the TMDL, the LDC flow intervals were grouped into five flow zones: high flows (0–10%), moist conditions (10–40%), mid-range flows (40–60%), dry conditions (60–90%), and low flows (90–100%) according to EPA's LDC guidance.

The LDCs shown in Figures 4-1 and 4-2 in the TMDL document represent dynamic expressions of parameter-specific TMDLs for the impaired segment of the Whitewood Creek that are based on the daily maximum and 30-day geometric mean *E. coli* criteria, resulting in unique loads that correspond to measured and simulated average daily flows.

Two bacteria LDCs were constructed for the bacteria-impaired reach of Whitewood Creek. The curve, which represents loading capacity, within the first LDC was constructed using the product of simulated flow data, the daily maximum bacteria criteria, and a unit conversion factor. Box plots in the second LDC represent the simulated geometric mean bacteria data and simulated geometric mean flow data.

To ensure that all applicable water quality standards are met, TMDL loads were set according to the criterion (either acute or chronic) that required the greatest load reduction percentage by flow zone. The TMDL loading capacities are included in Tables 5-1 and 5-2 of the TMDL document. These loads, when met, will attain compliance with all applicable water quality standards for *E. coli* in the listed segment of Whitewood Creek.

COMMENTS: None.

4.1 Data Set Description

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

Minimum Submission Requirements:

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

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

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

SUMMARY: The Whitewood Creek TMDL data description and summary are included mostly in the Available Data section and in tables throughout the document. The full data set is included in Appendix A of the TMDL document. The South Dakota Department of Environment and Natural Resources (SD DENR) collected bacteria samples at the Whitewood Creek ambient water-quality monitoring (WQM) station 123 near Deadwood since 1991. A total of 34 *E. coli* samples were collected at WQM 123 during the recreation season from May 1 to September 30. Fecal coliform bacteria concentration data was also collected at WQM 123, and includes a total of 106 samples collected during the recreation season. Bacteria sample data collected to date in Whitewood Creek near Deadwood at WQM 123 show a statistically significant correlation between fecal coliform bacteria and *E. coli* concentrations. Because the two indicators are closely related, the paired fecal coliform and *E. coli* were used to develop a site-specific translator function to convert fecal coliform loading estimates to *E. coli* loading estimates to address impairments to the immersion recreation impairment of Whitewood Creek. The mean ratio of *E. coli* to fecal coliform was calculated to be 1.21 cfu *E. coli* / cfu fecal coliform. The data set also includes the flow record on Whitewood Creek that was used to create the load duration curves for the listed segment included in the TMDL document.

COMMENTS: None.

4.2 Waste Load Allocations (WLA):

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

Minimum Submission Requirements:

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

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

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

SUMMARY: One point source, the permitted Lead/Deadwood wastewater treatment plant located in Deadwood, discharges effluent containing *E. coli* bacteria directly into the impaired segment of Whitewood

Creek. The WLA for the Lead/Deadwood WWTP was based on its discharge permit and was determined by multiplying the WWTP reported flows by 126 cfu/100 mL for the geometric mean TMDL and by 235 cfu/100 mL for the daily maximum TMDL and converting this value to cfu/day with a conversion factor. The WLA was assigned values 2.22×10^{10} cfu/day for the daily maximum TMDL value and 1.19×10^{10} cfu/day for the geometric mean TMDL value.

No permitted concentrated animal feeding operations currently exist within the Whitewood Creek watershed.

One combined sewer outfall (CSO) remains in the city of Lead. During some storm and snowmelt events, the flow in the combined sewer exceeds the capacity of the sewer line and overflows the weir. The waste that passes over the weir from the overflow travels down a concrete channel and flows into Gold Run Creek and eventually into Whitewood Creek. An average overflow, resulting from approximately 1 inch of rain per hour, likely results in an overflow of 250,000 gallons. The WLA for the Lead CSO was set to zero because the Lead CSO permit requires its elimination.

COMMENTS: None.

4.3 Load Allocations (LA):

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

Minimum Submission Requirements:

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

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

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

SUMMARY: To develop the *E. coli* bacteria load allocation (LA), the loading capacity was first determined using the data sources specified. The daily maximum criterion (235 cfu/100 mL) was used in the calculation of the daily maximum loading capacities, and the geometric mean criterion (126 cfu/100 mL) was used for the calculation of the geometric mean loading capacities. The loading capacities for Whitewood Creek were calculated by multiplying the specified *E. coli* bacteria criterion by the specified flow data. For each of the flow zones, the 95th percentile of the range of loading capacities within a zone was set as the flow zone goal. Bacteria loads experienced during the largest stream flows (e.g., top 5 percent) cannot be feasibly controlled by practical management practices. Thus setting the flow zone goal at the 95th percentile of the range of

loading capacities will protect the immersion recreation beneficial use and allow for the natural variability of the system. The TMDL (and loading capacity) is the sum of the waste load allocation (WLA), the LA, and margin of safety (MOS). Portions of the loading capacity were allocated to nonpoint sources as an LA and an MOS to account for uncertainty in the calculations of these load allocations. The method used to calculate the MOS is discussed below. The overall LA was determined by subtracting the WLA and MOS from the loading capacity. The resulting LA was allocated to the various nonpoint sources identified in the watershed.

COMMENTS: None.

