Fecal Coliform Bacteria TMDLs for the Rush River in Cass County, North Dakota

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1.0 INTRODUCTION AND DESCRIPTION OF THE WATERSHED

The Rush River watershed is a 101,591 acre watershed located in Cass and Traill Counties in southeastern North Dakota (Figure 1). For the purposes of this TMDL, the impaired watershed segments are located in Cass County. The Rush River is a tributary of the Lower Sheyenne River and lies within the Level III Lake Agassiz Plain (48) and Northern Glaciated Plains (46) ecoregions.

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

Legal Name	Rush River
Stream Classification	Class III
Major Drainage Basin	Red River
8-Digit Hydrologic Unit	09020204
Counties	Cass County and Traill County
Ecoregions	Lake Agassiz Plain and North Glaciated Plains (Level III), Glacial Lake Agassiz Basin and Drift Plains (Level IV)
Watershed Area (acres)	101,591

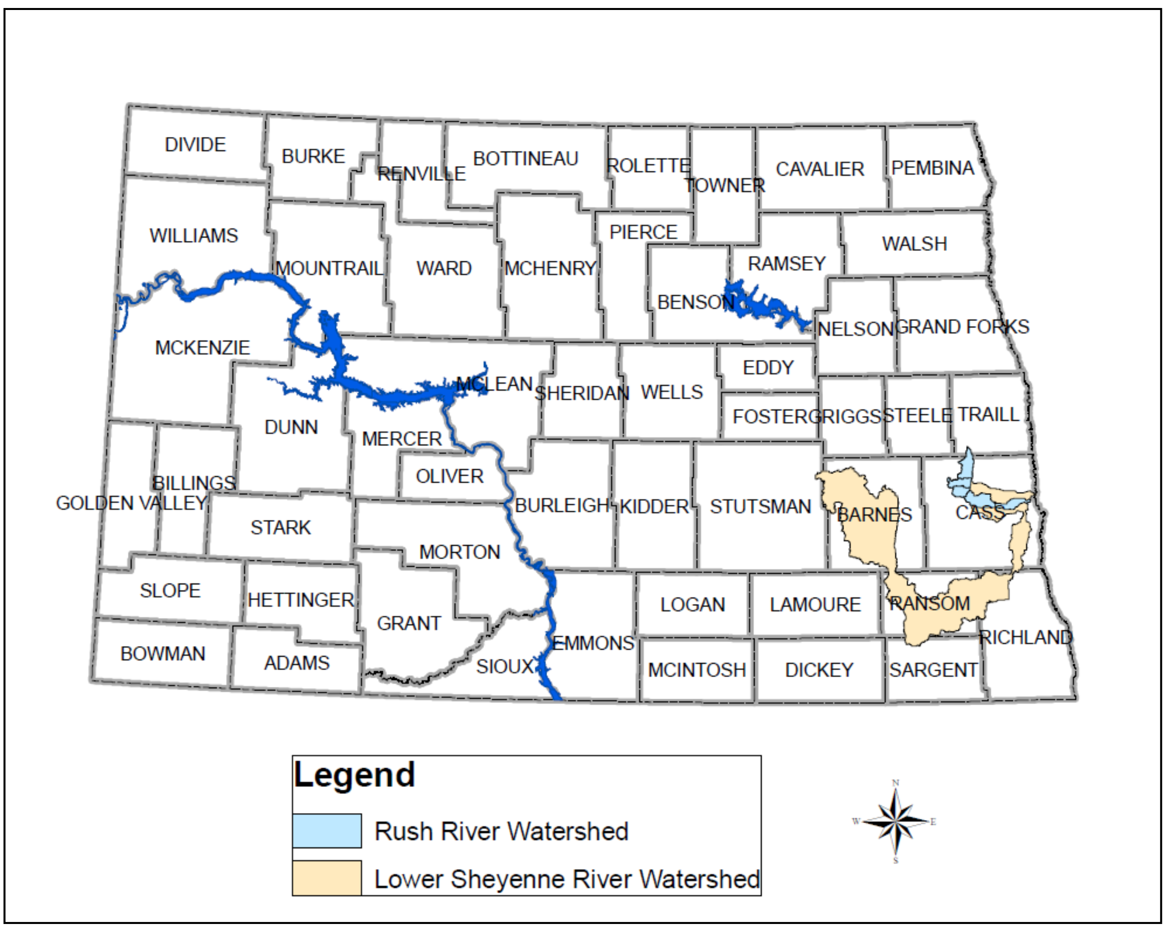

Figure 1. Rush River and Lower Sheyenne River Watersheds in North Dakota.

1.1 Clean Water Act Section 303(d) Listing Information

Based on the 2010 Section 303(d) List of Impaired Waters Needing TMDLs (NDDoH, 2010), the North Dakota Department of Health has identified a 41.4 mile segment (ND-09020204-007-S_00) on the Rush River, downstream to an unnamed tributary watershed (ND-09020204-012-S_00), located in north central Cass County and a 17.6 mile segment (ND-09020204-004-S_00) from its confluence with an unnamed tributary watershed (ND-09020204-012-S_00), downstream to its confluence with the Lower Sheyenne River, as not supporting to fully supporting but threatened for recreational uses. The impairment is due to fecal coliform bacteria (Tables 2 and 3).

Table 2. Rush River Section 303(d) Listing Information for Assessment Unit ND-09020204-007-S_00 (NDDoH, 2010).

Assessment Unit ID	ND-09020204-007-S_00
Waterbody Description	Rush River, downstream to an unnamed tributary watershed (ND-09020204-012-S_00). Located in north central Cass County.
Size	41.4 miles
Designated Use	Recreation
Use Support	Not Supporting
Impairment	Fecal Coliform Bacteria
TMDL Priority	Low

Table 3. Rush River Section 303(d) Listing Information for Assessment Unit ND-09020204-004-S_00 (NDDoH, 2010).

Assessment Unit ID	ND-09020204-004-S_00
Waterbody Description	Rush River from its confluence with an unnamed tributary watershed (ND-09020204-011-S_00), downstream to its confluence with the Lower Sheyenne River.
Size	17.6 miles
Designated Use	Recreation
Use Support	Fully Supporting, but Threatened
Impairment	Fecal Coliform Bacteria
TMDL Priority	Low

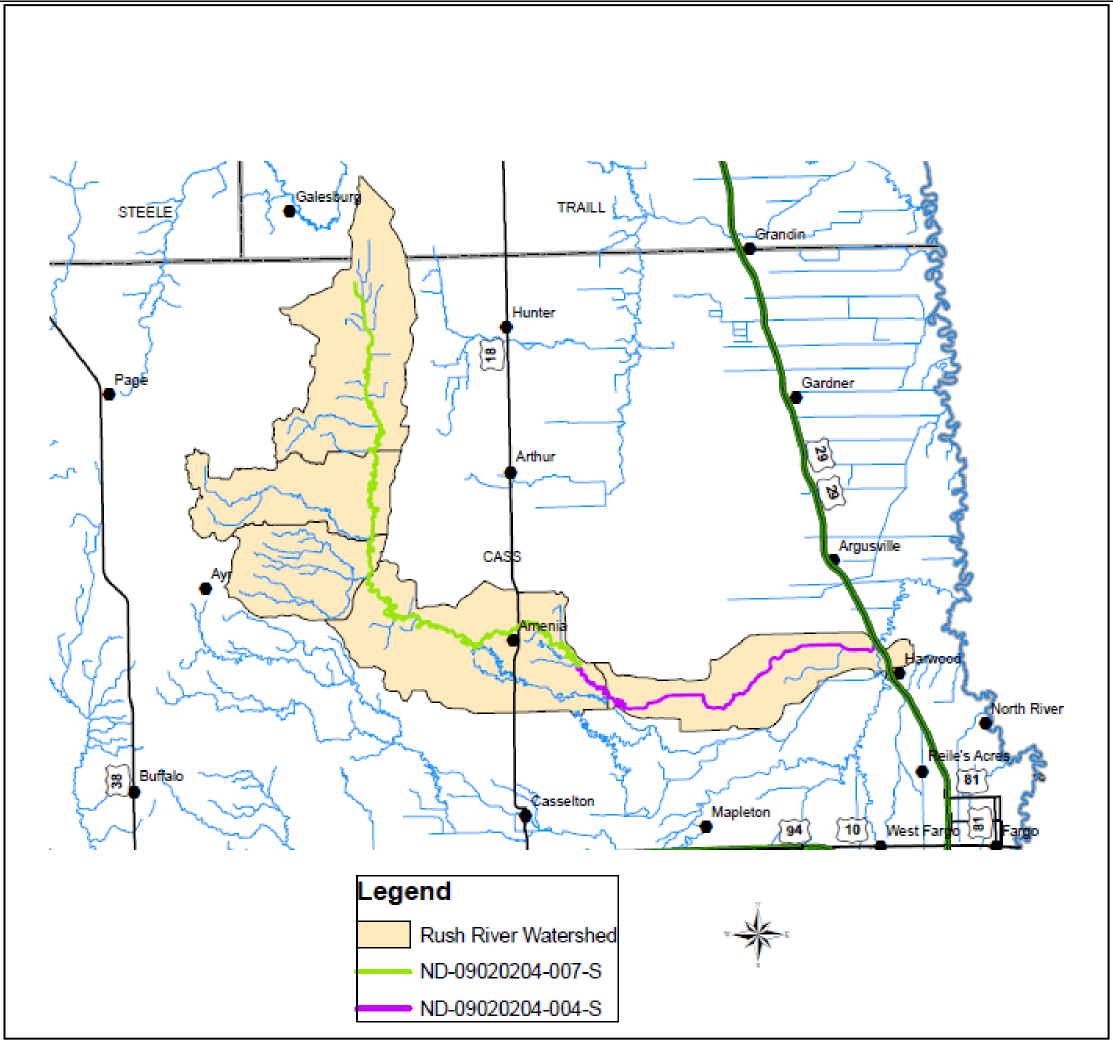

Figure 2. Rush River TMDL Listed Segments.

1.2 Topography

Approximately 96 percent of the associated subwatersheds for the Section 303(d) listed segments highlighted in this TMDL are within the Level IV Glacial Lake Agassiz Basin (48a) ecoregions with the remaining 3.5 percent located in the Drift Plains and 0.5 percent in the Sand Deltas and Beach Ridges (48b) ecoregions (Figure 3). The Lake Agassiz Plain (48a) ecoregions is comprised of thick beds of glacial drift overlain by silt and clay lacustrine deposits from glacial Lake Agassiz. The topography of this ecoregion is extremely flat, with sparse lakes and pothole wetlands. Tallgrass prairie was the dominant habitat pre European settlement and has now been replaced with intensive agriculture. Agricultural production in the southern region consists of corn, soybeans, wheat, and sugar beets. The Drift Plains (46i) ecoregions was created when the Wisconsinan glaciers left a subtle topography and thick glacial till. Temporary and seasonal wetlands are found in the drift plains. This region is entirely cultivated. The Drift Plains were a transitional mix of tallgrass and shortgrass prairie. The dominant crops of this ecoregion consist of spring wheat, barley, sunflowers, and alfalfa. The Sand Deltas and Beach Ridges (48b) ecoregion disrupts the flat topography of the Red River Valley. The beach ridges are parallel lines of sand and gravel that were formed by wave action of the contrasting shoreline levels of Lake Agassiz. The deltas consist of lenses of fine to coarse sand and are blown into dunes (USGS, 2006).

