Pipestone Creek Fecal Coliform Bacteria and Turbidity TMDL Implementation Plan

For Submission to:

Minnesota Pollution Control Agency

Submitted by:

Pipestone County Conservation and Zoning Office

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Pipestone National Monument Falls

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1. TMDL Implementation Plan Executive Summary

This implementation plan was written by staff of the Pipestone County Conservation and Zoning Office with assistance from the Pipestone County Advisory Committee (PCAC), Pipestone Planning Commission, Pipestone Soil and Water Conservation District (SWCD) Board of Supervisors and guidance from the Minnesota Pollution Control Agency (MPCA). This implementation plan is based on the *Pipestone Creek Fecal Coliform Bacteria and Turbidity Total Maximum Daily Load (TMDL) Report* which was approved by EPA on July 3, 2008. Beginning in February 2005, the PCAC was created to oversee and provide input on the development of the TMDL study and implementation plan. The committee is composed of landowners, local, state and federal agency staff, City of Pipestone, and general public. Various informational and input meetings were held (Appendix A) during the Pipestone Creek TMDL Study and implementation plan development process. This plan was reviewed and approved for submittal to MPCA during a final implementation plan meeting held on August 19, 2008.

Three segments of Pipestone Creek are listed for both fecal coliform bacteria and turbidity, for a total of six impairments. Load duration curves were utilized to determine the TMDL for each of these reaches. A comprehensive source assessment including a watershed survey was instrumental in providing the information needed to complete an implementation plan. A summary of the TMDL report can be found in Section 2.

The portion of the Pipestone Creek watershed in Minnesota is fairly small and determining a priority area or concern was difficult. Section 3 discusses the priority areas and concerns.

There are several implementation measures that address turbidity and fecal coliform bacteria. It was important to the PCAC to provide many opportunities to address the impairments. Using a discussion based process, the PCAC selected feedlot runoff control, septic system upgrades, residue and nutrient management, vegetative buffers, wetland restoration, erosion control, as primary implementation measures. Total implementation plan project costs are estimated to be $2,870,870.00 which includes $894,200.00 needed in cash and $1,976,670.00 needed in-kind.

Implementation of items identified as priority will be completed within a ten-year period. Evaluation of watershed improvements through local monitoring will be completed at the end of the 5th and 10th years to determine TMDL load reductions. The MPCA is collecting data annually at one of the monitoring sites, which will be useful in determining year-to-year variability. This project would not have been possible without the assistance of the partners identified in Section 7.

2. TMDL Report Summary

2.1 Project History

In 2005, the Minnesota Pollution Control Agency (MPCA) began a partnership with the Pipestone County Conservation and Zoning office to develop a Total Maximum Daily Load (TMDL) Assessment for the impaired reaches in the Pipestone Creek watershed. Pipestone County Conservation and Zoning staff, in cooperation with the Pipestone National Monument staff, collected data in 2005-2006 and a draft TMDL assessment was produced in 2007. Public meetings were held to inform and involve the public. A Pipestone County Advisory Committee (PCAC) was developed and provided input throughout the process. EPA requested changes to the TMDL assessment which delayed the approval by seven months; the Pipestone Creek Fecal Coliform Bacteria and Turbidity TMDL Report was approved on July 3, 2008.

2.2 Watershed Characteristics

The Pipestone Creek watershed is located in southwestern Minnesota (Figure 2.1). The Minnesota portion of the Pipestone Creek Watershed is located in Pipestone County and encompasses 151 square miles (96,577 acres). The watershed is within the Northern Glaciated Plains eco-region and is a sub watershed of the Big Sioux River Watershed of the Missouri River Basin. Pipestone Creek flows from Minnesota into South Dakota, and back into Minnesota where it converges with Split Rock Creek. The watershed receives approximately 26 inches of precipitation annually.

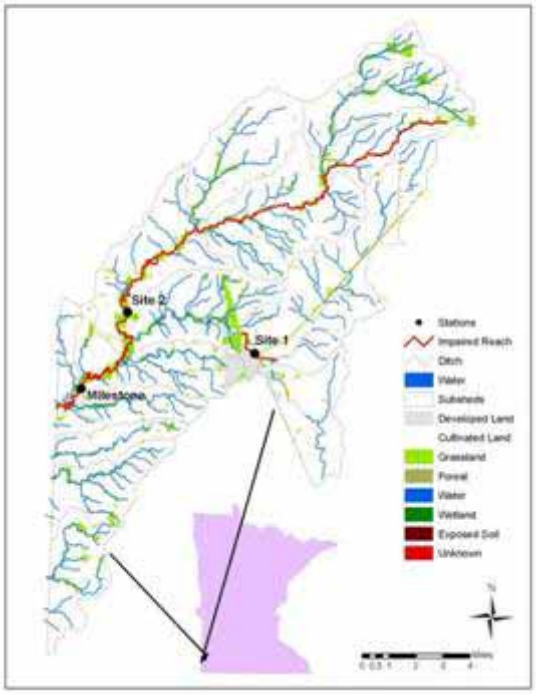


Figure 2.1. Pipestone Creek Watershed

The watershed has mostly dark-colored, gently sloping soils that formed in medium-textured or moderately fine textured wind- or glacier-deposited material. The original vegetation was tall and medium prairie grasses. Today, the majority of the watershed land use is cultivated land (87 percent). Upland cultivated land is dominated by corn and soybeans. Bottom lands along the creek are dominated by pasture, supporting numerous livestock operations. Approximately eight percent of the land use is grassland, 1.5 percent is farmstead and rural developments and 1.4 percent is forested. Only 1.2 percent is classified as urban with one community (City of Pipestone) in the watershed, which supports a population of 4,280. The population of the watershed is 5,242 (based on US Census in 2000 and E911 database). The area has shown a declining population in recent years. From 1990 to 2000 the population of Pipestone County decreased 5.7 percent.

There is limited recreational use of Pipestone Creek in Minnesota due to its small size and lack of game fish. The most use received by the creek is at Pipestone National Monument, which is visited by over 100,000 people each year (Rothman and Holder, 1992). Pipestone Creek provides habitat to several nongame fish species, including the Topeka shiner, an endangered species of native prairie minnow.

2.3 Impairments

The MPCA listed three stream reaches in the Pipestone Creek Watershed as not meeting the aquatic recreation and life beneficial uses due to excess fecal coliform bacteria and turbidity (Table 2.1).

Table 2.1: Pipestone Creek TMDL listings

Reach name on 303(d) list	Assessment Unit ID	Monitoring Station	Impairment	Year Listed
Main Ditch; CD A to Pipestone Cr	10170203-527	Site 1 (S000-646)	Fecal, Turbidity	2004, 2006
Pipestone Creek, North Br; Headwaters to Pipestone Cr	10170203-514	Site 2 (S001-904)	Fecal, Turbidity	2004, 2006
Pipestone Creek; N Br Pipestone Cr to MN/SD border	10170203-501	Milestone (S000-099)	Fecal, Turbidity	1994, 2002

2.4 Source Assessment

2.4.1 Source Assessment-Fecal Coliform Bacteria

The source assessment included inventorying existing fecal coliform bacteria sources, estimating the amount of bacteria produced per day, and estimating the runoff and delivery potential of bacteria to Pipestone Creek. Livestock numbers were determined using a level II feedlot inventory by Pipestone County Conservation and Zoning staff. The number of people using septic systems is based on households in the county's E911 database. Adequate vs. inadequate was estimated by identifying the systems in the county septic database that have been updated and are in compliance, and then assuming that the remaining households are inadequate. The wastewater treatment plant population served is based on year 2000 census data for the City of Pipestone. Deer numbers are based on the DNR Slayton Office and in the absence of reliable data for other wildlife, an equivalency to deer is assumed. The estimated number of dogs and cats are based on American Veterinary Medicine Association data. The amount of fecal coliform bacteria produced daily by each animal type was obtained from a variety of sources, which are all recommended in the Environmental Protection Agency's (EPA) guidance document *Protocol for Developing Pathogen TMDLs*. Using the methodology defined in the 2002 version of the Regional TMDL Evaluation of Fecal Coliform Bacteria Impairments in the Lower Mississippi River Basin in Minnesota, delivery potential ratios were derived for the Pipestone Creek watershed. Through the five step process, it was determined that overgrazed pasture, and surface-applied manure had the best potential for delivering bacteria to Pipestone Creek (Table 2.2). Feedlots without runoff controls, incorporated manure and failing SSTS also had the potential to deliver fecal coliform to Pipestone Creek.

Table 2.2: Fecal Coliform Delivery Potential

SOURCE	ESTIMATED FC DELIVERED			
	Spring (wet)	Spring (dry)	Summer (wet)	Summer (dry)
Feedlots or stockpiles without runoff controls				
Overgrazed pasture near streams or waterways				
Other pasture				
Surface-applied manure				
Incorporated / injected manure				
Failing / inadequate septic systems				
Municipal wastewater treatment facility (excluding bypasses)				
Deer and other wildlife				
Dogs and cats in city—waste not collected				
Dogs and cats outside city				

Legend:

"very low to none" (less than 1%)	
"low" (1-5%)	
"moderate" (5-20%)	
"high" (greater than 20%)	

2.4.2 Turbidity Source Assessment

For the source assessment, various sources of information are used in the analysis including water quality data collected and other MPCA information, soil and land use information, and a stream survey conducted by Pipestone County Conservation and Zoning Office staff.

Turbidity has several sources and pathways. For the Pipestone Creek TMDL Report, seven sources were addressed: feedlots with pollution hazards, livestock in riparian zone, row cropland, ditches/channelization, impervious surfaces, permitted point sources and benthic feeders. Below is a summary of the source assessment for Pipestone Creek.

