Fecal Coliform Bacteria TMDLs for Bear Creek and Its Tributaries in Dickey, Ransom, LaMoure and Barnes Counties, North Dakota

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Prepared for:
US EPA Region 8
1595 Wynkoop Street
Denver, CO 80202-1129

Prepared by:
Jim Collins Jr.
ND Department of Health
Division of Water Quality
Gold Seal Center, 4th Floor
918 East Divide Avenue
Bismarck, ND 58501-1947

North Dakota Department of Health
Division of Water Quality

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John Hoeven, Governor
Terry Dwelle, M.D., State Health Officer

North Dakota Department of Health
Division of Water Quality
Gold Seal Center, 4th Floor
918 East Divide Avenue
Bismarck, ND 58501-1947

701.328.521

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1.0 INTRODUCTION AND DESCRIPTION OF THE WATERSHED

Bear Creek and the Bear Creek watershed are located within the Upper James River watershed. The watershed extends from Litchville in Barnes County to Oakes in Dickey County, North Dakota. The watershed is approximately 1087 square kilometers (km^2) or 268,800 acres in size. Table 1 summarizes the geographical, hydrological and physical characteristics, while Figure 1 shows the location of Bear Creek and the Bear Creek watershed.

Table 1. General Characteristics of Bear Creek and the Bear Creek Watershed.

Legal Name	Bear Creek
Stream Classification	Class III
Major Drainage Basin	James River - Missouri River
Nearest Municipality	Litchville, Marion, Verona
Assessment Unit IDs	ND 10160003-032-S_00, ND 10160003-034-S_00, ND 10160003-035-S_00
Counties	Dickey, LaMoure, Ransom and Barnes
Eco-Region	Drift Plains(46i) and Glacial Outwash (46j) level IV ecoregions and Northern Glaciated Plains level III ecoregion
Watershed Area	268,800 acres
River Miles	167 miles
Tributaries	Unnamed Tributary
Outlet	James River

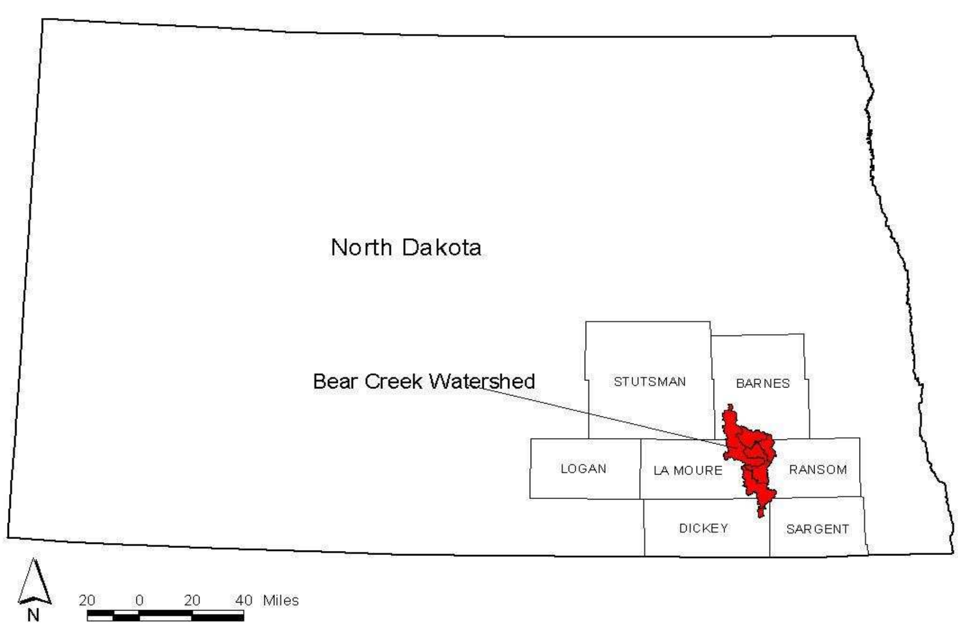

Figure 1. General Location of the Bear Creek Watershed in North Dakota.

1.1 Clean Water Act Section 303(d) Listing Information

As part of the 2008 Clean Water Act Section 303(d) Total Maximum Daily Load (TMDL) listing process, the North Dakota Department of Health (NDDoH) has identified three waterbodies within the Bear Creek watershed as impaired (Tables 2-4, Figure 2). The NDDoH assessed these waterbodies as fully supporting, but threatened for the beneficial use of recreation. This assessment is based on fecal coliform bacteria data collected from 2002 -2003.

Table 2. Section 303(d) TMDL Listing Information for Bear Creek Waterbody ND-10160003-032-S_00 (NDDoH, 2008).

Assessment Unit ID	ND 10160003-032-S_00
Waterbody Description	Bear Creek from tributary watershed downstream to its confluence with the James River.
Size	29.34 miles
Designated Uses Impaired	Recreation
Use Support	Fully supporting, but Threatened
Impairment	Fecal Coliform Bacteria
TMDL Priority	High

Table 3. Section 303(d) TMDL Listing Information for Bear Creek Waterbody ND-10160003-034-S_00 (NDDoH, 2008).

Assessment Unit ID	ND 10160003-034-S_00
Waterbody Description	Bear Creek upstream from tributary watershed, including tributaries.
Size	54.87 miles
Designated Uses Impaired	Recreation
Use Support	Fully Supporting, but Threatened
Impairment	Fecal Coliform Bacteria
TMDL Priority	High

Table 4. Section 303(d) TMDL Listing Information for Bear Creek Waterbody ND-10160003-035-S_00 (NDDoH, 2008).

Assessment Unit ID	ND 10160003-035-S_00
Waterbody Description	Unnamed tributary and its watershed to Bear Creek.
Size	30.07 miles
Designated Uses Impaired	Recreation
Use Support	Fully Supporting, but Threatened
Impairment	Fecal Coliform Bacteria
TMDL Priority	High

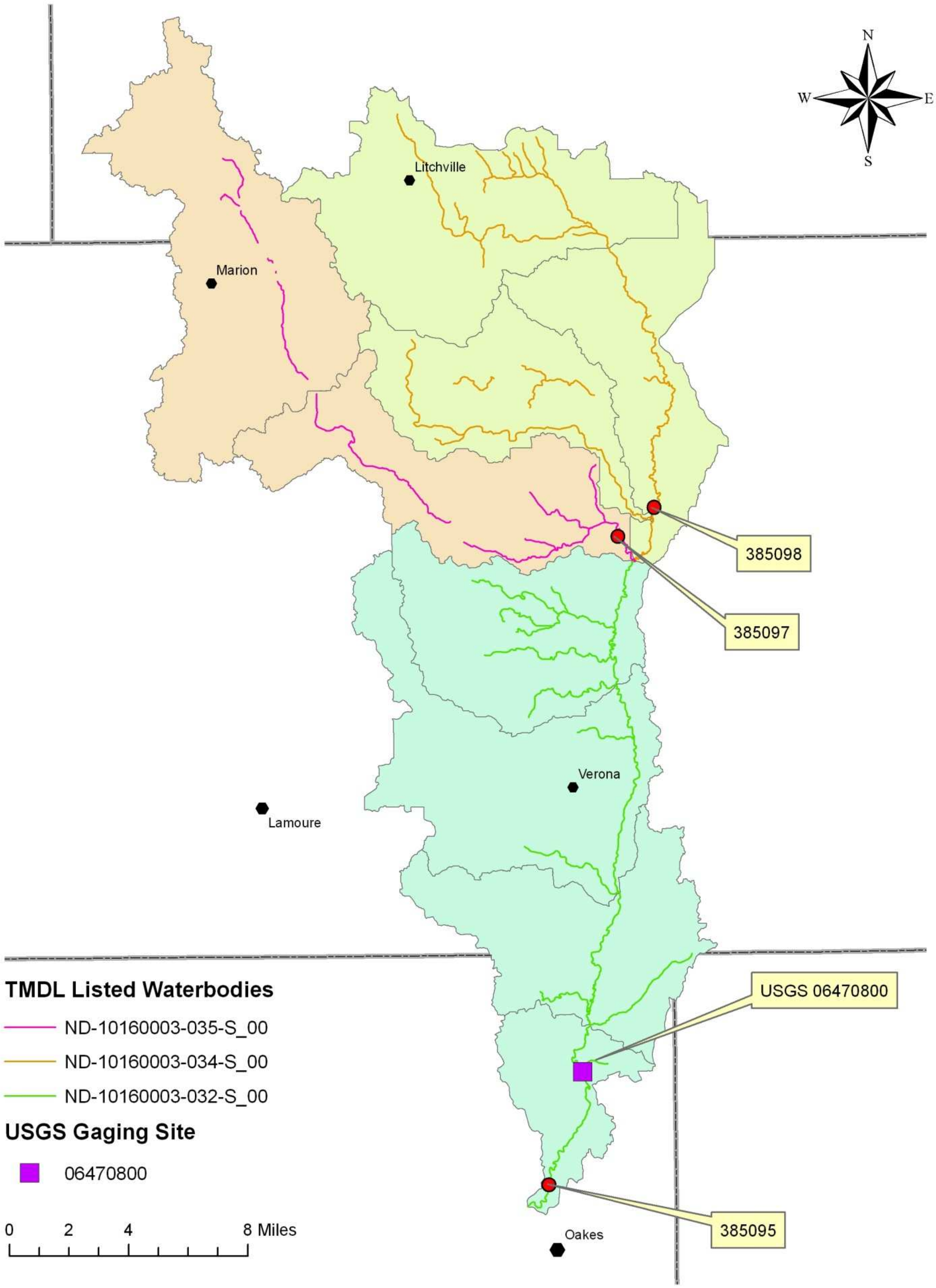

Figure 2. Bear Creek Subwatersheds, Sampling Sites and Section 303(d) Listed Waterbodies.

1.2 Topography

Approximately 88.7 percent of the watershed lies within the Drift Plains level IV ecoregion (46i) of the Northern Glaciated Plains level III ecoregion (46), while a minor portion of the headwaters lies within the Glacial Outwash level IV ecoregion (46j) (Figure 3). The Drift Plains ecoregion is characterized by generally flat to occasionally rolling topography with a thick layer of glacial till left behind by the Wisconsinan glaciers. Prior to cultivation, the Drift Plain grasslands were a mixture of tall grass and short grass prairie. Seasonal and temporary wetlands are common within this ecoregion as opposed to the semi-permanent and permanent wetlands that are common in the Missouri Coteau ecoregion. The Glacial Outwash ecoregion is characterized by flat to slightly rolling topography and highly permeable soils with low water holding capacity. Areas within the Glacial Outwash ecoregion high soil permeability have a poor to fair potential for crop production (USGS, 2006).

The dominant soil association in the Bear Creek watershed is Barnes-Svea-Hamerly (79.8 percent) followed by Renshaw-Hecla-Divide (8.2 percent), Hamerly-Tonka-Barnes (6.2 percent), Svea-Cavour-Barnes (3.8 percent), and LaPrairie-Renshaw (1.6 percent). The Barnes-Svea-Hamerly association is characterized by the level to hilly topography of summits, side slopes, and foot slopes with well-drained to somewhat poorly drained soils of medium texture. The landscape of this association has knolls, ridges, flats and depressions that result in much of the runoff flowing to the depressional areas instead of stream channels (NRCS, 1993). The Renshaw-Hecla-Divide association is characterized by level to moderately steep topography with somewhat poorly drained to somewhat excessively drained soils of medium to coarse texture. The Hamerly-Tonka-Barnes association is characterized by the level to undulating topography of flats, swells, and depressions with somewhat poorly drained to well-drained soils of medium texture. The Svea-Cavour-Barnes association is characterized by the level to undulating topography of swells and swales with moderately well to well drained soils of medium texture. The LaPrairie-Renshaw association is characterized by the level topography of floodplains and terraces with moderately well-drained to somewhat excessively drained soils of medium texture (NRCS, 1993).

