E. coli Bacteria TMDL for the Souris River in McHenry County, North Dakota

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1.0 INTRODUCTION AND DESCRIPTION OF THE WATERSHED

The Souris (Mouse) River originates in the Yellow Grass Marshes north of Weyburn, Saskatchewan, Canada, and flows southeast, crossing the northern boundary of North Dakota west of Sherwood, North Dakota. It then forms a loop and flows back north, entering Manitoba, Canada near Westhope, North Dakota. The river eventually flows into the Assiniboine River near Brandon, Manitoba (Figure1). A map of the entire Souris River watershed can be found in Appendix A. Flow in the upper Souris River is regulated by three reservoirs in Canada (Boundary Reservoir, 48,990 acre-ft; Rafferty Reservoir, 356,400 acre-ft; and Alameda Reservoir, 85,560 acre-ft), as well reservoirs in the United States managed by the U.S. Fish and Wildlife Service (Lake Darling Reservoir and J. Clark Salyer Refuge). Additionally, some diversions for irrigation and municipal supply exist along the river.

The Total Maximum Daily Load (TMDL) listed segment (ND-09010003-005-S_00) of this river is located in McHenry County in north central North Dakota (Figure 2). It consists of 74.9 miles of the Souris River from the confluence with Wintering River downstream to its confluence with Willow Creek. Its watershed has an area of approximately 152,593 acres (Figure 3). Table 1 summarizes some of the geographical, hydrological and physical characteristics of this TMDL listed segment of the Souris River.

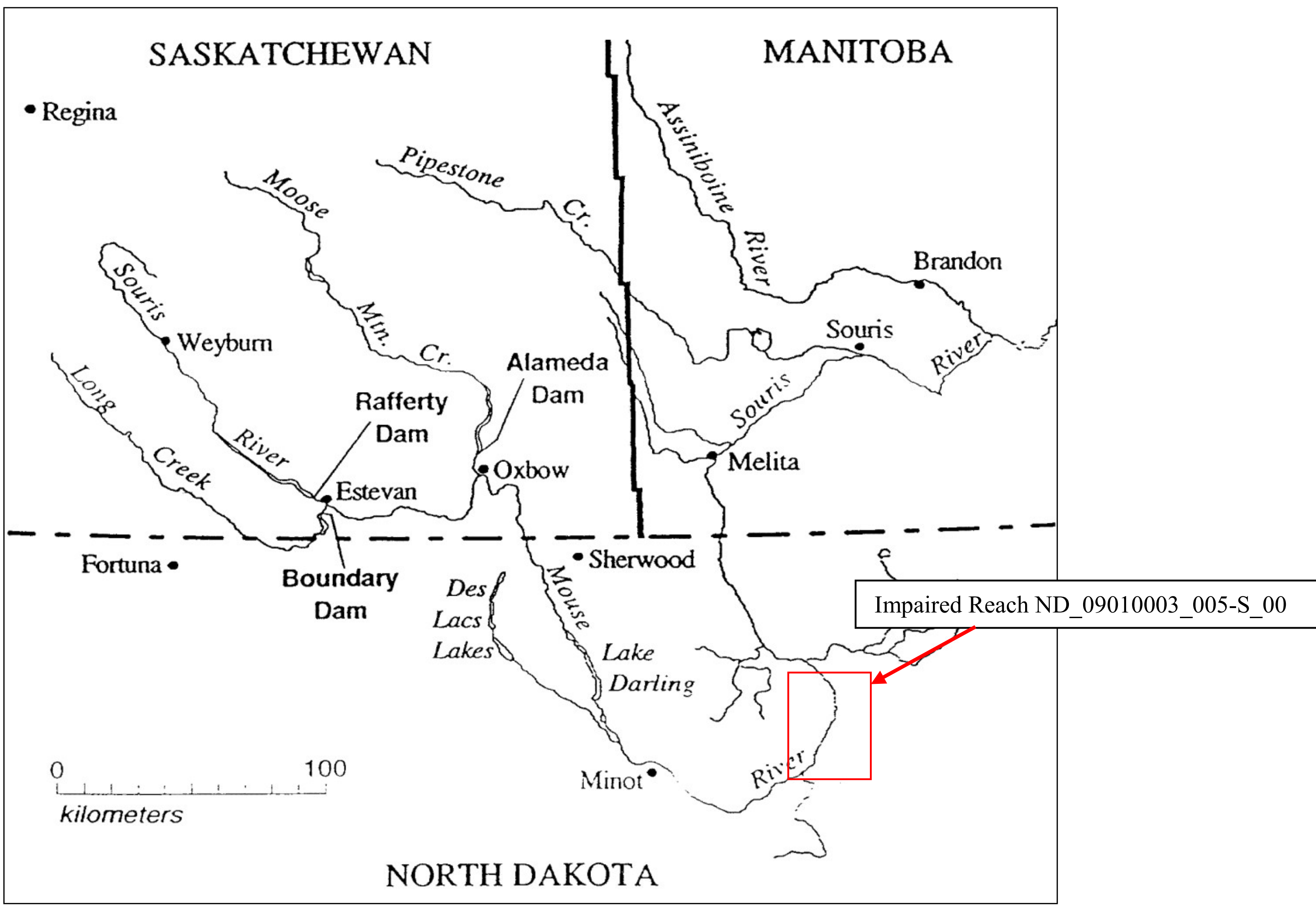

Figure 1. Souris River and TMDL Impaired Reach.

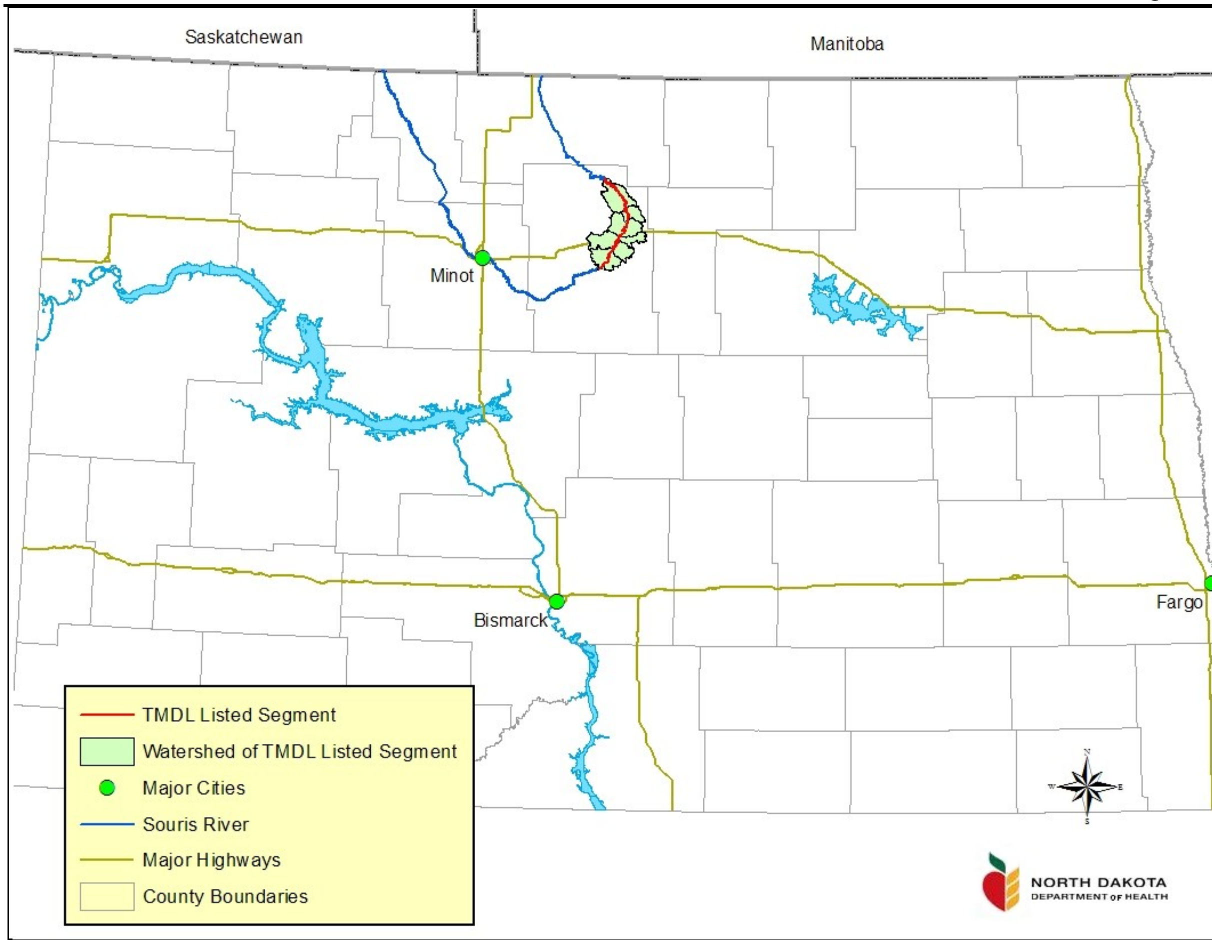

Figure 2. Location of Souris River in North Dakota.

Table 1. General Characteristics of the Souris River and Its Watershed.

Legal Name	Souris (Mouse) River[1]
Stream Classification	Class IA
Major Drainage Basin	Souris (Mouse) River[1]
8 Digit HUC	09010003
County	McHenry County, ND
Ecoregion: Level III	Level III: Northern Glaciated Plains (46)
Ecoregion: Level IV	Level IV: Glacial Lake Basins (46c) and Glacial Lake Deltas (46d)
Watershed Area	152,593 acres
River Miles	74.9 miles

[1] Local legislation passed that determined the river shall be called Mouse River on all identifiable signs in North Dakota. It is known as the Souris River in Canada and to many state and federal agencies within North Dakota.

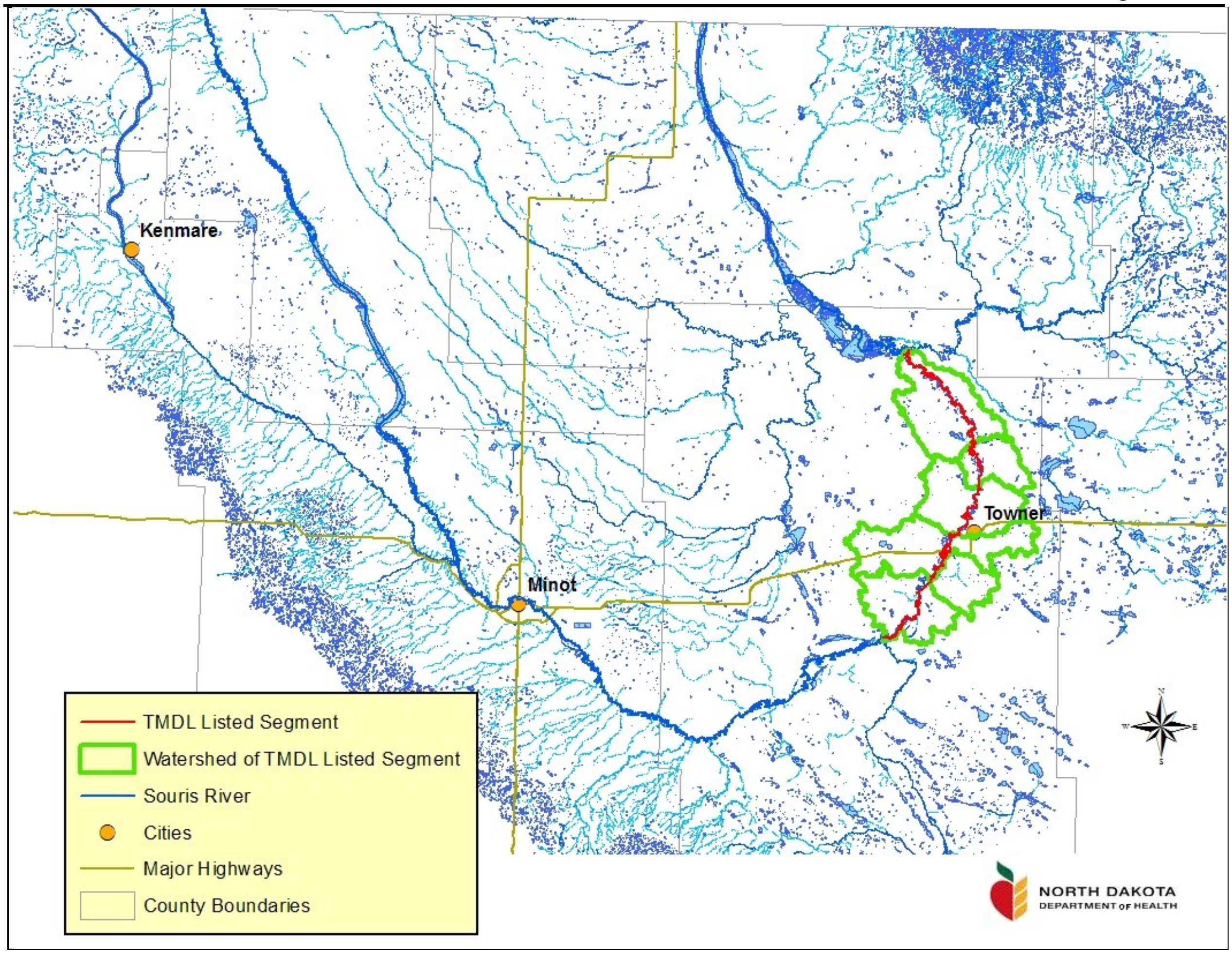

Figure 3. Location of the TMDL Listed Segment of the Souris River and Its Watershed.