During the watershed survey, Pipestone County staff determined that approximately 15 feedlots have a runoff problem and need corrective measures to minimize runoff. Overgrazing in riparian pastures does not seem to be chronic problem, although there is evidence to suggest this source is a concern and should be further identified and addressed especially in the north branch. The fact that much of the watershed riparian area is in pasture and that much is relatively well managed is an overall positive.

Using RUSLE, there were low levels of potential soil loss for the vast majority of upland areas, with the exception of an upper sub watershed with higher slopes. Intermittent streams within cropped areas that lack adequate buffers could be providing excess sediment delivery. The watershed survey located portions of the north branch that have significant bank erosion. While some eroding banks were associated with overgrazed areas, many were not. It was concluded that much of the problem appears

to be due to drainage alterations across the watershed. A full assessment of the influence of ditches/channelization in terms of turbidity is difficult. The limited continuous monitoring data, which was taken downstream of the main ditch, did show elevated spring turbidity levels.

Storm water-related turbidity concerns do exist for the City of Pipestone. The watershed survey noted significant erosion on an intermittent stream where storm water discharges. A review of MPCA records since 2001 reveals 23 TSS-related violations for the City of Pipestone WWTP. These violations appear to represent a small to perhaps moderate contribution to Pipestone Creek during the facility's discharge windows (spring and fall). Ongoing efforts by the city as well as continued regulatory oversight by MPCA are needed and should minimize this contribution. MPCA records show that the number of construction projects per year is relatively small. Therefore, this source appears to be a very minor turbidity source. Regarding industrial storm water sources, there are four permit holders in the watershed according to the MPCA's DELTA database. None have TSS limits or otherwise appear to represent a TSS loading concern in this watershed.

One other potential turbidity contributor worth noting is carp and other benthic feeders that stir up fine sediments. It is difficult to gage the relative impact of this internal source, but limited fish monitoring by MPCA in August of 2004 does show significant biomass of carp where sampling was conducted.

2.5 Measurable Water Quality Goals

2.5.1 Fecal Coliform Bacteria Measurable Water Quality Goals

Recently, the fecal coliform bacteria water quality standard changed to *E. coli*. Since the TMDL report was approved using fecal coliform bacteria as a water quality standard, both standards are shown below. The *E. coli* standard is listed in parentheses behind the fecal coliform standard.

- Organisms not to exceed 200 organisms (126 organisms) per 100 milliliters as a geometric mean of not less than five samples in any calendar month,
- Nor shall more than ten percent of all samples taken during any calendar month individually exceed 2000 organisms (1,260 organisms) per 100 milliliters.

The standard applies only between April 1 and October 31. To adapt the fecal coliform TMDL allocations based on *E. coli* standards would require a multiplication factor of 0.63.

The geometric mean of all samples collected at all of the sites for summer is 875 organisms per 100 ml of fecal coliform bacteria. The summer geometric mean is about seven times higher than the spring geometric mean, although the spring and summer *wet* geometric means are of the same general magnitude. Overall, the spring geometric mean is low and falls below the water quality standard. Overall, the "season × runoff" situation geometric means fall out as follows: summer-wet ≥ spring-wet >> summer-dry > spring-dry. In general, all season × runoff situation geometric means exceed the standard except spring-dry.

The percent of samples greater than the 2,000 organisms/100 ml portion of the fecal coliform bacteria water quality standard varied among the sites, although all exceeded that level more than 10 percent of the time.

$$\left(\frac{\text{monthly geomean-water quality standard}}{\text{monthly geomean}}\right) \text{ X } 100 = \text{percent reduction}$$

In order to determine percent reduction needed to meet the water quality standard, a simple equation is used and shown below.
An estimate for an overall load reduction percentage using the summer geometric mean (875 organisms /100 ml) and the standard (200 organisms/100 ml) is as follows:

$$[(875 - 200) / 875] \times 100 = 77\%$$

This reduction percentage is only intended as a rough approximation, as it does not account for flow, and is not a required element of a TMDL. It serves to provide a starting point based on available water quality data for assessing the magnitude of the effort needed in the watershed to achieve the standard.

2.5.2 Turbidity Measurable Water Quality Goals

Minn. Rules Ch. 7050.0222 subpart 5, turbidity water quality standard for Class 2C waters, is 25 nephelometric turbidity units (NTUs). Essentially, listings occur when greater than ten percent of data points collected within the previous ten-year period exceed the 25 NTU standards. Total suspended solids (TSS) and transparency (using a transparency tube) are two surrogates that can also be used. The TSS threshold is 66 milligrams per liter (mg/L) in the Northern Glaciated Plains Eco-region. The surrogate standard for transparency is 20 centimeters.

To determine the TSS equivalent to the turbidity standard of 25 NTU, paired turbidity and TSS samples were compiled. Using a simple regression equation, a TSS concentration of 54 mg/L was determined to be the surrogate value to the 25 NTU turbidity standards.

For a percent reduction, consideration was given to the assessment criteria, which is based on 10 percent of the data within a dataset exceed the 25 NTU standard. Therefore, to meet the water quality standard 90 percent of the time would mean reducing the 90^{th} percentile value from the dataset down to 25 NTU. An estimate for an overall load reduction percentage using the 90^{th} percentile (34 NTU) and the standard (25 NTU) is as follows:

$$[(34 - 25) / 34] \times 100 = 26\%$$

This reduction percentage is only intended as a rough approximation, as it does not account for flow, and is not a required element of a TMDL. It serves to provide a starting point based on available water quality data for assessing the magnitude of the effort needed in the watershed to achieve the standard.

2.6 Loading Capacities and Allocations

2.6.1 Fecal Coliform Allocations

Table 2.3: Pipestone Creek; N Branch Pipestone Cr to border

	FLOW ZONE				
	High	Moist	Mid	Dry	Low
	Billion organisms per day				
Average Total Daily Loading Capacity	541	139	61	32	12
Wasteload Allocation					
Pipestone Wastewater Treatment Facility	25	25	25	25	*
Livestock Facilities Requiring NPDES Permits**	0	0	0	0	0
"Straight Pipe" Septic Systems	0	0	0	0	0
Load Allocation	286	57	20	7	*
Margin of Safety	231	57	17	Implicit	Implicit
	Percent of total daily loading capacity				
Average Total Daily Loading Capacity	100%	100%	100%	100%	100%
Wasteload Allocation					
Pipestone Wastewater Treatment Facility	5%	18%	40%	78%	*
Livestock Facilities Requiring NPDES Permits**	0%	0%	0%	0%	0%
"Straight Pipe" Septic Systems	0%	0%	0%	0%	0%
Load Allocation	53%	41%	33%	22%	*
Margin of Safety	43%	41%	27%	Implicit	Implicit

* See Section 3.3 for allocations for these specific categories in these flow zones.
** The individual facilities are listed in Table 3.2.

Table 2.4: Pipestone Cr, N Branch; Headwaters to Pipestone Cr

	FLOW ZONE				
	High	Moist	Mid	Dry	Low
	Billion organisms per day				
Average Total Daily Loading Capacity	287	74	33	17	6
Wasteload Allocation					
Livestock Facilities Requiring NPDES Permits*	0	0	0	0	0
"Straight Pipe" Septic Systems	0	0	0	0	0
Load Allocation	165	43	24	9	3
Margin of Safety	123	30	9	7	4
	Percent of total daily loading capacity				
Average Total Daily Loading Capacity	100%	100%	100%	100%	100%
Wasteload Allocation					
Livestock Facilities Requiring NPDES Permits*	0%	0%	0%	0%	0%
"Straight Pipe" Septic Systems	0%	0%	0%	0%	0%
Load Allocation	57%	59%	73%	56%	43%
Margin of Safety	43%	41%	27%	44%	57%

* The individual facilities are listed in Table 3.4.

Table 2.5: Main ditch; CD A to Pipestone Cr

	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
	Percent of total daily loading capacity				
Average Total Daily Loading Capacity	100%	100%	100%	100%	100%
Wasteload Allocation					
"Straight Pipe" Septic Systems	0%	0%	0%	0%	0%
Load Allocation	57%	59%	73%	56%	43%
Margin of Safety	43%	41%	27%	44%	57%

2.6.2 Turbidity Allocations (expressed as TSS)

Table 2.6: Pipestone Creek; N Branch Pipestone Cr to border

	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					
Pipestone Wastewater Treatment Facility	0.6	0.6	0.6	*	*
Lincoln Pipestone Holland Well Water Trt Fac	0.02	0.02	0.02	*	*
Load Allocation	8.6	1.8	0.7	*	*
Margin of Safety	6.9	1.7	0.5	Implicit	Implicit
	Percent of total daily loading capacity				
Average Total Daily Loading Capacity	100%	100%	100%	100%	100%
Wasteload Allocation					
Pipestone Wastewater Treatment Facility	4%	15%	33%	*	*
Lincoln Pipestone Holland Well Water Trt Fac	0.1%	1%	1%	*	*
Load Allocation	53%	43%	38%	*	*
Margin of Safety	43%	41%	27%	Implicit	Implicit

* See Section 4.3 for allocations for these specific categories in these flow zones.

Table 2.7: Pipestone Cr, N Branch; Headwaters to Pipestone Cr

	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
	Percent of total daily loading capacity				
Average Total Daily Loading Capacity	100%	100%	100%	100%	100%
Wasteload Allocation					
Lincoln Pipestone Holland Well Water Trt Fac	0.3%	1%	2%	5%	12%
Load Allocation	57%	58%	71%	51%	31%
Margin of Safety	43%	41%	27%	44%	57%

Table 2.8: Main ditch; CD A to Pipestone Cr

	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
	Percent of total daily loading capacity				
Average Total Daily Loading Capacity	100%	100%	100%	100%	100%
Wasteload Allocation					
Load Allocation	57%	59%	73%	56%	43%
Margin of Safety	43%	41%	27%	44%	57%

3. Identification of Priority Management Areas

Due to the limited size and variations in land use within the watershed, the entire area will be identified as the priority area. There are land use practices, which will prompt specific BMP implementation more in one area then another. One example is the pasture management BMP. The Main Ditch sub watershed has no grazing, but the other two sub watersheds have significant grazing. The same is true for feedlot runoff control, and SSTS upgrade sites. The Main Ditch sub watershed is primarily utilized for crop production, which residue management and buffer practices would be promoted.

