Bacteria TMDL for Deep Creek and West Branch Deep Creek in Bowman and Slope Counties, North Dakota

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1.0 INTRODUCTION AND DESCRIPTION OF THE WATERSHED

The Middle Little Missouri River sub-basin (10110203) is approximately 2,180 square miles (1,395,300 acres) covering parts of four counties (Billings, Bowman, Golden Valley, and Slope) in North Dakota. For purposes of this TMDL, the impaired stream segments are located in Slope and Bowman Counties that comprise a watershed area of approximately 182,309 acres (Table 1 and Figure 1). The Deep Creek and West Branch Deep Creek impaired stream segments lie within the Level III Northwestern Great Plains (43) ecoregion.

Table 1. General Characteristics of the Deep Creek Watershed.

Legal Name	Deep Creek
Stream Classification	Class III
Major Drainage Basin	Missouri River
8-Digit Hydrologic Unit	10130201
Counties	Bowman and Slope Counties
Level III Ecoregion	Northwestern Great Plains (43)
Watershed Area (acres)	182,309

1.1 Clean Water Act Section 303(d) Listing Information

Based on the 2012 Section 303 (d) List of Impaired Waters Needing TMDLs (NDDoH, 2012), the North Dakota Department of Health (NDDoH) has identified a 42.51 mile segment of Deep Creek from the confluences of East Branch Deep Creek and West Branch Deep Creek downstream to its confluence with the Little Missouri River (ND-10110203-003-S_00) and a 117.25 mile segment of West Branch Deep Creek and its tributaries (ND-10110203-004-S_00) as fully supporting, but threatened for recreational uses. The impairments are due to fecal coliform bacteria (Tables 2 and 3 and Figure 1).

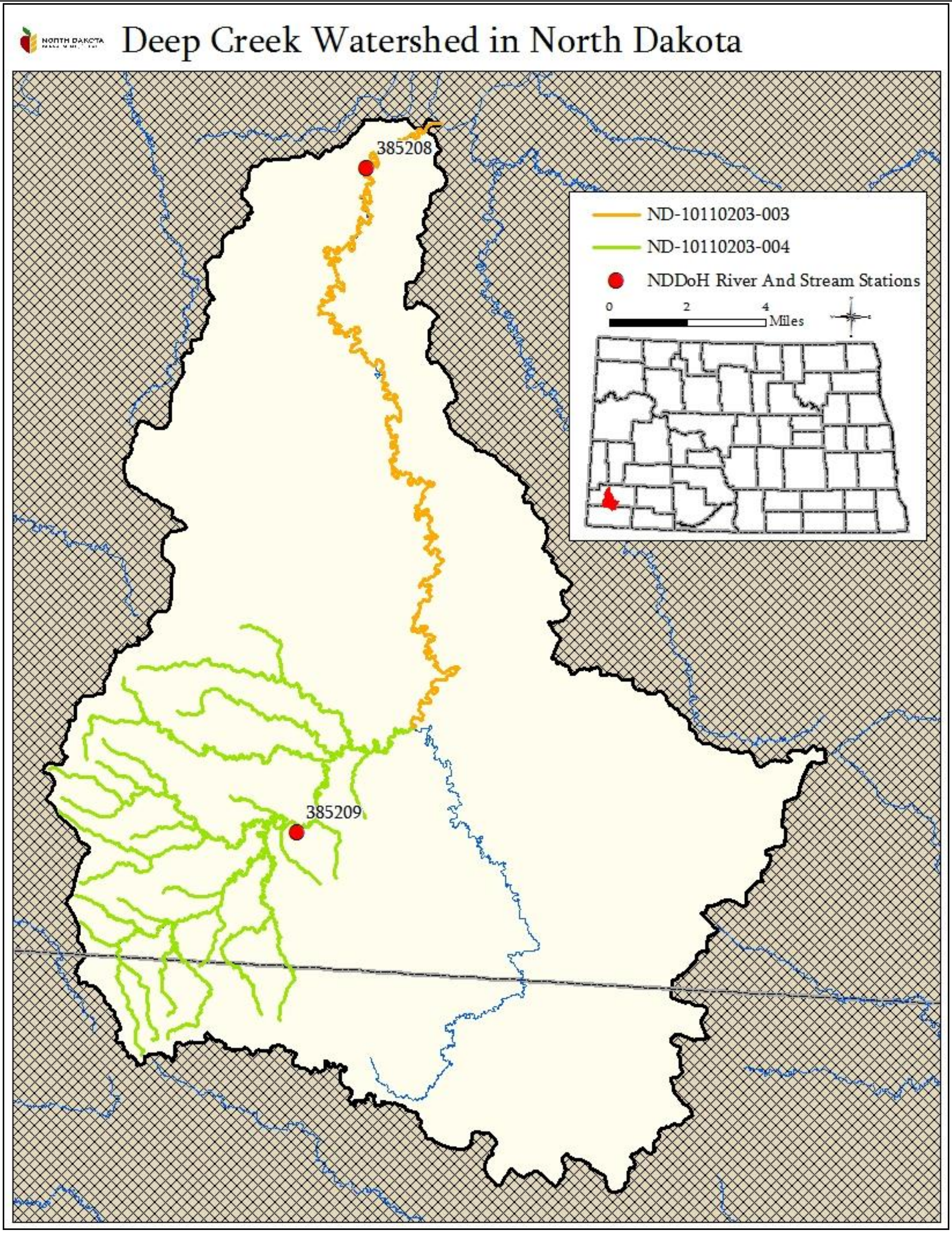

Figure 1. Deep Creek TMDL Listed Segments in North Dakota.

Table 2. Deep Creek Section 303(d) Listing Information for Assessment Unit ID ND-10110203-003-S_00 (NDDoH, 2012).

Assessment Unit ID	ND-10110203-003-S_00
Waterbody Description	Deep Creek from the confluences of East Branch Deep Creek and West Branch Deep Creek downstream to its confluence with the Little Missouri River
Size	42.51 miles
Designated Use	Recreation
Use Support	Fully Supporting, but Threatened
Impairment	Fecal Coliform Bacteria
TMDL Priority	High

Table 3. West Branch Deep Creek Section 303(d) Listing Information for Assessment Unit ID ND-10110203-004-S_00 (NDDoH, 2012).

Assessment Unit ID	ND-10110203-004-S_00
Waterbody Description	West Branch Deep Creek and its tributaries
Size	117.25 miles
Designated Use	Recreation
Use Support	Fully Supporting, but Threatened
Impairment	Fecal Coliform Bacteria
TMDL Priority	High

1.2 Ecoregions

The watershed for the Section 303(d) listed segments highlighted in this TMDL lie within the Missouri Plateau (43a) and Little Missouri Badlands (43b) level IV ecoregions (Figure 2). The topography of the Missouri Plateau ecoregion (43a) was largely unaffected by glaciations and retains its original soils and complex stream drainage pattern. A mixture of spring wheat, alfalfa, and grazing land covers the shortgrass prairie. The Little Missouri Badlands ecoregion (43b) is highly dissected and sparsely vegetated. Ephemeral, flashy stream flow is typical and has created steep, downcut channels. Vegetation is typically sparse shortgrass prairie. Rocky Mountain junipers grow on north-facing hillslopes while cottonwood and green ash appear in the riparian areas. Grazing and recreation are the dominant land uses (USGS, 2006).

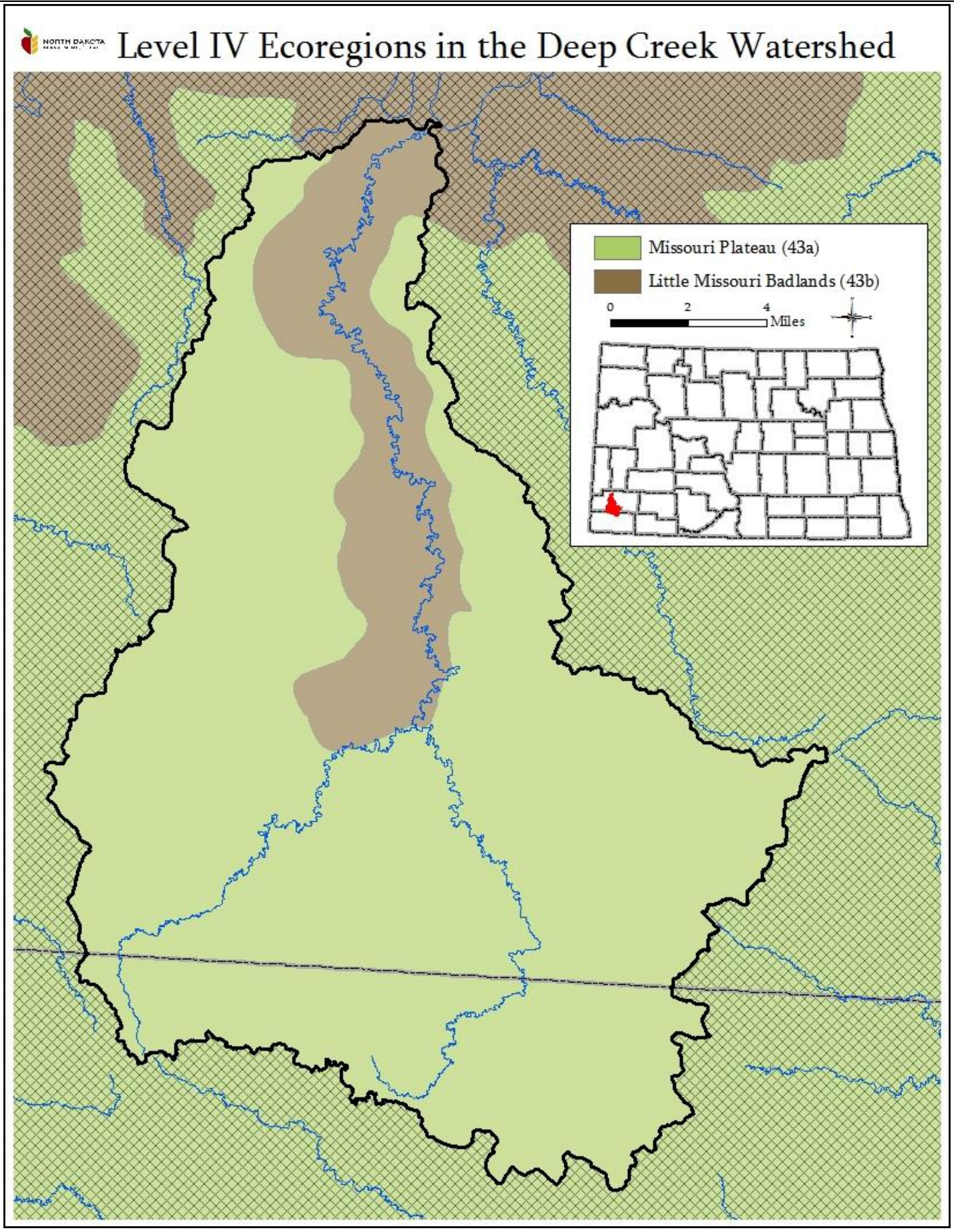

Figure 2. Level IV Ecoregions in the Deep Creek TMDL Listed Watershed.

1.3 Land Use

The dominant land use in the watershed of the Deep Creek TMDL listed segments is grassland. According to the 2010 National Agricultural Statistical Service (NASS) land survey data, approximately 68 percent of the land is grassland, 17 percent is small grain agriculture and 7 percent is hay/alfalfa. The remaining 8 percent is corn/sunflower, developed space, oil seeds, water/wetland, woodlands or fallow. The majority of the crops grown consist of spring wheat, barley, sunflowers, and durum wheat (Figure 3).

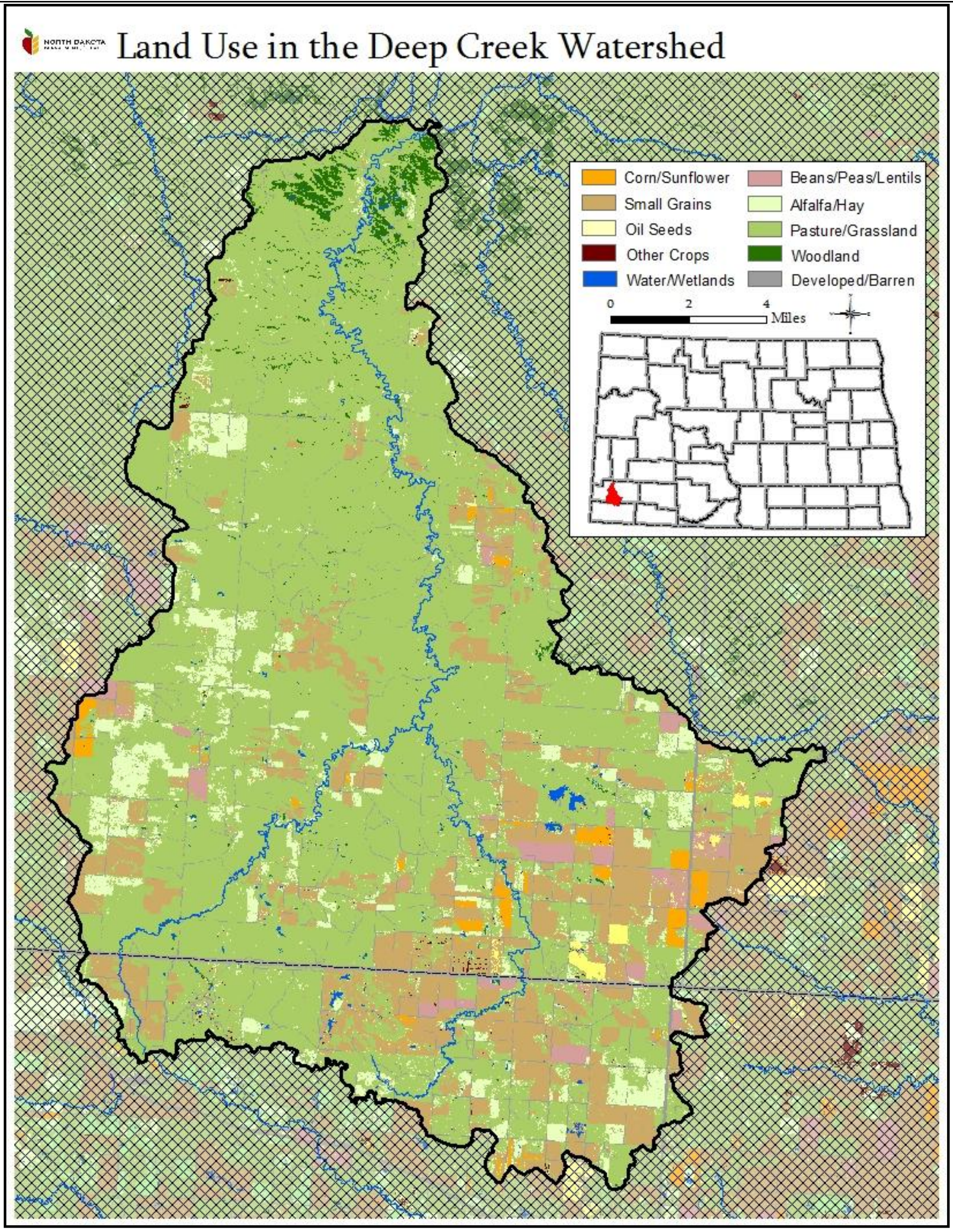

Figure 3. Land Use in the Deep Creek TMDL Listed Watershed (NASS, 2010).