1.1 Clean Water Act Section 303(d) Listing Information

Based on the 2012 Section 303(d) list of impaired waters needing TMDLs, the North Dakota Department of Health (NDDoH) has identified segment ND-09010003-005-S_00 of the Souris River as fully supporting, but threatened for recreational beneficial uses due fecal coliform bacteria (Table 2). It is also listed as fully supporting, but threatened for aquatic life beneficial uses due to sedimentation. This impairment will be addressed in a separate TMDL report.

While this segment of the Souris River is listed in the 303(d) report as being impaired due to fecal coliform bacteria, North Dakota water quality standards for bacteria have been changed to E. coli bacteria to reflect current information on human health hazards. Data in this report indicate that this segment is also impaired due to E. coli bacteria, and an E. coli TMDL target will be given to reflect compliance with current water quality standards. Meeting the E. coli target will result in having the recreation beneficial use restored to this segment of the Souris River.

Table 2. 2012 Section 303(d) TMDL Listing Information for Souris River, Assessment Unit ID ND-09010003-005-S_00 (NDDoH, 2012).

Assessment Unit ID	ND-09010003-005-S_00
Waterbody Description	Souris River from the confluence with Wintering River to the confluence with Willow Creek, McHenry County, ND.
Size	74.9 miles
Impaired Designated Use	Recreation
Use Support	Fully Supporting, but Threatened
Impairment	Fecal Coliform Bacteria/E. coli Bacteria
TMDL Priority	Low

1.2 Topography

This watershed is characterized as glaciated and generally flat, with occasional "washboard" undulations. High concentrations of temporary and seasonal wetlands are present and the drainage pattern is simple. Surficial material consists of glacial till over Cretaceous Pierre Shale. The soils present belong to the Order Mollisols and are typically Barnes, Svea, Hamerly, Cresbard, Buse, and Parnell. Though the till soil is very fertile, agricultural success is subject to annual climatic fluctuations (USEPA, et al. 1998). Elevation in the watershed ranges from 1,500 to 1,970 msl (USGS, 2006).

1.3 Land Use and Ecoregions in the Watershed

This segment of the Souris River watershed lies within the Northern Glaciated Plains (46) level III ecoregion. This ecoregion is further subdivided into several level IV ecoregions as described below (Figure 4).

Within the Northern Glaciated Plains (46) level III ecoregion, the subhumid conditions foster a grassland transition between the tall and short grass prairie. High concentrations of temporary and seasonal wetlands are found throughout the region as well. The watershed for this TMDL listed segment lies within Glacial Lake Basins (46c) and Glacial Lake Deltas (46d) ecoregions which were occupied or deposited by Glacial Lake Souris. The deep soils of the Glacial Lake Basins are intensively cultivated, while the sandy, fine gravel soils of the Glacial Lake Deltas are used mainly for grazing or irrigated agriculture.

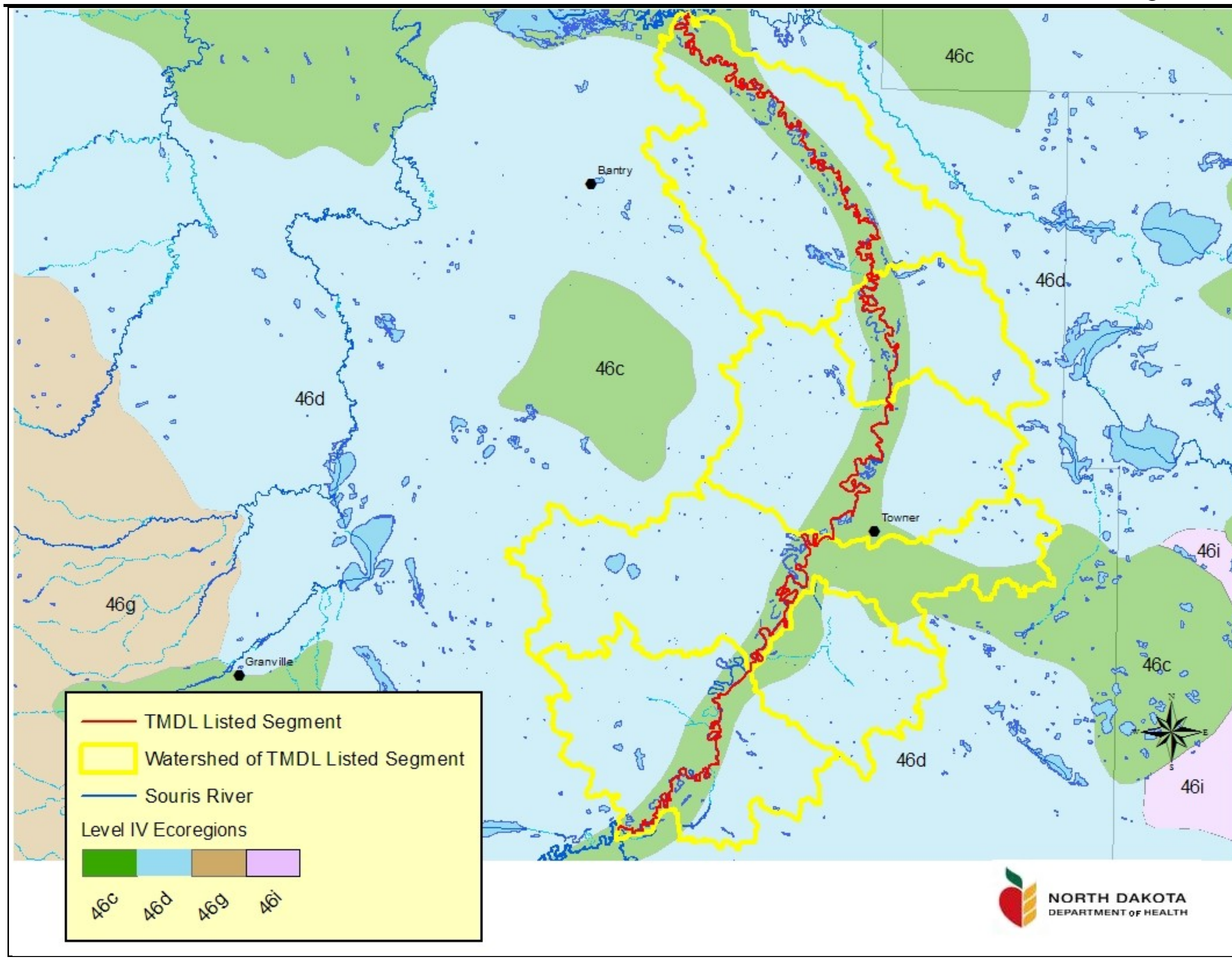

Figure 4. Level IV Ecoregions for the Souris River TMDL Listed Segment and Watershed.

Land use data from the National Agricultural Statistics Service (NASS, 2011) indicates that the listed segment's watershed is primarily agricultural (90.1 percent), consisting of crop production (including barren/fallow land) and livestock grazing. Almost 35 percent of the watershed is actively cultivated, tilled mainly for durum, spring wheat, and other small grains, but including a variety of crops. A little over 52 percent is in pasture/range/haylands. Water and woods make up almost nine percent of the watershed (Tables 3 and 4, Figure 5). There are two permitted animal feeding operation (AFOs) which allow zero discharge and are a significant distance from the river, and no confined animal feeding operations (CAFOs). The exact number of non-permitted animal feeding operations within the watershed is unknown, but significant. The billboard entering Towner states it is the cattle capital of North Dakota.

Table 3. Major Land Use Categories in the Watershed of the Section 303(d) Listed Souris River Segment (based on 2011 NASS data).

Major Category	Acres	Percent of Watershed
Hay/Pasture/Grass/Alfalfa	79,964	52.4
Agriculture/Cultivated	53,173	34.8
Barren/Fallow	4,492	2.9
Urban/Roads	6,132	4.0
Water	5,395	3.6
Woods	3,437	2.3

Table 4. Land Use Types in the Watershed of the Section 303 (d) Listed Souris River Segment (based on 2011 NASS data).

Land Use Type	Acres	Percent of Watershed
Hay/Pasture/Grass	78,031	51.1
Alfalfa	1,933	1.3
Wheat	24,109	15.8
Soybeans	15,262	10.0
Corn	7,338	4.8
Canola/Flax	3,067	2.0
Other	3,397	2.2
Barren/Fallow	4,492	2.9
Urban/Roads	6,132	4.0
Woods	3,437	2.3
Water	5,395	3.6
TOTAL	152,593	100

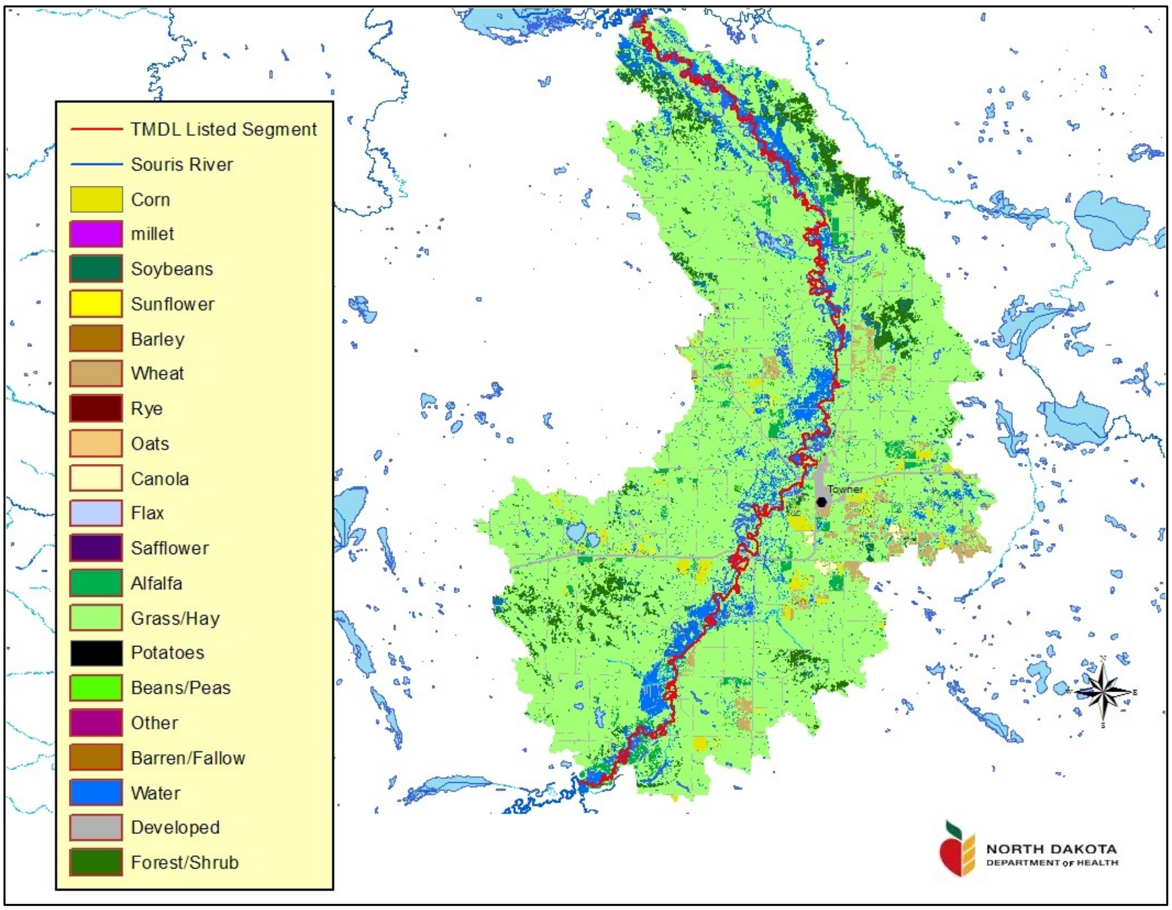

Figure 5. Land Use Map for the Watershed of the Souris River TMDL Segment (NASS, 2011).

1.4 Climate and Precipitation

North Dakota's climate is characterized by large temperature variation across all time scales, light to moderate irregular precipitation, plentiful sunshine, low humidity, and nearly continuous wind. Its location at the geographic center of North America results in a strong continental climate, which is exacerbated by the mountains to the west. There are no barriers to the north or south so a combination of cold, dry air masses originating in the far north and warm humid air masses originating in the tropical regions regularly flow over the state. Movement of these air masses and their associated fronts cause near continuous wind and often result in large day to day temperature fluctuations in all seasons. The average last freeze in spring occurs in late May. In the fall, the first 32 degree or lower temperature occurs between September 10th and 25th. However, freezing temperatures have occurred as late as mid-June and as early as mid-August. About 75 percent of the annual precipitation falls during the period of April to September, with 50 to 60 percent occurring between April and July. Most of the summer rainfall is produced during thunderstorms, which occur on an average of 25 to 35 days per year. On the average, rains occur once every three or four days during the summer. Winter snowpack, although persistent from December through March, only averages around 15 inches (Enz, 2003). Historical average precipitation data for the climate station at Towner, ND, which is within the watershed, were obtained from the High Plains Regional Climate Center (HPRCC) and can be seen in Figure 6.