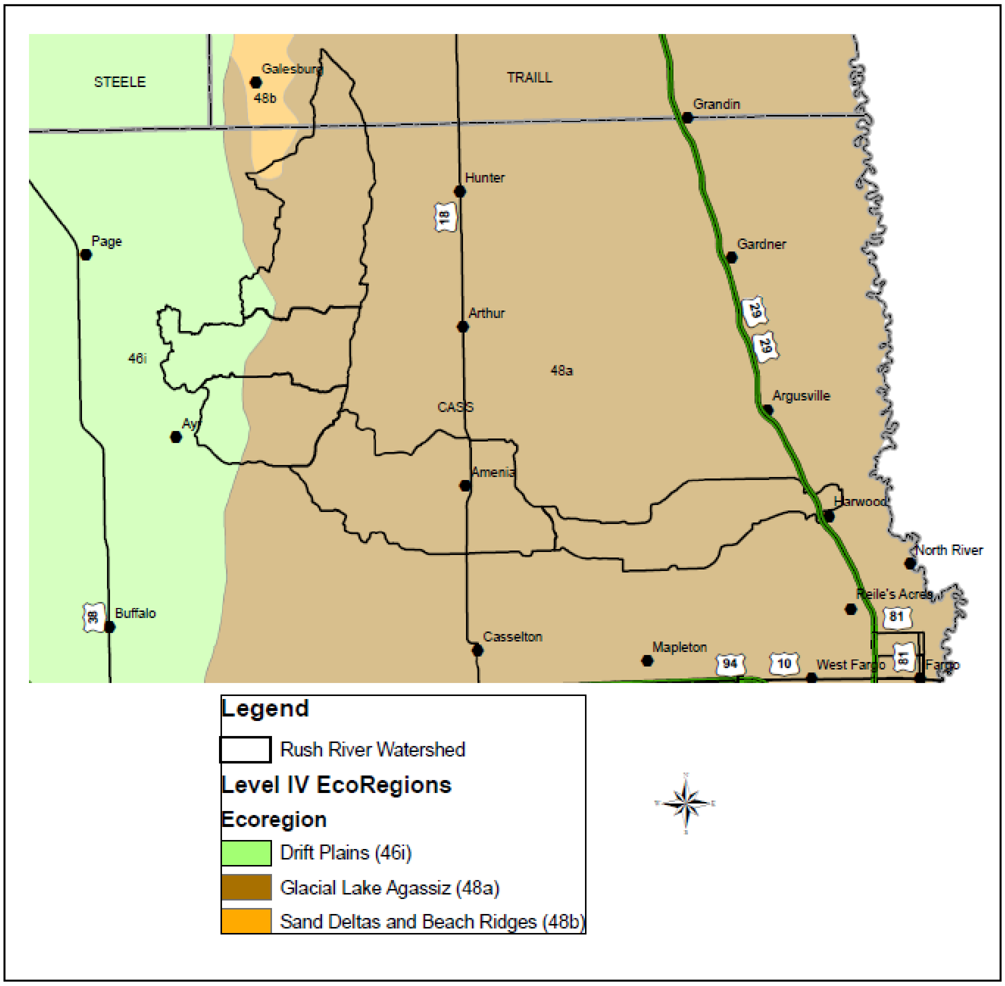

Figure 3. Level IV Ecoregions in the Rush River Watershed.

1.3 Land Use

The dominant land use in the Rush River watershed is row crop agriculture. According to the 2006 National Agricultural Statistical Service (NASS) land survey data, approximately 86 percent of the land is cropland, 7.5 percent in urban development, and 6.5 percent is either wetlands, water, woods, and grassland. The majority of the crops grown consist of soybeans, corn, spring wheat, and sugar beets (Figure 4). Unpermitted animal feeding operations and "hobby farms" are also present in the Rush River watershed, but their number and location are unknown.

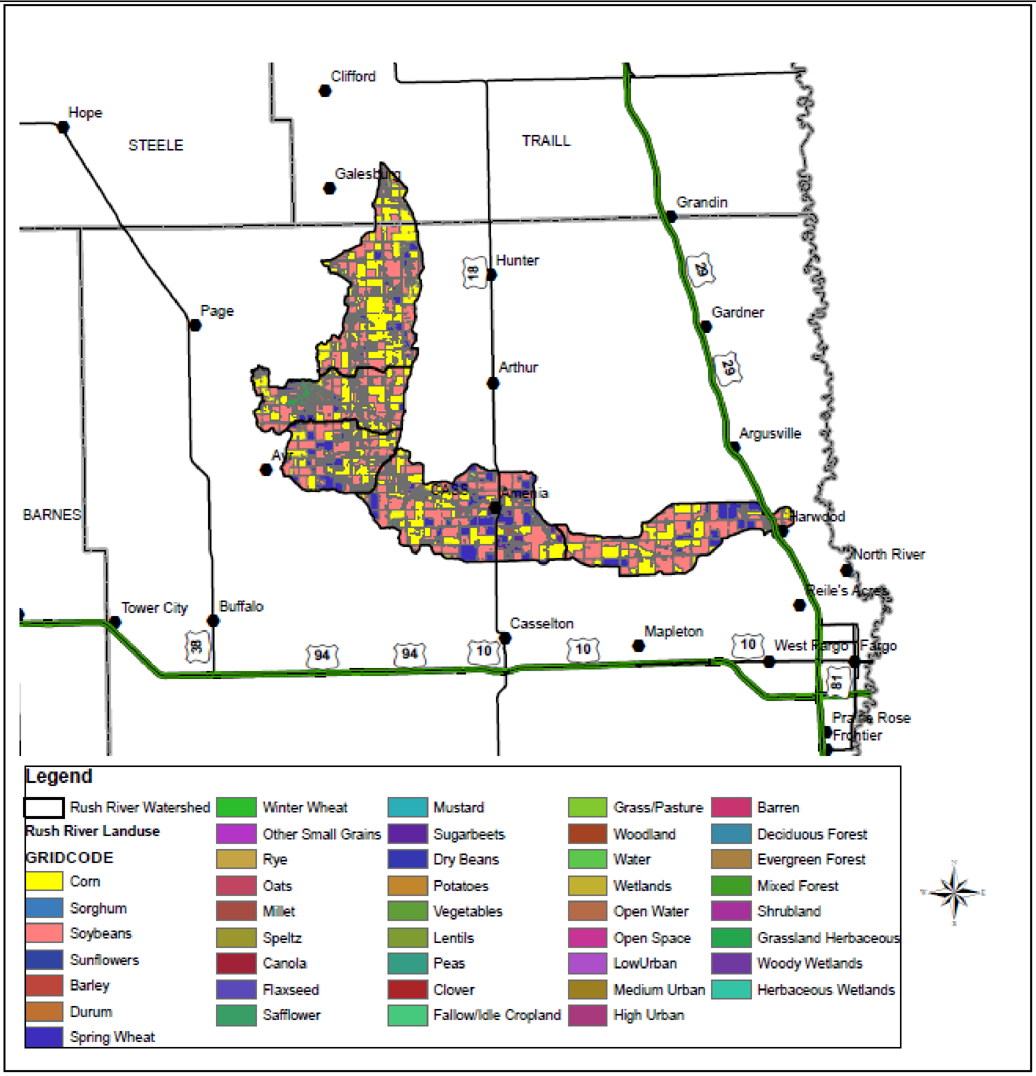

Figure 4. Land Use in the Rush River Watershed (NASS, 2006).

1.4 Climate and Precipitation

Figures 5 and 6 show the annual precipitation and average temperature for the Prosper, ND (Cass County) North Dakota Agriculture Weather Network (NDAWN) station from 1991-2009. Cass County has a subhumid climate characterized by warm summers with frequent hot days and occasional cool days. Average temperatures range from 12° F in winter to 60° F in summer. Precipitation occurs primarily during the warm period and is normally heavy in later spring and early summer. Total annual precipitation is about 20 inches.

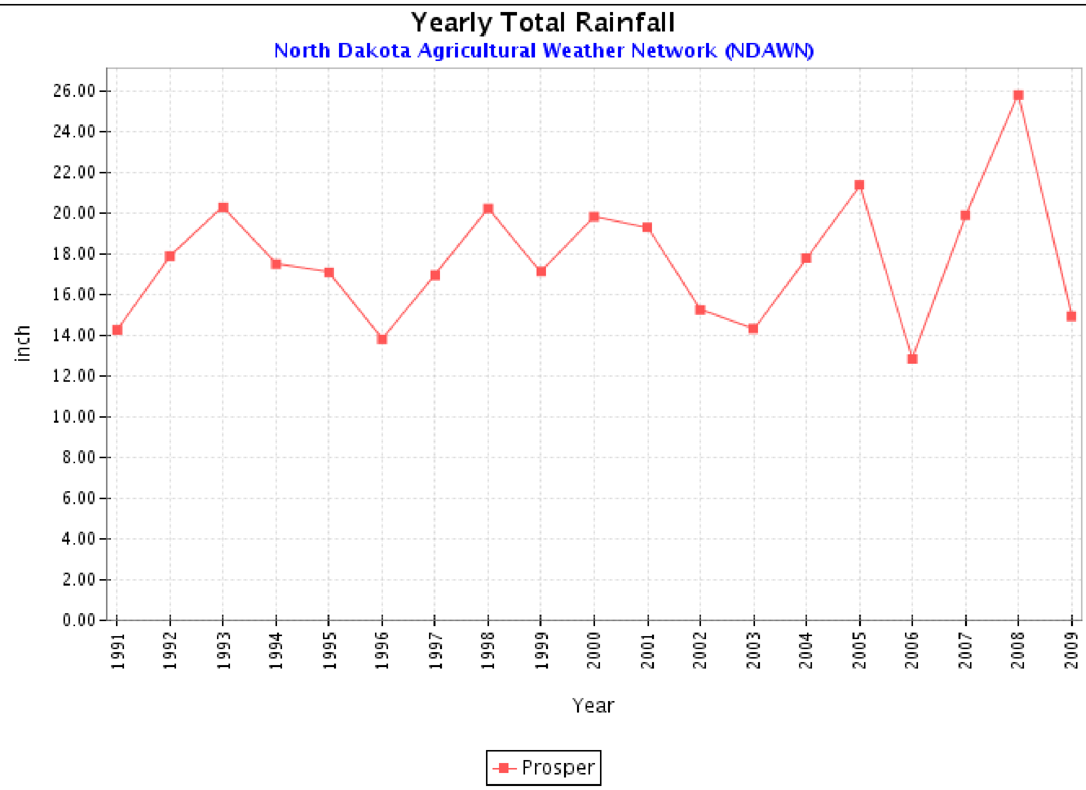

Figure 5. Annual Total Precipitation at Prosper, North Dakota from 1991-2009 (NDAWN, 2009).