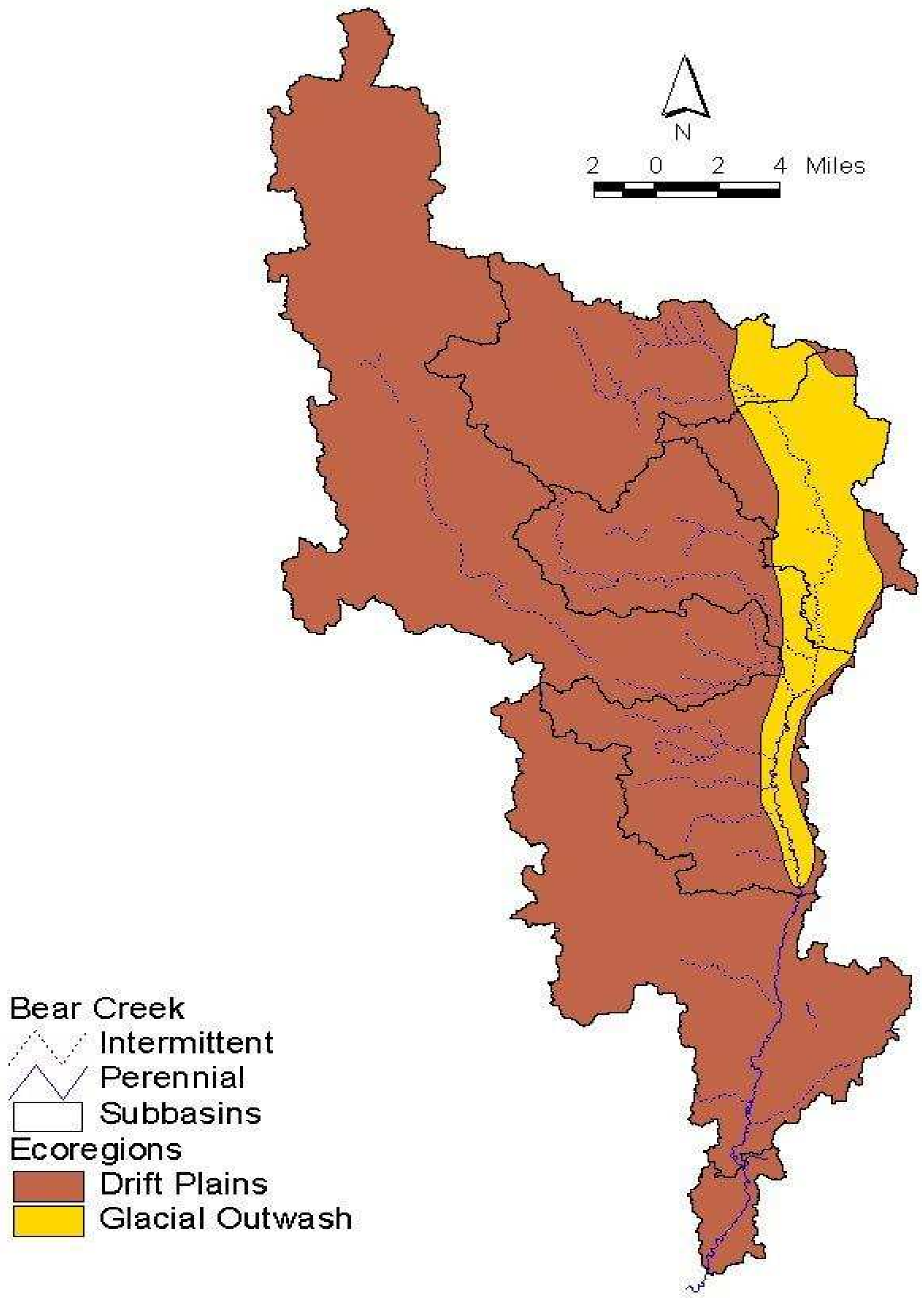

Figure 3. Level IV Ecoregions Included in the Bear Creek Watershed

1.3 Land Use/Land Cover

Cropland data from the North Dakota Agricultural Statistics Service (NASS) for the years of 2002 and 2007 shows the changes in cropping practices (Table 5). These changes are partially dictated by the changes in commodity markets and conservation programs. The NASS data from 2002 indicated that the Bear Creek watershed was dominated by soybean and spring wheat/winter wheat. In 2007, due to increased market prices, soybean acres were the most dominant with corn becoming the second most dominant crop. Comparisons between non-cropland acreages from 2002 and 2007 could not be made because the method of determining and classifying those acres was changed by NASS.

Table 5. Dominant Crop Types in the Bear Creek Watershed in 2002 and 2007 (based on NASS Land Use/Cover Data).

Land Use/Land Cover	2002 Acres	2007 Acres
Corn	22,524	51,348
Soybean	52,310	63,899
Sunflower	3,625	127
Barley	2,103	290
Spring Wheat/Winter Wheat	51,908	18,447
Dry Beans	1,499	713

Table 6 details the percentage of acres per land use in each of the listed segment watersheds. In 2002, soybeans were dominate in two of the three watersheds followed by spring wheat/winter wheat.

Table 6. Land Use/Land Cover (based on percentage) in Impaired Sub-watersheds of the Bear Creek Watershed (based on 2002 NASS Data).

Land Use/Land Cover	Impaired Sub-watershed		
	ND 10160003-32-S_00	ND 10160003-34-S_00	ND 10160003-35-S_00
Corn	6.1	6.9	11.7
Dry Bean	1.7	2.5	2.4
Pasture/Range/CRP	14.6	17.1	16.4
Idle/Fallow	15.2	24.2	13.2
Soybean	28.7	21.0	32.2
Spring Wheat/Winter Wheat	25.8	19.7	15.8
Sunflower	1.8	2.0	1.6
Water	1.2	0.8	3.0

1.4 Climate and Precipitation

The climate of the region varies significantly depending on the season. Precipitation data for the climate station near Verona, ND (329035) from the period of 1948 through 2006 were obtained from the High Plains Regional Climate Center (HPRCC). Precipitation occurs mainly in the form of rainfall with the majority occurring during the months of April through October (Figure 4).

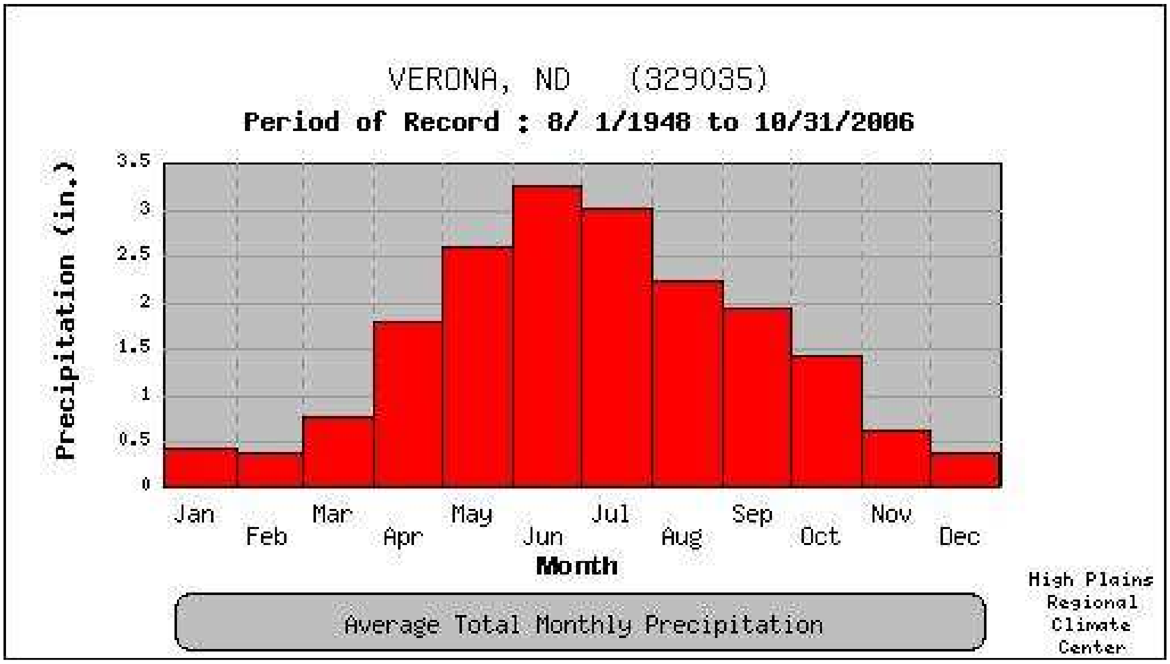

Figure 4. Average Monthly Precipitation at Verona, North Dakota.

1.5 Available Data

1.5.1 Fecal Coliform Bacteria Data

Water quality samples and discharge data used for this report were collected at three locations as part of the pre-project assessment (2002-2003) and throughout the implementation of a Section 319 Nonpoint Source Pollution reduction project (2004-2007) (Figure 2). Fecal coliform data are provided in Appendix A.

Table 7 provides a summary of fecal coliform geometric mean concentrations, the percentage of samples exceeding 400 CFU/100 mL, and the recreational use assessment by sampling site. The geometric mean concentration of fecal coliform bacteria and the percent of samples over 400 CFU/100 mL were calculated for each sampling location using those samples collected during the recreational period of May 1 through September 30. Site 385095 (Oakes) had the highest geometric mean fecal coliform bacteria concentration and the highest percent of samples over 400 CFU/100 mL at 179 CFU/100 mL, and 32 percent respectively. This was followed in descending order by 385097 (NW Tributary) and 385098 (Fort Ransom). Based on the data collected, site 385098 (Fort Ransom) would be classified as fully supporting for recreational uses, while the other two sites would be classified as fully supporting, but threatened.

Table 7. Summary of Fecal Coliform Bacteria Data (2002-2007).

Site Identification	Geometric Mean Concentration (CFU/100 mL)	Percentage of Samples Exceeding 400 CFU/100 mL	Recreational Use
Assessment Unit ID (ND 10160003-032-S_00)			
385095 Oakes	179	32	Fully Supporting but Threatened
Assessment Unit ID (ND 10160003-034-S_00)			
385098 Fort Ransom	47	4	Fully Supporting
Assessment Unit ID (ND 10160003-035-S_00)			
385097 NW Tributary	79	24	Fully Supporting but Threatened

1.5.2 Hydraulic Discharges

Mean daily flow for the period October 10, 1976 through December 3, 2007 was obtained from the United States Geological Survey (USGS) gauging site on Bear Creek at Highway 13 (06470800). Stream discharge measurements were also collected at sites 385095 (Oakes), 385097 (NW Tributary) and 385098 (Ft. Ransom) (Appendix B).

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 wasteload allocations for point sources and load allocations for nonpoint 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., nutrients, dissolved oxygen).

2.1 Narrative Water Quality Standards

The North Dakota Department of Health has set narrative water quality standards that apply to all surface waters in the State. The narrative general water quality standards are listed below (NDDoH, 2008).

- 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:
  1) Cause a public health hazard or injury to environmental resources;
  2) Impair existing or reasonable beneficial uses of the receiving waters; or
  3) Directly or indirectly cause concentrations of pollutants to exceed applicable standards of the receiving waters.

In addition to the narrative standards, the NDDoH has set a biological goal for all surface waters in the State. The goal states that “the biological condition of surface waters shall be similar to that of sites or waterbodies determined by the department to be regional reference sites” (NDDoH, 2006).

2.2 Numeric Water Quality Standards

Bear Creek is a Class III stream which carries the following definition:

Class III - 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 have been developed for Class III streams for fecal coliform bacteria (Table 8). The fecal coliform bacteria standard applies only during the recreation season, May 1 to September 30.

Table 8. North Dakota Fecal Coliform Bacteria Standards for Class III Streams.

Parameter	Water Quality Standard	
	Geometric Mean[1]	Maximum[2]
Fecal Coliform Bacteria	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.**

3.0 TMDL TARGET

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 Bear Creek is based on the North Dakota fecal coliform bacteria standard for Class III streams.

3.1 Bear Creek Fecal Coliform Bacteria TMDL Targets

Bear Creek and its tributaries are fully supporting but threatened because of fecal coliform bacteria counts exceeding the North Dakota water quality standard. The North Dakota water quality standard for fecal coliform bacteria is a 30-day geometric mean of 200 CFU/100 mL during the recreation season which is from May 1 to September 30. In addition, no more than 10 percent of the samples collected within the 30-day period may exceed 400 CFU/100 mL. Therefore, the TMDL target for this report is the fecal coliform bacteria standard expressed as the 30-day geometric mean 200 CFUs/100 mL. While the standard is intended to be expressed as the 30-day geometric mean, the target is expressed as the daily average fecal coliform bacteria concentration based on a single grab sample. Expressing the target in this way will ensure the TMDL will result in both components of the standard being met and recreational uses are restored.

4.0 SIGNIFICANT SOURCES

4.1 Point Sources

Within the Bear Creek watershed, there are three point sources permitted through the North Dakota Pollutant Discharge Elimination System (NDPDES) Program. The point sources, which are lagoon systems for wastewater treatment, are located in Marion, Litchville, and Verona. Each of these municipalities utilize secondary treatment systems and discharge to ephemeral streams which eventually drain to Bear Creek. Due to the location of the discharges, fecal coliform monitoring is not required by their North Dakota Pollutant Discharge Elimination System discharge permits. It can be assumed, therefore, that fecal coliform bacteria loadings to the Bear Creek are negligible from these three point sources.

In addition, there are 12 (six small and six medium) permitted CAFOs/AFOs in the watershed, however, they are zero discharge facilities and are not deemed a significant source of fecal coliform bacteria loadings to Bear Creek.

4.2 Nonpoint Sources

The data collected during the water quality assessment (NDDoH, 2004) and subsequent water quality improvement project indicate that the primary nonpoint sources for fecal coliform bacteria in the Bear Creek watershed are as follows:

- Runoff of manure from cropland and pastureland;
- Runoff of manure from unpermitted animal feeding areas;
- Direct deposit of manure into Bear Creek by grazing livestock; and
- Background levels associated with wildlife.

Animal feeding areas within the Bear Creek watershed were identified as part of data collection effort for the AGNPS model (NDDoH, 2004). The identified animal feeding areas contained almost exclusively beef or dairy cattle, with a few containing sheep and horses. The AGNPS model assigned each animal feeding area a rating score based primarily on the number of animals and their setting in the landscape. The ratings scores for the 73 identified animal feeding areas within the Bear Creek watershed ranged from 0 to 50 and averaged 19.6. The 25 animal feeding areas within sub-watershed ND-10160003-032-S_00 had the highest average rating score at 22.9 followed by the 29 animal feeding areas within sub-watershed ND-10160003-035-S_00 at 20.3, and the 19 animal feeding areas within sub-watershed ND-10160003-034-S_00 at 14.3 (Table 9).

Table 9. Number of Animal Feeding Areas and Animals Located Within Each Impaired TMDL Sub-watershed of the Bear Creek Watershed, as well as the Average AGNPS Rating Scores for Those Animal Feeding Areas.

Impaired Sub-watershed	Animal Feeding Areas	Number of Animals	Average AGNPS Rating Score
ND-10160003-032-S_00	25	1820	22.9
ND-10160003-034-S_00	19	790	14.3
ND-10160003-035-S_00	29	1734	20.3
Total	73	4344	19.6

These data indicate that the primary contributors of fecal coliform bacteria for the sub-watersheds are unpermitted animal feeding areas located in close proximity to Bear Creek and livestock grazing and watering directly in and adjacent to Bear Creek.

5.0 TECHNICAL ANALYSIS

In TMDL development, the goal is to define the linkage between the water quality target and the identified source or sources of the pollutant (i.e. fecal coliform bacteria) to determine the load reduction needed to meet the target. To determine the cause-and-effect relationship between the water quality target and the identified source, the “load duration curve” methodology was used. The loading capacity or TMDL is the amount of pollutant (e.g. fecal coliform bacteria) a waterbody can receive and still meet and maintain water quality standards and beneficial uses. The following technical analysis addresses the fecal coliform load allocation and the load allocation reductions necessary to achieve the water quality standards target of 200 CFU/100 mL plus a margin of safety.

