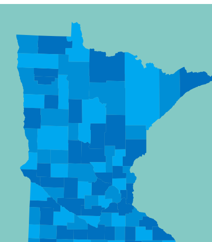
Grant

May 2020

Pipestone, Split Rock, and Mound Creeks Section 319 Small Watershed Focus Nine Element Plan

MINNESOTA POLLUTION CONTROL AGENCY



Authors

Kyle Krier, Pipestone SWCD
Nicole Schwebach, Pipestone SWCD
Doug Bos, Rock County SWCD
Minnesota Pollution Control Agency

Greg Johnson
Cindy Penny
Abel Green

Minnesota Pollution Control Agency

520 Lafayette Road North | Saint Paul, MN 55155-4194 |

651-296-6300 | 800-657-3864 | Or use your preferred relay service. | Info.pca@state.mn.us

This report is available in alternative formats upon request, and online at www.pca.state.mn.us.

Document number: wq-cwp2-12

Contents

List of figures

List of tables

Executive summary

The U.S. Environmental Protection Agency (EPA) has identified nine key elements described in the EPA Handbook for Developing Watershed Plans to Restore and Protect Our Waters (2008) that should be contained within a watershed plan (EPA, 2008). The purpose of this Section 319 Nine Key Element Plan (NKE plan), is to create a watershed based plan that meets these nine elements and to focus the implementation efforts to Pipestone, Split Rock, and Mound Creeks. This plan will be implemented over the next 16 years and will receive priority for federal Clean Water Act Section 319 Grant funding in federal fiscal years (FFY) 2020, 2024, 2028, and 2032. The goal of this NKE plan is to implement sufficient best management practices (BMPs) and activities to achieve need reductions for all three waterbodies to meet water quality standards. It is expected that this plan, if fully implemented, will meet the required reductions recommended by the total maximum daily load (TMDL) studies.

The selection of the three watersheds was based on the community and regional importance, especially the presence of two state parks and a national monument. The selection of these waterbodies make the HUC descriptions unusual. There are two HUC8 watersheds involved, with 11 HUC12s. This will allow the partners to focus on the three main waterbodies; however, it does make the scale appear to be larger than what may be desirable for a NKE plan. The five HUC12s watersheds in Pipestone Creek Watershed and the five HUC12s in Split Rock Creek are included to address the impairments of the entire stream. Pipestone Creek is a tributary to Split Rock Creek. Mound Creek Watershed is a single HUC12.

Pipestone and Rock county Soil and Water and Conservation Districts (SWCDs) have been working with multiple partners in the Lower Big Sioux River watershed to create a measurable impact on water quality. This partnership has even crossed state lines, Pipestone SWCD has been working very closely with Moody County SWCD in South Dakota. Within the last few years Moody SWCD has designed and implemented a new BMP strategy called Seasonal Rotational Area Management (SRAM) which will be described in detail in section 6.1.1. Pipestone and Rock SWCDs have realized the benefit of the SRAM practice and using field observation and other monitoring efforts have identified three streams that can benefit from this practice. The SWCDs have identified critical total suspended solids (TSS) and *E. coli* loading is a result of livestock in these streams, and the use of SRAM is the optimal BMP. This BMP is ideal because it gives the landowners the ability to continue to benefit from the riparian areas while still getting water quality on track to meet and exceed standards. The use of new and innovative practices is the definition of an adaptive management approach which is necessary for successful implementation.

The NKE plan will be updated, as the plan is implemented, local water quality problems improve, new priorities arise and when additional information becomes available. The process of implementing the NKE plan will be iterative. Using effectiveness monitoring strategies, the intention is to reassess this plan every two years, to make sure interim milestones are being met, and that funds are being maximized with the most efficient management practices.

1. Introduction

1.1 Document overview

The intent of this document is to concisely address the nine elements identified in EPA's *Handbook for Developing Watershed Plans to Restore and Protect our Waters* (EPA 2008) that EPA feels are critical to preparing effective watershed plans to address nonpoint source pollution. EPA emphasizes the use of watershed-based plans containing the nine elements in Section 319 watershed projects in its guidelines for the Clean Water Act Section 319 program and grants (EPA 2013).

This plan's foundation is the data collection, analysis, and development of plans from multiple sources and scales. Most of the monitoring and planning efforts sponsored by the state (intensive watershed monitoring (IWM), assessments, TMDLs, Watershed Restoration and Protection Strategies (WRAPS), One Watershed One Plan (1W1P), etc.) are conducted and report on as a hydrological unit code (HUC)8. These foundational efforts provide the support and understand to develop the very targeted and detailed NKE Plan for small watersheds. Instead of broad, strategies, this NKE plan will delve into specific and targeted actions to achieve water quality goals in the Pipestone, Split Rock, and Mound Creek Watersheds.

This NKE plan is intended to be a living document. Through the initial development, first steps of implementation, and the final data collection, this road map is intended to change, react, and correct the course of watershed implementation in the Sand Creek Watershed. This is only the first step along the path to water quality goals in the Pipestone, Split Rock, and Mound Creek Watersheds.

The intent of the nine elements and the EPA watershed planning guidelines is to provide direction in developing a sufficiently detailed plan at an appropriate scale so that problems and solutions are targeted effectively. The nine elements are listed in Table 1 along with the section of this report in which each nine element can be found.

Table 1. Nine elements and report section...

Section 319 Nine Element	**Applicable Report Section**
Identification of causes of impairment and pollutant sources or groups of similar sources that need to be controlled to achieve needed load reductions, and any other goals identified in the watershed plan.	Section 5
An estimate of the load reductions expected from management measures.	Section 7 and Appendix A
A description of the nonpoint source management measures that will need to be implemented to achieve load reductions in element b, and a description of the critical areas in which those measures will be needed to implement this plan.	Section 7
An estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement this plan.	Section 7
An information and education component used to enhance public understanding of the project and encourage the public's early and continued participation in selecting, designing, and implementing the nonpoint source management measures that will be implemented.	Section 7 and Section 8
Schedule for implementing the nonpoint source management measures identified in this plan that is reasonably expeditious.	Section 7

Section 319 Nine Element	Applicable Report Section
A description of interim measurable milestones for determining whether nonpoint source management measures or other control actions are being implemented.	Section 7
A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made toward attaining water quality standards.	Section 7
A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item h immediately above.	Section 9

1.2 Planning purpose and process

The purpose of this watershed planning effort is to provide the foundation upon which to compile and integrate past, present, and future monitoring and implementation activities in the Pipestone, Split Rock, and Mound Creek watersheds and to achieve and measure the water quality goals for the streams. The ultimate water quality goals for all stream reaches is to meet water quality standards. The length of time in which that will occur will vary.

This plan will incorporate detailed work for specific waterbodies. It builds off of the Pipestone County SWCD and Rock County SWCDs 10-year planning cycle or frameworks. Much of the data and information for the SRAM BMP plan is built on the work completed by Moody County Conservation District in South Dakota.

Part of the development of this plan includes synthesizing and compiling the information from these multiple scale planning efforts. Planning needs to be conducted within the existing structure of the SWCD and framework of the partners. This Small Watershed NKE plan will contain more detail than planning efforts to date and bring that value to implementation efforts.

Circumstances in the watershed will continue to change. Land use can change, BMPs will be implemented, the climate will continue to change, etc., and the needs of the watershed will change based on these inputs. The milestones and intentional monitoring of progress will guide the changes needed to this plan throughout the implementation process.

1.3 Planning foundations

The foundation of this plan was written by compiling and synthesizing the information describing previous and current work in the watershed, quantifying current sources and pollutant loads, determining load reductions needed to meet the water quality goals, and identifying the management measures and levels of implementation needed to achieve the reductions. Through this process, gaps in the existing planning efforts have been identified and will be addressed. Efforts will be focused in various levels throughout the watershed in critical areas, such as pasturelands in Pipestone Creek, Split Rock Creek, and Mound Creek subwatersheds. Critical area selection includes physical science influence, such as critical loading areas, but also will take into account social aspects such as citizens' priorities and landowner willingness to participate.

2. Watershed prioritization

Pipestone Creek and the northern part of Split Rock Creek are priority waterbodies in Pipestone County. The southern part of Split Rock Creek and Mound Creek are priority waterbodies in Rock County. Land use in all three watersheds is similar, consisting primarily of agricultural cropland and non-cropland/pastureland. The streams serve as an important source of water for cattle and other grazing livestock on the pastures. They are also priorities because Pipestone Creek flows through Pipestone National Monument, Split Rock Creek flows through Split Rock State Park, and Mound Creek flows through Blue Mound State Park. Additionally the Blue Mound State Park has struggled to provide safe water to campers and hikers because of high nitrates and *E.coli*. The watersheds provide a good opportunity for the implementation of Seasonal Riparian Area Management (SRAM) to achieve a measurable change in water quality. These park sites provide recreation opportunities that are limited in the area such as hiking, fishing, boating, camping and an opportunity to enjoy the special aspects of the prairie ecosystem.

Many public recreational opportunities exist at the Pipestone National Monument, Split Rock Creek State Park, and Blue Mounds State Park.

Pipestone National Monument: quarrying of Pipestone by Native Americans, host cultural demonstrations and ranger programs, tallgrass prairie, hiking, and birding

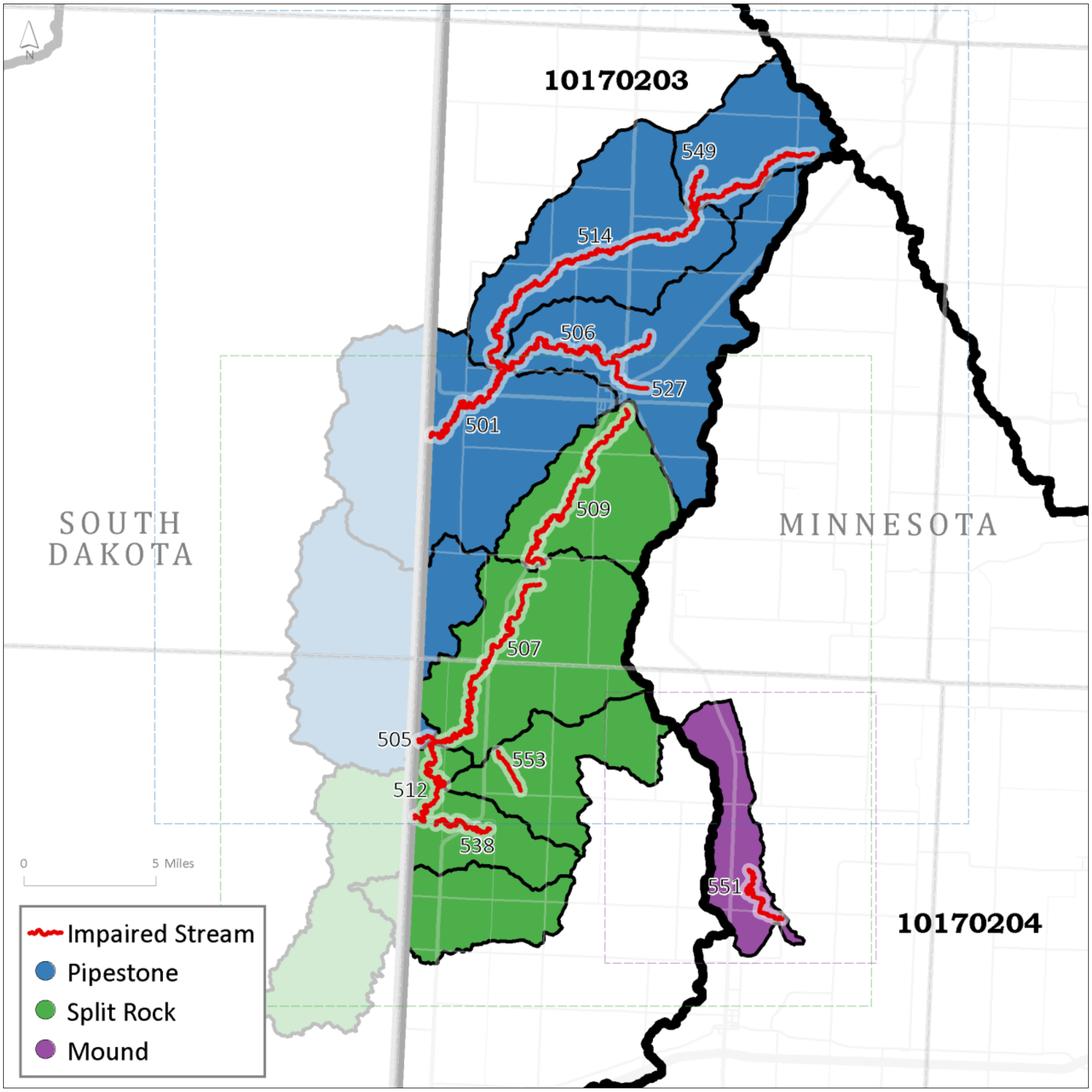
Split Rock Creek State Park: camping, water recreation, swimming, fishing, wildlife/waterfowl observation, hiking, and horse riding trails

Blue Mounds State Park: camping, hiking, rock climbing, wildlife, bison herd, prairie wildflowers/grasses

3. Watershed description

The Pipestone, Split Rock, and Mound Creek Watersheds (Figure 1) have unique geological features that will influence the actions taken on the landscape. This plan covers several watersheds including Pipestone Creek Watershed (Table 2), Split Rock Creek (Table 3), and Mound Creek (Table 4). Pipestone Creek Watershed and Split Rock Creek Watershed cross the Minnesota and South Dakota borders. Pipestone Creek drains into Split Rock Creek, which eventually feeds into the Lower Big Sioux River. The Mound Creek Watershed is completely located in Minnesota and is approximately 11,100 acres and eventually drains into the Rock River. The physical characteristics of the watersheds are very similar and are described collectively in this section.

Figure 1. Pipestone Creek, Split Rock Creek, and Mound Creek Watersheds



Split Rock Creek and Pipestone Creek are physically connected to each other; however, Mound Creek Watershed is not connected to the other two watersheds. The connection for planning purposes is to address the three impaired streams in the three regionally important sites. The three watersheds provide recreation and are important to the residents and visitors for the restoration and preservation of state parks and the national monument.

Figure 2. Elevation map of Pipestone Creek Watershed

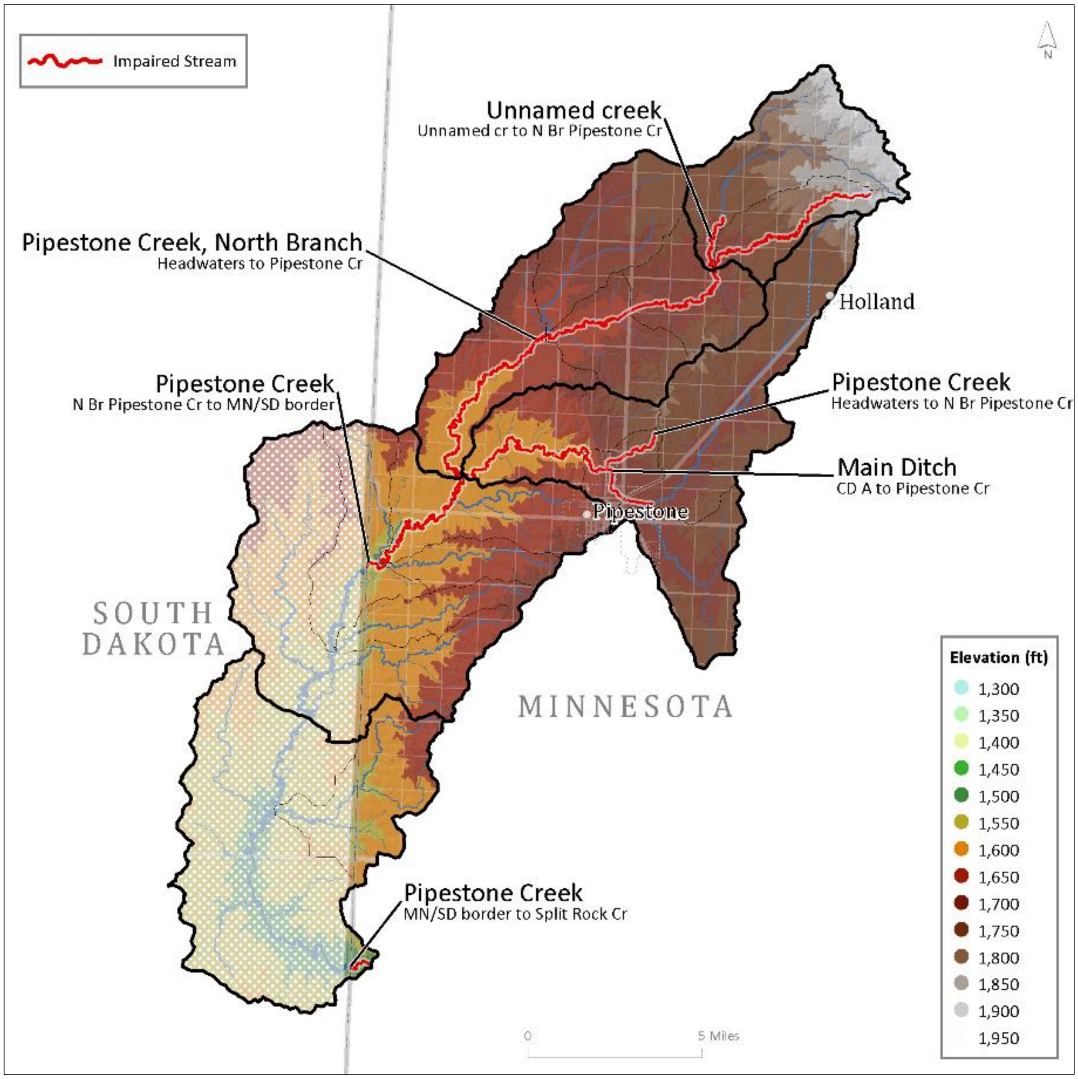


Table 2. Pipestone Creek Watershed HUC12s and acres by state

HUC12	State	Acres
101702031301	MN	28,712
101702031302	MN	13,986
101702031303	MN	26,965
101702031304	MN	21,901
	SD	18,363
101702031305	MN	5,638
	SD	25,776
MN Total		**97,202**
Total		**141,341**

Figure 3. Elevation in the Split Rock Creek Watershed

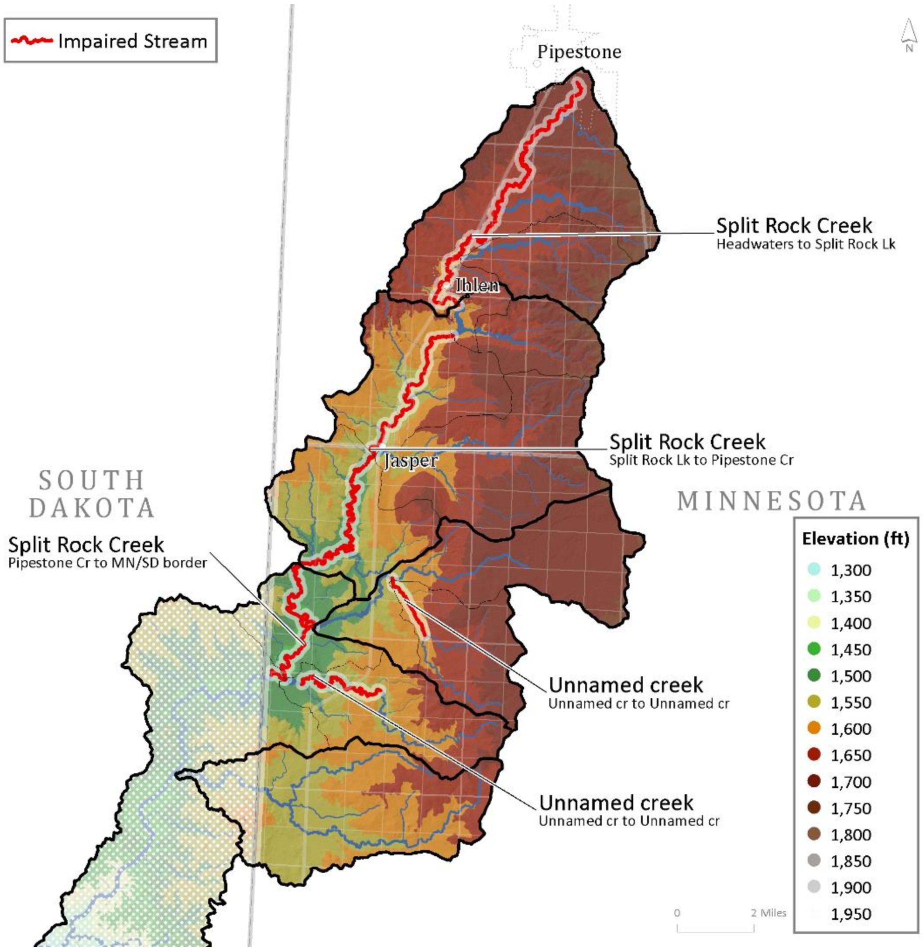


Table 3. Split Rock Creek Watershed HUC12s and acres by state

HUC12	State	Acres
101702031601	MN	16,950
101702031602	MN	28,338
	SD	189
101702031603	MN	14,724
101702031604	MN	10,350
	SD	2,147
101702031605	MN	10,837
	SD	21,021
MN Total		**81,199**
Total		**104,556**

Figure 4. Elevation in the Mound Creek Watershed

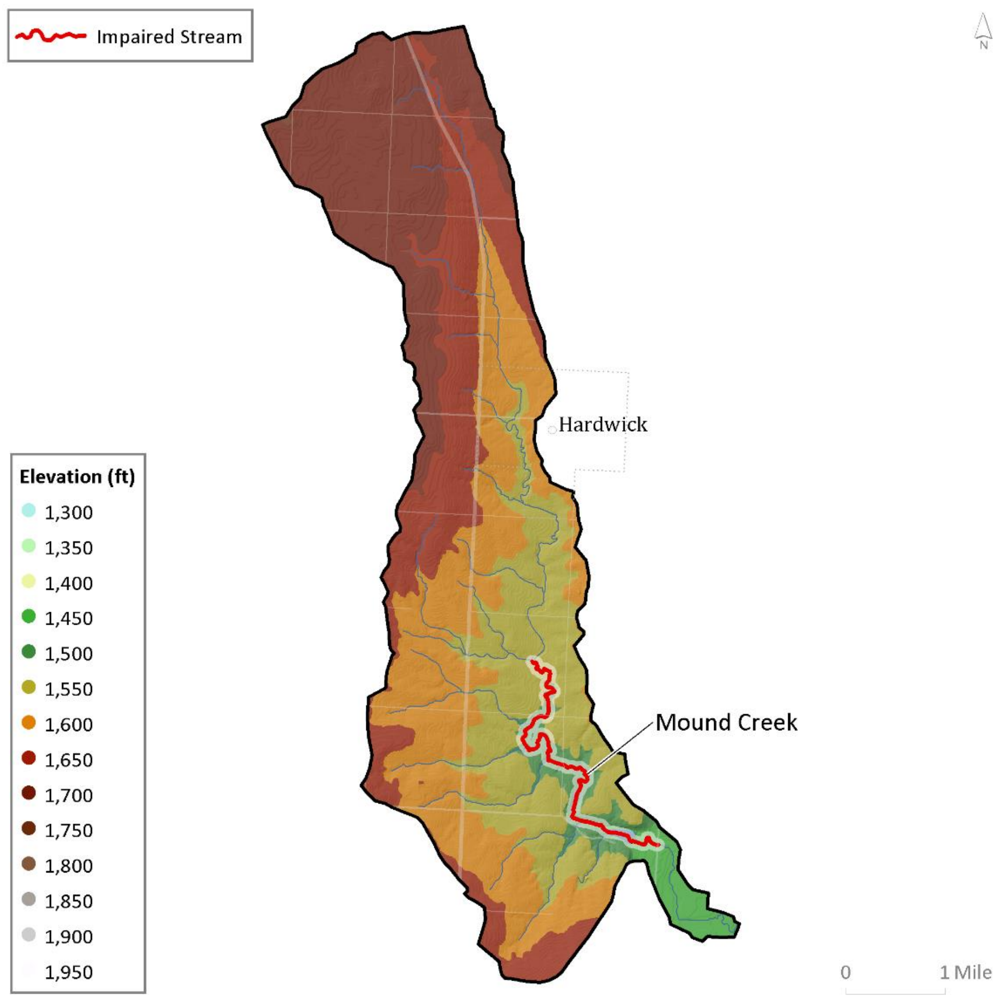


Table 4. Mound Creek Watershed by HUC12 and acres

HUC12	State	Acres
101702040109	MN	11,106

3.1 Geology and soils

Buffalo Ridge, part of the Coteau des Prairies landform, crosses Pipestone County from the northwest to southeast, creating a steep escarpment (elevation 1995 feet) that is home to some of the largest wind farms in the United States. The southern portion of the Coteau Moraines is characterized as a transition from shallow deposits of windblown silt (loess) over glacial till. The Inner Coteau covers southwestern Pipestone County with highly dissected moraines of pre-Wisconsin drift. Bedrock is covered by up to 800 feet of glacial till; however, there are exposures of red Upper Precambrian quartzite in the area. The USDA NRCS *U.S. General Soil Map* delineates seven general soil units in Pipestone County. Soil Associations include: Barnes-Buse, Barnes-Flom, Brookings-Hidewood, Estelline-Lamore, Ihlen-Rock outcrop, Kranzburg-Vienna, and Moody-Trent-Whitewood.

3.2 Wetlands

The surficial geology in the Lower Big Sioux Watershed resulted in significant wetland resources occurring in topographic depressions and flats, as well as along upper reaches of the stream drainage network. The historical wetlands present in the watersheds have largely been drained for agriculture and development. Wetland loss is estimated at 87-98% for the priority watersheds. There are few areas that have been identified as restorable wetlands in these three watersheds. Those areas that have been identified as restorable are small and scattered throughout the watershed. Wetland restoration will not be a significant implementation focus in these areas. Potentially restorable wetlands are identified in Figure 5, Figure 6 and Figure 7.

