Cannonball River, North Dakota
Bacteria Total Maximum Daily Load

North Dakota Department of Health
Division of Water Quality
Final
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1.0 INTRODUCTION AND DESCRIPTION OF THE RIVER AND WATERSHED

The Cannonball River flows through five counties in southwest North Dakota, providing a recreational and agricultural water supply while it delineates county lines as it flows to Lake Oahe. Originating in the northeast corner of Slope County, the Cannonball River winds its way in a southeasterly direction across Hettinger and Grant Counties where it confluences with Cedar Creek. At its confluence with Cedar Creek, the Cannonball changes direction flowing northeast bisecting Sioux and Morton counties where it discharges into Lake Oahe near the town of Cannonball, North Dakota (Figure 1). Encompassing two sub-basins, the Cannonball River watershed is part of the Missouri River Basin. General characteristics of the Cannonball River and its watershed are outlined in Table 1. The segment of the Cannonball River listed on the State's 2004 303(d) list is 34.16 miles in length and approximately 110,403 acres of land drain to it in hydrologic unit 10130204. This Section 303(d) listed stream segment (ND-10130204-001-S_00) and its accompanying watershed will be the focus of this TMDL report (Figure 2).

1.1 Clean Water Act Section 303(d) Listing Information

Based on the "2004 Section 303(d) List of Impaired Waters needing TMDLs" (NDDoH, 2004), the North Dakota Department of Health (NDDoH) has identified a 34.16 mile segment of the Cannonball River from its confluence with Snake Creek downstream to its confluence with Cedar Creek (ND-10130204-001-S_00) as fully supporting, but threatened for recreational uses (Table 2). Recreational uses on the Cannonball River are currently fully supported, but threatened due to excessive fecal coliform bacteria concentrations. Fecal coliform bacteria levels periodically exceed the State standard, and E. coli bacteria originating from human sources have been discovered in the river.

1.2 Topography

The Section 303(d) listed segment of the Cannonball River highlighted in this TMDL is located in Grant County (Figure 2). Topography of the Cannonball River watershed in Grant County consists of short grass prairie rolling plains with prominent sandstone buttes. Elevation of the area ranges between 1,800-feet (MSL) near Shields, North Dakota to 2,700-feet (MSL) at the top of Coffin Butte south of New Leipzig (Soil Survey of Grant County, USDA Soil Conservation Service, 1988). Glaciation has had little to no effect on the topography of the area leaving original soils in place and a complex stream drainage system.

Table 1. General Characteristics of the Cannonball River and its Watershed.

Legal Name	Cannonball River
8-Digit HUC	10130204 and 10130206
Counties Traversed	Slope, Hettinger, Grant, Sioux, Morton Counties
Eco-region	Northwestern Great Plains (Level III), Missouri Plateau (Level IV)
Watershed Area	1,619,734 acres
Head Waters	Northeast Slope County
Outlet	Lake Oahe
ND Highways Crossed	Hwy 21, Hwy 22, Hwy 8, Hwy 49, Hwy 31, Hwy 6, Hwy 1806
Stream Class	Class II
Headwater Elevation	2770 feet
Outlet Elevation	1611 feet
River Length	346 miles
Annual Mean Stream flow for Year 2001	295 ft^3/s

Table 2. Cannonball River Section 303(d) Listing Information (NDDoH, 2004).

Assessment Unit ID	ND-10130204-001-S-00
Waterbody Description	Cannonball River from its confluence with Snake Creek downstream to its confluence with Cedar Creek
Size	34.16 miles
Designated Use	Recreation
Stream Class	Class II
Use Support	Fully Supporting, but Threatened
Impairment	Total Fecal Coliform Bacteria
TMDL Priority	High, Targeted

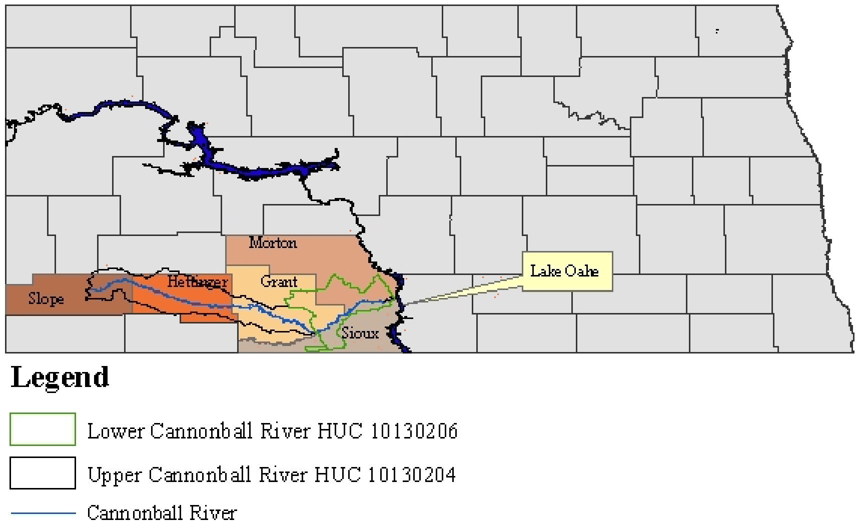

Figure 1. Cannonball River in North Dakota

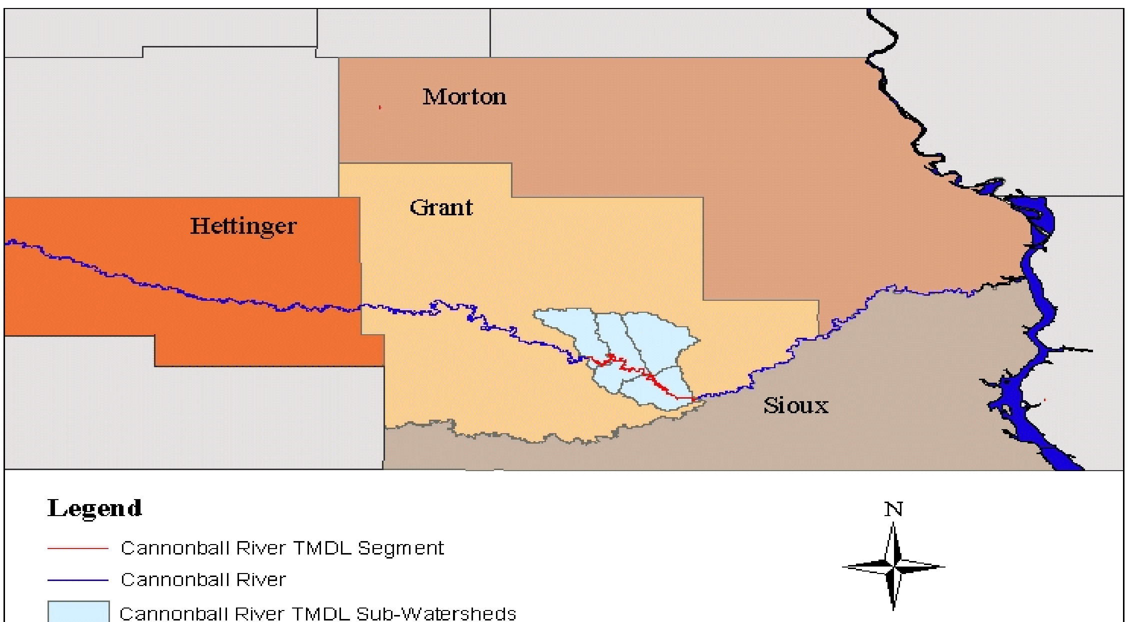

Figure 2. Location of the Cannonball River TMDL Listed Segment and its watersheds

1.3 Land Use/Land Cover

Land use in the Cannonball watershed is primarily agriculture (Figure 3). Since 80 percent of the county being pasture or rangeland (Table 3) the primary agricultural practice is livestock production, specifically cow-calf operations. Thin top soils of siltstone, sandstone, and shale minimize crop production leaving range and pasture land consisting of short grass prairie, forbs, and a wide variety of forage ideal for beef production. Crop production consists of small grain crops such as spring wheat and barley and accounts for approximately 6 percent of the land use. With the advent of no-till and minimum till technologies, the region is seeing an increase in higher water use crops such as corn that is grown and cut for feed silage, flax, sunflower, and canola.

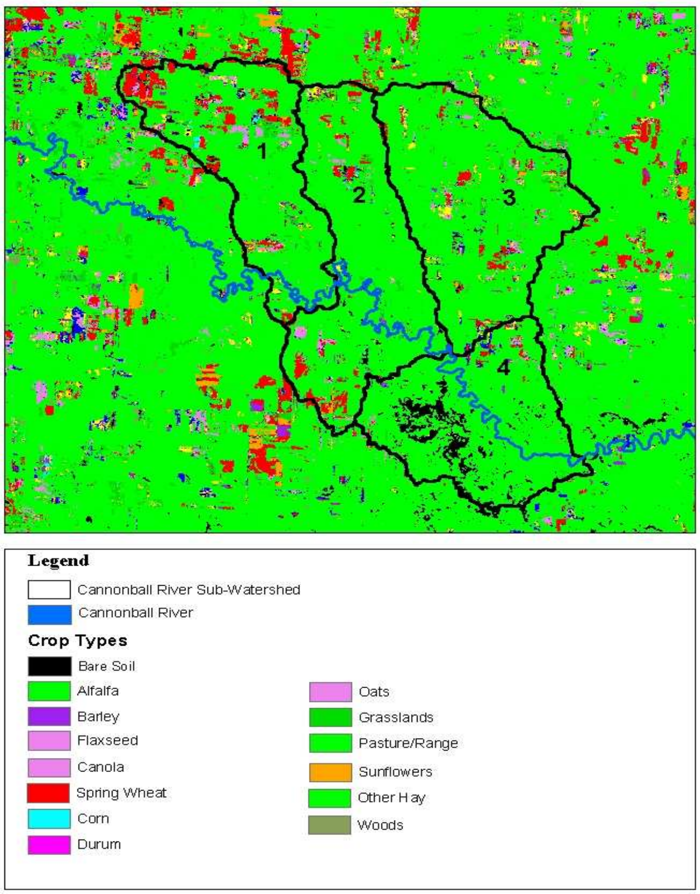

Figure 3. Land Use Data in the Cannonball River Watershed (NDSU, 2003).

