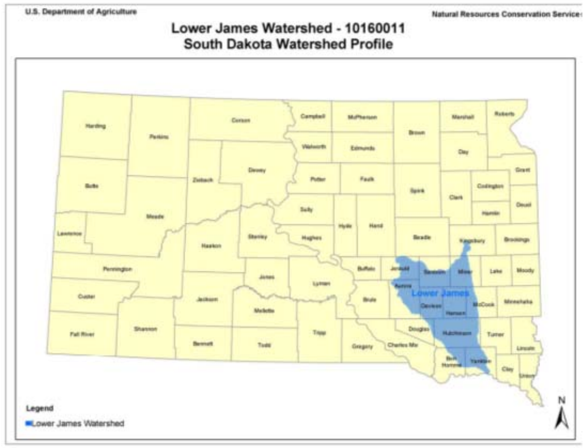
LOWER JAMES RIVER WATERSHED
FIVE YEAR STRATEGIC PLAN



In Cooperation With:

James River Water Development District
South Dakota Conservation Districts
South Dakota Association of Conservation Districts
South Dakota Department of Environment and Natural Resources
USDA Natural Resources Conservation Service

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Prepared by:
LEBEDA CONSULTING, LLC
26175 – 456th Avenue
Humboldt, SD 57035

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Executive Summary

The Lower James River watershed encompasses 2,558,800 acres within the Level III Ecoregion of the Northern Glaciated Plains in southeastern South Dakota (SD). This portion of the James River begins just south of Huron and flows southward, converging with the Missouri River at Yankton. The water quality of the James River was first reported on in 1972 by the U.S. Environmental Protection Agency in the *Report on Quality of Water of the James River, South Dakota.* This study identified practices in the watershed as causing DO concentrations to decrease, biological oxygen demand to increase, and fecal and total coliform bacteria densities to be high. The 2010 SD-DENR Integrated Report list of 303(d) impaired waterbodies included; Twin Lakes and Wilmarth Lake, Dawson Creek, Firesteel Creek, Pierre Creek, Wolf Creek, and the entire main stem of the James River. The causes of the listings were Escherichia coli, fecal coliform, total suspended solids (TSS), total dissolved solids (TDS), and chlorophyll-*a*.

The subwatershed Firesteel Creek/Lake Mitchell Water Quality Assessment Phase I was initiated in 1993 to identify, prioritize, and presents alternatives to correct nonpoint pollution sources. This assessment was reported in the 1997 Phase I Diagnostic Feasibility Study, Final Report, Lake Mitchell/Firesteel Creek, DENR. The watershed was evaluated by the use of The Agricultural Nonpoint Source Pollution Model (AGNPS) identifying land uses in critical cells as delivering excessive coliform, nutrients, and sediments to waterbodies. These land use practices included animal feeding operations/concentrated animal feeding operations (AFOs/CAFOs), excessive grazing, livestock access to stream banks, stream bank erosion, and tillage on cropland.

This 1997 report resulted in the Firesteel Creek / Lake Mitchell Watershed Project Segment 1 implementation project that was initiated in 1998 and continued through 2005. This implementation project was sponsored by the Davison Conservation District (CD) in partnership with the City of Mitchell, the Aurora and Jerauld CDs, the SD Department of Environment and Natural Resources (DENR), and United State Environmental Protection Agency (US EPA). The Segment 1 project was followed by the Segment 2 project which was completed in June 2010. The Firesteel Creek watershed was then combined with the Lower James River Implementation Project in the spring of 2010.

The entire watershed was addressed by the SD DENR, James River Water Development District, and US EPA in a four year assessment beginning in 2005 (*Lower James River Watershed Assessment*); to locate and document sources of nonpoint source pollution and produce feasible restoration recommendations. The project goals were to result in total maximum daily load (TMDL) reports for the 303(d) listed segments and lakes of the James River watershed and to provide information to develop a watershed implementation work plan that would decrease erosion, sedimentation, and fecal coliform loadings in the streams, and nutrients in the lakes. The TMDL reports have been produced for the watersheds of Dawson Creek, Pierre Creek, Rose Hill Lake/Sand Creek, the James River in Yankton County, and Wolf Creek.