4.4 Margin of Safety (MOS):

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

Minimum Submission Requirements:

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

- ☐ If the MOS is implicit, the conservative assumptions in the analysis that account for the MOS should be identified and described. The document should discuss why the assumptions are considered conservative and the effect of the assumption on the final TMDL value determined.
- ☒ If the MOS is explicit, the loading set aside for the MOS should be identified. The document should discuss how the explicit MOS chosen is related to the uncertainty and/or potential error in the linkage analysis between the WQS, the TMDL target, and the TMDL loading rate.
- ☐ If, rather than an explicit or implicit MOS, the TMDL relies upon a phased approach to deal with large and/or unquantifiable uncertainties in the linkage analysis, the document should include a description of the planned phases for the TMDL as well as a monitoring plan and adaptive management strategy.

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

SUMMARY: The Whitewood Creek TMDL includes an explicit MOS derived by calculating the difference between the loading capacity at the mid-point of each of the flow zones and the loading capacity at the minimum flow in each zone. The explicit MOS values are included in Tables 5-1, and 5-2 of the TMDL.

COMMENTS: None.

4.5 Seasonality and variations in assimilative capacity:

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

Minimum Submission Requirements:

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

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

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

COMMENTS: None.

5. Public Participation

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

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

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

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

SUMMARY: The State's submittal includes a summary of the public participation process that has occurred which describes the ways the public has been given an opportunity to be involved in the TMDL development

process so far. In particular, the State has encouraged participation through public meetings in the watershed, and a website was developed and maintained throughout the project. The TMDL has been available for a 30-day public notice period prior to finalization.

COMMENTS: None.

6. Monitoring Strategy

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

Minimum Submission Requirements:

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

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

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

SUMMARY: The impaired segment of Whitewood Creek will continue to be monitored through SD DENR's ambient water quality monitoring stations in the Whitewood Creek watershed. Stream water-quality monitoring will be accomplished through SD DENR's ambient water-quality monitoring stations which are sampled on a monthly basis during the recreational season. During the recreation season bacterial monitoring should be increased to collect at least 5 samples per month to assess the geometric mean criterion. Additional monitoring and evaluation efforts should be targeted toward designed BMPs to document the effectiveness of implemented BMPs. Post-implementation monitoring will be necessary to assure the TMDL has been reached and maintenance of the beneficial use occurs.

COMMENTS: None.

7. Restoration Strategy

The overall purpose of the TMDL analysis is to determine what actions are necessary to ensure that the pollutant load in a waterbody does not result in water quality impairment. Adding additional detail regarding the proposed approach for the restoration of water quality <u>is not</u> currently a regulatory requirement, but is considered a value added component of a TMDL document. During the TMDL analytical process, information is often gained that may serve to point restoration efforts in the right direction and help ensure

that resources are spent in the most efficient manner possible. For example, watershed models used to analyze the linkage between the pollutant loading rates and resultant water quality impacts might also be used to conduct "what if" scenarios to help direct BMP installations to locations that provide the greatest pollutant reductions. Once a TMDL has been written and approved, it is often the responsibility of other water quality programs to see that it is implemented. The level of quality and detail provided in the restoration strategy will greatly influence the future success in achieving the needed pollutant load reductions.

Minimum Submission Requirements:

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

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

SUMMARY: A variety of BMPs should be considered in the development of a water-quality management plan for the impaired portion of the Whitewood Creek Watershed. Based on water-quality monitoring, bacterial source tracking, and HSPF model results, there is reasonable assurance that the recommended control measures to be implemented in South Dakota will achieve the required load reductions and attain the TMDL goal.

The combined flow-weighted percent reductions required to meet the TMDL based on acute and chronic water-quality criterion were 60 and 59 percent, respectively. Required percent reductions for the five flow zones, either acute or chronic, ranged from 0 percent for the acute high flow zone to 92 percent for the acute midrange flow zone. In addition to the TMDL prepared, the following BMPs were simulated within the HSPF model framework: Complete replacement of the CSO system in Lead, South Dakota; reduction of on-site wastewater treatment system failures and leaking sewer lines; stormwater treatment/urban litter control programs for urban areas; and riparian buffers and filter strips; avian management practices; reduction of direct defecation; and reduction of overland load from forest, pasture, and cropland. The combination of these BMPs showed a 63 percent reduction of the daily load. Therefore, there is reasonable assurance that the TMDL can be attained considering inherent modeling error and the applied MOS. Implementation progress to date includes 40 percent replacement of the CSO system in Lead, South Dakota and replacement of over 90 percent of sewer lines in Deadwood. Completion of the CSO replacement project is a part of a 10-year plan.

The calibration results of the HSPF model application showed higher *E. coli* concentrations at low flow which indicates an influence from direct sources. The direct sources in the Whitewood Creek watershed above the TMDL endpoint primarily include septic system failures and leaking sewer lines. Indirect sources require high runoff to influence in-stream *E. coli* loads. The indirect sources in the Whitewood Creek watershed include landscape *E. coli* accumulation and washoff from wildlife and livestock. The model BMP simulation indicates that complete removal of the CSO, reduction of on-site wastewater treatment facilities and leaking sewer lines, and a Deadwood stormwater treatment/urban litter control program should be the primary target for future BMP implementation. There is reasonable assurance that the goals of this TMDL established for Whitewood Creek can be met with proper planning between state and local regulatory agencies, organizations, and stakeholders; BMP implementation; and access to adequate financial resources. Funds to implement watershed water-quality improvements can be obtained through the SD DENR.

COMMENTS: None.

8. Daily Loading Expression

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

Minimum Submission Requirements:

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

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

SUMMARY: The Whitewood Creek *E. coli* TMDL includes daily loads expressed as colonies forming units (cfu) per day. The daily TMDL loads are included in TMDL Section of the document.

COMMENTS: None.