,

Figure 5. Restorable wetlands in Pipestone Creek Watershed

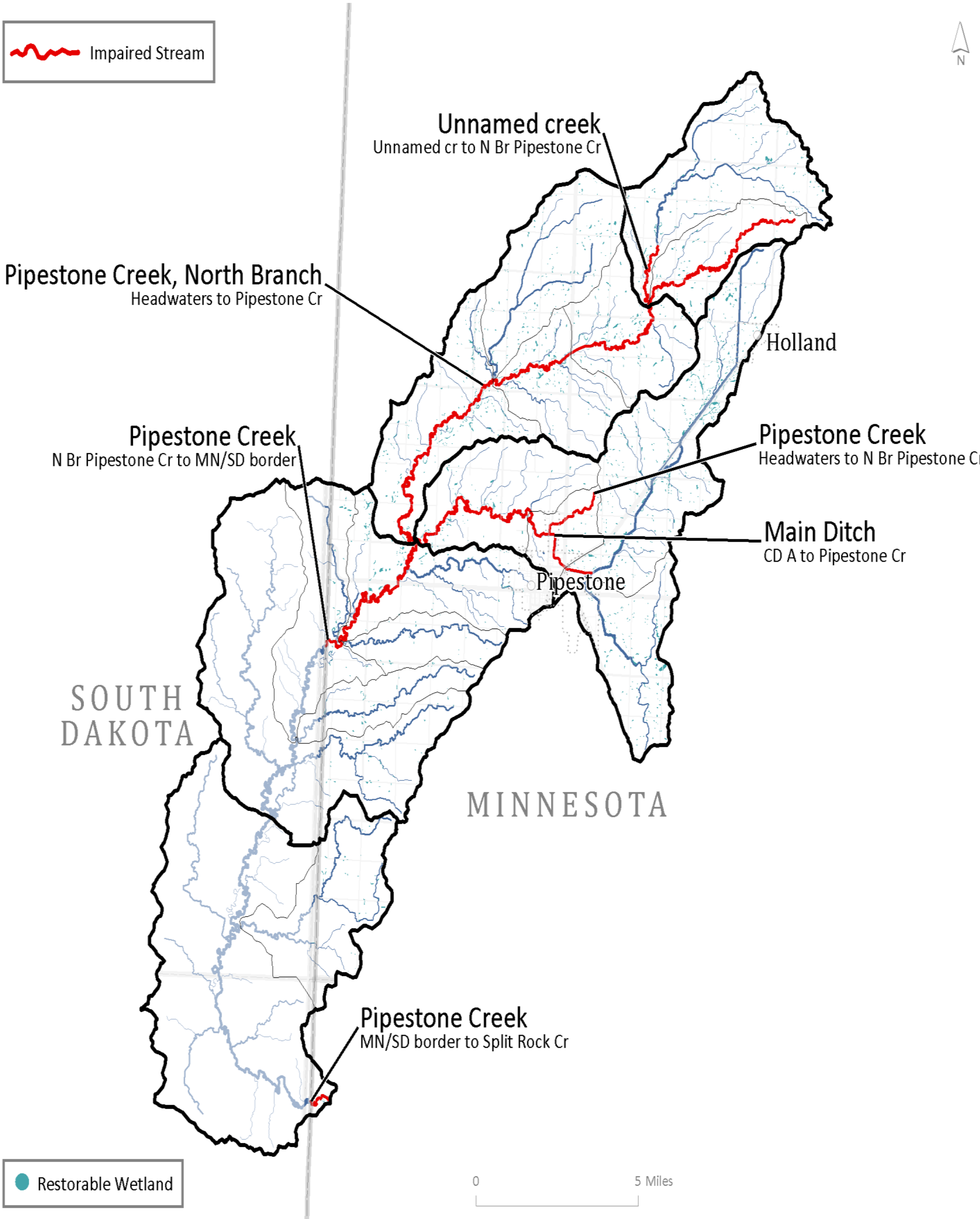


Figure 6. Restorable wetlands identified in Split Rock Creek Watershed

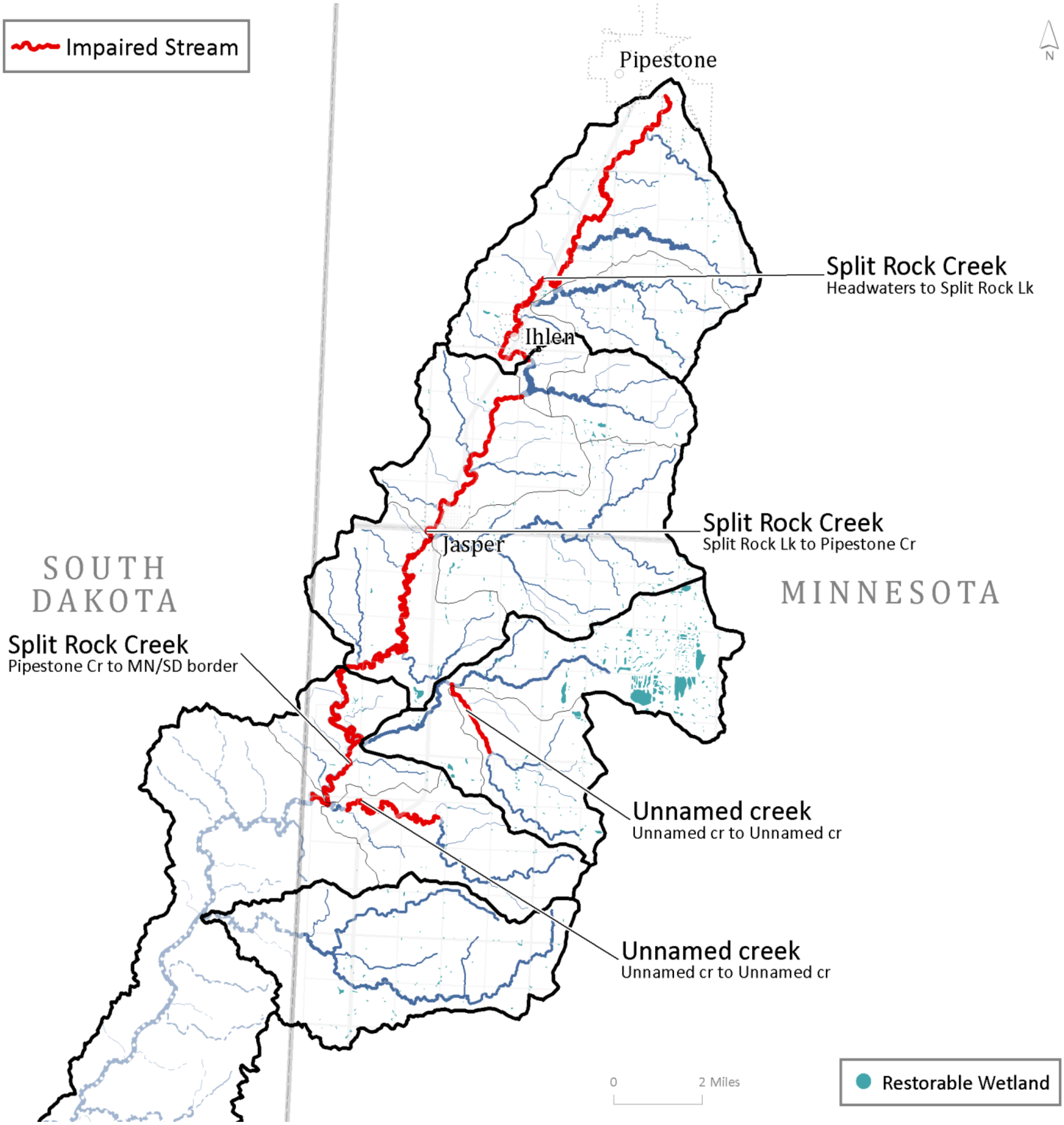
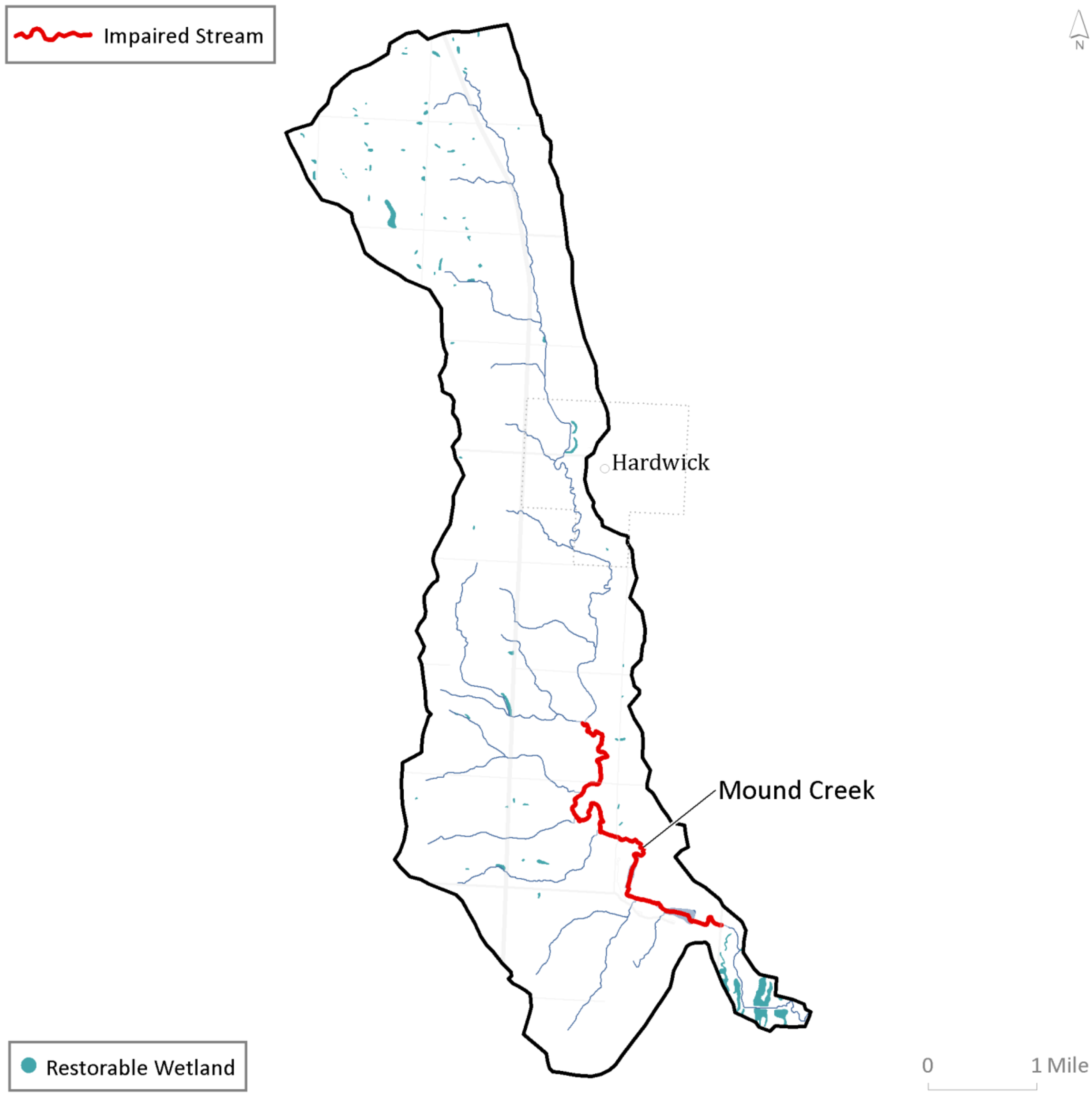


Figure 7. Restorable Wetlands in Mound Creek Watershed



3.3 Groundwater

Groundwater is not always a reliable source of water in Pipestone County, although groundwater tends to be the preferred source of drinking water in southern Minnesota. Surficial formations in glacial outwash, a common groundwater source, have the potential to yield large quantities of water depending on local factors of grain size, degree of sorting, and extent of deposit, but often also have high levels of contaminants. While water yielding from deeper wells and formation is moderate to low deep well water is typically high in dissolved minerals.

There are a very limited number of sources in Pipestone County that are considered public water suppliers by the Minnesota Department of Health (MDH). The MDH has completed source water assessments on 13 public water systems in the county, including several non-community systems. A Drinking Water Supply Management Area (DWSMA) provides a geographic focus for securing the water supply. Wellhead Protection Plans have been completed for Lincoln Pipestone Rural Water's Holland and North Holland Wellfields and for the city of Pipestone. The Pipestone SWCD has been assisting, and promoting the use of BMPs, within these wellhead areas. Additionally grant funds have been obtained through the Minnesota Department of Agriculture (MDA) to encourage producers to utilize nitrate inhibitors when applying nitrogen to agricultural fields.

There is growing concern in the region about the quantity and quality of available groundwater. Lincoln Pipestone Rural Water among others, are participating in the Lewis & Clark Regional Water System. This project will bring Missouri River water to southeast South Dakota, northwest Iowa, and Rock and Nobles counties in southwest Minnesota. Groundbreaking occurred in August 2003, and by July 2008, construction had reached Harrisburg, South Dakota. The project has an estimated completion date of 2019 depending on continued federal funding.

The sealing of older, unused wells is a critical activity to reduce the potential contamination of groundwater. The Pipestone SWCD offers cost share to assist landowners in the proper closure of unused wells. They will reimburse 50% of the cost to seal a well to a maximum of $300. Public demand for this assistance is likely to continue into the future.

3.4 Land use

Pipestone Creek Watershed

The detailed land use for each HUC12 watershed in Pipestone Creek Watershed is described in Table 5. The acreages and percentages are given for the Minnesota HUC12 watersheds. Land use for the watershed is illustrated in Figure 8. There are about 44,150 acres of -1304 and -1305 that extend into South Dakota. Those acres are not represented in the table. The partners do not intend to use Section 319 funds across state or EPA regional boundaries; however, these areas are part of the system. The watershed partners have a long and established partnership with South Dakota and have been working together to decrease NPS loading to Pipestone Creek.

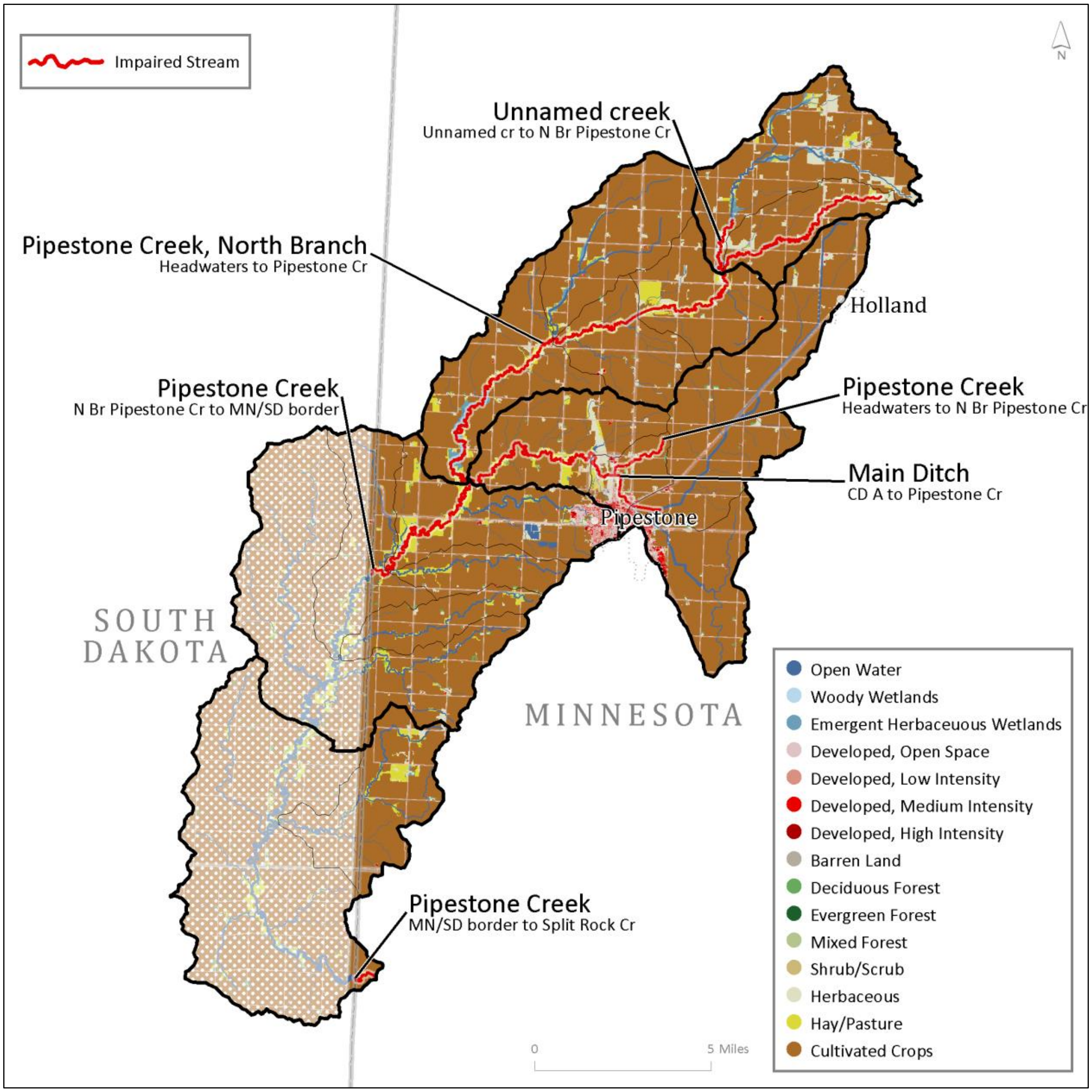
Table 5. Land use for Pipestone Creek Watershed HUC12s (NLCD), Minnesota only

	MN 101702031301 County Ditch A – Pipestone Creek		**MN 101702031302 Upper North Branch Pipestone Creek**		**MN 101702031303 Lower North Branch Pipestone Creek**		**MN 101702031304 South Branch Pipestone Creek— Pipestone Creek**		**MN 101702031305 Pipestone Creek**	
	Acres	**%**	**Acres**	**%**	**Acres**	**%**	**Acres**	**%**	**Acres**	**%**
Developed	1,972	7	528	4	949	4	1,537	7	160	3
Pasture/grassland	1,806	6	1,837	13	2,156	8	2,255	10	544	10
Cultivated Crop	24,672	86	11,054	79	23,103	86	17,774	81	4,886	87
Wetlands	108	0	538	4	705	3	89	0	29	1

	MN		MN		MN		MN		MN	
	101702031301		**101702031302**		**101702031303**		**101702031304**		**101702031305**	
	County Ditch A – Pipestone Creek		**Upper North Branch Pipestone Creek**		**Lower North Branch Pipestone Creek**		**South Branch Pipestone Creek— Pipestone Creek**		**Pipestone Creek**	
	Acres	**%**	**Acres**	**%**	**Acres**	**%**	**Acres**	**%**	**Acres**	**%**
Miscellaneous	153	1	29	0	51	0	245	1	20	0
Total	**28,712**	**100**	**13,986**	**100**	**26,965**	**100**	**21,901**	**100**	**5,638**	**100**

As demonstrated in Figure 8, much of the streambank is represented by pastureland; therefore, field observations and experiences and South Dakota's watershed partners' observation and experiences indicate that streambanks in pastures are the critical loading areas.

Figure 8. Land use in Pipestone Creek Watershed



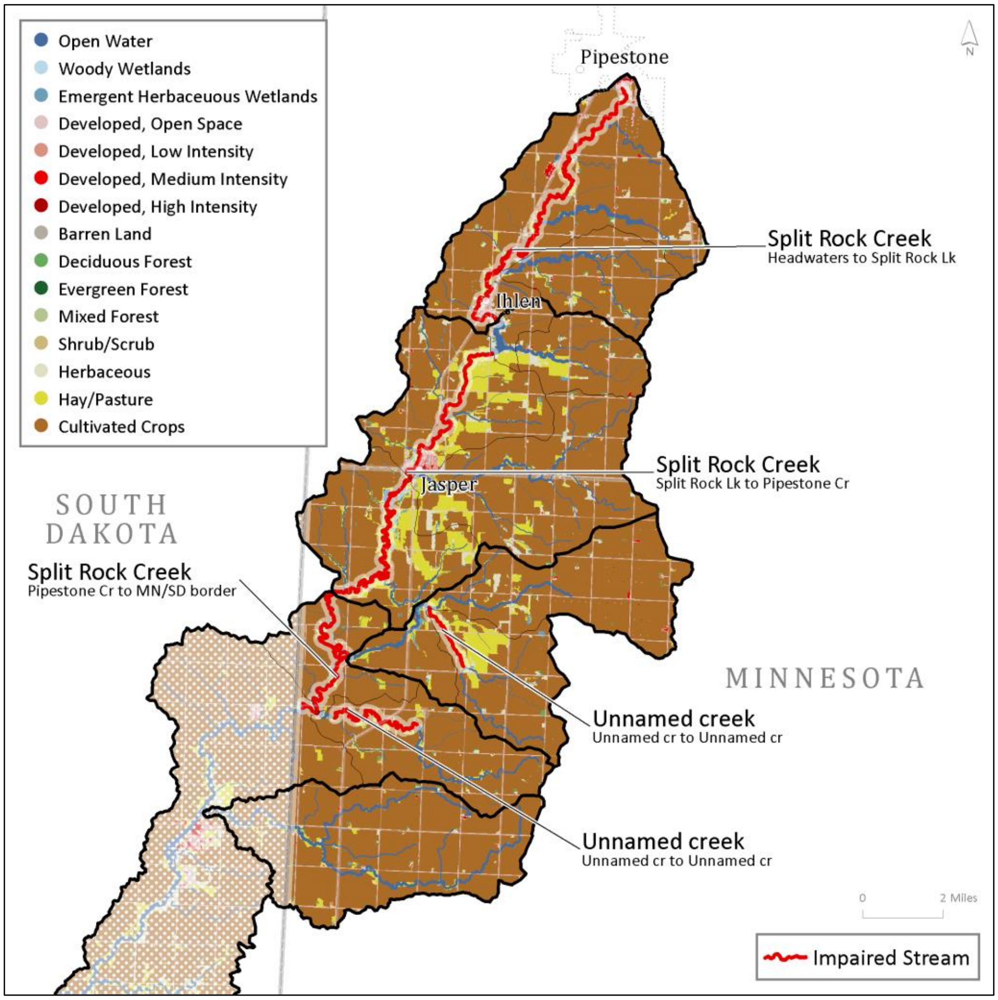
Split Rock Creek Watershed

The detailed land use for each HUC12 watershed in Split Rock Creek Watershed is described in Table 6 and shown in Figure 9. The acreages and percentages are given for the Minnesota HUC12 watersheds. There are about 23,400 acres from -1602, -1604, and -1605 that extend into South Dakota. The partners do not intend to use Section 319 funds across state or EPA regional boundaries; however, these areas are part of the system. The watershed partners have a long and established partnership with South Dakota and have been working together to decrease NPS loading to Split Rock Creek.

Table 6. Land use for Split Rock Creek Watershed HUC12s

	MN 101702031601 Headwaters Split Rock Creek		MN 101702031602 City of Jasper – Split Rock Creek		MN 101702031603 101702031603		MN 101702031604 Devil's Gulch		MN 101702031605 Palisades of Split Rock Creek	
	Acres	**%**	**Acres**	**%**	**Acres**	**%**	**Acres**	**%**	**Acres**	**%**
Developed	1,081	6.4	1,278	4.5	578	3.9	348	3.4	384	3.5
Pasture/ grassland	1,299	7.7	5,231	18.5	1,497	10.2	360	3.5	866	8.0
Cultivated Crop	14,410	85.0	21,197	74.8	12,455	84.6	9,483	91.6	9,387	86.6
Wetlands	75	0.4	316	1.1	128	0.9	125	1.2	124	1.1
Miscellaneous	85	0.5	317	1.1	67	0.5	33	0.3	76	0.7
Total	**16,950**	**100**	**28,338**	**100**	**14,724**	**100**	**10,350**	**100**	**10,837**	**100**

Figure 9. Land use in Split Rock Creek Watershed



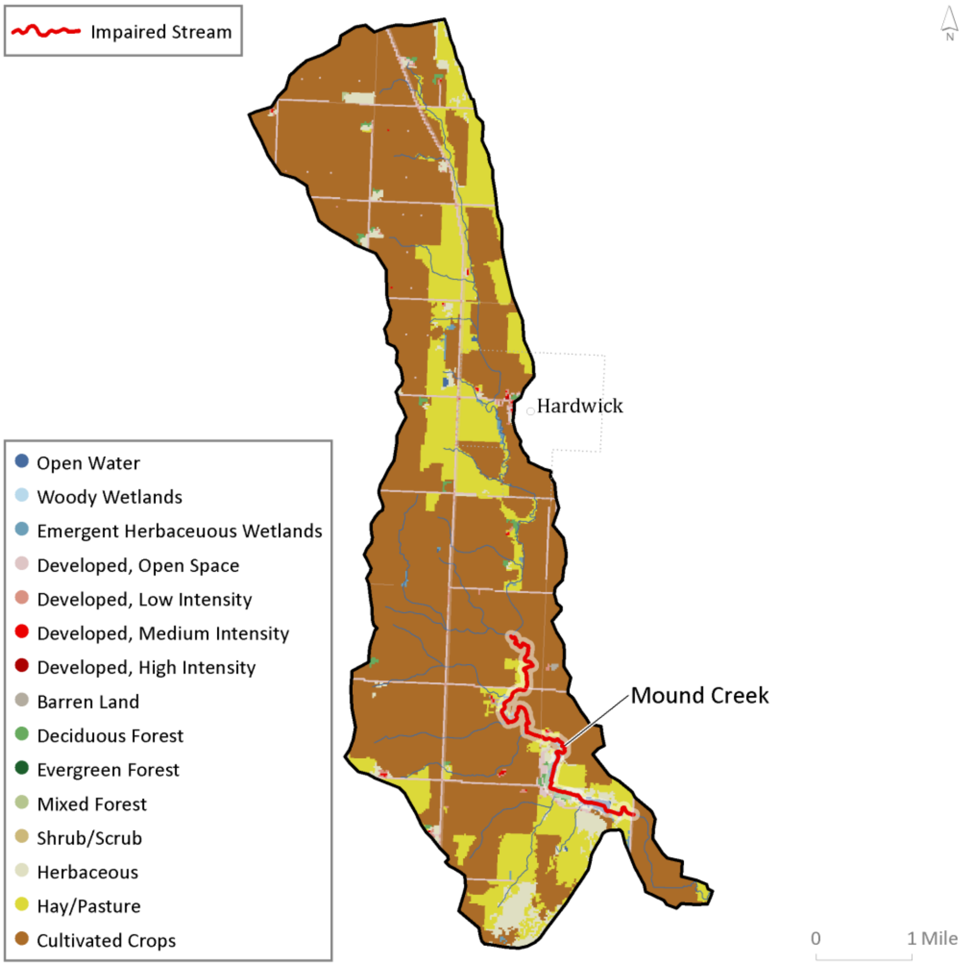
Mound Creek Watershed

The detailed land use for the in Mound Creek HUC12 watershed is described in Table 6 and shown in Figure 10.

Table 7. Land use for the Mound Creek Watershed by HUC 12

Description	MN	
	101702040109	
	Acres	%
Developed	394	3.5
Pasture/grassland	2,462	22.2
Cultivated Crop	8,098	72.9
Wetlands	54	0.5
Miscellaneous	98	0.9
Total	**11,106**	**100.0**

Figure 10. Land use in Mound Creek Watershed



Summary of planning area

Land use in the three watersheds is similar and dominated by agriculture. Agriculture is predominately row crops and livestock farming. Table 8 lists the land use percentages in the three watersheds.

Table 8. Land use percentages for the Minnesota portion of Pipestone, Split Rock, and Mound Creek Watersheds

Land Cover	**Pipestone Creek**	**Split Rock Creek**	**Mound Creek**
Cropland	83.80%	82.40%	72.90%
Pastureland	8.80%	11.40%	22.90%
Total agriculture	**92.60%**	**93.80%**	**92%**
Developed	5.30%	4.50%	3.50%
Wetlands	1.50%	0.90%	0.50%
Miscellaneous	0.50%	1.80%	0.90%

3.5 Climate/precipitation

The planning area is considered a typical prairie environment, with a typical humid, midcontinental climate, with cold, dry continental polar air dominating in the winter and hot, dry tropical air masses from the southwest meeting warm, moist maritime air masses from the Gulf of Mexico in the summer. Temperatures range from an average of 11 degrees Fahrenheit in January to an average 72 degrees in July. Average precipitation has ranged between 19 and 40 inches in the last two decades; between 21 and 26 inches of precipitation were observed across the county in 2008. Watersheds typically receive 25–30 inches of snow over the winter season (October to March).

4. Water quality and quantity

4.1 Water quality standards and beneficial uses

The federal Clean Water Act requires states to designate beneficial uses for all waters and develop water quality standards to protect each use. Water quality standards consist of several parts:

- Beneficial uses — Identify how people, aquatic communities, and wildlife use our waters
- Numeric criteria — Amounts of specific pollutants allowed in a body of water and still protects it for the beneficial uses
- Narrative criteria — Statements of unacceptable conditions in and on the water
- Antidegradation protections — Extra protection for high-quality or unique waters and existing uses

Together, the beneficial uses, numeric and narrative criteria, and antidegradation protections provide the framework for achieving Clean Water Act goals.

Minnesota's water quality standards are provided in Minnesota Rules chapters 7050. All current state water rules administered by the MPCA are available on the Minnesota water rules page (https://www.pca.state.mn.us/water/water-quality-rules).

4.1.1 Beneficial Uses

The beneficial uses for public waters in Minnesota are grouped into one or more classes as defined in Minnesota Rule (Minn. R.) ch. 7050.0140. The classes and beneficial uses are:

- Class 1 – domestic consumption
- Class 2 – aquatic life and recreation
- Class 3 – industrial consumption
- Class 4 – agriculture and wildlife
- Class 5 – aesthetic enjoyment and navigation
- Class 6 – other uses and protection of border waters
- Class 7 – limited resource value waters

The aquatic life use class now includes a tiered aquatic life uses (TALU) framework for rivers and streams. The framework contains three tiers—exceptional, general, and modified uses.

All surface waters are protected for multiple beneficial uses.

4.1.2 Numeric criteria and state standards

Narrative and numeric water quality criteria for all uses are listed for four common categories of surface waters in Minn. R. ch. 7050.0220. The four categories are:

- cold water aquatic life and habitat, also protected for drinking water: classes 1B; 2A, 2Ae, or 2Ag; 3A or 3B; 4A and 4B; and 5;
- cool and warm water aquatic life and habitat, also protected for drinking water: classes 1B or 1C; 2Bd, 2Bde, 2Bdg, or 2Bdm; 3A or 3B; 4A and 4B; and 5;
- cool and warm water aquatic life and habitat and wetlands: classes 2B, 2Be, 2Bg, 2Bm, or 2D; 3A, 3B, 3C, or 3D; 4A and 4B or 4C; and 5; and
- limited resource value waters: classes 3C; 4A and 4B; 5; and 7.

The narrative and numeric water quality criteria for the individual use classes are listed in Minn. R. ch. 7050.0221 through 7050.0227. The procedures for evaluating the narrative criteria are presented in Minn. R. ch. 7050.0150.

The MPCA assesses individual water bodies for impairment for class 2 uses—aquatic life and recreation. Class 2A waters are protected for the propagation and maintenance of a healthy community of cold water sport or commercial fish and associated aquatic life and their habitats. Class 2B waters are protected for the propagation and maintenance of a healthy community of cool or warm water sport or commercial fish, and associated aquatic life and their habitats. Both class 2A and 2B waters are also protected for aquatic recreation activities including bathing and swimming.

Protection for aquatic recreation entails the maintenance of conditions safe and suitable for swimming and other forms of water recreation. In streams, aquatic recreation is assessed by measuring the concentration of Escherichia coli (E. coli) in the water, which is used as an indicator species of potential waterborne pathogens. To determine if a lake supports aquatic recreational activities, its trophic status is evaluated using total phosphorus, Secchi depth, and chlorophyll-a as indicators. Lakes that are enriched with nutrients and have abundant algal growth are eutrophic and do not support aquatic recreation.

Protection of aquatic life entails the maintenance of a healthy aquatic community as measured by fish and macroinvertebrate IBIs. Fish and invertebrate IBI scores are evaluated against criteria established for individual monitoring sites by water body type and use subclass (exceptional, general, and modified).

General use waters harbor “good” assemblages of fish and macroinvertebrates that can be characterized as having an overall balanced distribution of the assemblages and with the ecosystem functions largely maintained through redundant attributes. Modified use waters have been extensively altered through legacy physical modifications, which limit the ability of the biological communities to attain the general use. Currently the modified use is only applied to streams with channels that have been directly altered by humans (e.g., maintained for drainage, riprapped).