The study evaluated the possible point sources of pollution, mainly municipalities with National Pollution Discharge Elimination System (NPDES) permits and private human sewage systems. The resulting determination was that the municipalities did not violate their NPDS permits and individual human sewage systems had very minimal effects on total nutrient and coliform bacteria loadings. The identified nonpoint sources of pollution were mainly agricultural in nature resulting from AFOs/CAFOs, overgrazing pastures, excessive grazing in riparian zones, direct livestock access to waterbodies, livestock trampling of shorelines, and excessive erosion on cropland. These sources were isolated in specific AGNPS critical cells and the application of best management practices (BMPs) needs to be directed to these identified cells.

Nonpoint source pollution management measures that were identified as successful in reducing nutrient loadings in the Lower James River Watershed were the following BMPs; animal waste storage facilities, nutrient management plans, prescribed grazing systems, managed grazing on riparian areas, cropland conservation tillage, grassed waterways, stream bank stabilization, wetland restoration and pond construction, and the conversion of cropland to grass land. These practices and the costs of implementation were calculated to reduce loading and attain TMDL criteria for the impaired waterbodies. The BMPs and administrative costs to implement the project were computed annually for this five year Strategic Implementation Plan.

1.0 INTRODUCTION

1.1 PROJECT BACKGROUND AND SCOPE

The Lower James River watershed lies entirely within the Level III Ecoregion of the Northern Glaciated Plains in southeastern SD. The watershed encompasses 2,558,800 acres within the 12 counties of Aurora, Bon Homme, Davison, Douglas, Hanson, Hutchinson, Jerauld, Kingsbury, McCook, Miner, Sanborn, and Yankton. See Figure 1-1, Lower James Watershed Basin. The Lower James River Watershed, Hydraulic Unit 10160011, begins just south of Huron and flows southward, converging with the Missouri River at the City of Yankton. The James River is a perennial stream with its tributaries ranging from intermittent to perennial. The streams in the watershed contribute loadings of pathogens, nutrients, and suspended solids related to snowmelt or rainfall events. The headwaters of the James River begin in North Dakota (ND) flowing through the communities of New Rockford and Oakes, ND. The River then crosses the state line into SD and flows southward near Aberdeen and Huron, entering the Lower James Watershed just south of Huron.

The James River basin has a sub humid, continental climate characterized by pronounced season differences in temperature, precipitation, and other climatic variables. Temperature varies from the northern to the southern end of the basin. High mean temperatures are slightly cooler in the northern region of the basin with Mitchell having a high mean temperature in July of 86.4 degrees Fahrenheit and a low mean temperature in January of 4.4 degrees Fahrenheit. Yankton, at the southern end of the watershed, has a high mean temperature in July of 89.1 degrees Fahrenheit and a low mean temperature in January of 6.4 degrees Fahrenheit.