1.4 Climate and Precipitation

North Dakota's climate is characterized by large temperature variation across all time scales, light to moderate irregular precipitation, plentiful sunshine, low humidity, and nearly continuous wind. Its location at the geographic center of North America results in a strong continental climate, which is intensified by the mountains to the west. There are no barriers to the north or south so a combination of cold, dry air masses originating in the far north and warm humid air masses originating in the tropical regions regularly overflow the state. Movement of these air masses and their associated fronts causes near continuous wind and often results in large day to day temperature fluctuations in all seasons. The average last freeze in spring occurs in late May. In the fall, the first 32^{o} F or lower temperature occurs between September 10th and 25th. However, freezing temperatures have occurred as late as mid-June and as early as mid-August. About 75 percent of the annual precipitation falls during the period of April to September.

The climate of the region varies significantly depending on the season. Climate data for the period of 1994 through 2011 was obtained from the North Dakota Agricultural Network (NDAWN) monitoring station at Bowman, ND, which is located two miles south of the Deep Creek watershed. The average daily temperature is 43° F, with an average monthly temperature of 67° F in July and 11° F in January (Figure 4). Average annual precipitation is approximately 12 inches for the region, ranging from 6.4 inches in 2002 to 19.2 inches in 2011 (Figure 5).

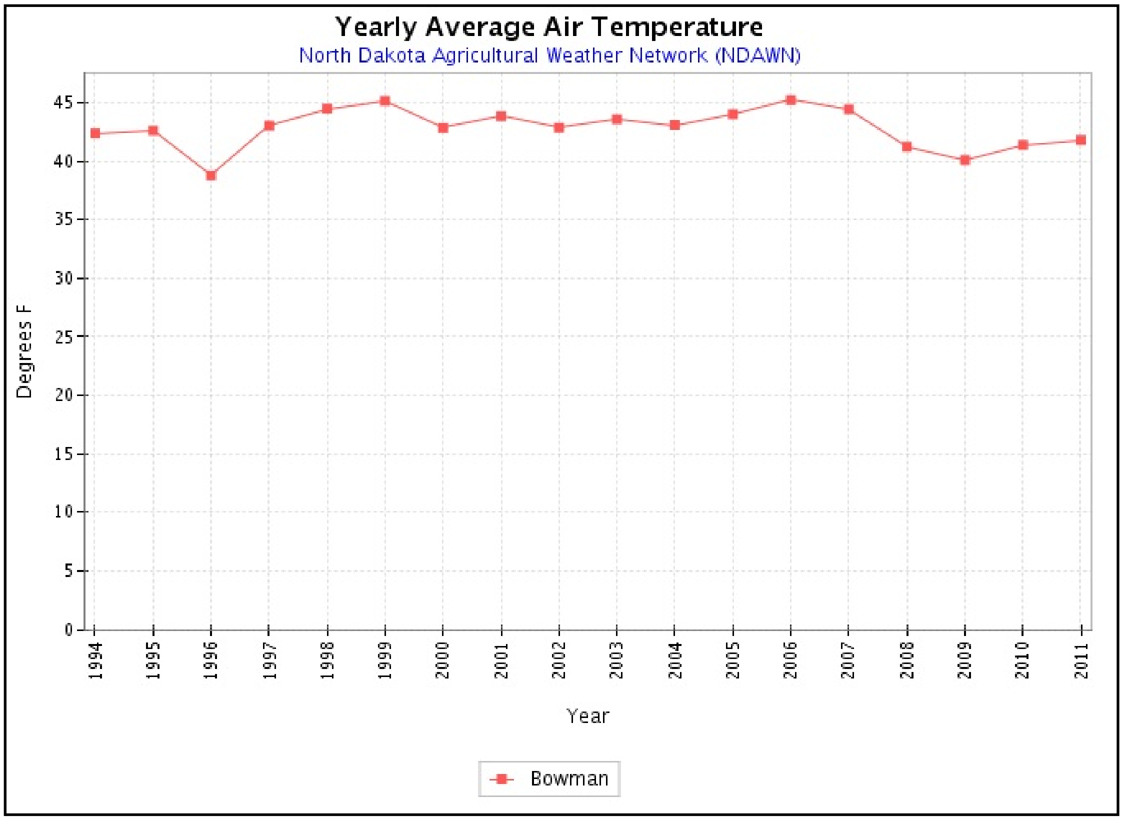

Figure 4. Annual Average Air Temperature at Bowman, North Dakota from 1994-2011. North Dakota Agricultural Weather Network (NDAWN).

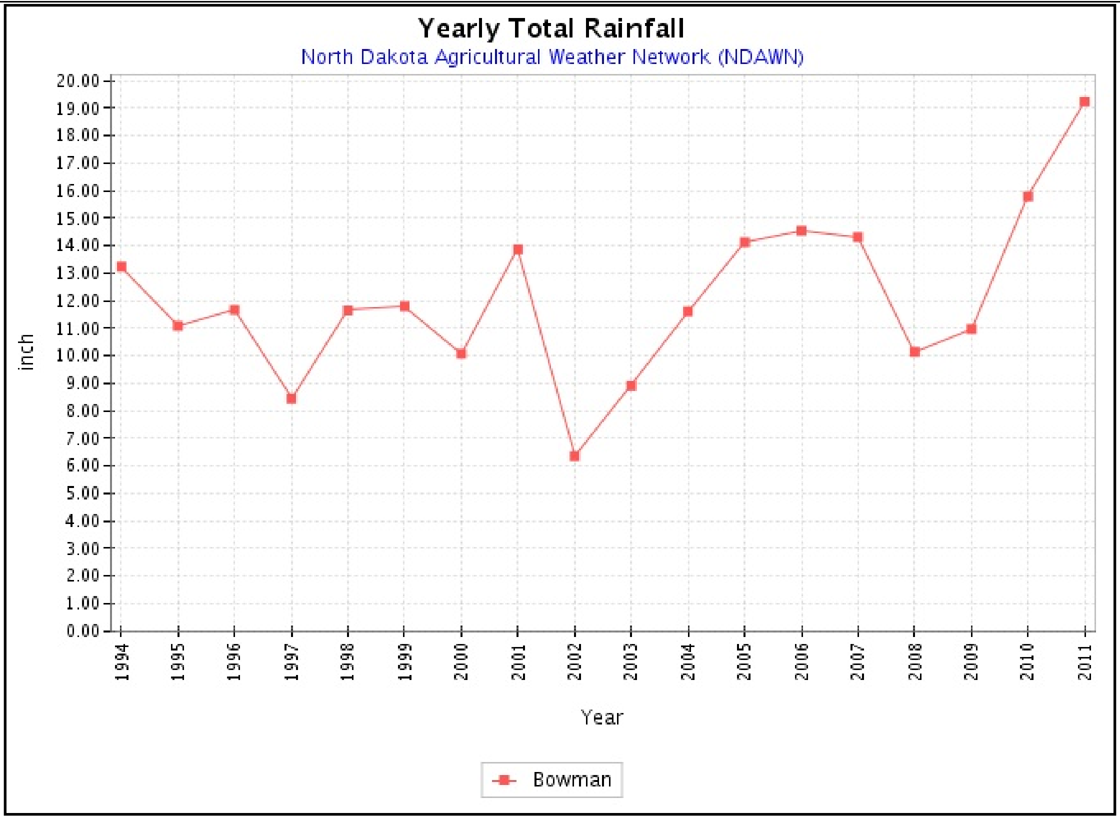

Figure 5. Annual Total Precipitation at Bowman, North Dakota from 1994-2011. North Dakota Agricultural Weather Network (NDAWN).

1.5 Available Data

1.5.1 Fecal Coliform Bacteria

Fecal coliform bacteria samples were collected at two locations corresponding with each of the impaired reaches addressed in this TMDL. The monitoring site located on Deep Creek (ND-10110203-003-S_00), station ID 385208, is located 22 miles north and three and three-quarter miles east of Rhame, ND. Monitoring site 385209 is located on West Branch Deep Creek (ND-10110203-004-S_00) five miles north and four miles east of Rhame, ND. Sites 385208 and 385209 were monitored weekly or when flow conditions were present during the recreation season (May 1st – September 30th) of 2006 and 2009 by the Bowman-Slope Soil Conservation District. Deep Creek and West Branch Deep Creek are ephemeral streams. As a result, samples were discontinued on Deep Creek and West Branch Deep Creek in July and June, respectively. While the state of North Dakota has an E. coli bacteria standard (see Section 2.2), no E. coli bacteria data are available for Deep Creek or West Branch Deep Creek.

Table 4 provides a summary of fecal coliform monthly geometric mean concentrations, the percentage of samples exceeding 400 CFU/100mL for each month and the recreational use assessment by month. The monthly geometric mean fecal coliform bacteria concentration and the percent of samples over 400 CFU/100ml were calculated for each month (May-September) using those samples collected during each month in 2006 and 2009.

Table 4. Summary of Fecal Coliform Bacteria Data for Sites 385208 and 385209 (Data Collected in 2006 and 2009).

385208					
Recreational Season	**May**	**June**	**July**	**August**	**September**
Number of Samples	11	10	8	0	0
Geometric Mean	230	81	81	N/A	N/A
% Exceeded 400 CFU/100 mL	36%	10%	25%	N/A	N/A
Recreational Use Assessment	NS	FS	FSBT	INSFD	INSFD
385209					
Recreational Season	**May**	**June**	**July**	**August**	**September**
Number of Samples	11	9	0	0	0
Geometric Mean	279	444	N/A	N/A	N/A
% Exceeded 400 CFU/100 mL	45%	78%	N/A	N/A	N/A
Recreational Use Assessment	NS	NS	INSFD	INSFD	INSFD

FS – Fully Supporting; FSBT- Fully Supporting but Threatened; NS – Not Supporting; INSFD – Insufficient Data

Analysis of fecal coliform bacteria data collected at site 385208 in 2006 and 2009 demonstrated that the month of May was not supporting, June was fully supporting, and July was fully supporting but threatened the recreational beneficial uses (Table 4 and Appendix A). A recreational use assessment could not be calculated for the months of August and September due to an insufficient amount of samples taken in 2006 and 2009.

The recreational use support assessment for site 385209 concluded that during the months of May and June recreational beneficial uses were not supporting (Table 4 and Appendix A). A recreational use assessment could not be evaluated for the months of July, August, and September due to an insufficient amount of samples taken in 2006 and 2009.

1.5.2 Hydraulic Discharge

Due to the lack of streamflow data for the Deep Creek watershed, an index station was used (see Section 5.1). This location was at the United States Geological Survey (USGS) gaging station located on Charbonneau Creek near Charbonneau, ND (06329597). A discharge record was constructed for the TMDL listed segments using the Drainage Area Ratio Method (DARM) (Ries et al., 2000) and the historical discharge measurements collected by the USGS at gaging station 06329597 from 2006 through 2009.

2.0 WATER QUALITY STANDARDS

The Clean Water Act requires that Total Maximum Daily Loads (TMDLs) be developed for waters on a state's Section 303(d) list. A TMDL is defined as "the sum of the individual waste load allocations for point sources and load allocations for non point sources and natural background" such that the capacity of the waterbody to assimilate pollutant loadings is not exceeded. The purpose of a TMDL is to identify the pollutant load reductions or other actions that should be taken so that impaired waters will be able to attain water quality standards. TMDLs are required to be developed with seasonal variations and must include a margin of safety that addresses the uncertainty in the analysis. Separate TMDLs are required to address each pollutant or cause of impairment (i.e., fecal coliform bacteria).

2.1 Narrative North Dakota 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, 2011).

- 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 water; 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 biological goal for all surface waters in the state. The goal states "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, 2011).

2.2 Numeric North Dakota Water Quality Standards

Deep Creek and West Branch Deep Creek are Class III streams. The NDDoH definition of a Class III stream is shown below (NDDoH, 2011).

Class III- The quality of the waters in this class shall be suitable for agricultural and industrial uses. Stream in this class generally have low average flows with prolonged periods of no flow. During periods of no flow, they are of limited value for recreation and fish aquatic biota. The quality of these waters must be maintained to protect secondary contact recreation uses (e.g., wading), fish and aquatic biota, and wildlife uses.

Effective January 2011, NDDoH revised the State water quality standards. In these latest revisions NDDoH eliminated the fecal coliform bacteria standard, retaining only the E. coli bacteria standard for the protection of recreational uses. This standards change was recommended by the US EPA as E. coli is believed to be a better indicator of recreational use risk (i.e., incidence of gastrointestinal disease). It is anticipated that the reductions necessary to achieve the fecal coliform bacteria water quality target will also meet the E. coli bacteria water quality standards. If future E. coli bacteria monitoring data shows that an E. coli bacteria impairment exists in one or both of the impaired segments, a separate reduction analysis will be conducted and this TMDL document will be revised or a separate TMDL will be developed.

Table 5 provides a summary of the current numeric E. coli criteria which applies to Class III streams as well as the former fecal coliform bacteria standard. The E. coli bacteria standard applies only during the recreation season of May 1 to September 30.

Table 5. North Dakota Bacteria Water Quality Standards for Class III Streams.

Parameter	Standard	
	Geometric Mean[1]	Maximum[2]
Fecal Coliform Bacteria*	200 CFU/100 mL	400 CFU/100 mL
E. coli Bacteria	126 CFU/100 mL	409 CFU/100 mL

[*] Previous State water quality standard.
[1] Expressed as a geometric mean of representative samples collected during any consecutive 30-day period.
[2] No more than ten percent of samples collected during any consecutive 30-day period shall individually exceed the standard.