The ecoregion standard for aquatic recreation protects lake users from nuisance algal bloom conditions fueled by elevated phosphorus concentrations that degrade recreational use potential.

4.1.3 Antidegradation policies and procedures

The purpose of the antidegradation provisions in Minn. R. ch. 7050.0250 through 7050.0335 is to achieve and maintain the highest possible quality in surface waters of the state. To accomplish this purpose:

1. Existing uses and the level of water quality necessary to protect existing uses shall be maintained and protected.
2. Degradation of high water quality shall be minimized and allowed only to the extent necessary to accommodate important economic or social development.

3. Water quality necessary to preserve the exceptional characteristics of outstanding resource value waters shall be maintained and protected.
4. Proposed activities with the potential for water quality impairments associated with thermal discharges shall be consistent with section 316 of the Clean Water Act, United States Code, title 33, section 1326.

4.1.4 Standards and criteria

The streams and lakes in the planning area are primarily designated as class 2B waters. The water quality standards and criteria used in assessing the streams and lakes in the planning area include the following parameters:

- *E. coli* – not to exceed 126 organisms per 100 milliliters (org/100 mL) as a geometric mean of not less than five samples representative of conditions within any calendar month, nor shall more than ten percent of all samples taken during any calendar month individually exceed 1,260 organisms per 100 milliliters. The standard applies between April 1 and October 31.
- Dissolved oxygen – daily minimum of 5 milligrams per liter (mg/L).
- pH – to be between 6.5 and 9.0 pH units.
- Total suspended solids (TSS) – 65 mg/L not to be exceeded more than 10% of the time between April 1 and October 31.
- Chloride
    - Chronic: 230 mg/L
    - Maximum standard: 860 mg/L
    - Final acute value: 1,720 mg/L
- Stream eutrophication – based on summer average concentrations for the South River Nutrient Region
    - Total phosphorus (TP) concentration less than or equal to 150 micrograms per liter (µg/L) and
    - Chlorophyll-*a* (seston) concentration less than or equal to 35 µg/L or
    - Diel dissolved oxygen (DO) flux less than or equal to 4.5 mg/L or
    - Five-day biochemical oxygen demand (BOD) concentration less than or equal to 3.0 mg/L.
    - If the TP criterion is exceeded and no other variable is exceeded, the eutrophication standard is met.
- Lake eutrophication – based on summer average values for shallow lakes in the western corn belt plains ecoregion
    - Total phosphorus concentration less than or equal to 90 µg/L and
    - Chlorophyll-*a* concentration less than or equal to 30 µg/L or
    - Secchi disk transparency not less than 0.7 meter.
- Biological indicators – The basis for assessing the biological community are the narrative water quality standards and assessment factors in Minn. R. 7050.0150. Attainment of these standards is measured through sampling of the aquatic biota and is based on impairment thresholds for indices of biological integrity (IBI) that vary by use class. Appendix 4.1 in the Cedar River Watershed Monitoring and Assessment Report (MPCA 2012) provides the IBI numeric thresholds.

4.2 Impairments

The Clean Water Act, Section 303(d) requires TMDLs to be developed for surface waters that do not meet applicable water quality standards necessary to support their designated uses. A TMDL determines the maximum amount of a pollutant a receiving waterbody can assimilate while still achieving water quality standards and allocates allowable pollutant loads to various sources needed to meet water quality standards.

There are 30 impairments along 12 reaches in the planning area (Table 9). The impairments affect aquatic life and aquatic recreation uses based on dissolved oxygen (DO), turbidity, nutrient/ eutrophication biological indicators, fish and macroinvertebrate bioassessments, and *E. coli* or fecal coliform concentrations. The bulk of the impairments are FIBI and MIBI (18), with six *E. coli,* four TSS, and one each nutrient/eutrophication and DO. More information on the impairment assessment of these waterbodies can be found in the *Missouri River Basin (Upper Big Sioux, Lower Big Sioux, Little Sioux, and Rock River Watersheds) Monitoring and Assessment Report* (MPCA 2014a). For the purposes of this NKE plan, listings for turbidity and fecal coliform will be addressed as TSS and *E. coli*, respectively.

Causes of the fish and macroinvertebrate impairments were investigated in the *Lower Big Sioux River Watershed Stressor Identification Report* (MPCA 2014b) and are summarized in Section 4.4.

Table 9. Impairments in the planning area

Resource of Concern	Description	WID	Use Class	Affected Use	Impairment	TMDL Status [a]
Pipestone Creek, North Branch	Headwaters to Pipestone Cr	10170203-514	2Bg, 3C	Aquatic recreation Aquatic life Aquatic life Aquatic life	Fecal coliform Fish Macroinvertebrates Turbidity	Approved None None Approved
Unnamed creek	Unnamed cr to N Br Pipestone Cr	10170203-549	2Bg, 3C	Aquatic life Aquatic life	Fish Macroinvertebrates	None None
Pipestone Creek	Headwaters to N Br Pipestone Cr	10170203-506	2Bg, 3C	Aquatic life Aquatic life	Fish Macroinvertebrates	None None
Main Ditch	CD A to Pipestone Cr	10170203-527	2Bg, 3C	Aquatic recreation Aquatic life	Fecal coliform Turbidity	Approved Approved
Pipestone Creek	N Br Pipestone Cr to MN/SD border (Pipestone County)	10170203-501	2Bg, 3C	Aquatic recreation Aquatic life Aquatic life Aquatic life	Fecal coliform Fish Macroinvertebrates Turbidity	Approved None None Approved
Split Rock Creek	Headwaters to Split Rock Lk	10170203-509	2Bg, 3C	Aquatic life Aquatic life	Fish Macroinvertebrates	None None
Split Rock Creek	Split Rock Lk to Pipestone Cr	10170203-507	2Bg, 3C	Aquatic life Aquatic life	DO Fish	None None

Resource of Concern	Description	WID	Use Class	Affected Use	Impairment	TMDL Status [a]
				Aquatic life	Macroinvertebrates	None
Pipestone Creek	MN/SD border to Split Rock Cr (Rock County)	10170203-505	2Bg, 3C	Aquatic recreation Aquatic life Aquatic life	E. coli Fish Macroinvertebrates	Approved None None
Split Rock Creek	Pipestone Cr to MN/SD border	10170203-512	2Bg, 3C	Aquatic recreation Aquatic life Aquatic life Aquatic life	E. coli Fish Nutrient/ eutrophication biological indicators Turbidity	Approved None None Approved
Unnamed creek	Unnamed cr to Unnamed cr	10170203-553	2Bg, 3C	Aquatic life Aquatic life	Fish Macroinvertebrates	None None
Unnamed creek	Unnamed cr to Unnamed cr	10170203-538	2Bg, 3C	Aquatic life	Macroinvertebrates	None
Mound Creek	Unnamed cr to T103 R45W S24, east line	10170204-551	2Bg, 3C	Aquatic recreation	E. coli	Approved

a. Approved TMDLs can be found in MPCA (2008) and Wenck Associates (2018).

4.3 Water quality summary

4.3.1 Turbidity and TSS

TSS data are summarized in Table 10.

Table 10. TSS data summary (MPCA 2018)

Reach Name	Reach (AUID)	Station	TSS			
			Year	# samples	# exceedances	Percent exceedance
Pipestone Creek, North Branch	514	S001-904	2002-2004	47	5	11%
Main Ditch	527	S000-646	2002-2013	218	18	8%
Pipestone Creek	501	S000-099	2000-2009	41	7	17%
		S000-510	2011-2014	59	20	34%
Pipestone Creek	505	S006-580	2011-2011	11	3	27%
Pipestone Creek	506	S007-394	2013-2013	11	3	27%
Split Rock Creek	507	S001-139	2013-2013	6	1	17%

Reach Name	Reach (AUID)	Station	TSS			
			Year	# samples	# exceedances	Percent exceedance
Split Rock Creek	509	S000-652	2013-2013	7	1	14%
Split Rock Creek	512	S004-528	2008-2015	180	67	37%
		S006-579	2011-2011	11	3	27%
Mound Creek	551	S006-168	2010-2013	60	11	18%

The extent of TSS impairment varies across the planning area, with a higher percentage of the TSS concentrations exceeding the standard in the lower reaches of Pipestone Creek and Split Rock Creek. On the most downstream reach of Split Rock Creek, which receives drainage from both the Split Rock Creek watershed and the Pipestone Creek watershed, TSS concentrations on average are higher under higher flows.

4.3.2 *E. coli*

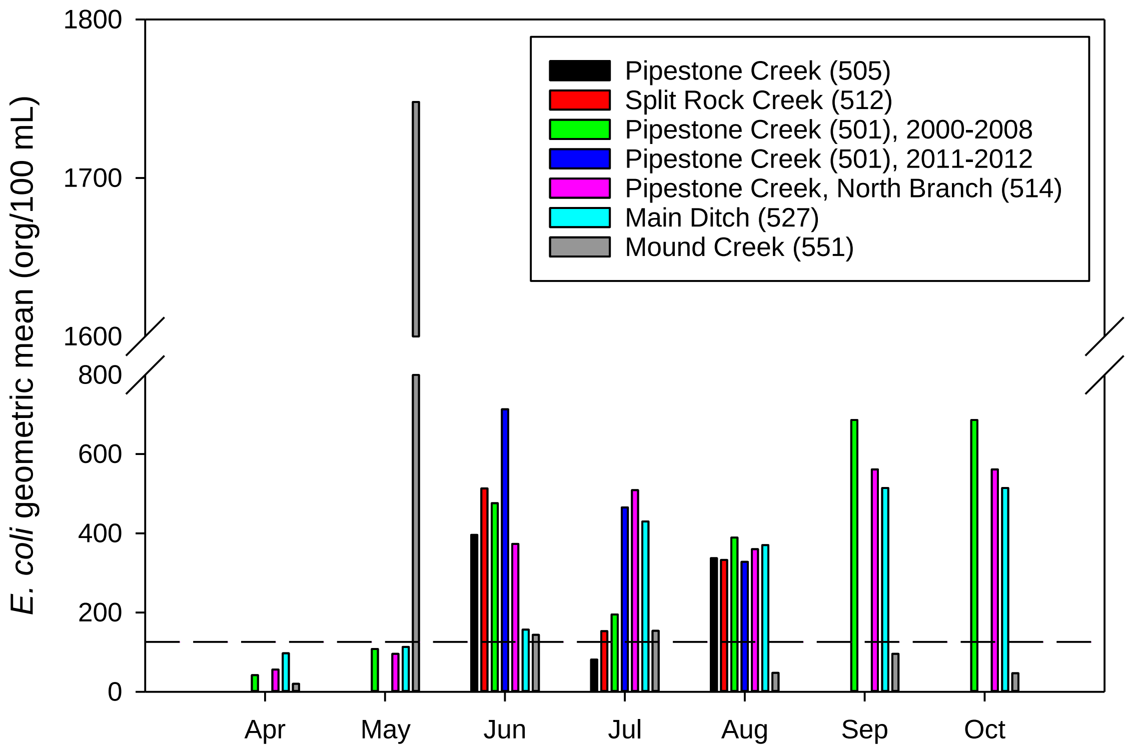
E. coli data are summarized in Table 11.

Table 11. *E. coli* data summary

Reach name	Reach	Station	Years	n	Geometric mean	%n > 1,260
Pipestone Creek	505	S006-580	2011-2012	15	221	13%
Split Rock Creek	512	S006-579	2011-2012	15	297	7%
Pipestone Creek	501	S000-099	2000-2008	41	206	7%
		S000-510	2011-2012	17	466	12%
Pipestone Creek, North Branch	514	S001-904	2002-2004	82	251	13%
Main Ditch	527	S000-646	2002-2004	84	222	21%
Mound Creek	551	S006-168	2010-2013	52	104	12%

The *E. coli* monthly geometric mean concentrations often exceeded the standard during the summer months (Figure 12).

Figure 11 Figure 12. *E. coli* monthly geometric means in impaired reaches in planning area (data from Wenck Associates 2018)



4.3.3 Nutrients

Phosphorus concentrations are high in all of the reaches in the planning area that have biological impairments (MPCA 2014b). In Split Rock Creek (10170203-512), which has an eutrophication impairment, the monthly mean phosphorus concentrations exceeded the 150 µg/L phosphorus standard during all months when the standard applies (June through September; Figure 13). The Jun–September average concentrations exceeded the standard annually across the data record (2008–2018; Table 12).

Figure 13. Total phosphorus average monthly concentrations in Split Rock Creek (10170203-512), 2008–2018

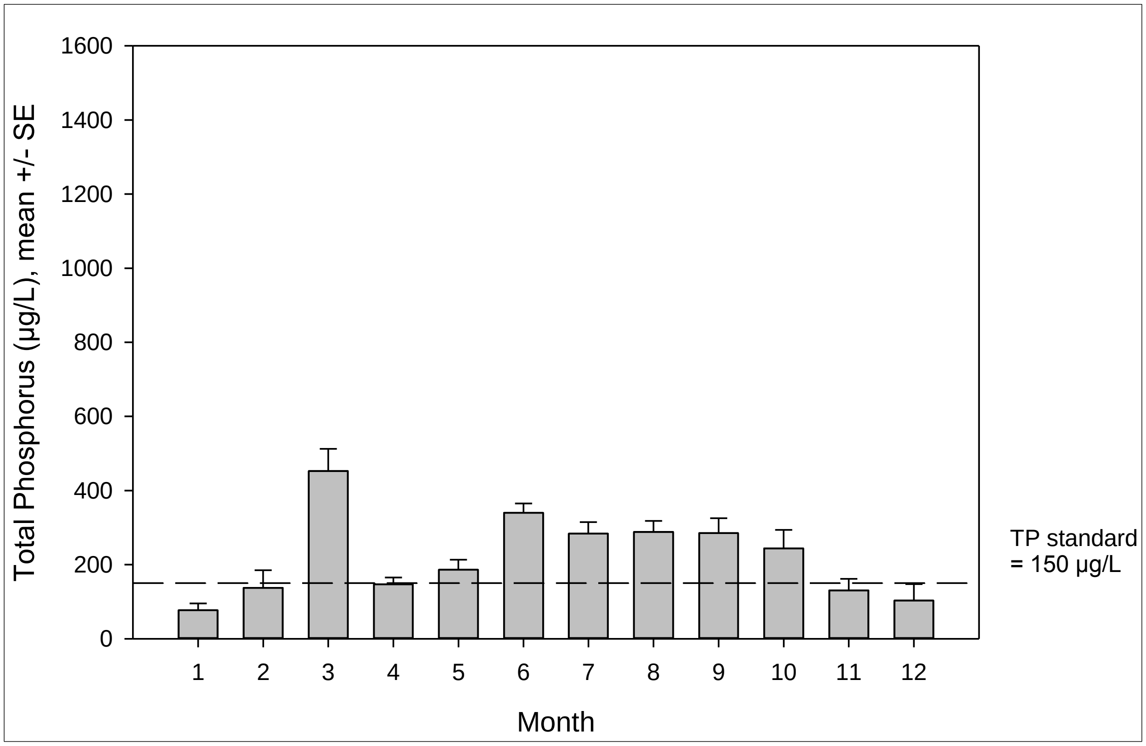


Table 12. Average Jun–Sep total phosphorus concentrations in Split Rock Creek (10170203-512)

Year	Number of Samples	TP Average Concentration, Jun–Sep (µg/L)
2009	9	223
2010	18	345
2011	17	312
2012	9	187
2014	14	311
2015	17	306
2016	4	200
2017	9	282
2018	15	402

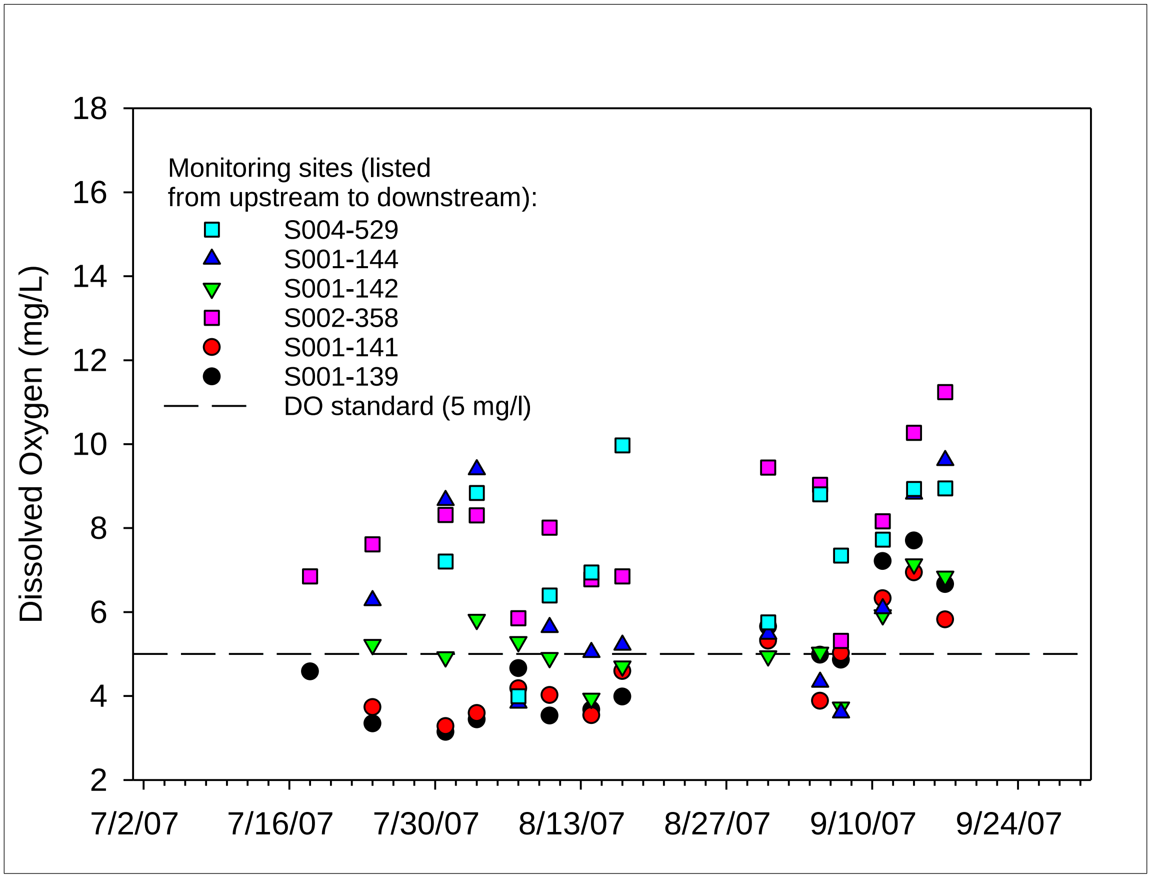
Nitrogen application through farming practices is a consideration for both surface and groundwater quality. Nitrates appearing in drinking water will be addressed through grants with MDA for nitrogen inhibitors and over all application strategies supported in this NKE plan.

4.3.4 Dissolved oxygen

Many of the streams in the planning area at times have low dissolved oxygen concentrations and/or a wide daily range of DO concentrations (MPCA 2014b). A wide daily range in DO can be caused by excessive algae or plant growth.

One reach has an aquatic life impairment due to low DO concentrations—Split Rock Creek from Split Rock Lake to Pipestone Creek (WID -507). In 2007, the DO concentration fell below the 5 mg/L standard multiple times throughout the monitored period (Figure 14). On average, concentrations were lowest at the most downstream sites (S001-139 and S001-141 in Figure 14). There are no continuous monitoring data available, and a TMDL has not yet been completed for this impairment.

Figure 14. 2007 dissolved oxygen concentrations in Split Rock Creek from Split Rock Lake to Pipestone Creek (10170203-507)



4.3.5 FIBI and MIBIs

Five reaches in the Pipestone Creek watershed were identified as impaired for fish and/or macroinvertebrates. Each reach had one or two samples sites. Four of the five reaches were classified as fish class 2 streams. Figure 15 shows the FIBI metrics for the four sites. The fifth reach was classified as a fish class 3 stream. Figure 16 shows the metrics for this stream.

Figure 15. Fish class 2 IBI metric value scores in the Pipestone Creek watershed *Average score of multiple sites

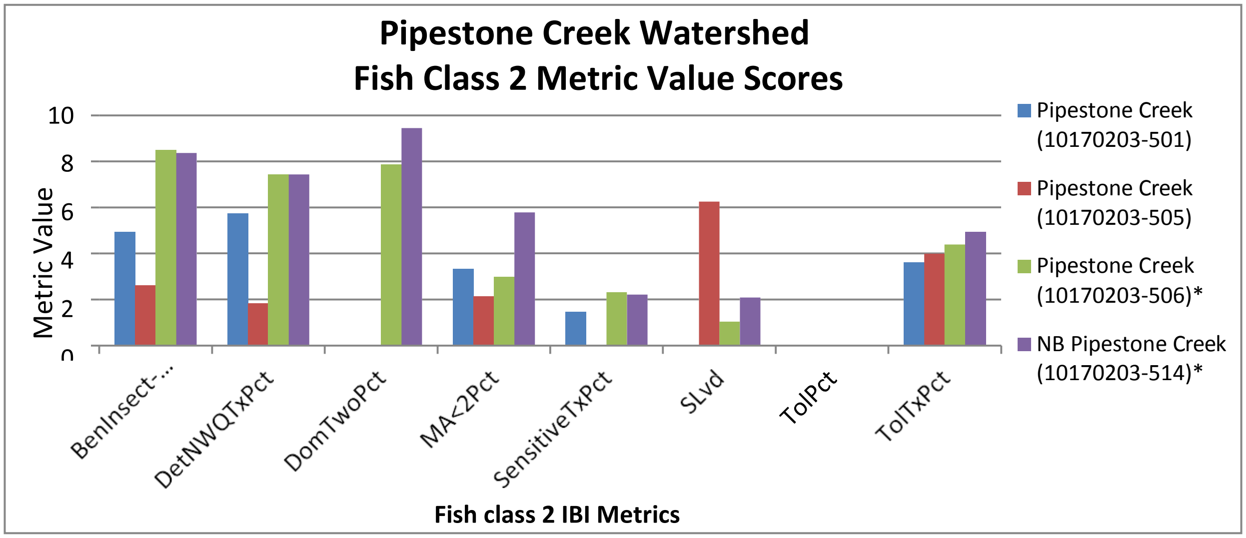
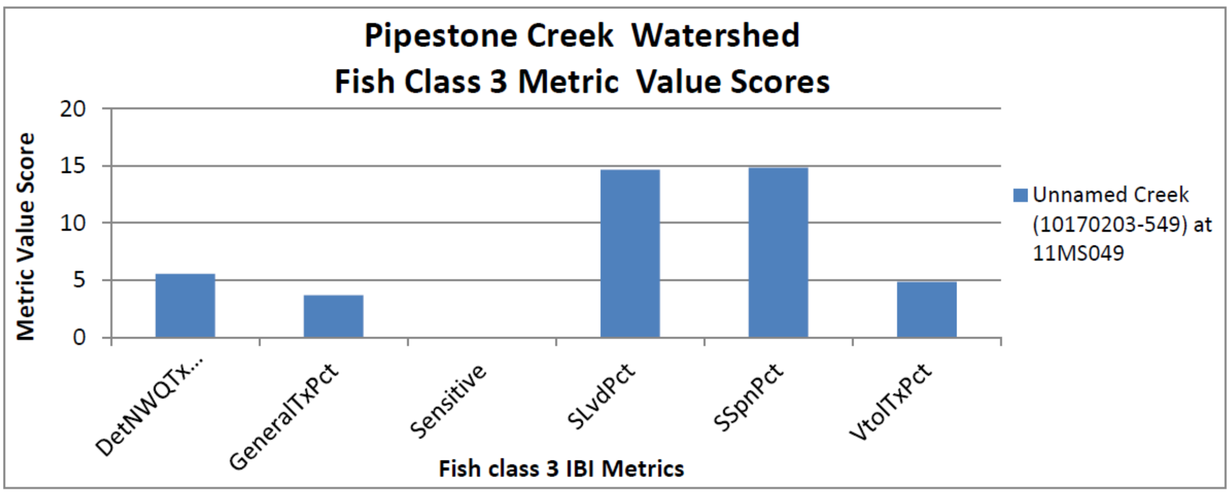


Figure 16. Fish class 3 IBI metric value scores for Unnamed Creek in the Pipestone Creek Watershed



Two of the seven reaches were classified as macroinvertebrate class 5 streams. Figure 17 shows the MIBI metrics for the two reaches. The other five reaches were classified as a macroinvertebrate class 7 streams. Figure 18 shows the MIBI metrics for these streams.

Figure 17. Macroinvertebrate class 5 IBI metric value scores in the Pipestone Creek watershed

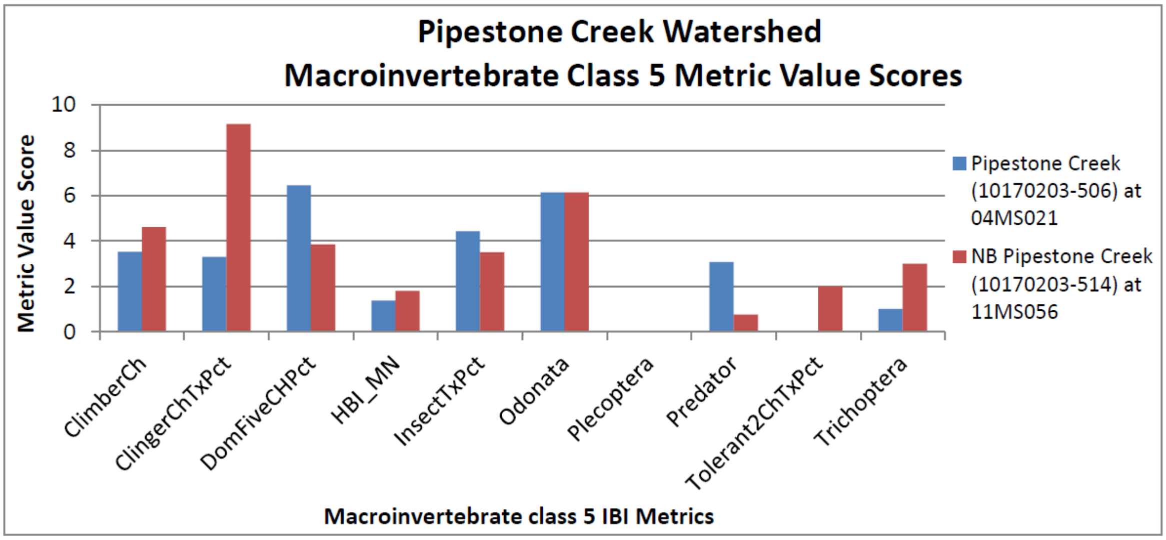
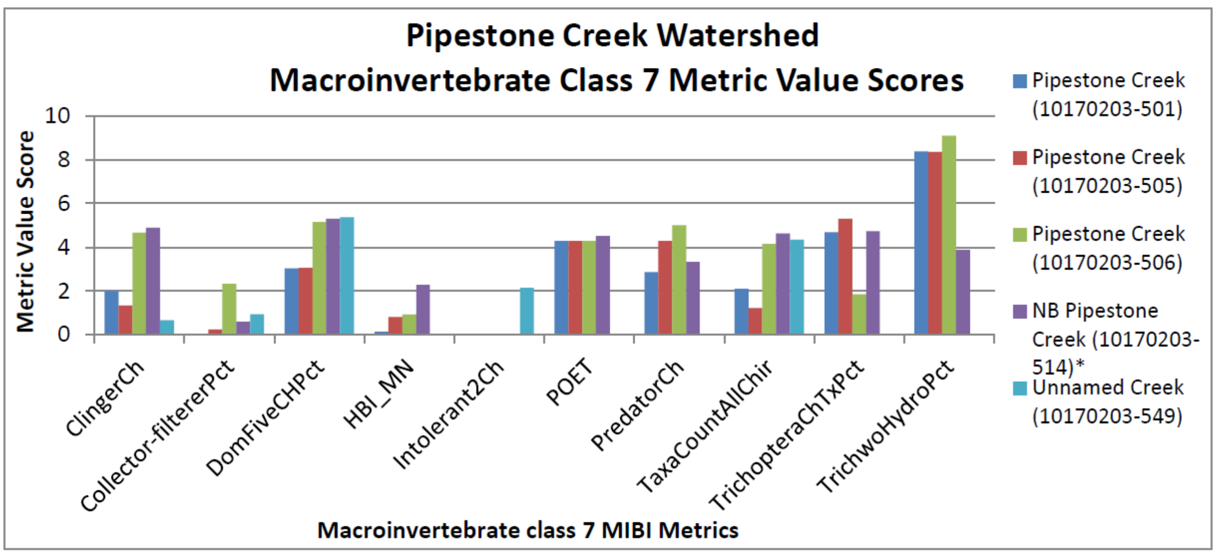


Figure 18. Macroinvertebrate class 7 IBI metric value scores in the Pipestone Creek Watershed



The Split Rock Creek Watershed contains five biologically impaired reaches. Split Rock Creek (101702033-512) is classified as a fish class 1 stream (Figure 19). The impaired stream reach, 10170203-507, located on Split Rock Creek is classified as a fish class 2 site (Figure 20). Two of the impaired AUIDS in the Split Rock Creek area are classified as class 3 streams (Figure 21).