5.1 Mean Daily Stream Flows

In south-central North Dakota, rain events are variable, occurring during the months of April through October. Rain events can be sporadic and heavy or light, occurring over a short duration or over several days. 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.

Mean daily flows for the period October 10, 1976 through December 3, 2007 used in the development of the flow duration curves and load duration curves for site 385095 (Oakes), 385098 (Ft. Ransom), and 385097 (NW tributary) were obtained from the USGS gauge site (06470800) (Figure 2). For sites 385095, 385097, and 385098, the mean daily flow record used in flow duration curve development and in the development of the load duration curve was synthesized using regression relationships developed for each site (Appendix B). Simple linear regression relationships were developed for each site using the measured flows at each site paired with the corresponding flow at USGS site 06470800 for the same day. Using the daily flow record for the USGS site as the dependent variable a corresponding daily flow was estimated for each site.

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. 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 (Figure 5). 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 5, a flow duration interval of thirty (30) percent, associated with a stream flow of 3.2 cfs, implies that 30 percent of all observed mean daily discharge values equal or exceed 3.2 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 5, the flow duration curve was divided into three zones, one representing high flows (0-5 percent), another for moderate flows (5-60 percent), and one for low flows (60-70 percent). Based on the flow duration curve analysis, no flow occurred 30 percent of the time (70-100 percent). These flow intervals were defined by examining the range of flows for the site for the period of record and then by looking for natural breaks in the flow record based on the flow duration curve plot (Figure 5). A secondary factor in determining the flow intervals used in the analysis is the number of fecal coliform observations available for each flow interval.

Based on the analysis of the flow duration curve developed for each site, three flow regimes were defined for all three sites (385095, 385097, and 385098). These flow regimes were used in the development of the TMDLs for each site (Appendix D). For purposes of this TMDL the high flow regime at all three sites were defined as flows which were exceeded 5 percent or less of the time. For sites 385097 and 385098, the low flow regime was defined as flows which are exceeded 25 and 30 percent of the time, respectively. Generally, these are flows which are less than 1.3 cfs. Based on the flow duration curve analysis, no flow occurred 60 percent of the time at site 385098 and 71 percent of the time at site 385097.

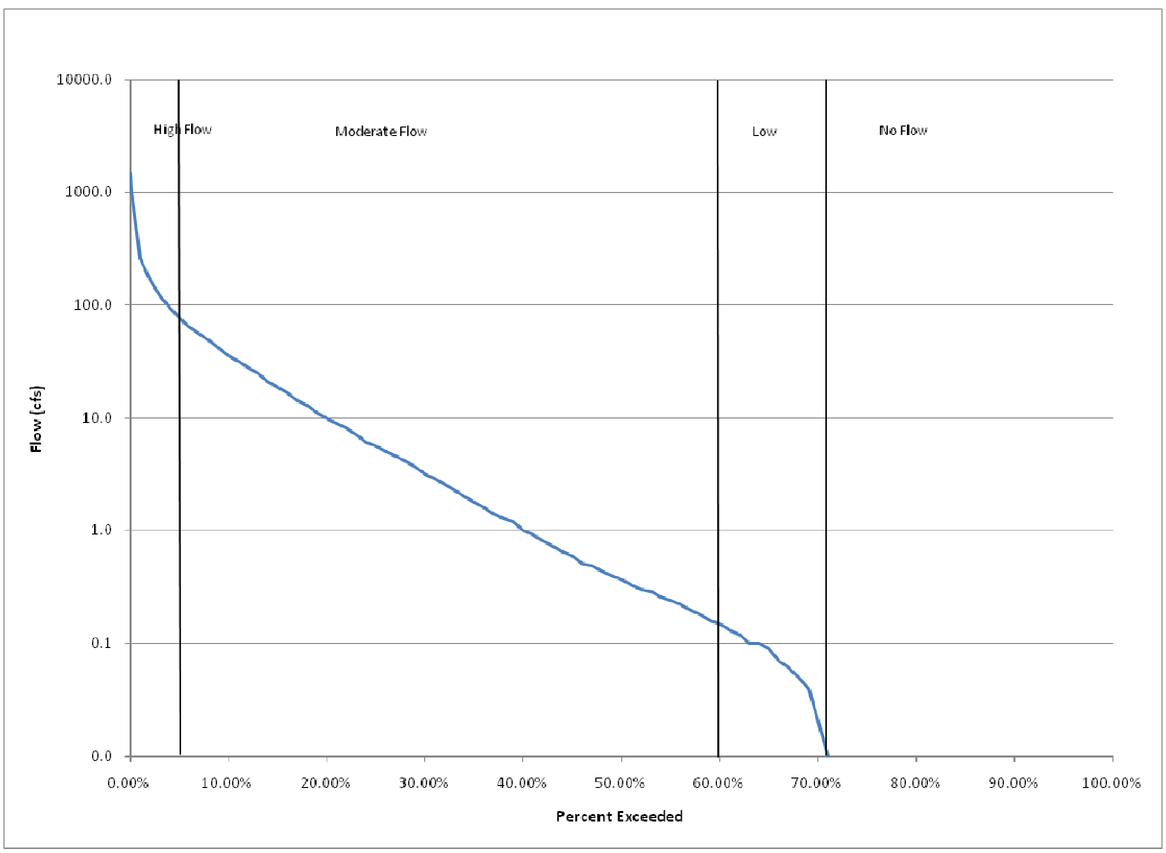

Figure 5. Flow Duration Curve for Bear Creek Site 385095 (near Oakes, North Dakota).

5.3 Load Duration Curve Analysis

An important factor in determining NPS pollution loads is variability in stream flows and loads associated with high and moderate to low flow. To better correlate the relationship between the pollutant of concern and hydrology of the 303(d) listed segment, a load duration curve was developed for each listed segment in the Bear Creek Watershed. The load duration curve was derived using the 200 CFU/100 mL target (i.e. state water standard) and the flows generated as described in Section 5.1.

Observed in-stream fecal coliform bacteria concentrations from monitoring sites 385095, 385097 and 385098 were converted to pollutant loads by multiplying fecal coliform bacteria concentrations by the flow and a conversion factor. These loads are plotted against the percent exceeded of the flow on the day of sample collection (Figure 6). Points plotted above the 200 CFU/100 mL target curve exceed the TMDL target. Points plotted below the curve are meeting the target of 200 CFU/100 mL.

Observed in-stream total fecal coliform bacteria concentrations from monitoring sites 385095, 385097, and 385098 were converted to pollutant loads by multiplying total fecal coliform bacteria concentrations by the daily flow on the date the sample was collected and a conversion factor. These loads are plotted against the percent of time exceeded for the flow on the day of sample collection (Figure 6). Points plotted above the 200 CFU/100 mL TMDL target curve exceed the TMDL target (Figure 6). Points plotted below the curve are meeting the water quality target of 200 CFU/100 mL.

For each flow interval or zone (i.e., high, moderate, low) and each site, 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 site 385095 depicting the regression relationship for each flow interval is provided in Figure 6. Load duration curves for the remaining sites are provided in Appendix E. The regression line for each flow interval was then used with the midpoint of the percent exceeded flow for that interval to calculate the existing total fecal coliform bacteria load for that flow interval. For example, in the example provided in Figure 6, the regression relationship between observed fecal coliform bacteria loading and percent exceeded flow for the high flow interval (0-5 percent) is:

Fecal coliform load (expressed as 10^7 CFUs/day) = antilog (6.36 + (-31.01*Percent Exceeded Flow))

Where the midpoint of the flow interval from 0 to 5 percent is 2.5 percent, the existing fecal coliform load is:

Fecal coliform load (10^7 CFUs/day) = antilog (6.36 + (-31.01*0.025))
= 384,370

The midpoint for the flow interval is also used to estimate the TMDL target load. In the case of the previous example, the TMDL target load for the midpoint or 5 percent exceeded flow derived from the 200 CFU/100 mL TMDL target curve is 68,513 x 10^7 CFUs/day (Figure 6).

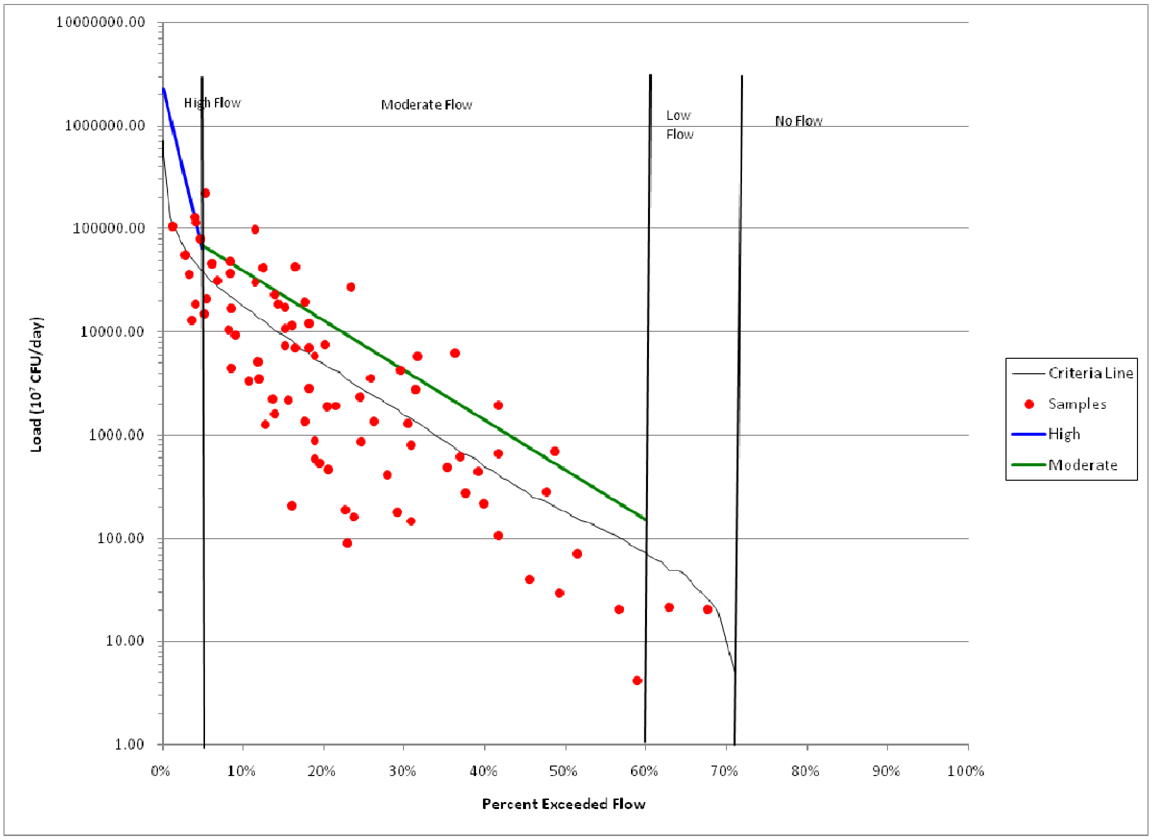

Figure 6. Load Duration Curve for Bear Creek Site 385095 (near Oakes, North Dakota).

5.4 Loading Sources

The load reductions can be generally allotted to nonpoint sources. Based on the data available, the general focus of BMPs and load reductions for the listed segments should be on unpermitted animal feeding areas and critical pasture areas described in the assessment report. Higher priority should be given to the unpermitted animal feeding areas located in close proximity to Bear Creek.

Significant sources of fecal coliform 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). TMDLs were developed for two flow regimes (i.e., high and medium) for segment ND-10160003-032-S_00, while TMDLs were only developed for the medium flow regime for segments ND-10160003-034-S_00 and ND-10160003-035-S_00. A single flow regime (medium) was used for segments ND-10160003-034-S_00 and ND-10160003-035-S_00 because samples indicated only one sample exceeded the water quality standard during periods of high flow, while segment ND-10160003-032-S_00 (represented by site 385095) use both high and medium flow regimes.

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, medium and low flows (Table 10). 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 moderate flows (Table 10). 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.

Since there are no point sources (see Section 4.1) impacting the fecal coliform bacteria loading in the watershed, sources exceeding the target curve in the medium flow regime and those in the high flow regime indicate nonpoint source pollution. Specific nonpoint sources of pollution and their potential to contribute fecal coliform bacteria loads under high, medium and low flow regimes in the Bear Creek watershed are described in Table 10.

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's (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 as 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 10 percent explicit margin of safety was used for this TMDL. The MOS was calculated as 10 percent of the TMDL. In other words 10 percent of the TMDL is set aside from the load allocation as a MOS. The 10 percent MOS was derived by taking the difference between the points on the load duration curve using the 200 CFU/100 mL standard and the curve using the 180 CFU/100 mL.

Table 10. Nonpoint Sources of Pollution and Their Potential to Pollute at a Given Flow Regime.

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

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

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 Bear Creek TMDL addresses seasonality because the flow duration curve was developed using thirty-one years of USGS gage data encompassing twelve months of the year. Additionally, the water quality standard is seasonally based on the recreation season from May 1 to September 30 and controls will be designed to reduce coliform loads during the seasons covered by the standard.

7.0 TMDL

The TMDL can be described by the following equation**:** 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 nonpoint sources;
MOS = margin of safety, or an accounting of uncertainty about the relationship between pollutant loads and receiving water quality. The margin of safety can be provided implicitly through analytical assumptions or explicitly by reserving a portion of loading capacity.