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 Deep Creek is based on the State water quality standard for fecal coliform bacteria. Since the E. coli bacteria water quality standard of 126 CFUs/100 mL is now the current applicable water quality standard for bacteria it is the primary TMDL target for the Deep Creek and West Branch Deep Creek impaired TMDL segments. Even though it is no longer considered a numeric criterion in the water quality standards for North Dakota, the secondary TMDL target for these TMDL segments remains the fecal coliform bacteria standard of 200 CFUs/100 mL. In addition, no more than ten percent of the samples may exceed 409 CFUs/100 mL for E. coli bacteria or 400 CFUs/100 mL for fecal coliform bacteia. While the 126 CFUs/100 mL and 200 CFUs/100 mL E. coli and fecal coliform bacteria criterion are intended to be expressed as a 30-day geometric mean, for purposes of these TMDLs, both are expressed as the daily average concentration based on individual grab samples. Expressing both the fecal coliform TMDL and the E. coli TMDL in this way will ensure the TMDLs will result in the target being met during all flow regimes, that both components of the criterion will be met, and that recreational uses will be restored.

As stated previously (see Section 1.5.1), there are currently no E. coli data available for the two listed TMDL reaches. Deep Creek reach ND-10110203-003-S_00 and West Branch Deep Creek reach ND-10110203-004-S_00 are classified as not supporting to fully supporting but threatened for recreational uses due to exceedences of the fecal coliform bacteria standard which was in effect at the time of the TMDL listing. For this reason, the fecal coliform standard will remain the secondary TMDL target, while the E.coli standard will be considered the primary TMDL target and TMDLs will be provided for both for the two TMDL segments which are the focus of this report.

4.0 SIGNIFICANT SOURCES

4.1 Point Source Pollution Sources

Within the Deep Creek and West Branch Deep Creek watershed, there are no municipal point sources permitted through the North Dakota Pollutant Discharge Elimination System (NDPDES) Program. There are no known permitted confined animal feeding operations (CAFOs) or animal feeding operations (AFOs) in the watershed of Deep Creek and West Branch Deep Creek.

4.2 Nonpoint Source Pollution Sources

The fecal coliform bacteria, and presumably E. coli bacteria, pollution to these segments is originating from nonpoint sources in the watershed. Unpermitted AFOs and livestock grazing and watering in proximity to Deep Creek are common along the TMDL listed segments.

The southwest portion of North Dakota typically experiences short duration, but intense precipitation during the spring. These storms can cause overland flooding and rising river levels. Due to the close proximity of livestock grazing and watering to the river (grassland areas on the land use map, Figure 5), it is likely that they contribute to the fecal coliform and E. coli bacteria pollution in the listed segments of Deep Creek and West Branch Deep Creek.

These assessments are supported by the load duration curve analysis (Section 5.3) which shows exceedences of the fecal coliform bacteria standard occurring during moist and dry conditions.

Wildlife may also contribute to the fecal coliform and E. coli bacteria found in the water quality samples, but most likely in a lower concentration. Wildlife are nomadic with fewer numbers concentrated in a specific area, thus decreasing the probability of their contribution of fecal coliform and E. coli bacteria in significant quantities.

Septic system failure might contribute to the fecal coliform and E. coli bacteria in the water quality samples. Failures can occur for several reasons, although 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. While the number of systems that are not functioning properly in this watershed is unknown, it is estimated that 28 percent of the systems in North Dakota are failing (USEPA, 2002).

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 TMDL 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 a pollutant (e.g., E. coli or 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 bacteria reductions necessary to achieve the secondary water quality standard target for fecal coliform bacteria of 200 CFU/100 mL with a margin of safety of 10 percent. It is expected that the estimated fecal coliform bacteria reductions will also meet the E. coli bacteria targets.

5.1 Mean Daily Stream Flow

In southwest North Dakota, rain events are variable, generally occurring during the months of April through June. 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. The low flow regime is characteristic of drought or precipitation events of small magnitude and do not contribute to runoff.

The discharge record for the watersheds were determined by utilizing the Drainage Area Ratio Method (DARM) (Ries et al., 2000). The DARM assumes that the streamflow at the ungaged site(s) is hydrologically similar (same per unit area) to the stream gaging station used as an index. Charbonneau Creek gaging station 06329597 was used as the index station as it is the closest, most hydrologically similar gaging station to the Deep Creek watershed. Table 6 depicts land use comparisons between the Deep Creek watershed and the Charbonneau Creek watershed to determine similarities (i.e., cropland, grassland). Drainage area and land use for the ungaged sites (385208 and 385209) and index station 06329597 were determined through GIS using digital elevation models (DEMs) and the 2010 NASS land use database. Streamflow data for the index station (06329597) was obtained from the USGS Water Science Center website. The index station (06329597) streamflow data was then divided by the drainage area to determine streamflows per unit area at the index station. Those values were then multiplied by the drainage area for the ungaged sites to obtain estimated flow statistics for ungaged sites 385208 and 385209.

Table 6. Land Use Comparison for the Charbonneau Creek and Deep Creek Watersheds.

Charbonneau Creek Watershed			**Deep Creek Watershed**	
Acres	**Watershed Percentage**	**Land Use Name**	**Watershed Percentage**	**Acres**
448	1%	Corn/Sunflower	1%	2,254
14,440	15%	Small Grains	17%	30,428
5	0%	Oil Seeds	0%	781
1,097	1%	Beans/Peas/Lentils	2%	3,347
7	0%	Other Crops	0%	195
6,231	6%	Alfalfa/Hay	7%	12,980
70,006	72%	Pasture/Grassland	68%	123,313
326	1%	Water/Wetlands	1%	786
2,564	3%	Developed/Barren	3%	5,935
543	1%	Woodland	1%	2,288
97,616		Total Acres		182,309

5.2 Flow Duration Curve Analysis

The flow duration curve serves as the foundation for the load duration curve used in the TMDL. Flow duration curve analysis looks at the cumulative frequency of historic flow data over a specified time period. A flow duration curve relates flow (expressed as mean daily discharge) to the percent of time those mean daily flow values have been met or exceeded. The use of *"percent of time exceeded"* (i.e., duration) provides a uniform scale ranging from 0 to 100 percent, thus accounting for the full range of stream flows for the period of record. Low flows are exceeded most of the time, while flood flows are exceeded infrequently (USEPA, 2007).

A basic flow duration curve runs from high to low (0 to 100 percent) along the x-axis with the corresponding flow value on the y-axis (Figures 6 and 7). Using this approach, flow duration intervals are expressed as a percentage, with zero corresponding to the highest flows in the record (i.e., flood conditions) and 100 to the lowest flows in the record (i.e., drought). Therefore, as depicted in Figure 6, a flow duration interval of 25 percent, associated with a stream flow of 1.1 cfs, implies that 25 percent of all observed mean daily discharge values equal or exceed 1.1 cfs.

Once the flow duration curve is developed for the stream site, flow duration intervals can be defined which can be used as a general indicator of hydrologic condition (i.e., wet vs dry conditions and to what degree). These intervals (or zones) provide additional insight about conditions and patterns associated with the impairment (fecal coliform bacteria in this case) (USEPA, 2007). As depicted in Figure 6, the flow duration curve was divided into four zones, one representing high flows (0-5 percent), another for moist conditions (5-24 percent), one for dry conditions (24-48 percent) and one for low flows (48-61 percent). Based on the flow duration curve analysis, no flow occurred 39 percent of the time (61-100 percent).

These flow intervals were defined by examining the range of flows for the site for the period of record and looking for natural breaks in the flow record based on the flow duration curve plot (Figures 6 and 7). A secondary factor in determining the flow intervals used in the analysis is the number of fecal coliform bacteria observations available for each flow interval.

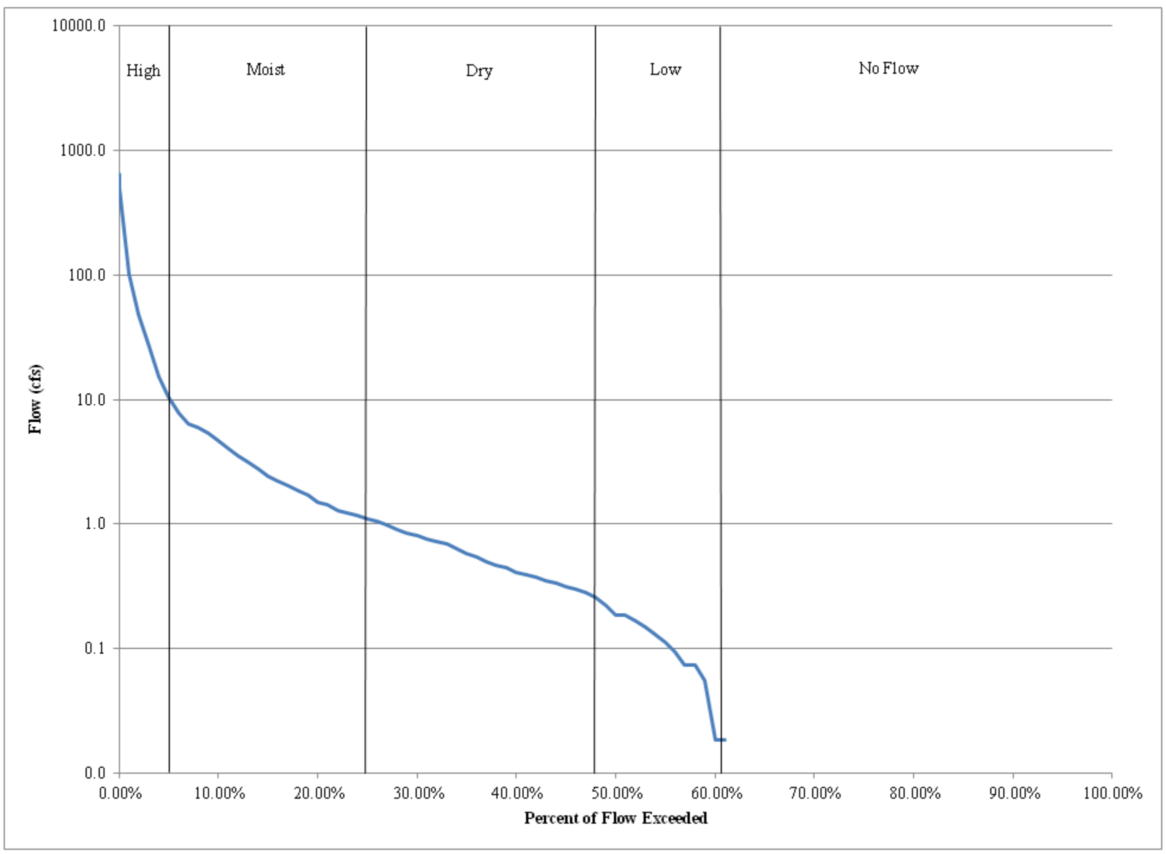

Figure 6. Flow Duration Curve for Deep Creek Monitoring Station 385208.

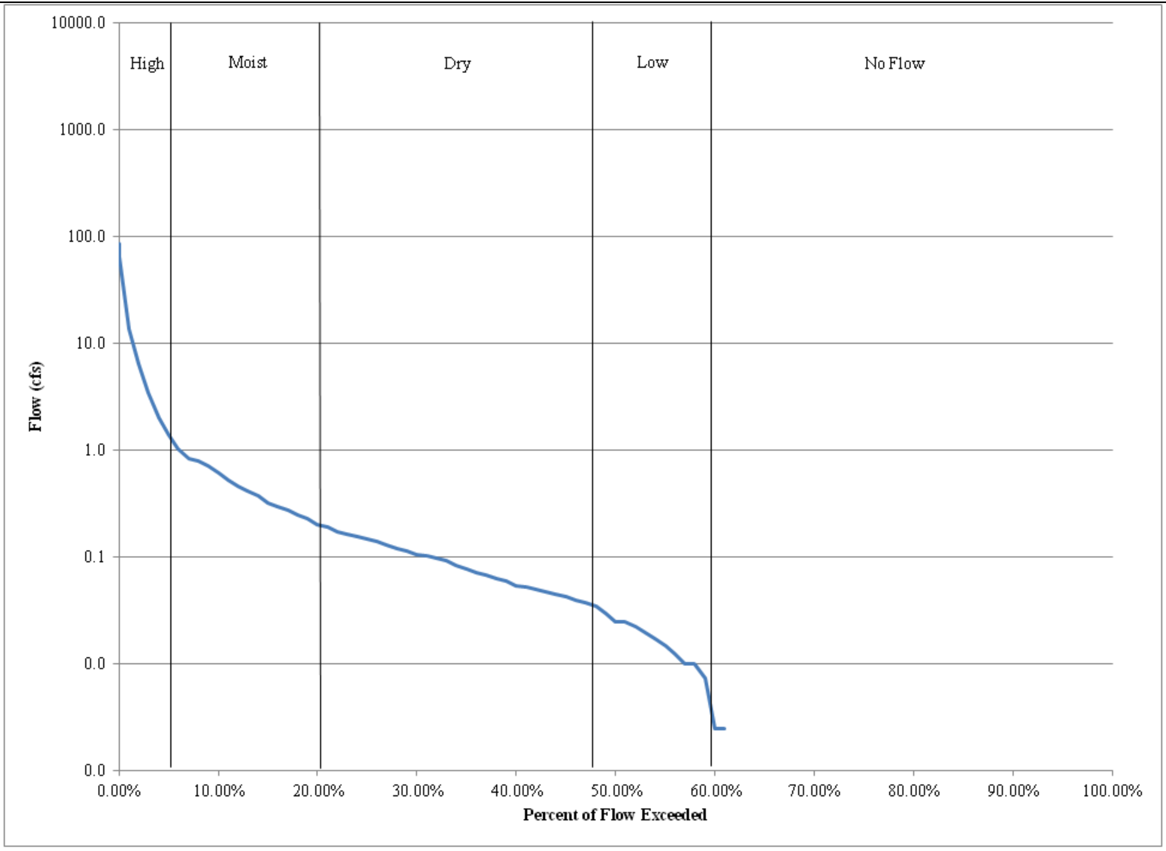

Figure 7. Flow Duration Curve for West Branch Deep Creek Monitoring Station 385209.

5.3 Load Duration Analysis

An important factor in determining NPS pollution loads is variability in stream flows and loads associated with high and low flow. To better correlate the relationship between the pollutant of concern and the hydrology of the Section 303(d) TMDL listed segments, a load duration curve was developed for Deep Creek and West Branch Deep Creek. The load duration curves for the TMDL listed reaches were derived using the fecal coliform bacteria TMDL target of 200 CFU/100 mL and the flows generated as described in Sections 5.1 and 5.2. Additional load duration curves were also developed to comply with the current State water quality standard for E. coli bacteria of 126 CFU/100 mL (Figures 9 and 11).