Other land uses include roads, water, and woods. New Leipzig, Elgin, and Carson are the more sizable towns in Grant County but are quite small taking into consideration the total population of Grant County in 2001 was 2,775 residence, (U.S. Census Bureau, 2001).

Table 3. Land uses and their Respective Acreage in the Cannonball River Watershed.

Land use	Sub-Watershed 1 (Acres)	2 (Acres)	3 (Acres)	4 (Acres)	Total Acres	%
Pasture/range	18606	24446	24997	20578	88633	80
Grasslands	906	688	982	134	2710	2
Other hay/alfalfa	1323	1446	2167	602	5538	5
Small grain (wheat,oats,barley)	3048	1882	1671	502	7102	6
Row crops (corn, sunflower)	303	122	76	1	502	.04
Other crops (soybean, flax)	505	364	727	136	1732	2
Bare soil	313	336	186	2535	3369	3
Water	182	89	266	166	702	.06
Woods	15	24	37	27	103	.01

1.4 Climate and Precipitation

Southwest North Dakota has a climate characterized by severe fluctuations in temperature, precipitation, near continuous air movement, and low relative humidity. Temperatures of the region range from a monthly average of 27°F in January to 85°F in August with an annual average of 56° F over the last twenty years, (NDAWN, 2003) (Figure 4).

Precipitation events are sporadic occurring primarily as rainfall in late spring and early summer (Figure 5). Based on precipitation records obtained from the North Dakota Agriculture Weather Network (NDAWN) station at Mott, North Dakota (NDAWN, 2003), average annual precipitation is 15.76 inches (NDAWN 2003).

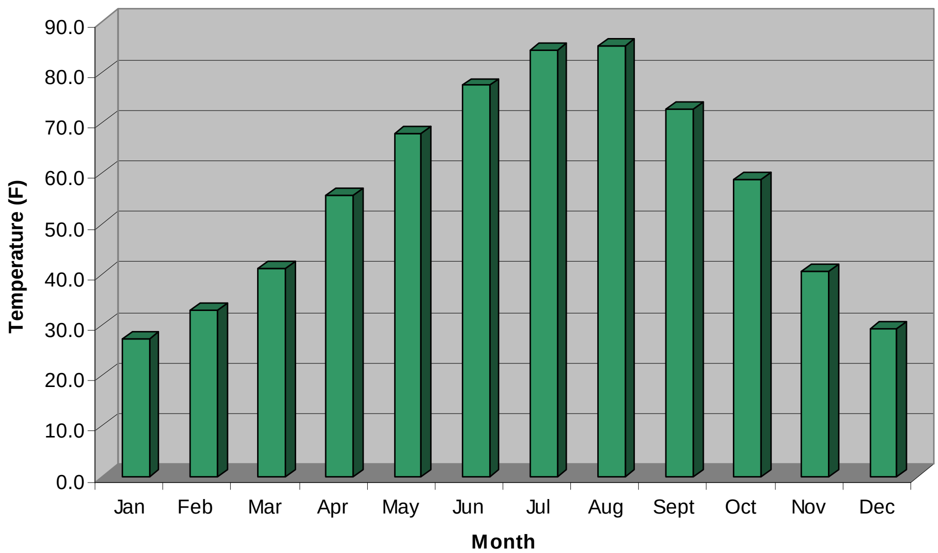

Figure 4. Average Monthly Temperatures From 1983-2002 at North Dakota Agriculture Weather Network (NDAWN), Mott, ND Weather Station.

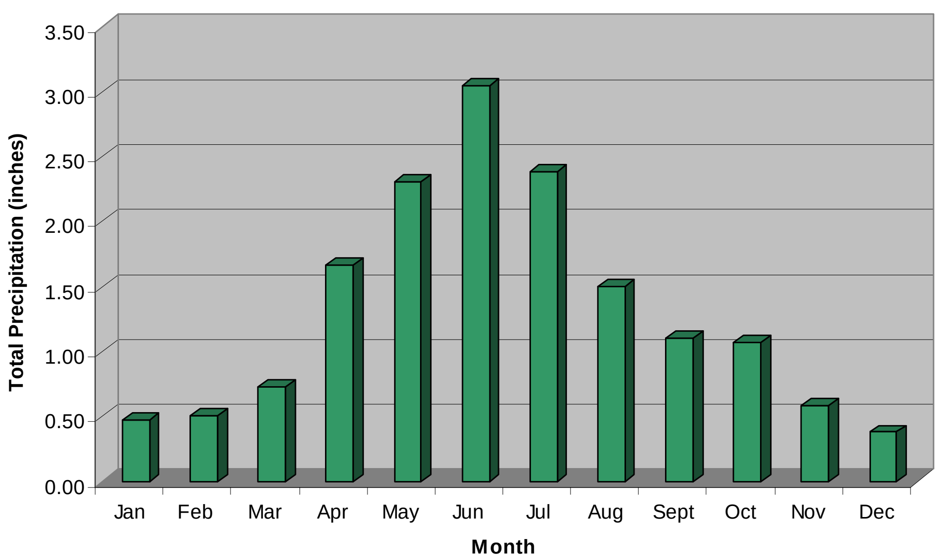

Figure 5. Average Monthly Precipitation from 1983-2002 at NDAWN, Mott, ND Weather Station.

1.5 Available Stream Water Quality Data

Fecal coliform and E. coli samples were collected at three locations within the impaired reach (Figure 6). One site, station 380105, is located near the downstream end of the reach. In addition to data collected specifically for this TMDL, this site also has ambient monitoring data collected from 1994-2002. Stations 385136 and 385137 were monitored during the recreation season May 1 through September 30, 2001 and 2002. Monitoring station 380105 is located sixteen miles south of Raleigh, North Dakota at the North Dakota Highway 31 bridge and is located near United States Geological Survey (USGS) gaging station number 06351200. As stated previously this site is a NDDoH ambient monitoring station that has been regularly monitored since 1994. The sample frequency for this site was every six weeks during the recreation seasons of 1994 through 2000. In support of this TMDL, sample frequency was increased to twice per week during the 2001 and 2002 recreation season. In addition, monitoring at stations 385136 and 385137 began in 2001 and continued through 2002 to supplement TMDL development. To coincide with site 380105, sample frequency at sites 385136 and 385137 was also set at twice per week during the recreation season of 2001 and 2002.

Location descriptions and statistics for water quality data for each monitoring station are shown in Table 4. Station 380105 is the furthest downstream site and has the highest percent of samples exceeding the water quality standard with 42 percent of the samples above the 200 colony forming units (CFU) per 100 mL state standard. Station 385137 is the next upstream site where 20 percent of the samples collected exceed the water quality standard. Of the three stations, station 385136 is the furthest upstream and had the lowest percent of samples above the standard with 13 percent exceeding. Maximum fecal coliform bacteria concentrations at stations 385136 and 385137 were recorded as greater than 1600. Station 380105 had a maximum concentration of 6700 CFU/100 mL.

Table 4. General Statistics for Water Quality Data and Monitoring Station Descriptions.

STORET	Location Description	# Collected / Years Collected	Max.	Min.	Geometric Mean	% Greater than 400 CFU per 100 mL	% Samples Exceeding the 200 CFU 100 mL Standard
385136	One mile E. and 13 miles S. of Carson	40 / 2001-2002	>1600*	10	78	<1	13
385137	Four miles E. and 13 miles S. of Carson	40 / 2001-2002	>1600*	10	100	<1	20
380105	Sixteen miles S. of Raleigh @ HWY 31 bridge	61 / 1994-2002	6700	10	153	24	42

*Some of the samples returned results of “too numerous to count” and a value of > 1600 was used in these situations.