4. Nonpoint Source Management Measures Alternatives and Analysis

4.1 Evaluation of Management Measures Alternatives

Also see Appendix B. Agroecoregion BMP Matrix for additional conservation practices. Pipestone Creek is included in the Inner Coteau argoecoregion.

1. Erosion Control Conservation Practices

Erosion control practices are practices installed typically on crop fields to reduce soil erosion from tillage. Erosion control practices reduce soil loss from entering surface waters and reduce turbidity and phosphorous loading. Some of the most often used erosion control practices used are: Sediment control basins which are small dams constructed to temporarily hold water and release it through tile, terraces which are berms created on the contour to direct water to stable outlets, and waterways which are sloped and grassed channels for water to flow. It is estimated that erosion control practices can reduce turbidity by 50% to 90% (Reference #2, section 11).

2. Feedlot Runoff Controls

Feedlots with no open lot runoff control are a significant source of fecal coliform bacterial loading. According to the Pipestone County Feedlot Inventory, there are 164 feedlots located in the watershed. Of those 164 feedlots, 9 are over 1,000 animal units and are regulated through National Pollutant Discharge Elimination System, 30 have 300-999 AU and 125 have less than 300 AU. Feedlot runoff control practices are installed to minimize and/or treat feedlot runoff prior to entering surface waters. In addition to open lots, there are dairy facilities with milk house waste that is currently discharged to surface water without proper treatment. Roof runoff management, waste storage facility, and waste treatment are three practices that are commonly utilized. It is estimated that installation of feedlot runoff control practices to be between 90% and 100% effective in the reduction of fecal coliform loading (reference #2section 11).

3. Nutrient Management Planning

Minn. R. ch. 7020 requires all feedlots with 300 or more animal units to have a manure management plan. It is estimated that through proper implementation of plans, nutrient load reductions of 50% to 90% can be expected (reference #1, section 11). These plans can greatly reduce the runoff and potential over application, which can significantly affect water quality. Land application of manure where buffer strips, immediate incorporation and maintenance of surface residue have been demonstrated to reduce manure and pathogen runoff. Stockpiled manure is also a potential source of fecal loading. Proper placement and management of these nutrients is needed. Currently, many producers have a manure management plans but do not use it for making decisions regarding rates and location of application. This can be addressed utilizing the EQIP Nutrient Management BMP. This BMP requires producers to work with an agronomist and the NRCS to develop a comprehensive plan which needs to be followed in order to receive cost-share.

4. Pasture Management

Throughout the watershed, pasture is dominant in riparian areas. Although surveys indicate cover is in fair to good condition, there still remains a need for improvement in pasture management. The overgrazing of pastures and non restricted access to waters increases fecal coliform and turbidity. Proper pasture management and the implementation of rotational grazing practices will greatly reduce loading and be an economical and beneficial practice. Research has shown that exclusion of livestock through fencing or controlled access can reduce fecal coliform bacteria and turbidity in the pastures by as much as 80 percent (reference #7, section 11). Rotational grazing plans are done by creating paddocks to allow cattle to be rotated from area to area and grass is allowed to rest between cycles. BMPs commonly utilized include: prescribed grazing, use exclusion, fencing, watering facility, and pasture and hay planting.

5. Conservation Tillage

Conservation tillage is a practice, which can reduce soil loss, increase nutrients, conserve moisture and increase yields. Conservation tillage is promoted by utilizing tillage and planting equipment which is able to maintain high amounts (30% or more) residue after planting in the spring. Equipment types include: no-till, strip-till, ridge-till, and other high residue types of equipment. No load reduction estimates are given with this BMP due to significant variations based on tillage type, crop, slope percent, and soil type.

6. Vegetative Buffers

Vegetative buffers include filter strips or a grass strip placed along a watercourse, buffers that may be utilized for feedlot and or milk house waste to be treated, and riparian buffers are buffers placed along creeks and stream. Buffers are one of the most cost effective and efficient runoff control practices available, research has shown that a grass filter strip 15 to 30 feet in length can remove 75 to 91% fecal coliform (reference #5, section 11).

Buffers also eliminate crop production and tillage up to the water body's edge therefore reducing turbidity by stopping sediments and nutrients from reaching our waters. Estimated load reduction of up to 90% (reference #5 section 11) can be seen. Reinvest in Minnesota (RIM), and Conservation Reserve Program (CRP) are two examples of cost-share programs that have been successful in Minnesota to install buffers and filter strips. With the current economy, conservation programs do not offer enough of a payment to interest most landowners to retiring land into a buffer program.

7. Wetland Restorations

Most natural wetland areas are now drained by tile. Wetlands in their natural setting act like a sponge, soaking up and filtering runoff before it is released into surface waters. Wetlands also serve as a groundwater recharge. Programs such as Wetland Reserve Program (WRP) and Continuous Conservation Reserve Program (CCRP) offer cost-share opportunities for landowners. Often additional incentive payments are needed to address the situations where these programs do not adequately compensate producers.

8. Manure Composting

There are several environmental advantages to composting manure. Advantages include: 1) the destruction of pathogens, 2) the conversion of manure to dry

material (manure is spread uniformly as a fertilizer and its nutrient content remains intact. It also reduces the risk of over-applying nutrients), and 3) when combined with the separation of liquids and solids, composting reduces the amount of storage needed. With education, technical support and financial assistance manure composting can significantly reduce manure runoff. This strategy can be cost effective with larger facilities where fixed costs can be spread over larger production in watersheds where fecal coliform impairment is high.

9. Urban Storm Water Runoff

Urban storm water discharges that carry fecal coliform bacteria as a result of pet waste, can be addressed through better site design (or low impact development) and the use of BMPs in urban areas. Common techniques and practices include: infiltration basins, grass channels/vegetative swales, detention/retention ponds, urban forests, street sweeping, snow management and catch basin cleaning, among others. Promotion of better site design and BMPs can be accomplished through education. Additional urban education is also needed to inform the city residents of their impacts on water when applying fertilizers and other day to day activities and how everyone can help. There are two cities in the watershed that could utilize storm water BMPs. The City of Pipestone is located on Pipestone Creek and is interested in addressing storm water concerns. A portion of the city of Holland is located in the upper watershed and does not have much contribution. Both communities are non-permitted Municipal Separate Storm Sewer Systems and do not require mandatory BMPs.

10. Stream Bank Erosion

Stream bank erosion is a large contributor to sediment delivery and stream bank BMPs include stream barb or J-hooks and Rock Weirs. Stream barb or J-hooks are installed where stream bank erosion is occurring. When installed, the barbs re-direct the energy of the stream back into the channel, reducing further stream bank erosion and also creating back water habitat for the Topeka shiner. Rock weirs will be installed where down cutting in the channel is a problem. The weirs will help prevent further head cutting in the stream. Research has shown that eliminating stream bank erosion can reduce turbidity by 90% (reference #4, section 11). It is estimated that 50% of the watersheds natural stream banks have some erosion issues. The drawbacks to stream barbs or J-hooks are that they are expensive to install and need technical assistance for correct placement.

4.2 Selection of Management Measures

The PCAC was utilized in the selection of management measures and development of the objectives located in Section 6. Appendix A displays the meeting materials, notices, and presentations that were used to develop this plan. Various meetings were held as identified in Appendix A. During PCAC meetings, it was clear that all practices should be done on a voluntary basis. All practices were supported as a whole but the ones selected where viewed as being most practical and beneficial. The practices were also selected based on the availability to funding sources, local technical assistance, and local producer acceptance of practices.

Management Measures chosen:

Feedlot runoff control practices: Through inspections and utilizing a feedlot evaluation model (FLEVAL), it is estimated that 15 feedlot sites within the watershed require some type of runoff control to be installed. Due to limited availability of cost-share dollars and the difficulty in meeting the NRCS's technical guide practice standards in many cases, the PCAC felt there was a need to provide producers with a cash incentive whether they were applying for cost-share assistance or not, provided they meet feedlot program compliance. A flat rate incentive payment of $10,000 per site was agreed upon for fixes over $10,000. For feedlots with fixes requiring less than $10,000, the incentive would cover the cost of the project. It is estimated that with installation of these practices an estimated 90 to 100% reduction in fecal coliform can be expected.

Vegetative Buffers: Vegetative buffers were viewed as being one of the most practical and cost effective practices. Through a watershed survey in 2005, it was estimated that there is a need for the installation of 13 miles of stream and ditch buffers within the watershed. Vegetative buffers will be promoted through current conservation programs, but the PCAC felt a one-time signup incentive payment of $1,000 per acre would be needed to ensure signup and installation. This payment amount is based on an assumed buffer of 16.5 feet wide and 0.5 mile long (1 acre).

Nutrient Management: Proper application of manure and fertilizers was viewed as being needed within the watershed. There are approximately 80 feedlots with less than 100 AU, where a manure management plan is not required. Planned goal is to complete plans on 50 of the 84 site needing plans. A $500.00 incentive would be available to those producers needing a plan. The USDA Environmental Quality Incentive Program Nutrient Management BMP program will also be promoted. This program will ensure the operators follow through with plan requirements.