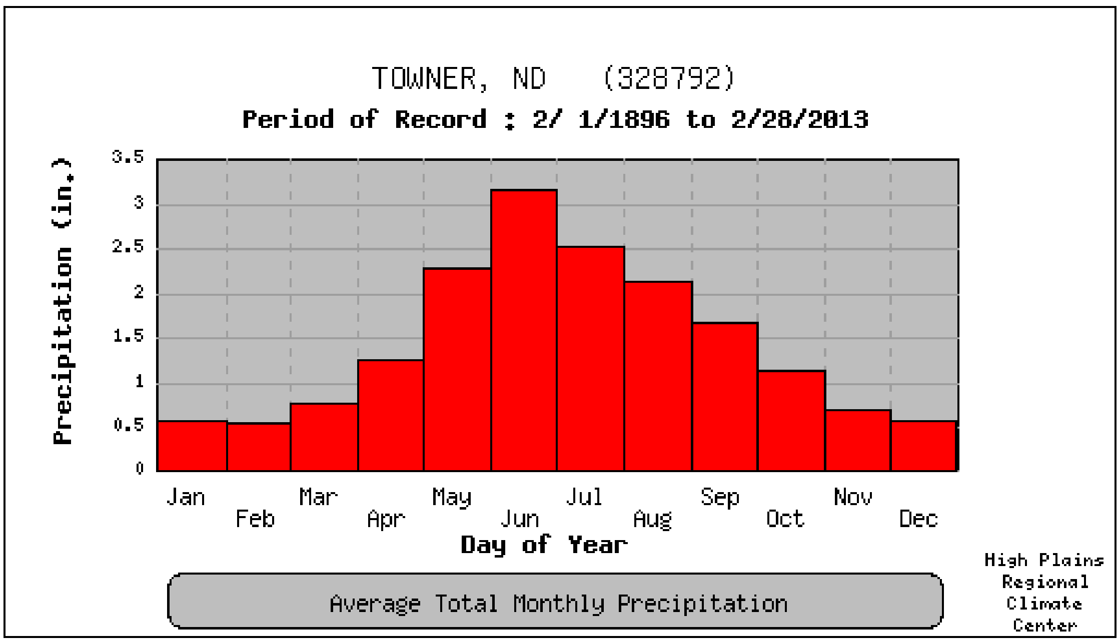

Figure 6. Average Total Monthly Precipitation Data for HPRCC Towner Station 328792 (1896-2013).

The average annual air temperature recorded at the Towner HPRCC station (328792) for the period of record (1896 – 2013) was 42.5^{o} F, with an average annual wind speed of 9.4 mph. Average annual precipitation for the period of record was 17.70 inches with 47 percent of that falling in the summer, 25 percent falling in spring, 19 percent falling in fall and 9 percent falling in winter. Average annual snowfall for the period of record was 39 inches. Average monthly temperatures are provided in Figure 7.

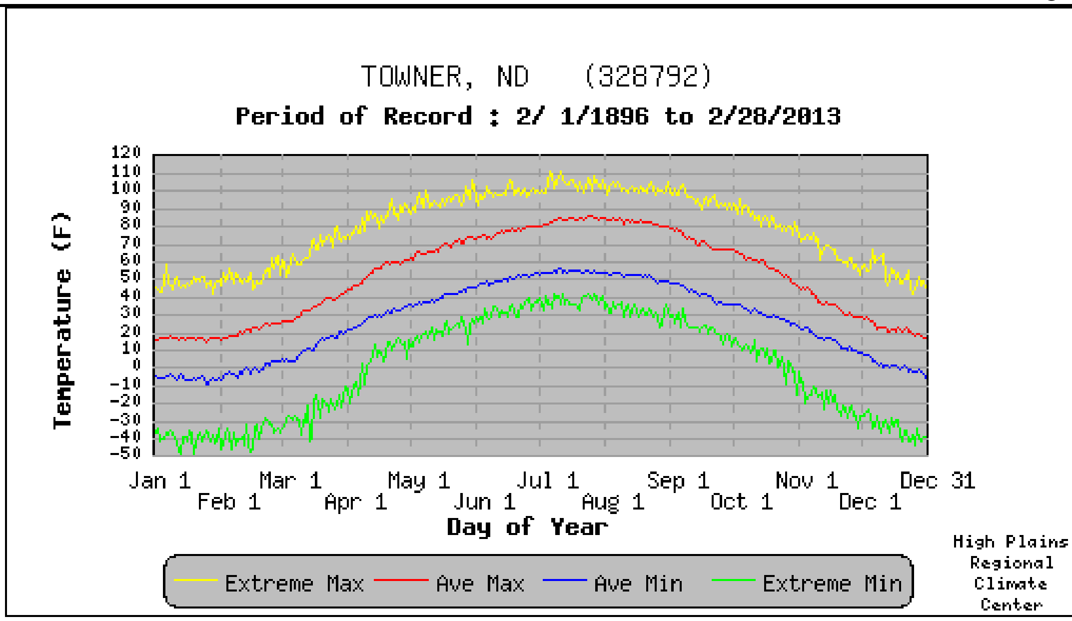

Figure 7. Average Monthly Temperatures at the Towner HPRCC Station 328792, (1896-2013).

1.5 Available Data

1.5.1 E. coli Bacteria Data

E. coli bacteria data were gathered from two NDDoH sampling stations (380018 and 380094) within the TMDL listed reach of the Souris River (Figure 8). These sites were sampled two to three times a week, every week of the recreation season (May 1 – September 30) in 2012. The corresponding recreational use assessments are shown in Tables 5 and 6 below. The full set of data is provided in Appendix B.

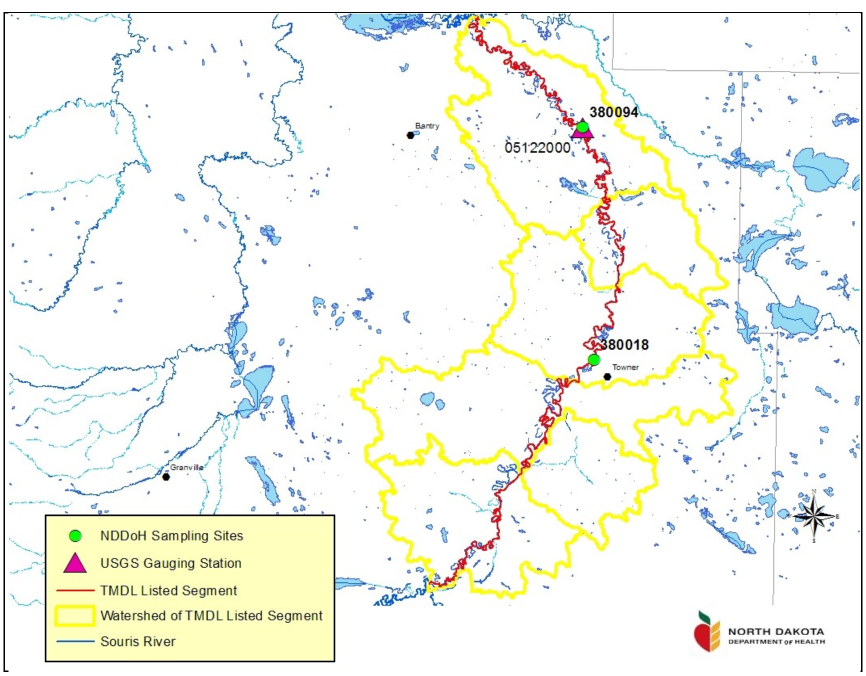

Figure 8. Sampling Site Locations for the TMDL Listed Segment of the Souris River.

Table 5 . Summary of E. coli Bacteria Data for Site 380018 for the Recreation Season of May 1st through September 30th, 2012.

Month	N	Geometric Mean* (CFU/100mL)	% Samples Exceeding 409 CFU/100mL	Recreational Use Assessment
May	10	14.31	0%	Fully Supporting
June	5	54.07	0%	Fully Supporting
July	8	251.65	38%	Not Supporting
August	8	96.85	0%	Fully Supporting.
September	5	76.21	0%	Fully Supporting

*** The value of half the detection limit (5 CFU/100mL) is used for all Non-Detect values in the computation of geometric mean.**

Table 6. Summary of E. coli Bacteria Data for Site 380094 for the Recreation Season of May 1st through September 30th, 2012.

Month	N	Geometric Mean* (CFU/100mL)	% Samples Exceeding 409 CFU/100mL	Recreational Use Assessment
May	10	14.22	0%	Fully Supporting
June	5	126.92	20%	Not Supporting
July	8	180.32	25%	Not Supporting
August	8	84.32	0%	Fully Supporting.
September	5	17.82	0%	Fully Supporting

*** The value of half the detection limit (5 CFU/100mL) is used for all Non-Detect values in the computation of geometric means.**

Based on the Discharge Monitoring Report (DMR) for the Towner, ND wastewater treatment facility (WWTF), mean E. coli and fecal bacteria concentrations for each discharge event never exceeded water quality standards for samples taken from 2009 through 2012. The Towner, ND WWTF changed from sampling for fecal coliform bacteria to sampling for E. coli bacteria in accordance with a change in the State's water quality standards (see Section 2.2). A summary of discharge data along with E.coli and fecal coliform bacteria is provided in Table 7. The DMRs are provided in Appendix C.

Table 7. Summary of E. Coli and Fecal Coliform Bacteria Data for Towner, ND Wastewater Treatment System Discharge into the Souris River, Recreation Season of May 1- September 30 (2009-2012).

Date	Cell	Discharge per period (MGal)	Discharge Period (Days)	Fecal Or E. coli	Geometric Mean (CFU/100mL)	% Exceeding Maximum Threshold
05/29/2009	4	9.27	14	Fecal	10*	0%
05/28/2010	4	13.91	15	Fecal	105	0%
8/30/2011	4	18.55	15	Fecal	10*	0%
6/1/2012	4	18.55	15	E. coli	10*	0%

* 10 CFU/100mL is the detection limit for both e. coli and fecal bacteria. For samples reported below detection limit, 10 CFU/100 mL was used in the discharge report.

1.5.2 Hydraulic Discharge

Flow in the upper portion of the Souris River is regulated by three reservoirs in Canada: the Boundary, Rafferty, and Alameda Reservoirs. Constructed by the Rafferty-Alameda Project (1988-1995), these reservoirs provide water to users in the area, as well as flood protection for residents downstream, including those in North Dakota. Water releases are governed in accordance with the Boundary Waters Treaty and determined by the International Souris River Board of Control (ISRB), under the International Joint Commission. Specifically, "the Province of Saskatchewan shall have the right to divert, store, and use waters which originate in the Saskatchewan portion of the Souris River basin, provided that such diversion, storage, and use shall not diminish the annual flow of the river at the international border crossing more than fifty percent of that which would have occurred in the state of nature, as calculated by the Board (ISRB 1992).

Flow in the Souris River is also affected by Lake Darling Reservoir, which is managed by the US Fish and Wildlife Service for waterfowl production and recreation.

Flow data was provided by U.S. Geological Survey (USGS) stream gauging station (05122000), collocated with the NDDoH water quality sampling station 380094. Data from this site was used in the construction of the flow and load duration curves.

There are no major tributaries or streams flowing into the Souris River within the watershed of the listed reach. As such, it has been determined that flow is similar (i.e. not gaining or losing) all along the 74.9-mile TMDL listed reach. Discharge for USGS site 05122000 is shown in Figure 9.

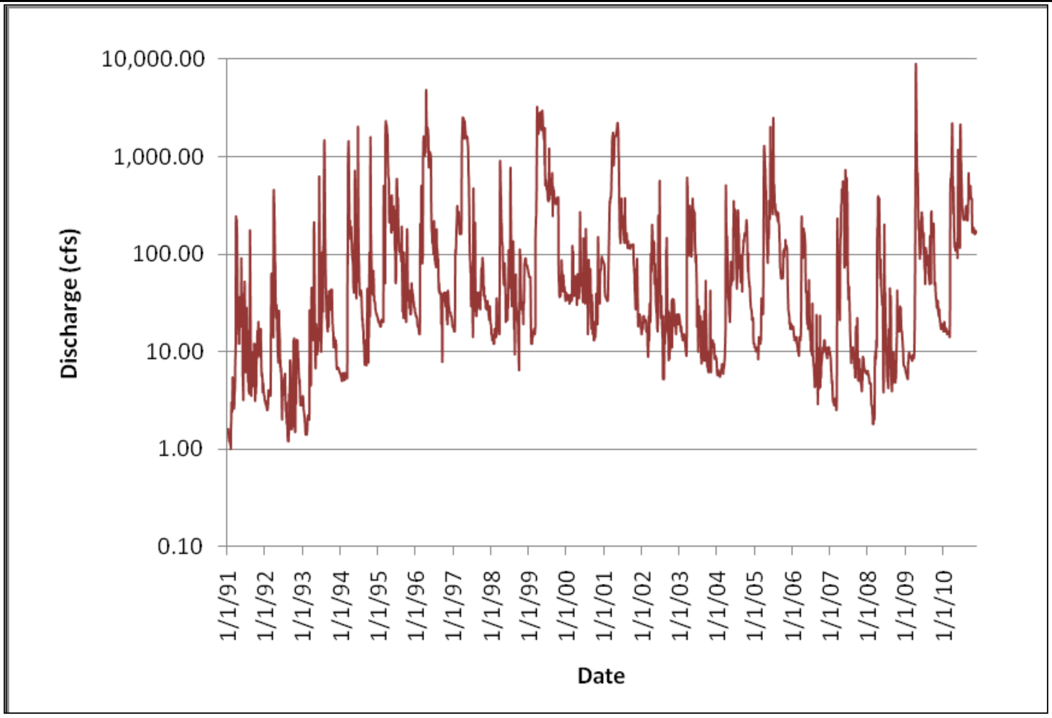

Figure 9. Discharge for USGS Site 05122000, 1994-2013.

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., E. coli 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, 2011).

- All waters of the State shall be free from substances attributable to municipal, industrial, or other discharges or agricultural practices in concentrations or combinations that are toxic or harmful to humans, animals, plants, or resident aquatic biota.
- No discharge of pollutants, which alone or in combination with other substances, shall:

   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, 2011).

2.2 Numeric Water Quality Standards

The Souris River is a Class IA stream. The NDDoH definition of a Class IA Stream is shown below (NDDoH, 2011)

> **Class IA** - The quality of waters in this class shall be suitable for the propagation or protection, or both, of resident fish species and other aquatic biota and for swimming, boating, and other water recreation. The quality of the waters shall be suitable for irrigation, stock watering, and wildlife without injurious effects. After treatment consisting of coagulation, settling filtration, and chlorination, or equivalent treatment processes, the water quality shall meet the bacteriological, physical, and chemical requirements of the Department for municipal or domestic use. Treatment for municipal use may also require softening to meet the drinking water requirements.