Table 11 provides an outline of the critical elements for each of the three waterbody specific fecal coliform bacteria TMDLs located within the Bear Creek watershed. TMDLs for waterbodies ND-10160004-032-S_00, ND-10160004-034-S_00, and ND-10160004-035-S_00 are presented in Tables 12, 13 and 14, respectively. Each TMDL summary provides an estimate of the existing daily load, an estimate of the average daily loads necessary to meet water quality target (i.e. TMDL load). This 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 11. TMDL Summary for Bear Creek .

Category	Description	Explanation
Beneficial Use Impaired	Recreation	Contact Recreation (i.e. swimming, fishing)
Pollutant	Fecal Coliform Bacteria	See Section 2.1
TMDL Target	200 CFU/100 mL	Based on North Dakota water quality standards
WLA		There are no contributing point sources in the watershed.
LA	Nonpoint Source Contributions	Loads are a result of nonpoint sources (i.e., rangeland, pasture land, etc.)
Margin of Safety (MOS)	Explicit	10 percent

Table 12. Fecal Coliform Bacteria TMDL (10^7 CFUs/day) for Bear Creek Waterbody Assessment Unit ID ND-10160003-032-S_00 (represented by site 385095).

	Flow Regime		
	High Flow	Medium Flow	Low Flow
Existing Load	384,370	3,229	No Reduction is Required
TMDL	68,513	1,174	
WLA	0	0	
LA	61,662	1,057	
MOS	6,851	117	

Table 13. Fecal Coliform Bacteria TMDL (10^7 CFUs/day) for Bear Creek Waterbody Assessment Unit ID ND-10160003-034-S_00 (represented by site 385098).

	Flow Regime		
	High Flow	Medium Flow	Low Flow
Existing Load	64,746	16,358	No Reduction is Required
TMDL	40,231	3,777	
WLA	0	0	
LA	36,208	3,399	
MOS	4,023	378	

Table 14. Fecal Coliform Bacteria TMDL (10^7 CFUs/day) for Bear Creek Waterbody Assessment Unit ID ND-10160003-035-S_00 (represented by site 38507).

	Flow Regime		
	High Flow	Medium Flow	Low Flow
Existing Load	No Reduction is Required	3,331	No Reduction is Required
TMDL		1,444	
WLA		0	
LA		1300	
MOS		144	

8.0 ALLOCATION

While there are point sources within the watershed, based on current data and permit requirements, none are known to add to the fecal coliform bacteria load at this time. Therefore, the entire fecal coliform load for this TMDL is allocated to nonpoint sources in the watershed. Three flow regimes (high flows, medium flows, low flows) were identified for the TMDL. TMDLs were not required for the high flow regime for segments ND-10160003-034-S_00 and ND-10160003-035-S_00 or the low flow regimes for all three segments because all samples collected at flows in these regimes were at or below the water quality standard of 200 cfu/100 mL.

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, upland grazing). To achieve the TMDL targets identified in the report will require the wide spread support and voluntary participation of landowners and residents in the immediate watershed as well as those living upstream. The TMDLs described in this report are a plan to improve water quality by implementing best management practices through non-regulatory approaches. "Best management practices" (BMPs) are methods, measures, or practices that are determined to be a reasonable and cost effective means for a land owner to meet nonpoint source pollution control needs," (USEPA, 2001). This TMDL plan should be considered an adaptive management plan and is put forth as a recommendation for what needs to be accomplished for Bear Creek, its tributaries and associated watershed to restore and maintain its recreational uses. Water quality monitoring should continue to assess the effects of the recommendations made in this TMDL. Monitoring may indicate that BMP implementation and/or the loading capacity recommendations should be adjusted.

Controlling nonpoint sources is a difficult undertaking requiring extensive financial and technical support. Provided that technical and financial assistance is available to stakeholders, these BMPs have the potential to significantly reduce fecal coliform loading to the Bear Creek. The following describe in detail those BMPs that will reduce fecal coliform bacteria levels in the Bear Creek.

8.1 Livestock Management Recommendations

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

<u>Livestock exclusion from riparian areas</u> - 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.

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

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

In a study by Tiedemann et al. (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 show that when livestock are managed at a stocking rate of 19 acres per animal unit month with water developments and fencing, bacteria levels were reduced significantly.

Waste management system - Waste management systems can be effective in controlling up to 90 percent of the loading originating from confined animal feeding areas. A waste management system is made up of various components designed to control NPS pollution from concentrated animal feeding operations (CAFOs) and animal feeding operations (AFOs). Diverting clean water around the feeding area and detaining dirty water from the feeding area in a pond are typical practices of a waste management system. Manure handling and application procedures are also integral to the waste management system. The application of manure is designed to be adaptive to environmental, soil, and plant conditions to minimize the probability of contamination of surface water.

9.0 PUBLIC PARTICIPATION

To satisfy the public participation requirement of this TMDL, a hard copy of the TMDL for Bear Creek and request for comment was mailed to participating agencies, partners, and to those requesting a copy. Those included in the hard copy mailing were:

- Barnes County Soil Conservation District;
- Ransom County Soil Conservation District;
- James River (Dickey County) Soil Conservation District;
- LaMoure County Soil Conservation District;
- Barnes County Water Resource Board;
- Ransom County Water Resource Board;
- Dickey County Water Resource Board;
- LaMoure County Water Resource Board;
- US EPA - Region VIII; and
- USDA-NRCS (State Office).

In addition to the mailed copies, the TMDL for Bear Creek 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_Comment.htm . A 30 day public notice soliciting comment and participation was also published in the following newspapers:

- Valley City Times-Record
- LaMoure Chronicle;
- Ransom County Gazette; and
- Dickey County Leader.

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 STRATEGY

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.

To insure that the best management practices (BMPs) and technical assistance that are implemented as part of the Section 319 Bear Creek Watershed Restoration Project are successful in reducing fecal coliform bacteria loadings to levels prescribed in this TMDL, water quality monitoring is being conducted in accordance with an approved Quality Assurance Project Plan (QAPP). As prescribed in the QAPP (NDDoH, 2003), weekly monitoring is being conducted at four sites for fecal coliform bacteria. Sampling began in October 2003 and will continue through June 2010.

11.0 RESTORATION STRATEGY

In response to the Bear Creek Watershed Assessment and in anticipation of this completed TMDL, local sponsors successfully applied for and received Section 319 funding for the Bear Creek Watershed Restoration Project. Beginning in October 2003, local sponsors have been providing technical assistance and implementing BMPs designed to reduce fecal coliform bacteria loadings and to help restore the beneficial uses of the Bear Creek (i.e., recreation). As the watershed restoration project progresses, water quality data are 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, 2003) has also been developed as part of this watershed restoration project that details the how, when and where monitoring will be conducted to gather the data needed to document success in meeting the TMDL implementation goal(s). As the data are gathered and analyzed, watershed restoration tasks 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).

Also, as part of the implementation plan for this TMDL, it is recommended that the permitted point sources (i.e., Marion WWTF, Litchville WWTF, Verona WWTF, and 12 AFO/CAFOs) in the watershed be inspected to ensure that they are being operated in compliance with their permit conditions, and to verify that they aren’t significant fecal coliform sources. Currently, the city waste water treatment facilities are inspected for compliance every five years, while all permitted CAFOs (greater than or equal to 1000 animal units) are inspected annually by the NDDoH. Permitted AFOs (<1000 animal units) in the Bear Creek watershed are inspected on an as needed basis.

12.0 REFERENCES

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Appendix A

Fecal Coliform Bacteria Data Collected in the Bear Creek Watershed

385095 Bear Creek at Oakes

DATE	Result
5/2/02	20
5/7/02	10
5/9/02	30
5/16/02	20
5/20/02	280
5/23/02	1600
5/28/02	500
5/30/02	840
6/4/02	170
6/11/02	910
6/18/02	250
6/24/02	1600
7/11/02	400
7/15/02	10
8/12/02	700
9/12/02	10
5/5/03	110
5/8/03	310
5/12/03	40
5/14/03	90
5/19/03	380
5/21/03	500
5/28/03	150
6/2/03	370
6/9/03	380
6/16/03	640
6/23/03	1100
6/30/03	220
7/14/03	160
8/11/03	80
9/15/03	140
5/4/04	150
5/11/04	30
5/18/04	20
5/25/04	170
6/1/04	420
6/8/04	30
6/15/04	50
6/21/04	40
6/29/04	90
7/6/04	570
7/20/04	80
7/27/04	40
8/10/04	30

DATE	Result
8/24/04	40
9/9/04	20
5/3/05	5
5/10/05	230
5/17/05	5
5/24/05	180
5/31/05	20
6/7/05	430
6/14/05	170
6/21/05	130
6/28/05	540
7/5/05	50
7/12/05	80
7/19/05	20
8/22/05	40
9/6/05	40
9/20/05	90
5/3/06	1200
5/10/06	90
5/17/06	70
5/24/06	360
5/31/06	200
6/7/06	60
6/14/06	390
6/21/06	110
6/28/06	50
7/5/06	90
7/12/06	80
5/2/07	50
5/8/07	170
5/15/07	80
6/13/07	290
6/20/07	120
6/26/07	320
7/2/07	1300
7/11/07	280
7/18/07	220
7/25/07	160
8/1/07	110
8/15/07	80
8/29/07	310

385097 NW Tributary to Bear Creek

DATE	Result
5/2/02	10
5/7/02	10
5/9/02	20
5/16/02	20
5/20/02	60
5/23/02	80
5/28/02	90
5/30/02	100
6/4/02	380
6/11/02	890
6/18/02	1200
6/24/02	760
7/11/02	80
7/15/02	1000
8/12/02	180
5/8/03	70
5/12/03	10
5/14/03	120
5/19/03	10
5/21/03	10
5/28/03	10
6/2/03	10
6/9/03	10
6/16/03	60
6/23/03	410
6/30/03	90
7/14/03	30
8/11/03	1600
5/4/04	60
5/11/04	170
5/18/04	40
5/25/04	380
6/1/04	1600
6/8/04	50
6/15/04	30
6/21/04	70
6/29/04	60
7/6/04	560
7/20/04	80
7/27/04	270
8/10/04	650
5/3/05	10
5/10/05	110
5/17/05	120
5/24/05	210
5/31/05	50

DATE	Result
6/7/05	80
6/14/05	160
6/21/05	210
6/28/05	70
7/5/05	90
7/12/05	40
7/19/05	30
8/22/05	140
9/6/05	330
9/20/05	370
5/3/06	80
5/10/06	50
5/17/06	150
5/24/06	190
5/31/06	130
6/7/06	90
6/14/06	460
6/21/06	1400
6/28/06	500
5/2/07	20
5/8/07	20
5/15/07	30
6/13/07	220
6/20/07	40
6/26/07	40
7/2/07	100
7/11/07	50
7/18/07	120
7/25/07	110
8/1/07	300
8/15/07	820
8/29/07	110

385098 Bear Creek near Ft. Ransom

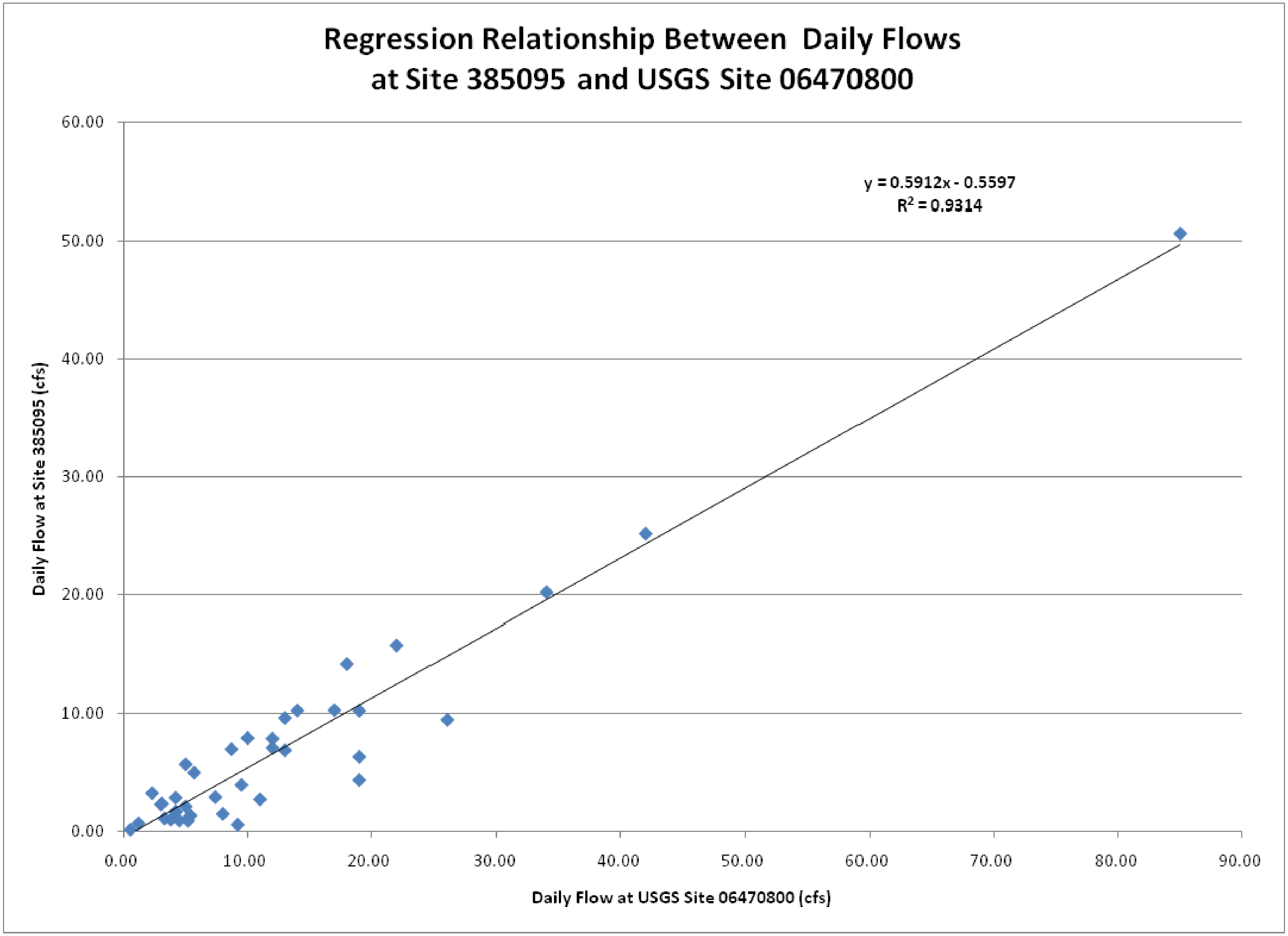
DATE	Result
5/16/02	130
5/20/02	10
5/23/02	10
5/28/02	50
5/30/02	90
6/4/02	50
6/11/02	30
6/18/02	160
6/24/02	40
7/11/02	80
7/15/02	50
5/5/03	50
5/8/03	10
5/12/03	10
5/14/03	30
5/19/03	230
5/21/03	100
5/28/03	10
6/2/03	20
6/9/03	30
6/16/03	50
6/23/03	1600
6/30/03	80
7/14/03	40
5/4/04	10
5/11/04	10
5/18/04	10
5/25/04	20
6/1/04	760
6/8/04	20
6/15/04	20
6/21/04	80
6/29/04	30