Figure 19. Fish class 1 metric value scores at site 11MS013 along Split Rock Creek (10170203-512)

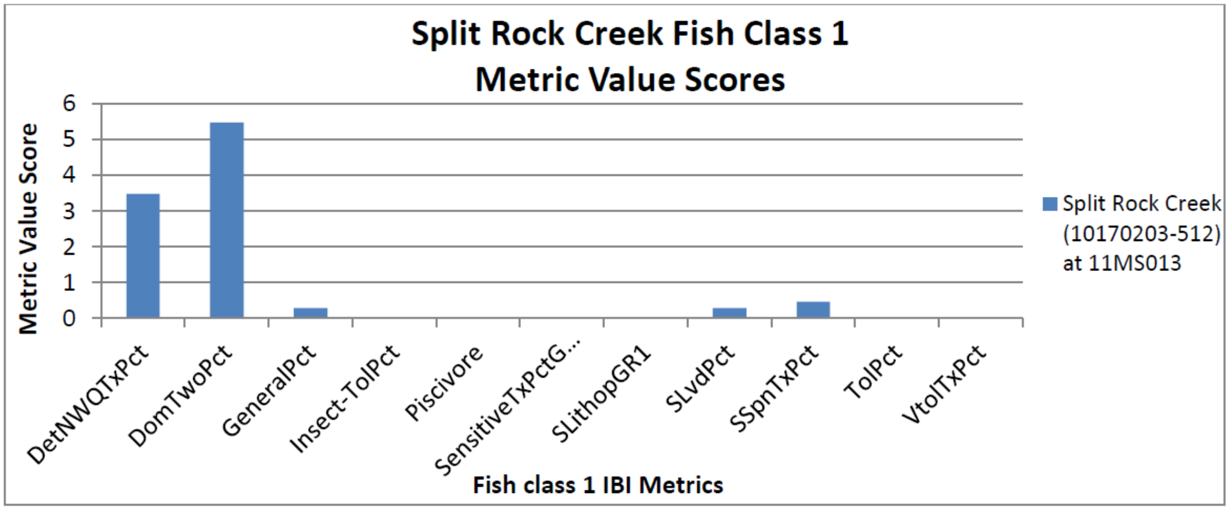


Figure 20. Fish class 2 metric value scores at sites along Split Rock Creek (10170203-507)

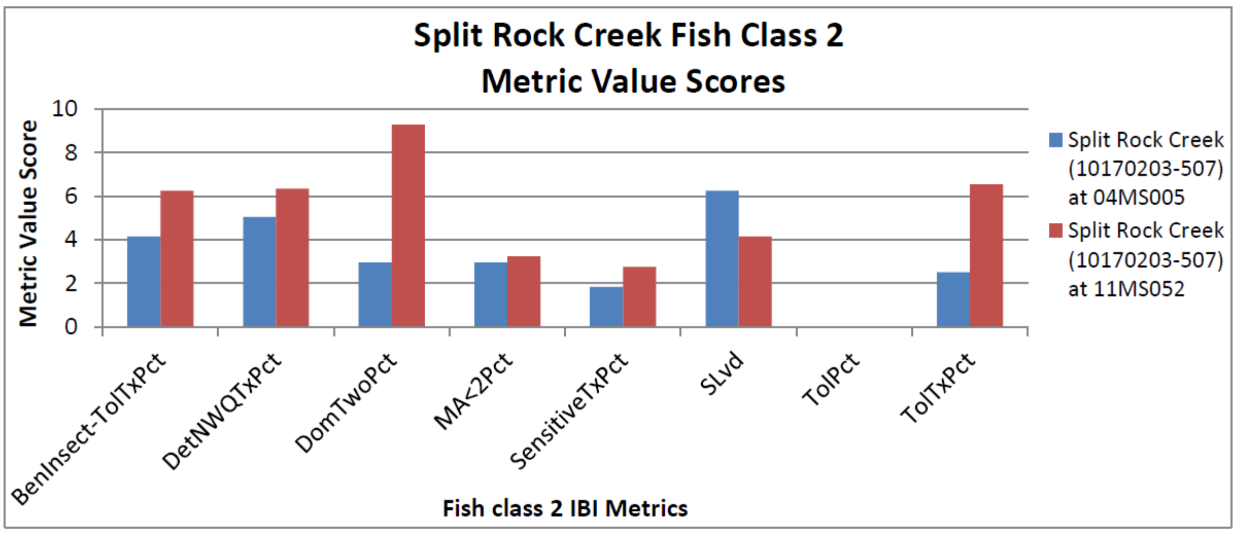
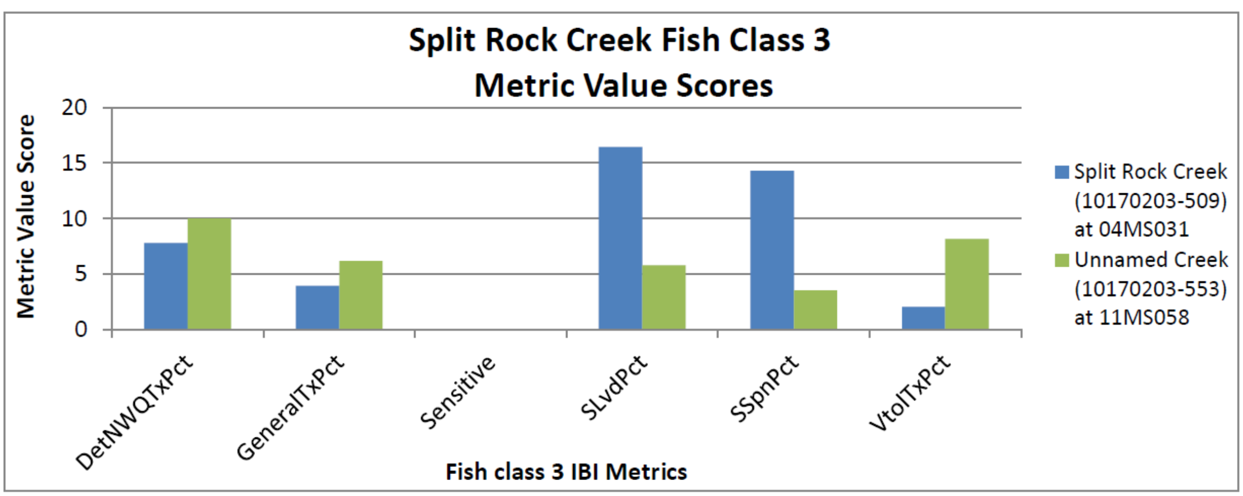


Figure 21. Fish class 3 metric value scores along two AUIDs in the Split Rock Creek watershed



Two reaches had three biological sites with a class 5 designation (Figure 22). Three reaches had three sites designated as macroinvertebrate class 7 sites (Figure 23).

Figure 22. Macroinvertebrate class 5 metric value scores at three sites in the Split Rock Creek Watershed

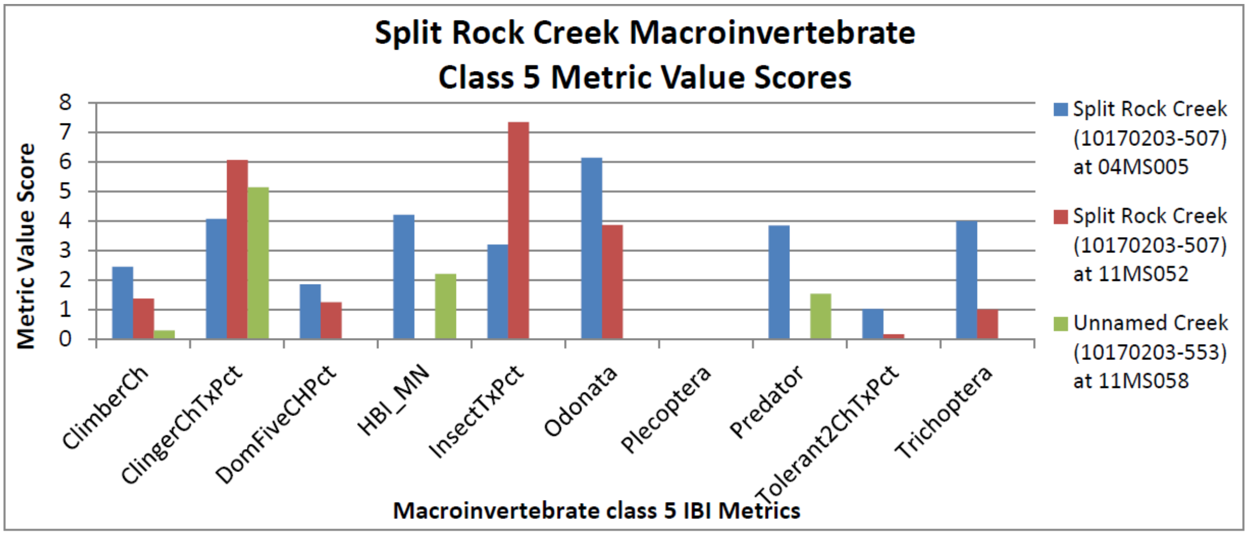
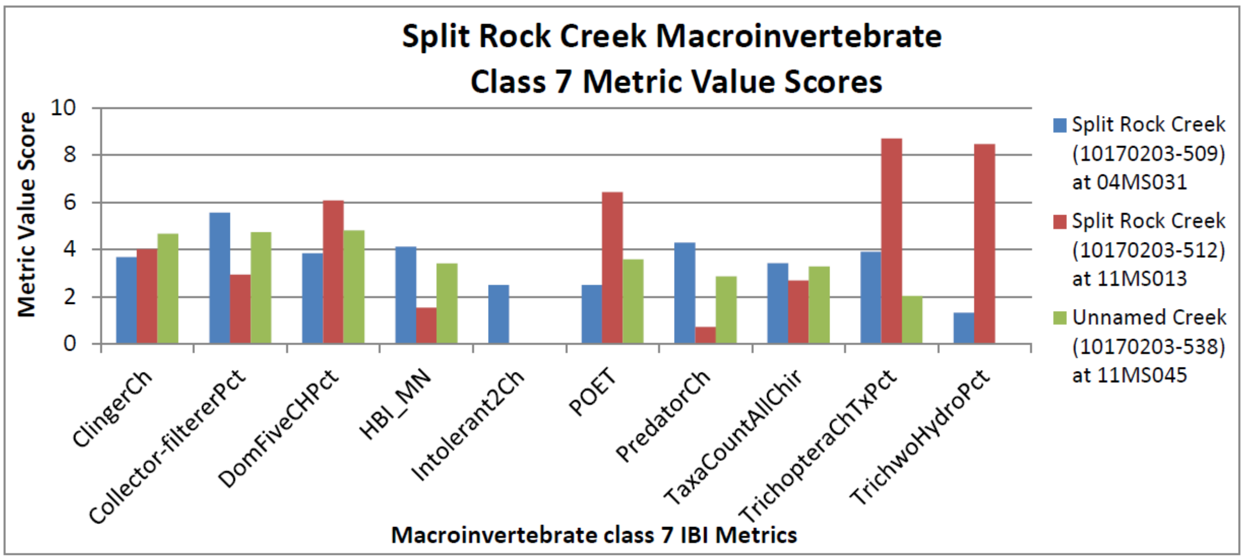


Figure 23. Macroinvertebrate class 7 metric value scores along three AUIDs in the Split Rock Creek Watershed



4.4 Stressor Identification

Stressors to waterbodies with either fish or macroinvertebrate impairments are determined through a biological stressor identification (SID) process. SIDs evaluate both pollutant and non-pollutant-related (e.g., altered hydrology, fish passage, habitat) factors as potential stressors. Table 13 summarizes the stressors associated with biological impairments. These stressors are described in more detail in the subsections that follow.

Table 13. Summary of the stressors associated with the biologically impaired reaches in the planning area (MPCA 2015)

Resource of Concern	Description	WID	Impairment	Low DO	High Phosphorus	High Nitrate	High TSS	Lack of Habitat
Pipestone Creek Watershed								
Pipestone Creek, North Branch	Headwaters to Pipestone Cr	10170203-514	Fish + Macroinvertebrates	●	●	●	●	x
Unnamed creek	Unnamed cr to N Br Pipestone Cr	10170203-549	Fish + Macroinvertebrates	●	●	x	●	●
Pipestone Creek	Headwaters to N Br Pipestone Cr	10170203-506	Fish + Macroinvertebrates		●	●	●	●
Pipestone Creek	N Br Pipestone Cr to MN/SD border (Pipestone County)	10170203-501	Fish + Macroinvertebrates	●	●	●	●	●
Split Rock Creek Watershed								
Split Rock Creek	Headwaters to Split Rock Lk	10170203-509	Fish + Macroinvertebrates	●	●		●	●
Split Rock Creek	Split Rock Lk to Pipestone Cr	10170203-507	Fish + Macroinvertebrates	x	●	x		x
Pipestone Creek	MN/SD border to Split Rock Cr (Rock County)	10170203-505	Fish + Macroinvertebrates	x	●	●	●	●
Split Rock Creek	Pipestone Cr to MN/SD border	10170203-512	Fish	●	●	x	●	●
Unnamed creek	Unnamed cr to Unnamed cr	10170203-553	Fish + Macroinvertebrates	●	●		x	x
Unnamed creek	Unnamed cr to Unnamed cr	10170203-538	Macroinvertebrates		●	x	x	●

●: stressor, x: not a stressor, blank: inconclusive or not enough evidence

5. Pollutant source assessments

The pollutant sources addressed in this NKE plan include agriculture, feedlots, stormwater, wastewater treatment, SSTS, and streambank erosion. Each is described below.

5.1 Pollutant source types

5.1.1 Agriculture

Agriculture is a source of nutrients, sediment, and bacteria. Agricultural activities include crop production (tillage, fertilizer and manure applications, drainage, etc.), livestock grazing, and feedlots. Agricultural drainage consists of public and private ditches and subsurface tile.

Cropland accounts for over 80% of the land use in each of the three watersheds.

Table 14 lists the number of animals in watersheds.

Table 14. Total number of head of livestock in each watershed

Type of livestock	Pipestone Creek Watershed	Split Rock Creek Watershed	Mound Creek Watershed
Beef	12,000	13,000	6,500
Swine	99,000	100,000	475
Sheep	6,500	600	1,300
Dairy	6,000	4,900	0
Horses	30	100	0
Bison	0	0	125

Livestock manure is a potential source of nutrient and bacteria pollution. The land application of manure is often a larger contributor to nutrient loading. Loading issues from feedlots are minimized by following the Minnesota Feedlot Rules.

5.1.2 Stormwater

Stormwater encompasses both permitted and non-permitted stormwater. Permitted stormwater includes MS4, industrial, and construction stormwater. There are no MS4s in these watersheds. There are seven industrial stormwater permits issued with addresses in the city of Pipestone. Three have stormwater runoff and four have no stormwater runoff risk. There are no industrial stormwater permits in the Split Rock and Mound Creek Watersheds in Rock County. Construction stormwater permits are required for any construction activity disturbing a) one acre or more of soil, b) less than one acre of soil if that activity is part of a "larger common plan of development or sale" that is greater than one acre, or c) less than one acre of soil, but the MPCA determines that the activity poses a risk to water resources. The TMDL estimated that 0.2% of the entire HUC8 watershed is under construction at any given time. This NKE plan assumes that the same amount of construction subject to construction stormwater permits.

Permitted industrial and construction stormwater activities are negligible contributors to pollutant loading in the watersheds.

Stormwater runoff from developed areas, mostly Pipestone, Holland, Ihlen, Jasper and Hardwick, may contribute sediment, nutrients, and bacteria to the streams but are identified as negligible sources.

5.1.4 Wastewater Treatment Plants

Two permitted wastewater treatment plants (WWTPs) located in the planning area discharge to Split Rock Creek. These permitted WWTPs are operating within their permitted limits. The wastewater treatment system for the City of Ihlen is a municipal mound treatment system that does not discharge to surface waters.

5.1.5 Subsurface sewage treatment systems

Subsurface sewage treatment systems (SSTS) for rural households may be sources of nutrients and *E. coli*. Properly functioning and maintained SSTS are not sources. Table 15 describes the estimated failure rates and number of SSTS by each watershed.

Table 15. SSTS numbers and failure rates by watershed

Watershed	# of SSTS	% SSTS failure rate	# failing SSTS
Pipestone Creek	467	5	24
Split Rock Creek	390	5	20
Mound Creek	48	17	8

5.1.6 Streambank erosion

Streambank erosion is a primary source of sediment to the streams. Erosion can be a result of limited riparian cover, excess cattle access, low channel stability, and elevated stream flows.

5.2 Pollutant-specific source summaries by land use and watershed

Pollutant sources vary by land use types and watershed. The estimated source loads using Spreadsheet Tool for Estimating Pollutant Load (STEPL) is summarized in Table 16. The User Defined land use is miscellaneous, which includes wetlands, open water, barren, and shrub/herbaceous land uses, which makes up approximately 7% of the watersheds.

Table 16. Estimated percentage source loads by watershed

Land use	Pollutant	Pipestone Creek	Split Rock Creek	Mound Creek
Urban	N	0.5	0.5	0.5
	P	0.3	0.3	0.3
	TSS	0.3	0.2	0.2
	E. coli	0.7	0.7	0.4
Cropland	N	89	83	88
	P	92	86	90
	TSS	58	40	67
	E. coli	51	48	28
Pastureland	N	7	10	8
	P	3	4	3
	TSS	1	1	2
	E. coli	9	13	6

Land use	Pollutant	Pipestone Creek	Split Rock Creek	Mound Creek
User Defined	N	0.7	0.8	1
	P	1	1	2
	TSS	5	4	6
	E. coli	1	1	0.6
Septic	N	0.1	0.1	0.4
	P	0.2	0.2	0.6
	TSS	0	0	0
	E. coli	38	37	65
Streambank	N	2	5	3
	P	4	9	4
	TSS	36	55	25
	E. coli	0	0	0

5.3 Pipestone Creek Watershed pollutant sources

The primary sources of pollution in the in the Pipestone Creek Watershed are runoff from cropland and pastures, and streambank erosion (Table 17).

Table 17. Pollutant loading by land use in the Pipestone Creek Watershed (STEPL)

	N load		P load		TSS load		*E. coli* load	
Sources	lb/yr	%	lb/yr	%	t/yr	%	Billion MPN/yr	%
Urban	2,734	0.5	422	0.3	63	0.3	932	0.7
Cropland	495,649	89	118,579	92	13,866	58	70,388	51
Pastureland	39,064	7	3,255	3	328	1	12,933	9
Miscellaneous	3,680	0.7	1,417	1	1,150	5	1,409	1
SSTS	726	0.1	284	0.2	0	0	52,024	38
Streambank	13,787	2	5,308	4	8,617	36	0	0
Total	555,640	100	129,264	100	24,024	100	137,685	100

TSS sources

The primary TSS loading sources in the Pipestone Creek Watershed identified by STEPL are cropland and streambank erosion (Table 17). The HSPF model that was used in the development of the TMDL determined that sediment loads from bed and bank erosion are the largest contributor and are influenced by channel condition and stability. The Pipestone Creek streams with biological impairments were rated as moderately unstable (Table 18) in the *Lower Big Sioux Stressor Identification* report (MPCA 2014b).

Table 18. Streambank stability ratings in Pipestone Creek Watershed

Subwatershed	Subwatershed Average Score	Subwatershed Average Rating
North Branch Pipestone Creek	51	Moderately Unstable
Upper Pipestone Creek	47	Moderately Unstable
Lower Pipestone Creek	67	Moderately Unstable

Streambank erosion is largely associated with animal disturbance of the streambank from pasturelands located along the stream (Figure 8). The watershed partners have identified that when livestock have unlimited access to stream and streambanks in pastureland, it is a significant contributor to streambank erosion and *E. coli* loading. Pastureland use is not inherently problematic, nor is limited livestock access. SRAM, described in 7.1.1, describes a mutually beneficial solution for producers and water quality. This conclusion is based on observation and information gathered from South Dakota. Pipestone Creek Watershed land uses (Figure 8) illustrates the pastureland use all along the impaired reaches of Pipestone Creek. In the professional judgement of the watershed partners, heavy pasture grazing degrades the streambank quality, increasing erosion of the banks. The practices to address pastureland and streambank loading are described in Section 7.1.1. In Figure 27, a high-level map illustrates the most vulnerable streambanks to begin the prioritization process. The watershed partners have critical areas identified in these areas through local knowledge and observation. These individual areas are not included in this document due to privacy concerns.

Cropland runoff contributes about 60% of the sediment loading as described in Table 17. The watershed partners have primarily relied upon visual surveys to target the most critical loading points. Critical areas are identified as those areas that have the highest K-factor and are within 1,000 ft of a stream. The practices to address cropland runoff are addressed in Sections 7.1.2 and 7.1.3.

Point sources are not a significant TSS source. The permitted TSS concentrations in wastewater effluent from the Pipestone is 45 mg/L as a calendar monthly average and 65 mg/L as a maximum calendar weekly average. Loading from permitted industrial stormwater is not a significant source.

E. coli

The primary sources of *E. coli* in the Pipestone Creek Watershed are cropland, failing/nonconforming SSTS, and pasture land (Table 17). Cropland manure application is a significant source of loading, especially on cropland within 1,000 feet of the stream. These areas of cropland will be considered critical loading areas and will be a focus for implementation of manure management plans.

It is estimated that approximately 5% of the SSTS are failing in the watershed, with approximately 24 systems needing upgrading or replacing. There are two unsewered communities in the planning area—Pipestone North Subdivision and Pipestone South Subdivision. They are addressing their wastewater treatment through SSTS upgrades regulated by county ordinances and funded by various sources, such as the Clean Water Fund and Clean Water Partnership (CWP) State Revolving Fund (SRF) Loan Program. Activities to address failing and nonconforming SSTS are addressed in 7.1.4.

The developed areas associated with the cities of Pipestone and Holland can be a source of *E. coli* to surface waters, but accounts for less than 1% of the modeled source identification.

The NPDES permitted Pipestone WWTP is not significant sources of *E. coli*.

Nutrients

Nutrient sources are dominated by nonpoint sources in the watersheds, with the majority of the load originating from cropland surface runoff (Table 17). Nutrient runoff from cropland is the primary focus for action in this NKE plan. Nutrient loss from cropland is associated with excess application of chemical fertilizer and manure. The second largest loading source of nutrients is from pastureland. Nutrient runoff from cropland is addressed in Sections 7.1.2 and 7.1.3.

5.4 Split Rock Creek Watershed

The primary sources of pollution by land use in the Split Creek Watershed is described in Table 19. The primary sources are runoff from cropland and pastureland, and streambank erosion.

Table 19. Split Rock Creek Watershed sources of pollutant loading (STEPL)

Sources	N Load		P Load		Sediment Load		*E. coli* load	
	lb/yr	%	lb/yr	%	t/yr	%	Billion MPN/yr	%
Urban	2,283	0.5	352	0.3	52	0.18	778	0.7
Cropland	390,793	83	93,805	86	11,541	40	55,194	48
Pastureland	45,947	10	3,851	4	408	1	15,186	13
Miscellaneous	3,590	0.8	1,382	1	1,122	4	1,295	1
SSTS	606	0.1	237	0.2	0	0.00	43,446	38
Streambank	25,276	5	9,731	9	15,798	55	0	0
Total	**468,495**	**100.0**	**109,359**	**100.0**	**28,921**	**100.00**	**115,899**	**100.0**

TSS sources

The primary TSS loading sources in the Split Rock Creek Watershed identified by STEPL (Table 19) are cropland and streambank erosion. The HSPF model that was used in the development of the TMDL determined that sediment loads from bed and bank erosion are the largest contributor and are influenced by channel condition and stability. Sediment loads from bed and bank erosion are influenced by channel condition and stability; streams with biological impairments were rated as moderately unstable (Table 20) in the *Lower Big Sioux Stressor Identification* report (MPCA 2014b).

Table 20. Streambank stability rating in Split Rock Creek Watershed

Subwatershed	Subwatershed Average Score	Subwatershed Average Rating
Upper Split Rock Creek	59	Moderately Unstable

Streambank erosion is largely associated with animal disturbance of the streambank from pasturelands located along the stream (Figure 9). The watershed partners have identified that when livestock have unlimited access to stream and streambanks in pastureland, it is a significant contributor to streambank erosion and *E. coli* loading. Pastureland use is not inherently problematic, nor is limited livestock access. SRAM, described in 7.1.1, describes a mutually beneficial solution for producers and water quality. This conclusion is based on observation and information gathered from South Dakota. Split Rock Creek Watershed land uses (Figure 9) illustrates the pastureland use all along the impaired reaches of Split Rock Creek. In the professional judgement of the watershed partners, heavy pasture grazing degrades the streambank quality, increasing erosion of the banks. The practices to address pastureland and streambank loading are described in Section 7.1.1. In Figure 27, a high-level map illustrates the most vulnerable streambanks to begin the prioritization process. The watershed partners have critical areas identified in these areas through local knowledge and observation. These individual areas are not included in this document due to privacy concerns.

Cropland runoff contributes about 40% of the sediment loading as described in Table 19. The watershed partners have primarily relied upon visual surveys to target the most critical loading points. Critical areas are identified as those areas that have the highest K-factor and are within 1,000 ft of a stream. The practices to address cropland runoff are addressed in Sections 7.1.2 and 7.1.3.

Point sources are not a significant TSS source. The permitted TSS concentrations in wastewater effluent from the Jasper WWTFs is 45 mg/L as a calendar monthly average and 65 mg/L as a maximum calendar weekly average. Loading from permitted industrial stormwater is not a significant source.

E. coli sources

The primary sources of E. coli in the Split Rock Creek Watershed are cropland, failing/nonconforming SSTS, and pasture land (Table 19). Cropland manure application is a significant source of loading, especially on cropland within 1,000 feet of the stream. These areas of cropland will be considered critical loading areas and will be a focus for implementation of manure management plans.

It is estimated that approximately 5% of the SSTS are failing in the watershed, with approximately 20 systems needing upgrading or replacing. Activities to address failing and nonconforming SSTS are described in Section 7.1.4.

The developed areas associated with the cities of Pipestone and Holland can be a source of E. coli to surface waters, but accounts for less than 1% of the modeled source identification.

The NPDES permitted Pipestone WWTP is not significant sources of E. coli.

Nutrient sources

Nutrient sources are dominated by nonpoint sources in the watersheds, with the majority of the load originating from cropland surface runoff (Table 18). Nutrient runoff from cropland is the primary focus for action in this NKE plan. Nutrient loss from cropland is associated with excess application of chemical fertilizer and manure. The second largest loading source of nutrients is from pastureland. Nutrient runoff from cropland is addressed in Sections 7.1.2 and 7.1.3.

5.5 Mound Creek Watershed

The primary sources of pollution by land use in the Split Creek Watershed is described in Table 21. The primary sources are runoff from cropland and pastureland, and streambank erosion.

Table 21. Mound Creek Watershed sources of pollutant loading (STEPL)

Sources	N load		P load		Sediment load		*E. coli* load	
	lbs/yr	%	lbs/yr	%	t/yr	%	Billion MPN/yr	%
Urban	310	0.5	48	0.3	7	0.2	106	0.4
Cropland	59,020	88	14,730	90	2,841	67	7,787	28
Pastureland	5,097	8	459	3	77	2	1,650	6

Sources	N load		P load		Sediment load		*E. coli* load	
	lbs/yr	**%**	**lbs/yr**	**%**	**t/yr**	**%**	**Billion MPN/yr**	**%**
Miscellaneous	851	1	328	2	266	6	176	0.6
SSTS	254	0.4	99	0.6	0	0	18,181	65
Streambank	1,723	3	664	4	1,077	25	0	0
Total	**67,255**	**100**	**16,327**	**100**	**4,269**	**100**	**27,899**	**100**

TSS sources

Streambank erosion is largely associated with animal disturbance of the streambank from pasturelands located along the stream (Figure 10). The watershed partners have identified that when livestock have unlimited access to stream and streambanks in pastureland, it is a significant contributor to streambank erosion and *E. coli* loading. Pastureland use is not inherently problematic, nor is limited livestock access. SRAM, described in 7.1.1, describes a mutually beneficial solution for producers and water quality. This conclusion is based on observation and information gathered from South Dakota. Mound Creek Watershed land uses (Figure 10) illustrates the pastureland use all along the impaired reach of Mound Creek. In the professional judgement of the watershed partners, heavy pasture grazing degrades the streambank quality, increasing erosion of the banks. The practices to address pastureland and streambank loading are described in Section 7.1.1. In Figure 27, a high-level map illustrates the most vulnerable streambanks to begin the prioritization process. The watershed partners have critical areas identified in these areas through local knowledge and observation. These individual areas are not included in this document due to privacy concerns.

Cropland runoff contributes almost 70% of the sediment loading as described in Table 19. The watershed partners have primarily relied upon visual surveys to target the most critical loading points. Critical areas are identified as those areas that have the highest K-factor and are within 1,000 ft of a stream. The practices to address cropland runoff are addressed in Sections 7.1.2 and 7.1.3.

Nutrient sources

Nutrient sources are dominated by nonpoint sources in the watersheds, with the majority of the load originating from cropland surface runoff (Table 19). Nutrient runoff from cropland is the primary focus for action in this NKE plan. Nutrient loss from cropland is associated with excess application of chemical fertilizer and manure. The second largest loading source of nutrients is from pastureland. The activities to address nutrient runoff are addressed in Sections 7.1.2 and 7.1.3.