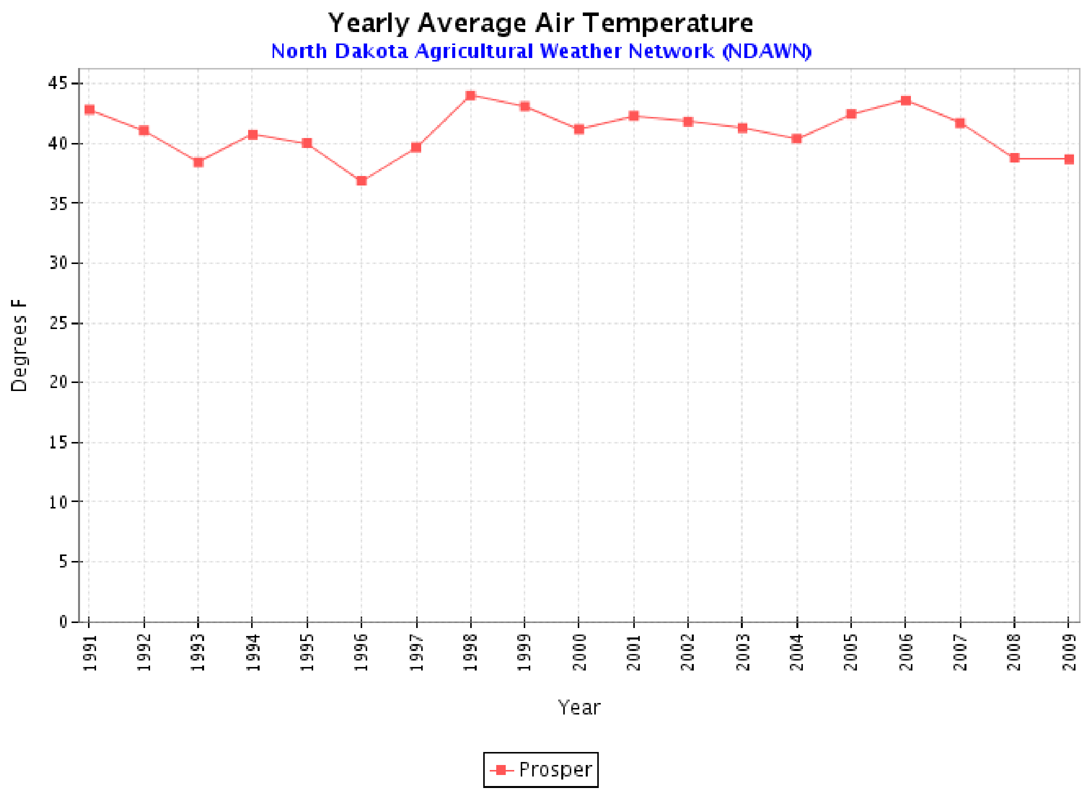

Figure 6. Annual Average Air Temperature at Prosper, North Dakota from 1991-2009 (NDAWN, 2009).

1.5 Available Data

1.5.1 Fecal Coliform Bacteria Data

Fecal coliform bacteria samples were collected at two locations within the TMDL listed watershed (Figure 7). Monitoring site 385302, located on Highway 18 near Amenia, ND, and site 385303, located 1.5 miles west of Prosper, ND are collocated with United States Geological Survey (USGS) gaging stations 05060500 and 05060550, respectively. Site 385302 was sampled weekly or when flow conditions were present during the recreation season of 2004-2005 and 2008-2009, while site 385303 was sampled only during the recreation season from 2004-2005. Both sites were sampled by the Cass County Soil Conservation District The recreation season in North Dakota is May 1 to September 30 (NDDoH, 2006). While the state of North Dakota has an E. coli bacteria standard (see Section 2.0), no E. coli data are available for the TMDL reaches described in this report.

Tables 4 and 5 provide a summary of monthly fecal coliform bacteria geometric mean concentrations, the percentage of samples exceeding 400 CFU/100mL for each month and the recreational use assessment by month. The geometric mean fecal coliform bacteria concentration and the percent of samples over 400 CFU/100mL were calculated for each month (May 1st to September 30th) using those samples collected during each month.

Table 4. Summary of Fecal Coliform Bacteria Data for Site 385302 (Data Collected in 2004-2005 and 2008-2009).

Month	N	Geometric Mean Concentration (CFU/100mL)	Percentage of Samples Exceeding 400 CFU/100mL	Recreational Use Assessment
May	16	30	0%	Fully Supporting
June	19	169	21%	Fully Supporting but Threatened
July	15	233	33%	Not Supporting
August	16	103	0%	Fully Supporting
September	14	93	14%	Fully Supporting but Threatened

Table 5. Summary of Fecal Coliform Bacteria for Site 385303 Data (Collected in 2004-2005).

Month	N	Geometric Mean Concentration (CFU/100mL)	Percentage of Samples Exceeding 400 CFU/100mL	Recreational Use Assessment
May	9	37	0%	Fully Supporting
June	9	78	0%	Fully Supporting
July	8	251	25%	Not Supporting
August	8	96	0%	Fully Supporting
September	5	251	20%	Not Supporting

1.5.2 Hydraulic Discharges

A discharge record was obtained for the TMDL listed segment ND-09020204-007-S based on historical discharge measurements collected at USGS gaging station 05060500 from 1985-2009 and at USGS gauging station 05060550 from 1985-2005 for segment ND-09020204-004-S. These two USGS gauging stations are collocated with water quality monitoring sites 385302 and 385303, respectively.

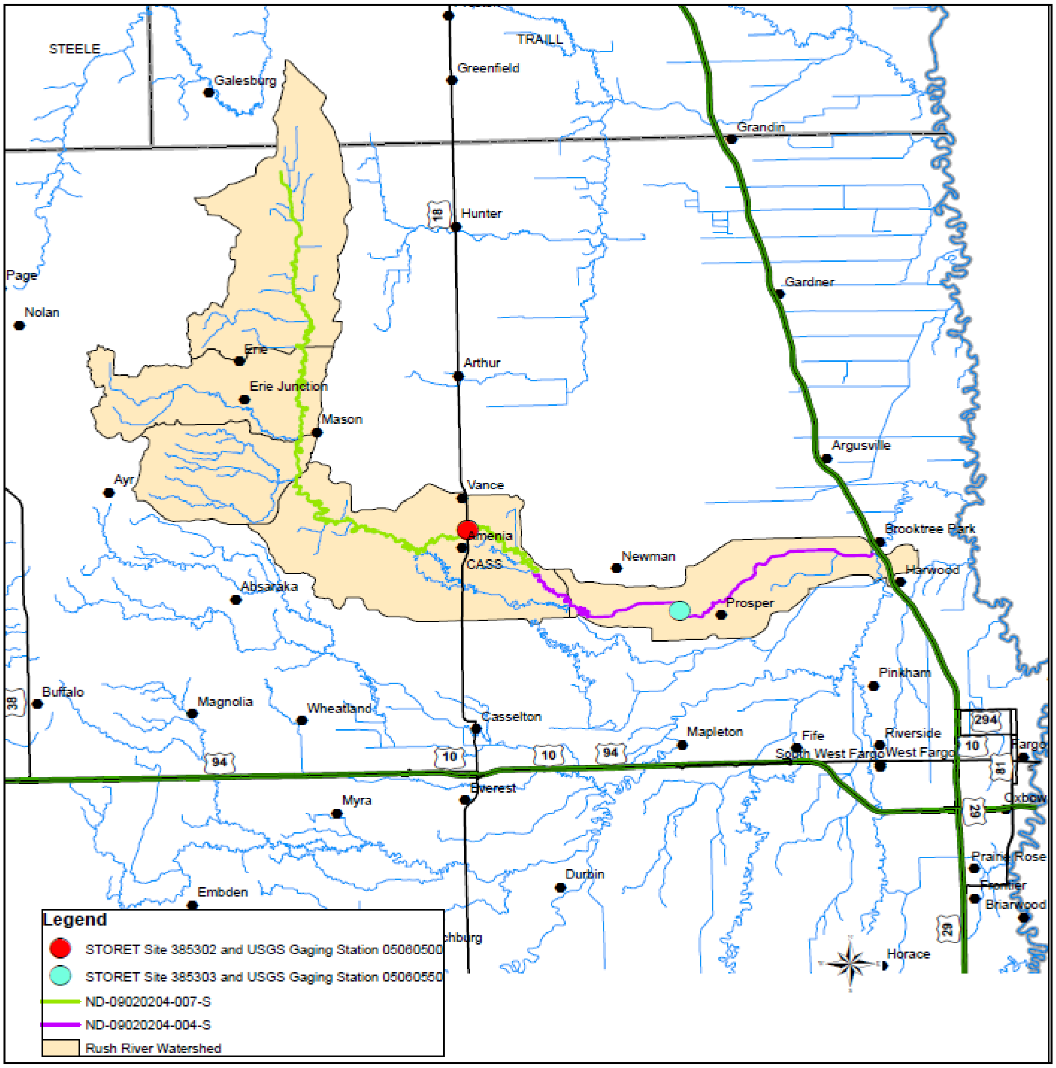

Figure 7. Fecal Coliform Bacteria Sample Sites (385302 and 385303) and USGS Gaging Stations (05060500 and 05060550) on the TMDL Listed Segments of the Rush River.

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, which in this case is fecal coliform bacteria.

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, 2006).

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

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

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

2.2 Numeric Water Quality Standards

Rush River is a Class III stream. The NDDoH definition of a Class III stream is shown below (NDDoH, 2006).

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 both fecal coliform bacteria and E. coli (Table 6). Both bacteria standards applies only during the recreation season of May 1 to September 30.

Table 6. North Dakota Fecal Coliform and E. coli Bacteria Standards for Class III Streams.

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

[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 TARGETS

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

3.1 Rush River Target Reductions in Fecal Coliform Bacteria Concentrations

The Rush River is impaired because of fecal coliform bacteria. The Rush River is not supporting to fully supporting, but threatened, for recreational beneficial uses 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 geometric mean concentration of 200 CFU/100 mL during the recreation season from May 1 to September 30. Thus, the TMDL target for this report is 200 CFU/100 mL. In addition, no more than ten percent of samples collected for fecal coliform bacteria should exceed 400 CFU/100 mL.

While the standard is intended to be expressed as the 30-day geometric mean, the target is based on the 200 CFU/100 mL geometric mean standard. 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.