Observed in-stream total fecal coliform bacteria concentrations obtained for monitoring sites 385208 and 385209 from 2006 and 2009 (Appendix A) were converted to a pollutant load by multiplying total fecal coliform bacteria concentrations by the mean daily flow for the site on the day the sample was collected and a conversion factor. These loads are plotted against the percent exceeded of the flow on the day of sample collection (Figures 8 and 10). Points plotted above the 200 CFU/100 mL target curve exceed the State water quality target. Points plotted below the curve are meeting the previous State water quality target of 200 CFU/100 mL.

For each flow interval or zone, a regression relationship was developed between the samples which occur above the TMDL target (200 CFU/100 mL) curve and the corresponding percent exceeded flow. The load duration curve for sites 385208 and 385209 depicting a regression relationship for each flow interval are provided in Figures 8 and 10.

As there was only one fecal coliform bacteria concentration above the TMDL target in the low flow regime for site 385209 the single data point was used to derive the existing load for that flow regime.

The regression lines for flow regimes with multiple total fecal coliform bacteria concentrations above the TMDL target were then used with the midpoint of the percent exceeded flow for that interval to calculate the existing fecal coliform bacteria load for that flow interval. In the example provided in Figure 8, the regression relationship between observed fecal coliform bacteria loading and percent exceeded flow for the moist condition and dry condition flow intervals are:

Fecal coliform bacteria load (expressed as 10^7 CFUs/day) = antilog (Intercept + (Slope*Percent Exceeded Flow))

Where the midpoint of the moist condition interval from 5 to 24 percent is 14.5 percent, the existing fecal coliform bacteria load is:

Fecal coliform bacteria load (10^7 CFUs/day) = antilog (4.17 + (-5.84*0.145))
= 2,089 x 10^7 CFUs/day

Where the midpoint of the dry condition interval from 24 to 48 percent is 36 percent, the existing fecal coliform bacteria load is:

Fecal coliform bacteria load (10^7 CFUs/day) = antilog (3.99 + (-3.22*0.36))
= 673 x 10^7 CFUs/day

The midpoint for the flow intervals is also used to estimate the TMDL target load. In the case of the previous examples, the TMDL target load for the midpoints or 14.5 and 36 percent exceeded flow derived from the 200 CFU/100 mL TMDL target curves are 1,280 x 10^7 CFUs/day, and 265 x 10^7 CFUs/day, respectively.

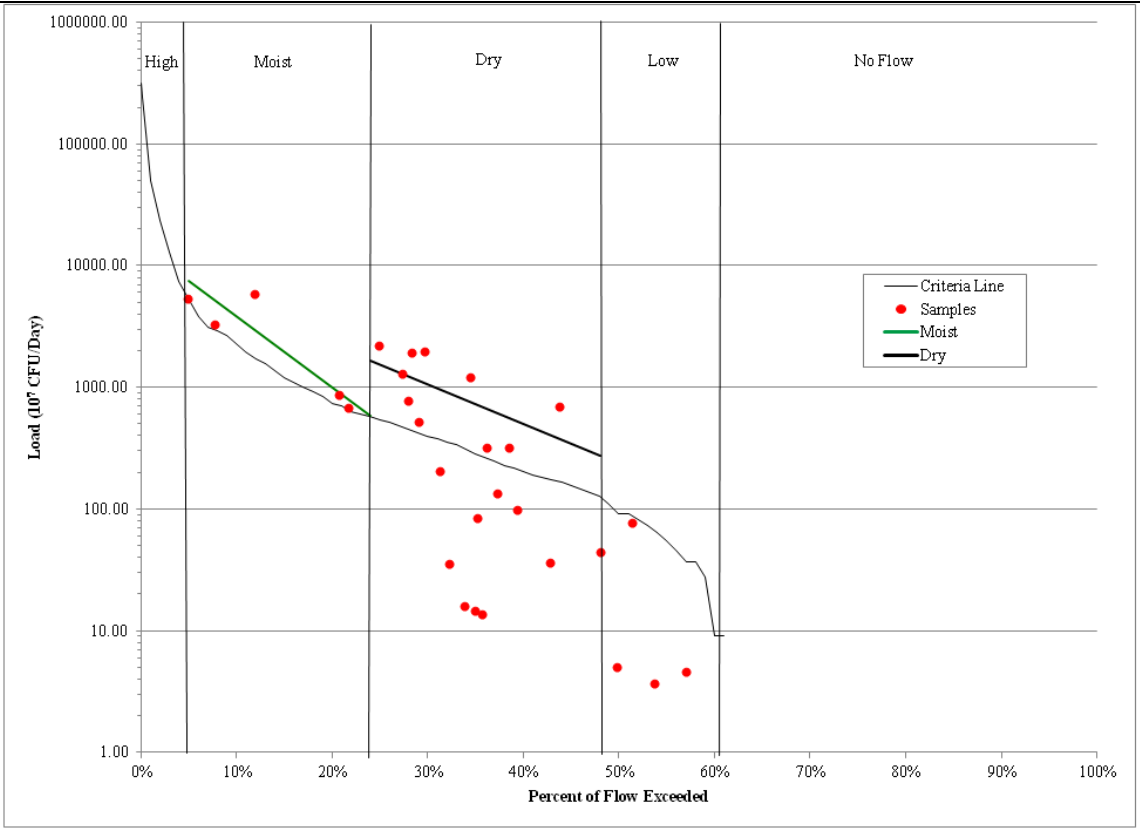

Figure 8. Fecal Coliform Bacteria Load Duration Curve for Deep Creek Monitoring Station 385208. The curve reflects flows collected from 2006-2009.

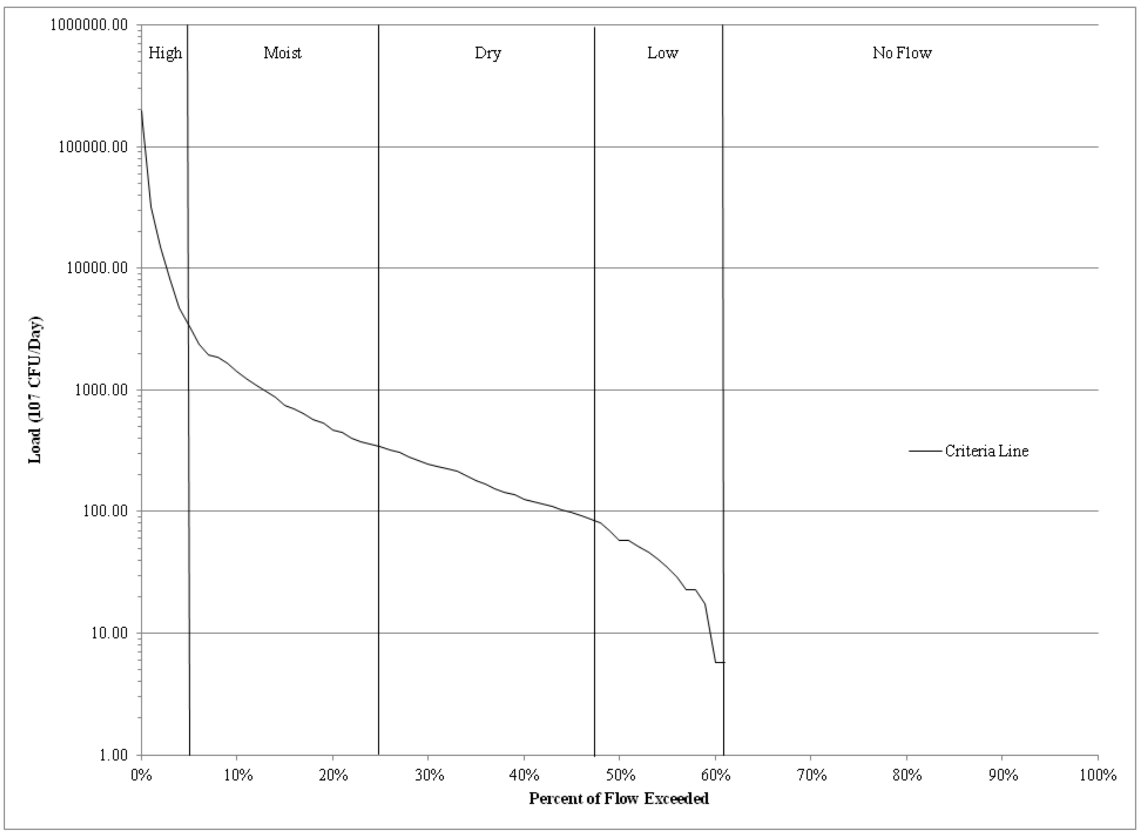

Figure 9. E. coli Bacteria Load Duration Curve for Deep Creek Monitoring Station 385208. The curve reflects flows collected from 2006-2009.

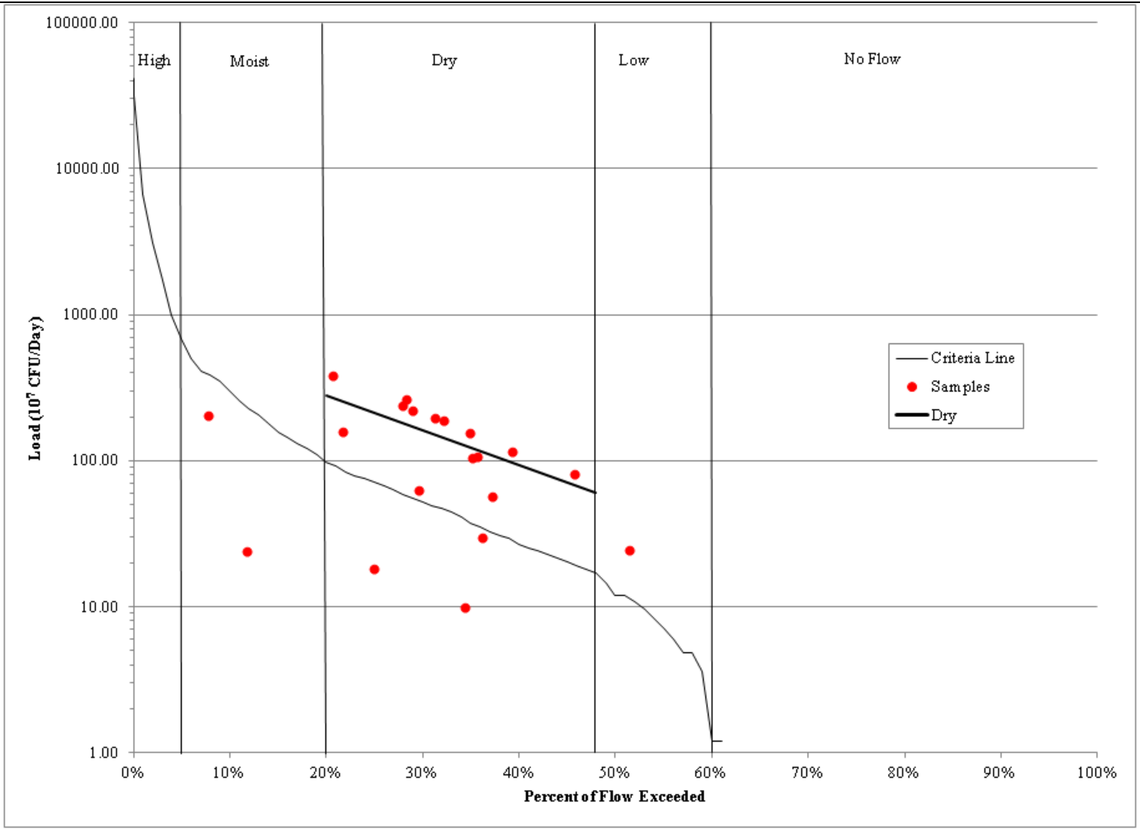

Figure 10. Fecal Coliform Bacteria Load Duration Curve for West Branch Deep Creek Monitoring Station 385209. The curve reflects flows collected from 2006-2009.

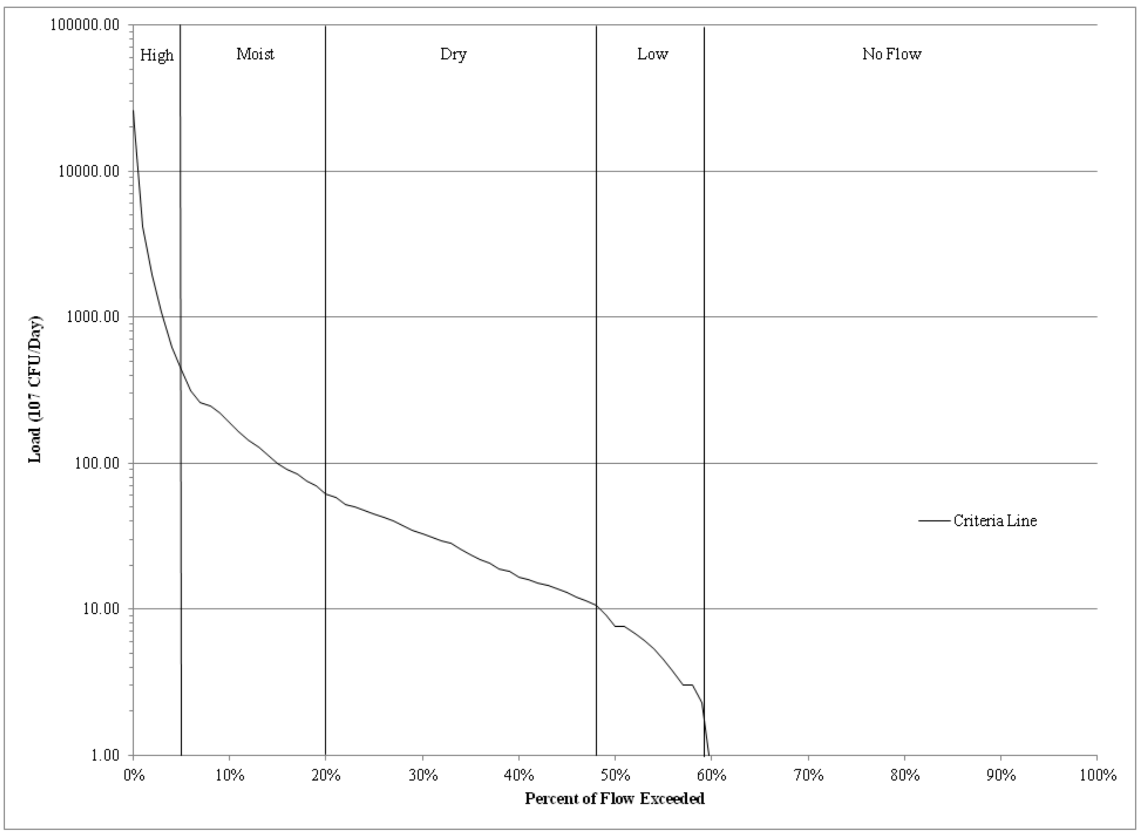

Figure 11. E. coli Bacteria Load Duration Curve for West Branch Deep Creek Monitoring Station 385209. The curve reflects flows collected from 2006-2009.