Date	Result
7/6/04	190
7/20/04	540
5/3/05	5
5/10/05	110
5/17/05	5
5/24/05	10
5/31/05	5
6/7/05	180
6/14/05	300
6/21/05	20
6/28/05	80
7/5/05	5
7/12/05	200
7/19/05	20
8/22/05	5
9/6/05	970
9/20/05	10
5/3/06	20
5/10/06	20
5/17/06	10
5/24/06	150
5/31/06	20
6/7/06	200
6/14/06	1200
5/2/07	30
5/8/07	10
5/15/07	50
6/13/07	40
6/20/07	40
6/26/07	40
7/2/07	50
7/11/07	70
7/18/07	30

Appendix B

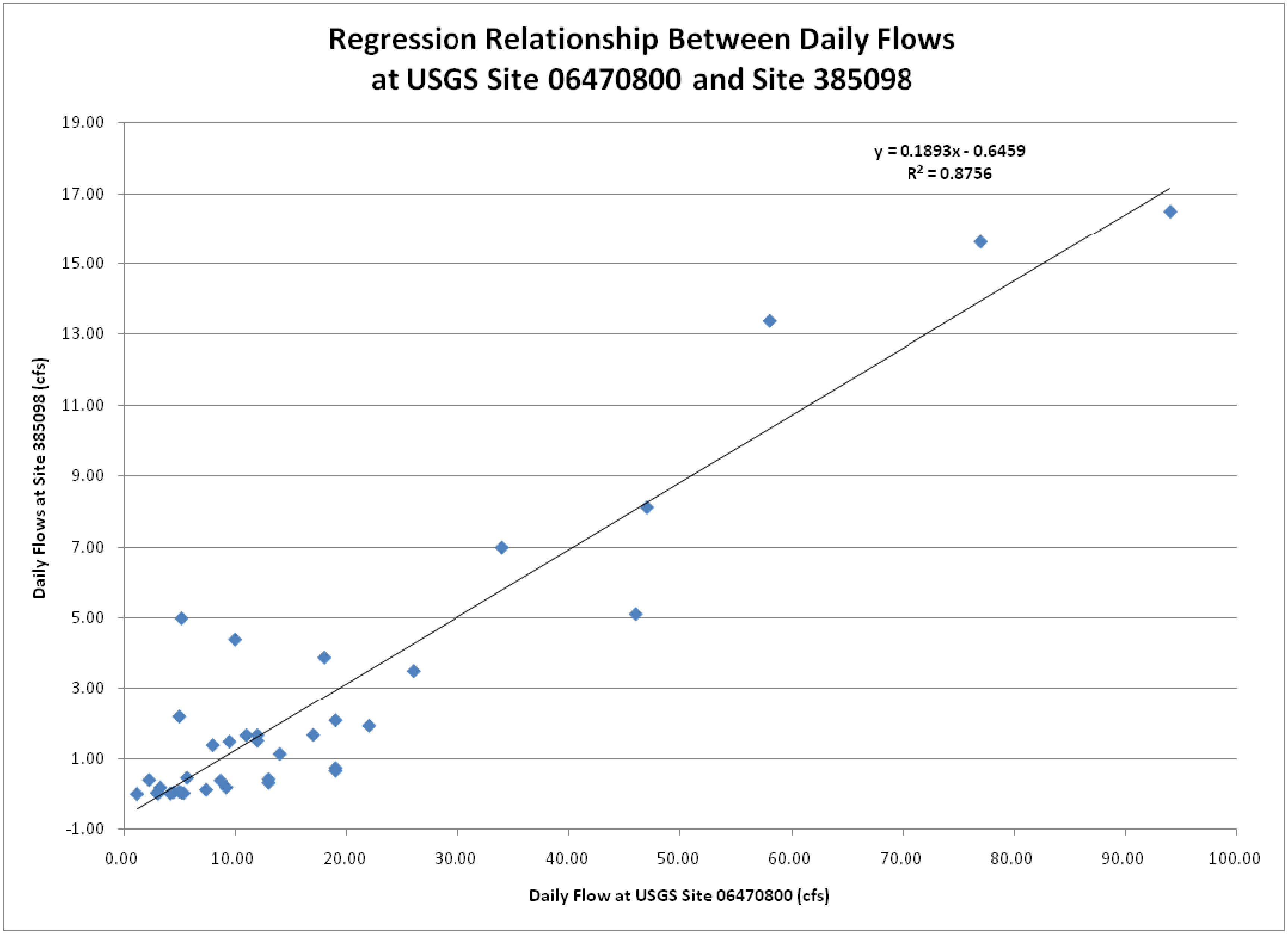
Stream Discharge Measurements and Dicharge Regression Relationships for Sites 385095, 385098 and 385097

385095	
Date	**Q**
03/24/03	9.67
03/27/03	13.93
03/31/03	6.08
04/09/03	6.39
04/16/03	15.48
04/18/03	16.89
04/21/03	18.32
04/23/03	10.74
04/28/03	12.53
04/30/03	10.95
05/05/03	19.08
05/08/03	38.08
05/12/03	39.52
05/14/03	53.59
05/28/03	37.52
06/02/03	18.77
06/09/03	14.28
07/14/03	26.74
03/23/04	5.39
03/30/04	12.02
04/06/04	10.61
04/13/04	4.96
05/04/04	6.46
05/18/04	2.43
05/25/04	9.33
06/15/04	22.66
06/21/04	17.82
06/29/04	10.54
07/27/04	5.11
08/10/04	1.04
08/24/04	2.88
09/21/04	3.53
10/05/04	1.49
04/05/05	12.20
04/12/05	13.58
04/19/05	18.41
04/26/05	9.93
05/10/05	21.38
05/17/05	19.28
05/31/05	13.51
06/07/05	23.22
07/12/05	87.70
07/19/05	32.66



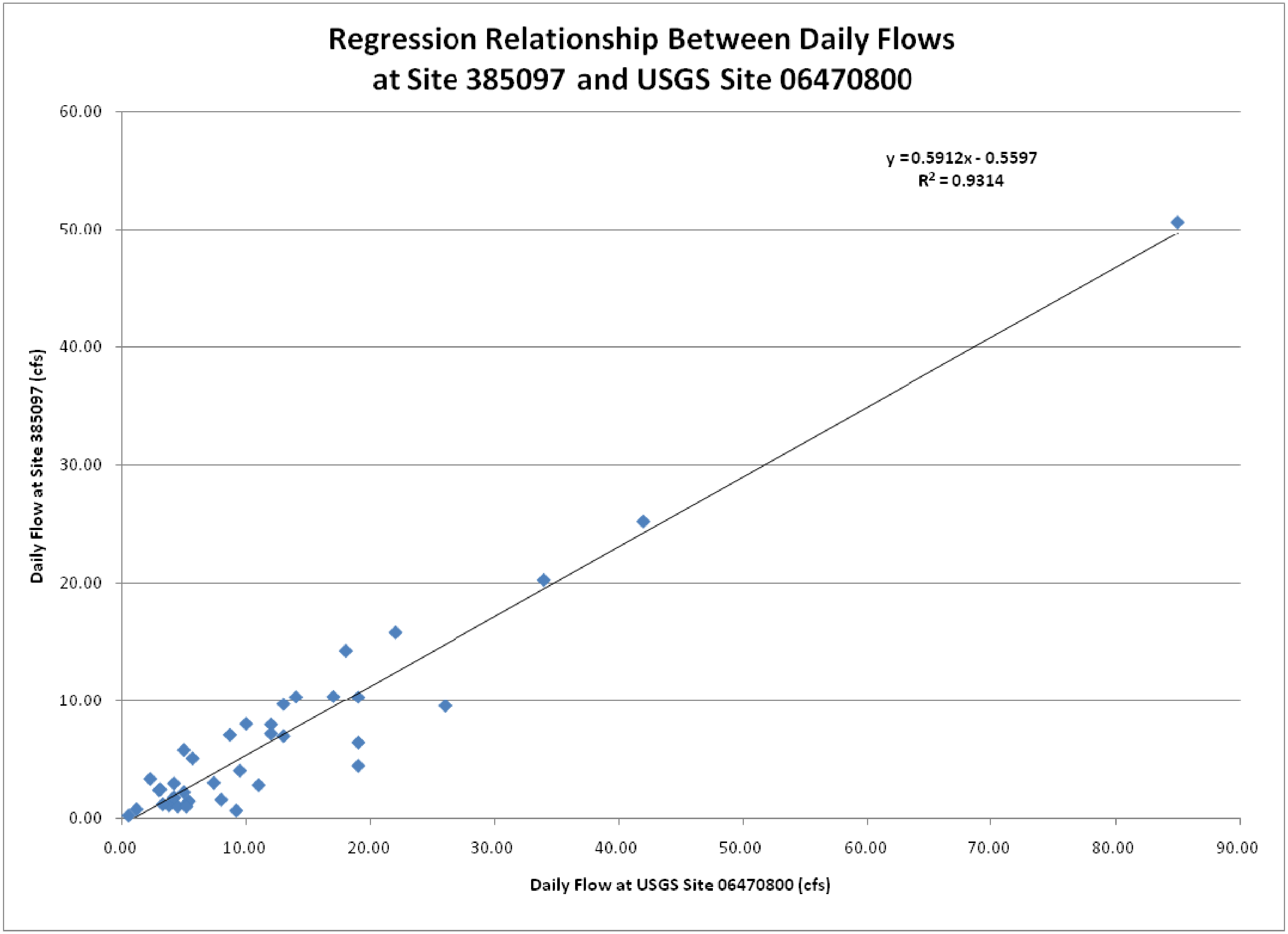
Regression Relationship Between Daily Flows
at Site 385095 and USGS Site 06470800
y = 0.5912x - 0.5597
R^2 = 0.9314
Daily Flow at Site 385095 (cfs)
Daily Flow at USGS Site 06470800 (cfs)
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
90.00

385098	
Date	**Q**
03/24/03	0.19
03/27/03	1.39
03/31/03	0.41
04/16/03	0.06
04/18/03	0.05
04/21/03	0.03
04/23/03	0.08
04/28/03	0.02
05/05/03	2.20
05/08/03	4.40
05/12/03	7.00
05/14/03	14.94
05/19/03	40.08
05/21/03	16.51
05/28/03	5.12
06/02/03	2.09
06/09/03	0.33
06/30/03	13.39
07/14/03	0.74
03/30/04	5.00
04/06/04	1.49
04/13/04	0.47
04/27/04	0.19
05/04/04	0.01
05/18/04	0.04
05/25/04	0.02
06/01/04	8.13
06/08/04	10.38
06/15/04	3.89
06/21/04	1.14
06/29/04	0.39
04/05/05	1.67
04/12/05	1.67
04/19/05	0.43
05/03/05	0.13
05/10/05	0.67
05/17/05	1.68
05/31/05	1.52
06/07/05	1.94
07/12/05	15.63
07/19/05	3.51