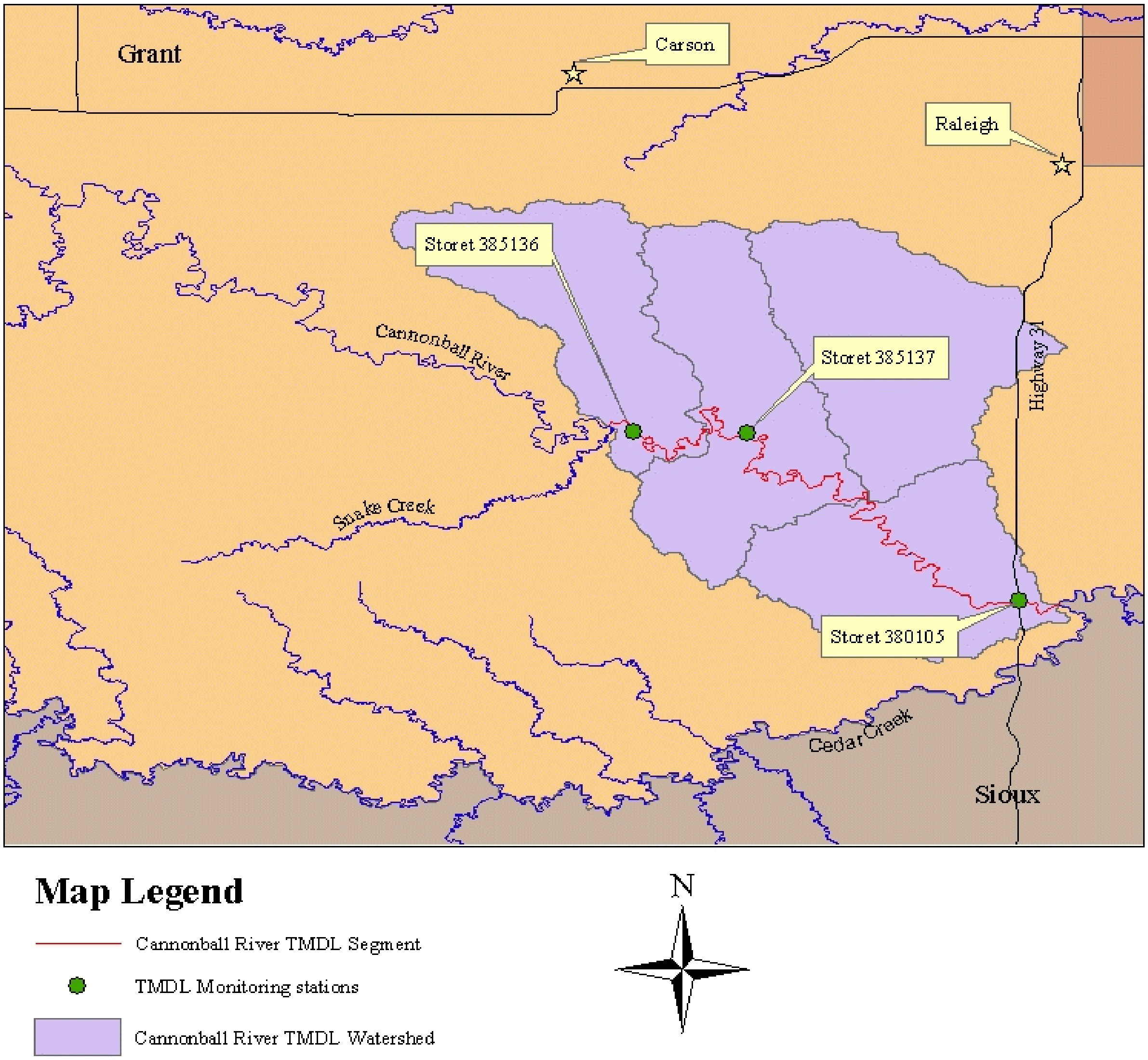

Figure 6. Cannonball River Monitoring Stations

The segment of the Cannonball River from its confluence with Snake Creek downstream to its confluence with Cedar Creek (ND-10130204-001-S_00) is listed as fully supporting, but threatened for recreational uses (NDDoH, 2004). A fully supporting but threatened recreational use assessment was made using fecal coliform data collected between 1994 and 2003 at station 380105 and extrapolated upstream to the end of the assessment unit. Based on these fecal coliform data, the following use support decision criteria were used:

Criterion 1: The geometric mean of the samples should not exceed 200 CFU/100 mL.
Criterion 2: Not more than 10 percent of the samples should have a density exceeding 400 CFU/100 mL.

The two criteria were then applied using the following use support decision criteria:

Fully Supporting: Both criteria 1 and 2 are met.
Fully Supporting but Threatened: Criterion 1 is met, but 2 is not.
Not Supporting: Criterion 1 is not met, or Criteria 1 and 2 are not met.

A geometric mean of 153 CFU/100 mL was calculated for station 380105 indicating that criterion one was met. Twenty-four percent of samples exceed 400 CFU/100 mL (Table 4) indicating that criterion two was not met. Based on these two criteria a fully supporting but threatened use support decision was reached.

2.0 WATER QUALITY STANDARDS

The Cannonball River is not meeting its designated use for recreation due to total fecal coliform bacteria levels that exceed the State water quality standard. The fecal coliform standard applicable to the Cannonball River is 200 CFU/100 mL. This standard only applies during the recreation season from May 1st to September 30th. State narrative standards are also applicable and are discussed in Section 2.1 of the TMDL.

2.1 Narrative Water Quality Standards

The North Dakota Department of Health has set narrative water quality standards that apply to all surface waters in the State. The narrative general water quality standards are listed below (NDDoH, 2001).

- All waters of the State shall be free from substances attributable to municipal, industrial, or other discharges or agricultural practices in concentrations or combinations that are toxic or harmful to humans, animals, plants, or resident aquatic biota.

- No discharge of pollutants, which alone or in combination with other substances, shall:
  a. Cause a public health hazard or injury to environmental resources;
  b. Impair existing or reasonable beneficial uses of the receiving waters; or
  c. Directly or indirectly cause concentrations of pollutants to exceed applicable standards of the receiving waters.

In addition to the narrative standards, the NDDoH has set a biological goal for all surface waters in the State. The goal states that "the biological condition of surface waters shall be similar to that of sites or waterbodies determined by the department to be regional reference sites" (NDDoH, 2001).

2.2 Numeric Stream Water Quality Standards

The Cannonball River is a Class II stream. The NDDoH definition of a Class II stream is shown below (NDDoH, 2001).

> **Class II -** The quality of the waters in this class shall be suitable for the propagation and/or protection of resident fish species and other aquatic biota and for swimming, boating, and other water recreation. The quality of the waters shall be for irrigation, stock watering, and wildlife without injurious effects. After treatment consisting of coagulation, settling, filtration, and chlorination, or equivalent treatment processes, the water quality shall meet the bacteriological, physical, and chemical requirements of the department for municipal or domestic use. Additional treatment for municipal use may be required to meet the drinking water requirements of the Department. Streams in this classification may be intermittent in nature which would make these waters of limited value for beneficial uses such as municipal water, fish life, or irrigation.

Numeric criteria have been developed for Class II streams for fecal coliform bacteria. Fecal coliform bacteria guidelines have been established and are shown in Table 5. The fecal coliform standard applies only during the recreation season from May 1 to September 30.

Table 5. North Dakota Fecal Coliform Bacteria Guidelines for Class II Streams.

Parameter	Guidelines (max)	Recreation Season
Fecal Coliform Bacteria	200 CFU/100mL	May 1 to Sept. 30

3.0 TMDL TARGETS

A TMDL target is the value that is measured to judge the success of the TMDL effort. TMDL targets must be based on State water quality standards, but can also include site-specific values when no numeric criteria are specified in the standard. The following TMDL target for the Cannonball River is based on the NDDoH water quality standard for fecal coliform bacteria.

3.1 Cannonball River Targets

The Cannonball River from its confluence with Snake Creek, to its confluence with Cedar Creek is fully supporting but threatened because of fecal coliform bacteria counts exceeding the North Dakota water quality standard. The North Dakota water quality standard for fecal coliform bacteria is 200 CFU/100mL during the recreation season from May 1 to September 30. Thus, the TMDL target for this report is 200 CFU/100mL.

4.0 SIGNIFICANT SOURCES

There are no known point sources in this TMDL listed segment of the Cannonball River. Fecal coliform bacteria and E. coli bacteria polluting the river are from non-point sources. According to the 2003 National Agricultural Statistics Service (NASS) land use/land cover data, the dominant land use/land cover within an estimated 250 meter riparian buffer around the Cannonball is range and pasture at 97 percent. The watershed is entirely rural with 80 percent of the land classified as range or pasture while agricultural crop production accounts for 8 percent (Figure 3, Table 3). With agriculture being predominant, farms and ranches are located throughout the watershed.

To better determine the sources of fecal coliform bacteria, samples were analyzed by Source Molecular to isolate the genetic make up of E. coli. This process is termed "DNA Fingerprinting". The goal of "DNA Fingerprinting" is to determine whether E. coli found in Cannonball River water samples originate from animal or human sources.

Two samples from each monitoring station were analyzed using DNA fingerprinting (i.e. bacteria source tracking) of E. coli to determine if the sources were human or non-human. Both human and animal sources were found in the samples, however, of the 27 isolates, most were found to be animal sources (only 5 of the 27 were determined to be human sources). Animal feeding areas and livestock grazing are likely contributors. Human sources are likely to be from failing septic systems or from the direct discharge of sewage.

Table 6. Results from DNA Analysis of E. coli Isolates at STORET Station 385136.

STORET Station #	Fecal Coliform mpn*/100 mL	E. coli Isolate # (3-5 colonies of cultured E. coli were analyzed)	Probable Source
385136	=210	1	Animal
		2	Animal
		3	Animal
		4	Animal
		5	Animal
385136	=4	1	Animal
		2	Animal
		3	Animal

*mpn=most probable number of fecal coliforms in 100mL of sample after 20 hrs of cultivation at 44.5°C.

It is not surprising that animal E. coli were dominant (Table 6) in samples analyzed as livestock production is a dominant agricultural practice in Grant County. Grant County ranked 4 out of 53 counties in North Dakota with an estimated 80,000 cattle (NDASS, 2003). One NDDoH permitted Concentrated Animal Feeding Operation (CAFO) of 1000 animals or greater is located in the watershed. Twelve Animal Feeding Operations (AFOs) of 100 to 1000 animals and one AFO with 100 animals or fewer are located in the riparian area or in a location where pollution from livestock waste is certain (Espe, 2005). There may be other AFOs, however there location and size are currently unknown.

Wildlife may also contribute to the animal E. coli found in water quality samples, but most likely at lower concentrations. Wildlife are nomadic with fewer numbers concentrating in a specific area, thus decreasing the probability of their contribution of fecal matter in large quantities.

The amount of human E. coli (Tables 7 and 8) is a concern and indicates that failing septic systems or direct discharge sewage systems are most likely located within the watershed. Single family dwellings and farmsteads are located throughout the watershed. These types of dwellings are located on the Cannonball River near two of the three monitoring stations. While it has not been documented, the land application of septic sludge may be another source of contamination. As stated previously, the possibility of point source pollution from waste water treatment facilities is unlikely in the 110,000 plus acre watershed.

Table 7. Results from DNA Analysis of E. coli Isolates at STORET Station 385137.