5.4 Loading Sources

The load reductions needed for the Deep Creek fecal coliform bacteria TMDL can generally be allotted to nonpoint sources. Based on the data available, the general focus of best management practices (BMPs) and load reductions for the listed segment should be on riparian grazing adjacent to or in close proximity to Deep Creek.

Significant sources of total fecal coliform bacteria loading were defined as nonpoint source pollution originating from livestock. One of the more important concerns regarding nonpoint sources is variability in stream flows. Variable stream flows often cause different source areas and loading mechanisms to dominate (Cleland, 2003). A TMDL was developed for two flow regimes at site 385208 (i.e., moist, dry) and one flow regime at site 385209 (i.e., dry), as samples indicated this is where the exceedences of the water quality standard occurred (Figures 8 and 9).

By relating runoff characteristics to each flow regime one can infer which sources are most likely to contribute to fecal coliform bacteria 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 flow or under moist and dry conditions (Table 7). In contrast, intensive grazing of livestock in only the upland area has a high potential to impact water quality at high flows and medium impact under moist and dry flows (Table 7). Exclusion of livestock from the riparian area eliminates the potential of direct manure deposit and therefore is considered to be of high importance at all 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.

Table 7. Nonpoint Sources of Pollution and Their Potential to Pollute at a Given Flow Regime.

Nonpoint Sources	Flow Regime		
	High Flow	**Moist Conditions**	**Dry Conditions**
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 nonpoint source area to contribute bacteria loads under a given flow regime. (H: High; M: Medium; L: Low)

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) 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 a separate component of the TMDL (explicit).

To account for the uncertainty associated with known sources and the load reductions necessary to reach the TMDL target of 200 CFU/100 mL, a ten percent explicit margin of safety was used for this TMDL. The MOS was calculated as ten percent of the TMDL. In other words ten percent of the TMDL is set aside from the load allocation as a MOS.

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 Deep Creek and West Branch Deep Creek TMDLs address seasonality because the flow duration curves were developed using four years of USGS gage data encompassing all 12 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 fecal coliform bacteria loads during the seasons covered by the standard.

7.0 TMDL

Table 8 provides an outline of the critical elements of the bacteria TMDL for the two TMDL listed segments. TMDLs for Deep Creek (ND-10110203-003-S_00) and West Branch Deep Creek (ND-10110203-004-S_00) are summarized in Tables 9-12, respectively. The TMDLs provide a summary of average daily loads by flow regime necessary to meet the water quality target (i.e., TMDL). The TMDL for each segment and flow regime provide an estimate of the existing daily load, an estimate of the average daily loads necessary to meet the primary E. coli water quality target and the secondary fecal coliform bacteria target (i.e., TMDL load). The TMDL load includes a load allocation from known nonpoint sources and a 10 percent margin of safety.

It should be noted that the TMDL loads, load allocations, and the MOS are estimated based on available data and reasonable assumptions and are to be used as a guide for implementation. The actual reduction needed to meet the applicable water quality standards may be higher or lower depending on the results of future monitoring.

Table 8. TMDL Summary for Deep Creek.

Category	Description	Explanation
Beneficial Use Impaired	Recreation	Contact Recreation (i.e., swimming, fishing)
Pollutants	Fecal Coliform Bacteria E. coli Bacteria	See Section 2.1
Secondary Fecal Coliform Bacteria TMDL Target	200 CFU/100 mL	Based on the former state water quality standard for fecal coliform bacteria.
Primary E. coli Bacteria TMDL Target	126 CFU/100 mL	Based on the current state water quality standard for E. coli bacteria.
WLA	Point Source Contributions	There are no contributing point sources in the TMDL watersheds.
LA	Nonpoint Source Contributions	Loads are a result of nonpoint sources (i.e., rangeland, pasture land).
Margin of Safety (MOS)	Explicit	10 percent

TMDL = LC = WLA + LA + MOS

where

LC = loading capacity, or the greatest 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 non-point sources;

MOS = margin of safety, or an accounting of the 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.

Table 9. Fecal Coliform Bacteria TMDL (10^7 CFU/day) for Deep Creek Waterbody ND-10110203-003-S_00 as Represented by Site 385208 (Based on Previous State Water Quality Standards).

	Flow Regime			
	High Flow	Moist Conditions	Dry Conditions	Low Flow
Existing Load		2,089	673	
TMDL	18,279[1]	1,280	265	60[1]
WLA		0	0	
LA		1,152	238	
MOS		128	27	

[1]TMDL load is provided as a guideline for watershed management and BMP implementation.

Table 10. E. coli Bacteria TMDL (10^7 CFU/day) for Deep Creek Waterbody ND-10110203-003-S_00 as Represented by Site 385208 (Based on New State Water Quality Standards).

	Flow Regime			
	High Flow	Moist Conditions	Dry Conditions	Low Flow
TMDL	11,516	807	167	38
WLA	0	0	0	0
LA	10,365	726	149	34
MOS	1,151	81	18	4

Table 11. Fecal Coliform Bacteria TMDL (10^7 CFU/day) for West Branch Deep Creek Waterbody ND-10110203-004-S_00 as Represented by Site 385209 (Based on Previous State Water Quality Standards).

	Flow Regime			
	High Flow	Moist Conditions	Dry Conditions	Low Flow
Existing Load			130	
TMDL	2,407[1]	216[1]	41	12[1]
WLA			0	
LA			37	
MOS			4	

[1]TMDL load is provided as a guideline for watershed management and BMP implementation.

Table 12. E. coli Bacteria TMDL (10^7 CFU/day) for West Branch Deep Creek Waterbody ND-10110203-004-S_00 as Represented by Site 385209 (Based on New State Water Quality Standards).

	Flow Regime			
	High Flow	Moist Conditions	Dry Conditions	Low Flow
TMDL	1,516	107	37	6
WLA	0	0	0	0
LA	1,364	96	33	5
MOS	152	11	4	1

8.0 ALLOCATION

There are no known point sources impacting the watershed. The entire fecal coliform bacteria load allocation for this TMDL is allocated to nonpoint sources in the watersheds. The entire 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, or waste management).

Nonpoint source pollution is a contributor to elevated total fecal coliform bacteria levels in the Deep Creek and West Branch Deep Creek watersheds. The fecal coliform bacteria samples and load duration curve analysis of the impaired reaches identified moist and dry flow regimes for ND-10110203-003-S and dry flow regime for ND-10110203-004-S as the time of fecal coliform bacteria exceedences for the 200 CFU/100 mL target. To reduce NPS pollution for the high, moderate, and low flow regimes, specific BMPs are described in Section 8.1 that will mitigate the effects of fecal coliform bacteria loading to the impaired reaches.

To achieve the TMDL targets identified in the report, it will require the wide spread support and voluntary participation of landowners and residents in the watershed. The TMDLs described in this report are a plan to improve water quality by implementing BMPs through non-regulatory approaches. BMPs are methods, measures, or practices that are determined to be a reasonable and cost effective means for a land owner to meet nonpoint source pollution control needs," (USEPA, 2001). This TMDL plan is put forth as a recommendation for what needs to be accomplished for the Deep Creek and West Branch Deep Creek watersheds to restore and maintain their recreational uses. Water quality monitoring should continue in order to measure BMP effectiveness and determine through adaptive management if loading allocation recommendations need to be adjusted.

Controlling nonpoint sources is an immense undertaking requiring extensive financial and technical support. Provided that technical/financial assistance is available to stakeholders, these BMPs have the potential to significantly reduce fecal coliform bacteria loading to Deep Creek and West Branch Deep Creek. The following sections describe in detail those BMPs that will reduce fecal coliform bacteria levels in the watersheds.

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, 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 because of livestock. These specific BMPs are known to reduce nonpoint source pollution from livestock.

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 nonpoint 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 public.

Prescribed grazing- This practice is used 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 Resource 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. (1998), 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.

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

Grazing Strategy		Geometric Mean Bacteria 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	950/L

Waste management system- Waste management systems can be effective in controlling up to 90 percent of bacteria loading originating from confined animal feeding areas (Table 14). A waste management system is made up of various components designed to control nonpoint source 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 of manure is designed to be adaptive to environmental, soil and plant conditions to minimize the probability of contamination of surface water.

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 Bacteria (%)
Animal Waste System[e]	-	90	80	60	85
Diversion System[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 and waste treatment lagoons.

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 bacteria is quite successful. Results from a study by Pennsylvania State University (1992a) as presented by USEPA (1993), suggest that vegetative filter strips are capable of removing up to 55 percent of bacteria 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 System – 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

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. Wastes 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 bacteria. Land application of septic system sludge, although unlikely, may also be a source of contamination.

Septic system failure can occur for several reasons, although 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. 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).

9.0 PUBLIC PARTICIPATION

To satisfy the public participation requirement of this TMDL, a letter was sent to the following agencies and/or organizations notifying them that the draft report was available for review and public comment. Those included in the mailing were as follows:

- Bowman-Slope Soil Conservation District;
- Bowman-Slope Water Resource Board;
- Natural Resource Conservation Service (State Office); and
- U.S. Environmental Protection Agency, Region VIII.

In addition to notifying specific agencies of this draft TMDL report's availability, the report was posted on the North Dakota Department of Health, Division of Water Quality web site at http://www.ndhealth.gov./WQ/SW/Z2 TMDL/TMDLs Under PublicComment/B Under Public Commment.html . A 30 day public notice soliciting comment and participation was also published in the Bowman County Pioneer.

Comments were only received from US EPA Region 8, which were provided as part of their normal public notice review (Appendix E). The NDDoH's response to these comments are provided in Appendix F.

10.0 MONITORING

As stated previously, it should be noted that the TMDL loads, load allocations, and the MOS are estimated based on available data and reasonable assumptions and are to be used as a guide for implementation. The actual reduction needed to meet the applicable water quality standards may be higher or lower depending on the results of future monitoring.

Best management practices and technical assistance were implemented from 2005 through 2009 as part of the Section 319 Deep Creek Watershed Restoration Project. One of the goals of this project was to reduce fecal coliform bacteria loadings to Deep Creek. Water quality monitoring was also conducted as part of this project in accordance with an approved Quality Assurance Project Plan (QAPP). As prescribed in the QAPP (NDDoH, 2005), monitoring was conducted for all variables that were causing impairments to the beneficial uses of the waterbody. These included, but were not limited to fecal coliform bacteria. Sampling began in May 2006 and continued through September 2009.

In the event new watershed restoration activities and BMPs are implemented based on the recommendation provided in this TMDL report, additional water quality monitoring will be conducted, in accordance with an approved Quality Assurance Project Plan (QAPP). Specifically, monitoring will be conducted for the fecal coliform and E. coli bacteria. In the event a new watershed restoration plan (e.g., Section 319 PIP) is implemented, monitoring will be conducted in the stream beginning two years after implementation and extending five years after the implementation project is complete.

11.0 TMDL IMPLEMENTATION STRATEGY

In response to the Deep Creek Watershed Assessment and in anticipation of this completed TMDL, local sponsors successfully applied for and received Section 319 funding for the Deep Creek Watershed Restoration Project. Beginning in October 2007, local sponsors provided technical assistance and implementing BMPs designed to reduce fecal bacteria loadings and to help restore the beneficial uses of Deep Creek (i.e., recreation). As part of the watershed restoration project, water quality data were collected to monitor and track the effects of BMP implementation as well as to judge overall success of the project in reducing fecal coliform bacteria loadings. A QAPP (NDDoH, 2005) was developed as part of this watershed restoration project that detailed the how, when and where monitoring were conducted to gather the data needed to document success in meeting the TMDL implementation goal(s). As the data are analyzed, watershed restoration efforts will be adapted, if necessary, to place BMPs where they will have the greatest benefit to water quality and in meeting the TMDL goal(s).

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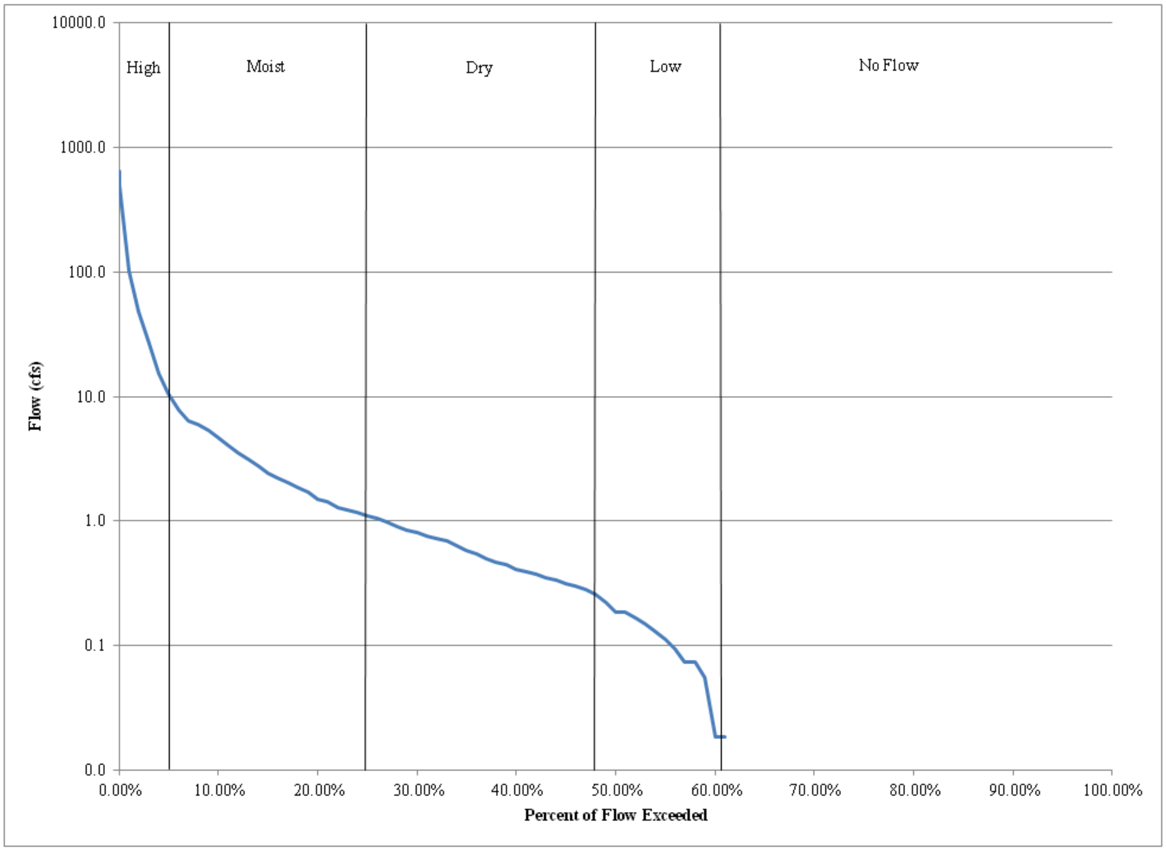
Appendix A
Fecal Coliform Bacteria Data Collected for Sites 385208 and 385209 (2006 and 2009)