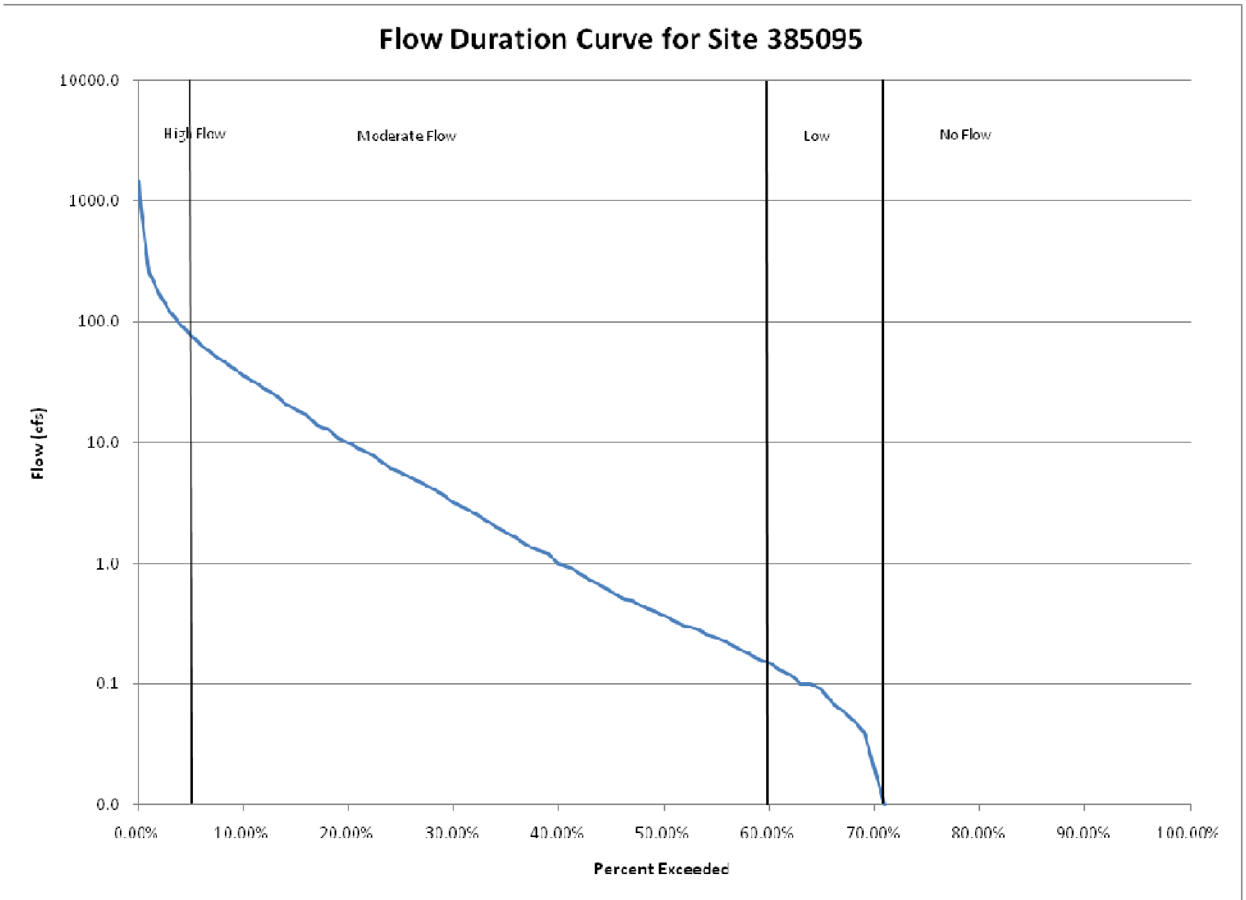
Regression Relationship Between Daily Flows
at USGS Site 06470800 and Site 385098
y = 0.1893x - 0.6459
R² = 0.8756
Daily Flows at Site 385098 (cfs)
Daily Flow at USGS Site 06470800 (cfs)
19.00
17.00
15.00
13.00
11.00
9.00
7.00
5.00
3.00
1.00
-1.00
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
90.00
100.00

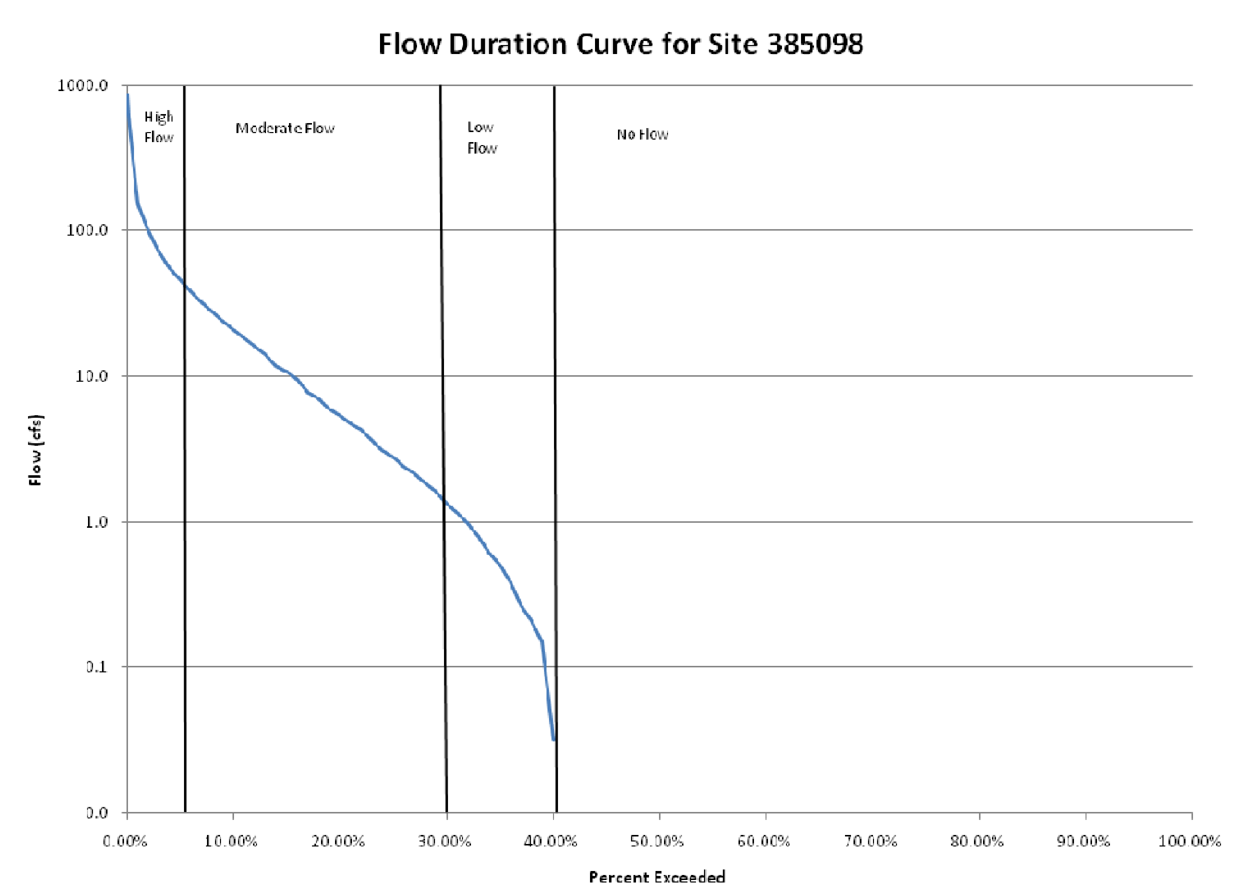
385097	
Date	Q
03/24/03	0.61
03/27/03	1.53
03/31/03	3.29
04/09/03	1.72
04/14/03	1.04
04/16/03	0.97
04/18/03	1.17
04/21/03	1.40
04/23/03	2.16
04/28/03	1.69
05/05/03	5.73
05/08/03	7.96
05/12/03	20.24
05/14/03	25.20
05/19/03	50.65
05/21/03	27.54
05/28/03	12.61
06/02/03	10.27
06/09/03	9.66
07/14/03	6.37
03/30/04	0.95
04/06/04	3.99
04/13/04	5.03
04/27/04	1.14
05/04/04	0.72
05/18/04	2.34
05/25/04	2.40
06/01/04	9.71
06/08/04	15.81
06/15/04	14.24
06/21/04	10.30
06/29/04	7.02
07/27/04	2.91
08/10/04	0.19
04/05/05	2.76
04/12/05	7.91
04/19/05	6.92
05/03/05	2.96
05/10/05	4.40
05/17/05	10.33
05/31/05	7.13
07/12/05	14.82
07/19/05	9.51

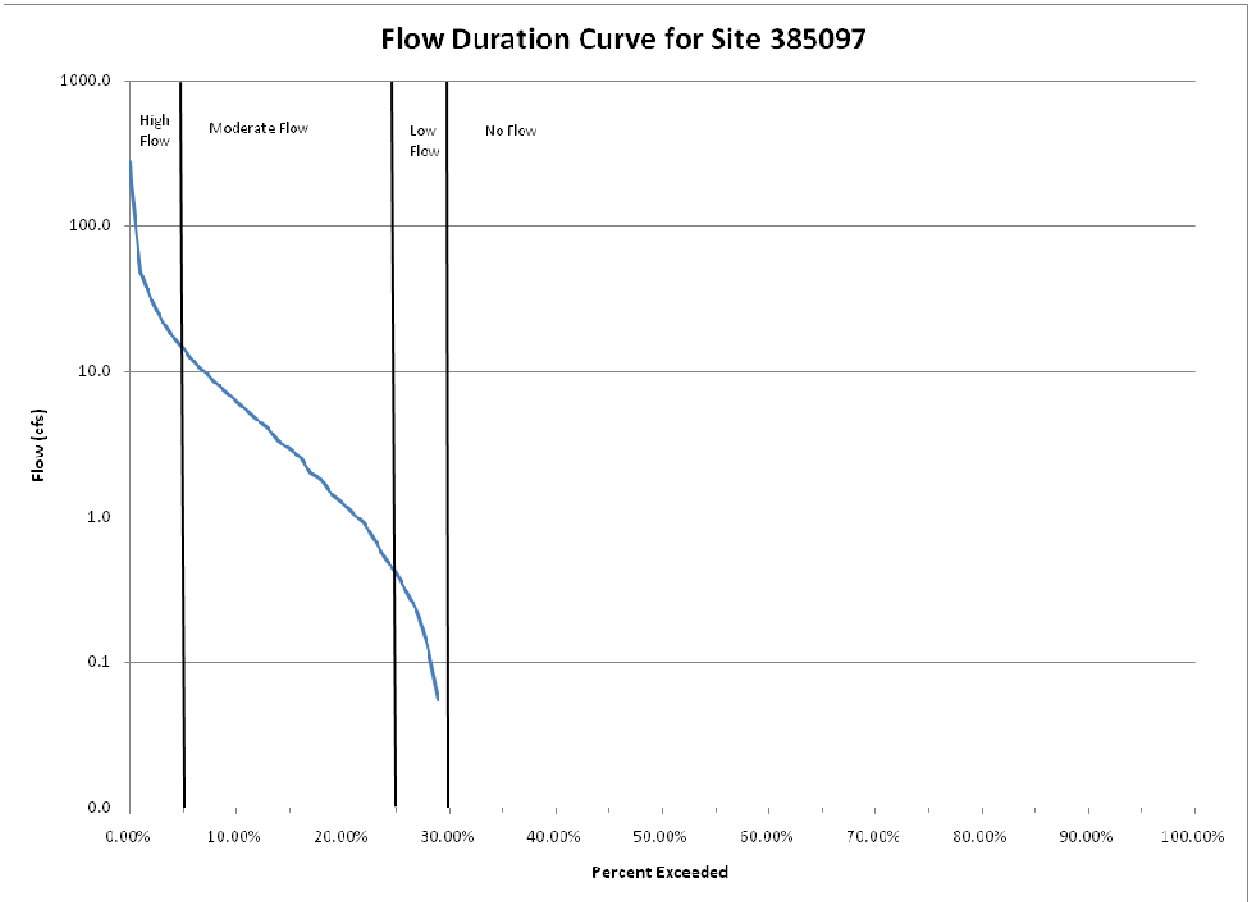


Regression Relationship Between Daily Flows
at Site 385097 and USGS Site 06470800
y = 0.5912x - 0.5597
R² = 0.9314
Daily Flow at Site 385097 (cfs)
Daily Flow at USGS Site 06470800 (cfs)
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
90.00

Appendix C
Flow Duration Curves for Sites 385095, 385098, and 385097


Flow Duration Curve for Site 385095
High Flow
Moderate Flow
Low
No Flow
Flow (cfs)
10000.0
1000.0
100.0
10.0
1.0
0.1
0.0
0.00%
10.00%
20.00%
30.00%
40.00%
50.00%
60.00%
70.00%
80.00%
90.00%
100.00%
Percent Exceeded


Flow Duration Curve for Site 385098
High Flow
Moderate Flow
Low Flow
No Flow
Flow (cfs)
1000.0
100.0
10.0
1.0
0.1
0.0
0.00%
10.00%
20.00%
30.00%
40.00%
50.00%
60.00%
70.00%
80.00%
90.00%
100.00%
Percent Exceeded



Flow Duration Curve for Site 385097
1000.0
100.0
10.0
1.0
0.1
0.0
Flow (cfs)
High Flow
Moderate Flow
Low Flow
No Flow
0.00%
10.00%
20.00%
30.00%
40.00%
50.00%
60.00%
70.00%
80.00%
90.00%
100.00%
Percent Exceeded

Appendix D

Estimated Loads, TMDL Targets, Percentage of Reduction Required and Load Duration Curves for Sites 385095, 385098, 385097