STORET Station #	Fecal Coliform mpn*/100 mL	E. coli Isolate # (5 colonies of cultured E. coli were analyzed)	Probable Source
		1	Animal
		2	Animal
385137	=23	3	Animal
		4	Animal
		5	Animal
		1	Animal
385137	=7	2	Animal
		3	Human
		4	Animal
		5	Human

*mpn=most probable number of fecal coliforms in 100mL of sample after 20 hrs of cultivation at 44.5°C.

Table 8. Results from DNA Analysis of E. coli Isolates at STORET Station 380105.

Storet Station	Fecal Coliform mpn*/100 mL	E. coli Isolate # (4-5 colonies of cultured E. coli were analyzed)	Probable Source
		1	Animal
		2	Human
380105	=1,100	3	Human
		4	Human
		1	Animal
380105	> 2,400	2	Animal
		3	Animal
		4	Animal
		5	Animal

*mpn=most probable number of fecal coliforms in 100mL of sample after 20 hrs of cultivation at 44.5°C.

5.0 TECHNICAL ANALYSIS

In TMDL development, the goal is to define the linkage between the water quality target and the identified source or sources of the pollutant (i.e. fecal coliform bacteria) to determine the load reduction needed to meet the target. To determine the cause-and-effect relationship between the water quality target and the identified source, the "load duration curve" methodology was used.

The loading capacity or TMDL is the amount of pollutant (e.g. fecal coliform bacteria) a waterbody can receive and still meet and maintain water quality standards and beneficial uses. The following technical analysis addresses the fecal coliform waste load allocation and load allocation reductions necessary to achieve the water quality standards target of 200 CFU/100 mL with a margin of safety.

In Section 4.0, significant sources of fecal coliform loading were defined as non-point sources originating from failing septic systems and livestock. An important factor in determining NPS pollution loads is variability in stream flows and loads associated with high and low flow. To better characterize the hydrograph of the TMDL listed river segment, a load duration curve was derived for monitoring site 380105 located south of Raleigh, North Dakota (Figure 6). The load duration curve for this site was derived using the 200 CFU/100 mL water quality standard. Flows for site 380105 were extrapolated based on drainage area from the discharge record at the United States Geological Survey (USGS) gage site (06354000) located near Breien, North Dakota.

A hydrograph or flow duration curve for the Cannonball can be developed by generating a flow frequency table using daily stream flow data over a twenty year period and plotting the points as a flow duration curve (Figure 7). For purposes of this TMDL low flow is defined as flows which are exceeded 80 percent of the time or flows less than 4 cubic feet per second (cfs). High flows are flows that are exceeded less than 20 percent of the time or flows greater than 80 cfs. Moderate flows are flows between 4 cfs and 80 cfs. Observed in-stream fecal coliform bacteria concentrations from monitoring site 380105 were converted to pollutant loads by multiplying

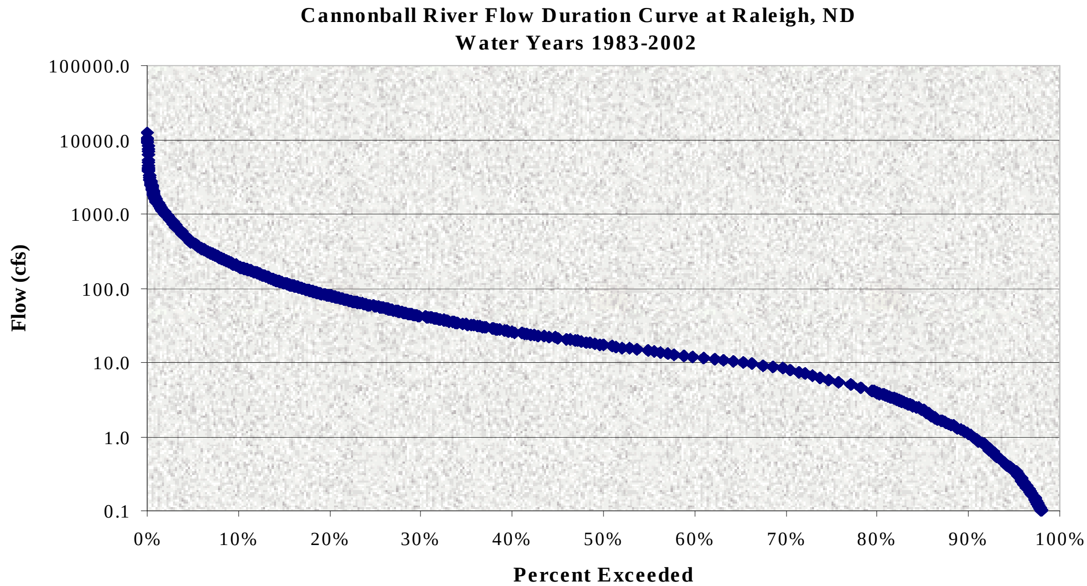

Figure 7. Cannonball River Flow Duration Curve.

concentrations by the flow and a conversion factor. These loads are plotted against the percent exceeded of the flow on the day of sample collection (Figure 9). Points plotted above the 200 CFU/100 mL target curve exceed the water quality target (Figure 9). Points plotted below the curve are meeting the water quality target of 200 CFU/100 mL.

Observed loads plotted on the load duration curve exceeded the target curve in all three flow regimes. Those loads above the target curve in the low flow regime less than 4 cfs indicate direct sources of pollution, such as point sources or livestock located in close proximity to the stream. Since there are no known point sources in the watershed, loading sources exceeding the target curve in the low flow regime are considered to originate from direct deposit of fecal matter by livestock utilizing the river as a water source during low flows. Discharges from failing septic systems are also likely occurring at low flow. Fecal coliform bacteria loads above the target line in the medium flow regime, between 4 cfs and 80 cfs, and those loads greater than 80 cfs in the high flow regime indicate non-point source pollution. Specific non-point sources of pollution and their potential to contribute fecal coliform bacteria loads under high, medium and low flow regimes in the Cannonball River watershed are described in Table 9.

Table 9. Non-Point Sources of Pollution and their Potential to Pollute at a Given Flow Regime.

Non-Point Sources	Flow Regime		
	High Flow	Medium Flow	Low Flow
Riparian Area Grazing (Livestock)	H	H	H
Animal Feeding Operations	H	M	L
Manure Application to Crop and Range Land	H	M	L
Intensive Upland Grazing (Livestock)	H	M	L

Note: Potential importance of non-point source area to contribute fecal coliform bacteria loads under a given flow regime. (H: High; M: Medium; L: Low)

A linear regression was developed for the sample loads above the TMDL target (200 CFU/100 mL) curve and the percent exceeded for site 380105 (Figure 8). The linear regression line for site 380105 was then used with percent exceeded of the flow to calculate existing fecal coliform bacteria loads and the fecal coliform load for each flow regime necessary to reach the TMDL target concentration of 200 CFU/100 mL (Figure 9).

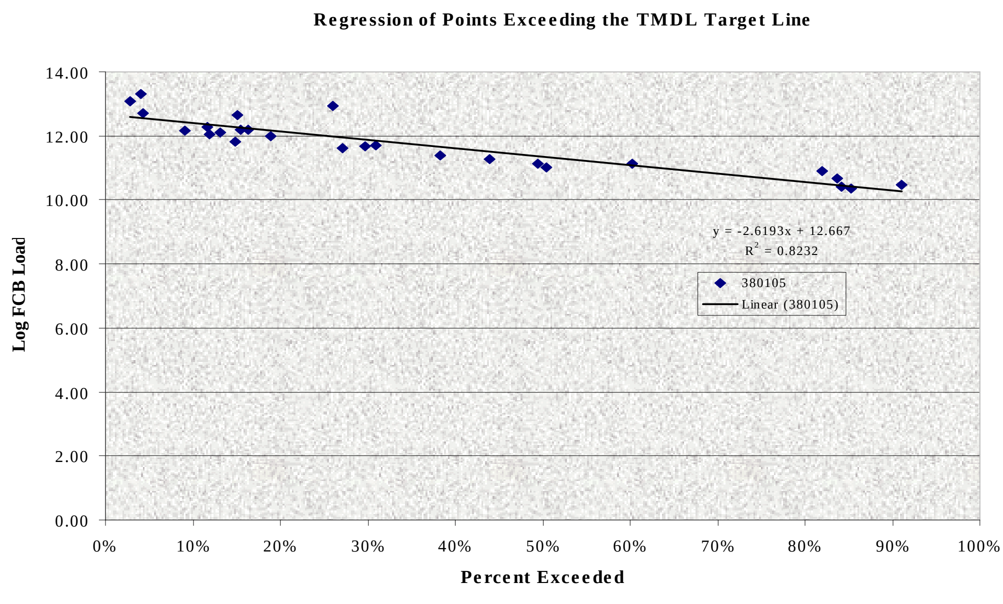

Figure 8. Regression of Points Exceeding the TMDL Target Curve.

For each flow regime, (high, medium, low) the existing load was calculated from the linear regression as the average load of each percent exceeded flow value within the flow regime. For example, for the high flow regime the average existing daily load is calculated from each estimated daily load for the 1st, 2nd, 3rd, 4th..., 20th percent exceeded flow values.

The loading capacity or TMDL for each flow regime is average load needed to meet the TMDL target concentration of 200 CFU/100 mL. For example, the TMDL for the high flow regime is estimated as the average of each percent exceeded flow value (1st, 2nd, 3rd, 4th, ..., 20th) calculated from the load duration curve line (Figure 9).