There are no *E. coli* impairments in Mound Creek; however, failing and nonconforming SSTS activities for the watershed are described in Section 7.1.4.

5.6 TMDLs

TMDLs were developed in the *Pipestone Creek Fecal Coliform Bacteria and Turbidity Total Maximum Daily Load Report* (MPCA 2008) and the *Missouri River Basin Total Maximum Daily Load: Lower Big Sioux River, Little Sioux River, and Rock River Watersheds* (Wenck Associates 2018) for load-based impairments in the planning area. Table 22 lists the summaries of the TMDLs were developed and, where available, the percent load reductions needed to achieve the TMDL.

Table 22. TMDL reports addressing planning area impairments and recommended reductions

Waterbody name and description	WID	TMDL report	TMDL Pollutant	% TSS/turbidity reduction	% *E. coli*/fecal coliform reduction
Pipestone Creek, North Branch(Headwaters to Pipestone Cr)	10170203-514	2008	TSS and fecal coliform	26%	77%
Main Ditch(CD A to Pipestone Cr)	10170203-527	2008	TSS and fecal coliform	26%	77%
Pipestone Creek(N Br Pipestone Cr to MN/SD border (Pipestone County))	10170203-501	2008	TSS and fecal coliform	26%	75%
Pipestone Creek(MN/SD border to Split Rock Cr (Rock County))	10170203-505	2018	E. coli		77%
Split Rock Creek(Pipestone Cr to MN/SD border)	10170203-512	2018	TSS and *E. coli*	85%	67%
Mound Creek(Unnamed Cr to T103 R45W S24, east line)	10170204-551	2018	E. coli		93%

The TMDLs for Pipestone Creek (-505), Split Rock Creek (-512), and Mound Creek (-551) were completed as part of the *Missouri River Basin TMDL (2018)* for TSS and *E. coli*. Split Rock Creek is the only reach with a TSS TMDL. The *Pipestone Creek Fecal Coliform and Turbidity TMDL* (2008) addresses Pipestone Creek (-501, -514, and -527). Table 23 through Table 32 present the TMDLs for the stream reaches.

Table 23. Pipestone Creek (-505) *E. coli* TMDL

		Flow Zone*				
		Very High	High	Mid	Low	Very Low
		***E. coli* Load (billions of organisms/day)**				
Wasteload	Total WLA	48.5	48.5	48.5	48.5	**
	Pipestone WWTP	48.5	48.5	48.5	48.5	**
Load	Total LA	848.26	161.83	43.84	6.94	**
	MN Watershed Nonpoint Sources	582.75	111.18	30.12	4.77	**
	SD Watershed Nonpoint Sources	265.51	50.65	13.72	2.17	**
MOS		99.64	23.37	10.26	6.16	3.64
TOTAL LOAD (TMDL)		996.4	233.7	102.6	61.6	36.4
Existing Load (geomean of observed data)		2,471	309	218	5	160
Estimated Reduction (%)		60%	24%	53%	0%	77%

* HSPF simulated flow was used to develop the flow zones and loading capacities for this reach.

** The WLA and LA in the very low flow zone are determined by the following formula: Allocation = (flow contribution from a given source) X (E. coli concentration limit or standard).

Table 24. Split Rock Creek (-512) *E. coli* TMDL

		Flow Zone*				
		Very High	High	Mid	Low	Very Low
		***E. coli* Load (billions of organisms/day)**				
Wasteload	Total WLA	53.2	53.2	53.2	53.2	**
	Pipestone WWTP	48.5	48.5	48.5	48.5	**
	Jasper WWTP	4.7	4.7	4.7	4.7	**
Load	Total LA	2,038.04	340.37	95.21	27.26	**
	MN Watershed Nonpoint Sources	1608.01	268.55	75.12	21.51	**
	SD Watershed Nonpoint Sources	430.03	71.82	20.09	5.75	**
MOS		232.36	43.73	16.49	8.94	4
TOTAL LOAD (TMDL)		2,323.6	437.3	164.9	89.4	40.0
Existing Load (geomean of observed data)		4,268	975	503	34	102
Estimated Reduction (%)		46%	55%	67%	0%	61%

* HSPF simulated flow was used to develop the flow zones and loading capacities for this reach.

** The WLA and LA in the very low flow zone are determined by the following formula: Allocation = (flow contribution from a given source) X (E. coli concentration limit or standard).

Table 25. Split Rock Creek (-512) TSS TMDL

	Flow Zone*				
	Very High	High	Mid	Low	Very Low
	TSS Load (pounds/day)				
Total WLA	3,080	2,778	2,734	2,722	**
Total LA	151,222.3	26,346.9	8,263.1	3,203.6	**
MOS	17,144.7	3,236.1	1,221.9	658.4	293.5
TOTAL LOAD (TMDL)	171,447	32,361	12,219	6,584	2,935
Existing Load (90th percentile of observed data)	1,123,636	89,617	13,724	7,495	3,025
Estimated Reduction (%)	85%	64%	11%	12%	3%

* HSPF simulated flow was used to develop the flow zones and loading capacities for this reach.

** The WLA and LA in the very low flow zone are determined by the following formula: Allocation = (flow contribution from a given source) X (E. coli concentration limit or standard).

Table 26. Mound Creek (-551) *E. coli* TMDL

	Flow Zone*				
	Very High	High	Mid	Low	Very Low
	E. coli Load (billions of organisms/day)				
Total WLA	0.0	0.0	0.0	0.0	0.0
Total LA	141.39	28.8	12.6	6.39	2.79
MOS	15.71	3.2	1.4	0.71	0.31
TOTAL LOAD (TMDL)	157.1	32.0	14.0	7.1	3.1
Existing Load (geomean of observed data)	2,394	27	3	3	2
Estimated Reduction (%)	93%	0%	0%	0%	0%

* HSPF simulated flow was used to develop the flow zones and loading capacities for this reach.

Table 27. Pipestone Creek (-501) fecal coliform TMDL

	FLOW ZONE				
	High	Moist	Mid	Dry	Low
	Billion organisms per day				
Average Total Daily Loading Capacity	541	139	61	32	12
Wasteload Allocation	25	25	25	25	*
Load Allocation	286	57	20	7	*
Margin of Safety	231	57	17	Implicit	Implicit

* The total daily loading capacities in the dry and low flow zone are very small due to the occurrence of very low flows in the long-term flow records.

Table 28. Pipestone Creek (-501) turbidity TMDL

	FLOW ZONE				
	High	**Moist**	**Mid**	**Dry**	**Low**
	Tons TSS per day				
Total Daily Loading Capacity	16.1	4.1	1.8	0.9	0.3
Wasteload Allocation	0.62	0.62	0.62	*	*
Load Allocation	8.6	1.8	0.7	*	*
Margin of Safety	6.9	1.7	0.5	Implicit	Implicit

* The total daily loading capacities in the dry and low flow zone are very small due to the occurrence of very low flows in the long-term flow records.

Table 29. Pipestone Creek (-514) fecal coliform TMDL

	FLOW ZONE				
	High	**Moist**	**Mid**	**Dry**	**Low**
	Billion organisms per day				
Average Total Daily Loading Capacity	287	74	33	17	6
Wasteload Allocation	0	0	0	0	0
Load Allocation	165	43	24	9	3
Margin of Safety	123	30	9	7	4

Table 30. Pipestone Creek (-514) turbidity TMDL

	FLOW ZONE				
	High	**Moist**	**Mid**	**Dry**	**Low**
	Tons TSS per day				
Total Daily Loading Capacity	8.5	2.2	1.0	0.5	0.2
Wasteload Allocation					
Lincoln Pipestone Holland Well Water Trt Fac	0.02	0.02	0.02	0.02	0.02
Load Allocation	4.9	1.3	0.7	0.3	0.06
Margin of Safety	3.6	0.9	0.3	0.2	0.1

Table 31. Pipestone Creek (-527) fecal coliform TMDL

	FLOW ZONE				
	High	**Moist**	**Mid**	**Dry**	**Low**
	Billion organisms per day				
Average Total Daily Loading Capacity	142	37	16	8	3
Wasteload Allocation					
"Straight Pipe" Septic Systems	0	0	0	0	0
Load Allocation	81	21	12	5	1
Margin of Safety	61	15	4	4	2

Table 32. Pipestone Creek (-527) turbidity TMDL

	FLOW ZONE				
	High	**Moist**	**Mid**	**Dry**	**Low**
	Tons TSS per day				
Total Daily Loading Capacity	4.2	1.1	0.5	0.2	0.09
Wasteload Allocation					
Load Allocation	2.4	0.6	0.3	0.1	0.04
Margin of Safety	1.8	0.4	0.1	0.1	0.05

The standard was exceeded across multiple flow zones, indicating a variety of sources (Figure 24 through Figure 26). Concentrations are higher on average in wet conditions. Two TMDLs reports cover these stream reaches: *Pipestone Creek Fecal Coliform Bacteria and Turbidity Total Maximum Daily Load Report (2008)* and *Missouri River Basin TMDL Report (2018)*. For the purposes of this plan, *E. coli* will be used as the parameter for bacteria impairments.

Figure 24. Fecal coliform load duration curve for Pipestone Creek (WID 10170203-501) near the MN-SD border (1984–2004 data, figure from MPCA 2008)

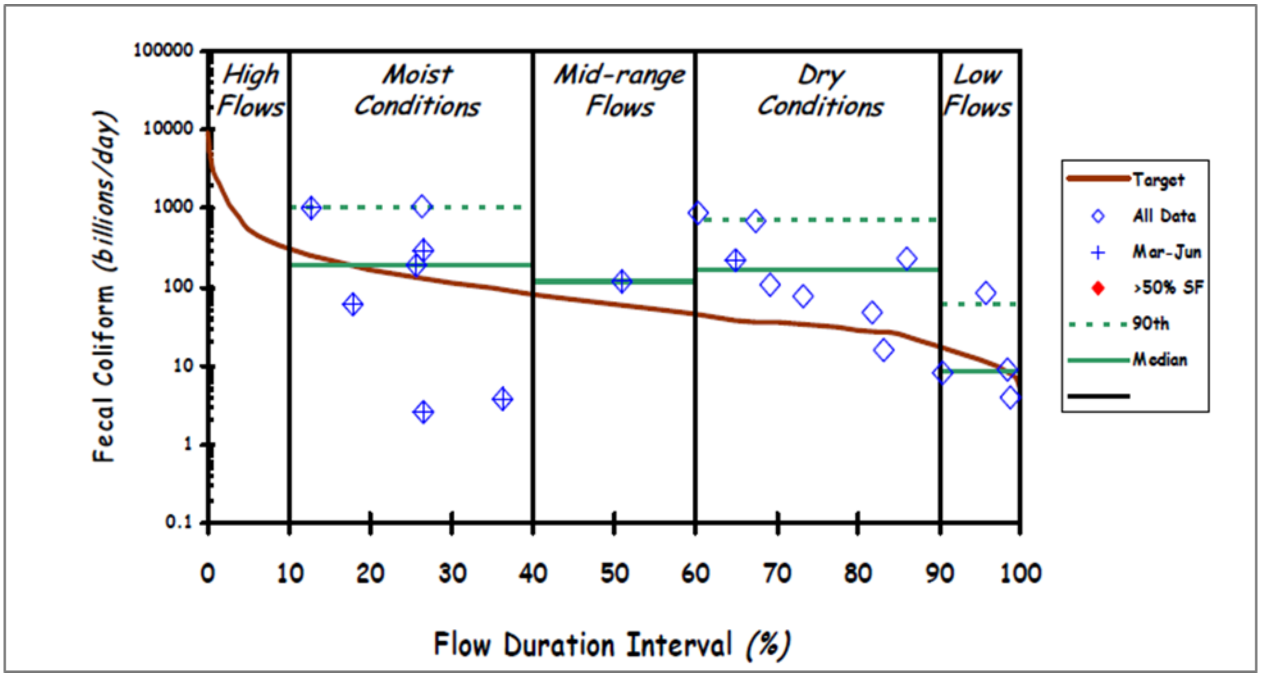


Figure 25. . E. coli load duration curve for Split Rock Creek (WID 10170203-512; figure modified from Wenck Associates 2018)

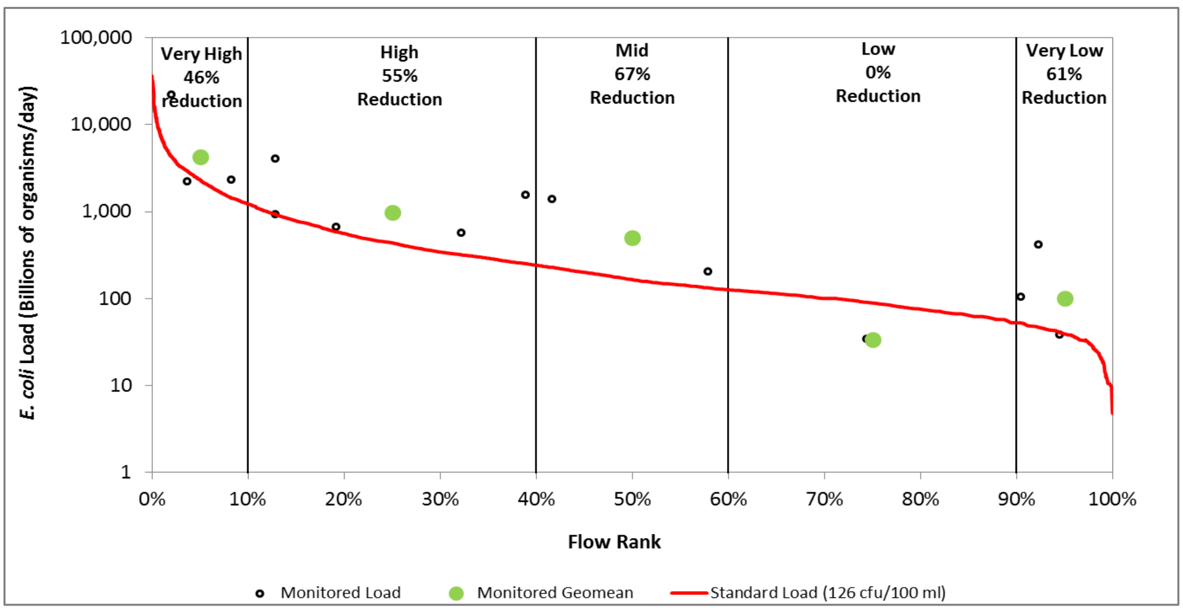
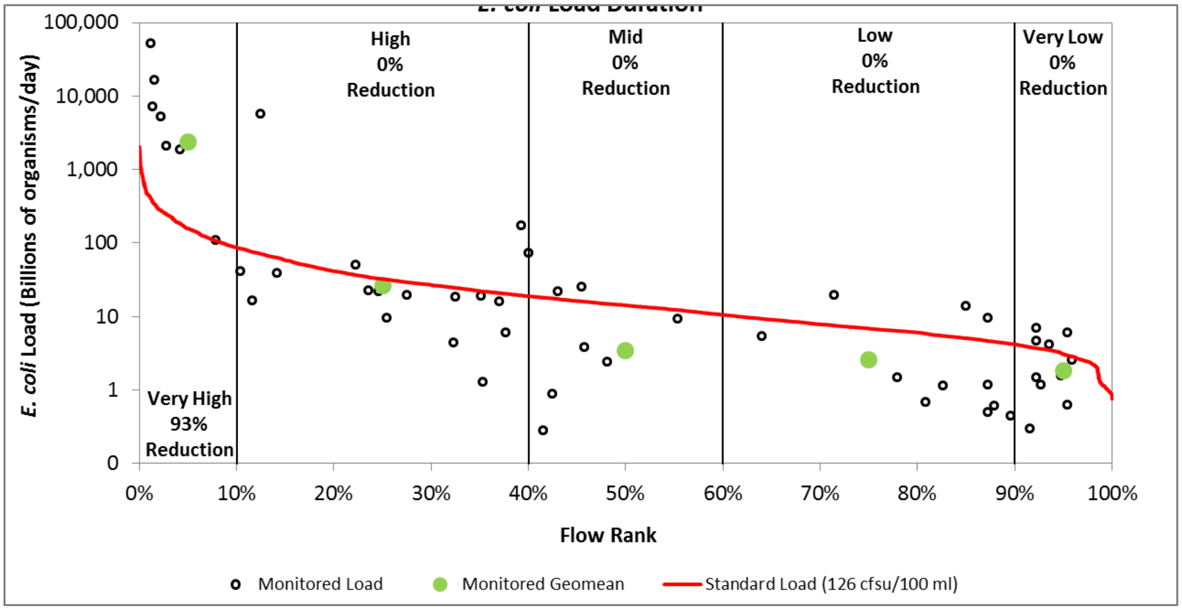


Figure 26. *E. coli* load duration curve for Mound Creek (WID 10170204-551; figure modified from Wenck Associates 2018)



6. Watershed goals

The watershed partners' goals are to provide good water quality for the many public recreational opportunities exist at the Pipestone National Monument, Split Rock Creek State Park, and Blue Mounds State Park. This includes the restoration of the creek through the Pipestone National Monument, a significant historical and cultural area. The Split Rock Creek State Park provides areas for camping, water recreation, swimming, fishing, wildlife/waterfowl observation, hiking, and horse riding trails for area residents and beyond. The Blue Mounds State Park is also an area for camping, hiking, rock climbing, wildlife and bison viewing, and observing native prairie wildflowers and grasses.

These areas of import are negatively affected by the poor water quality of the streams. When visiting these parks, visitors are warned to avoid contact with the water due to bacterial impairments. Further, the habitat of the fish and insects is negatively impacted by the low DO, TSS and nutrient/eutrophication.

One of the primary focus of action for the watershed partners is to address the riparian pasture areas. The partners have been working with South Dakota and have observed success by Skunk Creek being delisted for TSS. Skunk Creek is in the same river basin and share many land use and geological and hydrological similarities to Pipestone, Split Rock, and Mound Creeks. The SWCDs have identified critical TSS and *E. coli* loading is a result of livestock in these streams and the use of SRAM is the optimal BMP. This BMP is ideal because it gives the landowners the ability to continue to benefit from the riparian areas while still getting water quality on track to meet and exceed standards. The use of new and innovative practices is the definition of an adaptive management approach which is necessary for successful implementation.

Overall goals include:

- Restore water quality to meet standards for the streams in the Pipestone Creek, Split Rock Creek, and Mound Creek Watersheds
- Maintain standards and protection of water bodies currently meeting water quality standards
- Promote grazing management and riparian restoration
- Promote soil health practices on all cropland
- Maintain agricultural production for watershed producers

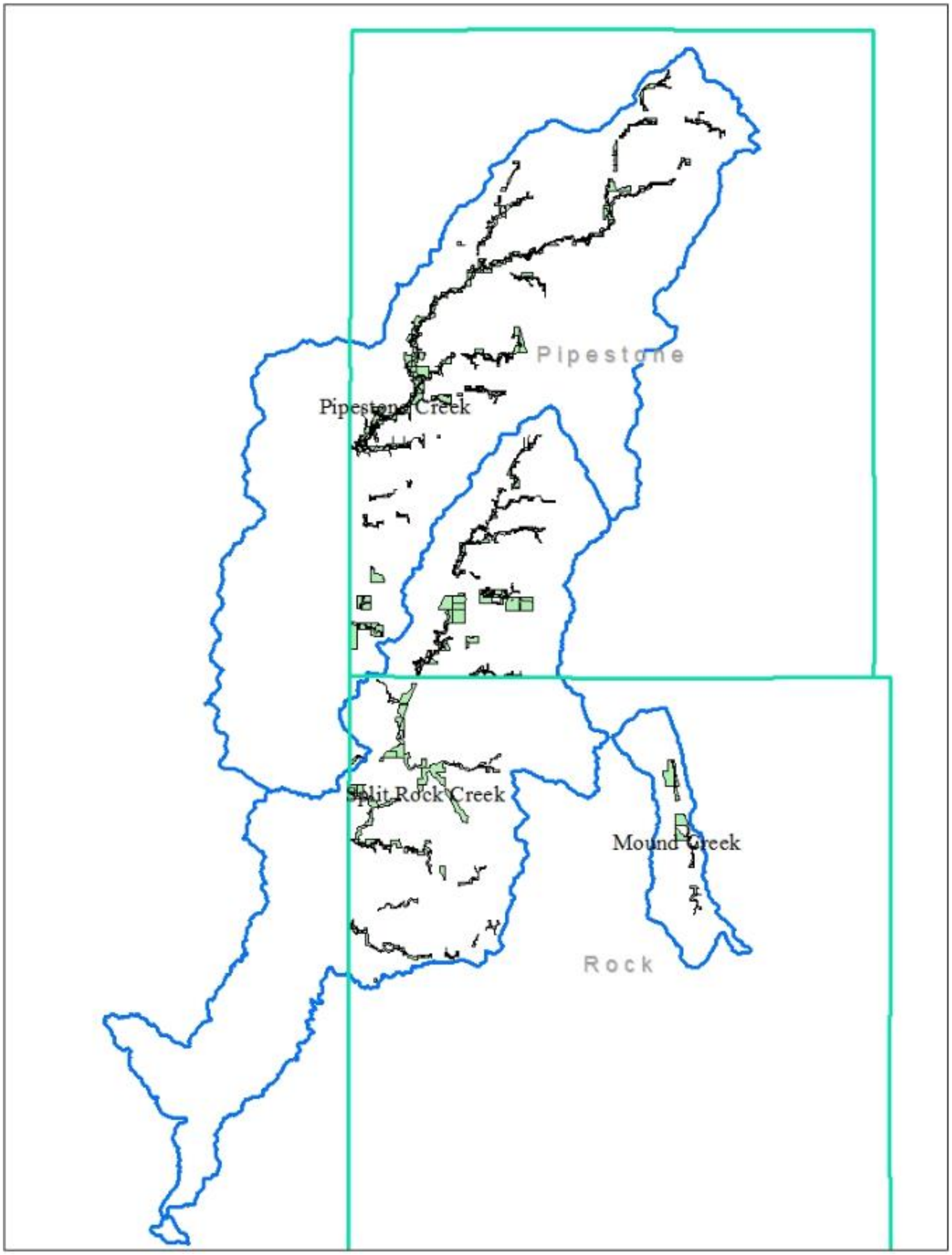
6.1 Priorities and critical areas

Priority 1 riparian pasture areas

The erodibility index completed for riparian pasture areas in Figure 27 identify critical areas for SRAM implementation. Details for SRAM are in Section 7.1.1. Figure 27 is intentionally high-level to avoid privacy concerns by identifying specific producers; however, the SWCDs and partners have specific information that will remain non-public.

The watershed partners have analyzed the data from soil and streambank erodibility and targeted specific areas with higher likelihood of deterioration. To augment the desktop analysis, they have conducted field/pasture surveys with producers to further target the most erosive areas, especially where livestock overgrazing has resulted in excessive streambank erosion and poor channel conditions. Livestock manure runoff and direct access to the streams contributes to elevated *E. coli*. These areas are the most critical area for TSS, *E. coli*, and stream habitat. There is a secondary benefit of reducing nutrient loading.

Figure 27. Riparian area pastures to be targeted for SRAM



Priority 2 cropland

Cropland is a primary source of TSS, *E. coli* and nutrients. TSS is largely a result of surface runoff causing erosion. *E. coli* is primarily from surface runoff of manure applied to the fields. Nutrient contributions are a combination of manure and chemical fertilizer carried by field runoff and tile drainage. Critical areas have been identified using the soil erosion and slope analysis and by visual identification of high erosion in the fields (Figure 28, Figure 29, and Figure 30). Cropland located near streams is likely a greater contributor of pollutants. These areas will be targeted for agricultural BMPs, especially activities and practices to increase soil health as described in Section 7.1.2.

Figure 28. Soil erodibility in the Pipestone Creek Watershed (white areas represent a data gap)

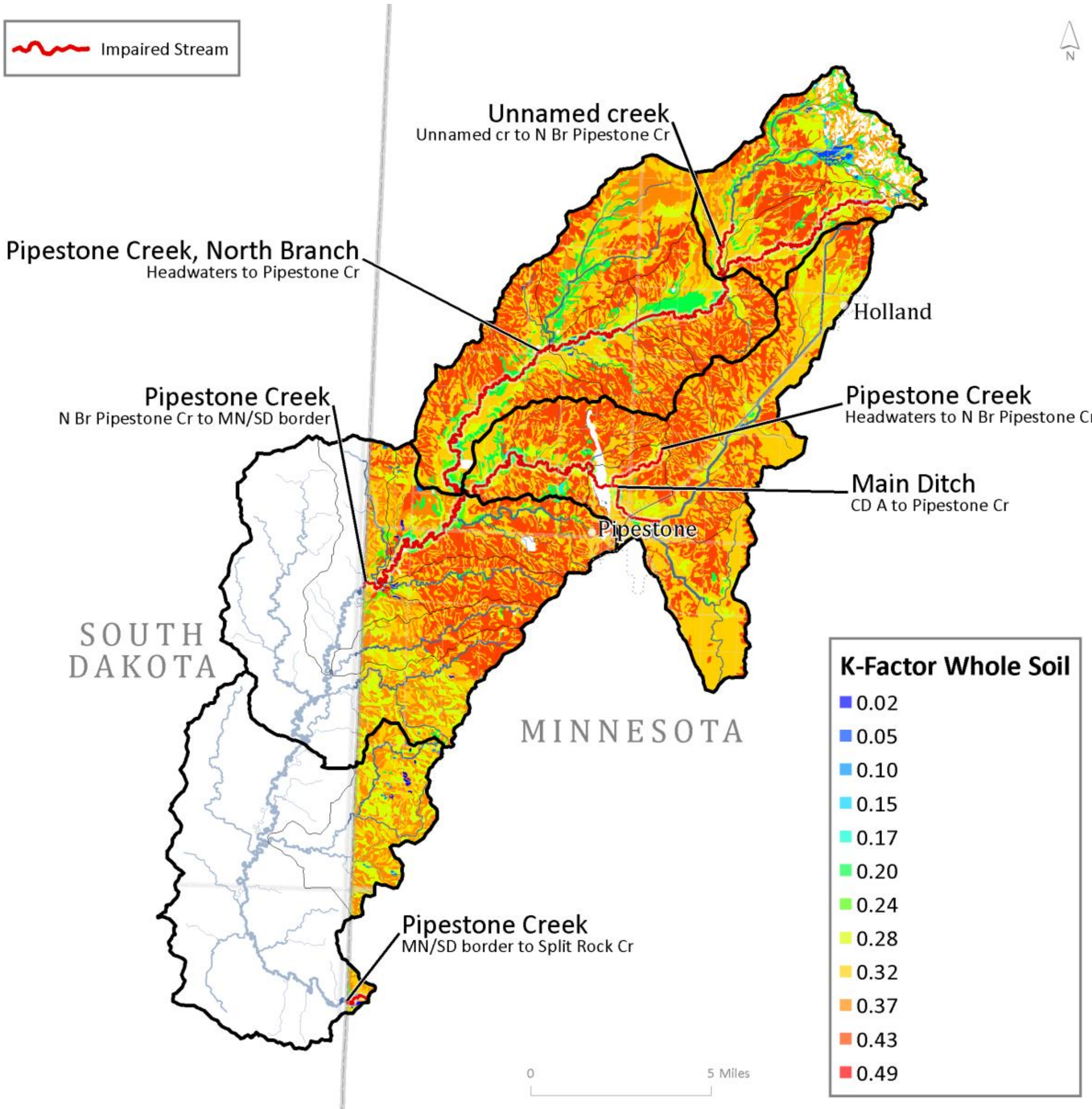


Figure 29. Soil erodibility in the Split Rock Creek Watershed (white areas represent a data gap)