Site 385095 Bear Creek at Oakes

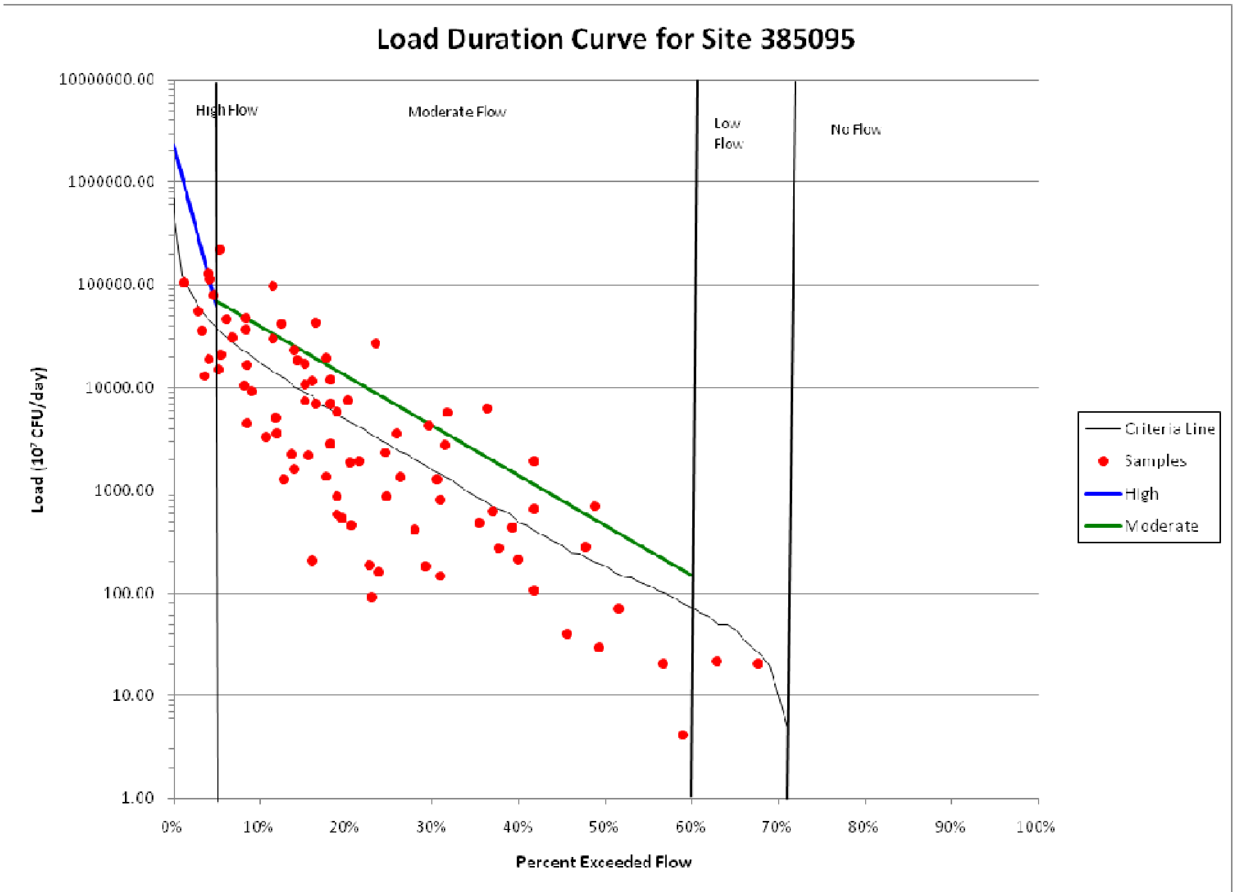
	Load (10^7 CFU/Day)				Load (10^7 CFU/Period)		
	Median Percentile	Existing	TMDL	Days	Existing	TMDL	Percent Reduction
High	2.50%	384370.46	68513.17	18.25	7014760.90	1250365.29	82.18%
Moderate	32.51%	3229.38	1174.51	200.71	648180.97	235740.30	63.63%
			Total	219	7662942	1486106	80.61%

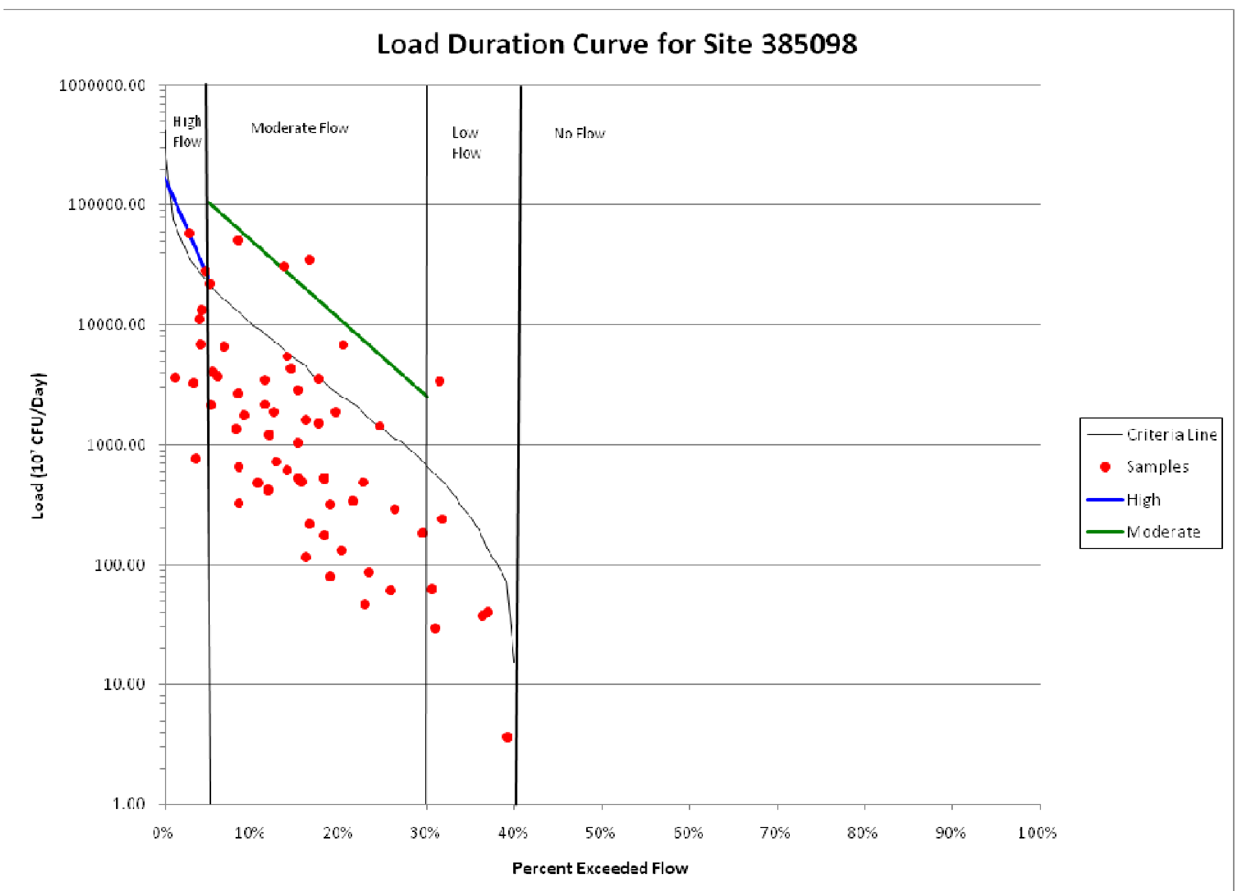
Site 385098 Bear Creek at Ft. Ransom

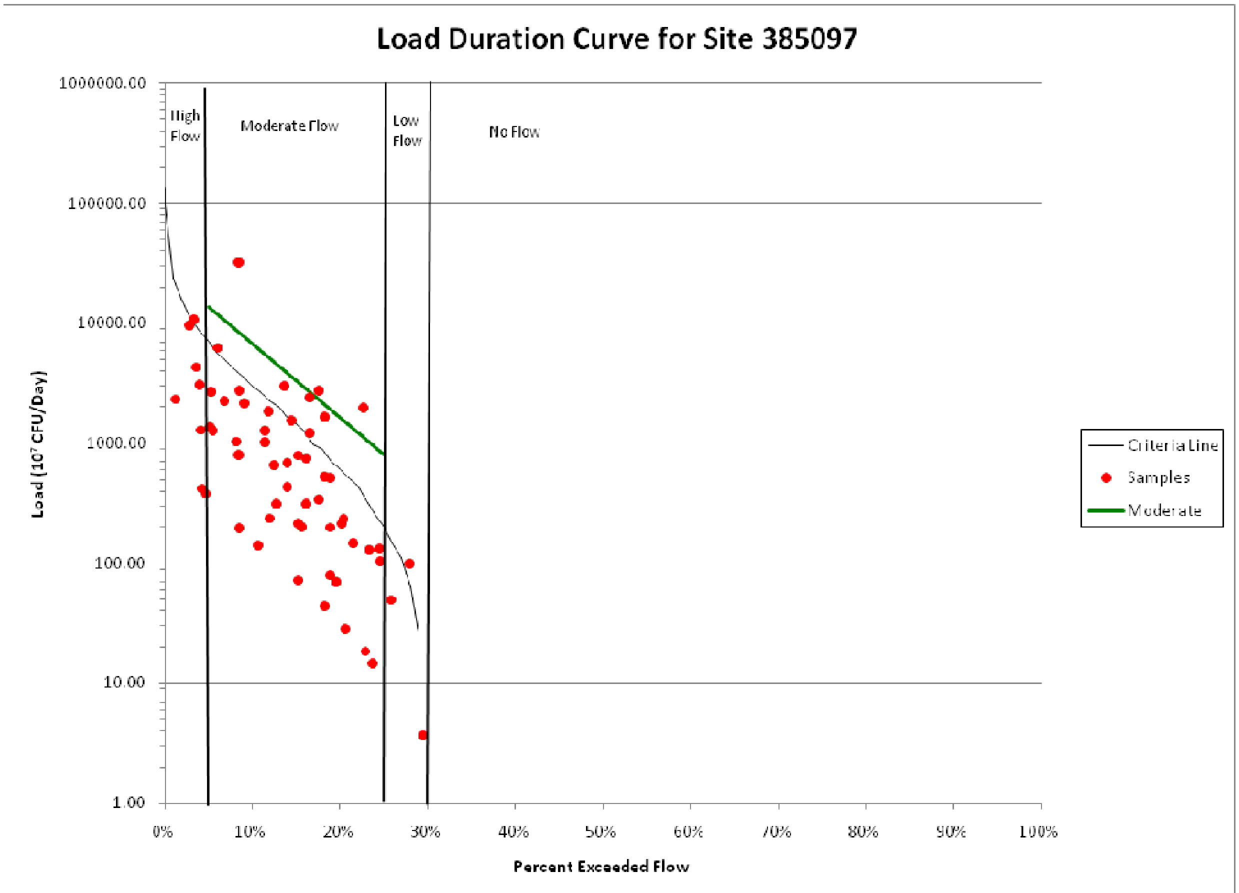
	Load (10^7 CFU/Day)				Load (10^7 CFU/Period)		
	Median Percentile	Existing	TMDL	Days	Existing	TMDL	Percent Reduction
High	2.50%	64745.96	40231.08	18.25	1181613.84	734217.18	37.86%
Moderate	17.51%	16358.05	3776.59	91.21	1492074.60	344476.22	76.91%
			Total	109	2673688	1078693	59.66%

Site 385097 NW Tributary to Bear Creek

	Load (10^7 CFU/Day)				Load (10^7 CFU/Period)		
	Median Percentile	Existing	TMDL	Days	Existing	TMDL	Percent Reduction
Moderate	15.01%	3331.48	1444.06	72.96			
			Total	73			


Load Duration Curve for Site 385095
10000000.00
1000000.00
100000.00
10000.00
1000.00
100.00
10.00
1.00
High Flow
Moderate Flow
Low Flow
No Flow
Load (10⁷ CFU/day)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent Exceeded Flow
Criteria Line
Samples
High
Moderate


Load Duration Curve for Site 385098
1000000.00
100000.00
10000.00
1000.00
100.00
10.00
1.00
High Flow
Moderate Flow
Low Flow
No Flow
Load (10⁷ CFU/Day)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent Exceeded Flow
Criteria Line
Samples
High
Moderate



Load Duration Curve for Site 385097
1000000.00
100000.00
10000.00
1000.00
100.00
10.00
1.00
High Flow
Moderate Flow
Low Flow
No Flow
Load (10^7 CFU/Day)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent Exceeded Flow
Criteria Line
Samples
Moderate

Appendix E
US EPA Region 8 Public Notice Review and Comments

EPA REGION VIII TMDL REVIEW

TMDL Document Info:

Document Name:	**Fecal Coliform Bacteria TMDL for Bear Creek and Tributaries in Dickey, Ransom and Barnes Counties, North Dakota**
Submitted by:	**Mike Ell, North Dakota Department of Health**
Date Received:	**August 14, 2009**
Review Date:	**September 17, 2009**
Reviewer:	**Vern Berry, EPA**
Rough Draft / Public Notice / Final?	**Public Notice Draft**
Notes:	

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

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

Approval Notes to Administrator:

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

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

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

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

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

1. Problem Description

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

1.1 TMDL Document Submittal Letter

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

Minimum Submission Requirements.

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

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

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

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

SUMMARY: The public notice draft Bear Creek fecal coliform TMDL was submitted to EPA for review during the public notice period via an email from Mike Ell, NDDoH on August 14, 2009. The email included the draft TMDL document and a public notice announcement requesting review and comment.

COMMENTS: None

1.2 Identification of the Waterbody, Impairments, and Study Boundaries

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

Minimum Submission Requirements:

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

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

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

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

SUMMARY: The Bear Creek its tributaries are a stream system located in Dickey, Ransom and Barnes Counties, in southeast North Dakota. Bear Creek is part of the larger James River basin in the Upper James sub-basin (HUC 10160003). The Bear Creek and tributary segments flow approximately 167 miles, with a total drainage area of 268,800 acres. There are three 303(d) listed segments of Bear Creek, they include: 1) Unnamed tributary and its watershed to Bear Creek (ND-10160004-035-S_00); 2) Bear Creek upstream from tributary watershed, including tributaries (ND-10160004-034-S_00); and 3) Bear Creek from tributary watershed downstream to its confluence with the James River (ND-10160003-032-S_00. All three segments are listed as high priority for TMDL development.

The designated use for the listed segments of the Bear Creek and its tributaries are based on the Class III stream classification in the ND water quality standards (NDCC 33-15-02.1-09). The segments were included on the ND 2008 303(d) list for fecal coliform bacteria which is impairing primary contact recreation uses.

COMMENTS: Tables 1 and 2 show the lower segment as "101600**03-**032-S," but the Figure 2 maps shows that segment as "101600**04-**032-S." The 2008 ND IR and 303(d) list shows all three segments as being in HUC "10160003" – the assessment unit ID numbers should be revised as needed to be consistent within the document and with the 303(d) listings.

1.3 Water Quality Standards

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

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

Minimum Submission Requirements:

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

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

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

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

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

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

SUMMARY: The Bear Creek segments addressed by these TMDLs are impaired based on fecal coliform concentrations for primary contact recreational uses. Bear Creek and its tributaries are Class III streams that must be protected for agricultural and industrial uses. Class III streams generally have low flow and prolonged dry periods and hence secondary contact recreational uses and standards are applied. Numeric criteria for fecal coliforms in Class III streams have been established and are presented in the excerpted Table 8 shown below. Discussion of additional applicable water quality standards for Bear Creek can be found on pages 8 and 9 of the TMDL.