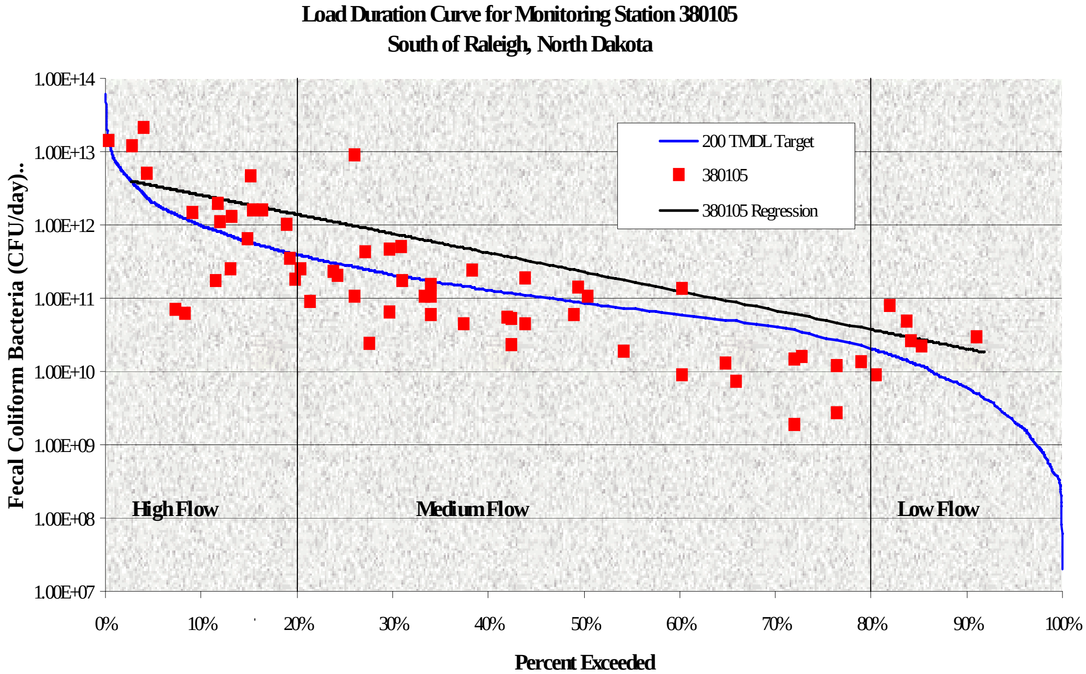

Figure 9. Cannonball River Load Duration Curve at Monitoring Station 380105, South of Raleigh, North Dakota.

One of the more important concerns regarding non-point sources is variability in stream flows. Variable stream flows often cause different source areas and loading mechanisms to dominate (Cleland, 2003). As previously described, three flow regimes were selected to represent the hydrology of the watershed (Figure 9). In southwest North Dakota, rain events are also variable. Rain events can be sporadic and heavy or light, occurring over a short duration. Precipitation events of large magnitude, occurring at a faster rate than absorption, contribute to high runoff events. These events are represented by runoff in the high flow regime. The medium flow regime is represented by runoff that contributes to the stream over a longer duration and for a longer period of time. The low flow regime is characteristic of drought or precipitation events of small magnitude and do not contribute to runoff. By relating runoff characteristics to each flow regime one can infer which sources are most likely to contribute to fecal coliform loading. Animals grazing in the riparian area contribute fecal coliform bacteria by depositing manure where it has an immediate impact on water quality. Due to the close proximity of manure to the stream or by direct deposition in the stream, riparian grazing impacts water quality at high, medium and low flows (Table 9). In contrast, intensive grazing of livestock in the upland and not in the riparian area has a high potential to impact water quality at high flows, medium impact at moderate flows and a low impact at low flows (Table 9). Exclusion of livestock from the riparian area eliminates the potential of direct manure deposit and therefore is considered to be of high importance at low flows. However, intensive grazing in the upland creates the potential for manure accumulation and availability for runoff at high flows and a high potential for fecal coliform bacteria contamination. Best professional judgement indicates that three flow regimes are adequate in identifying source areas and loading mechanisms.

6.0 MARGIN OF SAFETY AND SEASONALITY

6.1 Margin of Safety

Section 303(d) of the Clean Water Act and the U.S. Environmental Protection Agency EPA's regulations require that "TMDLs shall be established at levels necessary to attain and maintain the applicable narrative and numerical water quality standards with seasonal variations and a margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality." The margin of safety (MOS) can be either incorporated into conservative assumptions used to develop the TMDL (implicit) or added to separate component of the TMDL (explicit).

- To account for the uncertainty associated with known sources and the load reductions necessary to reach the water quality target of 200 CFU/100 mL, a 10 percent explicit margin of safety was used for this TMDL. The MOS was calculated as 10 percent of the TMDL. In other words 10 percent of the TMDL is set aside from both the load allocation and the wasteload allocation as a margin of safety. The 10 percent MOS was derived by taking 10 percent of the TMDL for each flow regime.

6.2 Seasonality

Section 303(d)(1)(C) of the Clean Water Act and associated regulations require that a TMDL be established with seasonal variations. The Cannonball River TMDL addresses seasonality because the flow duration curve was developed using 20 years of USGS gage data encompassing twelve months of the year. Additionally, the water quality standard is seasonally based on the recreation season from May 1 to September 30 and controls will be designed to reduce coliform loads during the seasons covered by the standard.

7.0 TMDL

Table 10 provides the reader an outline of the critical elements of the Cannonball River TMDL. Table 11 provides a summary of average daily loads necessary to meet the water quality target (i.e. TMDL). This load or TMDL includes a load allocation from known non-point sources, a waste load allocation from known point sources and a 10 percent margin of safety.

Table 10. TMDL Summary for the Cannonball River.

Category	Description	Explanation
Beneficial Use Impaired	Recreation	Contact Recreation (i.e. swimming, fishing)
Pollutant	Fecal Coliform Bacteria	See Section 2.1
TMDL Target	200 CFU/100 mL	Based on North Dakota water quality standards
Significant Sources	Non-Point Sources	No Point Sources in Sub-Watershed
Margin of Safety (MOS)	Explicit	10%

The TMDL can be generically described by the following equation:

TMDL = WLA + LA + MOS

where:

TMDL = Total Maximum Daily Load, or the maximum loading a waterbody can receive without violating water quality standards;

WLA = Wasteload allocation, or the portion of the TMDL allocated to existing or future point sources;

LA = Load allocation, or the portion of the TMDL allocated to existing or future NPS; and

MOS = Margin of safety, or an accounting of uncertainty about the relationship between pollutant loads and receiving water quality. The margin of safety can be provided implicitly through analytical assumptions or explicitly by reserving a portion of the loading capacity

Based on the "load duration curve" analyses (See Section 5), an average daily load (TMDL) of fecal coliform at high flows is estimated to be 1.135E+12 CFU/day (Table 11). At high flows, the margin of safety is 10 percent of the TMDL or 1.135E+11 CFU/day. Since there are no point sources in the watershed all of the remaining load is allocated to nonpoint sources. The load allocation is therefore the difference between the TMDL and the 10 percent margin of safety or

1.022E+12 CFU/day. To meet the water quality standard of 200 CFU/100 mL at medium and low flows, the average daily load allocation is 1.192E+11 and 1.197E+10 CFU/day, respectively. At medium flows the margin of safety is 10 percent of the TMDL or 1.192E+10 CFU/day and at low flows the margin of safety is 1.197E+09 CFU/day. At medium and low flows all of the remaining load is also allocated to nonpoint sources, therefore the load allocation is the difference between the TMDL and the 10 percent margin of safety or 1.073E+11 CFU/day for medium flows and 1.077E+10 CFU/day for low flows (Table 11).

Future monitoring to determine compliance with loads listed in Table 11 is dependent upon financial support and available staff. While limited to 8-9 samples per year, ambient monitoring will be continued at Station 380105 south of Raleigh. Implementation of BMPs necessary to achieve the TMDL will be accomplished through the Environmental Quality Incentive Program (EQIP) and/or the 319 Non-point Source Pollution Management Program (319). If 319 is used for implementation, monitoring will be included as a component of the project to document BMP effectiveness. If EQIP is used, NRCS has no requirements to monitor to document program effectiveness.

Table 11. Fecal Coliform Bacteria Loads for Cannonball River at Site 380105.

Loads Expressed as Average CFU/day			
Flow Regime	High Flow	Medium Flow	Low Flow
Existing Load	2.452E+12	3.768E+11	2.743E+10
TMDL	1.135E+12	1.192E+11	1.197E+10
WLA	0.000E+0	0.000E+0	0.000E+0
LA	1.022E+12	1.073E+11	1.077E+10
MOS	1.135E+11	1.192E+10	1.197E+09

8.0 ALLOCATION

All of the nonpoint source load is allocated as a single load because there is not enough detailed source data to allocate the load to individual uses (e.g., animal feeding, septic systems, riparian grazing, upland grazing). Because there are no known point sources, all of the fecal coliform load for this TMDL was allocated to nonpoint sources in the watershed. To achieve the TMDL targets identified in the report will require the wide spread support and voluntary participation of landowners and residents in the immediate watershed as well as those living upstream. The TMDL's described in this report are a plan to improve water quality by implementing best management practices through non-regulatory approaches. "Best management practices" (BMPs) are methods, measures, or practices that are determined to be a reasonable and cost effective means for a land owner to meet non-point source pollution control needs," (USEPA, 2001). This

TMDL plan is put forth as recommendations for what needs to be accomplished for the Cannonball River and its watershed from its confluence at Snake Creek downstream to its confluence with Cedar Creek to restore and maintain its recreational uses. It is recommended that as BMPs are implemented to achieve these TMDL targets, water quality monitoring should also be implemented to measure BMP effectiveness and to determine through adaptive management if loading allocation recommendations need to be adjusted.

Non-point source pollution is the sole contributor to elevated fecal coliform bacteria levels in the Cannonball River, no point source pollution sources are located within the watershed. Three flow regimes (high flows, medium flows, low flows) have been identified for the TMDL. Each flow regime has the capacity to deliver pollutant loads from different sources in the watershed at varying magnitudes. To reduce NPS pollution for each flow regime, specific BMPs are described that will mitigate the affects of fecal coliform loading to the impaired reach. Table 12 illustrates specific BMPs that, when implemented in the watershed and based on specific hydrologic conditions, will result in reducing fecal coliform loading necessary to meet the water quality target.