Currently, the state of North Dakota has both a fecal coliform bacteria standard and an E. coli bacteria standard. During the current triennial water quality standards review period, the Department will be eliminating the fecal coliform bacteria standard and will only have the E. coli standard for bacteria. This standards change is recommended by the US EPA as E. coli is believe to be a better indicator of recreational use risk (i.e., incidence of gastrointestinal disease). During this transition period to an E. coli only bacteria standard, the fecal coliform bacteria target for this TMDL and the resulting load allocation is believe to be protective of the E. coli standard as well. This conclusion is based on the assumption that the ratio of E. coli to fecal coliform in the environment is equal to or less that the ratio of the E. coli bacteria standard to the fecal coliform bacteria standard, which is 63% (126:200). If the ratio of E. coli to fecal coliform in the environment is greater than 63%, then it is unlikely that the current TMDL will result in attainment of the E. coli standard. The department will assess attainment of the E. coli standard through additional monitoring consistent with the state's water quality standards and beneficial use assessment methodology.

4.0 SIGNIFICANT SOURCES

4.1 Point Source Pollution Sources

Within the Rush River watershed, there is a municipal point source located in Amenia, ND located on segment ND-090204-007-S. This facility is permitted through the North Dakota Pollutant Discharge Elimination System (NDPDES) Program. The Amenia facility discharges intermittently into Rush River, generally for short periods of time. From 2005-2008 the city of Amenia discharge eight (8) times (Appendix D). Each discharge last from 4-6 days and totaled 0.98 million gallons of water. Water quality samples were taken once per discharge period. The concentration of fecal coliform bacteria reported in seven of the eight discharge was 20 CFU/100 mL with one reported as 93 CFU/100 mL. As the majority of the samples were reported as 20 CFU/100 mL, this value will be used in the waste load allocation (WLA) for the TMDL for segment ND-09020204-007-S.

There are seven permitted animal feeding operations (AFOs) in the TMDL watershed of the Rush River. The NDDoH has permitted one large (1,000 + animal units (AUs)) AFO to operate. Four small (0-300 AUs) and two medium (301-999 AUs) AFOs are currently in the permitting process. All seven AFOs are zero discharge facilities and are not deemed a significant point source of fecal coliform bacteria loadings to the Rush River.

4.2 Nonpoint Source Pollution Sources

The TMDL listed segments on the Rush River are experiencing fecal coliform bacteria pollution from nonpoint sources in the watershed. Livestock production is not the dominant agricultural practice in the watershed but unpermitted AFOs and “hobby farms” with fewer than 100 animals in proximity to the Rush River are common in the TMDL listed segments. The southeast section of North Dakota typically experiences long duration or intense precipitation during the early summer months. These storms can cause overland flooding and rising river levels. Due to the close proximity of these unpermitted AFOs and “hobby farms” to the river, it is likely that this contributes fecal coliform bacteria to the Rush River.

This assessment is also supported by the load duration curve analysis (Section 5.3) which shows all of the exceedences of the fecal coliform bacteria standard occurring during high and moderate flows. Further examination of these data show that these exceedences all occurred during high and moderate flow events cause by intense spring and summer rain storms.

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

Septic system failure might contribute to the fecal coliform bacteria in the water quality samples. Failures can occur for several reasons, although the most common reason is improper maintenance (e.g. age, inadequate pumping). Other reasons for failure include improper installation, location, and choice of system. Harmful household chemicals can also cause failure by killing the bacteria that digest the waste. While the number of systems that are not functioning properly is unknown, it is estimated that 28 percent of the systems in North Dakota are failing (USEPA, 2002).

5.0 TECHNICAL ANALYSIS

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

The loading capacity or total maximum daily load (TMDL) is the amount of a 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 bacteria reductions necessary to achieve the water quality standards target of 200 CFU/100 mL with a margin of safety.

5.1 Mean Daily Stream Flow

In southeastern North Dakota, rain events are variable occurring during the months of April through August. Rain events can be sporadic and heavy or light, occurring over a short duration. Precipitation events of large magnitude, occurring at a faster rate than absorption, contribute to high runoff events. These events are represented by runoff in the high flow regime. The medium flow regime is represented by runoff that contributes to the stream over a longer duration. The low flow regime is characteristic of drought or precipitation events of small magnitude and do not contribute to runoff.

Flows used in the load duration curve analysis for segments ND-09020204-007-S and ND-09020204-004-S are based on the mean daily flow record collected at the United States Geological Survey (USGS) gaging sites located at Amenia, ND (05060500) from 1985-2009 and at Prosper, ND (05060550) from 1985-2005, respectively. Since the location of the USGS gage sites and water quality monitoring sites are collocated no adjustment in flow was made for the flow and load duration curve analysis.

5.2 Flow Duration Curve Analysis

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

A basic flow duration curve runs from high to low (0 to 100 percent) along the x-axis with the corresponding flow value on the y-axis (Figure 8). 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 8, a flow duration interval of nineteen (19) percent, associated with a stream flow of 10 cfs, implies that 19 percent of all observed mean daily discharge values equal or exceed 10 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 8, the flow duration curve for USGS site 05060500, collocated with water quality site 385302 and representing TMDL segment ND-09020204-004-S, was divided into four zones, one representing high flows (0-4 percent), another for moist conditions (4-19 percent), dry conditions (19-58 percent), and one for low flows (58-80 percent). Based on the flow duration curve analysis, no flow (or zero flow) was met or exceeded 80-100 percent.

Similarly, as depicted in Figure 9, the flow duration curve for USGS site 05060550, collocated with water quality site 385303 and representing TMDL segment ND-09020204-007-S, was also divided into four zones, one representing high flows (0-2 percent), another for moist conditions (2-28 percent), dry conditions (28-60 percent), and one for low flows (60-77 percent). Based on the flow duration curve analysis, no flow (or zero flow) was met or exceeded 77-100 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 plots (Figures 8 and 9). A secondary factor in determining the flow intervals used in each analysis was the number of fecal coliform bacteria observations available for each flow interval.

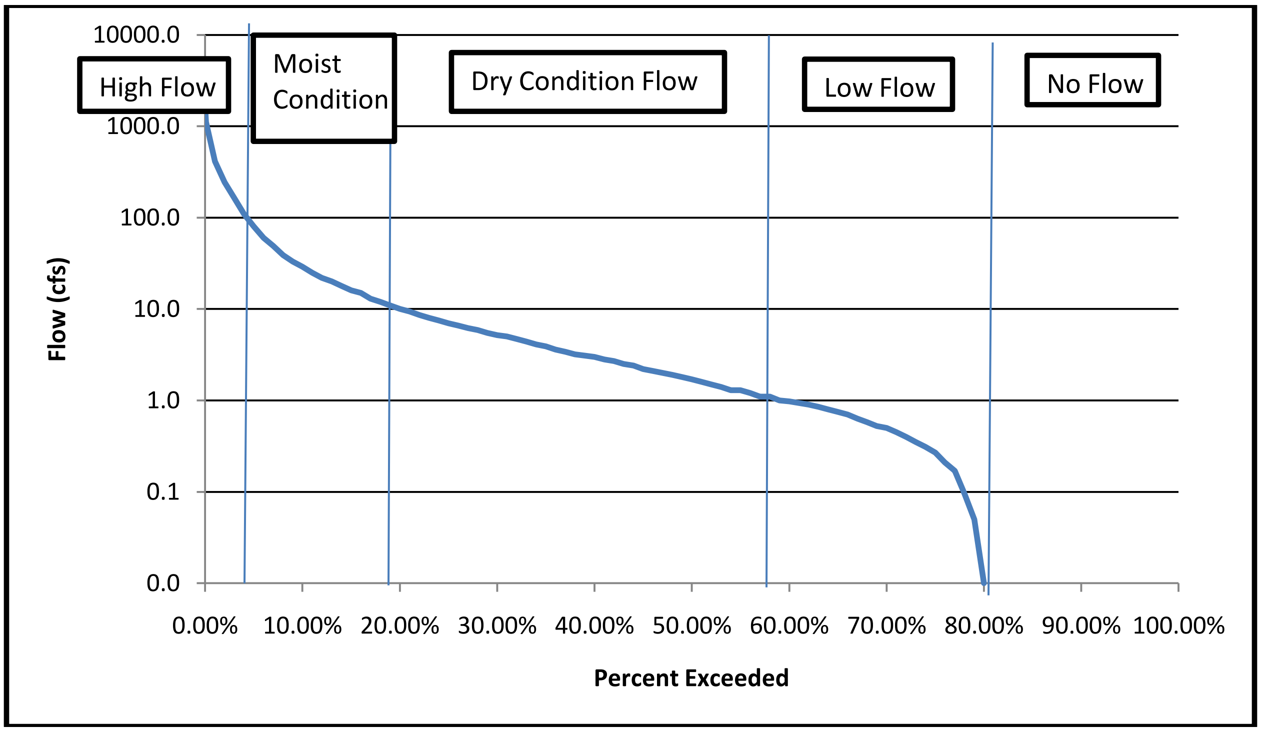

Figure 8. Flow Duration Curve for the Rush River Monitoring Station 385302 collocated with USGS Station 05060500 at Amenia, North Dakota.

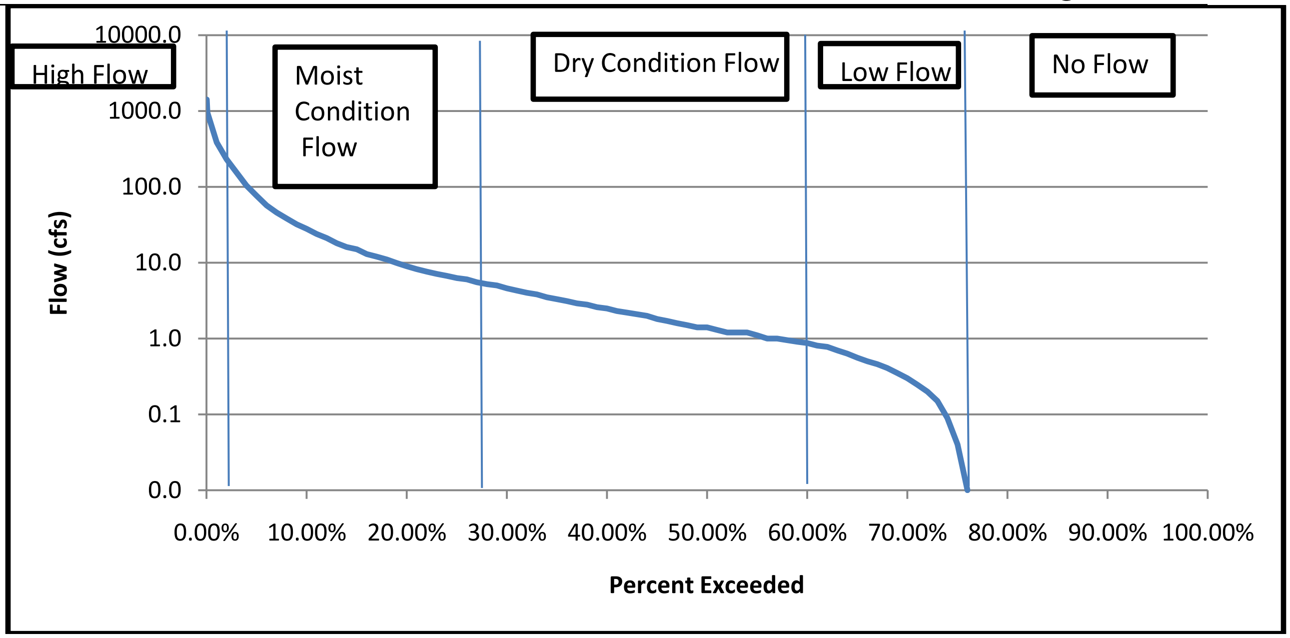

Figure 9. Flow Duration Curve for the Rush River Monitoring Station 385303 collocated with USGS Station 05060550 at Prosper, North Dakota.