Pasture Management: With much of the riparian zone being utilized as pasture, there is a need to ensure these pastures are being maintained in a manor that will minimize water quality impacts. Approximately 2.5 percent (2,414 acres) of watershed is in pasture; the goal would be to implement pasture management plans on 1,000 acres. The PCAC recommended a one time $100 per acre incentive payment be made available to entice producers to signup for the Environmental Quality Incentive Program for pasture management practices. The EQIP program would be utilized to ensure practice planning and installation.

Wetland Restoration: Although wetland restoration is difficult to achieve the PCAC felt that this would be an important practice to include. Wetlands in their natural setting act like a sponge, soaking up and filtering runoff before it is released into surface waters. It was discussed and agreed that a $1,000 per acre incentive should be available to willing landowners. A restoration goal of 10 acres of wetlands was set.

Conservation Tillage: Since the majority of the watershed is utilized for crop

production (91 percent), conservation tillage was looked at as being an essential practice to be promoted. A residue survey in 2004 found that fifty-seven percent of the land is not utilizing conservation tillage. Currently there are USDA programs in place to provide incentives for these practices. The PCAC discussed and agreed that an initiative for conservation tillage should be included if the current federal programs would ever be discontinued. A goal of 8,000 acres of conservation tillage was set with a per acre payment of $7.00 per acre.

Urban Storm Water Runoff: It is estimated that there are two storm water discharge locations from the City of Pipestone, which are eroding ditch banks and would be relatively easy to address. The PCAC agreed a $15,000 incentive per area to abate these erosion issues would be worthwhile. In addition, these fixes would provide great opportunities to educate the public on erosion, conservation, and the project. No other cost-share dollars are anticipated being available to the city for these repairs.

Management Measures not chosen:

The other listed management measures were viewed as being beneficial but it was felt that either there were current programs and incentives in place to adequately address the practice. Other measures such as stream bank erosion were looked at as needed but not cost effective nor practical due to the large number of stream miles in need.

5. Point Source Management Measures Alternatives and Analysis

A. Evaluation of Management Measures

1. Subsurface Sewage Treatment Systems

Subsurface Sewage Treatment Systems (SSTS) with proper drain fields provide nearly complete treatment of fecal coliform bacteria. Acceptable designs are described in Minn. R. ch. 7080. Failing and non- compliant septic systems are a low contributor of fecal coliform load to the watershed during wet conditions, but are a high contributor of the load during the periods between storms. EPA estimates a 99% bacteria reduction (reference # 6, section 11).

2. Municipal Sewage Control

The city of Pipestone is the only wastewater treatment facility that discharges in the watershed. The city is permitted to discharge twice annually if they are meeting permit limits. Since 2001, the city has had six exceedances of the fecal coliform monthly geometric mean (during non-discharging occasions). Emergency bypasses are regulated under the Clean Water Act and are the responsibility of the MPCA. The City of Pipestone WWTF has had five bypasses in the last five years. The city is in the process of addressing inflow and infiltration issues, (replacement of failing infrastructure, fixing cross connections, disconnecting sump pumps, and disconnecting down spouts from the sanitary sewers).

B. Selection of Management Measures

Subsurface Sewage Treatment Systems (SSTS) was the point source management measure selected by the PCAC. Appendix A displays the meeting materials that were used to develop this plan. Although there are not as many opportunities for reducing bacteria and turbidity in point sources as in nonpoint sources, the one practice selected was felt to have a significant reduction of fecal coliform bacteria. The PCAC felt that based on the TMDL report; there are approximately 5% of the estimated 142 out of compliance systems that outlet directly into surface waters. It was decided that an incentive of 50% of the system cost up to $5,000 be made available on the 10 systems which discharge directly into waters and an incentive of $1,000 be available to the remaining 132 systems. Pipestone County does offer a low interest loan program for homeowners which could be used to finance the remaining balance of the upgraded system.

6. Identification and Summary of Implementation Objectives and Tasks

Project Summary

Objective		Funding Sources		Total
		Cash	In-Kind	
1	Nonpoint Source Pollutant	$ 397,000.00	$ 418,320.00	$ 815,320.00
2	Point Source Pollutant	$ 182,000.00	$ 1,394,850.00	$ 1,576,850.00
3	Education Outreach	$ 4,000.00	$ 12,600.00	$ 16,600.00
4	Project Evaluation	$ 11,200.00	$ 15,900.00	$ 27,100.00
5	Administration	$ 300,000.00	$ 135,000.00	$ 435,000.00
Total of Program Elements		$ 894,200.00	$1,976,670.00	$ 2,870,870.00

Objective 1: Nonpoint Source Pollutant Loading Reductions

Task A: Feedlot Runoff Control Practices

- Implement runoff control practices on 15 feedlot sites with an incentive of $10,000 per site. Roof runoff management, waste storage facility, and waste treatment are three practices that may be used, but projects are not limited to. If feedlot fix is less than $10,000, the cost of the fix will be paid for.
- Provide technical assistance to each feedlot site that implements runoff control practices. It is estimated the average total cost of the 15 feedlots will be $20,000. Inkind contributions are the landowner share, and technical assistance (Pipestone County Conservation/Zoning, NRCS, SPJPO) is estimated to be 10 percent of the project cost.
  - Time frame: January 2009 to December 2018
  - Persons responsible: Conservation/Zoning, NRCS, and SWPJPO
  - Total Cost: $330,000.00
    Cash: 15 sites x $10,000/site incentive = $150,000.00
    Inkind: $180,000.00
    Landowner: 15 sites x $10,000/site = $150,000.00
    Technical assistance: 15 sites x $2,000/site = $30,000.00

Task B: Vegetative Buffer

- Promote the installation of 26 acres of vegetative buffers along watercourses in the Pipestone Creek watershed including County Ditch #1.
- Provide an incentive payment of $1,000 per acre of buffer when enrolled into a conservation program. This payment amount is based on an assumed buffer of 16 ½ feet in width. Incentives for buffer beyond the width of 16 ½ feet will be lower priority.
- Inkind contributions will be the landowner's share of seed and seeding estimated at $200 per acre and technical assistance (Pipestone County Conservation/Zoning, and NRCS).
    - Time frame: January 2009 to December 2018
    - Person(s) responsible: Conservation/Zoning and NRCS
    - Total Cost: $33,020.00
      Cash: 26 acres x $1,000 acre = $26,000.00
      Inkind: $7,020.00
      Landowner: 26 acres x $200/acre = $5,200.00
      Technical Assistance: 2 hrs/acre x 26 acres x $35/hr =$1,820.00

Task C: Nutrient Management

- Promote the development of 50 nutrient management plans. The incentive would only be available to feedlot operations between 300 and 999 animal units. This would address approximately 60 percent of feedlots in the watershed, which are required to have a manure management plan.
- An incentive of $500 per plan will be provided to producers who participate in the NRCS's EQIP.
- Inkind is estimated to be the producer's cost of plan implementation and record keeping. The average development cost for a nutrient management plan is $300 to $500.
- Inkind costs for Conservation/Zoning and the NRCS staff is estimated for review and approval of plans.
    - Time frame: January 2009 to December 2018
    - Person(s) responsible: NRCS, Conservation/Zoning and agronomists
    - Total Cost: $59,000.00
      Cash: 50 plans x $500/plan incentive = $25,000.00
      Inkind: $34,000.00
      Producer Share: 50 plans x $400/plan = $20,000.00
      Tech. Assistance: 8 hrs/plan x 50 plans x $35/hr =$14,000.00

Task D: Pasture Management

- Promote 1,000 acres of pasture management.
- Provide producers with a $100.00 per acre incentive payment for enrollment and installation of an EQIP pasture management plan. Practice components will vary based on site. Typical management plans will include fencing to create paddocks, watering system, seeding, and an operational plan.

- Inkind costs are estimated to be $100 per acre out of pocket expense for a producer to cover practice installation cost (fencing, seeding, water system, etc).
- Technical assistance costs are estimated at 1 hr/10 acres; these inkind costs would include plan development and installation review.
    - Time frame: January 2009 to December 2018
    - Person(s) responsible: NRCS
    - Total Cost: $203,500.00
      Cash: 1,000 acres x $100/acre incentive = $100,000.00
      Inkind: $103,500.00
      Producer Share: 1,000 acres x $100/acre = $100,000.00
      Tech. Assistance: 0.1hr/ac x 1,000 acres x $35/hr = $3,500.00

Task E: Wetland Restoration

- Promote restoration of 10 acres of wetlands.
- Provide landowners with a $1,000 per acre incentive payment for program enrollment and restoration of wetlands. Wetland programs include CRP, RIM, WRP and other land retirement programs.
- Inkind costs are estimated to be $50 per acre technical assistance to be completed by the SWJPO for survey, design, and checkout.
    - Time frame: January 2009 to December 20182018
    - Person(s) responsible: NRCS, SWJPO, SWCD
    - Total Cost: $15,000.00
      Cash: 10 acres x $1,000/acre incentive = $10,000.00
      Inkind: $5,000.00
      Technical Assistance: 10 hrs/acre x 10 acres x $50/hr = $5,000.00

Task F: Conservation Tillage

- Promote 8,000 acres of conservation tillage.
- Provide producers with a $7 per acre incentive payment for development and installation of an EQIP conservation tillage plan.
- Inkind costs are estimated to be $7 per acre for producer expenses (based on $7 per acre cost-share from EQIP representing 50% total cost).
- Technical Assistance to be completed by NRCS for plan review and field residue verification.
    - Time frame: January 2009 to December 2018
    - Person(s) responsible: NRCS
    - Total Cost: $114,800.00
      Cash: 8,000 acres x $7/acre incentive = $56,000.00
      Inkind: $58,800.00
      Producer Share: 8,000 acres x $7/acre = $56,000.00
      Tech. Assistance: 0.01hrs/ac x 8,000 acres x $35/hr = $2,800.00