Table 12. Management Practices and Flow Regimes Affected by Implementation.

Management Practice	Flow Regime and Expected Reduction		
	High Flow 58%	Medium Flow 71%	Low Flow 60%
Livestock Exclusion From Riparian Area	✓	✓	✓
Water Well & Tank Development	✓	✓	✓
Prescribed Grazing	✓	✓	✓
Waste Management System	✓	✓	
Vegetative Filter Strip		✓	
Septic System Repair		✓	✓

Note: ✓ Denotes potential of management practice to contribute to reduction needed under defined flow regime.

Controlling non-point sources is an immense undertaking requiring extensive financial and technical support. Provided that technical and financial assistance is available to stakeholders, these BMPs have the potential to significantly reduce fecal coliform loads to the Cannonball River. The following describe in detail those BMPs listed in Table 12 that will reduce fecal coliform bacteria levels in the Cannonball River.

8.1 Livestock Management Recommendations

Livestock management BMPs are designed to promote healthy water quality and riparian areas through management of livestock and associated grazing land. Fecal matter from livestock and erosion from poorly managed grazing land and riparian areas can be a significant source of fecal coliform bacteria loading to surface water. Precipitation, plant cover, number of animals, and soils are factors that affect the amount of bacteria delivered to a waterbody as a result of livestock. These specific BMPs are known to reduce NPS pollution from livestock. They are:

Livestock exclusion from riparian areas - This practice is established to remove livestock from grazing riparian areas and watering in the stream. Livestock exclusion is accomplished through fencing. A reduction in stream bank erosion can be expected by minimizing or eliminating hoof trampling. A stable stream bank will support vegetation that will hold banks in place and serve a secondary function as a filter from non-point source runoff. Added vegetation will create aquatic habitat and shading for macroinvertebrates and fish. Direct deposit of fecal matter into the stream and stream banks will be eliminated as a result of livestock exclusion by fencing.

Water well and tank development - Fencing animals from stream access requires an alternative water source, installing water wells and tanks satisfies this need. Installing water tanks provides a quality water source and keeps animals from wading and defecating in streams. This will reduce the probability of pathogenic infections to livestock and the environment.

Prescribed grazing - To increase ground cover and ground stability by rotating livestock throughout multiple fields. Grazing with a specified rotation minimizes overgrazing and resulting erosion. The Natural Resources Conservation Service (NRCS) recommends grazing systems to improve and maintain water quality and quantity. Duration, intensity, frequency, and season of grazing can be managed to enhance vegetation cover and litter, resulting in reduced runoff, improved infiltration, increased quantity of soil water for plant growth, and better manure distribution and increased rate of decomposition, (NRCS, 1998).

In a study by Tiedemann et al. (1988), as presented by USEPA, (1993), the effects of four grazing strategies on bacteria levels in thirteen watersheds in Oregon were studied during the summer of 1984. Results of the study (Table 13) showed that when livestock are managed at a stocking rate of 19 acres per animal unit month with water developments and fencing, bacteria levels were reduced significantly.

Waste management system - Waste management systems can be effective in controlling up to 90 percent of fecal coliform loading originating from confined animal feeding areas

(Table 14). A waste management system is made up of various components designed to control NPS pollution from concentrated animal feeding operations (CAFOs) and animal feeding operations (AFOs). Diverting clean water from the feeding area and containing dirty water from the feeding area in a pond are typical practices of a waste management system. Manure handling and application procedures are also integral to the waste management system. The application of manure is designed to be adaptive to environmental, soil, and plant conditions to minimize the probability of contamination of surface water.

Table 13. Bacterial Water Quality Response to Four Grazing Strategies (Tiedemann et al., 1988).

Practice	Geometric Mean Fecal Coliform Count
Strategy A: Ungrazed	40/L
Strategy B: Grazing without management for livestock distribution; 20.3 ac/AUM.	150/L
Strategy C: Grazing with management for livestock distribution: fencing and water developments; 19.0 ac/AUM.	90/L
Strategy D: Intensive grazing management, including practices to attain uniform livestock distribution and improve forage production with cultural practices such as seeding, fertilizing, and forest thinning; 6.9 ac/AUM.	920/L

8.2 Other recommendations

Vegetative filter strip - Vegetated filter strips are used to reduce the amount of sediment, particulate organics, dissolved contaminants, nutrients, and in the case of this TMDL, fecal coliform bacteria to streams. The effectiveness of filter strips and other BMPs in removing fecal coliform bacteria is quite successful. Results from a study by Pennsylvania State University (1992a) as presented by USEPA (1993) (Table 14), suggest that vegetative filter strips are capable of removing up to 55 percent of fecal coliform loading to rivers and streams (Table 14). The ability of the filter strip to remove contaminants is dependent on field slope, filter strip slope, erosion rate, amount and particulate size distribution of sediment delivered to the filter strip, density and height of vegetation, and runoff volume associated with erosion producing events (NRCS 2001).

Septic Systems - Septic systems provide an economically feasible way of disposing of household wastes where other means of waste treatment are unavailable (e.g., public or private treatment facilities). The basis for most septic systems involves the treatment and distribution of household wastes through a series of steps involving the following:

1. A sewer line connecting the house to a septic tank
2. A septic tank that allows solids to settle out of the effluent
3. A distribution system that dispenses the effluent to a leach field
4. A leaching system that allows the effluent to enter the soil

Table 14. Relative Gross Effectiveness[a] of Confined Livestock Control Measures (Pennsylvania State University, 1992a).

Practice[b] Category	Runoff[c] Volume	Total[d] Phosphorus (%)	Total[d] Nitrogen (%)	Sediment (%)	Fecal Coliform (%)
Animal Waste System[e]	-	90	80	60	85
Diversion Systems[f]	-	70	45	NA	NA
Filter Strips[g]	-	85	NA	60	55
Terrace System	-	85	55	80	NA
Containment Structures[h]	-	60	65	70	90

NA = not available.
a Actual effectiveness depends on site-specific conditions. Values are not cumulative between practice categories.
b Each category includes several specific types of practices.
c - = reduction; + = increase; 0 = no change in surface runoff
d Total phosphorus includes total and dissolved phosphorus; total nitrogen includes organic-N, ammonia-N, and nitrate-N
e Includes methods for collecting, storing, and disposing of runoff and process-generated wastewater.
f Specific practices include diversion of uncontaminated water from confinement facilities.
g Includes all practices that reduce contaminant losses using vegetative control measures.
h Includes such practices as waste storage ponds, waste storage structures, waste treatment lagoons.

Septic system failure occurs when one or more components of the septic system do not work properly and untreated waste or wastewater leaves the system. The waste may pond in the leach field and ultimately run off directly into nearby streams or percolate into groundwater. Untreated septic system waste is a potential source of nutrients (nitrogen and phosphorus), organic matter, suspended solids, and fecal coliform bacteria. Results from DNA fingerprinting of E. coli indicate two of the three monitoring stations on the Cannonball River contained E. coli of human origin (Tables 7 and 8). Failing septic systems are the most likely source of human E. coli in the Cannonball River. Land application of septic system sludge, although unlikely, may also be a source of contamination.

Septic system failure can occur for several reasons, the most common reason is improper maintenance (e.g. age, inadequate pumping). Other reasons for failure include improper installation, location, and choice of system. Harmful household chemicals can also cause failure by killing the bacteria that digest the waste.

Results from "DNA Fingerprinting" analysis indicates that loads from onsite wastewater treatment systems are a potential source of bacteria in the Cannonball River watershed. While the number of systems that are not functioning properly is unknown, it is estimated that 28 percent of the systems in North Dakota are failing (USEPA, 2002). Based on the age of most residences in the Cannonball River watershed, it is reasonable to assume that this rate is even higher in the Cannonball River watershed.

9.0 PUBLIC PARTICIPATION

To satisfy the public participation requirement of this TMDL, a hard copy of the TMDL for the Cannonball River and a request for comment was mailed to participating agencies, partners, and to those who requested a copy. Those included in the mailing of a hard copy were as follows:

- Grant County Soil Conservation District
- Grant County Water Resource Board
- Natural Resources Conservation Service
- Environmental Protection Agency
- U.S. Fish & Wildlife Service

In addition to mailing copies of this TMDL for the Cannonball River to interested parties, the TMDL was posted on the North Dakota Department of Health, Division of Water Quality web site at http://www.health.state.nd.us/wq/sw/B_Main.htm. A 30 day public notice soliciting comment and participation was also published in the following newspapers:

- Carson Press, Published February 23, 2005
- Grant County News, Published February 23, 2005
- Bismarck Tribune, Published February 21, 2005

A meeting was held with stakeholders and those who will be involved with implementation of the TMDL. Those stakeholders attending the meeting were Grant County Soil Conservation District staff and board members, the Grant County Water Resource Board Chairperson and the District Conservationist from the Natural Resources Conservation Services Grant County Field Office. One set of comments were received during the comment period which started February 21, 2005 and ended March 24, 2005. These were received from Vern Berry, TMDL Coordinator/Project Officer with US EPA Region VIII. Mr. Berry's comments and the Departments response to his comments are provided in Appendix A.

10.0 ENDANGERED SPECIES ACT COMPLIANCE

States are encouraged to participate with the U.S. Fish and Wildlife Service and EPA in documenting threatened and endangered species on the Endangered Species List. In an effort to assist in Endangered Species Act compliance, a request for a list of endangered and/or threatened species was made to the U.S. Fish and Wildlife Service (Figure 10). A hard copy of the draft TMDL report will also be sent to the U.S. Fish and Wildlife Services Bismarck, North Dakota office for review. The following is a list of threatened or endangered species specific to the Cannonball River and Grant County:

Whooping Crane (Grus americana), Endangered
Black-Footed Ferret (Mustela nigripes), Endangered
Bald Eagle (Haliaeetus leucocephalus), Threatened

U.S. FISH & WILDLIFE SERVICE
3425 MIRIAM AVENUE
BISMARCK ND 58501

OFFICE TRANSMITTAL

Received 12-13-04

TO: Mark A. Glaser
ND Department of Health
Dickinson, ND

☐ ACTION
☑ INFORMATION

FROM: Kevin Johnson DIVISION: Ecological Services DATE: 12-8-04

Information you requested.