385208						
	May		June		July	
	5/1/2006	210	6/1/2006	250	7/6/2006	10
	5/9/2006	640	6/7/2006	10	7/13/2006	20
	5/16/2006	800	6/8/2006	240	7/26/2006	10
	5/18/2006	960	6/13/2006	800	7/1/2009	280
	5/23/2006	20	6/22/2006	10	7/8/2009	200
	5/25/2006	880	6/29/2006	10	7/15/2009	540
	5/30/2006	340	6/9/2009	240	7/22/2009	40
	5/5/2009	210	6/17/2009	90	7/29/2009	800
	5/13/2009	110	6/20/2009	70		
	5/20/2009	60	6/24/2009	170		
	5/27/2009	110				
Number of Samples		11		10		8
Geometric Mean		230		81		81
% Exceeding 400 CFU/100mL		36%		10%		25%
Recreational Use Assessment	NS		FS		FST	

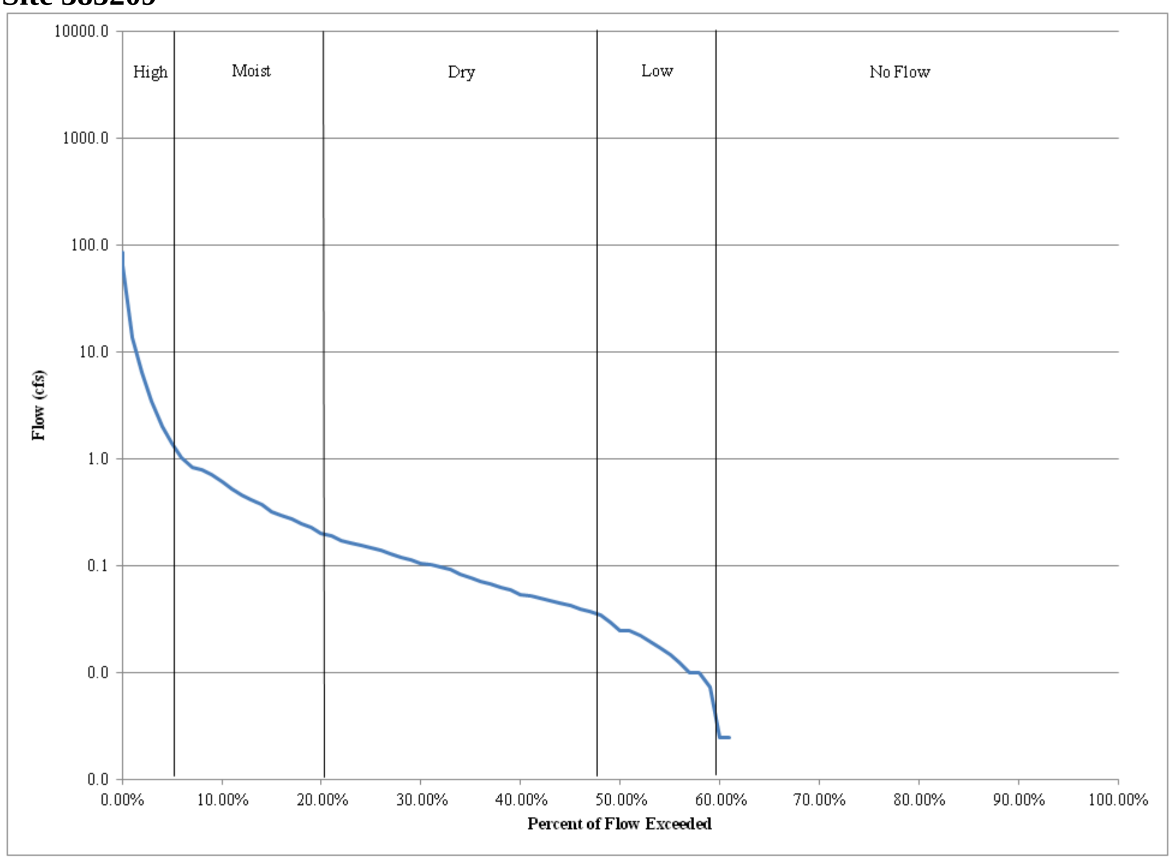
385209						
	May		June		July	
	5/1/2006	100	6/1/2006	800		
	5/9/2006	20	6/7/2006	590		
	5/16/2006	50	6/8/2006	170		
	5/18/2006	230	6/13/2006	50		
	5/23/2006	800	6/22/2006	800		
	5/25/2006	920	6/2/2009	800		
	5/30/2006	800	6/9/2009	800		
	5/5/2009	370	6/17/2009	800		
	5/13/2009	800	6/24/2009	410		
	5/20/2009	560				
	5/27/2009	350				
Number of Samples		11		9		
Geometric Mean		279		444		
% Exceeding 400 CFU/100mL		45%		78%		
Recreational Use Assessment	NS		NS			

Appendix B
Flow Duration Curves for Sites 385208 and 385209

Site 385208



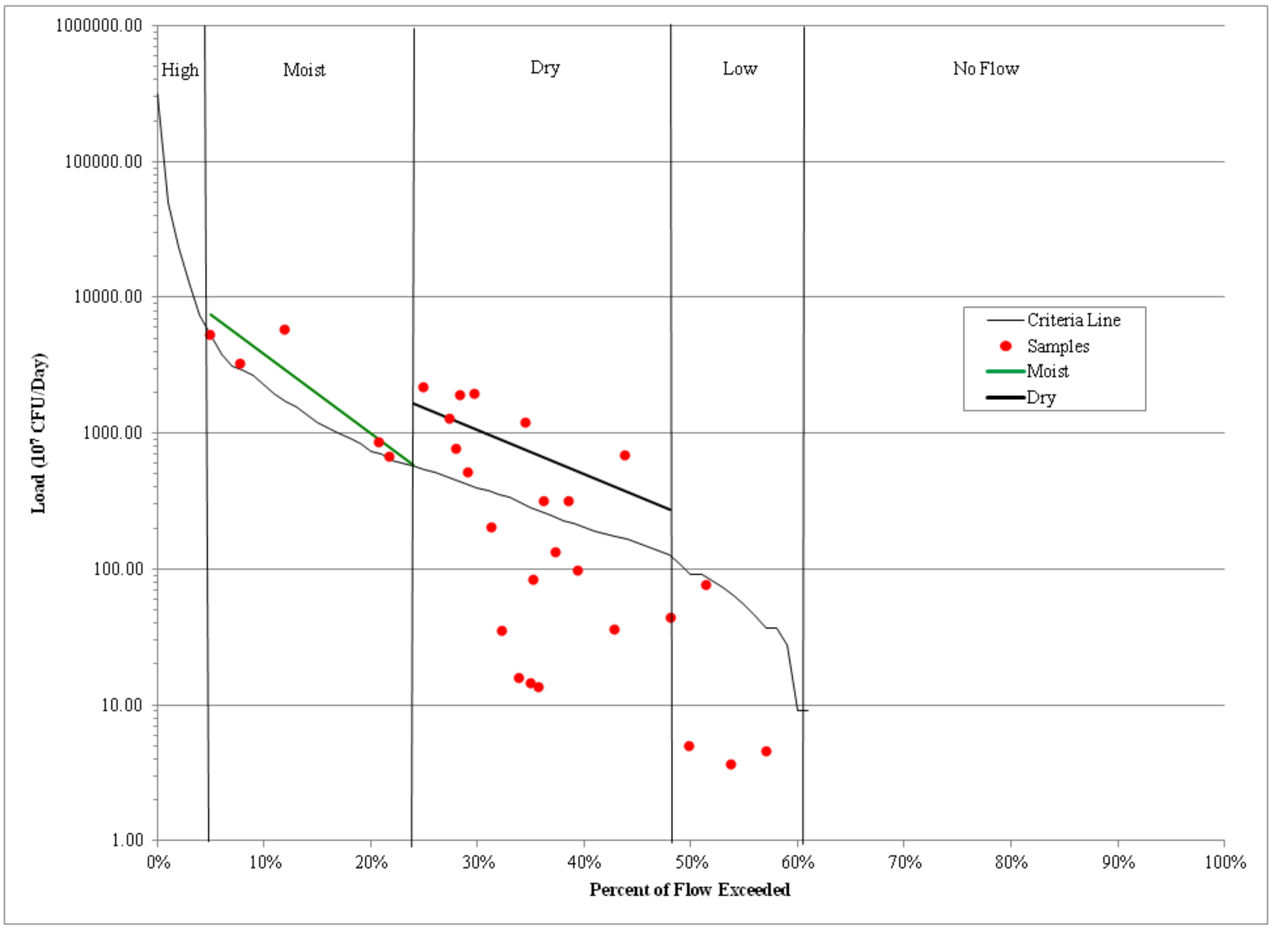
Site 385209



Appendix C
Load Duration Curve, Estimated Loads, TMDL Targets, and Percentage of Reduction Required for Sites 385208 and 385209

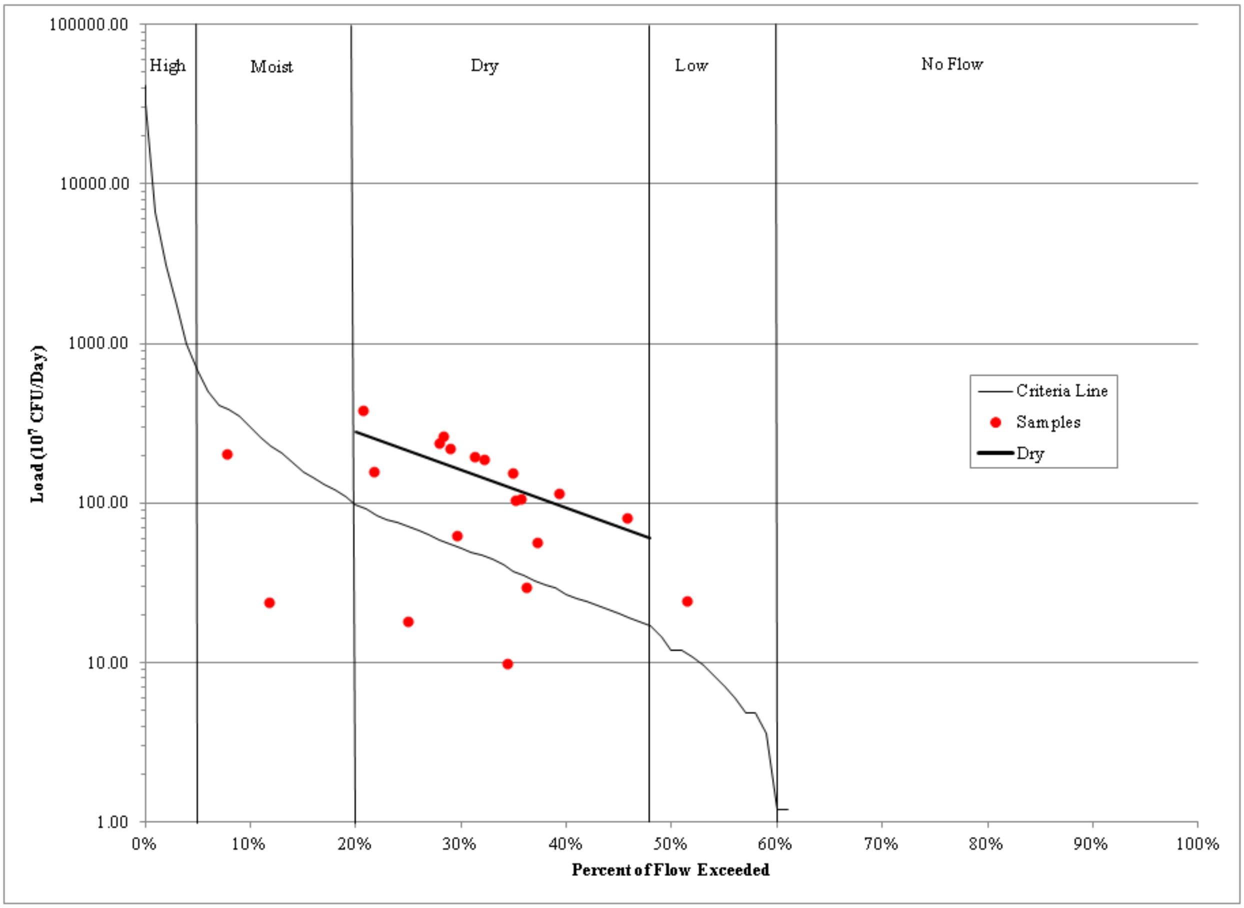
385208 Deep Creek

	Load (10^7 CFUs/Day)				Load (10^7 CFUs/Period)		
	Median Percentile	Existing	TMDL	Days	Existing	TMDL	Percent Reduction
Moist	14.50%	2088.74	1279.55	69.35	144853.98	88736.68	38.74%
Dry	36.00%	673.06	265.05	87.60	58960.40	23218.32	60.62%
			Total	157	203814	111955	45.07%