Effective January 2011, the NDDoH revised the State water quality standards. In these latest revisions the NDDoH eliminated the fecal coliform bacteria standard, retaining only the E. coli bacteria standard for the protection of recreational uses (Table 8). This change in water quality standard was recommended by the US Environmental Protection Agency as E. coli is believed to be a better indicator of recreational use risk (i.e. incidence of gastrointestinal disease).

Table 8. North Dakota E. coli Bacteria Standard for Class IA Streams.

	Parameter	Geometric Mean[1]	Maximum[2]
Water Quality Standard	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 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 Souris River is based on the North Dakota water quality standard for E. coli bacteria. If the target is met, the recreation beneficial use will be fully supported.

3.1 E. coli Bacteria Target

The Souris River is impaired because of E. coli bacteria. The Souris River recreation beneficial use is identified as fully supporting, but threatened because E. coli bacteria counts exceed the State water quality standard. The State water quality standard for E. coli bacteria is a geometric mean concentration of 126 CFU/100 mL during the recreation season of May 1st through September 30th. Thus, the TMDL target for this report is 126 CFU/100 mL. In addition, no more than ten percent of samples collected for E. coli bacteria should exceed 409 CFU/100 mL.

While the standard is intended to be expressed as the 30-day geometric mean, the target is based on the 126 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 that recreational uses will be restored.

4.0 SIGNIFICANT SOURCES

4.1 Point Sources

Within the watershed of the TMDL listed reach of the Souris River, there is one wastewater treatment system permitted through the North Dakota Pollution Elimination System (NDPDES) Program. It is for the community of Towner, North Dakota (Figure 8). This system is allowed to discharge on an “as needed” basis, usually once a year from one cell (Appendix C). The wastewater treatment facility changed from sampling fecal coliform to E. coli in 2012, in accordance with the State’s water quality standards. As Table 7 indicates, the E. coli bacteria concentration entering this portion of the Souris River from the lagoon is well below water quality standards. Data from 2009 through 2011 (Table 7, Appendix C) also indicates that fecal coliform discharge concentrations had not exceeded the previous fecal coliform standard. This point source is deemed to not be a primary cause of bacteria impairment. As a part of the NDPDES program, E. coli data will be collected during discharge according to the permit to assure levels remain within standard limits and the point source is given a load allocation to account for any events.

There are two permitted medium (301–999 animal units) animal feeding operations (AFO) in the watershed. However they are a significant distance from the river and are zero discharge facilities so not deemed significant sources for this report.

4.2 Nonpoint Sources

The E. coli bacteria pollution to this segment is primarily originating from nonpoint sources in the watershed. Unpermitted animal feeding operations (AFOs) and livestock grazing and watering in proximity to the Souris River are common along the TMDL listed reach.

This area of North Dakota typically experiences short duration but intense precipitation during the spring and early summer months. These storms can cause overland flooding and rising river levels. Due to the close proximity of livestock grazing and watering to the river (grassland areas on the land use map, Figure 5), it is likely that they contribute to the E. coli bacteria pollution in this listed segment of the Souris River.

These assessments are supported by the load duration curve analysis (Section 5.3) which shows exceedences of the E. coli bacteria standard occurring during wet, moist, and low conditions.

Wildlife may also contribute to the E. coli bacteria found in the water quality samples, but most likely in a lower concentration. Wildlife are nomadic with fewer numbers concentrated in a specific area, thus decreasing the probability of their contribution of fecal coliform bacteria 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 in this watershed is unknown, it is estimated that 28 percent of the systems in North Dakota are failing (USEPA, 2002).

5.0 TECHNICAL ANALYSIS

In TMDL development, the goal is to define the linkage between the water quality target and the identified source or sources of the pollutant (i.e. E. coli bacteria) to determine the load reduction needed to meet the TMDL target. To establish 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. E. coli bacteria) a waterbody can receive and still meet and maintain water quality standards and beneficial uses. The following technical analysis addresses the E. coli bacteria reductions necessary to achieve the water quality standards target for E. coli bacteria of 126 CFU/100 mL with a margin of safety.

5.1 Mean Daily Stream Flow

In north-central North Dakota, rain events are variable, generally occurring during the months of April through August. 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 (wet and moist conditions as depicted in Figure 10 below) 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 for the TMDL list reach were obtained for the USGS gauging station 05120000 from the USGS Water Science Center website.

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 10). 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 10, a flow duration interval of 20 percent associated with a stream flow of 368 cfs, implies that 20 percent of all observed mean daily discharge values (flows) equal or exceed 368 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 regimes, provide additional insight about conditions and patterns associated with the impairment (USEPA, 2007). The flow duration curve (Figure 10) derived from data from the USGS gauging station was divided into four flow regimes, one representing high flows (0-13 percent), one for wet conditions (13-36 percent), one for moist conditions (36-61 percent), and one for low flows (61-100 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. A secondary factor in determining the flow intervals used in the analysis is the number of E. coli bacteria observations available for each flow interval.

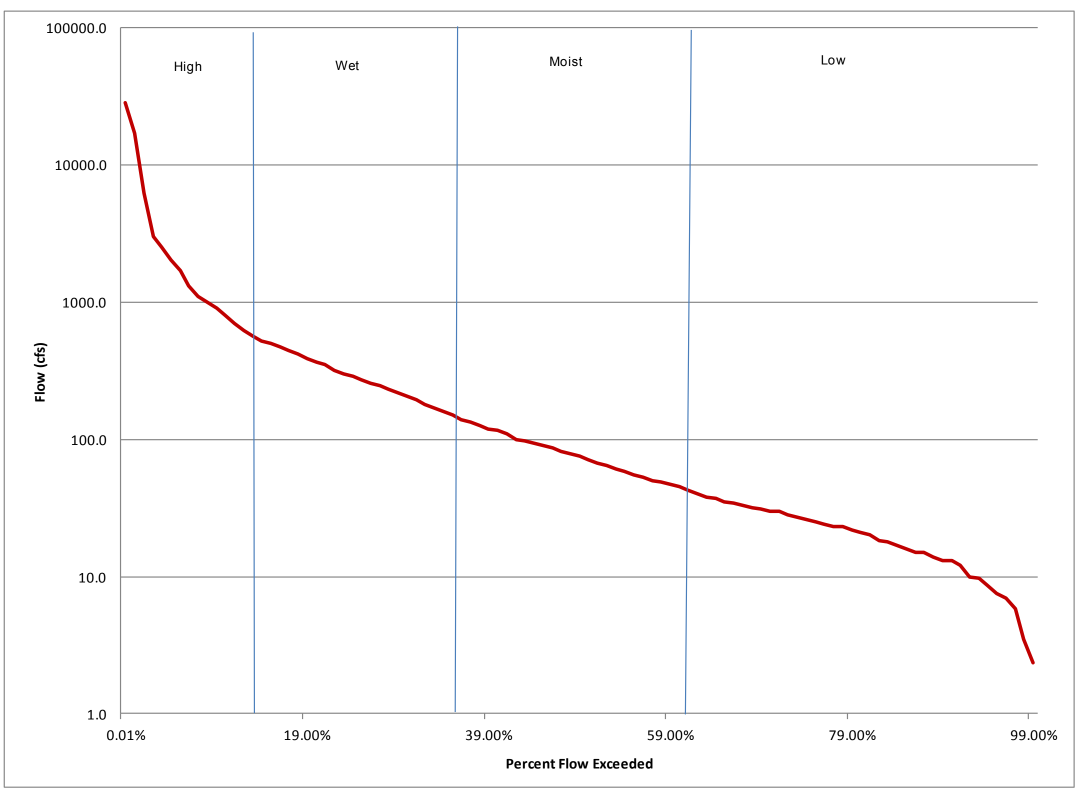

Figure 10. Flow Duration Curve for Souris River USGS Gauging Site 05122000, Based on Data Collected from 1993 – 2013.

5.3 E. coli Bacteria Load Duration Curve 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 303(d) TMDL listed segment, a load duration curve was developed for this impaired reach of the Souris River. The load duration curve was derived using the E. coli bacteria TMDL target of 126 CFU/100mL and flows generated as described in Sections 5.1 and 5.2.

Observed in-stream E. coli bacteria concentrations from monitoring sites 380018 and 380094 (Appendix B) were converted to a pollutant load by multiplying E. coli bacteria concentrations by the mean daily flow and a conversion factor. These loads are plotted against the percent exceeded of the flow on the day of sample collection (Figures 11 and 12). Points plotted above the 126 CFU/100 mL target curve exceed TMDL target. Points plotted below the curve are meeting the target of 126 CFU/100 mL. As there are two sampling sites located within the TMDL reach, the most impaired site (contributing greatest load), 380018, was chosen to represent this segment for the TMDL, while data from site 380094 is provided for informational purposes. In between the two sites is a large hay irrigation project that is flooded each year in the spring with water from the river. Site 380018 is before the hay irrigation project and has more exceedences during the wet flow regime. It is possible that the hay meadow acts as a filter for the E. coli bacteria before it reaches site 380094 downstream. Should an implementation project be initiated, target reductions based upon the most impaired portion will assure the entire reach meets water quality standards.

For each flow interval or regime with more than one data point above the above the load duration curve (i.e., high and low), a regression relationship was developed between the samples which occur above the TMDL target (126 CFU/100 mL) curve and the corresponding percent exceeded flow. The load duration curve for sites 380018 and 380094 depicting regression relationships for each flow interval are provided in Figures 11and 12. The regression lines for the wet and moist flow regimes for site 380018 and for the moist and low flow regimes for site 380094 were then used with the midpoint of the percent exceeded flow for each interval to calculate the existing E. coli bacteria load for that flow interval. Using Figure 11 as an example, the regression relationship between observed E. coli bacteria loading and percent exceeded flow for the flow interval is:

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

Where the midpoint of the wet condition interval from 13 to 36 percent is 24.5 percent, the existing E. coli bacteria load is:

E. coli bacteria load (10^7 CFUs/day) = antilog (4.8575 + (3.36136*0.245))
= 479,957 x 10^7 CFUs/day

Where the midpoint of the moist condition interval from 36 to 61 percent is 48.5 percent, the existing E. coli bacteria load is:

E. coli bacteria load (10^7 CFUs/day) = antilog (8.7280 + (-7.6830*0.485))
= 100,421 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 example, the TMDL target load for the midpoint of the wet flow, or 24.5 percent exceeded flow, derived from the 126 CFU/100 mL TMDL target curve is 86,943 x 10^7 CFUs/day, while the TMDL target load for moist conditions, derived from the midpoint of the moist flow interval, is 23,432 x 10^7 CFUs/day.

As there were no E. coli samples above the load duration curve for the high or low flow regimes, thus meeting standards, no existing load was calculated.

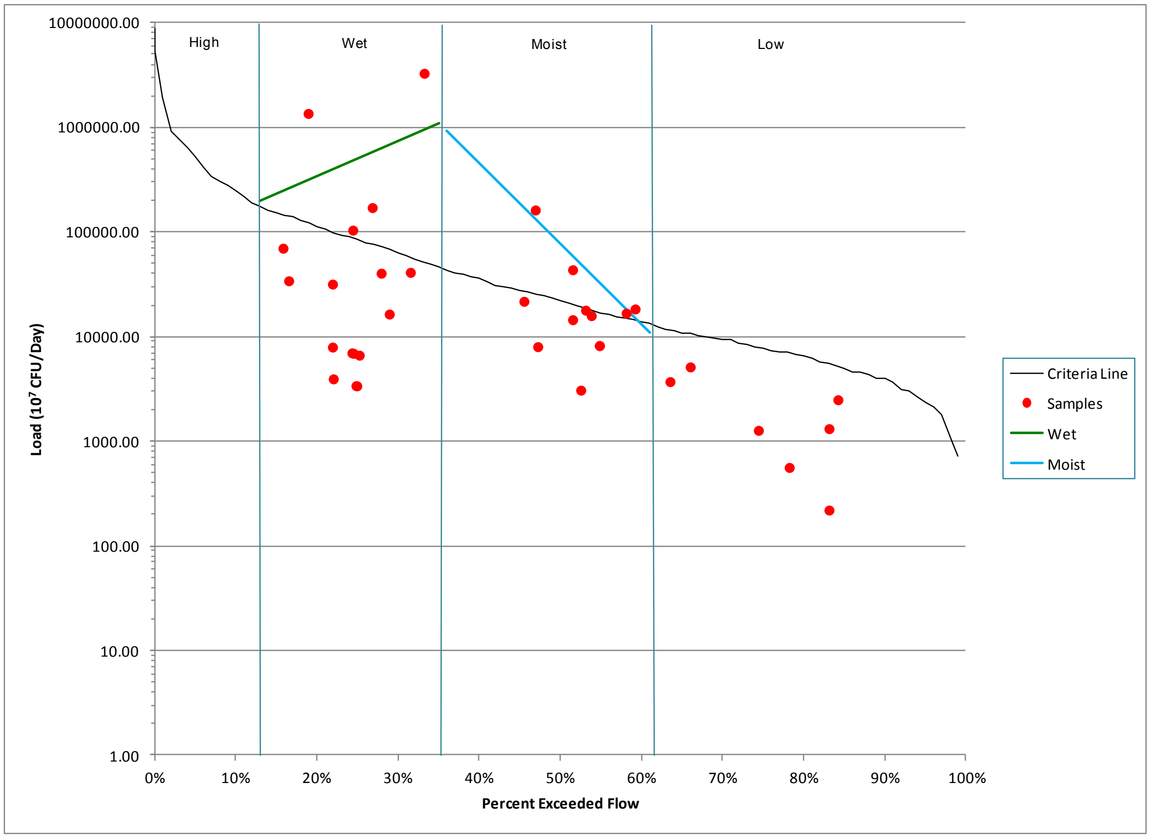

Figure 11. E. coli Bacteria Load Duration Curve with Regression Lines for Souris River Site 380018.