FEDERAL THREATENED AND ENDANGERED SPECIES
AND DESIGNATED CRITICAL HABITAT FOUND IN
GRANT, MORTON, AND SIOUX COUNTIES, NORTH DAKOTA

ENDANGERED SPECIES

Birds

Interior least tern (Sterna antillarum): Nests along midstream sandbars of the Missouri and Yellowstone Rivers. (Morton and Sioux counties)

Whooping crane (Grus Americana): Migrates through west and central counties during spring and fall. Prefers to roost on wetlands and stockdams with good visibility. Young adult summered in North Dakota in 1989, 1990, and 1993. Total population 140-150 birds. (Grant, Morton, and Sioux counties)

Fish

Pallid sturgeon (Scaphirhynchus albus): Known only from the Missouri and Yellowstone Rivers. No reproduction has been documented in 15 years. (Morton and Sioux counties)

Mammals

Black-footed ferret (Mustela nigripes): Exclusively associated with prairie dog towns. No records of occurrence in recent years, although there is potential for reintroduction in the future. (Grant, Morton and Sioux counties)

THREATENED SPECIES

Birds

Bald eagle (Haliaeetus leucocephalus): Migrates spring and fall statewide but primarily along the major river courses. It concentrates along the Missouri River during winter and is known to nest in the floodplain forest. (Grant, Morton and Sioux counties)

Piping plover (Charadrius melodus): Nests on midstream sandbars of the Missouri and Yellowstone Rivers and along shorelines of saline wetlands. More nest in North Dakota than any other state. (Morton and Sioux counties)

Figure 10. Office Transmittal and Threatened and Endangered Species List

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ACKNOWLEDGMENTS

A host of resources and professionals were utilized in the development of this TMDL. In particular, thank you to James Meek, Environmental Scientist, for assistance with technical analysis and load duration curve development. Thank you to Michael J. Ell, Environmental Administrator and Program Manager, for review and comment.

APPENDIX A.

EPA Comments from the Public Notice Period
and the
States Response

EPA Region VIII TMDL Review Form

Document Name:	Cannonball River - Bacteria TMDL
Submitted By:	Mike Ell, NDDH
Date Received:	February 9, 2005
Review Date:	March 7, 2005
Reviewer:	Vern Berry, EPA
Formal or Informal Review?	Informal - Public Notice

This document provides a standard format for EPA Region VIII to provide comments to the North Dakota Department of Health on TMDL documents provided to the EPA for either official formal, or informal review. All TMDL documents are measured against the following 12 review criteria:

1. Water Quality Impairment Status
2. Water Quality Standards
3. Water Quality Targets
4. Significant Sources
5. Technical Analysis
6. Margin of Safety and Seasonality
7. Total Maximum Daily Load
8. Allocation
9. Public Participation
10. Monitoring Strategy
11. Restoration Strategy
12. Endangered Species Act Compliance

Each of the 12 review criteria are described below to provide the rational for the review, followed by EPA's comments. This review is intended to ensure compliance with the Clean Water Act and also to ensure that the reviewed documents are technically sound and the conclusions are technically defensible. This document review form incorporates by reference the Region VIII TMDL review criteria (see Region VIII's annotated criteria).

1. Water Quality Impairment Status

Criterion Description – Water Quality Impairment Status

TMDL documents must include a description of the listed water quality impairments. While the 303(d) list identifies probable causes and sources of water quality impairments, the information contained in the 303(d) list is generally not sufficiently detailed to provide the reader with an adequate understanding of the impairments. TMDL documents should include a thorough description/summary of all available water quality data such that the water quality impairments are clearly defined and linked to the impaired beneficial uses and/or appropriate water quality standards

✔Satisfies Criterion

☐ Satisfies Criterion. Questions or comments provided below should be considered.

☐ Partially satisfies criterion. Questions or comments provided below need to be addressed.

☐ Criterion not satisfied. Questions or comments provided below need to be addressed.

☐ Not a required element in this case. Comments or questions provided for informational purposes.

SUMMARY - The Cannonball River flows through five counties in southwest North Dakota. The Cannonball River is part of the Missouri River Basin and flows into Lake Oahe near the town of Cannon Ball. The segment covered by this TMDL is described on the State's 2004 303(d) list as the segment from the River's confluence with Snake Creek downstream to its confluence with Cedar Creek in Grant County, North Dakota. The length of this segment is 34.16 miles. The impaired use and pollutant is recreation for total fecal coliform bacteria respectively. Approximately 110,403 acres of land drain to this segment of the Cannonball River. It is a Class II stream and is listed as a high priority for TMDL development. The majority of the land use in this sub-watershed is pasture and rangeland

2. Water Quality Standards

Criterion Description – Water Quality Standards

The TMDL document must include a description of all applicable water quality standards for all affected jurisdictions. TMDLs result in maintaining and attaining water quality standards. Water quality standards are the basis from which TMDL's are established and the TMDL targets are derived, including the numeric, narrative, use classification, and antidegradation components of the standards.

✔ Satisfies Criterion

☐ Satisfies Criterion. Questions or comments provided below should be considered.

☐ Partially satisfies criterion. Questions or comments provided below need to be addressed.

☐ Criterion not satisfied. Questions or comments provided below need to be addressed.

☐ Not a required element in this case. Comments or questions provided for informational purposes.

SUMMARY - The Cannonball River is not meeting its designated use for recreation due to total fecal coliform bacteria levels that exceed the State water quality standard. The fecal coliform standard applicable to the Cannonball River is 200 colony-forming units (CFU) per 100 mL. This standard only applies during the recreation season from May 1st to September 30th. State narrative standards are also applicable and are discussed in Section 2.1 of the TMDL.

3. Water Quality Targets

Criterion Description – Water Quality Targets *Quantified targets or endpoints must be provided to address each listed pollutant/water body combination. Target values must 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 TMDL target. For pollutants with narrative standards, the narrative standard must 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 targets representing water column sediment such as TSS, embeddeness, stream morphology, up-slope conditions, and a measure of biota).*

Satisfies Criterion
✔ Satisfies Criterion. Questions or comments provided below should be considered.
☐ Partially satisfies criterion. Questions or comments provided below need to be addressed.
☐ Criterion not satisfied. Questions or comments provided below need to be addressed.
☐ Not a required element in this case. Comments or questions provided for informational purposes.

SUMMARY - The water quality target for the segment of the Cannonball River covered by this TMDL is 200 fecal coliforms per 100 mL. This target is based on NDDH's fecal coliform standard for Class II waters to protect recreational uses.

4. Significant Sources

Criterion Description – Significant Sources *TMDLs must consider all significant sources of the stressor of concern. All sources or causes of the stressor must be identified or accounted for in some manner. The detail provided in the source assessment step drives the rigor of the allocation step. In other words, it is only possible to specifically allocate quantifiable loads or load reductions to each significant source when the relative load contribution from each source has been estimated. Ideally, therefore, the pollutant load from each significant source should be quantified. This can 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 can be employed so long as the approach is clearly defined in the document.*

✔ Satisfies Criterion
☐ Satisfies Criterion. Questions or comments provided below should be considered.
☐ Partially satisfies criterion. Questions or comments provided below need to be addressed.
☐ Criterion not satisfied. Questions or comments provided below need to be addressed.
☐ Not a required element in this case. Comments or questions provided for informational purposes.

SUMMARY - The Cannonball River TMDL is a nonpoint source TMDL. There are no known point sources in this segment of the river. The largest contributor of fecal coliform bacteria to this segment of the Cannonball River is various agricultural nonpoint sources. The majority of the land use in the sub-watershed covered by this TMDL is pasture and rangeland. Cropland, CRP, farmstead and other non-crop uses makeup the remainder of the land use in this sub-watershed.

Two samples from each monitoring station were analyzed using DNA fingerprinting (i.e., bacteria source tracking) of E. coli to determine if the sources were human or non-human. Both human and animal sources were found in the samples, however, of the 27 isolates, most were found to be animal sources (only 5 of the 27 were determined to be human sources). Animal feeding areas and livestock grazing are likely contributors. Human sources are likely to be from failing septic systems or direct discharge sewage systems.

5. Technical Analysis

Criterion Description – Technical Analysis

*TMDLs must be supported by an appropriate level of technical analysis. It 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. Of particular importance, the cause and effect relationship between the pollutant and impairment and between the selected targets, sources, TMDLs, and allocations needs to be supported by an appropriate level of technical analysis.*

☐ Satisfies Criterion
✔ Satisfies Criterion. Questions or comments provided below should be considered.
☐ Partially satisfies criterion. Questions or comments provided below need to be addressed.
☐ Criterion not satisfied. Questions or comments provided below need to be addressed.
☐ Not a required element in this case. Comments or questions provided for informational purposes.

SUMMARY - The technical analysis addresses the fecal coliform reductions necessary to achieve the water quality standard. The TMDL recommends fecal coliform reductions that vary depending on the flow in the river (i.e., high, medium or low). The reduction in fecal coliform loading from nonpoint sources is 58% at higher flows, 71% at medium flows, and 44% at lower flows. The TMDL uses a load duration curve to determine the cause and effect relationship between the water quality target and the identified sources. The flow duration curve was developed for monitoring station 380105 near the downstream end of the listed segment. The flow data for this point was extrapolated using the hydrologic record from a USGS station located near Breien, North Dakota.