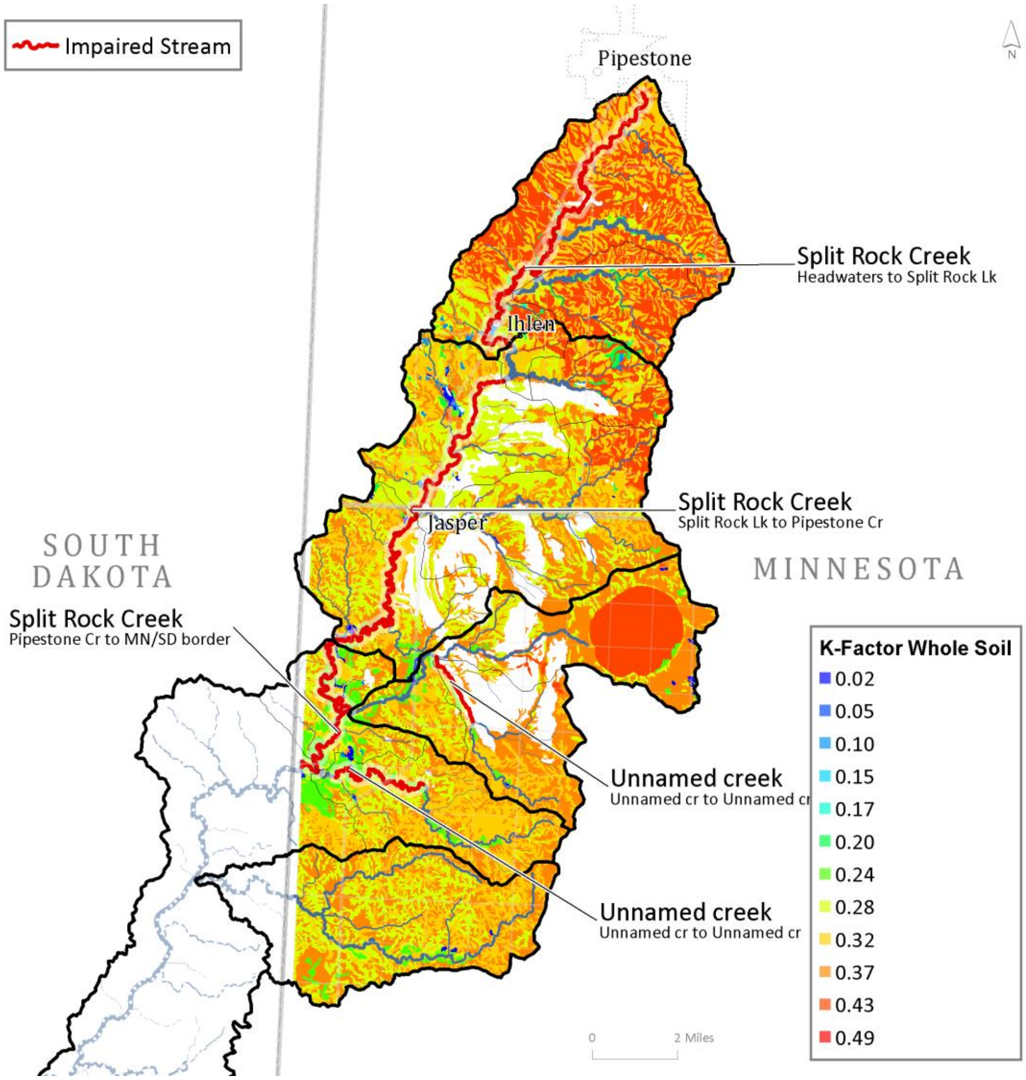
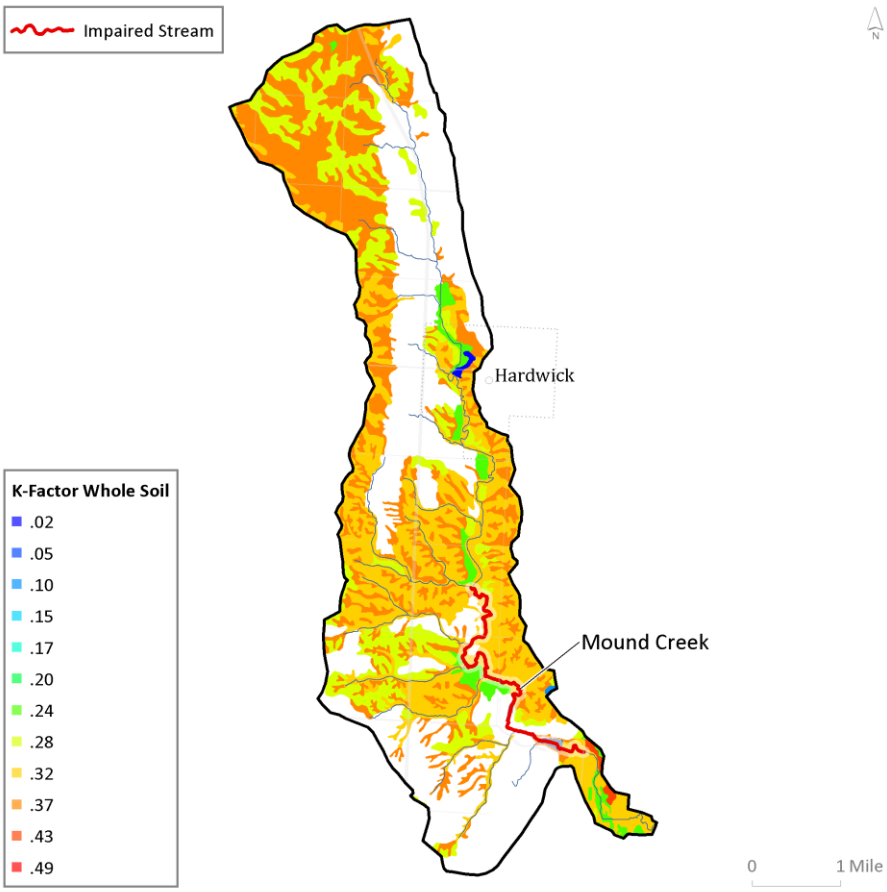


Figure 30. Soil erodibility in the Mound Creek Watershed (white areas represent a data gap)



Priority 3 Failing/noncompliant SSTS

In all three watersheds, all failing or noncompliant SSTS are considered critical for replacement or upgrading to full functionality. Failing and noncompliant SSTS are significant contributors of *E. coli* loading and are a source of nutrient loading. All failing SSTS will be upgraded and replaced as necessary over the next ten years.

7. Management strategies and activities

7.1 Implementation strategies

The implementation strategies for this NKE Plan are provided in Table 36, Table 40, and Table 44. Each table includes the strategy, schedule, milestones, assessment criteria, and costs for each activity. Implementation progress will be tracked against a two-year milestone for each management activity or strategy. More information about each strategy or activity is provided in the following sections.

Reductions have been calculated using STEPL (Section 7.2). It is expected that practices described in this plan will achieve water quality standards when fully implemented. Every two years, the progress of the plan will be checked against the milestones to determine any necessary course corrections and milestones will be added. It is expected that the BMPs included in this plan will achieve water quality standards, if implemented to the levels described.

Federal Clean Water Act Section 319 funding approval note

As of 5/4/2020, this NKE plan is only approved for funding projects in the following HUC12s

Table 33. As of 5/4/2020, the following HUC12 are approved for funding for Pipestone Creek Watershed

	MN		**MN**		**MN**	
	101702031301		**101702031302**		**101702031303**	
	County Ditch A – Pipestone Creek		**Upper North Branch Pipestone Creek**		**Lower North Branch Pipestone Creek**	
	Acres	**%**	**Acres**	**%**	**Acres**	**%**
Developed	1,972	7	528	4	949	4
Pasture/grassland	1,806	6	1,837	13	2,156	8
Cultivated Crop	24,672	86	11,054	79	23,103	86
Wetlands	108	0	538	4	705	3
Miscellaneous	153	1	29	0	51	0
Total	**28,712**	**100**	**13,986**	**100**	**26,965**	**100**

Table 34. As of 5/4/2020, the following HUC12s are approved for funding Split Rock Creek Watershed

	MN		**MN**		**MN**	
	101702031601		**101702031602**		**101702031603**	
	Headwaters Split Rock Creek		**City of Jasper – Split Rock Creek**		**101702031603**	
	Acres	**%**	**Acres**	**%**	**Acres**	**%**
Developed	1,081	6.4	1,278	4.5	578	3.9
Pasture/ grassland	1,299	7.7	5,231	18.5	1,497	10.2
Cultivated Crop	14,410	85.0	21,197	74.8	12,455	84.6
Wetlands	75	0.4	316	1.1	128	0.9
Miscellaneous	85	0.5	317	1.1	67	0.5
Total	**16,950**	**100**	**28,338**	**100**	**14,724**	**100**

Table 35. All of the Mound Creek Watershed is approved for funding

Description	**MN**	
	101702040109	
	Mound Creek	
	Acres	**%**
Developed	394	3.5
Pasture/grassland	2,462	22.2
Cultivated Crop	8,098	72.9
Wetlands	54	0.5
Miscellaneous	98	0.9
Total	**11,106**	**100.0**

7.1.1 SRAM

The watershed partners have determined that the most critical TSS and *E. coli* loading are coming from streambanks in pasture lands. These areas will be the focus of restoration and pastureland BMPs to address these issues (Figure 27).

SRAM is a flexible conservation program designed with the producer in mind. While many other conservation programs remove acres from production, the intent of the SRAM program is to allow those acres, that would otherwise have been removed, to remain in production but still provide the ability to enhance conservation and improve water quality The SRAM program is essentially a 6-month deferred grazing program for those portions of a pasture that lie within a 100-year floodplain of a stream. A minimum of 30’ up to 120’ max or extent of floodplain with up to 10% round out. During this time,

Figure 31 Figure 32. Before and after implementation of SRAM in Skunk Creek, South Dakota

grazing livestock will be given an alternative water source, as they will not be permitted access to the watercourse allowing riparian areas to heal. Producers enter into contracts with the local Soil and Water Conservation District (SWCD) where they are incentivized to manage their pasture as specified in the management plan. Overgrazing can often lead to negative impacts to the watercourse and aquatic life by increasing erosion; promote sedimentation, increase nutrient and bacterial loading (e.g. *E. coli*). These negative impacts are not only detrimental to aquatic life but also to human and livestock health as well. The SRAM activities include the natural restoration of streambanks as shown in Figure 32.

Our neighbors to the west in Moody County, South Dakota, are successfully implementing an SRAM program. Results have shown tremendous reductions in TSS and *E. coli* in the Skunk Creek Watershed, their project area. This program was such a success that Skunk Creek has now been delisted for TSS. According to the EPA's SRAM Success Story (Appendix B), approximately 1,200 acres of SRAM yielded estimated reductions of 45,371 lbs/yr N, 14,331 lbs/yr P, 3,203 t/yr sediment, and 1.9E+10 *E. coli*. It is our hope that by implementing SRAM in our three project areas (Pipestone Creek, Split Rock Creek, and Mound Creek), we will be able to produce similar results.

Education and outreach activities for Pipestone, Split Rock, and Mound Creeks SRAM are described in Table 36. SRAM activities for Pipestone Creek are Table 37 , for Split Rock Creek Table 38, and for Mound Creek Table 39. Reduction estimates for SRAM include both the upland pasture practices and streambank restoration, as described in Appendix A and Section 7.2.

Table 36. Education and outreach activities, milestones, goals, and assessments for SRAM BMPs

Practices	Milestones					Long-Term Goals	Assessment	Costs
	2-year (2022)	4-year (2024)	6-year (2026)	8-year (2028)	10-year (2030)			
Landowner outreach for SRAM	Promotion/outreach of the program and target 10 willing landowners	Promotion/outreach of the program and target 10 willing landowners	Promotion/outreach of the program and target 10 willing landowners	Promotion/outreach of the program and target 10 willing landowners	Promotion/outreach of the program and target 10 willing landowners	All landowners practicing SRAM	# of landowners contacted	$5,000
Outreach and education position for SRAM (.33 FTE)	Coordinate efforts, conduct outreach, provide technical assistance, track progress, and plan events	Coordinate efforts, conduct outreach, provide technical assistance, track progress, and plan events	Coordinate efforts, conduct outreach, provide technical assistance, track progress, and plan events Assess effectiveness of outreach efforts and adjust	Coordinate efforts, conduct outreach, provide technical assistance, track progress, and plan events	Coordinate efforts, conduct outreach, provide technical assistance, track progress, and plan events	Staff capacity to fully implement SRAM	# of interactions with landowners # of enrollees # of new contacts	$330,000

Table 37. Implementation activities, milestones, goals, and assessments for SRAM BMPs in Pipestone Creek Watershed

Practices	Milestones					Long-Term Goals	Assessment	Costs
	2-year (2022)	4-year (2024)	6-year (2026)	8-year (2028)	10-year (2030)			
SRAM implementation (restoring streambanks to decrease erosion and increase habitats	1.6 mi in Pipestone Creek streambank	1.6 mi in Pipestone Creek streambank	1.6 mi in Pipestone Creek streambank	1.6 mi in Pipestone Creek streambank	1.6 mi in Pipestone Creek streambank	Streambank restoration of 8 miles of stream (as part of the SRAM)	# miles of stream	$177,776
Grazing Land Management (rotational grazing with fenced areas)	2,069.4 acres added in grazing land management in Pipestone Creek	2,069.4 acres added in grazing land management in Pipestone Creek	2,069.4 acres added in grazing land management in Pipestone Creek	2,069.4 acres added in grazing land management in Pipestone Creek	2,069.4 acres added in grazing land management in Pipestone Creek	All pastureland with grazing land management 10,347 pasture acres	# acres grazing land management	Included in SRAM
Alternate water supply	2,069.4 acres added in alternate water supplies in Pipestone Creek	2,069.4 acres added in alternate water supplies in Pipestone Creek	2,069.4 acres added in alternate water supplies in Pipestone Creek	2,069.4 acres added in alternate water supplies in Pipestone Creek	2,069.4 acres added in alternate water supplies in Pipestone Creek	All pastureland utilizing alternative water supplies 10,347pasture acres	# of acres alternative water supply	Included in SRAM

Practices	Milestones					Long-Term Goals	Assessment	Costs
	2-year (2022)	4-year (2024)	6-year (2026)	8-year (2028)	10-year (2030)			
Streambank stabilization and fencing	2,069.4 acres added in streambank stabilization and fencing in Pipestone Creek	2,069.4 acres added in streambank stabilization and fencing in Pipestone Creek	2,069.4 acres added in streambank stabilization and fencing in Pipestone Creek	2,069.4 acres added in streambank stabilization and fencing in Pipestone Creek	2,069.4 acres added in streambank stabilization and fencing in Pipestone Creek	All pastureland utilizing streambank stabilization and fencing 10,347 pasture acres	# of acres streambank stabilization and fencing	Included in SRAM

Table 38. Implementation activities, milestones, goals, and assessments for SRAM BMPs in Split Rock Creek Watershed

Practices	Milestones					Long-Term Goals	Assessment	Costs
	2-year (2022)	4-year (2024)	6-year (2026)	8-year (2028)	10-year (2030)			
SRAM implementation (restoring streambanks to decrease erosion and increase habitats	10.8 miles streambank Split Rock Creek	10.8 miles streambank Split Rock Creek	10.8 miles streambank Split Rock Creek	10.8 miles streambank Split Rock Creek	10.8 miles streambank Split Rock Creek	Streambank restoration of 54 miles of stream (as part of the SRAM)	# miles of stream	$1,199,988

Practices	Milestones					Long-Term Goals	Assessment	Costs
	2-year (2022)	4-year (2024)	6-year (2026)	8-year (2028)	10-year (2030)			
Grazing Land Management (rotational grazing with fenced areas)	2,430 acres added in grazing land management in Split Rock Creek	2,430 acres added in grazing land management in Split Rock Creek	2,430 acres added in grazing land management in Split Rock Creek	2,430 acres added in grazing land management in Split Rock Creek	2,430 acres added in grazing land management in Split Rock Creek	All pastureland with grazing land management 12,150 pasture acres	# acres grazing land management	Included in SRAM
Alternate water supply	2,430 acres added in alternate water supplies in Split Rock Creek	2,430 acres added in alternate water supplies in Split Rock Creek	2,430 acres added in alternate water supplies in Split Rock Creek	2,430 acres added in alternate water supplies in Split Rock Creek	2,430 acres added in alternate water supplies in Split Rock Creek	All pastureland utilizing alternative water supplies 12,150 pasture acres	# of acres alternative water supply	Included in SRAM
Streambank stabilization and fencing	2,430 acres added to streambank stabilization and fencing in in Split Rock Creek	2,430 acres added to streambank stabilization and fencing in in Split Rock Creek	2,430 acres added to streambank stabilization and fencing in in Split Rock Creek	2,430 acres added to streambank stabilization and fencing in in Split Rock Creek	2,430 acres added to streambank stabilization and fencing in in Split Rock Creek	All pastureland utilizing streambank stabilization and fencing 12,150 pasture acres	# of acres streambank stabilization and fencing	Included in SRAM

Table 39. Implementation activities, milestones, goals, and assessments for SRAM BMPs in Mound Creek Watershed

Practices	Milestones					Long-Term Goals	Assessment	Costs
	2-year (2022)	4-year (2024)	6-year (2026)	8-year (2028)	10-year (2030)			
SRAM implementation (restoring streambanks to decrease erosion and increase habitats	.2 miles streambank Mound Creek	.2 miles streambank Mound Creek	.2 miles streambank Mound Creek	.2 miles streambank Mound Creek	.2 miles streambank Mound Creek	Streambank restoration of 1 mile of stream (as part of the SRAM)	# miles of stream	$22,222
Grazing Land Management (rotational grazing with fenced areas)	264 acres added in grazing land management in Mound Creek	264 acres added in grazing land management in Mound Creek	264 acres added in grazing land management in Mound Creek	264 acres added in grazing land management in Mound Creek	264 acres added in grazing land management in Mound Creek	All pastureland with grazing land management 1,320 pasture acres	# acres grazing land management	Included in SRAM
Alternate water supply	264 acres added in alternate water supplies in Mound Creek	264 acres added in alternate water supplies in Mound Creek	264 acres added in alternate water supplies in Mound Creek	264 acres added in alternate water supplies in Mound Creek	264 acres added in alternate water supplies in Mound Creek	All pastureland utilizing alternative water supplies 1,320 pasture acres	# of acres alternative water supply	Included in SRAM

Practices	Milestones					Long-Term Goals	Assessment	Costs
	2-year (2022)	4-year (2024)	6-year (2026)	8-year (2028)	10-year (2030)			
Streambank stabilization and fencing	264 acres added in streambank stabilization and fencing in Mound Creek	264 acres added in streambank stabilization and fencing in Mound Creek	264 acres added in streambank stabilization and fencing in Mound Creek	264 acres added in streambank stabilization and fencing in Mound Creek	264 acres added in streambank stabilization and fencing in Mound Creek	All pastureland utilizing streambank stabilization and fencing 1,320 pasture acres	# of acres streambank stabilization and fencing	Included in SRAM

7.1.2 Soil health efforts

Practices that will improve soil health are critical in reducing nutrient and sediment loading from cropland. Soil health practices encompass a suite of practices, which includes cover crops, reducing tillage, reducing chemical fertilizer application, applying manure at agronomic rates and the right time (incorporating the 4Rs of nutrient stewardship: right source, right rate, right time, and right place). In addition to reducing nutrient sediment losses, improved soil health also increases water holding capacity, decreases runoff, and decreases peak stream flows. The development of nutrient management and manure management plans for producers will be supported.

Implementation of soil health practices is affected by many factors including market considerations, weather, and equipment limitations/availability. Pipestone County SWCD has been partnering with NRCS and other conservation organizations in the promotion of Soil Health. There is a constant need to balance program standards, such as national criteria which may conflict with mapped or actual conditions in the field. These concerns must be addressed by agricultural educators and advocates, such as the University of Minnesota Extension Service, watershed districts, SWCD, and other County officials, through promotion, education and demonstration.

Outreach and education is critical to the success of this program. The partners have included various activities, milestones, and assessment criteria in Table 40. The partners believe strongly that providing one-on-one consultations with landowners and producers (i.e. field walkovers) about agricultural BMPs, field productivity benefits of BMPs, alternative crops and land uses, and available financial incentive options for funding them will be instrumental to increase participation. Other activities that will be promoted by the partners are the use of precision agriculture through education, technical, and financial assistance based on the economic and environmental capacity of each area of a field. Conservation irrigation methods and pesticide management will also be addressed.

Education and outreach activities, milestones, goals, and assessment criteria are detailed in Table 40. Soil health improvement activities for Pipestone Creek are Table 34, for Split Rock Creek Table 35, and for Mound Creek Table 36. Reduction estimates for soil health improvement activities include both the upland pasture practices and streambank restoration, as described in Appendix A and Section 7.2.

Table 40. Education and outreach activities, milestones, goals, and assessments for soil health BMPs

Practice	Milestones					Long-Term Goals	Assessment	Costs
	2-year (2022)	4-year (2024)	6-year (2026)	8-year (2028)	10-year (2030)			
Soil health promotion: identify willing land owners and assess which practice best fits their needs	Conduct annual field day events to promote soil health	Conduct annual field day events to promote soil health	Conduct annual field day events to promote soil health	Conduct annual field day events to promote soil health	Conduct annual field day events to promote soil health	Engage and educate landowner about Soil Health	# of events # of landowners contacted	$10,000
Outreach and education position for soil health efforts (.33 FTE)	Coordinate efforts, conduct outreach, provide technical assistance, track progress, and plan events	Coordinate efforts, conduct outreach, provide technical assistance, track progress, and plan events	Coordinate efforts, conduct outreach, provide technical assistance, track progress, and plan events Assess effectiveness of outreach efforts and adjust	Coordinate efforts, conduct outreach, provide technical assistance, track progress, and plan events	Coordinate efforts, conduct outreach, provide technical assistance, track progress, and plan events	Staff capacity to fully implement soil health practices	# of interactions with landowners # of participants # of new contacts	$330,000
Cover Crop Field Days	Annual field day	Annual field day	Evaluate/reassess effectiveness, implement improvements	Continue improved field days	Start to effect cultural change to adopt soil health practices	Engage and educate landowner about Soil Health	# Field days conducted # new attendees	$5,000
Cover Crop 101 Workshops	Biennial engaging 5 new	Biennial engaging 5 new landowners per workshop	Evaluate/reassess effectiveness	Implement improvements	Implement improvements	Engage and educate landowner	# workshops conducted	$5,000

Practice	Milestones					Long-Term Goals	Assessment	Costs
	2-year (2022)	4-year (2024)	6-year (2026)	8-year (2028)	10-year (2030)			
	landowners per workshop					about Soil Health	# new attendees	
Provide one-on-one consultations with landowners and producers	Target potential locations and assess interest	provide field walkovers and assess for potential BMP projects	fund BMP projects, assess producers	fund BMP projects, assess producers	provide field walkovers for at least 100 or more producers and assess soil health	Engage and educate landowners	# walkovers	$10,000
Encourage the use of precision agriculture through education, technical, and financial assistance	Promotion/ outreach of the program	Promotion/ outreach of the program	Promotion/ outreach of the program	Promotion/ outreach of the program	10% of cropland in watershed utilizing precision agriculture	Engage and educate landowners	# acres # participants	$20,000
Provide education, financial incentives, and technical to employ conservation irrigation water management	Promotion/ outreach of the program	Promotion/ outreach of the program	Promotion/ outreach of the program	Promotion/ outreach of the program	Promotion/ outreach of the program	Engage and educate landowners	# acres conservation irrigation	$10,000

Practice	Milestones					Long-Term Goals	Assessment	Costs
	2-year (2022)	4-year (2024)	6-year (2026)	8-year (2028)	10-year (2030)			
Promote the development of pesticide management plans	Promotion/ outreach of the program	Promotion/ outreach of the program	Promotion/ outreach of the program	Promotion/ outreach of the program	Promotion/ outreach of the program	Engage and educate landowners	# pest management plans	$10,000

Table 41. Implementation activities, milestones, goals, and assessments for soil health improvement BMPs in Pipestone Creek Watershed

Practice	Milestones					Long-Term Goals	Assessment	Costs
	2-year (2022)	4-year (2024)	6-year (2026)	8-year (2028)	10-year (2030)			
Cover crops	15,908 acres of cover crops	15,908 acres of cover crops	15,908 acres of cover crops	15,908 acres of cover crops	15,908 acres of cover crops	79,570acres cropland using cover crops	# acres cover crops	$316,688
Reduce fertilization rates to UMN rates	15,908 acres of reduced nutrient application	15,908 acres of reduced nutrient application	15,908 acres of reduced nutrient application	15,908 acres of reduced nutrient application	15,908 acres of reduced nutrient application	79,570 acres cropland using reduced nutrient application	# acres reduced nutrient application	$47,742

Practice	Milestones					Long-Term Goals	Assessment	Costs
	2-year (2022)	4-year (2024)	6-year (2026)	8-year (2028)	10-year (2030)			
Conservation tillage	15,908 acres of conservation tillage	15,908 acres of conservation tillage	15,908 acres of conservation tillage	15,908 acres of conservation tillage	15,908 acres of conservation tillage	79,570 acres cropland using reduced tillage	# acres reduced tillage	$47,742
Maintain 100% of buffers per MN Buffer Law	100% compliance	100% compliance	100% compliance	100% compliance	100% compliance	All buffers required properly maintained	% compliance	$5,000
Manure application at agronomic rates and times	15,908 acres of managed manure application	15,908 acres of managed manure application	15,908 acres of managed manure application	15,908 acres of managed manure application	15,908 acres of managed manure application	79,570 acres cropland using managed manure application	# acres manure managed	$47,742
Develop and implement nutrient and/or manure management plans for agricultural producers	Promotion/ outreach of the program	Develop plans with producers 2 plans	Develop plans with producers 2 plans	Develop plans with producers 2 plans	Develop plans with producers 2 plans	All producers have a nutrient and/or manure application, minimum 8 plans	# plans	$2,000

Practice	Milestones					Long-Term Goals	Assessment	Costs
	2-year (2022)	4-year (2024)	6-year (2026)	8-year (2028)	10-year (2030)			
Identify non-conforming feedlots and target to bring into compliance.	assess 2 feedlots annually	assess 2 feedlots annually	assess 2 feedlots annually	assess 2 feedlots annually	assess 2 feedlots annually	Continue to assess feedlots and identify opportunities to improve	# assessments	$1,500

Table 42. Implementation activities, milestones, goals, and assessments for soil health improvement BMPs in Split Rock Creek Watershed

Practice	Milestones					Long-Term Goals	Assessment	Costs
	2-year (2022)	4-year (2024)	6-year (2026)	8-year (2028)	10-year (2030)			
Cover crops	12,474 acres of cover crops	12,474 acres of cover crops	12,474 acres of cover crops	12,474 acres of cover crops	12,474 acres of cover crops	62,370 acres cropland using cover crops	# acres cover crops	$248,233
Reduce fertilization rates to UMN rates	12,474 acres of reduced nutrient application	12,474 acres of reduced nutrient application	12,474 acres of reduced nutrient application	12,474 acres of reduced nutrient application	12,474 acres of reduced nutrient application	62,370 acres cropland using reduced nutrient application	# acres reduced nutrient application	$37,422

Practice	Milestones					Long-Term Goals	Assessment	Costs
	2-year (2022)	4-year (2024)	6-year (2026)	8-year (2028)	10-year (2030)			
Conservation tillage	12,474 acres of reduced tillage	12,474 acres of reduced tillage	12,474 acres of reduced tillage	12,474 acres of reduced tillage	12,474 acres of reduced tillage	62,370 acres cropland using reduced tillage	# acres reduced tillage	$37,422
Maintain 100% of buffers per MN Buffer Law	100% compliance	100% compliance	100% compliance	100% compliance	100% compliance	All buffers required properly maintained	% compliance	$5,000
Manure application at agronomic rates and times	12,474 acres of managed manure application	12,474 acres of managed manure application	12,474 acres of managed manure application	12,474 acres of managed manure application	12,474 acres of managed manure application	62,370 acres cropland using managed manure application 100% of acres	# acres manure managed	$37,422

Practice	Milestones					Long-Term Goals	Assessment	Costs
	2-year (2022)	4-year (2024)	6-year (2026)	8-year (2028)	10-year (2030)			
Develop and implement nutrient and/or manure management plans for agricultural producers	Promotion/ outreach of the program	Develop plans with producers 2 plans	Develop plans with producers 2 plans	Develop plans with producers 2 plans	Develop plans with producers 2 plans	All producers have a nutrient and/or manure application, minimum 8 plans	# plans	$2,000
Identify non-conforming feedlots and target to bring into compliance.	assess 2 feedlots annually	assess 2 feedlots annually	assess 2 feedlots annually	assess 2 feedlots annually	assess 2 feedlots annually	Continue to assess feedlots and identify opportunities to improve	# assessments	$1,500

Table 43. Implementation activities, milestones, goals, and assessments for soil health improvement BMPs in Mound Creek Watershed

Practice	Milestones					Long-Term goal	Assessment	Costs
	2-year (2022)	**4-year (2024)**	**6-year (2026)**	**8-year (2028)**	**10-year (2030)**			
Conservation tillage	1,760 acres of reduced tillage	1,760 acres of reduced tillage	1,760 acres of reduced tillage	1,760 acres of reduced tillage	1,760 acres of reduced tillage	8,800 acres cropland using reduced tillage	# acres reduced tillage	$ 5,255
Maintain 100% of buffers per MN Buffer Law	100% compliance	100% compliance	100% compliance	100% compliance	100% compliance	All buffers required properly maintained	% compliance	$5,000
Manure application at agronomic rates and times	1,760 acres of managed manure application	1,760 acres of managed manure application	1,760 acres of managed manure application	1,760 acres of managed manure application	1,760 acres of managed manure application	8,800 acres cropland using managed manure application	# acres manure managed	$ 5,255
Develop and implement nutrient and/or manure management plans for agricultural producers	Promotion/ outreach of the program	Develop plans with producers 1 plans	Develop plans with producers 1 plans	Develop plans with producers 1 plans	Develop plans with producers 1 plans	All producers have a nutrient and/or manure application, minimum 4 plans	# plans	$2,000
Identify non-conforming feedlots and target to bring into compliance.	assess 2 feedlots annually	assess 2 feedlots annually	assess 2 feedlots annually	assess 2 feedlots annually	assess 2 feedlots annually	Continue to assess feedlots and identify opportunities to improve	# assessments	$1,500

7.1.3 Upland BMPs

Upland BMPs for this NKE plan include structural BMPs, water storage practices and programs that provide permanent vegetation. Practices and activities reduce erosion, increase water storage and infiltration, manage drainage, restore wetlands, and increase permanent vegetation. These activities reduce pollutant loading and peak stream flows. Many of the BMPs improve upland habitat.