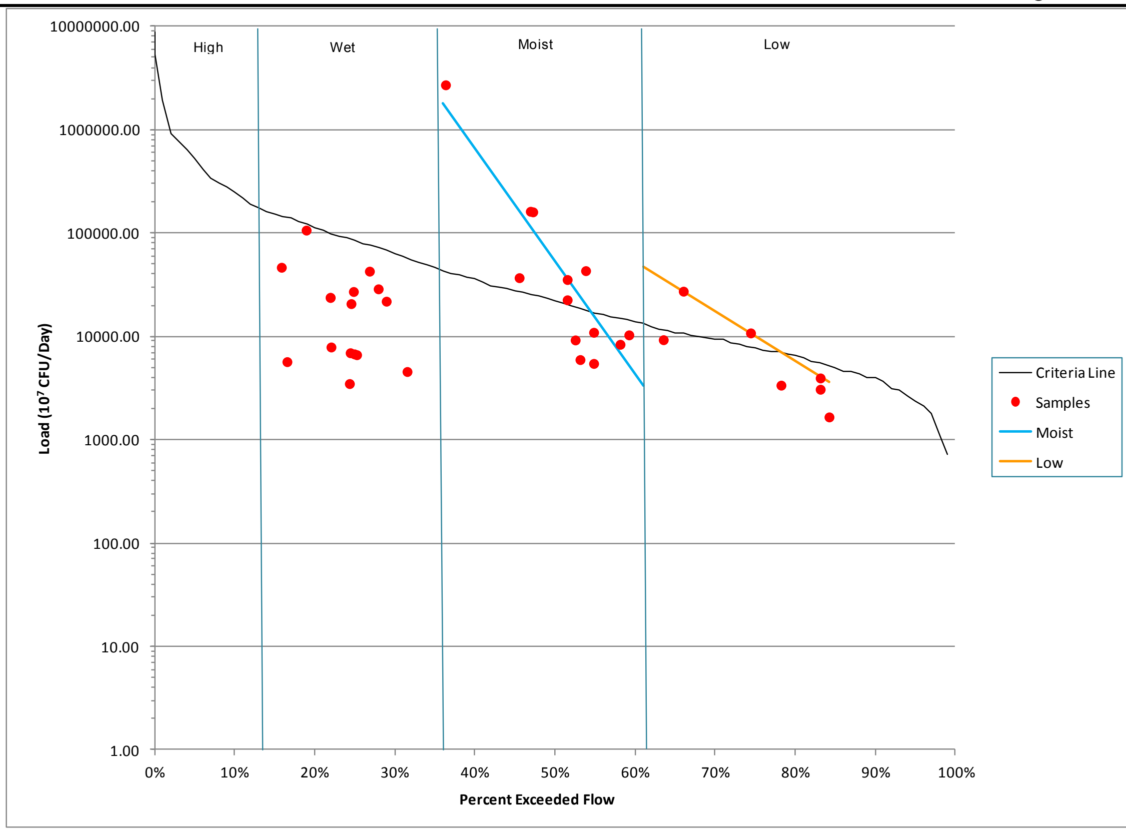

Figure 12. E. coli Bacteria Load Duration Curve with Regression Lines for Souris River Site 380094.

5.4 Wasteload Allocation Analysis

There is one town, Towner, ND, located within the watershed of this impaired reach of the Souris River. It contains a wastewater treatment system permitted through the NDPDES Program administered by the NDDoH. This system is located upstream of site 380018, so a wasteload allocation was computed for this TMDL. According to the permit, the Towner facility is allowed to discharge on an "as needed basis". The Discharge Monitoring Report (DMR) indicates this system discharges from one cell once a year. Based on the DMR data (Appendix C), this system discharges an average of 15.07 million gallons of treated wastewater over an average of 14.75 days. This is equal to 1.02 million gallons per day (1.55 cfs). E. coli data shows that there have been no exceedences in the State E. coli water quality standard, so the system is assigned the water quality standards value of 126 CFU/100 mL for this TMDL.

The wasteload allocation for Towner was determined by taking the average daily discharge and multiplying it by the assumed E. coli bacteria maximum concentration of 126 CFU/100 mL, times appropriate conversion factors.

WLA = 1.02 million gallons/day * 126 CFU/100 mL

= 1.02 million gallons/day * 3.7854 L/gal * 1,000 mL/L * 126 CFU/100 mL

= 486.5 x 10^7 CFU/day

5.5 Loading Sources

The load reduction needed for this listed segment of the Souris River E. coli bacteria TMDL can primarily be allotted to nonpoint sources, with the one point source mentioned in Section 5.4 given a small portion of the allocation. Based on the data available, the general focus of BMPs and load reductions for the listed segment should be on unpermitted animal feeding operations, range/pastureland, and riparian areas that are greatly disturbed. Higher priority should be given to the animal feeding areas rated higher or located in close proximity to the Souris River.

Significant sources of E. coli bacteria loading were defined as nonpoint source pollution originating from livestock. One of the more important concerns regarding nonpoint sources is variability in stream flows. Variable stream flows often cause different source areas and loading mechanisms to dominate (Cleland, 2003). As previously described, four flow regimes (i.e. High, Moist, Dry and Low) were selected to represent the hydrology of the listed segment for the purposes of this TMDL. Two flow regimes (i.e Wet and Moist) were used in conjunction with water quality data for site 380018 because samples indicated exceedences of the E. coli water quality standard (contributing to the greatest load of the two sample sites) during these flows.

By relating runoff characteristics to each flow regime one can infer which sources are most likely to contribute to coliform bacteria loading. Animals grazing in the riparian area contribute 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 (moist and dry flow regimes) and low flows (Table 9). In contrast, intensive grazing of livestock in the upland and not in the riparian area has a high potential to impact water quality at high flows and medium impact at moderate flows. Exclusion of livestock from the riparian area eliminates the potential of direct manure deposit and therefore is considered to be of high importance at all flows. However, intensive grazing in the upland creates the potential for manure accumulation and availability for runoff at high flows and a high potential for coliform bacteria contamination.

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

Nonpoint Sources	Flows		
	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)			

6.0 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 126 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 126 CFU/100 mL standard and the curve using the 113 CFU/100 mL.

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 Souris River TMDL addresses seasonality because the flow duration curve was developed using 20 years of USGS gauge data encompassing 12 months of the year. Additionally, the water quality standard is seasonally based on the recreation season of May 1 through September 30 and controls will be designed to reduce E. coli bacteria loads during the seasons covered by the standard.

7.0 TMDL

Table 10 provides an outline of the critical elements of the Souris River E. coli bacteria TMDL. The TMDL for the Souris River impaired segment (ND-09010003-005-S_00) is summarized in Table 11. The TMDL for each segment and flow regime provide an estimate of the existing daily load, and estimate of the average daily loads necessary to meet the water quality target (i.e. TMDL). This table provides an estimate of the existing daily loads and an estimate of the average daily loads necessary to meet the water quality target (i.e. TMDL load). This TMDL includes a load allocation for nonpoint sources, a wasteload allocation for a point source, and a ten 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.

While there were no exceedences of the 126 CFU/100 mL E. coli bacteria standard at site 380018 for the high or low flow regimes, a TMDL load has been provided for these flow regimes based on the criteria line for those flows as a guide to future watershed management. Based on available data, it can be assumed that this segment of the Souris River is currently meeting the water quality standard for these flow regimes.

Table 10. TMDL Summary for the Souris River Impaired Reach ND-09010003-005-S_00.

Category	Description	Explanation
Beneficial Use Impaired	Recreation	Contact Recreation (i.e. swimming, fishing)
Pollutant	E. coli Bacteria	See Section 2.1
E. coli TMDL Target	126 CFU/100 mL	Based on North Dakota water quality standards
WLA	Towner Wastewater Treatment Lagoon	This permitted point source discharges on "as needed" basis
LA	Nonpoint Source Contributions	Loads are a result of nonpoint sources (i.e., rangeland, pasture land, etc.)
Margin of Safety (MOS)	Explicit	10 percent

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. E. coli Bacteria TMDL (10^7 CFU/day) for Souris River ND-09010003-005-S_00.

	Loads Expressed as Average 10^7 CFU/day			
	High Flow	**Wet Flow**	**Moist Flow**	**Low Flow**
Existing Load		479,957	100,421	
TMDL	374,966[a]	86,943	23,432	5,901[a]
WLA	No Reduction Necessary	487	487	No Reduction Necessary
LA		77,762	20,602	
MOS		8,694	2,343	

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

8.0 ALLOCATION

The one point source in the watershed is given a small wasteload allocation based on its historic and future projected discharges and State water quality standards. The remaining E. coli bacteria load allocation for this TMDL is given to nonpoint sources in the watershed. 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, it will require significant reductions in the nonpoint source load. This will require the wide spread support and voluntary participation of landowners and residents in the watershed. The TMDL described in this report is 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 this listed segment of the Souris River and its associated watershed to restore and maintain recreational uses. Water quality monitoring should continue in order to measure BMP effectiveness and determine, through adaptive management, if loading allocations recommendations need to 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 E. coli bacteria loading to the Souris River. The following describe in detail those BMPs that will reduce E. coli bacteria levels in the Souris River.

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

Management Practice	Flow Regime and Expected Reduction		
	High Flow/ 70% Reduction	Moderate Flow/ 80% Reduction	Low Flow/ 74% Reduction
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 and erosion from poorly managed grazing land and riparian areas can be a significant source of E. coli bacteria loading to surface water. Precipitation, plant cover, number of animals, and soils are factors that affect the amount of bacteria delivered to a waterbody as a result of livestock. The following specific BMPs are known to reduce NPS pollution from livestock.

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

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

Prescribed grazing – This practice 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. (1988), as presented by USEPA, (1993), the effects of four grazing strategies on bacteria levels in thirteen watersheds in Oregon were studied during the summer of 1984. Results of the study 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 (Table 13).

Waste management system - Waste management systems can be effective in controlling up to 90 percent of bacteria loading originating from confined animal feeding areas (Table 14). A waste management system is made up of various components designed to control NPS pollution from concentrated animal feeding operations (CAFOs) and animal feeding operations (AFOs). Diverting clean water around the feeding area and containing dirty water from the feeding area in a pond are typical practices of a waste management system. Manure handling and application procedures are also integral to the waste management system. The application of manure is designed to be adaptive to environmental, soil, and plant conditions to minimize the probability of contamination of surface water.

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

Grazing Strategy		Geometric Mean CFU
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

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

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

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

8.2 Other Recommendations

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

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

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

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

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

9.0 PUBLIC PARTICIPATION

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

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

In addition to notifying specific agencies of this draft TMDL report's availability, the report was posted on the North Dakota Department of Health, Division of Water Quality web site at: http://www.ndhealth.gov/WQ/SW/Z2_TMDL/TMDLs_Under_PublicComment/B_Under_Public

_Comment.htm . A 30 day public notice soliciting comment and participation was also published in the Mouse River Journal (Towner, ND).

In response to the NDDoH's request for comments, the Natural Resources Conservation Service (NRCS) (State Office) sent a letter dated September 10, 2013. In this letter the NRCS stated that they had no comments on the TMDL report "at this time", but "does welcome the chance to comment on the alternatives." Comments were also received from US EPA Region 8, which were provided as part of their normal public notice review (Appendix E). The NDDoH's response to US EPA Region 8's comments are provided in Appendix F.

10.0 MONITORING

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

To ensure that the BMPs that are implemented and the technical assistance that is provided as a part of any watershed restoration program are successful in reducing E. coli bacteria loadings to levels prescribed in this TMDL, water quality monitoring will be conducted in accordance with an approved Quality Assurance Project Plan (QAPP).

Specifically, monitoring will be conducted for all variables that are currently causing impairments to the beneficial uses of the waterbody. This includes, but is not limited to E. coli bacteria. Once a watershed restoration plan (e.g. Section 319 Non point Source Project Implementation Plan [PIP]) is implemented, monitoring will be conducted in the watershed beginning two years after implementation and extending five years after the implementation project is complete.

11.0 TMDL IMPLEMENTATION STRATEGY

Implementation of TMDLs is dependent upon the availability of Section 319 NPS funds or other watershed restoration programs (e.g. USDA Environmental Quality Incentive Program), as well as securing a local project sponsor and required matching funds. Provided these three requirements are in place, a project implementation plan (PIP) is developed in accordance with the TMDL and submitted to the ND Nonpoint Source Pollution Task Force and US EPA for approval. The implementation of the BMPs contained in the NPS PIP is voluntary. Therefore, success of any TMDL implementation project is ultimately dependant on the ability of the local project sponsor to find cooperating producers.

Monitoring is an important and required component of any PIP. As a part of the PIP, data are collected to monitor and track the effects of BMP implementation as well as to judge overall project success. Quality Assurance Project Plans (QAPPs) detail the strategy of how, when, and where monitoring will be conducted to gather the data needed to document the TMDL implementation goal(s). As data are gathered and analyzed, watershed restoration tasks are adapted to place BMPs where they will have the greatest benefit to water quality.

Also, as a part of any implementation plan for this TMDL, it is recommended that permitted point sources (i.e. CAFOs, AFOs, and NDPDES permit holders) in the watershed be inspected to ensure that they are being operated in compliance with their permit conditions, and to verify that they are not a significant E. coli bacteria source. Currently, it is the policy of the NDDoH that all permitted CAFOs (greater than or equal to 1000 animal units) be inspected annually. Permitted AFOs (<1000 animal units) in the Souris River watershed are inspected on an as needed basis.

Included in the implementation strategy for this TMDL, the city of Towner WWTF will continue to monitor effluent limits for E. coli bacteria to assure continued compliance with State water quality standards.