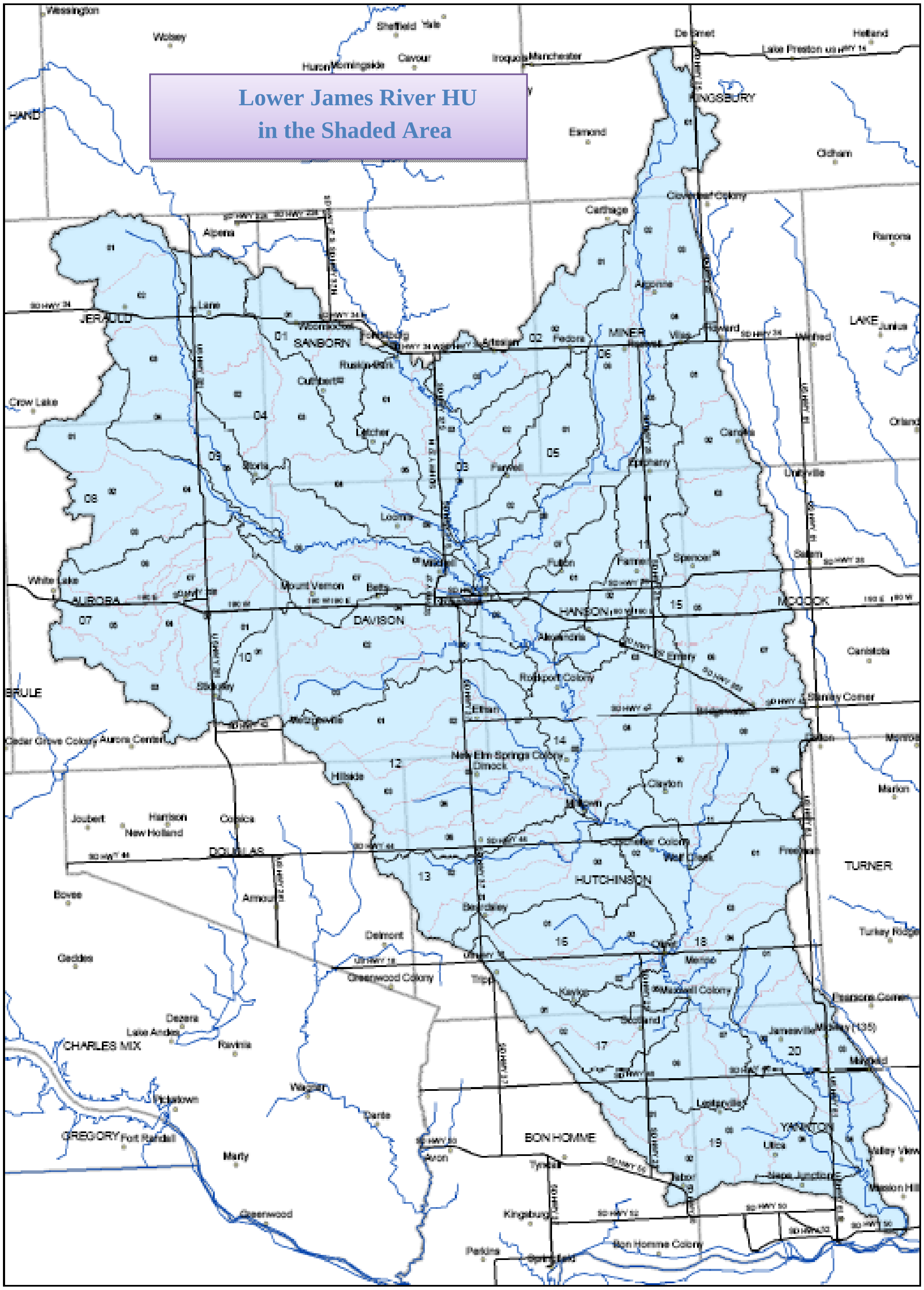
There are approximately 29 incorporated cities and 30 unincorporated towns, villages, and populated centers within the Lower James River watershed area. The city of Mitchell at the north end of the watershed has the largest population with 15,254 residents. The second largest city is Yankton with a population of 14,454. The population of the watershed is rural in nature with 20,773 residents listed as rural not living on farms, 6,208 as rural living on farms, and 16,111 as urban (United States Department of Agriculture - National Resources Inventory 2009). Table 1-1 lists the cities with populations of over 500 in the watershed. Many of these municipalities have discharge permits.