5.3 Load Duration Analysis

An important factor in determining nonpoint source pollution loads is variability in stream flows and loads associated with high and low flow. To better correlate the relationship between the pollutant of concern and hydrology of the Section 303(d) TMDL listed segments, load duration curves were developed for the two Rush River TMDL segments. The load duration curves were derived using the 200 CFU/100 mL state water quality standard and the flows generated as described in Section 5.1 and 5.2.

Observed in-stream total fecal coliform bacteria data from monitoring sites 385302, representing TMDL segment ND-09020204-007-S, and 385303, representing segment ND-09020204-004-S, (Appendix A) were converted to a pollutant load by multiplying total 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 (Figures 8 and 9). Points plotted above the 200 CFU/100 mL target curve exceed the water quality target. Points plotted below the curve are meeting the water quality target of 200 CFU/100 mL.

For each flow interval or zone, a regression relationship was developed between the samples which occur above the TMDL target (200 CFU/100 mL) curve and the corresponding percent exceeded flow. The load duration curves for sites 385302, representing segment ND-09020204-007-S, and 385303, representing segment ND-09020204-004-S, showing the regression relationship for each flow interval are provided in Figures 10 and 11.

The regression lines for the high, moist condition, dry condition, and low flows were 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 Figure 10 the regression relationship between observed fecal coliform bacteria loading and percent exceeded flow for the high, moist condition, dry condition and low flow intervals are:

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

Where the midpoint of the high flow interval from 0 to 4 percent is 2.01 percent, the existing fecal coliform load is:

Fecal coliform load (10^7 CFUs/day) = antilog (5.85+ (-13.07*0.0201))
= 383,926 x 10^7 CFUs/day

Where the midpoint of the moist condition flow interval from 4 to 19 percent is 11.51 percent, the existing fecal coliform load is:

Fecal coliform load (10^7 CFUs/day) = antilog (5.27+ (-8.07*0.1151))
= 22,044 x 10^7 CFUs/day

Where the midpoint of the dry condition flow interval from 19 to 58 percent is 38.51 percent, the existing fecal coliform load is:

Fecal coliform load (10^7 CFUs/day) = antilog (4.34 + (-2.04*0.3851))
= 3,580 x 10^7 CFUs/day

Where the midpoint of the low flow interval from 58 to 80 percent is 69.01 percent, the existing fecal coliform load is:

Fecal coliform load (10^7 CFUs/day) = antilog (6.47+ (-5.51*0.6901))
= 462 x 10^7 CFUs/day

The midpoint for the flow intervals is also used to estimate the TMDL target load. In the case of the previous examples, the TMDL target load for the midpoints of 2.01,11.51, 38.51, and 69.01 percent exceeded flow derived from the 200 CFU/100 mL TMDL target curves are 118,892 x 10^7 CFUs/day, 11,745 x 10^7 CFUs/day, 1,566 x 10^7 CFUs/day and 254 x 10^7 CFUs/day, respectively.

5.4 Waste Load Allocation (WLA) Analysis

Based on the city of Amenia's discharge monitoring report (DMR) data for the period 2005-2008 (Appendix D), the city discharged eight times. The total volume of wastewater discharged each time was 0.98 million gallons and the average discharge period was 5 days (range 4-6 days). As stated earlier, since the majority (7 of 8) of the reported fecal coliform concentrations reported in the DMRs were 20 CFU/100 mL this value will be used to estimate a the WLA for the TMDL. Based on these assumptions a daily load of 14.8 x 10^7 CFUs/day is estimated for the WLA used for TMDL segment ND-09020204-007-S. The following is the formula used in calculated the WLA:

$$WLA = \frac{\text{0.98 million gallons/discharge x 20 CFU/100 mL}}{\text{5 days/discharge}}$$

$$= \frac{\text{0.98 million gallons/discharge x 3.7854 liters/gallon x 1000 mL/1-Liter x 200 CFU/100 mL}}{\text{5 days/discharge}}$$

$$= 14.8 \times 10^7 \text{ CFUS/day}$$

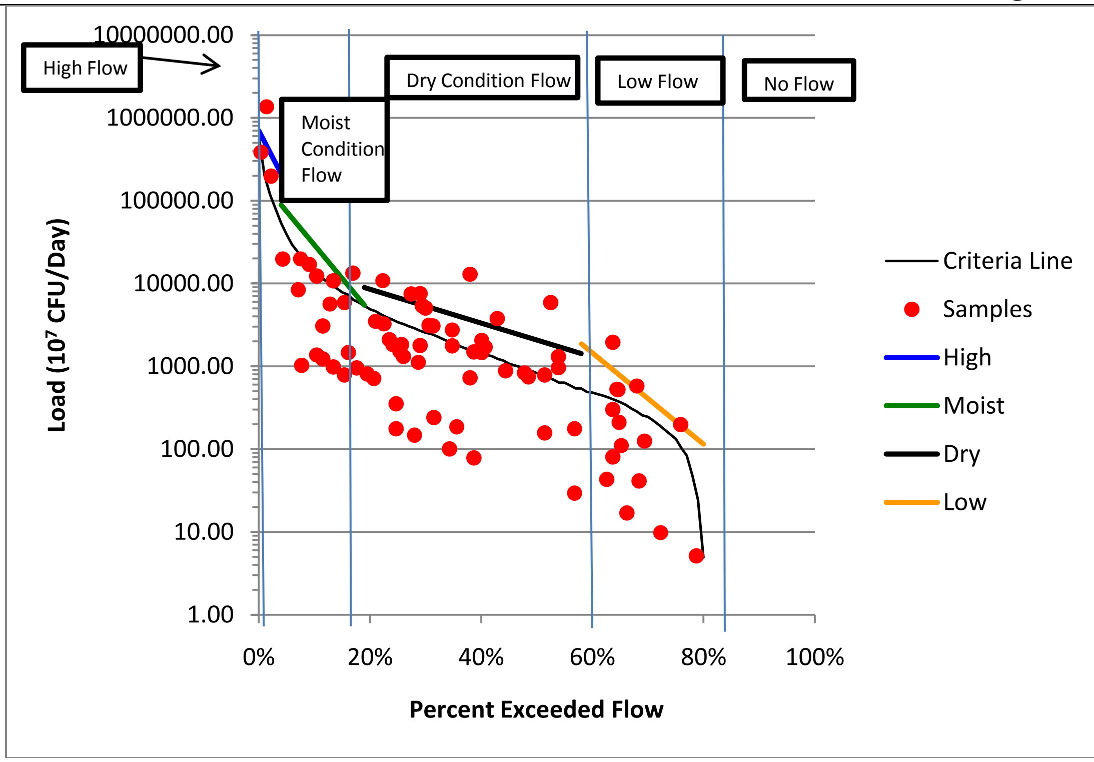

Figure 10. Load Duration Curve for the Rush River Monitoring Station 385302 collocated with USGS Station 05060500 at Amenia, ND (The curve reflects flows collected from 1985-2009).

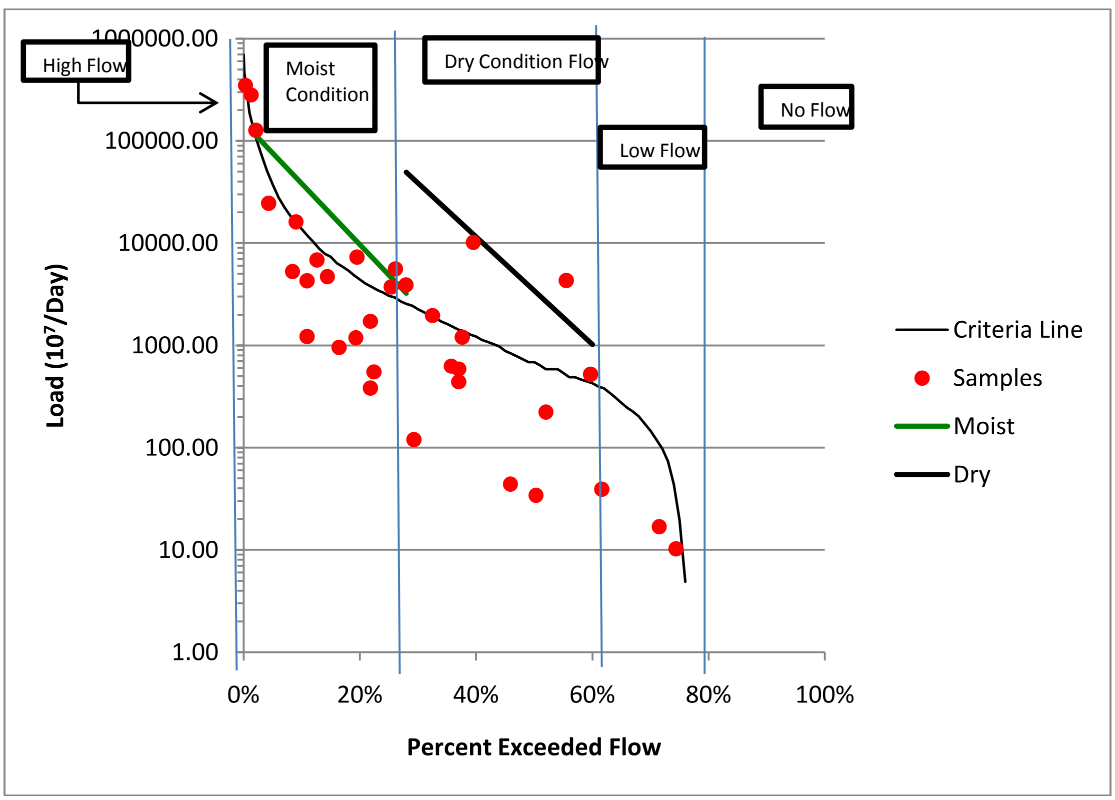

Figure 11. Load Duration Curve for the Rush River Monitoring Station 385303 collocated with USGS Station 05060550 at Prosper, ND (The curve reflects flows collected from 1985-2005).

5.5 Loading Sources

The majority of load reductions can generally be allotted to nonpoint sources, however to account for uncertainty due to periodic discharges from a permitted municipal facility (i.e., Amenia) we are including a waste load allocation (WLA) for the impaired segment ND-09020204-007-S.