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Appendix A
Map of Entire Souris River Watershed


Map of the Souris River Drainage Basin
INTERNATIONAL JOINT COMMISSION • COMMISSION MIXTE INTERNATIONALE
1909
North
0 5 10 15 20
Miles
0 10 20 30 40
Kilometres
Legend
Souris River Basin
Indian / Native Reserve
Provincial Park
US Fish and Wildlife
Gauging Stations
City
Town, Village
Highway
River
Lake or Reservoir
Datum: NAD 1983
Projection: Lambert Conformal Conic
Latitude of Origin: 49°
Central Meridian: -104°
Standard Parallel 1: 49°
Standard Parallel 2: 77°
Date: September 2007
Contact: M.R. Gilchrist, 306-780-6411
Environment Canada
SASKATCHEWAN
MANITOBA
MONTANA
NORTH DAKOTA
Regina
Weyburn
Estevan
Brandon
Minot
Bottineau
Rugby
Williston
Moose Mountain Provincial Park
Turtle Mountain Provincial Park
Spruce Woods Provincial Park
Riding Mountain National Park
Des Lacs NWR
Upper Souris NWR
J. Clark Salyer NWR
Lostwood NWR
FORT PECK INDIAN RESERVATION
FORT BERTHOLD INDIAN RESERVATION
SPIRIT LAKE INDIAN RESERVATION
TURTLE MOUNTAIN INDIAN RESERVATION
Saskatchewan
Manitoba
Canada
U.S.A.
Montana
North Dakota

Appendix B
E. coli Bacteria Data
For STORET Sites 380018 and 380094

E. coli Bacteria Data

STORET_NUM	DATE_COLL	TIME_COLL	Parameter	Result	Number for Data Analysis
380018	01-May-12	13:30	E. coli bacteria	*NON-DETECT	5
380018	02-May-12	08:09	E. coli bacteria	150	150
380018	07-May-12	08:45	E. coli bacteria	10.	10
380018	08-May-12	09:30	E. coli bacteria	*NON-DETECT	5
380018	15-May-12	08:41	E. coli bacteria	10.	10
380018	16-May-12	08:36	E. coli bacteria	10.	10
380018	22-May-12	08:29	E. coli bacteria	30.	30
380018	23-May-12	08:05	E. coli bacteria	60.	60
380018	29-May-12	14:31	E. coli bacteria	*NON-DETECT	5
380018	30-May-12	12:45	E. coli bacteria	10.	10
380018	04-Jun-12	12:45	E. coli bacteria	30.	30
380018	05-Jun-12	08:10	E. coli bacteria	70.	70
380018	12-Jun-12	07:46	E. coli bacteria	1400	1400
380018	19-Jun-12	07:08	E. coli bacteria	40.	40
380018	27-Jun-12	19:03	E. coli bacteria	280	280
380018	09-Jul-12	12:51	E. coli bacteria	90.	90
380018	10-Jul-12	07:45	E. coli bacteria	Too Numerous to Count	8000
380018	16-Jul-12	14:45	E. coli bacteria	100	100
380018	17-Jul-12	07:46	E. coli bacteria	200	800
380018	18-Jul-12	09:12	E. coli bacteria	40.	40
380018	24-Jul-12	07:46	E. coli bacteria	90.	90
380018	25-Jul-12	07:50	E. coli bacteria	270	270
380018	30-Jul-12	16:18	E. coli bacteria	20.	20
380018	01-Aug-12	13:30	E. coli bacteria	120	120
380018	06-Aug-12	10:06	E. coli bacteria	60.	60
380018	08-Aug-12	10:40	E. coli bacteria	110	110
380018	14-Aug-12	08:44	E. coli bacteria	60.	60
380018	20-Aug-12	08:01	E. coli bacteria	140	140
380018	22-Aug-12	13:07	E. coli bacteria	160	160
380018	28-Aug-12	13:47	E. coli bacteria	40.	40
380018	29-Aug-12	14:04	E. coli bacteria	60.	60
380018	05-Sep-12	07:44	E. coli bacteria	20.	20
380018	10-Sep-12	16:02	E. coli bacteria	10.	10
380018	18-Sep-12	08:12	E. coli bacteria	*NON-DETECT	5
380018	24-Sep-12	08:10	E. coli bacteria	30.	30
380018	26-Sep-12	07:38	E. coli bacteria	60.	60

STORET_NUM	DATE_COLL	TIME_COLL	Parameter	Result	Number for Data Analysis
380094	01-May-12	13:03	E. coli bacteria	40.	40
380094	02-May-12	07:43	E. coli bacteria	10.	10
380094	07-May-12	08:17	E. coli bacteria	*NON-DETECT	5
380094	08-May-12	09:11	E. coli bacteria	10.	10
380094	15-May-12	08:13	E. coli bacteria	30.	30
380094	16-May-12	07:56	E. coli bacteria	30.	30
380094	22-May-12	07:44	E. coli bacteria	*NON-DETECT	5
380094	23-May-12	07:21	E. coli bacteria	40.	40
380094	29-May-12	14:15	E. coli bacteria	10.	10
380094	30-May-12	12:09	E. coli bacteria	10.	10
380094	04-Jun-12	07:04	E. coli bacteria	40.	40
380094	05-Jun-12	07:03	E. coli bacteria	50.	50
380094	12-Jun-12	07:12	E. coli bacteria	110	110
380094	19-Jun-12	11:35	E. coli bacteria	30.	30
380094	27-Jun-12	19:52	E. coli bacteria	70.	70
380094	09-Jul-12	13:20	E. coli bacteria	10.	10
380094	10-Jul-12	07:21	E. coli bacteria	Too numerous to count	8000
380094	16-Jul-12	14:24	E. coli bacteria	170	170
380094	17-Jul-12	07:08	E. coli bacteria	300	800
380094	18-Jul-12	07:08	E. coli bacteria	300	800
380094	24-Jul-12	07:01	E. coli bacteria	140	140
380094	25-Jul-12	07:08	E. coli bacteria	220	220
380094	30-Jul-12	15:56	E. coli bacteria	60.	60
380094	01-Aug-12	07:40	E. coli bacteria	40.	40
380094	06-Aug-12	10:32	E. coli bacteria	40.	40
380094	08-Aug-12	10:17	E. coli bacteria	300	300
380094	14-Aug-12	08:08	E. coli bacteria	80.	80
380094	20-Aug-12	07:21	E. coli bacteria	70.	70
380094	22-Aug-12	12:40	E. coli bacteria	90.	90
380094	28-Aug-12	14:12	E. coli bacteria	100	100
380094	29-Aug-12	13:43	E. coli bacteria	320	320
380094	05-Sep-12	07:12	E. coli bacteria	170	170
380094	10-Sep-12	15:38	E. coli bacteria	60.	60
380094	18-Sep-12	07:47	E. coli bacteria	70.	70
380094	24-Sep-12	07:38	E. coli bacteria	90.	90
380094	26-Sep-12	07:05	E. coli bacteria	40.	40

Appendix C
Discharge Monitoring Report (DMR) for Towner Wastewater Treatment System

DMR Discharge and E. coli Data for Towner Wastewater Lagoon

Date Printed: 5/24/2013

ND Dept of Health Water Quality NDPDES DMR Data Report

Discharge Start >= '10/1/2008' AND Discharge End <= '3/31/2013'

Environmental Interest: Towner City Of Permit: NDG121822
Discharge Point: 001 A Parameter: Drain/Month

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	5/29/2009	6/11/2009	Cell 4	14						9.27	MGAL	0		Monthly/Calculated
Effluent	5/29/2009	6/11/2009	Cell 3	14						5.35	MGAL	0		Monthly/Calculated
Effluent	5/28/2010	6/11/2010	Cell 4	15						13.91	MGAL	0		Monthly/Calculated
Effluent	5/28/2010	6/11/2010	Cell 3	15						5.35	MGAL	0		Monthly/Calculated
Effluent	8/30/2011	9/13/2011	Cell 4	15						18.55	MGAL	0		Monthly/Calculated
Effluent	8/30/2011	9/13/2011	Cell 3	15						8.03	MGAL	0		Monthly/Calculated
Effluent	6/1/2012	6/15/2012	Cell 3	15						8.03	MGAL	0		Monthly/Calculated
Effluent	6/1/2012	6/15/2012	Cell 4	15						18.55	MGAL	0		Monthly/Calculated

Date Printed: 5/24/2013

ND Dept of Health Water Quality NDPDES DMR Data Report

Discharge Start >= '10/1/2008' AND Discharge End <= '3/31/2013'

Environmental Interest: Towner City Of Permit: NDG121822
Discharge Point: 001 A Parameter: E Coli Geo Mean

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	5/29/2009	6/11/2009	Cell 4	14								0	8	/
Effluent	5/29/2009	6/11/2009	Cell 3	14								0	8	/
Effluent	5/28/2010	6/11/2010	Cell 3	15								0	9	/
Effluent	5/28/2010	6/11/2010	Cell 4	15								0	9	/
Effluent	8/30/2011	9/13/2011	Cell 3	15				Num/100 mL				0		Weekly/Grab
Effluent	8/30/2011	9/13/2011	Cell 4	15				Num/100 mL				0		Weekly/Grab
Effluent	6/1/2012	6/15/2012	Cell 3	15	10	10	10	Num/100 mL				0		Weekly/Grab
Effluent	6/1/2012	6/15/2012	Cell 4	15	10	10	10	Num/100 mL				0		Weekly/Grab

Date Printed: 5/24/2013

ND Dept of Health Water Quality NDPDES DMR Data Report

Discharge Start >= '10/1/2008' AND Discharge End <= '3/31/2013'

Environmental Interest: Towner City Of Permit: NDG121822
Discharge Point: 001 A Parameter: Fecal Geo Mean

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	5/29/2009	6/11/2009	Cell 3	14	10	10	10	Num/100 ml				0		Weekly/Grab
Effluent	5/29/2009	6/11/2009	Cell 4	14	10	10	10	Num/100 ml				0		Weekly/Grab
Effluent	5/28/2010	6/11/2010	Cell 4	15	10	105	200	Num/100 ml				0		Weekly/Grab
Effluent	5/28/2010	6/11/2010	Cell 3	15	10	10	10	Num/100 ml				0		Weekly/Grab
Effluent	8/30/2011	9/13/2011	Cell 3	15	10	10	10	Num/100 ml				0		Weekly/Grab
Effluent	8/30/2011	9/13/2011	Cell 4	15	10	10	10	Num/100 ml				0		Weekly/Grab
Effluent	6/1/2012	6/15/2012	Cell 3	15								0	E	/
Effluent	6/1/2012	6/15/2012	Cell 4	15								0	E	/

10 Num/100 mL is the minimum detection limit for both E. coli and Fecal Coliform. Values less than the detection limit are reported as 10 Num/100 mL.

Appendix D
Estimated Loads and TMDL Targets from Load Duration Curve Spreadsheet

Existing and TMDL Load Results for Sampling Sites 380018 and 380094

STORET 380018, Towner, ND

	Load (Million CFU/Day)				Load (Million CFU/Period)		
	Median Percentile	Existing	TMDL	Days	Existing	TMDL	Percent Reduction
Wet	24.51%	479956.97	86943.21	83.91	40274869.28	7295708.90	81.89%
Moist	48.50%	100421.00	23431.50	91.25	9163416.26	2138124.64	76.67%
			Total	175	49438286	9433834	80.92%

STORET 380094, Bantry, ND

	Load (Million CFU/Day)				Load (Million CFU/Period)		
	Median Percentile	Existing	TMDL	Days	Existing	TMDL	Percent Reduction
Moist	48.50%	77284.91	23431.50	91.25	7052248.00	2138124.64	69.68%
Low	72.60%	13199.76	8632.66	84.68	1117755.43	731013.56	34.60%
			Total	176	8170003	2869138	64.88%

Appendix E
EPA Region 8 TMDL Review Form and Decision Document

EPA REGION 8 TMDL REVIEW FORM AND DECISION DOCUMENT

TMDL Document Info:

Document Name:	**E. coli Bacteria TMDL for the Souris River in McHenry County, North Dakota**
Submitted by:	**Mike Ell, North Dakota Department of Health**
Date Received:	**September 6, 2013**
Review Date:	**December 2, 2013**
Reviewer:	**Vern Berry, US Environmental Protection Agency**
Rough Draft / Public Notice / Final Draft?	**Public Notice**
Notes:	

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

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

Approval Notes to the Administrator:

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

1. Problem Description
    1.1. TMDL Document Submittal
    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 review elements relative to that section, a brief summary of the EPA reviewer's findings, and the reviewer's comments and/or suggestions. Use of the verb "must" in this review form denotes information that is required to be submitted because it relates to elements of the TMDL required by the CWA and by regulation. Use of the term "should" below denotes information that is generally necessary for EPA to determine if a submitted TMDL is approvable.

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

1. Problem Description

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

1.1 TMDL Document Submittal

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

Review Elements:

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

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

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

Summary: *The notification of the availability of the public notice draft TMDL document was submitted to EPA via a letter attached to an email received on September 6, 2013. The letter includes the details of the public notice, explains how to obtain a copy of the TMDL, and requests the submittal of comments to NDDoH by October 4, 2013.*

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.

Review Elements:

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

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

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

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

<u>Summary:</u>
Physical Setting and Listing History:
The Souris River TMDL document includes one impaired stream segment within the Lower Souris watershed (HUC 09010003) which is part of the larger Souris River basin in north-central North Dakota. The impaired segment drains a watershed area of approximately 152,593 acres and is located in McHenry County, North Dakota.

The impaired segment included in the TMDL document is: Souris River from its confluence with the Wintering River downstream to its confluence with Willow Creek (74.9 miles; ND-09010003-005-S_00).

The TMDL document addresses the recreational use impairments from fecal coliform and E. coli bacteria. The aquatic life impairment due to sedimentation / siltation will be addressed in a separate report. The complete impairment information is included in the table below.