Structural BMPs include filter strips, grassed waterways, and water and sediment control basins (WASCOB). Water storage activities will include upland and floodplain storage, retention ponds, and conservation and/or flowage easements. For the purposes of this plan these activities were modeled as impoundments in STEPL. Critical area planting and permanent vegetation programs will be utilized and promoted. These programs include Conservation Reserve Program (CRP), Conservation Reserve Enhancement Program (CREP), Grassland Reserve Program (GRP), Environmental Quality Incentives Program (EQIP), Reinvest in Minnesota (RIM), Wetland Reserves Program (WRP), and other similar initiatives. Conservation easement programs will be encouraged in marginal, highly erodible land, especially within drinking water source management areas (DWSMA) and priority recharge areas within wellhead protection areas.

Wetland restoration is included in this NKE plan. The restoration of wetlands provides water storage to reduce peak flows and can reduce pollutant loading in the system. It also provides wildlife habitat. The loss of wetlands in the Prairie Pothole Region has dramatically changed the landscape. Increasing tile drainage with today's agricultural methods continues to potentially impact the number of wetlands. The Restorable Wetlands Inventory map for each watershed (Figure 5, Figure 6, and Figure 7) identifies areas that could be restored as wetlands. The watershed partners will work with any interested landowners in pursuing wetland restoration opportunities given that landowner interest is generally low. This will not be a strong focus of implementation.

Activities and BMPs planned for implementation are in Table 44.

Table 44. Education and outreach activities, milestones, goals, assessment criteria, and costs for structural agricultural BMPs

Practices	Milestones					Long-Term Goals	Assessment	Costs
	2-year (2022)	4-year (2024)	6-year (2026)	8-year (2028)	10-year (2030)			
Promotion/outreach of the program: promote practices that enhance hydrologic storage and stream stability by increasing perennial native vegetation in upland and riparian areas.	Meet with 2 targeted landowners	Meet with 2 targeted landowners	Meet with 2 targeted landowners	Meet with targeted landowners	Meet with 2 targeted landowners	Increase water storage through perennial vegetation (specific practices below) by involving landowners and producers	# of landowners	$1,000
Outreach and education position for upland BMPs (.33 FTE)	Coordinate efforts, conduct outreach, provide technical assistance, track progress, and plan events	Coordinate efforts, conduct outreach, provide technical assistance, track progress, and plan events	Coordinate efforts, conduct outreach, provide technical assistance, track progress, and plan events Assess effectiveness of outreach efforts and adjust	Coordinate efforts, conduct outreach, provide technical assistance, track progress, and plan events	Coordinate efforts, conduct outreach, provide technical assistance, track progress, and plan events	Staff capacity to fully implement upland BMPs	# of interactions with landowners # of participants # of new contacts	$330,000

Table 45. Implementation activities, milestones, goals, and assessments for structural agricultural BMPs in Pipestone Creek Watershed

Practices	Milestones					Long-Term goals	Assessment	Costs
	2-year (2022)	4-year (2024)	6-year (2026)	8-year (2028)	10-year (2030)			
Critical Area Planting: protect and restore grassland areas with focused effort on increasing native species populations.	Implement 16 acres of critical area planting and assess program interest	Implement 16 acres of critical area planting and assess program interest	Implement 16 acres of critical area planting and assess program interest	Implement 16 acres of critical area planting and assess program interest	Implement 16 acres of critical area planting and assess program interest	Critical area planting on 80 acres	# acres	$5,714
WASCOBS	Target potential locations and implement 1 WASCOB	Implement 1 WASCOB	Implement 1 WASCOB	Implement 1 WASCOB	Implement 1 WASCOBs and assess effectiveness and identify more areas, if warranted	Install 5 or more WASCOBs	# WASCOBs	$100,000
Create or restore wetlands.	Work with and engage landowners		Restore 5 acres of wetlands (5 ac Pipestone)		Assess effectiveness and identify more areas, if warranted	Restore 5 acres of wetland, treating 200 acres of land	# acres	$10,000
Filter Strips	Install 400 ft of filter strips	Install 400 ft of filter strips	Install 400 ft of filter strips	Install 400 ft of filter strips	Install 400 ft of filter strips	2,000 ft of filter strips	# feet	$6,000

Practices	Milestones					Long-Term goals	Assessment	Costs
	2-year (2022)	4-year (2024)	6-year (2026)	8-year (2028)	10-year (2030)			
Grassed Waterways	Install 400 ft of grassed waterways	Install 400 ft of grassed waterways	Install 400 ft of grassed waterways	Install 400 ft of grassed waterways	Install 400 ft of grassed waterways	2,000 ft of grassed waterways	# feet	$5,200
Impoundment, water detention	Assess ditch inventory to target, design, work with land owners	Install 1 impoundment (detention) structures	Install 1 impoundment (detention) structures		Assess effectiveness and identify more areas, if warranted	Install 2 10-acre impoundments	# impoundments	$24,000
Facilitate protection of natural and pervious lands through such programs as acquisition, property tax credits and easements (e.g. CREP, CRP, RIM, etc.).	assess interest in landowners by using mailings and social media	Implement program	Build program to continually increase individual buy in	Implement 40 ac easement in each watershed	Implement 40 ac easement in each watershed	80 ac easement in each watershed	# acres	$200,000

Table 46. Implementation activities, milestones, goals, and assessments for structural agricultural BMPs in Split Rock Creek Watershed

Practices	Milestones					Long-Term Goals	Assessment	Costs
	2-year (2022)	**4-year (2024)**	**6-year (2026)**	**8-year (2028)**	**10-year (2030)**			
Critical Area Planting: protect and restore grassland areas with focused effort on increasing native species populations.	Implement 32 acres of critical area planting and assess program interest	Implement 32 acres of critical area planting and assess program interest	Implement 32 acres of critical area planting and assess program interest	Implement 32 acres of critical area planting and assess program interest	Implement 32 acres of critical area planting and assess program interest	Critical area planting on 60 acres	# acres	$11,429
WASCOBS	Target potential locations and implement 1 WASCOB	Target potential locations and implement 1 WASCOB	Target potential locations and implement 1 WASCOB	Target potential locations and implement 1 WASCOB	Implement 1 WASCOB and assess effectiveness and identify more areas, if warranted	Install 5 or more WASCOBs	# WASCOBs	$100,000

Practices	Milestones					Long-Term Goals	Assessment	Costs
	2-year (2022)	**4-year (2024)**	**6-year (2026)**	**8-year (2028)**	**10-year (2030)**			
Create or restore wetlands.	Work with and engage landowners			Restore 5 acres of wetlands	Assess effectiveness and identify more areas, if warranted	Restore 5 acres of wetland, treating 200 acres of land	# acres	$10,000
Filter Strips	Install 400 ft of filter strips	Install 400 ft of filter strips	Install 400 ft of filter strips	Install 400 ft of filter strips	Install 400 ft of filter strips	2,000 ft of filter strips	# feet	$6,000
Grassed Waterways	Install 400 ft of grassed waterways	Install 400 ft of grassed waterways	Install 400 ft of grassed waterways	Install 400 ft of grassed waterways	Install 400 ft of grassed waterways	2,000 ft of grassed waterways	# feet	$5,200
Impoundment, water detention	Assess ditch inventory to target, design, work with land owners		Install 1 impoundment (detention) structures	Install 1 impoundment (detention) structures	Assess effectiveness and identify more areas, if warranted	Install 2 10-acre impoundments	# impoundments	$24,000

Practices	Milestones					Long-Term Goals	Assessment	Costs
	2-year (2022)	**4-year (2024)**	**6-year (2026)**	**8-year (2028)**	**10-year (2030)**			
Facilitate protection of natural and pervious lands through such programs as acquisition, property tax credits and easements (e.g. CREP, CRP, RIM, etc.).	assess interest in landowners by using mailings and social media	Implement program	Build program to continually increase individual buy in	Implement 40 ac easement	Implement 40 ac easement	80 ac easement	# acres	$200,000

Table 47. Implementation activities, milestones, goals, and assessments for structural agricultural BMPs in Mound Creek Watershed

Practices	Milestones					Long-Term Goal	Assessment	Costs
	2-year (2022)	**4-year (2024)**	**6-year (2026)**	**8-year (2028)**	**10-year (2030)**			
Critical Area Planting: protect and restore grassland areas with focused effort on increasing native species populations.	Implement 8 acres of critical area planting and assess program interest	Implement 8acres of critical area planting and assess program interest	Implement 8 acres of critical area planting and assess program interest	Implement 8 acres of critical area planting and assess program interest	Implement 8 acres of critical area planting and assess program interest	Critical area planting on 40 acres	# acres	$2,857
WASCOBS	Target potential locations and implement 1 WASCOB	Implement 1 WASCOB	Implement 1 WASCOB	Implement 1 WASCOB	Implement 1 WASCOB and assess effectiveness and identify more areas, if warranted	Install 5or more WASCOBs	# WASCOBs	$100,000

Practices	Milestones					Long-Term Goal	Assessment	Costs
	2-year (2022)	**4-year (2024)**	**6-year (2026)**	**8-year (2028)**	**10-year (2030)**			
Create or restore wetlands.	Work with and engage landowners	Restore 5 acres of wetlands			Assess effectiveness and identify more areas, if warranted	Restore 5 acres of wetland, treating 600 acres of land	# acres	$30,000
Filter Strips	Install 200 ft of filter strips	Install 200 ft of filter strips	Install 200 ft of filter strips	Install 200 ft of filter strips	Install 200 ft of filter strips	1,000 ft of filter strips	# feet	$3,000
Grassed Waterways	Install 200 ft of grassed waterways	Install 200 ft of grassed waterways	Install 200 ft of grassed waterways	Install 200 ft of grassed waterways	Install 200 ft of grassed waterways	1,000 ft of grassed waterways	# feet	$2,600
Impoundment, water detention	Assess ditch inventory to target, design, work with land owners	Install 1 impoundment (detention) structures			Assess effectiveness and identify more areas, if warranted	Install 1 10-acre impoundments	# impoundments	$12,000

Practices	Milestones					Long-Term Goal	Assessment	Costs
	2-year (2022)	**4-year (2024)**	**6-year (2026)**	**8-year (2028)**	**10-year (2030)**			
Facilitate protection of natural and pervious lands through such programs as acquisition, property tax credits and easements (e.g. CREP, CRP, RIM, etc.).	assess interest in landowners by using mailings and social media	Implement program	Build program to continually increase individual buy in	Implement 40 ac easement in each watershed	Implement 40 ac easement in each watershed	80 ac easement in each watershed	# acres	$300,000

7.1.4 SSTS

The upgrade and replacement of failing and non-compliant SSTS has been identified as a priority by the watershed partners. Replacement of the systems will reduce *E. coli* and nutrient loading to surface waters. Pipestone County has been successful in obtaining and providing low interest loans to landowners to upgrade their septic systems. The majority of systems installed will utilize the loan programs available. All of the failing and non-compliant SSTS will be replaced or upgraded. There are approximately 52 failing SSTS and total cost for replacement is estimated at $780,000.

7.2 Results achieved following implementation

Pollutant reductions have been calculated using the STEPL for the practices planned in Table 36, Table 40, and Table 44. It is expected that practices described in this plan, along with the estimated reductions from recent watershed work, will achieve load reductions needed to meet water quality standards when fully implemented. The estimated reductions by watershed are described below.

Full details for STEPL, including combined BMPs and assumptions, are included in Appendix A. The STEPL reductions were calculated using the combined BMP efficiency tool and the BMP calculator function.

Every two years, the progress of the plan will be checked against the milestones to determine any necessary course corrections and milestones will be amended or new ones added. When this plan is fully implemented, the estimated reductions exceed the reductions necessary to meet water quality standards for all impaired waterbodies in the Pipestone Creek, Split Rock Creek, and Mound Creek Watersheds.

Reductions in Pipestone Creek Watershed

Implementation of BMPs described in Sections 7.1.1 to 7.1.4 result in estimated reductions described in Table 48. These reductions exceed the reductions needed to achieve the TMDLs (Table 22). The TMDLs called for a 26% reduction in TSS and a 77% reduction in *E. coli* in Pipestone Creek.

The biological impairments in Pipestone Creek Watershed are expected to be resolved by addressing the TSS and nutrient loading. Additionally, the stream restoration associated with the implementation of SRAM will increase habitat for aquatic stream biota.

Table 48. Current load, load reduction with implementation, and percent reduction for Pipestone Creek Watershed (STEPL)

Load without BMPs				Reductions after BMPs				Reductions by percentage			
N lb/yr	P lb/yr	TSS t/yr	*E. coli* billion MPN/yr	N lb/yr	P lb/yr	TSS t/yr	*E. coli* billion MPN/yr	N	P	TSS	*E. coli*
555,640	129,264	24,024	137,685	326,500	99,018	15,065	129,126	59	77	63	94

Table 49 describes the estimated reductions from BMPs by land use. Based on the estimated sources described in Table 17, the reductions are commiserate with the source loading proportions.

Table 49. Reductions from activities in the Pipestone Creek Watershed

Sources	Pollutant	Loading before BMPs	Loading after BMPs	Reductions	% reduced
Urban	**N**	2,734	2,734	--	--
	P	422	422	--	--
	TSS	63	63	--	--
	E. coli	932	932	--	--
Cropland	**N**	495,649	209,339	286,311	58
	P	118,579	24,465	94,113	79
	TSS	13,866	1,816	12,050	87
	E. coli	70,388	5,701	64,686	92
Pastureland	**N**	39,064	3,666	35,397	91
	P	3,255	316	2,939	90
	TSS	328	41	287	88
	E. coli	12,933	517	12,415	96
User Defined	**N**	3,680	3,680	--	--
	P	1,417	1,417	--	--
	TSS	1,150	1,150	--	--
	E. coli	1,409	1,409	--	--
Septic	**N**	726	0	726	100
	P	284		284	100
	TSS	--	--	--	--
	E. coli	52,024	0	52,024	100
Streambank	**N**	13,787	9421.21	4,366	32
	P	5,308	3627.166	1,681	32
	TSS	8,617	5888.256	2,729	32
	E. coli	0	0	0	--
Total	**N**	555,640	228,840	326,800	59
	P	129,264	30,247	99,018	77
	TSS	24,024	8,959	15,065	63
	E. coli	137,685	8,559	129,126	94

N=lbs/yr, P=lbs/yr, TSS=t/yr, and *E. coli*=billion MPN/yr

This NKE plan will achieve the estimated reductions needed to reach water quality standards in Pipestone Creek Watershed if implemented as planned.

Reductions in Split Rock Creek Watershed

Implementation of BMPs described in Sections 7.1.1 to 7.1.4 result in estimated reductions described in Table 51. These reductions exceed the reductions needed to achieve the TMDLs (Table 22). The TMDLs called for an 85% reduction in TSS and a 67% reduction in *E. coli* in Split Rock Creek.

The reductions described meet or exceed the reductions needed to meet the TMDLs for the waterbody. No TMDLs have been completed for the dissolved oxygen or nutrient/eutrophication for Split Rock Creek. The DO and nutrient/eutrophication impairments are expected to be addressed through the P reductions yielded by the BMPs implemented to meet the TSS standard. The MIBI and FIBI impairments will be addressed through TSS and nutrient reductions and improved habitat through SRAM. By meeting the standards for TSS and reducing the nutrient concentrations to mitigate low DO, four of the stressors to biology will be addressed. The last will be addressed by the improved habitat from the implementation of the SRAM practices. Continuous monitoring of DO will be conducted to evaluate changes in DO levels in the stream and identify whether additional implementation is needed.

Table 50. Current load, load reduction with implementation, and percent reduction for Split Rock Creek Watershed (STEPL)

Load with no BMPs				**Reductions with BMPs**				**Reduction by percentage**			
N lb/yr	**P lb/yr**	**TSS t/yr**	***E. coli* billion MPN/yr**	**N lb/yr**	**P lb/yr**	**TSS t/yr**	***E. coli* billion MPN/yr**	**N**	**P**	**TSS**	***E. coli***
468,495	109,359	28,921	115,899	292,614	87,472	25,394	108,748	62	80	88	94

Table 51 describes the estimated reductions from BMPs by land use. Based on the estimated sources described in Table 17, the reductions are commiserate with the source loading proportions.

Table 51. Current load, estimated load reduction with implementation, and percent reduction for Split Rock Creek Watershed by land use

Sources	**Pollutant**	**Load without BMPs**	**Load with BMPs**	**Reductions**	**%**
Urban	N	2,283	2,283	--	--
	P	352	352	--	--
	TSS	52	52	--	--
	E. coli	778	778	--	--
Cropland	N	390,793	164,430	226,364	58
	P	93,805	19,292	74,513	79
	TSS	11,541	1,512	10,029	87
	E. coli	55,194	4,471	50,723	92
Pastureland	N	45,947	4,315	41,632	91
	P	3,851	374	3,477	90
	TSS	408	51	357	88

Sources	Pollutant	Load without BMPs	Load with BMPs	Reductions	%
	E. coli	15,186	607	14,579	96
Misc.	N	3,590	3,590	--	--
	P	1,382	1,382	--	--
	TSS	1,122	1,122	--	--
	E. coli	1,295	1,295	--	--
SSTS	N	606	0	606	100
	P	237	0	237	100
	TSS	--	--	--	--
	E. coli	43,446	0	43,446	100
Streambank	N	25,276	1,264	24,013	95
	P	9,731	487	9,245	95
	TSS	15,798	790	15,008	95
	E. coli	--	--	--	--
Total	N	468,495	176,487	292,008	62
	P	109,359	22,125	87,234	80
	TSS	28,921	3,527	25,394	88
	E. coli	115,899	50,597	65,302	56

N=lbs/yr, P=lbs/yr, TSS=t/yr, and *E. coli*=billion MPN/yr

This NKE plan will achieve the estimated reductions needed to reach water quality standards in Split Rock Creek Watershed if implemented as planned.

Reductions in Mound Creek Watershed

Implementation of BMPs described in Sections 7.1.1 to 7.1.4 result in estimated reductions described in Table 52. These reductions exceed the reductions needed to achieve the TMDL (Table 22). The TMDL called for a 93% reduction in *E. coli* in Mound Creek.

Table 52. Current load, load reduction with implementation, and percent reduction for Mound Creek Watershed (STEPL)

Load without BMPs				Reductions				Reduction by percentage			
N lbs/yr	P lbs/yr	TSS t/yr	E. coli billion MPN/yr	N lbs/yr	P lbs/yr	TSS t/yr	E. coli billion MPN/yr	N	P	TSS	*E. coli*
67,255	16,327	4,269	27,899	40,727	12,534	2,878	26,922	61	77	67	96

Table 53 describes the estimated reductions from BMPs by land use. Based on the estimated sources described in Table 17, the reductions are commiserate with the source loading proportions.

Table 53. Current load, estimated load reduction with implementation, and percent reduction for Mound Creek Watershed by land use

Sources	Pollutant	Load without BMPs	Load with BMPs	Reductions	%
Urban	**N**	310	310	--	--
	P	48	48	--	--
	TSS	7	7	--	--
	E. coli	106	106	--	--
Cropland	**N**	59,020	23,708	35,311	60
	P	14,730	2,918	11,812	80
	TSS	2,841	372	2,469	87
	E. coli	7,787	631	7,157	92
Pastureland	**N**	5,097	482	4,615	91
	P	459	46	413	90
	TSS	77	10	68	88
	E. coli	1,650	66	1,584	96
Misc.	**N**	851	851	--	--
	P	327	327	--	--
	TSS	266	266	--	--
	E. coli	176	176	--	--
SSTS	**N**	254	0	254	100
	P	99	0	99	100
	TSS	--	--	--	--
	E. coli	18,181	0	18,181	100
Streambanks	**N**	1,723	1,178	546	32
	P	664	453	210	32
	TSS	1,077	736	341	32
	E. coli	--	--	--	--
Total	**N**	67,255	26,782	40,473	60
	P	16,327	3,892	12,435	76
	TSS	4,269	1,391	2,878	67
	E. coli	27,899	19,159	8,741	31

N=lbs/yr, P=lbs/yr, TSS=t/yr, and *E. coli*=billion MPN/yr

This NKE plan will achieve the estimated reductions needed to reach water quality standards in Mound Creek Watershed if implemented as planned.

8. Information and education activities

Working with and engaging landowners is a focus of the watershed partners. Activities to conduct outreach related to BMPs are included in Table 36, Table 40, and Table 44. These tables each include 0.33 of a full-time equivalent (FTE), for an entire FTE total, to help facilitate the outreach activities needed to achieve these goals.

Activities include actively promoting soil health through workshops, field days and education events. Field walkovers and BMP demonstrations will be used as a way of engaging individual landowners. These activities reflect the priority of engagement that emerged through the development of the Missouri River Watershed One Watershed One Plan, which focused on networking, education and demonstrations including programming on soil health, altered hydrology, SSTS, and nutrient/manure management.

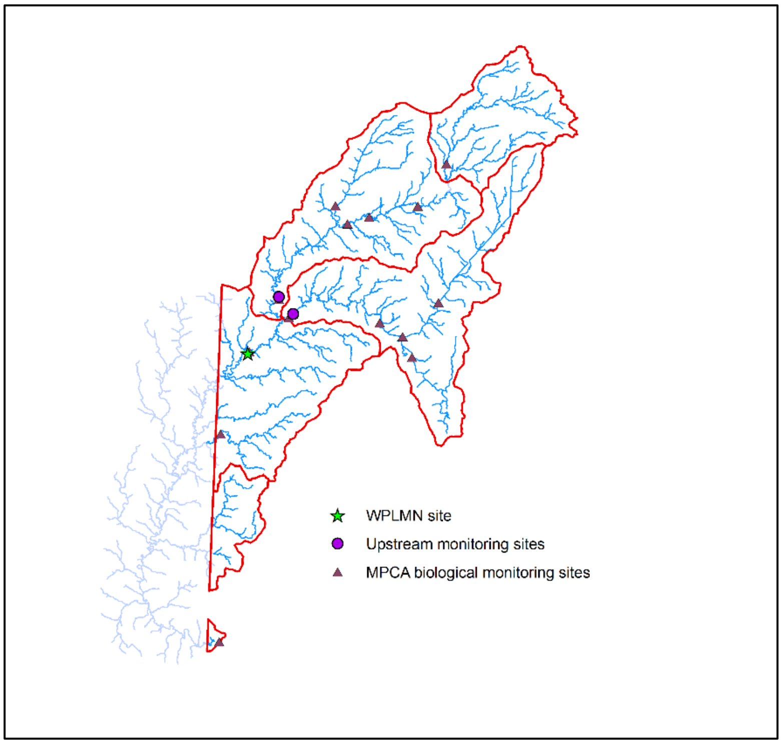
Landowner engagement will include SWCD and NRCS contacts, promotion of the Minnesota Agricultural Water Quality Certification Program (MAWQCP), producer and environmental non-governmental organizations (NGO), and other similar programs. Partnerships include working jointly with Moody County, South Dakota, SWCD staff to host annual field days to provide producers with working examples of how pasture management practices (SRAM) are being implemented, herd health benefits, and economic benefits are achieved.

The Pipestone and Rock County Environmental offices will promote the citizen steam-monitoring program for citizen engagement, as well as to obtain stream water quality data that will be used as a means to measure stream water quality improvements. Their goal is to secure three or more monitors per watershed. Citizen involvement will be promoted during County fairs and similar public events.

9. Monitoring

Long-term stream flow and water quality monitoring sites are located on Pipestone Creek (Figure 33) and Split Rock Creek (Figure 34) as part of the Minnesota Watershed Pollutant Load Monitoring Network (WPLMN). The sites will provide data to determine progress toward and eventual achievement of water quality standards for the streams. The sites include continuous water level, development and maintenance of a streamflow rating curve, routine field measurements, and discrete water sampling and laboratory analysis. Continuous turbidity and temperature sensors will be added when possible.

Figure 33. WPLMN, biological, and proposed monitoring sites in Pipestone Creek Watershed



Six additional stream flow and water quality-monitoring sites will be considered to further the performance evaluation monitoring for the watersheds and if funding is available. Initial candidate sites are shown as upstream monitoring sites in Figure 33, Figure 34, and Figure 35. Discrete water samples would be collected on a storm event basis, targeting a minimum of 25 samples per year. Lab analysis will include TSS, E. coli, TP, and nitrate. Field measurements will include turbidity, Secchi tube transparency, temperature, DO, and specific conductivity.

Streamflow and water quality sampling will provide load calculations to evaluate for load reductions and the effectiveness of the practices implemented in the three watersheds.

Figure 34. WPLMN, biological, and proposed monitoring sites in Split Rock Creek Watershed

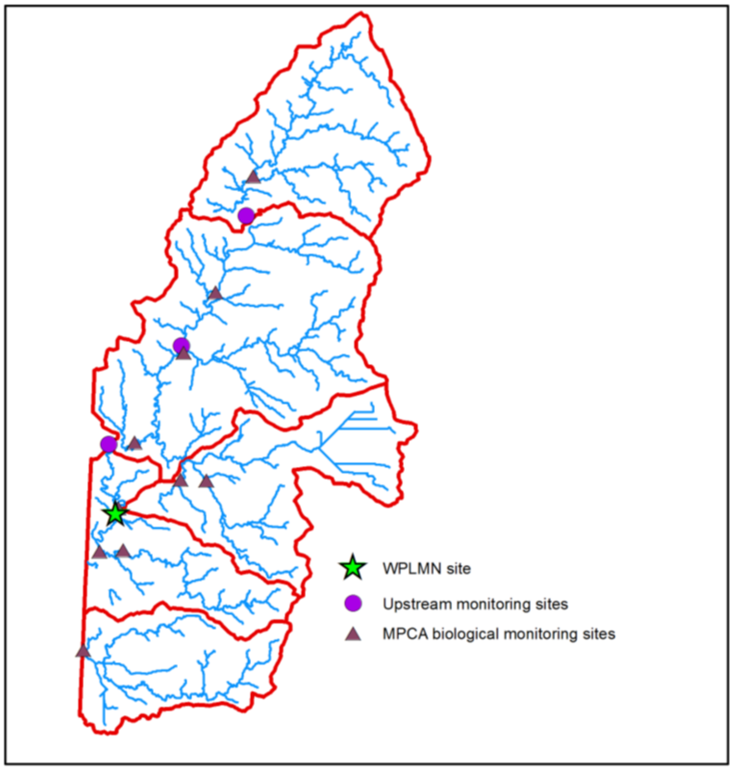
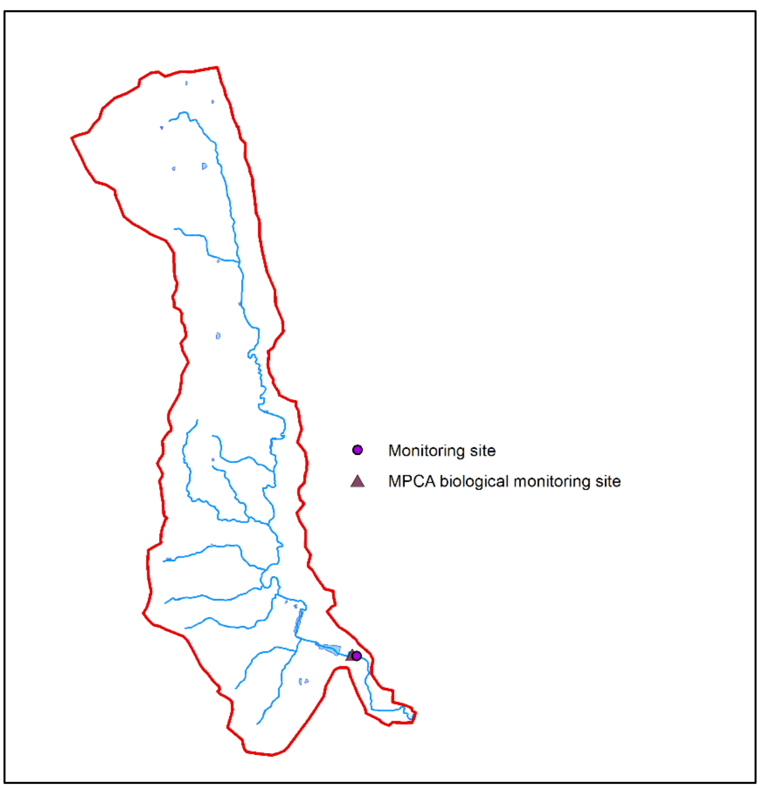


Figure 35. WPLMN, biological, and proposed monitoring sites in Mound Creek Watershed



The 10-year cycle intensive watershed monitoring conducted by MPCA and its partners is scheduled for the 2021. Biological monitoring was conducted at 25 sites in 2011 with many likely to be sampled again in 2021. Water quality monitoring is also conducted at several sites between 10 and 20 times in a two-year period. An outcome of this monitoring effort is the identification of waters that are impaired (i.e., do not meet standards and need restoration) and waters in need of protection to prevent impairment.

Additional annual stream biological monitoring will also be conducted, if resources are available. Stream habitat and geomorphology monitoring will be completed in conjunction with the flow, chemistry, and biology monitoring.

The Pipestone and Rock County Environmental offices will promote the citizen steam-monitoring program for citizen engagement, as well as to obtain stream water quality data that will be used as a means to measure stream water quality improvements.

BMP implementation is tracked by the Board of Water and Soil Resources (BWSR) in its eLINK database for state-funded implementation and the United States Department of Agriculture for federally funded implementation. Both agencies track the locations of BMP installations; however, reporting is generally limited to individual watersheds due to data privacy limits. Changes in land cover and land use not associated with BMP implementation will be tracked using visual observations, field measurements, and aerial imaging.