Task G: Urban Storm Water Runoff

- Repair two city storm water gully areas with the City of Pipestone.
- Provide incentive of $15,000/gully for repairing erosion area. Estimated project costs are $30,000 per gully.
- Inkind costs include the City of Pipestone's cost ($15,000/gully).
  - Time frame: January 2010 to December 2012
  - Person(s) responsible: City of Pipestone
  - Total Cost: $60,000.00
    Cash: 2 gully projects x $15,000/project = $30,000.00
    Inkind: Pipestone: 2 gully projects x $15,000/project =$30,000.00

Objective 2: Point Source Pollutant Loading Reductions

Task A: Subsurface Sewage Treatment System Upgrades-High Priority

- Update 10 high priority septic systems with an outlet directly into surface waters.
- Provide cost-share of 50% system costs up to $5,000.
- Inkind cost will be 50% remaining paid by homeowner; county and Ag BMP loan funds will also be available to assist with landowner out of pocket costs.
- Technical assistance inkind will be completed by Pipestone County Conservation and Zoning Office staff for soil verification, system design review, installation review, certificate issuance, and record keeping.
  - Time frame: January 2009 to December 2018
  - Persons responsible: Conservation/Zoning
  - Total Cost: $101,750.00
    Cash: 10 systems x $5,000 per system = $50,000.00
    Inkind: $51,750.00
    Homeowner: 10 systems x $5,000/system = $50,000.00
    Tech. Assistance: 5 hrs/system x 10 systems x $35/hr=$1,750.00

Task B: Subsurface Sewage Treatment System Upgrades

- Update 132 nonconforming septic systems.
- Provide a onetime $1,000 incentive payment per system upgrade.
- Inkind costs will be the landowner's costs for the system upgrade based on an average per system cost of $10,000. County and Ag BMP loan dollars will also be made available to assist homeowners with system upgrade costs.
- Technical assistance inkind will be completed by Pipestone County Conservation and Zoning Office staff for soil verification, system design review, installation review, certificate issuance, and record keeping.
  - Time frame: January 2009 to December 2018
  - Persons responsible: Conservation/Zoning
  - Total Cost: $1,475,100.00
    Cash: 132 systems x $1,000/system incentive = $132,000.00

Inkind: $1,343,100.00
Homeowner: 132 systems x $10,000/system = $1,320,000.00
Tech. Assistance: 5 hrs/system x 132 systems x $35/hr = $23,100.00

Objective 3: Education and Outreach

Task A: Field Tours

- Hold two field tours where various conservation practices and benefits will be displayed to the public. It is estimated that for materials, busing and meals it will cost about $25 per attendee.
- Estimated that 50 people will attend each tour.
- Inkind costs will be publication and disbursement expenses and staff time for the day of the tours.
    - Time frame: 2009 and 2011
    - Persons responsible: Conservation/Zoning, NRCS, MN Extension Service, and Lincoln Pipestone Rural Water
    - Total Cost: $9,500.00
      Cash: 50 attendees x $25/person x 2 field days = $2,500.00
      Inkind: Staff: 50 hours x 4 persons x $35/hour = $7,000.00

Task B: Mailings and Media

- Distribute an annual Pipestone Creek newsletter to approximately 150 watershed residents to update them on progress and programs.
- Publish an annual Pipestone Creek newspaper article in the local paper.
- Inkind will be staff time for development and distribution of news releases.
    - Time frame: January 2009 to December 2018
    - Persons responsible: Conservation/Zoning
    - Total Cost: $7,100.00
      Cash: 150 articles x $1/article x 10 years = $1,500.00
      Inkind: Staff Time: 8 hrs/article x 20 articles x $35/hour = $5,600.00

Objective 4: Project Evaluation

Task A: Pipestone Creek Advisory Committee

- The PCAC will be held annually to review and evaluate project and program effectiveness.
- Inkind will be staff and Advisory Committee time.
    - Time frame: January 2009 to December 2018
    - Persons responsible: Conservation/Zoning, and Pipestone Creek Advisory Committee
    - Total Cost: $7,500.00
      Cash: $0.00
      Inkind: 10 members x $75/meeting x 10 meetings = $7,500.00

Task B: Effectiveness Monitoring

- Water monitoring will be completed during year 2013 and year 2018 of this implementation plan to determine water quality improvement. Water samples will be collected and analyzed for turbidity, total suspended solids and *E. coli*. Field parameters will also be collected. Shipping costs include shipping and ice. The MPCA will assist with data compilation.
- Inkind will be staff time needed to collect samples and data analysis.
  - Time frame: 2013 and 2018
  - Persons responsible: Conservation/Zoning, National Monument, and MPCA
  - Total Cost: $16,100.00
    Cash: $11,200.00
    Sample Analysis: 5 samples/mo x 7 mo x 3 sites x $45/sample x 2 yrs = $9,450.00
    Shipping: $25/sampling occasion x 35 occasions x 2 years = $1,750.00
    Inkind: 10 hrs/mo x $35/hour x 7 mo x 2 years = $4,900.00

Task C: MPCA Watershed Load Study Monitoring

- Provide support to MPCA for the Watershed Load Study. This may be through data analysis, site visits or collection. Samples are collected 25 times/year at the site in Pipestone. Sampling parameters: transparency, turbidity, conductivity, nitrogen series, temperature, pH, dissolved oxygen, total suspended solids, suspended volatile solids, phosphorus, chloride, sulfate, calcium, and magnesium.
- Inkind will be staff time needed to collect samples or data analysis.
  - Time frame: January 2009 to December 2018
  - Persons responsible: Conservation/Zoning, National Monument, and MPCA
  - Total Cost: $3,500.00
    Cash: $0.00
    Inkind: 10 hrs/yr x $35/hour x 10 years = $3,500.00

Objective 5: Administration

Task A: Staffing

- A fulltime staff position will be needed to implement practices and make producer contacts through the 10 years of plan implementation. Sharing of this position with the Rock River TMDL will be considered and pursued if possible.
- Inkind time will be related to overseeing the grant administrative tasks. This will be done by the Conservation/Zoning.
  - Time frame: January 2009 to December 2018
  - Persons responsible: Conservation/Zoning
  - Total Cost: $360,000.00
    Cash: $30,000/year x 10 years = $300,000.00
    Inkind: 120 hrs/yr x $50/hour x 10 years = $60,000.00

Task B: Office and Equipment

- Current office supplies and equipment (vehicle, survey, GPS) will be utilized by project staff to complete plan implementation.
- Inkind will be the utilization of Conservation and Zoning office equipment.
    - Time frame: January 2009 to December 2018
    - Persons responsible: Conservation/Zoning
    - Total Cost: $75,000.00
      Cash: $0.00
      Inkind: $75,000.00
      Vehicle: $5,000/year x 10 years = $50,000.00
      Office Space: 150 sq ft x $10/sq ft x 10 years = $15,000.00
      Supplies: $1,000/year x 10 years = $10,000.00

7. Roles and Responsibilities of Project Partners

Pipestone Creek Advisory Committee (PCAC)
See Appendix A for a complete PCAC listing, meeting agendas, and minutes. The primary organization overseeing the overall project is the Pipestone Creek Advisory Committee. This advisory committee encompasses a diverse group of individuals that represent: farmers, concerned citizens, townships, Pipestone National Monument, City of Pipestone, SWCD, County Commissioners, County Ditch Committee, and NRCS.

Natural Resources Conservation Service
NRCS will be key participants in the completion and implementation of priority practices through the implementation of the EQIP program and technical assistance. NRCS will be utilized to assist with all tasks in Objective 1.

Pipestone County Conservation and Zoning Office
The Pipestone County Conservation and Zoning Office is the combination of the SWCD and County Zoning. Staff will be primary contact of the implementation plan and all objectives and tasks. Staff will also be responsible for the completion of all grant applications, and reports. Staff will have oversight of all tasks and will be responsible for primary coordination of this implementation plan. Staff will provide technical assistance in correlation with program oversight in areas such as feedlot and septic programs, and also coordinate all educational activities.

Pipestone County Soil and Water Conservation District
SWCD Board of Supervisors: LeRoy Stensgaard, AnnaMae Fritz, Ian Cunningham, Cal Spronk, and Ed Loll.
The Pipestone County Soil and Water Conservation District (SWCD) will be the fiscal agent and will also oversee progress of initiatives on a monthly basis. The SWCD Board of Supervisors will be responsible for application review and approval of projects and distribution of funds. The SWCD has joined offices with the Pipestone County Zoning and is co-located with USDA Natural Resources Conservation

Services (NRCS). The staff is included under Pipestone County Conservation and Zoning Office.

Southwest Prairie Joint Power Organization (SPJPO)
The Southwest Prairie JPO was formed to provide technical survey, design, and certified engineer signoff on practices. The JPO will be utilized for feedlot runoff control practices and other practices which require engineering assistance (Objective 1: A, E, and G).

Board of Water and Soil Resources (BWSR): BWSR is a state entity which provides cost-share and technical assistance. BWSR has taken a lead in restoration of impaired waters. They will also be invited to serve on the PCAC (Objective 4: A).

Lincoln Pipestone Rural Water System
The Lincoln Pipestone Rural Water is also an entity which will be utilized to assist in educational efforts (Objective 3: A, B); they are currently coordinating efforts with the SWCD in development and implementation of a mitigation plan for water withdrawals and discharges into Pipestone Creek from the Holland Well field treatment plant.

Pipestone County Extension Service
The Pipestone County Extension Service will be utilized as needed to assist with publication and information distribution. They may also provide personnel to assist in field tours and demonstrations (Objective 3: A, B).