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

Class IA – Souris River, Segment ND-09010003-005-S_00

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

***Impairment status**:*
The 2012 North Dakota 303(d) list identifies 2 stream segments within the Lower Souris watershed as impaired. The impairment information for the segment that is addressed by this TMDL document is as follows:

Stream Segment	Designated Use / Support Status	Impairment Cause	TMDL Priority
Souris River ND-09010003-005-S_00	*Recreation; Fully Supporting, but Threatened*	*Fecal coliform*	*Low*
	Fish and Other Aquatic Biota; Fully Supporting, but Threatened	*Sedimentation / Siltation*	*Low*

The 2012 303(d) list includes this segment of the Souris River as impaired due to fecal coliform bacteria based on the water quality standards and data available at the time it was originally listed. However, the North Dakota water quality standards for bacteria were changed to E. coli to reflect current information on human health illness risk. The data used to develop the TMDL for this impaired segment indicate that the segment is also impaired due to E. coli bacteria. The E. coli target used in this TMDL is consistent with the current bacteria water quality standards. NDDoH anticipates that meeting the E. coli target will result in restoration of the recreation beneficial use for this segment of the Souris River.

Comments: *None.*

1.3 Water Quality Standards

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

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

Review Elements:

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

☒ The purpose of a TMDL analysis is to determine the assimilative capacity of the waterbody that corresponds to the existing water quality standards for that waterbody, and to allocate that assimilative capacity between the identified sources. Therefore, <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 Souris River, Segment ND-09010003-005-S_00 is impaired based on E. coli bacteria concentrations impacting the recreational uses. Tables 5 and 6 in the TMDL document provide a summary of the data used to determine the current use impairment status. This segment is classified as fully supporting but threatened for recreational uses due to exceedences of the fecal coliform bacteria standard which was in effect at the time of the TMDL listing. The assessment of the E. coli data, collected during the 2012 recreation season, concludes that the segment is also impaired by E. coli bacteria.*

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

The Souris River segment included in the TMDL document is defined as a Class IA stream. The quality of waters in this class shall be suitable for the propagation or protection, or both, of resident fish species and other aquatic biota and for swimming, boating, and other water recreation. The quality of the waters shall be suitable for irrigation, stock watering, and wildlife without injurious effects. After treatment consisting of coagulation, settling filtration, and chlorination, or equivalent treatment processes, the water quality shall meet the bacteriological, physical, and chemical requirements of the Department for municipal or domestic use. Treatment for municipal use may also require softening to meet the drinking water requirements.

Numeric criteria for E. coli have been established for North Dakota Class IA streams and are presented in the excerpted Table 8 shown below. Discussion of additional applicable water quality standards for this stream segment can be found on pages 11 – 12 of the TMDL document.

Table 8. North Dakota E. coli Bacteria Standards for Class IA Streams.

Parameter	Standard	
	Geometric Mean[1]	Maximum[2]
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.

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, embeddedness, stream morphology, up-slope conditions and a measure of biota).

Review Elements:

☒ The TMDL should identify a numeric water quality target(s) for each waterbody pollutant combination. The TMDL target is a quantitative value used to measure whether or not the applicable water quality standard is attained. *Generally, the pollutant of concern and the numeric water quality target are, respectively, the chemical causing the impairment and the numeric criteria for that chemical (e.g., chromium) contained in the water quality standard. Occasionally, the pollutant of concern is different from the parameter that is the subject of the numeric water quality target (e.g., when the pollutant of concern is phosphorus and the numeric water quality target is expressed as a numerical dissolved oxygen criterion). In such cases, the TMDL should explain the linkage between the pollutant(s) of concern, and express the quantitative relationship between the TMDL target and pollutant of concern. In all cases, TMDL targets must represent the attainment of current water quality standards.*

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

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

Summary: *The water quality target for this TMDL is based on the numeric water quality standards for E. coli bacteria that have been established to protect the recreational beneficial uses for the impaired stream segment of the Souris River.*

Bacteria standards are expressed in coliform forming units (cfu) per 100 milliliters (mL) of the water sample. The E. coli target for the impaired segment is: 126 cfu/100 mL during the recreation season from May 1 to September 30. While the standards are intended to be expressed as the 30-day geometric mean, the TMDL target for the stream segment 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 identified source (or source category) when the relative load contribution from each source has been estimated. Therefore, the pollutant load from each identified source (or source category) should be specified and quantified. This may be accomplished using site-specific monitoring data, modeling, or application of other assessment techniques. If insufficient time or resources are available to accomplish this step, a phased/adaptive management approach may be appropriate. The approach should be clearly defined in the document.

Review Elements:

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

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

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

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

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

Summary: *The TMDL document includes the landuse breakdown for the watershed based on the 2011 National Agricultural Statistics Service (NASS) data. In 2011, the dominant land use in the drainage area of the Souris River segment was agriculture. Approximately 52 percent of the landuse in the watershed was pasture / grassland / hayland, 35 percent was cropland and the remaining 13 percent was either developed space, barren, water or woods. The majority of the crops grown consisted of wheat, soybeans and corn.*

Section 4.0, Significant Sources, beginning on page 13 of the TMDL document, provides the pollutant source analysis for the listed segment of the Souris River. There is one municipal point source within the drainage area of the Souris River segment. The community of Towner, ND *operates a wastewater treatment facility (WWTF) that collects domestic waste from the sewer system that is connected to homes and businesses in town. Any discharges from this facility are covered by a municipal wastewater permit issued by the North Dakota Pollutant Discharge Elimination System Program. The available bacteria effluent data is limited to a single discharge event in June 2012. Therefore, it's difficult to determine whether the discharge causes localized E. coli impacts downstream of the facility.*

There are two permitted medium (301–999 animal units) animal feeding operations (AFO) in the watershed. They are a significant distance from the river and are zero discharge facilities so not deemed significant point sources for this report.

The bacteria loading to this segment primarily originates from nonpoint sources in the watershed. Livestock production is the dominant agricultural practice in watershed. Livestock grazing and watering in proximity to the Souris River are common along the TMDL listed segment. This area of North Dakota typically experiences long duration or intense precipitation during the spring and early summer months. These storms can cause flash flooding and fast rising river levels. Due to the close proximity of livestock grazing and watering to the river, it is likely that the combination of landuse and precipitation patterns result in runoff that contributes E. coli bacteria to the listed segment of the Souris River.

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

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

Comments: 1) *The landuse percentages provided in the text (Section 1.3, page 5) don't match the percentages shown in Table 3 (48 vs. 35 percent cultivated; 37 vs. 52 percent hay/pasture/grass). Please check the numbers and revise as necessary.*

2) The point source discussion (Section 4.1, page 13) and the information in Table 7 seem to imply that there's enough effluent data from the Towner WWTF to draw conclusions about the affect of the loading on the stream impairment. The DMR data report in Appendix C seems to indicate that one grab sample was taken from two different cells during one discharge event in June 2012. Table 7 includes discharge data from September 2011that is identical to the June 2012 data. The September 2011 data is not included in Appendix C – was that added to Table 7 in error or is there data missing in Appendix C? Given the high average daily volume of effluent that is discharged from the facility during discharge events, the potential for localized in-stream impacts to the recreational use is high if the discharge concentration of bacteria is at or above the current criteria (depending on the upstream flow, upstream bacteria concentration and mixing conditions). Without a larger dataset of bacteria concentration being discharged from the facility, (e.g., data from several years of discharge that include multiple samples during each discharge event) and/or an adequate E. coli dataset collected at monitoring site 380018 during multiple discharge events, the actual impact to the stream, from this point source, cannot be stated with much confidence. Please check the existing data and revise Table 7 as needed and revise the statement in Section 4.1, about the potential impact from this source, to reflect the *need for more data (see the summary language above).*

It is worth noting that the highest E. coli result collected from site 380018 was taken during the period when the Towner WWTF was discharging in 2012. That may be a coincidence or it may be an indication that more data is needed from this source. We suggest coordinating with the NDPDES permits program to ensure that all future discharges are sampled for E. coli, so that a more complete compliance record can be established. We also suggest evaluating the feasibility of establishing an ambient sampling plan for E. coli data collection at site 380018, during periods when the Towner WWTF is discharging.

4. TMDL Technical Analysis

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

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

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

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

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

Where:

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

Review Elements:

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

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

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

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

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

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

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

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

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

Summary: *The technical analysis should describe the cause and effect relationship between the identified pollutant sources, the numeric targets, and achievement of water quality standards. It should also include a description of the analytical processes used, results from water quality modeling, assumptions and other pertinent information. Section 5.0, Technical Analysis, beginning on page 14 of the TMDL document, describes how the E. coli loads and loading capacity was derived in order to meet the applicable water quality standards for the impaired stream segment of the Souris River. The loads and loading capacity was derived using the load duration curve (LDC) approach. To correlate the relationship between the pollutant of concern, the water quality targets and the hydrology, a LDC was developed for the listed stream segment.*

Streamflow data is available for one location on the listed segment. The USGS gauging station 05122000, collocated with NDDoH's water quality sampling station 380094, is located on the Souris River, within the J Clark Salyer National Wildlife Refuge, east of Bantry, ND.

A LDC was derived for the listed segment using the USGS streamflow data from 1993-2013, the E. coli TMDL target and the observed bacteria data collected from monitoring site 380094. A second LDC was derived using data collected at an upstream monitoring site 380018 located north of Towner, ND (see Figure 8 of the TMDL document for a map of the monitoring site locations). The downstream LDC was chosen to represent the TMDL for this stream segment and the upstream LDC will be used to help guide implementation actions in the upper portion of the listed segment.

The observed in-stream E. coli bacteria data, obtained from the monitoring stations, were converted to pollutant loads by multiplying the E. coli bacteria concentration value by the mean daily flow value and a conversion factor. These loads were plotted on the LDC based on the in-stream flow on the day of sample collection (see Figures 11 - 12 in the TMDL document). Points plotted above the 126 cfu/100 mL target curve exceeded the TMDL target. Points plotted below the curve were meeting the State water quality standard for E. coli of 126 cfu/100 mL.

The following steps were used to estimate the E. coli reductions that are needed to reach the TMDL target: 1) a linear regression line was drawn through the E. coli data points plotted above the TMDL curve, in each flow regime; 2) the midpoint of each flow regime was determined; 3) the loading capacity (i.e., TMDL load) was determined for each flow regime by finding the load on the LDC line, at the midpoint of the flow regime; 4) the existing load was determined for each flow regime by finding the load on the linear regression line, at the midpoint of the flow regime; 5) the difference between the value of the existing load and the value of the TMDL load is the amount of E. coli load that needs to be reduced in each flow regime. Often the load reduction amounts are converted to a percent reduction needed (i.e., the percent of the existing load that needs to be kept from reaching the stream). See Appendix D in the TMDL document for examples of these calculations. Load reduction calculations are not included for those flow regimes where there is no E. coli data or where the existing load is below the allowable load (i.e., no reduction is needed).

The LDCs represent flow-variable TMDL targets across the flow regimes shown in this TMDL document. The LDC is a dynamic expression of the allowable load for any given daily flow. The loading capacity for each flow regime is represented by the load value on the LDC at the midpoint of the flow regime. Table 11 in the TMDL document includes the E. coli loading capacity (i.e., TMDL load) values, which represent each flow regime of the LDC, for the listed segment of the Souris River.

Comments: *The Appendix D load reduction calculations for the LDC developed for monitoring site 380094 appear to be incomplete. Please revise the table to show the estimated bacteria load reduction needed for the moist flow regime.*

4.1 Data Set Description

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

Review Elements:

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

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

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

***Summary**: The TMDL data description and summary for the listed segment of the Souris River is included in the Available Data section (Section 1.5) and in the data tables in Appendix B. Recent water quality monitoring was conducted from May 2012 – September 2012 and included 36 E. coli samples collected from NDDoH monitoring station 380094 and 36 E. coli samples collected from NDDoH monitoring station 380018. The data set also includes the streamflow record from USGS gauging station 05122000. The flow data, the E. coli data and the TMDL target, was used to develop the E. coli load duration curve for the Souris River, Segment ND-09010003-005-S_00.*

***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.

Review Elements:

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

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

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

***Summary**: There is one municipal point source within the drainage area of the Souris River segment. The community of Towner, ND operates a wastewater treatment facility (WWTF) that collects domestic waste from the sewer system that is connected to homes and businesses in town. Any discharges from this facility are covered by a municipal wastewater permit issued by the North Dakota Pollutant Discharge Elimination System Program (permit number NDG121822). The permit issued to this WWTF allows discharges on an "as needed" basis, usually once a year, from two different wastewater lagoon cells. The available bacteria effluent data is limited to a single discharge event in June 2012. Therefore, it's difficult to determine whether the discharge causes localized E. coli impacts downstream of the facility.*

There are two permitted medium (301–999 animal units) animal feeding operations (AFO) in the watershed. They are a significant distance from the river and are zero discharge facilities so not deemed significant point sources for this report.

An E. coli WLA for the Towner WWTF was estimated using the available discharge data from the facility. Section 5.4, Wasteload Allocation Analysis, explains the calculations and assumptions that were used to derive the estimated load from this facility.

Comments: *Based on the information given in Section 5.4, and Appendix C of the TMDL document, each time there is a discharge from the Towner WWTF, wastewater is released from cell 3* ***and*** *cell 4 for approximately 2 weeks. Therefore, the event total volume discharged is the sum of cell 3 and cell 4 volumes for each discharge period provided in the first table of Appendix C. The sum of the event total volumes discharged, divided by the number of discharge events (i.e., four), equals the average volume discharged during each discharge event (i.e., 21.76 million gallons). Taking the total volume discharged during each discharge period and dividing by the number of days of discharge gives the volume discharged per day per event. Averaging the volume discharged per day per event, for all 4 discharge events, results in calculated average discharge rate of 1.468 million gallons per day. Using that rate, the E. coli permit limit of 126 cfu/100mL and the conversion factors, we calculate the WLA = 7.00E+09 cfu/day. That value is approximately double the value shown in Section 5.4, page 18 and in Table 11, page 21.*

It appears that the calculation in Section 5.4, for the average volume discharged per event, was derived by summing all the volumes shown in Table 1, Appendix A and dividing by the number of volumes given. However, the result of that calculation equals the average volume discharged per cell, not the average total volume discharged per event.