The most significant sources of total fecal coliform bacteria loading remain nonpoint source pollution originating from livestock. Based on the data available, the general focus of BMPs and load reductions for the listed segments should be on unpermitted animal feeding operations and “hobby farms” in close proximity of the Rush River. 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). As previously described, four flow regimes (i.e., High Flow, Moist Condition, Dry Condition, and Low Flow) were selected to represent the hydrology of the listed segments when applicable (Figures 8 and 9). The four flow regimes were used for sampling site 385302 because samples indicated exceedences of the water quality standard during all periods of flow. While two flow regimes (Moist and Dry Condition Flow) were used for sampling site 385303 because the samples signified exceedences of the water quality standard during periods of moderate flows.

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 7). 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 under moist conditions at moderate flows (Table 7). Exclusion of livestock from the riparian area eliminates the potential of direct manure deposit and therefore is considered to be of high importance at all flows. However, intensive grazing in the upland creates the potential for manure accumulation and availability for runoff at high flows and a high potential for total fecal coliform bacteria contamination.

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

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

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

6.0 MARGIN OF SAFETY AND SEASONALITY

6.1 Margin of Safety

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

To account for the uncertainty associated with known sources and the load reductions necessary to reach the TMDL target of 200 CFU/100 mL, a ten percent explicit margin of safety was used for this TMDL. The MOS was calculated as ten percent of the TMDL. In other words ten percent of the TMDL is set aside from the load allocation as a MOS. The ten 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. In addition, the waste load allocation (WLA) of 14.8 x 10^7 CFUs/day which is included for segment ND-09020204-007-S is also an implicite MOS. While this WLA applies to all four flow regimes and for every day, in fact the city of Amenia only discharge periodically and less than 10-15 days per year. For the remainder of the year this WLA is available as a MOS.

6.2 Seasonality

Section 303(d)(1)(C) of the Clean Water Act and associated regulations require that a TMDL be established with seasonal variations. The Rush River TMDL addresses seasonality because the flow duration curve was developed using 20 years of USGS gauge data encompassing all 12 months of the year. Additionally, the water quality standard is seasonally based on the recreation season from May 1 to September 30 and controls will be designed to reduce fecal coliform bacteria loads during the seasons covered by the standard.

7.0 TMDL

Table 8 provides an outline of the critical elements of the fecal coliform bacteria TMDL. TMDLs for the Rush River segments ND-09020204-007-S_00 and ND-09020204-004-S_00 are represented in Tables 9 and 10, respectively. The TMDLs provide a summary of average daily loads and waste loads by flow regime necessary to meet the water quality target (i.e. TMDL). The TMDLs for each segment and flow regime provide an estimate of the existing daily load, an estimate of the average daily loads necessary to meet the water quality target (i.e. TMDL load). The TMDL load for segment ND-09020204-007-S includes a load allocation from known nonpoint sources, waste load allocation from known point sources and a ten percent margin of safety. The TMDL for segment ND-09020204-004-S includes a load allocation from known nonpoint sources and a ten percent margin of safety.

While there were no exceedences of the 200 CFU/100 mL fecal coliform standard for the high flow and low flow regimes for segment ND-09020204-004-S, a TMDL load has been provided for each of these flow regimes as a guide to future watershed management. Based on available data, it can be assumed that this segment of the Rush River is currently meeting the water quality standard for those two flow regimes

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

Table 8. TMDL Summary for the Rush River.

Category	Description	Explanation
Beneficial Use Impaired	Recreation	Contact Recreation (i.e. swimming, fishing)
Pollutant	Fecal Coliform Bacteria	See Section 2.1
TMDL Target	200 CFU/100 ml	Based on North Dakota water quality standards
Significant Sources	Point and Nonpoint Sources	Includes nonpoint sources to both segments (e.g., unpermitted AFOs, hobby farms) and the city of Amenia for segment ND-09020204-007-S
Margin of Safety (MOS)	Explicit	10%

TMDL = LC = WLA + LA + MOS

where

LC = loading capacity, or the greatest loading a waterbody can receive without violating water quality standards;

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

LA = load allocation, or the portion of the TMDL allocated to existing or future non-point sources;

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

Table 9. Fecal Coliform Bacteria TMDL (10^7 CFU/day) for the Rush River Waterbody ND-09020204-007-S_00 as Represented by Site 385302.

	Flow Regime			
	High Flow	Moist Condition	Dry Condition	Low Flow
Existing Load	383,926	22,044	3,580	462
TMDL	118,891	11,745	1,566	254
WLA	14.8	14.8	14.8	14.8
LA	106,987	10,556	1,394	214
MOS	11,889	1,174	156	25

Table 10. Fecal Coliform Bacteria TMDL (10^7 CFU/day) for the Rush River Waterbody ND-09020204-004-S_00 as Represented by Site 385303.

	Flow Regime			
	High Flow	**Moist Condition**	**Dry Condition**	**Low Flow**
Existing Load		19,237	7,104	
TMDL	188,607[1]	7,341	979	171[1]
WLA	No load reduction necessary	0	0	No load reduction necessary
LA		6,607	881	
MOS		734	98	

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

8.0 ALLOCATION

There is a permitted municipal facility located in Amenia,ND which discharges to segment ND-09020204-007-S, therefore a portion, 14.8 x 10^7 CFU/day of the total fecal coliform bacteria load for this TMDL has been allocated to this point source. The remaining load has been allocated to nonpoint sources in the watershed. For segment ND-09020204-004-S, the entire fecal coliform bacteria load has been allocated to nonpoint sources located in the watershed. The nonpoint source load is allocated as a single load because there is not enough detailed source data to allocate the load to individual uses (e.g., animal feeding, septic systems, riparian grazing, waste management). To achieve the TMDL targets identified in the report, it will require the wide spread support and voluntary participation of landowners and residents in the 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 is put forth as a recommendation for what needs to be accomplished for Rush River and associated watersheds to restore and maintain its recreational uses. Water quality monitoring should continue, in order to measure BMP effectiveness and determine through adaptive management if loading allocation recommendations need to be adjusted.

Nonpoint source pollution is the largest contributor to elevated total fecal coliform bacteria levels in the Rush River watershed. The fecal coliform samples and load duration curve analysis of the impaired reaches identified the high, moist condition, dry condition, and low flow regimes for ND-09020204-007-S_00 and moist condition and dry condition flow regimes for ND-09020204-004-S_00 as the time of fecal coliform exceedences of the 200 CFU/100 mL target. To reduce nonpoint source pollution for the high and moderate flow regimes, specific BMPs are described in Section 8.1 that will mitigate the effects of total fecal coliform loading to the impaired reach.

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

Table 11. Management Practices and Flow Regimes Affected by the Implementation of BMPs.

Management Practice	Flow Regime and Expected Reduction		
	High Flow-70%	Moderate Flow-80%	Low Flow-74%
Livestock Exclusion From Riparian Area	X	X	X
Water Well and Tank Development	X	X	X
Prescribed Grazing	X	X	X
Waste Management System	X	X	
Vegetative Filter Strip		X	
Septic System Repair		X	X

8.1 Livestock Management Recommendations

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

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

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

Prescribed grazing- To increase ground cover and ground stability by rotating livestock throughout multiple fields. Grazing with a specified rotation minimizes overgrazing and resulting erosion. The Natural Resource Conservation Service (NRCS) recommends grazing systems to improve and maintain water quality and quantity. Duration, intensity, frequency, and season of grazing can be managed to enhance vegetation cover and litter, resulting in reduced runoff, improved infiltration, increased quantity of soil water for plant growth, and better manure distribution and increased rate of decomposition, (NRCS, 1998). In a study by Tiedemann et al. (1998), as presented by USEPA (1993), the effects of four grazing strategies on bacteria levels in thirteen watersheds in Oregon were studied during the summer of 1984. Results of the study (Table 12) showed that when livestock are managed at a stocking rate of 19 acres per animal unit month, with water developments and fencing, bacteria levels were reduced significantly.

Waste management system- Waste management systems can be effective in controlling up to 90 percent of fecal coliform loading originating from confined animal feeding areas (Table 13). A waste management system is made up of various components designed to control nonpoint source pollution from concentrated animal feeding operations (CAFOs) and animal feeding operations (AFOs). Diverting clean water from the feeding area and containing dirty water from the feeding area in a pond are typical practices of a waste management system. Manure handling and application of manure is designed to be adaptive to environmental, soil, and plant conditions to minimize the probability of contamination of surface water.

Table 12. Bacterial Water Quality Response to Four Grazing Strategies (Tiedemann et al., 1988).

Grazing Strategy		Geometric Mean Fecal Coliform Count
Strategy A:	Ungrazed	40/L
Strategy B:	Grazing without management for livestock distribution; 20.3 ac/AUM.	150/L
Strategy C:	Grazing with management for livestock distribution: fencing and water developments; 19.0 ac/AUM	90/L
Strategy D:	Intensive grazing management, including practices to attain uniform livestock distribution and improve forage production with cultural practices such as seeding, fertilizing, and forest thinning; 6.9 ac/AUM	950/L

8.2 Other Recommendations

Vegetative filter strip- Vegetated filter strips are used to reduce the amount of sediment, particulate organics, dissolved contaminants, nutrients, and in the case of this TMDL, fecal coliform bacteria to streams. The effectiveness of filter strips and other BMPs in removing fecal coliform bacteria is quite successful. Results from a study by Pennsylvania State University (1992a) as presented by USEPA (1993) (Table 13), suggest that vegetative filter strips are capable of removing up to 55 percent of fecal coliform bacteria loading to rivers and streams (Table 13). The ability of the filter strip to remove contaminants is dependent on field slope, filter strip slope, erosion rate, amount and particulate size distribution of sediment delivered to the filter strip, density and height of vegetation, and runoff volume associated with erosion producing events (NRCS, 2001).

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

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

Septic system failure occurs when one or more components of the septic system do not work properly and untreated waste or wastewater leaves the system. Wastes may pond in the leach field and ultimately run off directly into nearby streams or percolate into groundwater. Untreated septic system waste is a potential source of nutrients (nitrogen and phosphorus), organic matter, suspended solids, and fecal coliform bacteria. Land application of septic system sludge, although unlikely, may also be a source of contamination.

Septic system failure can occur for several reasons, although the most common reason is improper maintenance (e.g. age, inadequate pumping). Other reasons for failure include improper installation, location, and choice of system. Harmful household chemicals can also cause failure by killing the bacteria that digest the waste. While the number of systems that are not functioning properly is unknown, it is estimated that 28 percent of the systems in North Dakota are failing (USEPA, 2002).

Table 13. Relative Gross Effectiveness[a] of Confined Livestock Control Measures (Pennsylvania State University, 1992a).

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

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

9.0 PUBLIC PARTICIPATION

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

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

In addition to mailing copies of this TMDL for Rush River to interested parties, the TMDL will be posted on the North Dakota Department of Health, Division of Water Quality web site at http://www.ndhealth.gov./WQ/SW/Z2 TMDL/TMDLs Under PublicComment/B Under Public Commment.html . A 30 day public notice soliciting comment and participation will also be published in the Fargo Forum.