Pipestone National Monument
The Pipestone National Monument is part of the PCAC, staff have been and will continue to be utilized to assist in the collection of samples and assessment of water quality. The Monument will also be utilized as a technical resource and educational organization (Objective 3: A, B and Objective 4: B).

City of Pipestone
The City of Pipestone is a member of the PCAC. The city will be responsible for storm water gully issues and improvements made to the WWTF (Objective 1: G).

Minnesota Pollution Control Agency (MPCA): The MPCA will be involved in several areas relating to the project. The MPCA will provide a regulatory role in feedlots, SSTS, stormwater and WWTP. They will also provide technical assistance and analysis in the monitoring and evaluation tasks (Objective 4: B, C). The MPCA will also serve on the PCAC (Objective 4: A).

8. Milestone Schedule by Objectives and Tasks

Years 2009-2018

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Objective 1 Non-point source Pollutant Loading Reductions										
Task A (Feedlot Runoff)	x	x	x	x	x	x	x	x	x	x
Task B (Vegetative Buffer)	x	x	x	x	x	x	x	x	x	x
Task C (Nutrient Management)	x	x	x	x	x	x	x	x	x	x
Task D (Pasture Management)	x	x	x	x	x	x	x	x	x	x
Task E (Wetland Restoration)	x	x	x	x	x	x	x	x	x	x
Task F (Conservation Tillage)	x	x	x	x	x	x	x	x	x	x
Task G (Urban Storm Water Runoff)		x	x	x						
Objective 2: Point Source Loading Reductions										
Task A (SSTS Upgrades-High Priority)	x	x	x	x	x	x	x	x	x	x
Task B (SSTS Upgrades)	x	x	x	x	x	x	x	x	x	x
Objective 3: Education and Outreach										
Task A (Field Tours)	x		x							
Task B (Mailings and Media)	x	x	x	x	x	x	x	x	x	x
Objective 4: Project Evaluation										
Task A (Advisory Committee)	x	x	x	x	x	x	x	x	x	x
Task B (Monitoring)					x					x
Task C (MPCA Load Study Monitoring)	x	x	x	x	x	x	x	x	x	x
Objective 5: Administration										
Task A (Staffing)	x	x	x	x	x	x	x	x	x	x
Task B (Office and Equipment)	x	x	x	x	x	x	x	x	x	x

9. Adaptive Management

Implementation of the TMDL will be conducted primarily by staff of the Conservation and Zoning office, which also includes the staff from the local Soil and Water Conservation District. All activities and the majority of watershed grants will be administered and overseen by the Pipestone Soil and Water Conservation District Board of Supervisors. If staff or others identify a need to make adjustments to an implementation item during implementation, the Conservation and Zoning office will be informed and staff will propose the adjustments to the SWCD Board, who will make a decision during monthly meetings. PCAC will be meeting on an annual basis to also oversee and modify implementation items as needed.

10. Project Budget

Itemized Program Objective Budget						
Objective 1 Nonpoint Source Pollutant Loading Reductions						
Cost Category	*Unit Cost*	*Unit*	*Quantity*	*Cash*	*In-Kind*	*Total*
Task A (Feedlot Runoff Control Practices)						
Incentives	$ 10,000.00	sites	15	$ 150,000.00		$ 150,000.00
Producer share	$ 10,000.00	sites	15		$ 150,000.00	$ 150,000.00
Technical Assistance	$ 2,000.00	sites	15		$ 30,000.00	$ 30,000.00
Task B (Vegetative Buffer)						
Incentives	$ 1,000.00	acre	26	$ 26,000.00		$ 26,000.00
Producer share	$ 200.00	acre	26		$ 5,200.00	$ 5,200.00
Technical Assistance	$ 70.00	acre	26		$ 1,820.00	$ 1,820.00
Task C (Nutrient Management)						
Incentives	$ 500.00	plan	50	$ 25,000.00		$ 25,000.00
Producer share	$ 400.00	plan	50		$ 20,000.00	$ 20,000.00
Technical Assistance	$ 280.00	hr/plan	50		$ 14,000.00	$ 14,000.00
Task D (Pasture Management)						
Incentives	$ 100.00	acre	1000	$ 100,000.00		$ 100,000.00
Producer share	$ 100.00	acre	1000		$ 100,000.00	$ 100,000.00
Technical Assistance	$ 3.50	hr/ac	1000		$ 3,500.00	$ 3,500.00
Task E (Wetland Restoration)						
Incentives	$ 1,000.00	acre	10	$ 10,000.00		$ 10,000.00
Technical Assistance	$ 500.00	hr/ac	10		$ 5,000.00	$ 5,000.00
Task F (Conservation Tillage)						
Incentives	$ 7.00	acre	8000	$ 56,000.00		$ 56,000.00
Producer share	$ 7.00	acre	8000		$ 56,000.00	$ 56,000.00
Technical Assistance	$ 0.35	hr/ac	8000		$ 2,800.00	$ 2,800.00
Task G (Urban Storm Water Runoff)						
Incentives	$ 15,000.00	gully	2	$ 30,000.00		$ 30,000.00
Producer share	$ 15,000.00	gully	2		$ 30,000.00	$ 30,000.00
Subtotal Objective 1				$ 397,000.00	$ 418,320.00	$ 815,320.00

Objective 2 Point Source Loading Reductions						
Cost Category	*Unit Cost*	*Unit*	*Quantity*	*Cash*	*In-Kind*	*Total*
Task A (SSTS Upgrades-High priority)						
Incentives	$ 5,000.00	system	10	$ 50,000.00		$ 50,000.00
Producer share	$ 5,000.00	system	10		$ 50,000.00	$ 50,000.00
Technical Assistance	$ 175.00	hr/system	10		$ 1,750.00	$ 1,750.00
Task B (SSTS Upgrades)						
Incentives	$ 1,000.00	system	132	$ 132,000.00		$ 132,000.00
Producer share	$ 10,000.00	system	132		$ 1,320,000.00	$ 1,320,000.00
Technical Assistance	$ 175.00	hr/system	132		$ 23,100.00	$ 23,100.00
Subtotal Objective 2				$ 182,000.00	$ 1,394,850.00	$ 1,576,850.00
Objective 3 - Education and Outreach						
Cost Category	*Unit Cost*		*Quantity*	*Cash*	*In-Kind*	*Total*
Task A (Field Tours)						
Tour materials, supplies, rental	$ 25.00	person	100	$ 2,500.00		$ 2,500.00
Staff time	$ 35.00	hr	200		$ 7,000.00	$ 7,000.00
Task B (Mailings and Media)						
Newsletter and newspaper articles	$ 1.00	page	1500	$ 1,500.00		$ 1,500.00
Staff time	$ 280.00	hr/article	20		$ 5,600.00	$ 5,600.00
Subtotal Objective 3				$ 4,000.00	$ 12,600.00	$ 16,600.00
Objective 4 - Project Evaluation						
Cost Category	*Unit Cost*		*Quantity*	*Cash*	*In-Kind*	*Total*
Task A (Pipestone Creek Advisory Committee)						
Members commitment	$ 75.00	meeting	100		$ 7,500.00	$ 7,500.00
Task B (Monitoring)						
Sample Analysis	$ 45.00	sample	210	$ 9,450.00		$ 9,450.00
Shipping	$ 25.00	sample	70	$ 1,750.00		$ 1,750.00
Staff time	$ 35.00	hr	140		$ 4,900.00	$ 4,900.00
Task C (MPCA Watershed Load Study Monitoring)						
Inkind	$ 35.00	hour	100		$ 3,500.00	$ 3,500.00
Subtotal Objective 4				$ 11,200.00	$ 15,900.00	$ 27,100.00

Objective 5 - Administration						
Cost Category	*Unit Cost*		*Quantity*	*Cash*	*In-Kind*	*Total*
Task A (Staffing)						
Salary	$ 30,000.00	year	10	$ 300,000.00		$ 300,000.00
Grant oversight	$ 50.00	hour	1,200		$ 60,000.00	$ 60,000.00
Task B (Office and Equipment)						
Vehicle	$ 5,000.00	year	10		$ 50,000.00	$ 50,000.00
Office Space	$ 1,500.00	year	10		$ 15,000.00	$ 15,000.00
Supplies	$ 1,000.00	year	10		$ 10,000.00	$ 10,000.00
Subtotal Objective 5				$ 300,000.00	$ 135,000.00	$ 435,000.00
				Cash	*In-Kind*	*Total*
Subtotal Objective 1				**$ 397,000.00**	**$ 418,320.00**	**$ 815,320.00**
Subtotal Objective 2				**$ 182,000.00**	**$ 1,394,850.00**	**$ 1,576,850.00**
Subtotal Objective 3				**$ 4,000.00**	**$ 12,600.00**	**$ 16,600.00**
Subtotal Objective 4				**$ 11,200.00**	**$ 15,900.00**	**$ 27,100.00**
Subtotal Objective 5				**$ 300,000.00**	**$ 135,000.00**	**$ 435,000.00**
GRAND TOTAL				**$ 894,200.00**	**$ 1,976,670.00**	**$ 2,870,870.00**

11. References

1. Mindy Spiehs. 2007. *Best Management Practices for Pathogen Control in Manure Management Systems*. University of Minnesota, Extension.

2. John Brach. 1998. *Agriculture and Water Quality, Best Management Practices for Minnesota.*

3. Onsite Wastewater Treatment Manual US EPA 2002

4. Bracmort, Kelsi, Simone. An evaluation of structural best management practices 20 years after installation, Purdue University.