COMMENTS - The use of regression line drawn across the exceedances at all flow regimes (across the entire curve) may be appropriate for this stream segment (i.e., the points above the line at the upper end of the curve are about the same distance from the curve as they are at the lower end of the curve). However, this approach may not be appropriate for other stream segments in the state. There are other options for determining the best fit for the exceedances. Generally, a regression line or some other technique is fit to the exceedances in each flow regime separately. Future TMDLs that use load duration curves should consider other options.

STATES RESPONSE - Comments from EPA regarding the use of a regression line for each flow regime rather than across the exceedances of all flow regimes to calculate the TMDL was taken into consideration and implemented. Section 5.0 of the Cannonball River Bacteria TMDL explains the States methodology in calculating the TMDL for the Cannonball River using a linear regression line for each flow regime.

6. Margin of Safety and Seasonality

Criterion Description – Margin of Safety/Seasonality

A margin of safety (MOS) is a required component of the TMDL that accounts for the uncertainty about the relationship between the pollutant loads and the quality of the receiving water body (303(d)(1)(c)). The MOS can be implicitly expressed by incorporating a margin of safety into conservative assumptions used to develop the TMDL. In other cases, the MOS can be built in as a separate component of the TMDL (in this case, quantitatively, a TMDL = WLA + LA + MOS). In all cases, specific documentation describing the rational for the MOS is required.

Seasonal considerations, such as critical flow periods (high flow, low flow), also need to be considered when establishing TMDLs, targets, and allocations.

☐ Satisfies Criterion
✔ Satisfies Criterion. Questions or comments provided below should be considered.
☐ Partially satisfies criterion. Questions or comments provided below need to be addressed.
☐ Criterion not satisfied. Questions or comments provided below need to be addressed.
☐ Not a required element in this case. Comments or questions provided for informational purposes.

SUMMARY - An appropriate margin of safety is included in the TMDL as a 10% explicit margin of safety that is applied to the water quality standard. Seasonality was adequately considered through the use of the flow duration curve which was developed with 20 years of flow data that covers all twelve months of the year. Also, the water quality standard is seasonally based (i.e, May 1st to September 30th), and controls will be designed to reduce coliform loads during the seasons covered by the standard.

COMMENTS - The 10% explicit MOS was derived by taking the difference between the points on the load duration curve using the 200 cfu/100ml standard and the curve using the 180 cfu/100ml (i.e., in the spreadsheet the MOS values are the column "F" values minus the column "G" values). This is an acceptable approach, however it's not well explained in the MOS section (6.1). Please provide an explanation of how the MOS was derived.

STATES RESPONSE - Taking into consideration EPA comments and their request for an explanation of how the MOS was derived, the State further explained its rationale in how the MOS was calculated in Section 6.1 of the Cannonball River Bacteria TMDL.

7. TMDL

Criterion Description – Total Maximum Daily Load

TMDLs include a quantified pollutant reduction target. According to EPA reg (see 40 CFR 130.2(i)) TMDLs can be expressed as mass per unit of time, toxicity, % load reduction, or other measure. TMDLs must address, either singly or in combination, each listed pollutant/water body combination.

✔ Satisfies Criterion
☐ Satisfies Criterion. Questions or comments provided below should be considered.
☐ Partially satisfies criterion. Questions or comments provided below need to be addressed.
☐ Criterion not satisfied. Questions or comments provided below need to be addressed.
☐ Not a required element in this case. Comments or questions provided for informational purposes.

SUMMARY **-** The TMDL established for the Cannonball River is expressed as fecal coliform loads (i.e., average # CFU/day) to the River. The TMDL loads are provided for three major flow regimes shown on the load duration curve which represent high, medium and low flows (see Table 11). The range of fecal coliform load reduction that is necessary from nonpoint sources to achieve the water quality standard is 58-71% (including a MOS). The actual loading will vary from year-to-year, therefore this TMDL is considered a long term average percent reduction in fecal coliform loading to the River.

8. Allocation

Criterion Description – Allocation

TMDLs apportion responsibility for taking actions or allocate 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 dividing of responsibility. A performance based allocation approach, where a detailed strategy is articulated for the application of BMPs, may also be appropriate for non point sources.

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).

Allocating load reductions to specific sources is generally the most contentious and politically sensitive component of the TMDL process. It is also the step in the process where management direction is provided to actually achieve the desired load reductions. In many ways, it is a prioritization of restoration activities that need to occur to restore water quality. For these reasons, every effort should be made to be as detailed as possible and also, to base all conclusions on the best available scientific principles.

✔ Satisfies Criterion
☐ Satisfies Criterion. Questions or comments provided below should be considered.
☐ Partially satisfies criterion. Questions or comments provided below need to be addressed.
☐ Criterion not satisfied. Questions or comments provided below need to be addressed.
☐ Not a required element in this case. Comments or questions provided for informational purposes.

SUMMARY **-** This TMDL addresses the reductions in fecal coliform bacteria that are necessary to attain water quality standards in the Cannonball River. The allocation for the TMDL is a "load allocation" attributed to nonpoint sources. There are no known point sources in this segment of the river. The source allocation for fecal coliform is primarily attributed to runoff from pastureland, animal feeding operations, and failing septic systems. There is a desire to move forward with controls in the areas of the basin where there is confidence that fecal coliform reductions can be achieved through modifications to existing practices. Section 8.0 of the TMDL outlines various BMPs that are proposed to be implemented on a voluntary basis by working with landowners in the watershed. The BMPs include excluding livestock from riparian areas, building animal waste management systems and repairing septic systems.

9. Public Participation

Criterion Description – Public Participation *The fundamental requirement for public participation is that all stakeholders have an opportunity to be part of the process. Notifications or solicitations for comments regarding the TMDL should 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 review, a copy of the comments received by the state should be also submitted to EPA.*

☐ Satisfies Criterion
✔ Satisfies Criterion. Questions or comments provided below should be considered.
☐ Partially satisfies criterion. Questions or comments provided below need to be addressed.
☐ Criterion not satisfied. Questions or comments provided below need to be addressed.
☐ Not a required element in this case. Comments or questions provided for informational purposes.

SUMMARY **-** The TMDL includes a summary of the public participation process that has occurred, and describes the opportunities the public had to be involved in the TMDL development process. Specifically, copies of the draft TMDL were mailed to stakeholders in the watershed for comment, the draft TMDL was posted on NDDH's Water Quality Division website, and a public notice for comment was published in three newspapers in the state.

COMMENTS **-** The final TMDL needs to include a summary of the comments received during the public notice, and the State's response to the comments, as well as the dates of the start and end of the public notice.

STATES RESPONSE **-** Start and end dates were added to the Cannonball River TMDL in Section 9.0 per EPA comments. One set of comments were received from Vern Berry, TMDL Coordinator/Project Officer with US EPA Region VIII. Those comments and the States response are included in Appendix A of the Cannonball Bacteria TMDL.

10.0 Monitoring Strategy

> *Criterion Description – Monitoring Strategy*
>
> *TMDL's may have significant uncertainty associated with 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 documents to articulate the means by which the TMDL will be evaluated in the field, and to provide supplemental data in the future to address any uncertainties that may exist when the document is prepared.*
>
> *At a minimum, the monitoring strategy should:*
> ▪ *Articulate the monitoring hypothesis and explain how the monitoring plan will test it;*
> ▪ *Address the relationships between the monitoring plan and the various components of the TMDL (targets, sources, allocations, etc.);*
> ▪ *Explain any assumptions used;*
> ▪ *Describe monitoring methods; and*
> ▪ *Define monitoring locations and frequencies, and list the responsible parties*

☐ Satisfies Criterion
☐ Satisfies Criterion. Questions or comments provided below should be considered.
☐ Partially satisfies criterion. Questions or comments provided below need to be addressed.
☐ Criterion not satisfied. Questions or comments provided below need to be addressed.
✔ Not a required element in this case. Comments or questions provided for informational purposes.

SUMMARY - The document mentions that monitoring should be conducted to measure BMP effectiveness and to determine whether the goals of the TMDL are being met.

11. Restoration Strategy

> *Criterion Description – Restoration Strategy*
>
> *At a minimum, sufficient information should be provided in the TMDL document to demonstrate that if the TMDL were implemented, water quality standards would be attained or maintained. 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.*

☐ Satisfies Criterion
☐ Satisfies Criterion. Questions or comments provided below should be considered.
☐ Partially satisfies criterion. Questions or comments provided below need to be addressed.
☐ Criterion not satisfied. Questions or comments provided below need to be addressed.
✔ Not a required element in this case. Comments or questions provided for informational purposes.

SUMMARY - The North Dakota Department of Health is working with the local conservation district to develop a plan for a restoration project in the watershed.

12. Endangered Species Act Compliance

Criterion Description – Endangered Species Act Compliance *EPA's approval of a TMDL may constitute an action subject to the provisions of Section 7 of the Endangered Species Act ("ESA"). EPA will consult, as appropriate, with the US Fish and Wildlife Service (USFWS) to determine if there is an effect on listed endangered and threatened species pertaining to EPA's approval of the TMDL. The responsibility to consult with the USFWS lies with EPA and is not a requirement under the Clean Water Act for approving TMDLs. States are encouraged, however, to participate with USFWS and EPA in the consultation process and, most importantly, to document in its TMDLs the potential effects (adverse or beneficial) the TMDL may have on listed as well as candidate and proposed species under the ESA.*

☐ Satisfies Criterion
☐ Satisfies Criterion. Questions or comments provided below should be considered.
☐ Partially satisfies criterion. Questions or comments provided below need to be addressed.
☐ Criterion not satisfied. Questions or comments provided below need to be addressed.
✔ Not a required element in this case. Comments or questions provided for informational purposes.

SUMMARY - EPA will request ESA Section 7 concurrence from the USFWS for this TMDL.

13. Miscellaneous Comments / Questions