10.0 MONITORING

As stated previously, it should be noted that the TMDL loads, load allocations, waste load allocation, 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 Rush River Watershed Project are successful in reducing fecal coliform bacteria loadings, as well as E. coli 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, 2008), weekly monitoring is being conducted at two sites for fecal coliform and E. coli bacteria. Sampling began in May 2008 and will continue through September 2013.

11.0 TMDL IMPLEMENTATION STRATEGY

In response to Rush River Watershed Assessment and in anticipation of this completed TMDL, local sponsors successfully applied for and received Section 319 funding for the Rush River Watershed Project. Beginning in May 2008, 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 Rush River (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, 2008) 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).

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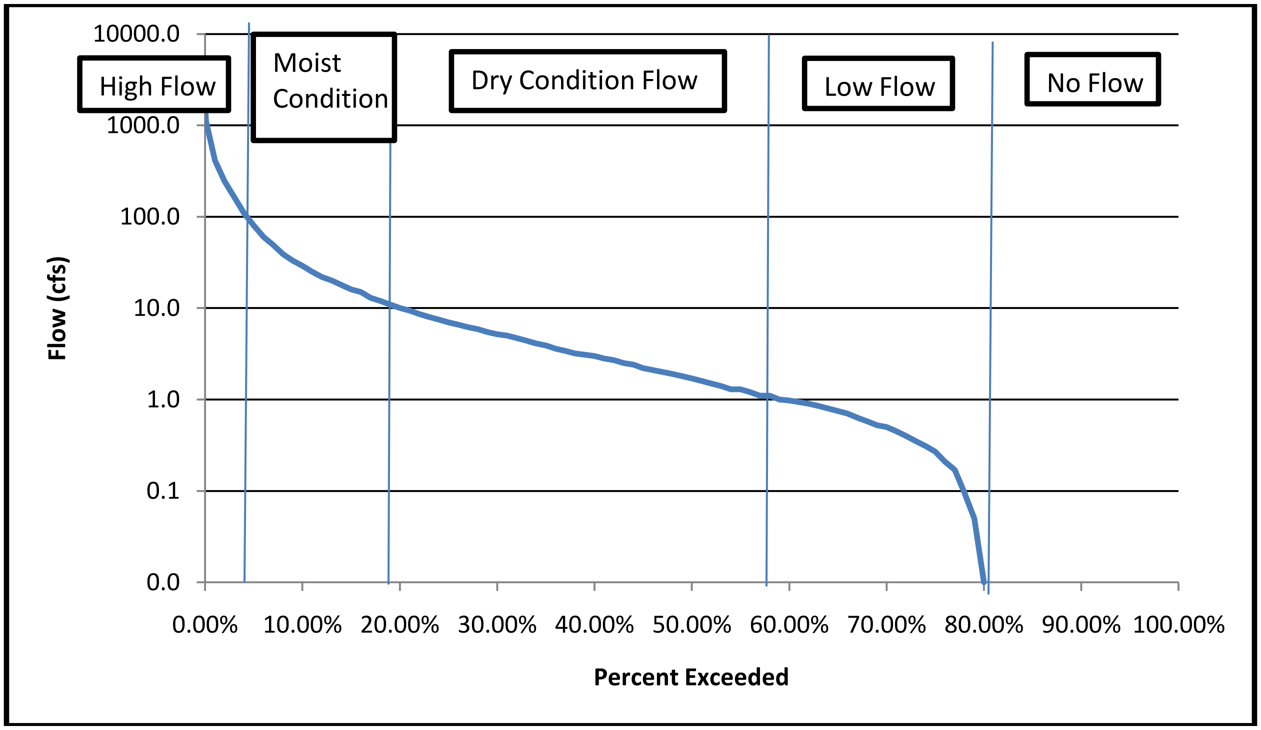
Appendix A
Fecal Coliform Bacteria Data Collected for Sites 385302 (2004-2005 and 2008-2009) and 385303 (2004-2005)

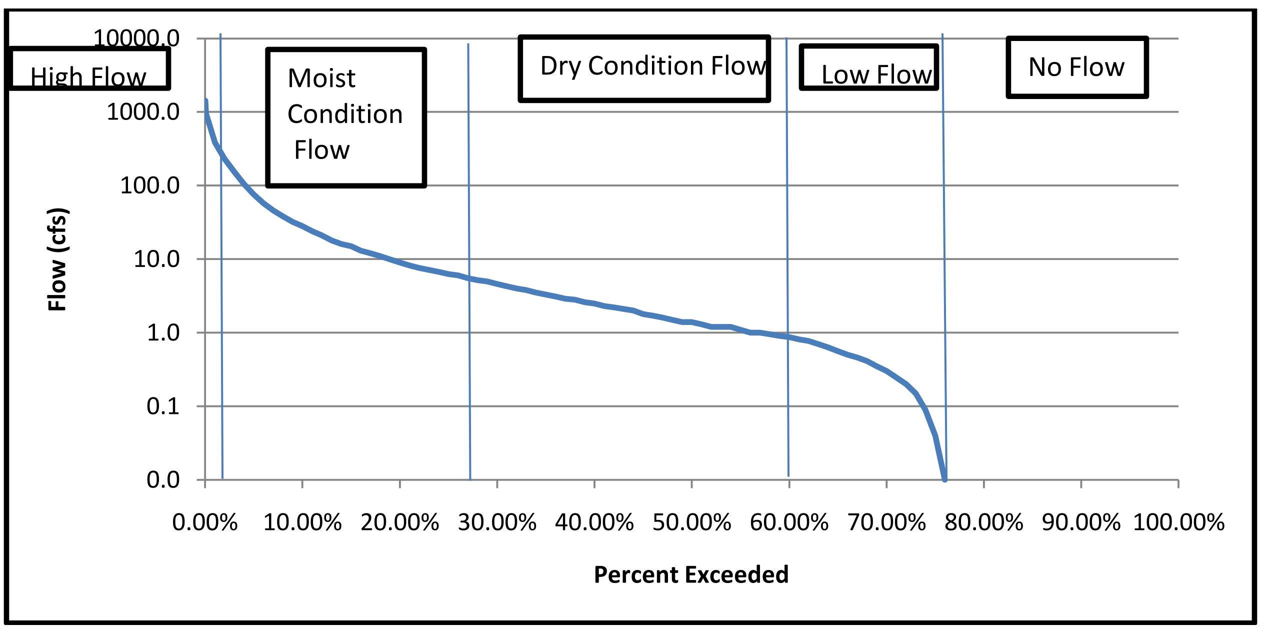
385302										
	May		June		July		August		September	
	06-May-04	10	01-Jun-04	1600	07-Jul-04	590	02-Aug-04	390	01-Sep-04	30
	13-May-04	210	07-Jun-04	20	13-Jul-04	360	11-Aug-04	180	08-Sep-04	240
	20-May-04	100	14-Jun-04	110	22-Jul-04	220	18-Aug-04	270	27-Sep-04	10
	26-May-04	30	21-Jun-04	200	29-Jul-04	500	24-Aug-04	350	07-Sep-05	660
	03-May-05	10	28-Jun-04	280	06-Jul-05	30	01-Aug-05	150	21-Sep-05	20
	12-May-05	20	06-Jun-05	50	11-Jul-05	250	09-Aug-05	30	02-Sep-08	280
	19-May-05	20	15-Jun-05	220	21-Jul-05	20	24-Aug-05	80	08-Sep-08	10
	24-May-05	70	20-Jun-05	80	25-Jul-05	970	31-Aug-05	10	15-Sep-08	160
	31-May-05	30	27-Jun-05	180	08-Jul-08	110	04-Aug-08	270	22-Sep-08	60
	05-May-08	10	02-Jun-08	80	14-Jul-08	150	11-Aug-08	250	30-Sep-08	40
	13-May-08	130	09-Jun-08	110	22-Jul-08	190	18-Aug-08	150	01-Sep-09	400
	19-May-08	20	17-Jun-08	180	06-Jul-09	1600	26-Aug-08	110	14-Sep-09	170
	27-May-08	90	24-Jun-08	520	13-Jul-09	1600	03-Aug-09	10	21-Sep-09	380
	05-May-09	10	30-Jun-08	550	21-Jul-09	200	10-Aug-09	160	30-Sep-09	150
	12-May-09	20	01-Jun-09	40	28-Jul-09	60	20-Aug-09	100		
	18-May-09	20	08-Jun-09	90			26-Aug-09	40		
			17-Jun-09	280						
			22-Jun-09	400						
			29-Jun-09	390						
Geomean		30		169		233		103		94
% Exceed		0.00		0.21		0.33		0.00		0.14
Use Assessment	Fully Supporting		Fully Supporting but Threatened		Not Supporting		Fully Supporting		Fully Supporting but Threatened	

385303										
	May		June		July		August		September	
	06-May-04	80	01-Jun-04	330	07-Jul-04	1600	02-Aug-04	300	01-Sep-04	60
	13-May-04	200	07-Jun-04	70	13-Jul-04	230	11-Aug-04	200	08-Sep-04	170
	20-May-04	30	14-Jun-04	20	22-Jul-04	140	18-Aug-04	20	27-Sep-04	380
	26-May-04	50	21-Jun-04	60	29-Jul-04	250	24-Aug-04	30	07-Sep-05	1600
	04-May-05	10	28-Jun-04	10	06-Jul-05	120	01-Aug-05	240	21-Sep-05	160
	12-May-05	80	06-Jun-05	310	11-Jul-05	90	09-Aug-05	310		
	19-May-05	30	15-Jun-05	200	21-Jul-05	70	24-Aug-05	70		
	24-May-05	20	20-Jun-05	100	25-Jul-05	1600	31-Aug-05	40		
	31-May-05	10	27-Jun-05	60						
Geomean		37		78		251		96		251
% Exceed		0.00		0.00		0.25		0.00		0.20
Use Assessment	Fully Supporting		Fully Supporting		Not Supporting		Fully Supporting		Not Supporting	