5. Richard C. Schultz, Thomas M. Isenhart and Joe P. Collett, 1994. Riparian Buffer Systems in Crop and Rangelands.

6. A Farmer's Guide To Agriculture and Water Quality Issues, USEPA.

7. National Management Measures to Control Nonpoint Source Pollution from Agriculture US EPA 2003.

12. Appendix A

Pipestone Creek Advisory Committee

First Name	Last Name	Organization	Address	City	State	Zip
Ian	Cunningham	SWCD	565 81st Street	Pipestone	MN	56164
Richard	Zupp	Citizen	417 136th Street	Pipestone	MN	56164
John	Hay	Moody Co.	202 East Third Ave.	Flandreau	SD	57028
Darrel	Tinklenberg	City Pipestone	806 8th St. SW	Pipestone	MN	56164
Jeff	Jones	City Pipestone	119 2nd Ave SW	Pipestone	MN	56164
Jim	LaRock	Monument	36 Reservation Ave	Pipestone	MN	56164
Chris	Zadak	MPCA	520 Lafayette Rd N	St. Paul	MN	55155
Sharon	Hanson	Co. Coordinator	406 Hiawatha Ave.	Pipestone	MN	56164
Gary	Griebel	Ditch	1414 120th Ave.	Pipestone	MN	56164
Wally	Bucher	Sweet Twp	760 70th Ave	Pipestone	MN	56164
Roger	Blom	Grange	1357 90th Ave	Pipestone	MN	56164
Ed	Loll	Troy	1696 60th Ave.	Pipestone	MN	56164
Harold	Brinkmeyer	Citizen	1717 120th Ave.	Holland	MN	56139
Luke	Johnson	County Board	PO Box 155	Holland	MN	56139
Dave	Halbersma	Hwy Dept	PO Box 276	Pipestone	MN	56164
Dennis	Healy	LPRW	P.O. Box 188	Lake Benton	MN	56149
Angie	Raatz	SWCD		Pipestone	MN	56164
Jerry	Purdin	NRCS		Pipestone	MN	56164
Kyle	Krier	Zoning		Pipestone	MN	56164
Kelli	Daberkow	MPCA Marshall	1420 E. College Dr, Ste 900	Marshall	MN	56258

Pipestone County
Conservation & Zoning Office

119 Second Avenue SW, Suite 13
Pipestone, MN 56164
"Working Together to better serve residents of Pipestone County"

August 2, 2006

RE: Pipestone Creek Advisory Meeting

Dear «First_Name» «Last_Name»,

I want to invite you to our next Pipestone Creek meeting. At this meeting you will have an opportunity to review and provide input on the draft TMDL Study results for Pipestone Creek.
It is crucial that you attend this meeting and provide input as this information will eventually be submitted to EPA. Your input is very important to us.
I would have provided a copy of the plan for your review prior to the meeting, but due to time restraints that was not possible.
We also need your input on the development of an implementation plan.
Please contact me should you have any questions or concerns.

What: **Pipestone Creek Advisory Meeting**

When: **Monday, August 14, 2006 @ 10:00 a.m.**

Where: **Pipestone County Courthouse**
Commissioners Room

Agenda

10:00	Introductions	
10:15	Watershed Survey	Kyle Krier
10:30	TMDL Study	Chris Zadak (MPCA)
11:00	Discussion of Implementation Plan	

Kyle Krier

Soil & Water Conservation District
State Cost Share Program / Tree Program
Survey/Design Practices / Reinvest In Minnesota
Best Management Loan Program / Water Plan
Phone: 507-825-4268 Fax: 507-825-6782

Pipestone County Planning and Zoning
Zoning / Feedlot Inspections
Agriculture Inspector / Solid Waste
Building Permits / Septic Systems
Phone: 507-825-6765 Fax: 507-825-6782

Pipestone County
Conservation & Zoning Office
119 Second Avenue SW, Suite 13
Pipestone, MN 56164
"Working Together to better serve residents of Pipestone County"

December 1, 2006

RE: Pipestone Creek TMDL / Pipestone County Zoning Ordinance

Dear Pipestone County Planning Commission and Pipestone Creek Advisory Board Members:

We are planning to have one final Pipestone Creek TMDL Study meeting. This meeting will provide an opportunity for the general public to hear about the TMDL process, the Pipestone Creek Study, and to provide comments. I am holding this meeting in conjunction with a Pipestone County Planning Commission meeting at which we will be reviewing our County Zoning Ordinance and discussing potential amendments. Your presence and comments at this meeting would be greatly appreciated. Please let me know if you have any questions or concerns.

Kyle Krier

What: Pipestone Creek Public Meeting
Zoning Ordinance Review

When: Tuesday, December 19, 2006 @ 7:00 p.m.

Where: Pipestone County Courthouse
Commissioners Room

Agenda

7:00	Introductions	
7:05	TMDL process	Kyle Krier/Chris Zadak
7:15	TMDL Study	Chris Zadak (MPCA)
7:40	Public Comments	
8:00	Zoning Ordinance Amendments Discussion	
9:00	Adjourn	

Soil & Water Conservation District
State Cost Share Program / Tree Program
Survey/Design Practices / Reinvest In Minnesota
Best Management Loan Program / Water Plan
Phone: 507-825-4268 Fax: 507-825-6782

Pipestone County Planning and Zoning
Zoning / Feedlot Inspections
Agriculture Inspector / Solid Waste
Building Permits / Septic Systems
Phone: 507-825-6765 Fax: 507-825-6782

The Pipestone County Conservation & Zoning Office Works jointly with the Natural Resources Conservation Service as an equal opportunity employer at 119 Second Avenue SW, Suite 13, Pipestone, MN 56164

Minutes of the Pipestone Creek Advisory Meeting December 19, 2006, 7:00 p.m. at the Pipestone County Courthouse, Pipestone, Minnesota

Members Present:

Chris Zadak, Kyle Krier, Arvin Pater, Harry Hansen, Leo Hillard, Curt Johnson, Leon Hanenberg, John Hay, Wallen Jackson, Dean Jaycob, Angie Raatz, Jaimie Sumption, Dick Paulson, Jim LaRock, Gia Wagner, Garyu Erickson, Ronald Francis, Ian Cunningham.

Krier began meeting with introduction, a brief summary of what the process and accomplishments are to date.

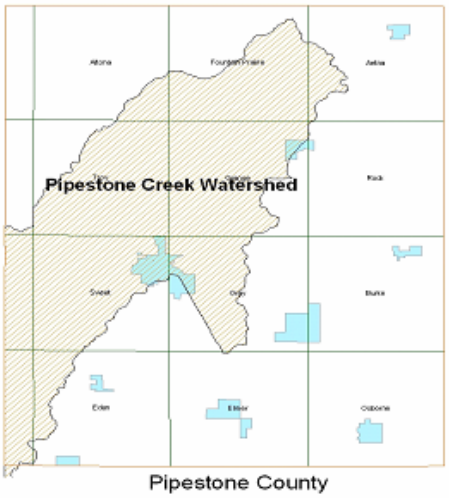
Chris Zadak from the MPCA, gave a summary of the TMDL process. A power point presentation of the Pipestone Creek TMDL plan was presented.

The meeting was then opened up for comments and questions.

Discussion was held on program that are currently being utilized for improvement. They included EQIP, CRP, State Cost share, CREP. Possible funding through the Clean Water Legacy was also discussed.

Meeting adjourned at 8:00 p.m.

Pipestone Creek
Total Maximum Daily Load (TMDL)
Implementation Plan Public Meeting



Pipestone County

Introduction

Pipestone Creek Watershed has submitted a TMDL study. The Pipestone County Conservation and Zoning Office would like to start the development of the Implementation Plan. Prior to the development of this plan we would like to invite all interested residents, farm organizations, businesses and others the opportunity to provide us with your input, concerns, or recommendations on the development of an implementation plan.

Agenda

11:30 Dinner
12:30 Watershed Study
12:45 Implementation Plan
1:30 Adjourn

Pizza and Pop will be provided by the Pipestone County Water Plan!!

Public Input Meeting

Date: Tuesday, July17
Time: 11:30 a.m. –1:30p.m.
Location: Dar's Pizza
607 8th Avenue SW
Pipestone, MN 56164

Please Join Us!

Comments will also be accepted by mail until August 10, 2007.
Please send comments to:
Pipestone County Conservation and Zoning
119 2nd Ave SW Suite 13
Pipestone, MN 56164

For further information contact:
Kyle Krier at 507-825-6765 or kyle.krier@mn.nacdnet.net

Pipestone County
Conservation & Zoning Office
119 Second Avenue SW, Suite 13
Pipestone, MN 56164
"Working Together to better serve residents of Pipestone County"

August 8, 2008

RE: Pipestone Creek TMDL Final Implementation Plan Meeting

Dear Pipestone Creek Advisory Board Members:

We are planning to have one final Pipestone Creek TMDL Implementation Plan meeting so that a final plan can be submitted for approval. This meeting will provide the last opportunity for yourselves, as well as the general public to hear about the TMDL plan and to provide comments.

If you have any questions, please contact the office at 507-825-6765!

What: **Pipestone Creek Public Final Implementation Plan Meeting**

When: **Tuesday, August 19, 2008 @ 7:00 p.m.**

Where: **Pipestone County Courthouse Community Room**

Agenda

7:00 Welcome / Introductions

7:15 TMDL Plan Review

7:45 Clean Water Legacy grant application discussion

8:00 Adjourn

Soil & Water Conservation District
State Cost Share Program / Tree Program
Survey/Design Practices / Reinvest In Minnesota
Best Management Loan Program / Water Plan
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Pipestone County Planning and Zoning
Zoning / Feedlot Inspections
Agriculture Inspector / Solid Waste
Building Permits / Septic Systems
Phone: 507-825-6765 Fax: 507-825-6782

Minutes of the Pipestone Creek Advisory Meeting August 19, 2008, 7:00 p.m. at the Pipestone County Courthouse, Pipestone, Minnesota

Members Present:

John Hay, Jack Majeres, Landen Swanson, Angie Raatz, Gary Erickson, Darrel Tinklenberg, Ian Cunningham, Wally Bucher, Dave Halbersma, Kelly Daberkow, Brad Tuinstra, and Kyle Krier.