Table 8. North Dakota Fecal Coliform Bacteria Standards for Class III Streams.

Parameter	Water Quality Standard	
	Geometric Mean[1]	Maximum[2]
Fecal Coliform Bacteria	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.

COMMENTS: None.

2. Water Quality Targets

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

Minimum Submission Requirements:

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

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

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

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

SUMMARY: The water quality targets for these TMDLs are based on the numeric water quality standards for fecal coliform bacteria based on the primary contact recreational beneficial use for Bear Creek and its tributaries. The target for the Bear Creek segments included in the TMDL document is the fecal coliform standard expressed as the 30-day geometric mean of 200 CFU/100 mL. While the standard is intended to be expressed as the 30-day geometric mean, the target was used to compare to values from single grab samples. This ensures that the reductions necessary to achieve the target will be protective of both the acute (single sample value) and chronic (geometric mean of 5 samples) standards.

COMMENTS: None.

3. Pollutant Source Analysis

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

Minimum Submission Requirements:

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

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

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

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

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

SUMMARY: The TMDL document, Table 5, includes the landuse breakdown in the watershed for 2002 and 2007. In 2002, approximately 60 percent of the landuse in the watershed was cropland under active cultivation, 16 percent was pasture/rangeland, 18 percent was idle/fallow and the remainder was water, roads or low density development.

The following nonpoint sources were found to be the primary sources for fecal coliform bacteria in the watershed:

- Runoff of manure from cropland and pastureland;
- Runoff of manure from unpermitted animal feeding areas;
- Direct deposit of manure into Bear Creek by grazing livestock; and
- Background levels associated with wildlife.

There are three point sources located in the Bear Creek watershed. The small towns of Marion (population estimate 125), Litchville (population estimate 165), and Verona (population estimate 92), have wastewater treatment lagoons that discharge to ephemeral streams which eventually drain to Bear Creek. Due to the small size and location of the discharges they are considered negligible sources of fecal coliform loading. There are also permitted concentrated animal feeding operations (CAFOs) and animal feeding operations (AFOs) in the watershed. Their permits require no discharge so they are not considered significant point sources in the TMDL document.

COMMENTS: The report states that data were collected at three locations in the watershed and the report also states that through the 2002 water quality assessment, it was determined that the above bulleted sources are the primary contributors of fecal coliforms in the watershed. As information regarding source identification efforts is not provided, it is not clear how these sources were found to be the major contributors. Are these the only potential sources besides the WWTF lagoons and CAFOs/AFOs located in the watershed? How many permitted CAFOs/AFOs are located within the watershed? Additional information regarding how it was determined that these are the primary sources of fecal coliforms in the watershed would be helpful.

As part of the implementation plan for this TMDL we recommend that the permitted point sources (i.e., WWTF lagoons, CAFOs and AFOs) in the watershed be inspected to ensure that they are being operated in compliance with their permit conditions, and to verify that they aren't significant fecal coliform sources.

4. TMDL Technical Analysis

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

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

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

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

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

Where:

TMDL = Total Pollutant Loading Capacity of the waterbody

LAs = Pollutant Load Allocations

WLAs = Pollutant Wasteload Allocations

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

Minimum Submission Requirements:

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

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

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

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

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

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

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

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

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

SUMMARY: The technical analysis should describe the cause and effect relationship between the identified pollutant sources, the numeric targets, and achievement of water quality standards. It should also include a description of the analytical processes used, results from water quality modeling, assumptions and other pertinent information. The technical analysis for the Bear Creek watershed TMDL describes how the fecal coliform 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 the Section 303(d) listed waterbody, a LDC was developed for each monitoring site within the three listed segments. All LDCs were derived using the 200 CFU/100 mL TMDL target (i.e., state water quality standard), the daily flow record obtained or synthesized for each site, and the observed fecal coliform data collected from the three water quality monitoring stations (see Figure 2 of the TMDL document) from 2002 through 2007.

Mean daily flows for the period October 10, 1976 through December 3, 2007 were obtained from the USGS gauge site (06470800). For the three monitoring sites, 385095 (Oakes), 380598 (Ft. Ransom) and 385097 (NW Tributary), the mean daily flow record used in flow duration curve development and in the development of the load duration curve was synthesized using regression relationships developed for each site. Simple linear regression relationships were developed for each site using the measured flows at each site paired with the corresponding flow at the USGS site for the same day. Using the daily flow record for the USGS site as the dependent variable a corresponding daily flow was estimated for each site.

The load duration curve plots the allowable fecal coliform load (using the 200 CFU/100 ml standard) across the three flow regimes. Single grab sample fecal coliform concentrations were converted to loads by multiplying by flow and a conversion factor to produce CFU/day values. Each value was plotted individually on the load duration curve. Values falling above the curve indicate exceedance of the TMDL at that flow value while values falling below the curve indicate attainment of the TMDL at that flow.

To estimate the required percent reductions in loading needed to achieve the TMDL, 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 three flow regimes were determined using the linear regression line.

The LDCs represent a flow-variable TMDL targets across the flow regimes shown in the TMDL document. For each Bear Creek and tributary segment covered by the TMDL document, the LDC is a dynamic expression of the allowable load for any given daily flow. Loading capacities were derived from this approach for each segment at each flow regime. Tables 11, 12, and 13 show the loading capacity loads (or TMDL loads) for each listed segment of the Bear Creek and its tributaries.

COMMENTS: It is not clear why 3 flow zones were used in the LDCs for these TMDLs. Page 11 of the document explains ***how*** the flow regimes were defined for each site, but no explanation is given for ***why*** 3 zones were used. A brief explanation of why 3 flow zones were used (e.g., based on the shape of the curve, no flow at low end of curve, etc) should be added to the document.

From the information provided on page 11 of the document, it is not clear how the linear regression line is used in determining the required percent reductions needed for LDC. NDDoH is asked to clarify the information and include a description as to how the percent reduction calculation is made using the linear regression line.

4.1 Data Set Description

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

Minimum Submission Requirements:

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

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

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

SUMMARY: The Bear Creek TMDL data description and summary are included tables throughout the document and in the data tables in Appendix A and B. The recent water quality monitoring was conducted over the period from 2002 to 2007. The data set also includes the 31 years of flow record on the Bear Creek from the USGS gauging site (06470800). The flow data was used to develop a load duration curves for the Bear Creek and tributary segments

COMMENTS: None.

4.2 Waste Load Allocations (WLA):

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

Minimum Submission Requirements:

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

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

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

SUMMARY: There are three point sources located in the Bear Creek watershed. The small towns of Marion (population estimate 125), Litchville (population estimate 165), and Verona (population estimate 92), have wastewater treatment lagoons that discharge to ephemeral streams which eventually drain to Bear Creek. Due to the small size and location of the discharges they are considered negligible sources of fecal coliform loading. There are also permitted concentrated animal feeding operations (CAFOs) and animal feeding operations (AFOs) in the watershed. Their permits require no discharge so they are not considered significant point sources in the TMDL document. Therefore, the WLAs for these TMDLs are zero.

COMMENTS: None.

4.3 Load Allocations (LA):

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

Minimum Submission Requirements:

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

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

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

SUMMARY: The TMDL document includes the landuse breakdown in the watershed for 2002. Approximately 60 percent of the landuse in the watershed was cropland under active cultivation, 16 percent was pasture/rangeland, 18 percent was idle/fallow and the remainder was water, roads or low density development. The point sources are considered negligible sources of fecal coliform loading. Therefore, the entire TMDL has been allocated to nonpoint sources as a load allocation (LA). Source specific data are limited so an aggregate LA is assigned to nonpoint sources with a ranking of important contributors under various flow regimes provided as seen in the following excerpted table.

Table 9. Nonpoint Sources of Pollution and Their Potential to Pollute at a Given Flow Regime.

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

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

COMMENTS: None.

4.4 Margin of Safety (MOS):

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

Minimum Submission Requirements:

☒ TMDLs must include a margin of safety (MOS) to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality (CWA §303(d)(1)(C), 40 C.F.R. §130.7(c)(1)). EPA's 1991

TMDL Guidance explains that the MOS may be implicit (i.e., incorporated into the TMDL through conservative assumptions in the analysis) or explicit (i.e., expressed in the TMDL as loadings set aside for the MOS).

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

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

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

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

SUMMARY: The Bear Creek TMDLs include explicit MOSs for each listed segment derived by calculating 10 percent of the loading capacity. The explicit MOSs for the listed segments of the Bear Creek watershed are included in Tables 11, 12 and 13.

COMMENTS: None.

4.5 Seasonality and variations in assimilative capacity:

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

Minimum Submission Requirements:

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

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

SUMMARY: By using the load duration curve approach to develop the TMDL allocations, seasonal variability in fecal coliform loads are taken into account. Highest steam flows typically occur during late spring, and the lowest stream flows occur during the winter months. Also, the TMDL is seasonal since the fecal coliform criteria are in effect from May 1 to September 30, therefore the TMDLs are only applicable during that period.

COMMENTS: None.

5. Public Participation

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

Minimum Submission Requirements:

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

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

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

SUMMARY: The 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. Copies 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 four newspapers.

COMMENTS: None.

6. Monitoring Strategy

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

Minimum Submission Requirements:

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

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

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

SUMMARY: Implementation of best management practices (BMPs) and technical assistance are specified in the Section 319 Bear Creek Watershed Restoration Project. To make sure those BMPs are successful in reducing fecal coliform bacteria loadings to levels prescribed in the TMDL document, water quality monitoring is being conducted in accordance with an approved Quality Assurance Project Plan (QAPP). As prescribed in the QAPP, weekly monitoring is being conducted at four sites for fecal coliform bacteria and E. coli. The sampling began in October 2003 and will continue through June 2010.

COMMENTS: None.

7. Restoration Strategy

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

Minimum Submission Requirements:

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

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

SUMMARY: In response to the Bear Creek Watershed Assessment, and in anticipation of this completed TMDL, local sponsors successfully applied for and received Section 319 funding for the Bear Creek Watershed Restoration Project. Beginning in October 2003, local sponsors have been providing technical assistance and implementing BMPs designed to reduce fecal bacteria loadings and to help restore the beneficial uses of the Bear Creek (i.e., recreation). Water quality data has been 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 has also been developed as part of this watershed restoration project that details the how, when and where monitoring will be conducted to gather the data needed to document success in meeting the TMDL implementation goal(s). As the data are gathered and analyzed, watershed restoration tasks 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: None.

8. Daily Loading Expression

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

Minimum Submission Requirements:

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

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

SUMMARY: The Bear Creek fecal coliform TMDL document includes daily loads expressed as colonies per day for the three listed segments in the watershed. The daily TMDL loads are included in TMDL section (Section 7.0) of the document.

COMMENTS: None.

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

EPA Region 8 Comment: Tables 1 and 2 show the lower segment as "101600**03**-032-S," but the Figure 2 maps shows that segment as "101600**04**-032-S." The 2008 ND IR and 303(d) list shows all three segments as being in HUC "10160003" – the assessment unit ID numbers should be revised as needed to be consistent within the document and with the 303(d) listings.

NDDoH Response: Waterbody assessment unit ID's in Tables 3 and 4 and in the legend in Figure 2 have been revised with the correct assessment unit ID's as ND-10160003-032-S_00, ND-10160003-034-S_00, and ND-10160003-035-S_00.

EPA Region 8 Comment: The report states that data were collected at three locations in the watershed and the report also states that through the 2002 water quality assessment, it was determined that the above bulleted sources (Runoff of manure from crop and pasture lands; Runoff of manure from unpermitted animal feeding areas; Direct deposit of manure into Bone Hill Creek by grazing livestock; and Wildlife contributions of fecal material in the watershed) are the primary contributors of fecal coliforms in the watershed. As information regarding source identification efforts is not provided, it is not clear how these sources were found to be the major contributors. Are these the only potential sources besides the WWTF lagoons and CAFOs/AFOs located in the watershed? How many permitted CAFOs/AFOs are located within the watershed? Additional information regarding how it was determined that these are the primary sources of fecal coliforms in the watershed would be helpful.

As part of the implementation plan for this TMDL we recommend that the permitted point sources (i.e., WWTF lagoons, CAFOs and AFOs) in the watershed be inspected to ensure that they are being operated in compliance with their permit conditions, and to verify that they aren't significant fecal coliform sources.

NDDoH Response: Additional justification along with a table summarizing the number of AFOs identified as part of the AGNPS watershed model was added to Section 4.2. The basis for this additional information wase data collected as part of the 2002-2003 watershed assessment and summarized in the 2004 Bear Creek Watershed Assessment Report (NDDoH, 2004).

The NDPDES database was inspected and 12 permitted AFO/CAFOs were identified in the Bear Creek Watershed.

The last paragraph of Section 11.0, Restoration Strategy, was also rewritten to further describe how implementation will include the inspection of permitted facilities.

EPA Region 8 Comment: It is not clear why 3 flow zones were used in the LDCs for these TMDLs. Page 11 of the document explains ***how*** the flow regimes were defined for each site, but no explanation is given for ***why*** 3 zones were used. A brief explanation of why 3 flow zones were used (e.g., based on the shape of the curve, no flow at low end of curve, etc) should be added to the document.

From the information provided on page 11 of the document, it is not clear how the linear regression line is used in determining the required percent reductions needed for LDC. NDDoH is asked to clarify the information and include a description as to how the percent reduction calculation is made using the linear regression line.

NDDoH Response: An additional section was added to Section 5.0, Technical Analysis. This new section, added as Section 5.2, describes the flow duration curve analysis, which is a precursor to the load duration curve analysis. This new section describes how the flow intervals used in the load duration curve are selected.

Additional language was also added to the "Load Duration Curve Analysis" section, now 5.3, which describes with an example of how the existing and TMDL loads are calculated from the regression line and the TMDL target curve. This section also describes how the midpoint for the flow interval is selected.