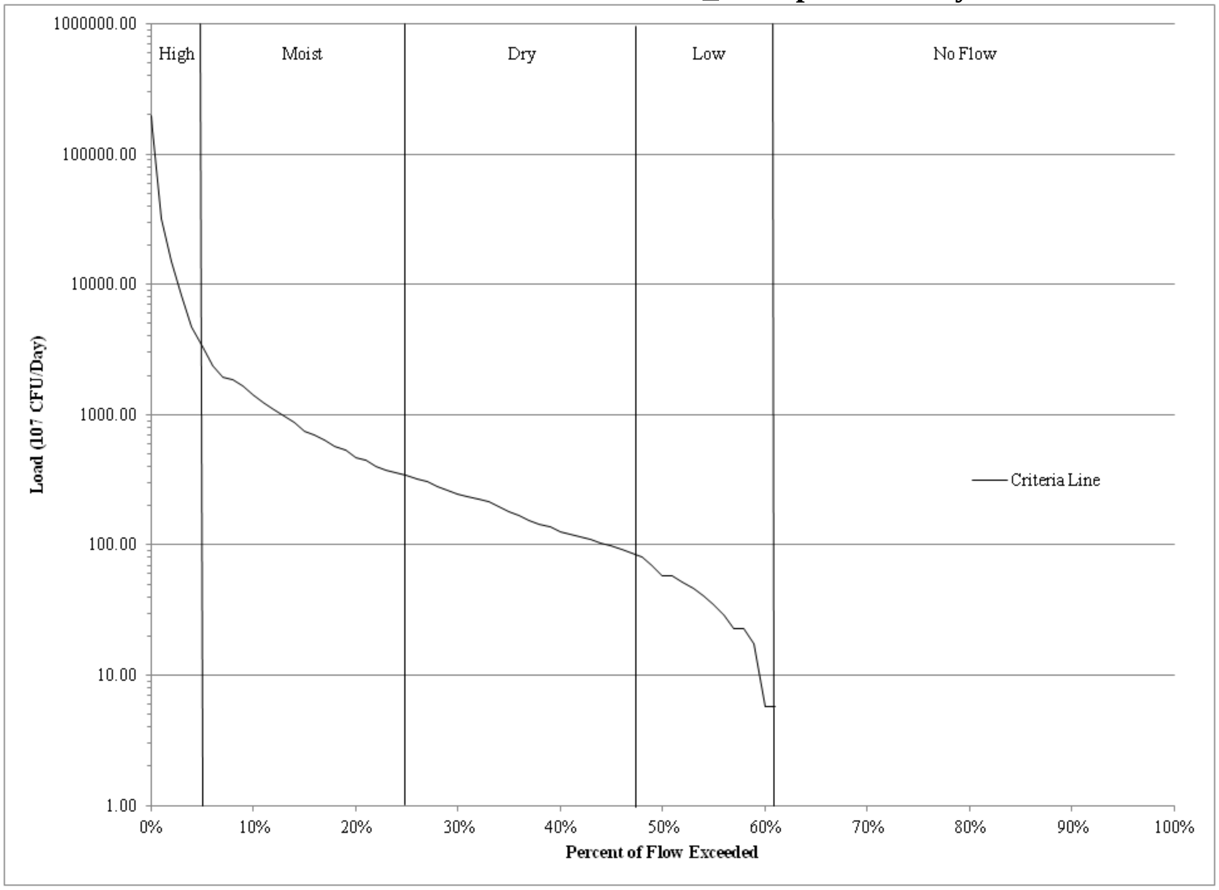
385209 West Branch Deep Creek

	Load (10^7 CFUs/Day)				Load (10^7 CFUs/Period)		
	Median Percentile	Existing	TMDL	Days	Existing	TMDL	Percent Reduction
Dry	34.00%	130.29	40.91	102.20	13315.56	4180.86	68.60%
			Total	102	13316	4181	68.60%

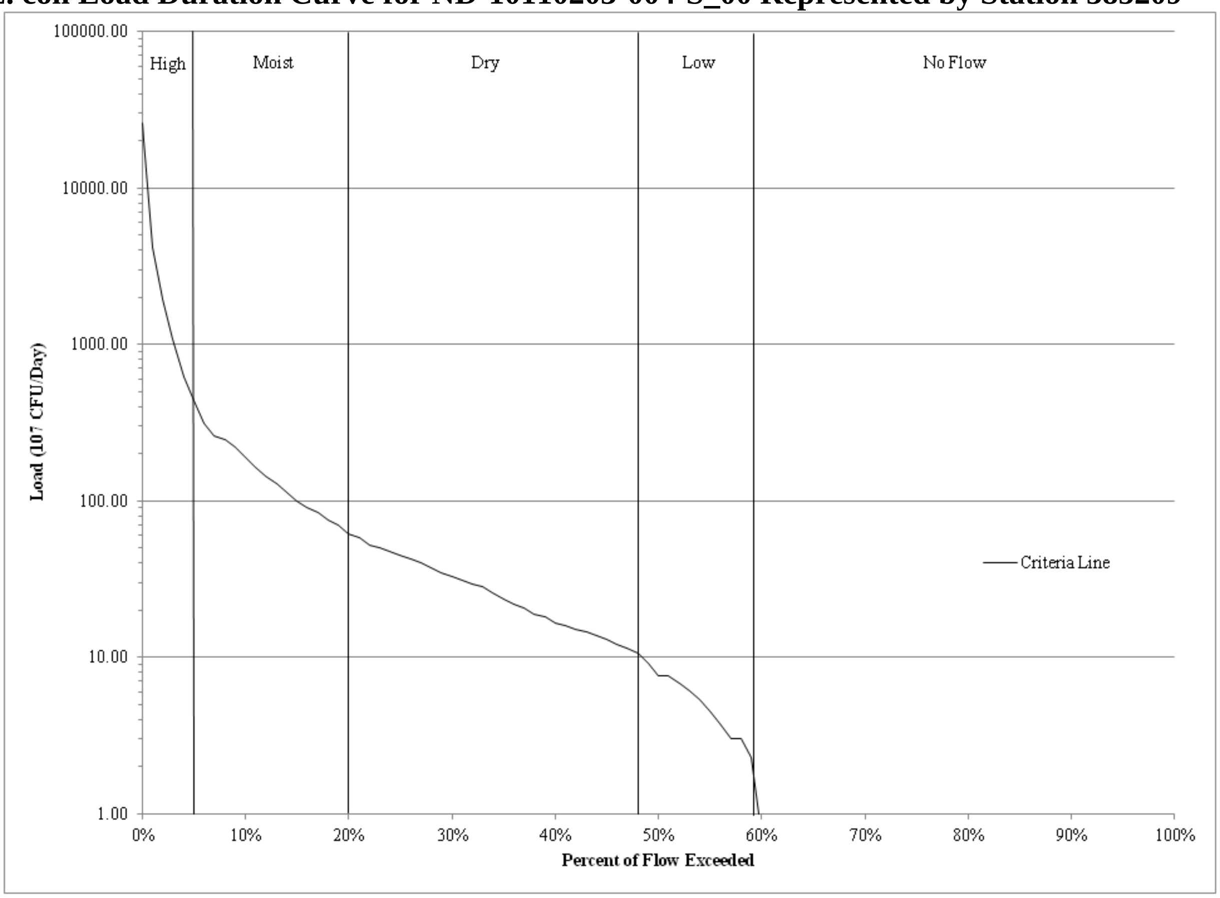


Appendix D
Load Duration Curves for Monitoring Sites 385208 and 385209 using the Current State Water Quality Standards for E. coli Bacteria (126 CFU/100mL)

E. coli Load Duration Curve for ND-10110203-003-S_00 Represented by Station 385208



E. coli Load Duration Curve for ND-10110203-004-S_00 Represented by Station 385209



Appendix E
US EPA Region 8 Public Notice Review and Comments

EPA REGION 8 TMDL REVIEW FORM AND DECISION DOCUMENT

TMDL Document Info:

Document Name:	**Bacteria TMDL for Deep Creek and West Branch Deep Creek in Bowman and Slope Counties, North Dakota**
Submitted by:	**Mike Ell, North Dakota Department of Health**
Date Received:	**August 10, 2012**
Review Date:	**September 8, 2012**
Reviewer:	**Vern Berry, US Environmental Protection Agency**
Rough Draft / Public Notice / Final Draft?	**Public Notice**
Notes:	

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

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

Approval Notes to the 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 TMDL review elements identified in the following 8 sections:

1. Problem Description
   a. ...TMDL Document Submittal
   b. Identification of the Waterbody, Impairments, and Study Boundaries
   c. Water Quality Standards
2. Water Quality Target
3. Pollutant Source Analysis
4. TMDL Technical Analysis
   a. Data Set Description
   b. Waste Load Allocations (WLA)
   c. Load Allocations (LA)
   d. Margin of Safety (MOS)
   e. 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 review elements 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 this review form 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 form 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

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

Review Elements:

☒ Each TMDL document submitted to EPA should include a notification of the document status (e.g., pre-public notice, public notice, final), and a request for EPA review.

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

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

Summary: *The notification of the availability of the public notice draft TMDL document was submitted to EPA via a letter received on August 10, 2012. The letter includes the details of the public notice, explains how to obtain a copy of the TMDL, and requests the submittal of comments to NDDoH by September 10, 2012.*

Comments: *No comments.*

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.

Review Elements:

☒ 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:

Physical Setting and Listing History*:*

This TMDL document includes two impaired stream segments within the Middle Missouri River sub-basin (HUC 10110203) in south-western North Dakota. These stream segments are part of the larger Missouri River basin. The two impaired segments are located in Bowman and Slope Counties which cover a watershed area of approximately 182,309 acres.

The two impaired segments included in this TMDL document are: 1) Deep Creek from the confluences of East Branch Deep Creek and West Branch Deep Creek downstream to its confluence with the Little Missouri River (42.51 miles; ND-10110203-003-S_00); and 2) West Branch Deep Creek and its tributaries (117.25 miles; ND-10110203-004-S_00). These segments are listed as impaired for fecal coliform bacteria and are a high priority for TMDL development.

CHAPTER 33-16-02.1, Appendix 1 of the North Dakota Century Code assigns the following classifications for the stream segments in this TMDL document. All tributaries not specifically mentioned in Appendix 1 are classified as Class III streams:

Class III – Deep Creek, Segment 003; and West Branch Deep Creek, Segment 004

The designated uses for Class III streams are discussed in the Water Quality Standards section below.

***Impairment status**:*
The 2012 North Dakota Integrated Report identifies the Deep Creek and West Branch Deep Creek as impaired based on the following information:

Stream Segment	Designated Use / Support Status	Impairment Cause	TMDL Priority
Deep Creek ND-11100203-003-S_00	*Recreation / Fully supporting but threatened*	*Fecal coliform*	*High*
West Branch Deep Creek ND-11100203-004-S_00	*Recreation / Fully supporting but threatened*	*Fecal coliform*	*High*

Comments: *No comments.*

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).

Review Elements:

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

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

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

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

Summary: *The Deep Creek, Segment 003 and West Branch Deep Creek, Segment 004 are impaired based on fecal coliform bacteria concentrations impacting the recreational uses. These segments are classified as not supporting to fully supporting but threatened for recreational uses due to exceedences of the fecal coliform bacteria standard which was in effect at the time of the TMDL listing. No E. coli data have been collected for these segments.*

Effective January 2011, the NDDoH revised the State water quality standards. In these latest revisions the NDDoH eliminated the fecal coliform bacteria standard, retaining only the E. coli bacteria standard for the protection of recreational uses. This change in water quality standard was recommended by the US Environmental Protection Agency as E. coli is believed to be a better indicator of recreational use risk (i.e., incidence of gastrointestinal disease).

Deep Creek and West Branch Deep Creek are Class III streams. The quality of the waters in this class shall be suitable for agricultural and industrial uses. Streams in this class generally have low average flows with prolonged periods of no flow. During periods of no flow, they are of limited value for recreation and fish and aquatic biota. The quality of these waters must be maintained to protect secondary contact recreation uses (e.g., wading), fish and aquatic biota, and wildlife uses.

Numeric criteria for E. coli and the previous criteria for fecal coliform as established for North Dakota, Class III streams have been established and are presented in the excerpted Table 5 shown below. Discussion of additional applicable water quality standards for these stream segments can be found on pages 8 – 10 of the TMDL document.

Table 6. North Dakota Bacteria Water Quality Standards for Class III Streams.

Parameter	Standard	
	Geometric Mean[1]	**Maximum[2]**
E. coli Bacteria	126 CFU/100 mL	409 CFU/100 mL
Fecal Coliform[*]	200 CFU/100 mL	400 CFU/100 mL

[1] Expressed as a geometric mean of representative samples collected during any consecutive 30-day period.
[2] No more than 10 percent of samples collected during any consecutive 30-day period shall individually exceed the standard.
[*] Previous State water quality standard.

Comments: *No comments.*

2. Water Quality Targets

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

Review Elements:

☒ 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 primary water quality targets for these TMDLs are based on the numeric water quality standards for E. coli bacteria established to protect the recreational beneficial uses for the two impaired stream segments in the Deep Creek watershed. The secondary water quality targets are based on the previous fecal coliform standards. There are currently no E. coli data* *available for the two listed TMDL reaches. Deep Creek reach ND-10110203-003-S_00 and West Branch Deep Creek reach ND-10110203-004-S_00 are classified as not supporting to fully supporting but threatened for recreational uses due to exceedences of the fecal coliform bacteria standard which was in effect at the time of the TMDL listing. For this reason, the fecal coliform standards were used as the secondary TMDL target, while the E.coli standard will be considered the primary TMDL target.*

Bacteria standards are expressed in coliform forming units (cfu) per 100 milliliters (mL) of the water sample. The E. coli target for each impaired segment is: 126 cfu/100 mL during the recreation season from May 1 to September 30. The fecal coliform target for each impaired segment is: 200 cfu/100 mL during the recreation season from May 1 to September 30. While the standards are intended to be expressed as the 30-day geometric mean, the target for each stream segment was used to compare to values from single grab samples. This ensures that the reductions necessary to achieve the targets will be protective of both the acute (single sample value) and chronic (geometric mean of 5 samples) standards.

Comments: *Section 2.2, first sentence, should include both "Deep Creek" and "West Branch Deep Creek" as Class III streams for purposes of describing both impaired segments addressed by the TMDL document.*

We recommend adding a statement somewhere in the document (e.g., introduction, WQS or targets section) that relates the fecal coliform TMDL to the current E. coli WQS. Something similar to: "It is anticipated that the reductions necessary to achieve the fecal coliform water quality target will also meet the E. coli water quality standards. If future E. coli monitoring data shows that an E. coli impairment exists in one or both of the impaired segments, a separate reduction analysis will be conducted and this TMDL document will be revised or a separate TMDL will be developed."

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 identified source (or source category) when the relative load contribution from each source has been estimated. Therefore, the pollutant load from each identified source (or source category) should be specified and quantified. 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.