Krier began meeting with introduction, a brief summary of what the process and accomplishments are to date.

The draft TMDL Implementation Plan was reviewed, with the major portion of discussion being held on the objectives within section 6. After discussion the following additions were recommended to be incorporated into the plan: Include Conservation Tillage as an objective with 8,000 acres at an estimated cost of $7 per acre as incentive payment. At the current time this practice is being provided through the EQIP program but if EQIP was no longer available this was felt to be a important practice. Also include Wetland restoration with 10 acres being restored and costs of incentive to be $1,000 per acre. To make the ISTS upgrades to be completed the committee wanted to provide 50% funding to an estimated 10 systems out letting directly into surface waters and tile lines, while providing a $1,000 incentive to the others. The committee felt with these additions the plan would be ready for submittal.

Discussion was also held on these objectives being voluntary and not mandatory, but yet at the same time would or could be needed based on other local and state requirements.

The meeting ended with a short discussion on possible funding sources and clean water legacy act application period and amounts.

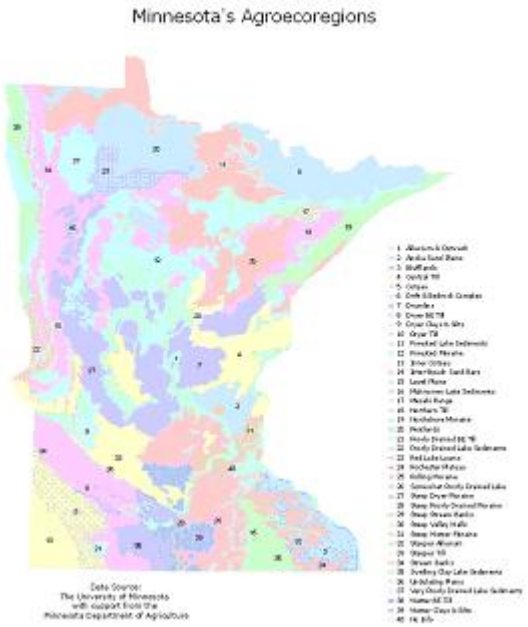
Meeting adjourned at 9:00 p.m.

13. Appendix B

Appendix B. Agroecoregion BMP Matrix

The matrix below was developed by David Mulla of the Department of Soil, Water, and Climate of the University of Minnesota and provides Best Management Practice (BMP) options based on agroecoregion. These agroecoregions for Minnesota are shown in the figure to the right.

Ratings in the table that follows are High (H), Medium (M) and Low (L). High means a practice that will be very effective over a large area. Low means a practice that will be very effective, but is suitable only for small portions of the agroecoregion.



NRCS #	Conservation Practices	Alluvium & Outwash	Anoka Sand Plains	Blufflands	Central Till	Coteau	Drumlins	Dryer Blue Earth Till	Dryer Clays & Silts	Dryer Till	Inner Coteau	Inter-Beach Sand Bars	Level Plains	Mahnomen Lake Sediments	Poorly Drained Blue Earth Till	Poorly Drained Lake Sediments	Rochester Plateau	Rolling Moraine	Somewhat Poorly Drained Lake	Steep Dryer Moraine	Steep Stream Banks	Steep Valley Walls	Steep Wetter Moraine	Steeper Alluvium	Steeper Till	Stream Banks	Swelling Clay Lake Sediments	Undulating Plains	Very Poorly Drained Lake Sediments	Wetter Blue Earth Till	Wetter Clays & Silts
	Riparian																														
393	**Grass Filter Strip**[1]	M	L	M-H		M	L	M-H		H	L	M	H	L	L	L	M	H	L	H	H	M	H	H	M	H	M	M	L	H	L
391	**Riparian Forest Buffer**	M	L	M-H		L	L			L		M	M			L	M	L	H	M	M	H	H		L	L		M	L	L	
580	**Streambank & Shoreline Protection**	L		H		H		L-M					L			M	M	M	L	H	H	H	H	M	M	H	M	L	L	M	M
657	**Wetland Restoration**[2]*	L	L				M	H				L	L	L	M	H		L	H	M		M	M		L		M		M	H	M
659	**Wetland Enhancement**						M	H								M			H												M
	Upland																														
328	**Conservation Crop Rotation**[3]	M	L	H		H	M	M	M	H	M	L	M	L	M	M	H	H	L	M	H	M	H	M	L	L		L	M	L	L
329	**Conservation Tillage**[4]	M	L	H		H	M	H	M	M	M	M	M	L	M		H	H	L	H	H	L	H	M	H	H		M		H	M
	Primary Crop																										L		L		
	Secondary Crop																										M		M		
332	**Contour Buffer Strip**					H				M	L		M				M	M		H			L					M		L	
330	**Contour Farming**		L	H		H	M	L		H	M		M				H	H	L	H			H	M	L			M		M	
340	**Cover Crop**	M	M	L		L		L-M			M											L	L		L			L		L	L
342	**Critical Area Planting**	M	M	L		L		L				M			L		L	M		M	H	H	M	H	L	H		L		M	
643	**Declining Habitat Restoration & Mgt**[5]*							M-H			M			L	M	L			H	M		M					M		M		L
362	**Diversion**					H											M	L			M									M	
554	**Drainage Water Mgnt**[6]							M-H					M	M	M-H	H		M	M						M		H	L	M	M	H
	Field Border																														L
655	**Forest Harvest Trails & Landings**						M												H	M									M		
666	**Forest Stand Improvement**						M												H	M									M		

NRCS Code	Conservation Practices	Alluvium & Outwash	Anoka Sand Plains	Blufflands	Central Till	Coteau	Drumlins	Dryer Blue Earth Till	Dryer Clays & Silts	Dryer Till	Inner Coteau	Inter-Beach Sand Bars	Level Plains	Mahnomen Lake Sediments	Poorly Drained Blue Earth Till	Poorly Drained Lake Sediments	Rochester Plateau	Rolling Moraine	Somewhat Poorly Drained Lake	Steep Dryer Moraine	Steep Stream Banks	Steep Valley Walls	Steep Wetter Moraine	Steeper Alluvium	Steeper Till	Stream Banks	Swelling Clay Lake Sediments	Undulating Plains	Very Poorly Drained Lake Sediments	Wetter Blue Earth Till	Wetter Clays & Silts
	Gully Erosion	L		H		H		L									H	H		M	H	H	M		M	M		L		M	L
410	Grade Stabilization			H		H											H					M	M		L			L		M	L
412	Grass Waterway			M		H		L		M	M						H	M		M	H		M		L			L		M	L
600	Terrace			M		H				L	M						H	M					L		L			M		L	
638	Water and Sediment Control Basin			H		H		L		L							H	H		M	H		H		M			L		M	L
	Grass Cover (CRP only) [7]*	M	L	H		H	L	L		H	L	M					H	H		H	M	H	H	L	M	M	M	L	L	H	L
512	Pasture & Hayland Planting	M	M	H		H	H	L-M		M	M						H	H	M	H			M		L	M		L		L	L
528A	Prescribed Grazing	M	L	M-H		H	H	L-M			L						M	M	M	M			M		L	M		L		L	L
350	Sediment Basin	M	L	M		M	L	L									M	H		M	H		H		M			L		M	
725	Sinkhole Treatment [8]			M													H											L			
585	Stripcropping [9]			H		M					M		M				H			M								L		L	
612	Tree/Shrub Planting *						M									L			M	M		M	M	L		M			M		
472/ 382	Use Exclusion / Fencing	M	L	L		H	H	L			H		L				M	L	M	M		L	M		L	H		M	M	L	
645	Upland Wildlife Habitat Management [10]*			M		M		M-H		H	M				M	L	M		M	M		M	L				L		M		L
658	Wetland Creation							H								L			H												
657	Wetland Restoration [11]	L	L				M	H				L	M	M	M	H		L	H	M		L	M		L		M	L	H	M	H
	Wind Erosion																														
589	Cross-Wind Ridges / X-Wind Stripcropping / X-Wind Trap Strips	L	M					M	H	L		H		M	L-M	M			M	L							H		M		
422	Hedgerow/ Herbaceous Wind Barrier	L	M						H	L		H		M	L-M	M			M	L							H		M		
380/ 650	Windbreak / Shelterbelt / Living Snow Fence *	L	M						H	L		H		M	L-M	M			M	L							H		M		

* A common CRP cover type in Minnesota

[1] Effectiveness depends on complementary upland practices (which may be true for several other practices in this table as well)
[2] In riparian zones, this means floodplain wetlands
[3] Refers to the addition of at least a third crop—one that is resource-conserving and regionally appropriate—to an existing 2-crop rotation.
[4] Refers to NRCS Standards 329A-329C (Residue Management) which encompass No-Till, Strip-Till, Mulch-Till and Ridge-Till
[5] When the habitat being restored is native prairie, this is effectively an enhanced version of a typical CRP grass stand.
[6] Refers to a range of "conservation drainage" practices, some currently in Mn-NRCS Standard 554 Drainage Water Management and many not; examples include blind inlets, rock inlets, and tile spacing and depth.
[7] Some CRP grass stands are planted with special attention to use of native species, while others are not (need to specify if there is a significant difference in terms of water quality).
[8] Treatment is typically with filter strips and/or diversions
[9] Includes contour stripcropping as well as stripcropping on flatter land
[10] In the Northern Tallgrass Prairie region, this often consists of grassland restoration
[11] In uplands (esp. in the Northern Tallgrass Prairie region), depressional "prairie potholes" are often the type of wetlands being rest