The estimated cost of conducting this monitoring for ten years is $580,000 (Table 54).

Table 54. Monitoring costs in Pipestone Creek, Split Rock Creek, and Mound Creek Watersheds

Monitoring type	Description	Unit cost (annual)	Total (10-years)
Streamflow and water quality sampling and analysis	0.2 FTE for 6 sites 0.1 FTE for data analysis Lab costs ($2,000/site) Equipment 4 sites ($5,000/site)	$20,000 $10,000 $12,000 $20,000 (total)	$440,000
Biological monitoring	0.1 FTE for 10 sites 2-4 person crew and data analysis	$10,000	$100,000
Habitat and stream geomorphology	0.2 FTE (2 times per 10-year period)	$20,000	$40,000
Total			**$580,000**

10. Costs to implement this plan

This NKE plan is an aggressive implementation plan to restore the waterbodies to water quality standards in the three watersheds. The total cost for implementation is estimated at approximately $5.2 million. It is recognized that this level of funding is likely not available, nor socially or politically palatable. Thus, the available funding, capacity, and participation levels will likely be lower.

These numbers reflect a total cost for all projects if implemented with direct payments to producers and landowners. An important feature of the practices in this NKE plan will be that many of the practices actually improve producers' profitability and productivity. Therefore, a key part of the plan is demonstrating that these practices are economically viable and beneficial to the participants. A significant part of the education and outreach goals are to create/provide economic benefits for the participants. This is especially shown in the soil health and SRAM practices. It is likely that producers will come to adopt the practices to increase the profitability of their operations. The estimated costs in this plan do not obligate the watershed partners and local communities to increase funding, but are intended to show the large collective effort and investments to reach the goals.

An additional $580,000 is needed for evaluation monitoring. Evaluation monitoring is critical to identify the effects of implemented practices and identify when alternative actions are needed. This information can then be used to select the most effective means of addressing the problems using adaptive management and will allow the watershed partners to determine the cost/benefits of the actions taken. Results from the monitoring will be used to guide the future goals of the plan and will adjust the future implementation recommendations.

Implementation of the Pipestone Creek, Split Rock Creek, and Mound Creek Watersheds NKE Plan will require additional financial and technical resources to be completed. A list of existing funding sources available to support implementation is provided in Table 55.

Table 55. Partial list of funding sources for restoration and protection strategies

Sponsor or information source	**Program description**
MPCA	**Section 319 Grants:** Federal grant funding from the EPA as part of the Clean Water Act, Section 319. Grants awarded by MPCA to local governmental units and other groups are to address NPS pollution through implementation projects. **Clean Water Partnership Loan**: The state funded Clean Water Partnership Program awards no-interest loans to local governmental units for work on projects that address nonpoint source pollution. **Clean Water State Revolving Fund:** The state revolving fund provides loans to for both point source (wastewater and stormwater) and nonpoint source water pollution control projects.
BWSR	**Clean Water Fund Competitive Grants:** These grants are to restore, protect, and enhance water quality. Eligible activities must be consistent with a comprehensive watershed management plan, county comprehensive local water management plan, soil and water conservation district comprehensive plan, metropolitan local water plan or metropolitan groundwater plan that has been State approved and locally adopted or an approved TMDL, WRAPS document, surface water intake plan, or well head protection plan. **Targeted Watershed Demonstration Program:** This program awards grants to local governmental units organized for the management of water in a watershed or subwatershed where multiyear plans that will result in a significant reduction in water pollution in a selected subwatershed are in place.

Sponsor or information source	Program description
	The Erosion Control and Water Management Program, commonly known as the State Cost-Share Program: This program provides funds to Soil and Water Conservation Districts to share the cost of systems or practices for erosion control, sedimentation control, or water quality improvements that are designed to protect and improve soil and water resources. Through this program, land occupiers can request financial and technical assistance from their local District for the implementation of conservation practices.
Minnesota Department of Agriculture (MDA)	**AgBMP Loan Program:** This program encourages implementation of BMPs that prevent or reduce pollution problems, such as runoff from feedlots, erosion from farm fields and shoreline, and noncompliant septic systems and wells. MDA provides a wide array of other information from their agency as well as other state and federal agencies on conservation programs addressing agriculture and other land uses. In addition, Clean Water Research Projects are available for funding.
Minnesota DNR	**DNR grants** are available for a variety of programs relating to land preservation, wildlife and habitat, native prairie, forestry and wetlands.
USDA NRCS	**Environmental Quality Incentives Program:** Voluntary program to implement conservation practices, or activities, such as conservation planning, that address natural resource concerns for agricultural producers. **Conservation Reserve Program – Continuous Signup:** This program is a USDA Farm Service Agency-funded voluntary program designed to help farmers restore and protect environmentally sensitive land—particularly wetlands, wildlife habitat and water quality buffers. **Conservation Stewardship Program:** Voluntary program to improve resource conditions such as soil quality, water quality, water quantity, air quality, habitat quality, and energy.

Literature Cited

DNR. 2014. *Missouri River Basin Hydrology, Connectivity, and Geomorphology Assessment Report*. Minnesota Department of Natural Resources, Division of Ecological and Water Resources. Document #wq-b7-01. October 10, 2014.

MPCA. 2008. *Pipestone Creek Fecal Coliform Bacteria and Turbidity Total Maximum Daily Load Report*. Developed by Chris Zadak (MPCA) and Kyle Krier (Pipestone County Conservation and Zoning Office). Document #WQ-iw7-07b. May 2008.

MPCA. 2014a. *Missouri River Basin (Upper Big Sioux, Lower Big Sioux, Little Sioux, and Rock River Watersheds) Monitoring and Assessment Report*. Document number wq-ws3-10170204b. September 2014.

MPCA. 2014b. *Lower Big Sioux River Watershed Biotic Stressor Identification Report*. Prepared by Mike Koschak. Document #wq-ws5-10170203a. December 2014.

MPCA. 2018. *Missouri River Basin Watersheds of Minnesota Watershed Restoration and Protection Strategies*. Document #wq-ws4-40a. January 2018.

Respec. 2014. *Model Development for the Minnesota Portions of the Big Sioux and the Little Sioux-Missouri River Watersheds*. Memorandum from Seth Kenner to Dr. Charles Regan. RSI(RCO)-2216/5-14/25. May 30, 2014.

Wenck Associates, Inc. 2018. *Missouri River Basin Total Maximum Daily Load: Lower Big Sioux River, Little Sioux River, and Rock River Watersheds*. Prepared for Minnesota Pollution Control Agency. Document #wq-iw7-44e. January 2018.

Appendix A.
STEPL output and assumptions

The STEPL was used to estimate N, P, TSS, and *E. coli* loads and reductions for the watershed. STEPL output and reduction estimates in Section 6.2 include loading and streambank restoration reductions.

The reductions for BMPs identified in the ten-year milestone table were summed and entered as combined efficiency practices in STEPL. The reductions for BMPs implemented between 2013 and 2018 were estimated in the same way. Reduction efficiencies for *E. coli* were assumed from MPCA (2011) and Wright Water Engineers, Inc. (2010) and added to the "BMPList" worksheet in 4TEPL. The practices and assumed reduction efficiencies are shown in Table 56.

Table 56. Land use, BMPs, and efficiencies for STEPL (added all *E. coli* efficiencies)

Land use	BMP & efficiency	N	P	TSS	*E. coli*	Assumptions and additions
Cropland						
Cropland	0 No BMP	0	0	0	0	Added all E. coli efficiencies
Cropland	Buffer - Grass (35ft wide)	0.338	0.435	0.533	0.65	
Cropland	Combined BMPs-Calculated	0.549	0.781	0.869	0.919	
Cropland	Conservation Tillage 2 (equal or more than 60% Residue)	0.25	0.687	0.77	0.65	
Cropland	Cover Crop 3 (Group A Traditional Early Planting Time) (High Till only for TP and Sediment)	0.204	0.15	0.2	0.5	
Cropland	Critical Area Planting	0.898	0.808	0.95	0.9	Added cropland Critical Area Planting, assuming same efficiencies as STEPL practice land Retirement
Cropland	Detention Basin	0.253	0.308	0.4	0.3	Assume each basin is 10 acres and each basin treats 100 acres. Assume same efficiencies as STEPL practice Terrace.
Cropland	Filter Strips	0.253	0.308	0.4	0.3	Added Filter Strip, assuming same efficiencies as STEPL practice Terrace, assume 50 acres treatment per acre of filter strip (assume 1,000 ft=1 acres)

Land use	BMP & efficiency	N	P	TSS	*E. coli*	Assumptions and additions
Cropland	Grassed Waterways	0.253	0.308	0.4	0.3	Added Grassed Waterways, assume 1,000 ft of grassed waterways treats 50 acres, assume same efficiencies as STEPL practice Terrace
Cropland	Impoundment	0.898	0.808	0.95	0.9	Added Impoundment, assume same efficiencies as STEPL practice Land Retirement
Cropland	Land Retirement	0.898	0.808	0.95	0.9	Added Nutrient/Manure Management, Assuming same efficiencies as STEPL practice Nutrient Management 1, increased e. coli efficiencies to .9, assume 160 ac treated for 80 ac retirement
Cropland	Manure/Nutrient Management	0.154	0.45	ND	0.9	
Cropland	Nutrient Management 2 (Determined Rate Plus Additional Considerations)	0.247	0.56	ND	0.9	
Cropland	Terrace	0.253	0.308	0.4	0.3	
Cropland	WASCOB (Water and Sediment Control Basin	0.253	0.308	0.4	0.3	Added WASCOB, assuming the same efficiencies as Terrace, assuming 40 acres treated per WASCOB
Cropland	Wetland Restoration	0.898	0.808	0.95	0.9	Added Wetland Restoration, assuming same efficiencies as STEPL practice Land retirement assuming 40 acres treated per acre of wetland
Pastureland						
Pastureland	0 No BMP	0	0	0	0	
Pastureland	Alternative Water Supply	0.133	0.115	0.187	0.65	
Pastureland	BMP Calc Pasture Mound (SRAM practices)	0.907	0.907	0.875	0.96	
Pastureland	BMP Calc Pasture Pipestone (SRAM practices)	0.907	0.907	0.875	0.96	

Land use	BMP & efficiency	N	P	TSS	*E. coli*	Assumptions and additions
Pastureland	BMP Calc Pasture Split Rock (SRAM practices)	0.907	0.907	0.875	0.96	
Pastureland	Grazing Land Management (rotational grazing with fenced areas)	0.43	0.263	ND	0.65	
Pastureland	Streambank Stabilization and Fencing	0.75	0.75	0.75	0.65	

Pipestone Creek Watershed

The Combined Efficiencies of the BMPs were created for Pipestone Creek described Table 57. The efficiencies used for soil health practices were calculated using the BMP Calculator tool in STEPL and are described in Table 58. The calculated efficiencies for pastureland are described in Table 59. The treatment efficiencies for the BMPs that are not in the original list of BMPs and reduction efficiencies (BMPList) in STEPL were assigned based on the similarity of the treatment processes with selected BMPList practices. A limitation of the BMP calculator in STEPL is that it does not include added or customized practices.

Table 57. Combined efficiencies for BMPs and acres treated with Upland BMPs as STEPL inputs for Pipestone Creek Watershed

Area (ac)	Select a BMP Type	N	P	TSS	*E. coli*
80	Critical Area Planting	0.898	0.808	0.950	0.900
200	WASCOB (Water and Sediment Control Basin	0.253	0.308	0.800	0.300
40	Wetland Restoration	0.898	0.808	0.950	0.900
100	Filter Strips	0.253	0.308	0.800	0.300
100	Grassed Waterways	0.253	0.308	0.800	0.300
200	Impoundment	0.898	0.808	0.950	0.900
160	Land Retirement	0.898	0.808	0.950	0.900
78,660	BMP Calculated Soil Health	0.549	0.781	0.869	0.919
79,540	**Total acres treated and combined total efficiencies**	**0.550**	**0.779**	**0.869**	**0.916**

Table 58. STEPL BMP calculator results for Cropland soil health BMPs in the Pipestone Creek Watershed (these practices will be applied in series)

Area (ac)	BMP type	N	P	TSS	*E. coli*
79,540	Cover crop 3	.204	.15	.2	.5
79,540	Conservation tillage 2	.25	.687	.77	.65
79,540	Nutrient management 2	.247	.56	0	.9
79,540	Nutrient management 1	.154	.45	0	.9
79,540	Buffers-grass 35 ft wide	.338	.435	.533	.65
79,540	Total acres treated and combined total efficiencies	.549	.781	.681	.919

Table 59. STEPL BMP calculator results for Pastureland BMPs in the Pipestone Creek Watershed (these practices will be applied in series)

Area (ac)	BMP type	N	P	TSS	*E. coli*
10,347	Grazing land management (rotational grazing with fenced area)	.8	.8	.75	.9
10,347	Streambank stabilization and fencing	.8	.8	.75	.9
10,347	Alternative water supply	.8	.8	.75	.9
10,347	Total pastureland SRAM practices combined total efficiencies	.907	.907	.875	.960

Split Rock Creek Watershed

The Combined Efficiencies of the BMPs were created for Split Rock Creek described Table 60. The efficiencies used for soil health practices were calculated using the BMP Calculator tool in STEPL and are described in Table 61. The calculated efficiencies for pastureland are described in Table 62. The treatment efficiencies for the BMPs that are not in the original list of BMPs and reduction efficiencies (BMPList) in STEPL were assigned based on the similarity of the treatment processes with selected BMPList practices. A limitation of the BMP calculator in STEPL is that it does not include added or customized practices.

Table 60. Combined efficiencies for BMPs and acres treated with Upland BMPs as STEPL inputs for Split Rock Creek Watershed

Area (ac)	Select a BMP Type	N	P	TSS	*E. coli*
160	Critical Area Planting	0.898	0.808	0.950	0.900
200	WASCOB (Water and Sediment Control Basin	0.253	0.308	0.800	0.300
40	Wetland Restoration	0.898	0.808	0.950	0.900
100	Filter Strips	0.253	0.308	0.800	0.300
100	Grassed Waterways	0.253	0.308	0.800	0.300
200	Impoundment	0.898	0.808	0.950	0.900
160	Land Retirement	0.898	0.808	0.950	0.900
61,410	BMP Calculated Soil Health	0.549	0.781	0.869	0.919
62,370	**Total acres treated and combined total efficiencies**	**0.550**	**0.778**	**0.869**	**0.915**

Table 61. STEPL BMP calculator results for Cropland soil health BMPs in the Split Rock Creek Watershed (these practices will be applied in series)

Area (ac)	BMP type	N	P	TSS	*E. coli*
62,370	Cover crop 3	.204	.15	.2	.5
62,370	Conservation tillage 2	.25	.687	.77	.65
62,370	Nutrient management 2	.247	.56	0	.9
62,370	Nutrient management 1	.154	.45	0	.9
62,370	Buffers-grass 35 ft wide	.338	.435	.533	.65
62,370	**Total acres treated and combined total efficiencies**	**.549**	**.781**	**.681**	**.919**

Table 62. STEPL BMP calculator results for Pastureland BMPs in the Split Rock Creek Watershed (these practices will be applied in series)

Area (ac)	Select a BMP Type	N	P	TSS	*E. coli*
12,150	Grazing land management (rotational grazing with fenced area)	.8	.8	.75	.9
12,150	Streambank stabilization and fencing	.8	.8	.75	.9
12,150	Alternative water supply	.8	.8	.75	.9
12,150	**Total pastureland SRAM practices combined total efficiencies**	**.907**	**.907**	**.875**	**.960**

Mound Creek Watershed

The Combined Efficiencies of the BMPs were created for Mound Creek described Table 63. The efficiencies used for soil health practices were calculated using the BMP Calculator tool in STEPL and are described in Table 64. The calculated efficiencies for pastureland are described in Table 65. The treatment efficiencies for the BMPs that are not in the original list of BMPs and reduction efficiencies (BMPList) in STEPL were assigned based on the similarity of the treatment processes with selected BMPList practices. A limitation of the BMP calculator in STEPL is that it does not include added or customized practices.

Table 63. Combined efficiencies for BMPs and acres treated with Upland BMPs as STEPL inputs for Mound Creek Watershed

Area (ac)	Select a BMP Type	N	P	TSS	*E. coli*
40	Critical Area Planting	0.898	0.808	0.950	0.900
200	WASCOB (Water and Sediment Control Basin	0.253	0.308	0.800	0.300
40	Wetland Restoration	0.898	0.808	0.950	0.900
50	Filter Strips	0.253	0.308	0.800	0.300
50	Grassed Waterways	0.253	0.308	0.800	0.300
100	Impoundment	0.898	0.808	0.950	0.900
160	Land Retirement	0.898	0.808	0.950	0.900
8160	BMP Calculated Soil Health	0.549	0.781	0.869	0.919
8800	**Total acres treated and combined total efficiencies**	**0.552**	**0.766**	**0.870**	**0.897**

Table 64. STEPL BMP calculator results for Cropland soil health BMPs in the Mound Creek Watershed (these practices will be applied in series)

Area (ac)	BMP type	N	P	TSS	*E. coli*
88,000	Cover crop 3	.204	.15	.2	.5
88,000	Conservation tillage 2	.25	.687	.77	.65
88,000	Nutrient management 2	.247	.56	0	.9
88,000	Nutrient management 1	.154	.45	0	.9
88,000	Buffers-grass 35 ft wide	.338	.435	.533	.65
88,000	**Total acres treated and combined total efficiencies**	**.549**	**.781**	**.681**	**.919**

Table 65. STEPL BMP calculator results for Pastureland BMPs in the Mound Creek Watershed (these practices will be applied in series)

Area (ac)	Select a BMP Type	N	P	TSS	*E. coli*
1,320	Grazing land management (rotational grazing with fenced area)	.8	.8	.75	.9
1,320	Streambank stabilization and fencing	.8	.8	.75	.9
1,320	Alternative water supply	.8	.8	.75	.9
1,320	**Total pastureland SRAM practices combined total efficiencies**	**.907**	**.907**	**.875**	**.960**

Estimated reduction summary for all watersheds for streambank restoration and SSTS

Streambank restoration TSS reduction summary for all three watersheds are described in Table 66. The streambank restoration and suite of practices described in Table 59, Table 62, and Table 65 will comprise the activities described as SRAM in Section 7.1.1.

Table 66. Streambank restoration, efficiencies, and reductions for all watersheds

Watershed	Length (ft)	Height (ft)	BMP efficiency (0-1)	Annual TSSS load (ton)	TSS load reduction (ton)
Pipestone Creek	21,120	4	0.95	1436	1364
Pipestone Creek	21,120	4	0.95	1436	1364
Pipestone Creek	21,120	4	0	1436	0
Pipestone Creek	21,120	4	0	1436	0
Pipestone Creek	21,120	4	0	1436	0
Pipestone Creek	21,120	4	0	1436	0
Split Rock Creek	21,120	8	0.95	2872	2729
Split Rock Creek	21,120	8	0.95	2872	2729
Split Rock Creek	21,120	8	0.95	2872	2729
Split Rock Creek	21,120	8	0.95	2872	2729
Split Rock Creek	21,120	8	0.95	2872	2729
Split Rock Creek	21,120	4	0.95	1436	1364
Mound Creek	5,280	4	0.95	359	341
Mound Creek	5,280	4	0	359	0
Mound Creek	5,280	4	0	359	0

The range rate for severe lateral recession for all banks is 0.3-0.5 ft/yr, the rate is 0.4 ft/yr. The lateral recession rate was observed to be severe for all streambanks. The soil textural class was silt loam for all streambanks, with an assumed soil dry weight of .0425 ton/ft3

The reductions for replacing and/or upgrading failing or non-conforming SSTS were estimated using the STEPL septic tab. Outputs from this worksheet are described in Table 67.

Table 67. STEPL output for SSTS *E. coli* load reductions for Pipestone Creek, Split Rock Creek, and Mound Creek Watersheds

Watershed	**# SSTS**	**SSTS failure rate %**	**# failing SSTS**	**N load lb/hr**	**P load lb/hr**	***E. coli* MPN/hr**
Pipestone Creek	467	5	23.35	0.083	0.032	5.9E+09
Split Creek Watershed	390	5	19.5	0.069	0.027	5.0E+09
Mound Creek	48	17	8.16	0.029	0.011	2.1E+09
Septic nutrient load in lb/yr except E. coli in MPN/yr)				**Load after reduction**		
Watershed	**N load lb/yr**	**P load lb/yr**	***E. coli* MPN/yr**	**N load lb/yr**	**P load lb/yr**	***E. coli* MPN/yr**
Pipestone Creek	725.91	284.31	5.2E+13	0	0	0
Split Creek Watershed	606.22	237.44	4.3E+13	0	0	0
Mound Creek	253.68	99.36	1.8E+13	0	0	0

Assumptions for SSTS		
The direct contribution of nutrients to a stream is from failing SSTS		
Required input for calculating SSTS nutrient load are number of SSTS, failure rate, loading rate (lb/hr), and flow (cfs)		
Assumption: failing SSTS are distributed evenly across the watershed based on land area		
Assume the average concentrations reaching the stream (from SSTS overcharge) are:		
Total Nitrogen:	60	mg/L (range of 20 to 100)
Total Phosphorus:	23.5	mg/L (range of 18 to 29)
Organics (BOD):	245	mg/L (range of 200 to 290)
E. coli *	9.50E+05	MPN/100ml
Typical septic overcharge flow rate of:	70	gal/day/person(range of 45 to 100)
* *E. coli* effluent # assumed to be 948,000 as equivalent from the BWSR SSTS Improvement Estimator Tool (Heger 2017) assumption		

Appendix B.
Success Story Skunk Creek

NONPOINT SOURCE SUCCESS STORY

South Dakota

Seasonal Riparian Area Management Improves Water Quality in Skunk Creek

Waterbody Improved Sedimentation from agricultural nonpoint source pollution degraded warmwater marginal fish habitat in 59.7 miles of Skunk Creek. As a result, the South Dakota Department of Environment and Natural Resources (DENR) placed the waterbody on South Dakota's 2012 Clean Water Act (CWA) section 303(d) list due to a total suspended solids (TSS) impairment. Natural resource agency partners collaborated on projects to implement riparian and other best management practices (BMPs) to reduce sediment loadings. With these improvements, DENR reclassified the Skunk Creek segment in 2016 as meeting its beneficial uses for warmwater marginal fish life and removed it from South Dakota's CWA section 303(d) list.

Problem

Skunk Creek drains 582 square miles of land before merging with the Big Sioux River inside the city limits of Sioux Falls (Figure 1). Skunk Creek is an important tributary of the Big Sioux River, providing much of the water entering the city when the diversion dam is closed. To meet water quality standards for TSS, the 30-day average TSS concentration must be less than or equal to 158 milligrams per liter (mg/L) and the daily maximum must not exceed 263 mg/L on more than 10% of the sampling dates.

Skunk Creek impairments were identified by ambient water quality monitoring (1990–2018) along with various water quality monitoring projects including the Central Big Sioux River Watershed Assessment Project (2000–2001), Central Big Sioux Implementation Monitoring Project (2005–2008), Sioux Falls Total Maximum Daily Load (TMDL) Assessment Project (2009), and the East Dakota Water Quality Monitoring Project (2011–2018). As a result, DENR added the segment to the state's list of impaired waters in 2012 for failure to attain its beneficial uses for warmwater marginal fish life due to elevated TSS. A National Water Quality Initiative (NWQI) project was initiated with the U.S. Department of Agriculture's (USDA's) Natural Resource Conservation Service (NRCS) in the Skunk Creek watershed from 2014 to 2017 to document water quality results and implement BMPs to reduce bacteria, sediment, and nutrients.

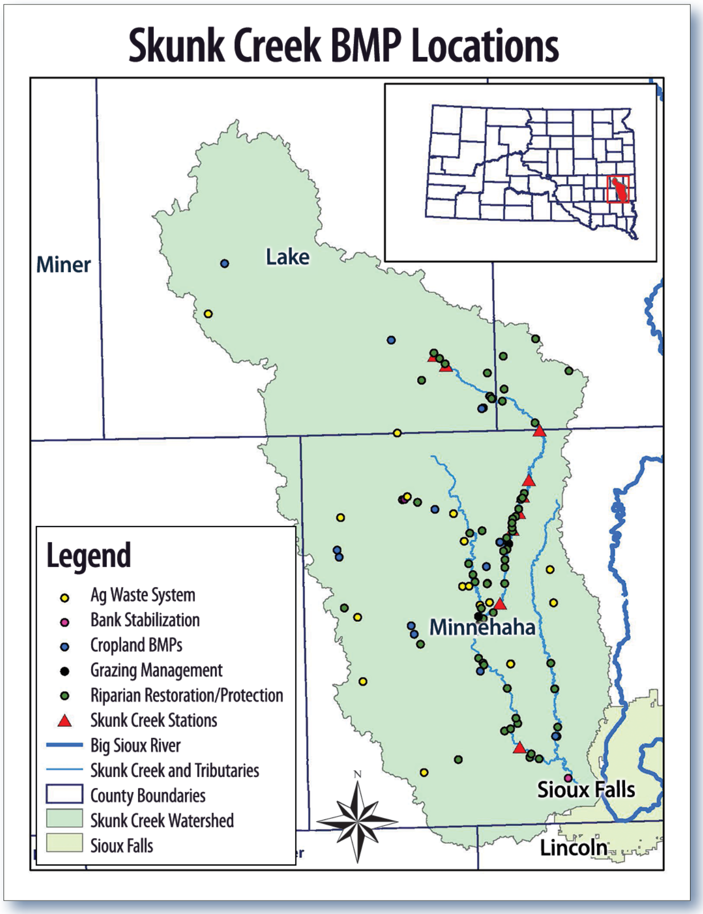


Figure 1. Landowners implemented many BMPs in the Skunk Creek watershed.

Figure 2. A section of Skunk Creek before (2013, left) and after SRAM (2018, right) was implemented.

Story Highlights

Watershed partners implemented a wide variety of BMPs including agricultural waste systems, cropland BMPs, alternative water sources, fencing, riparian area management, stream exclusion and bank protection. During the restoration of Skunk Creek and other Big Sioux reaches and tributaries, a new BMP was developed. Landowners found that the Seasonal Riparian Area Management (SRAM) practice is an attractive option for using land on the river corridor while also protecting it from livestock use during the recreation season (Figure 2). Livestock producers enrolling pasture into the program were paid $60 an acre to defer grazing from April through September but can graze in the off-season as long as a minimum vegetation stand of 4 inches is maintained. Haying is also allowed from June through September; alternative water is required if the area is grazed in the winter season. Land within the 100-year floodplain of Skunk Creek is eligible for the program. Over 1,200 acres of riparian area along Skunk Creek have been entered into SRAM to date.

The SRAM practice was later used as the model for the governor's buffer strip bill, which now applies statewide. This innovative practice is feasible because it meets both producers' needs and conservation objectives. Skunk Creek became an NWQI watershed in 2014–2017 when additional practices were implemented and water quality and other biology and habitat data were collected. Baseline conditions for bacteria, sediment and nutrients were established in the Jensen Creek–Skunk Creek watershed; monitoring continues today to test the difference between control (no SRAM) and treatment (SRAM present) sites.

Results

As of 2016, Skunk Creek TSS levels no longer violate water quality standards. According to STEPL modelling, sediment loads have been reduced by 365 tons per year during the Big Sioux Implementation Project Segment 3; 2,654 tons per year during the Central Big Sioux Implementation Project Segment 2; and 184 tons during the Central Big Sioux Implementation Project Segment 1. Total reductions of 45,371 pounds nitrogen; 14,331 pounds phosphorus; 3,203 tons of sediment; and 1.9 E10 most probable number of *Escherichia coli* were calculated for Skunk Creek alone during all three implementation project segments. Median TSS values have steadily declined across all sites in the Skunk Creek watershed from 60 mg/L in 2011 to 28 mg/L in 2018. Acute TSS violations have declined from 11% in 2011 to 3% in 2017. Slight improvements in macroinvertebrate and fish community measures between control (no-SRAM) and treatment (SRAM) locations in the NWQI watershed have been noted. As a result, Skunk Creek was removed from the state's 303(d) list for its TSS impairment in 2016.

Partners and Funding

CWA section 319 funds specifically were used for agricultural waste systems, cropland BMPs, and a variety of riparian restoration practices. Through three project segments spanning 13 years, CWA section 319 funds contributed $184,059 toward BMPs. Other federal sources, including the USDA Regional Conservation Partnership Program and the USDA Environmental Quality Incentives Program, provided $1,024,118 to support BMPs. State contributions include the Clean Water State Revolving Fund (Nonpoint Source), which granted $3,356,908—the bulk of the SRAM funding. Local sources, including landowners and East Dakota Water Development District, contributed $1,817,674. The local project sponsor is the Moody County Conservation District. Local partners include participating landowners, the city of Sioux Falls, the Lake and Minnehaha county conservation districts, East Dakota Water Development District, and the Big Sioux River Watershed Steering Committee. State partners include DENR. Federal partners include the U.S. Environmental Protection Agency and the USDA NRCS.

U.S. Environmental Protection Agency
Office of Water
Washington, DC

EPA 841-F-19-001Q
June 2019

For additional information contact:

Kris Dozark
South Dakota DENR
605-773-5682 • Kris.Dozark@state.sd.us