Review Elements:

☒ The TMDL should include an identification of the 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 the anthropogenic sources of the pollutant of concern have been identified, characterized, and 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 includes the landuse breakdown for the watershed based on the 2010 National Agricultural Statistics Service (NASS) data. In 2010, the dominant land use in the Deep Creek watershed was agriculture. Approximately 68 percent of the landuse in the watershed was grassland / pastureland, 17 percent was cropland, 7 percent was hay / alfalfa and the remaining 8 percent was wetlands, developed space, barren or woods. The majority of the crops grown consisted of spring wheat, barley, sunflowers and durum wheat.*

Section 4.0, Significant Sources beginning on page 10, provides the pollutant source analysis for the two listed segments in Deep Creek watershed. There are no known point sources located within the drainage area of these listed stream segments, and there no known animal feeding operations (AFOs).

The bacteria pollution to these segments originates from nonpoint sources in the watershed. Unpermitted AFOs, livestock grazing and watering in proximity to these streams is common along the TMDL listed segments. Intense early summer storms can cause overland flooding and rising river levels. Due to the close proximity of livestock grazing and watering to these stream segments, it is likely that runoff from these activities contribute to the bacteria pollution in the Deep Creek watershed.

Wildlife may also contribute to the bacteria found in the water quality samples, but most likely in a lower concentration. Wildlife is nomadic with fewer numbers concentrating in a specific area, thus decreasing the probability of their contribution of fecal matter in significant quantities.

Septic system failure might also contribute to the bacteria in the water quality samples. Failures can occur for several reasons, although the most common reason is improper maintenance (e.g. age, inadequate pumping). Other reasons for failure include improper installation, location, and system design. Harmful household chemicals can also cause failure by killing the bacteria that digest the waste. 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.

Comments: *No comments.*

4. TMDL Technical Analysis

TMDL determinations should be supported by an analysis of the available data, discussion of the known deficiencies and/or gaps in the 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:

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

Where:

TMDL	=	Total Maximum Daily Load (also called the Loading Capacity)
LAs	=	Load Allocations
WLAs	=	Wasteload Allocations
MOS	=	Margin Of Safety

Review Elements:

☒ 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 Deep Creek watershed TMDLs describes how the fecal coliform and E. coli loads were derived in order to meet the applicable water quality standards for the 303(d) impaired stream segments.*

The TMDL loads and loading capacities were derived using the load duration curve (LDC) approach. To better correlate the relationship between the pollutant of concern and the hydrology of each Section 303(d) listed waterbody, LDCs were developed for each stream segment.

The discharge record for the listed segments in the Deep Creek watershed were determined by utilizing the Drainage Area Ratio Method (DARM). The DARM assumes that the streamflow at the ungaged site(s) is hydrologically similar (same per unit area) to the stream gaging station used as an index. Table 6 in the TMDL document lists the land use comparisons between the Deep Creek watershed and the Charbonneau Creek watershed to determine similarities (i.e., cropland, grassland). Drainage area and land use for the ungaged sites (385208 and 385209) and index station 06329597 were determined through GIS using digital elevation models (DEMs) and the 2010 NASS land use database. Streamflow data for the index station (06329597) was obtained from the USGS Water Science Center website. The index station (06329597) streamflow data was then divided by the drainage area to determine streamflows per unit area at the index station. Those values were then multiplied by the drainage area for the ungaged sites to obtain estimated flow statistics for ungaged sites 385208 and 385209.

The LDCs were derived for each segment using the discharge record, the fecal coliform and E. coli TMDL targets and the observed bacteria data collected from the two monitoring stations (see Figure 1 of the TMDL document for a map of the monitoring locations).

Observed in-stream fecal coliform bacteria data, obtained from the monitoring stations, were converted to pollutant loads by multiplying fecal coliform bacteria concentrations by the mean daily flow and a conversion factor. These loads were plotted against the percent exceeded of the flow on the day of sample collection (see Figures 8 and 10 in the TMDL document). Points plotted above the 200 cfu/100 mL target curve exceeded the TMDL target. Points plotted below the curve were meeting the previous State water quality standard for fecal coliform of 200 cfu/100 mL.

To estimate the required percent reductions in loading needed to achieve the TMDL for each stream segment, a linear regression line through the fecal coliform load data above the TMDL curve in each flow regime was plotted. The required percent reductions needed under the four regimes were determined using the linear regression line (see Appendix C in the TMDL document).

The LDCs represent flow-variable TMDL targets across the flow regimes shown in this TMDL document. For the two Deep Creek watershed stream segments covered by this TMDL document, the LDCs are dynamic expressions of the allowable load for any given daily flow. Loading capacities were derived from this approach for each of the listed stream segments at each flow regime. Tables 9, 10, 11 and 12 show the loading capacity load (i.e., TMDL load) for fecal coliform and E. coli for the listed segments in the Deep Creek watershed.

Comments: *The introduction paragraphs of the Technical Analysis section (p. 11) mentions the fecal coliform reductions necessary to achieve the secondary TMDL target. We recommend adding an additional sentence to that paragraph that says something similar to: "It is expected that the estimated fecal coliform reductions will also meet the E. coli target."*

The Charbonneau Creek watershed that was used as the flow record source for the Deep Creek watershed is a long distance and a few sub-basins away from Deep Creek. We assume that the reason for choosing Charbonneau Creek is because it is the closest USGS gauging station – is that correct? If so, that reason should be included in the TMDL document.

Based on the flow record from Charbonneau Creek the stream runs dry approximately 39 percent of the time. Based on the information available from Deep Creek and West Branch Deep Creek – do these stream segments also go dry for a significant portion of the year (e.g., for a *couple of months in late summer / early fall)?*

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…).

Review Elements:

☒ 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 Deep Creek and West Branch Deep Creek TMDL data description and summary are included in the Available Data section (Section 1.5) and in the data tables in Appendix A. Recent water quality monitoring was conducted from May – September 2006 and 2009 and included 29 fecal coliform samples at station 385208 on the mainstem of Deep Creek, segment 003; 20 fecal coliform samples at station 385209 on West Branch Deep Creek, segment 004. The data set also includes approximately 4 years of flow record from USGS gauging station 06329597. The flow data, the fecal coliform data and the TMDL targets, were used to develop the fecal coliform load duration curves for the two segments of the Deep Creek watershed. No E. coli samples have been collected in this watershed, but the flow record and the E. coli target was used to create LDCs for the two impaired stream segments.*

Comments: *No Comments.*

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.

Review Elements:

☒ EPA regulations require that a TMDL include WLAs, which identify the portion of the loading capacity allocated to individual existing and 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*: Within the Deep Creek watershed, there are no known point sources located within the drainage area of the two listed stream segments. Therefore, the E. coli and fecal coliform WLAs are zero for each segment.*

Comments*: No comments.*

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.

Review Elements:

☒ 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 the anthropogenic sources of the pollutant of concern have been identified and given proper load or waste load allocations.

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

Summary*: The TMDL document includes the landuse breakdown for the watershed based on the 2010 National Agricultural Statistics Service (NASS) data. In 2010, the dominant land use in the Deep Creek watershed was agriculture. Approximately 68 percent of the landuse in the watershed was grassland / pastureland, 17 percent was cropland, 7 percent was hay / alfalfa and* *the remaining 8 percent was wetlands, developed space, barren or woods. The majority of the crops grown consisted of spring wheat, barley, sunflowers and durum wheat.*

The bacteria pollution to this segment is originating from nonpoint sources in the watershed. Intense early summer storms can cause overland flooding and rising river levels. Due to the presence of unpermitted AFOs and the close proximity of livestock grazing and watering to the river, it is likely that they contribute to the bacteria pollution in the listed segments in the Deep Creek watershed.

Wildlife and failing septic systems may also contribute to the bacteria found in the water quality samples, but most likely in a lower concentration.

By relating runoff characteristics to each flow regime one can infer which sources are most likely to contribute to bacteria loading. Animals grazing in the riparian area contribute 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, moist and dry condition, and low flows. 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 and medium impact at moist condition flows. Exclusion of livestock from the riparian area eliminates the potential of direct manure deposit and, therefore, is considered to be of high importance at all 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 bacterial contamination.

Source specific data are limited so aggregate LAs are assigned to nonpoint sources with a ranking of important contributors under various flow regimes provided as seen in the following excerpted table. Aggregate load allocations for each of the impaired segments in the Deep Creek watershed are included in Tables 9, 10, 11 and 12 of the TMDL document.

Table 7. Nonpoint Sources of Pollution and Their Potential to Pollute at a Given Flow Regime.

Nonpoint Sources	**Flow Regime**		
	High Flow	**Moist Conditions**	**Dry Conditions**
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 nonpoint source area to contribute E. coli bacteria loads under a given flow regime. (H: High; M: Medium; L: Low)

***Comments**: No comments.*

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).

Review Elements:

☒ 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).

☐ <u>If the MOS is implicit</u>, 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.

☒ <u>If the MOS is explicit</u>, 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.

☐ <u>If</u>, rather than an explicit or implicit MOS, the <u>TMDL relies upon a phased approach</u> 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

<u>Summary:</u> *The Deep Creek and West Branch Deep Creek TMDL document includes explicit MOSs for each of the listed segments in the watershed. The MOSs were derived by calculating 10 percent of the loading capacity for each segment. The explicit MOSs for Deep Creek, segment 003, are included in Tables 9 and 10 for fecal coliform and E. coli respectively; the explicit MOSs for West Branch Deep Creek, segment 004, are included in Tables 11 and 12 for fecal coliform and E. coli respectively.*

<u>Comments</u>*: No comments.*

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.

Review Elements:

☒ 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 fecal coliform loads are taken into account. The highest steam flows typically occur during late spring, and the lowest stream flows typically occur during the winter months. The TMDL also considers seasonality because the fecal coliform criteria are in effect from May 1 to September 30, as defined by the recreation season in North Dakota.*

Comments*: No comments.*

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.

Review Elements:

☒ 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 TMDL document includes a summary of the public participation process that has occurred. It describes the opportunities the public had to be involved in the TMDL development process. Letters notifying stakeholders of the availability of the draft TMDL* *document were mailed to stakeholders in the watershed during public comment. Also, the draft TMDL document was posted on NDoDH's Water Quality Division website, and a public notice for comment was published in local newspapers.*

Comments: *No comments.*

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.

Review Elements:

- ☐ 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: *Once a watershed restoration plan (e.g., Section 319 PIP) is developed and implemented, monitoring will be conducted in the stream beginning two years after implementation and extending five years after the implementation project is complete.*

Comments: *Section 10.0, Monitoring, mentions the monitoring that was conducted prior to development of the TMDL. However, that section should describe the post-TMDL or post-implementation monitoring that will occur to evaluate the success of BMP implementation. If the QAPP was developed in 2009, then the post-implementation monitoring would have begun in 2011 and continue until 2014? We recommend that this section be revised.*

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.

Review Elements:

☐ 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: *In response to the Deep Creek Watershed Assessment and in anticipation of this completed TMDL, local sponsors successfully applied for and received Section 319 funding for the Deep Creek Watershed Restoration Project. Beginning in October 2007, local sponsors provided technical assistance and implementing BMPs designed to reduce fecal bacteria loadings and to help restore the beneficial uses of Deep Creek (i.e., recreation). As part of the watershed restoration project, water quality data were collected to monitor and track the effects of BMP implementation as well as to judge overall success of the project in reducing fecal coliform bacteria loadings. A QAPP was developed as part of this watershed restoration project that detailed the how, when and where monitoring were conducted to gather the data needed to document success in meeting the TMDL implementation goal(s). As the data are analyzed, watershed restoration efforts will be adapted, if necessary, to place BMPs where they will have the greatest benefit to water quality and in meeting the TMDL goal(s).*

Comments: *No comments.*

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.

Review Elements:

☒ 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 Deep Creek / West Branch Deep Creek TMDL document includes daily loads expressed as colony forming units per day for the listed stream segments in the watershed. The daily TMDL loads for each segment are included in TMDL section (Section 7.0) of the document.*

Comments: *No comments.*

Appendix F
NDDoH’s Response to Comments Received from US EPA Region 8

US EPA Comment: Section 2.2, first sentence, should include both "Deep Creek" and "West Branch Deep Creek" as Class III streams for purposes of describing both impaired segments addressed by the TMDL document.

We recommend adding a statement somewhere in the document (e.g., introduction, WQS or targets section) that relates the fecal coliform TMDL to the current E. coli WQS. Something similar to: "It is anticipated that the reductions necessary to achieve the fecal coliform water quality target will also meet the E. coli water quality standards. If future E. coli monitoring data shows that an E. coli impairment exists in one or both of the impaired segments, a separate reduction analysis will be conducted and this TMDL document will be revised or a separate TMDL will be developed."

NDDoH Response: Section 2.2 has been modified to include both "Deep Creek" and "West Branch Deep Creek" and to make it clear that the reductions necessary to achieve the fecal coliform water quality target will also meet the E. coli water quality standards.

US EPA Comment: The introduction paragraphs of the Technical Analysis section (p. 11) mentions the fecal coliform reductions necessary to achieve the secondary TMDL target. We recommend adding an additional sentence to that paragraph that says something similar to: "It is expected that the estimated fecal coliform reductions will also meet the E. coli target."

The Charbonneau Creek watershed that was used as the flow record source for the Deep Creek watershed is a long distance and a few sub-basins away from Deep Creek. We assume that the reason for choosing Charbonneau Creek is because it is the closest USGS gauging station – is that correct? If so, that reason should be included in the TMDL document.

Based on the flow record from Charbonneau Creek the stream runs dry approximately 39 percent of the time. Based on the information available from Deep Creek and West Branch Deep Creek – do these stream segments also go dry for a significant portion of the year (e.g., for a couple of months in late summer / early fall)?

NDDoH Response: Wording in section 1.5.1 was revised to make it clear that it is expected that fecal coliform reductions will also meet the E. coli target.

Wording was added in section 5.1 as to why Charbonneau Creek was used to create the flow record source.

Section 1.5.1 was modified to include a statement signifying that Deep Creek and West Branch Deep Creek are ephemeral streams and that sampling concluded in July and June, respectively.

US EPA Comment: Section 10.0, Monitoring, mentions the monitoring that was conducted prior to development of the TMDL. However, that section should describe the post-TMDL or post-implementation monitoring that will occur to evaluate the success of BMP implementation. If the QAPP was developed in 2009, then the post-implementation monitoring would have begun in 2011 and continue until 2014? We recommend that this section be revised.

NDDoH Response: The reference to the Deep Creek Implementation Project QAPP was incorrect and has been changed from 2009 to 2005. Also, wording has been revised in Section 10 that mentions future monitoring that will be implemented if changes in the watershed do not appear to improve.