Our understanding of the operation of the Towner WWTF and the discharge records, as described by the calculations above, may be different than how it actually occurs. We recommend checking the information on how wastewater is discharged from this facility (i.e., is wastewater discharged from cell 3 straight to outfall 1, then when that cell is drained, wastewater is then discharged from cell 4 straight to outfall 1; OR perhaps they discharge from both cells concurrently; OR perhaps they discharge from cell 3 into cell 4, then from cell 4 to outfall 1, such that the total volume discharged each event is the cell 4 volume only). We also recommend checking the WLA calculations and revising the numbers, as needed, in Section 5.4 and Table 11. Note, that if the WLA value changes, the LAs in Table 11 will also need to be changed.

4.3 Load Allocations (LA):

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

Review Elements:

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

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

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

***<u>Summary</u>**: The TMDL document includes the landuse breakdown for the watershed based on the 2011 National Agricultural Statistics Service (NASS) data. In 2011, the dominant land use in the drainage area of the Souris River segment was agriculture. Approximately 52 percent of the landuse in the watershed was pasture / grassland / hayland, 35 percent was cropland and the remaining 13 percent was either developed space, barren, water or woods. The majority of the crops grown consisted of wheat, soybeans and corn.*

The bacteria loading to this segment primarily originates from nonpoint sources in the watershed. Livestock production is the dominant agricultural practice in watershed. Due to the close proximity of livestock grazing and watering to the river, it is likely that the combination of landuse and precipitation patterns result in runoff that contributes E. coli bacteria to the listed segment of the Souris River.

By relating runoff characteristics to each flow regime one can infer which sources are most likely to contribute to E. coli bacteria loading. Animals grazing in the riparian area contribute E. coli bacteria by depositing manure where it has an immediate impact on water quality. Due to the close proximity of manure to the stream or by direct deposition in the stream, riparian grazing impacts water quality at high flow or under moist and dry conditions. 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 impact at moderate flows. Exclusion of livestock from the riparian area eliminates the potential of direct manure deposit *and therefore is considered to be of high importance at all flows. However, intensive grazing in the upland creates the potential for manure accumulation and availability for runoff at high flows and a high potential for E. coli bacteria contamination.*

Source specific data are limited so aggregate LAs are assigned to nonpoint sources with a ranking of important contributors, under various flow regimes, as provided in the following excerpted table. Aggregate load allocations for the impaired segment of the Souris River are included in Table 11 of the TMDL document.

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

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

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

Comments: *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).

Review Elements:

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

☐ 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 Souris River TMDL document includes an explicit MOS for the listed segment. The MOS was derived by calculating 10 percent of the loading capacity for flow regime. The explicit MOS for the Souris River segment is included in Table 11 of the TMDL document.*

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.

Review Elements:

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

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

***Summary**: By using the load duration curve approach to develop the TMDL allocations, seasonal variability in E. coli loads were taken into account. The highest steam flows typically occur during late spring, and the lowest stream flows typically occur during the winter months. The TMDLs also consider seasonality because the E. coli criteria are in effect from May 1 to September 30, as defined by the recreation season in North Dakota.*

***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.

Review Elements:

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

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

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

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

***Comments**: 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.

Review Elements:

- ☐ When a TMDL involves both NPDES permitted point source(s) and nonpoint source(s) allocations, and attainment of the TMDL target depends on reductions in the nonpoint source loads, the TMDL document should include a monitoring plan that describes the additional data to be collected to determine if the load reductions provided for in the TMDL are occurring.
- ☐ Under certain circumstances, a phased TMDL approach may be utilized when limited existing data are relied upon to develop a TMDL, and the State believes that the use of additional data or data based on better analytical techniques would likely increase the accuracy of the TMDL load calculation and merit development of a second phase TMDL. EPA recommends that a phased TMDL document or its implementation plan include a monitoring plan and a scheduled timeframe for revision of the TMDL. These elements would not be an intrinsic part of the TMDL and would not be approved by EPA, but may be necessary to support a rationale for approving the TMDL. http://www.epa.gov/owow/tmdl/tmdl_clarification_letter.pdf

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

Summary: *Once a watershed restoration plan (e.g., 319 PIP) is implemented, monitoring will be conducted in the listed stream segment beginning two years after implementation and extending five years after the implementation project is complete. As a part of the PIP, data are collected to monitor and track the effects of BMP implementation as well as to judge overall project success. Quality Assurance Project Plans (QAPPs) detail the strategy of how, when, and where monitoring will be conducted to gather the data needed to document the TMDL implementation goal(s). As data are gathered and analyzed, watershed restoration tasks are adapted to place BMPs where they will have the greatest benefit to water quality.*

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.

Review Elements:

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

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

Summary: *Implementation of TMDLs is dependent upon the availability of Section 319 NPS funds or other watershed restoration programs, as well as securing a local project sponsor and the required matching funds. Provided these three requirements are in place, a project implementation plan (PIP) is developed in accordance with the TMDL and submitted to the North Dakota Nonpoint Source Pollution Task Force and EPA for approval. The implementation of the best management practices contained in the NPS PIP is voluntary. Therefore, success of any TMDL implementation project is ultimately dependent on the ability of the local project sponsor to find cooperating producers.*

Also, as a part of any implementation plan for this TMDL, it is recommended that permitted point sources (i.e. CAFOs, AFOs, and WWTFs with NDPDES permits) in the watershed be inspected to ensure that they are being operated in compliance with their permit conditions, and to verify that they are not a significant E. coli bacteria source. It is the current policy of the NDDoH that all permitted CAFOs (greater than or equal to 1000 animal units) be inspected annually. Permitted AFOs (<1000 animal units) in the Souris River watershed are inspected on an as needed basis.

Included in the implementation strategy for this TMDL, the city of Towner's NDPDES permit will be modified to include effluent limits and monitoring requirements for E. coli bacteria consistent with the waste load allocation provided for in this TMDL. This will be done when the permit comes up for renewal.

Comments: *We suggest reviewing the sentence about modifying Towner's NDPDES permit. We believe the Towner WWTF is covered by a general permit for municipal discharges which already requires E. coli monitoring and effluent limits. Rather than stating an implementation action that is already in place, it may be better to mention actions similar to our suggestion, in the Pollutant Source Analysis comments above, to gather additional effluent and/or ambient data to better characterize this source.*

8. Daily Loading Expression

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

Review Elements:

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

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

Summary: *The Souris River TMDL document includes daily loads expressed as colony forming units per day for the listed stream segment. The daily TMDL loads for the segment are included in TMDL section (Section 7.0) of the document.*

Comments: *None.*

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

US EPA Comment: 1) The land use percentages provided in the text (Section 1.3, page 5) don't match the percentages shown in Table 3 (48 vs. 35 percent cultivated; 37 vs. 52 percent hay/pasture/grass). Please check the numbers and revise as necessary.

2) The point source discussion (Section 4.1, page 13) and the information in Table 7 seem to imply that there's enough effluent data from the Towner WWTF to draw conclusions about the affect of the loading on the stream impairment. The DMR data report in Appendix C seems to indicate that one grab sample was taken from two different cells during one discharge event in June 2012. Table 7 includes discharge data from September 2011that is identical to the June 2012 data. The September 2011 data is not included in Appendix C – was that added to Table 7 in error or is there data missing in Appendix C? Given the high average daily volume of effluent that is discharged from the facility during discharge events, the potential for localized in-stream impacts to the recreational use is high if the discharge concentration of bacteria is at or above the current criteria (depending on the upstream flow, upstream bacteria concentration and mixing conditions). Without a larger dataset of bacteria concentration being discharged from the facility, (e.g., data from several years of discharge that include multiple samples during each discharge event) and/or an adequate E. coli dataset collected at monitoring site 380018 during multiple discharge events, the actual impact to the stream, from this point source, cannot be stated with much confidence. Please check the existing data and revise Table 7 as needed and revise the statement in Section 4.1, about the potential impact from this source, to reflect the need for more data (see the summary language above).

It is worth noting that the highest E. coli result collected from site 380018 was taken during the period when the Towner WWTF was discharging in 2012. That may be a coincidence or it may be an indication that more data is needed from this source. We suggest coordinating with the NDPDES permits program to ensure that all future discharges are sampled for E. coli, so that a more complete compliance record can be established. We also suggest evaluating the feasibility of establishing an ambient sampling plan for E. coli data collection at site 380018, during periods when the Towner WWTF is discharging.

NDDoH Response to Comment:
1) Section 1.3 and Table 3 were corrected to reflect the correct percentages of land use for the watershed.

2) These sections and tables were rewritten to include all discharges from 2009 – 2012 and both E. coli and fecal coliform values. Appendix C with the Discharge Reports was also updated.

While the current water quality standard is for E. coli, the additional fecal coliform data show no exceedences which supports that the WWTF is not a major contributor to the bacteria impairment of this reach of the Souris River. Section 1.3 discussing land use states this watershed contains a significant amount of cattle ranching, which is believed to be a more significant contributor. The information provided in Section 1.5.2 shows that river flow often ranges from 500 to over 1,000 cfs, so the average 15 Mgal of discharge at the WWTF (which equates to 1.55cfs once a year) is not a significant addition to the volume of the river.

One sample with a large concentration of E. coli (1400 CFU/100mL) was collected during the discharge period in 2012. However, if the WWTF was a significant source of the E. coli impairment to the river, multiple samples with high concentrations of E. coli would have been noted during and immediately following the discharge. Those immediately before and after the high concentration were less than 80 CFU/100 mL. The highest concentration (8,000 CFU/100mL) occurred over a month after the discharge ceased. It is also important to note that *due to spring flows, it was not feasible for cattle to be near the river until around the first or second week of June, which also coincides with the high concentration.*

While there are not multiple years of E. coli data for site 380018, there were 36 samples taken during the 2012 recreation season. The Towner WWTF changed to collecting E. coli data in 2012, and will continue to do so to assure the permit requirements of attaining water quality standards for discharge into the river are met. In addition to the current E. coli data there is additional fecal coliform data showing no exceedences of water quality standards at that time.

Therefore, based on the above information and because the Towner WWTF is meeting all of its permit requirements for both monitoring and discharge, which includes meeting water quality standards, NDDoH will not be adding Site 380018 to its ambient monitoring program to double monitor the WWTF discharges at this time. The NDDoH also believes there is more than sufficient information to support its position that the WWTF is not a significant source of E. coli to the Souris River.

US EPA Comment: The Appendix D load reduction calculations for the LDC developed for monitoring site 380094 appear to be incomplete. Please revise the table to show the estimated bacteria load reduction needed for the moist flow regime.

NDDoH Response to Comment:
It appears that the model running load calculations was corrupted. The model was re-run and the data and graphs were corrected throughout the report.

US EPA Comment: Based on the information given in Section 5.4, and Appendix C of the TMDL document, each time there is a discharge from the Towner WWTF, wastewater is released from cell 3 **and** cell 4 for approximately 2 weeks. Therefore, the event total volume discharged is the sum of cell 3 and cell 4 volumes for each discharge period provided in the first table of Appendix C. The sum of the event total volumes discharged, divided by the number of discharge events (i.e., four), equals the average volume discharged during each discharge event (i.e., 21.76 million gallons). Taking the total volume discharged during each discharge period and dividing by the number of days of discharge gives the volume discharged per day per event. Averaging the volume discharged per day per event, for all 4 discharge events, results in calculated average discharge rate of 1.468 million gallons per day. Using that rate, the E. coli permit limit of 126 cfu/100mL and the conversion factors, we calculate the WLA = 7.00E+09 cfu/day. That value is approximately double the value shown in Section 5.4, page 18 and in Table 11, page 21.

It appears that the calculation in Section 5.4, for the average volume discharged per event, was derived by summing all the volumes shown in Table 1, Appendix A and dividing by the number of volumes given. However, the result of that calculation equals the average volume discharged per cell, not the average total volume discharged per event.

Our understanding of the operation of the Towner WWTF and the discharge records, as described by the calculations above, may be different than how it actually occurs. We recommend checking the information on how wastewater is discharged from this facility (i.e., is wastewater discharged from cell 3 straight to outfall 1, then when that cell is drained, wastewater is then discharged from cell 4 straight to outfall 1; OR perhaps they discharge from both cells concurrently; OR perhaps they discharge from cell 3 into cell 4, then from cell 4 to outfall 1, such that the total volume discharged each event is the cell 4 volume only). We also recommend checking the WLA calculations and revising the numbers, as needed, in Section 5.4 and Table 11. Note, that if the WLA value changes, the LAs in Table 11 will also need to be changed.

NDDoH Response to Comment:
Upon further discussion with the NDPDES program, only cell 4 discharges into the Souris River. Cell 3 only discharges into cell 4, but as a double check they monitor those flows and concentrations as well. The Wasteload Allocation calculations and information in the TMDL Table 7 were corrected.

US EPA Comment: We suggest reviewing the sentence about modifying Towner's NDPDES permit. We believe the Towner WWTF is covered by a general permit for municipal discharges which already requires E. coli monitoring and effluent limits. Rather than stating an implementation action that is already in place, it may be better to mention actions similar to our suggestion, in the Pollutant Source Analysis comments above, to gather additional effluent and/or ambient data to better characterize this source.

NDDoH Response to Comment:
The sentence has been reviewed and rewritten.