Appendix B
Flow Duration Curves for Sites 385302 and 385303



Monitoring Site 385302

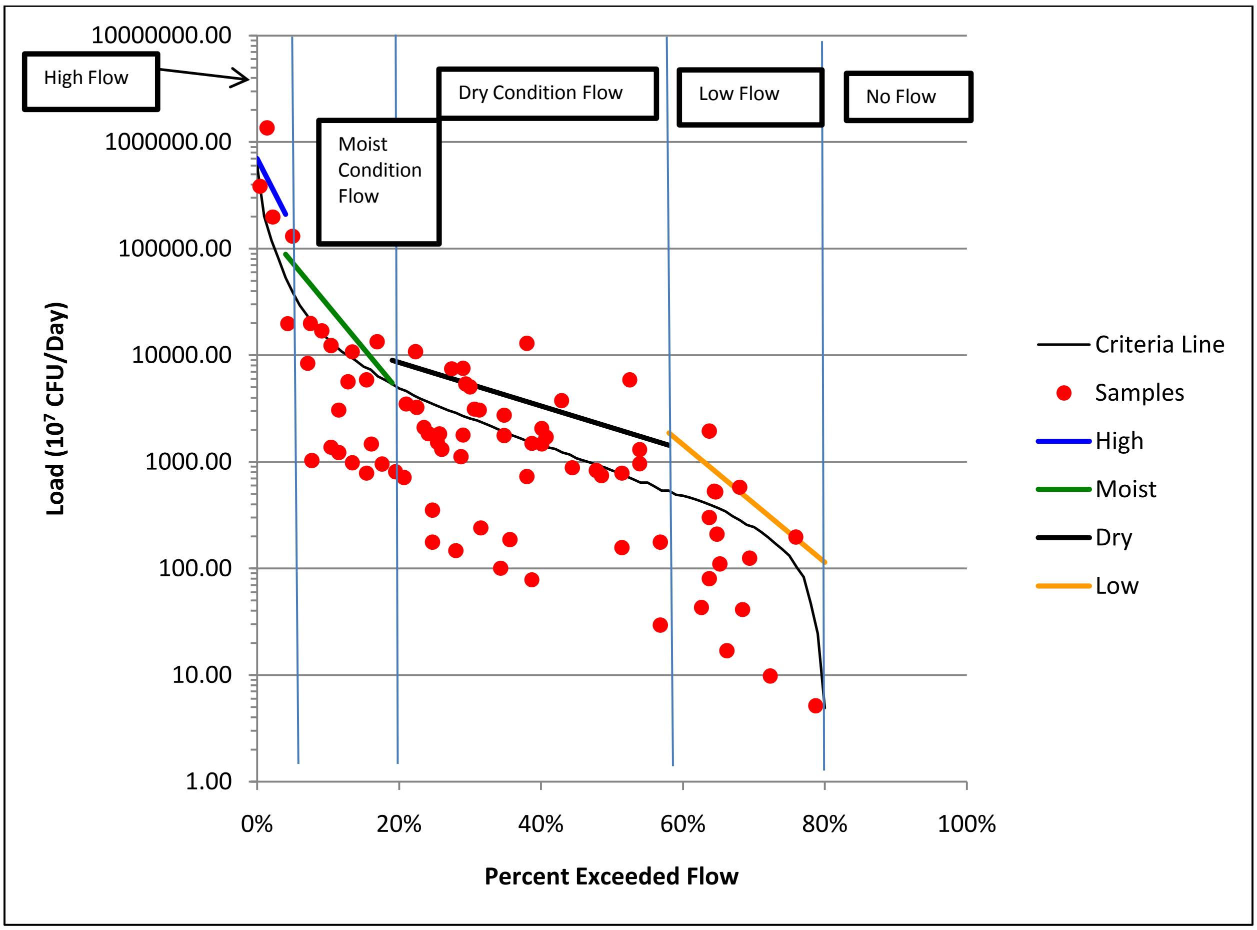


Monitoring Site 385303

Appendix C
Load Duration Curves, Estimated Loads, TMDL Targets, and Percentage of Reduction Required for Sites 385302 and 385303

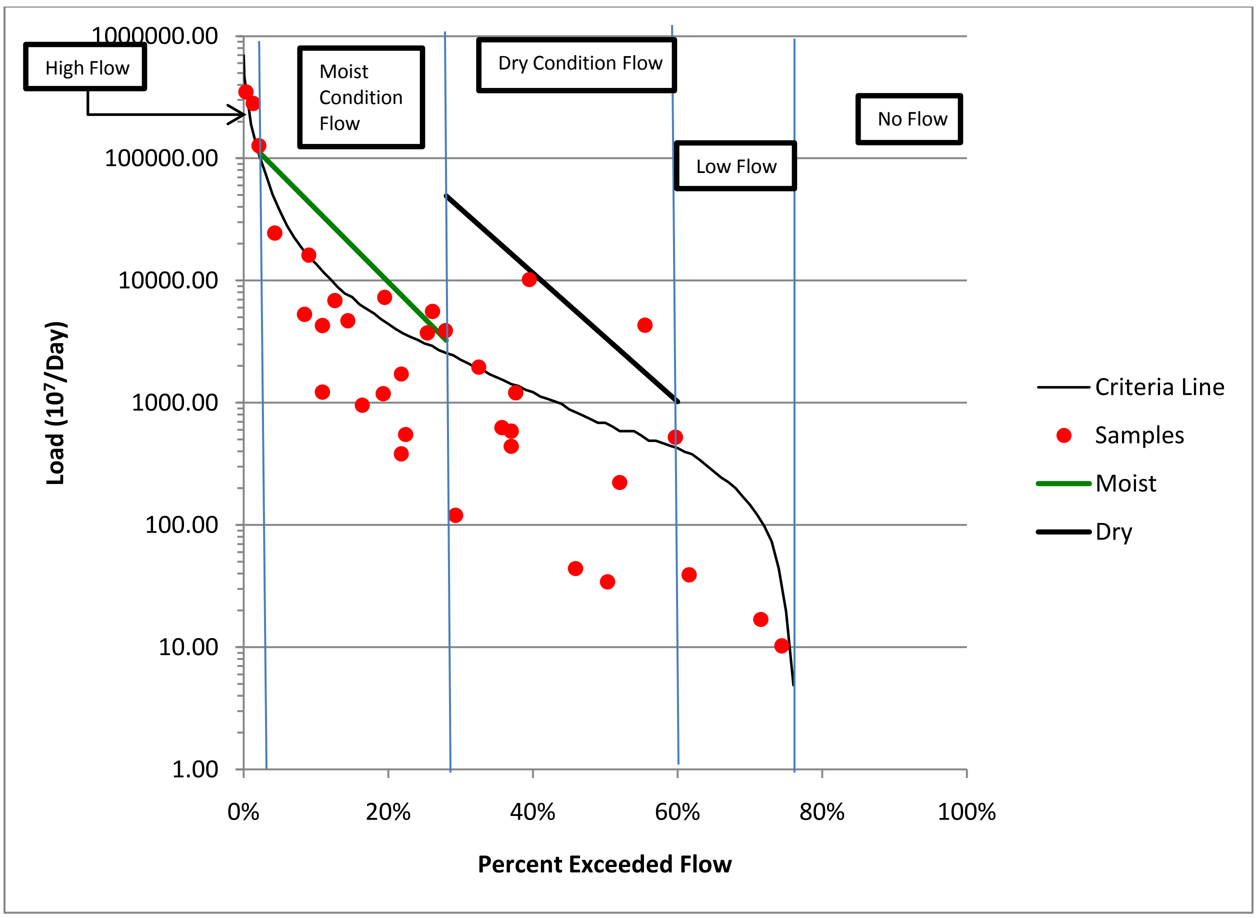
385302 Rush River near Amenia, ND

	Load (10^7 CFU/Day)				Load (Million CFU/Period)		
	Median Percentile	Existing	TMDL	Days	Existing	TMDL	Percent Reduction
High	2.01%	383925.96	118891.63	14.56	5591305.78	1731478.28	69.03%
Moist	11.51%	22043.83	11745.11	54.71	1206094.89	642616.31	46.72%
Dry	38.51%	3579.59	1566.02	142.31	509423.34	222865.11	56.25%
Low	69.01%	461.57	254.48	80.26	37047.27	20425.25	44.87%
			Total	292	7343871	2617385	64.36%



385303 Rush River near Prosper, ND

	Load (10^7 CFU/Day)				Load (Million CFU/Period)		
	Median Percentile	Existing	TMDL	Days	Existing	TMDL	Percent Reduction
Moist	15.00%	19236.99	7340.70	94.90			
Dry	44.00%	7104.45	978.76	116.80	829799.58	114319.11	86.22%
			Total	212	829800	114319	86.22%



Appendix D
North Dakota Department of Health Water Quality
NDPDES DMR Data Report for Amenia, North Dakota

Date Printed: 5/7/2009

ND Dept of Health Water Quality NDPDES DMR Data Report

Discharge Start between '1/1/2005' AND '5/7/2009' AND Discharge End BETWEEN '1/1/2005' AND '5/7/2009'

Environmental Interest: Amenia City Of Permit: NDG323477
Discharge Point: 001 A Parameter: Fecal

Disch	Discharge Dates		Treat		Concentration Data				Loading Data				No Di	
Type	Start	End	Struct	Duration	Min	Avg	Max	Units	Avg	Max	Units	No. Exc.	Code	Freq/Type
Effluent	5/23/2005	5/27/2005	Cell 2	5	20	20	20	Num/100 mL				0		Weekly/Grab
Effluent	6/27/2005	6/30/2005	Cell 2	4	20	20	20	Num/100 mL				0		Weekly/Grab
Effluent	10/28/2005	11/1/2005	Cell 2	5	20	20	20	Num/100 mL				0		Weekly/Grab
Effluent	4/12/2006	4/17/2006	Cell 2	6	40	40	40	Num/100 mL				0		Weekly/Grab
Effluent	5/8/2007	5/12/2007	Cell 2	5	20	20	20	Num/100 mL				0		Weekly/Grab
Effluent	7/3/2007	7/7/2007	Cell 2	5	20	20	20	#/100 ml				0		Weekly/Grab
Effluent	7/2/2008	7/5/2008	Cell 2	4	20	20	20	Num/100 mL				0		Weekly/Grab
Effluent	10/23/2008	10/27/2008	Cell 2	5	93.3	93.3	93.3	Num/100 mL				0		Weekly/Grab

Date Printed: 5/7/2009

ND Dept of Health Water Quality NDPDES DMR Data Report

Discharge Start between '1/1/2005' AND '5/7/2009' AND Discharge End BETWEEN '1/1/2005' AND '5/7/2009'

Environmental Interest: Amenia City Of Permit: NDG323477
Discharge Point: 001 A Parameter: Drain MG

Disch	Discharge Dates		Treat		Concentration Data				Loading Data				No Di	
Type	Start	End	Struct	Duration	Min	Avg	Max	Units	Avg	Max	Units	No. Exc.	Code	Freq/Type
Effluent	5/23/2005	5/27/2005	Cell 2	5						0.98	MGAL	0		Monthly/Calculated
Effluent	6/27/2005	6/30/2005	Cell 2	4						0.98	MGAL	0		Monthly/Calculated
Effluent	10/28/2005	11/1/2005	Cell 2	5						0.98	MGAL	0		Monthly/Calculated
Effluent	4/12/2006	4/17/2006	Cell 2	6						0.98	MGAL	0		Monthly/Calculated
Effluent	5/8/2007	5/12/2007	Cell 2	5						0.98	MGAL	0		Monthly/Calculated
Effluent	7/3/2007	7/7/2007	Cell 2	5						0.98	MGAL	0		Monthly/Calculated
Effluent	7/2/2008	7/5/2008	Cell 2	4						0.98	MGAL	0		Monthly/Calculated
Effluent	10/23/2008	10/27/2008	Cell 2	5						0.98	MGAL	0		Monthly/Calculated