Table 1-1. Cities with a Population of Over 500 in the Lower James Basin

U.S. Census Bureau 2010 Census

City	County	Population
Mitchell	Davison	15, 254
Yankton	Yankton	14,454
Parkston	Hutchinson	1,508
Freeman	Hutchinson	1306
Wessington Springs	Jerauld	956
Scotland	Bon Homme	841
Plankinton	Aurora	707
Woonsocket	Sanborn	655
Tripp	Hutchinson	647
Alexandria	Hanson	615
Menno	Hutchinson	608

Figure 1-1. Lower James Watershed Basin HU 10160011



1.2 JAMES RIVER WATERSHED STUDIES

The water quality of the James River has been a concern of several water quality investigations. The river water was analyzed and reported by US-EPA in their *Report on Quality of Water of the James River, South Dakota* (EPA 1972). This report sampled DO, biological oxygen demand, total coliform bacteria, fecal coliform bacteria, total solids, total phosphorous, nitrogen, and total alkalinity. The Lower James River was again addressed in the 2005 *Lower Watershed Assessment* initiated in 2005 by DENR, EPA, and the James River Water Development District. This watershed assessment report has not been completely finalized.

Preliminary analysis of the data in the *2005 DENR Lower Watershed Assessment Report* indicated that:

- Fecal coliform bacteria concentrations may be associated with land applications of manure, livestock feeding areas, and/or cattle pastured in riparian areas adjacent to streams.
- Excessive TSS concentrations were present in the river during all flow periods of the James River. Row crops planted within 30 meters of the river may be a cause of bank instability and sedimentation.
- Excessive TSS concentrations were present during periods of high flow. Sources of TSS may be associated with feeding areas located in close proximity to stream channels. The source of high TSS in the Lower James may be associated with an increased slope of the river channel, increased erodibility of the soil, and changes in land use compared to upstream reaches. The southernmost segment of the James River shows a greater percentage of row crops planted within 30 meters of the river than upstream segments.

The following sub-watersheds of the Lower James River have been investigated and the reports completed by the SD DENR:

- Phase I of the Diagnostic Feasibility Study Final Report for Lake Mitchell/Firesteel Creek Report was published by SD DENR in March 1997. The Firesteel Creek/Lake Mitchell Watershed project of which Segment I was published in December 2008, and Segment II was published in September 2010. The existing Firesteel Watershed Project was included in the larger Lower James River Implementation Project in 2010.
- Rose Hill and Sand Creek watershed report, *Phase I Watershed Assessment And TMDL Final Report, Rose Hill Lake/Sand Creek, Hand County, South Dakota*, was published in January, 2002, by SD DENR.
- The Pierre Creek Watershed in Hanson County final report was published in September 2011 by SD DENR; *Escherichia coli Total Maximum Daily Load Evaluation of Pierre Creek, Hanson County, South Dakota.*

- The Dawson Creek watershed report, *Fecal Coliform and Escherichia coli Bacteria Total Maximum Daily Load Evaluations for Dawson Creek, Hutchinson and Bon Homme Counties, South Dakota*, was published in January 2011.
- Twin Lakes and Wilmarth Lake had an assessment initiated by SD DENR in 2001. Twin Lakes is a natural lake located in Sanborn and Jerauld Counties and Wilmarth Lake is a man-made reservoir in Aurora County. The assessment was final and included in the Lake Mitchell/Firesteel Creek TMDL, SD DENR 1997.
- The Wolf Creek watershed report, *Total Suspended Solids Total Maximum Daily Load Evaluation for Wolf Creek, Hutchinson County, South Dakota*, was published in January 2011 by SD-DENR.
- The main stem of the James River as it flows through Yankton County final report, *Fecal Coliform Total Maximum Daily Load Evaluations of James River, Yankton County, South Dakota*, published in January 2011, SD-DENR.
- The Natural Resources Conservation Service completed a Rapid Watershed Assessment for the Lower James River in July 2009.

1.3 LOWER JAMES RIVER EPA WATERBODY DESIGNATIONS AND BENEFICIAL USES

The overall objective of the implementation project is to restore and protect the water quality of the Lower James River and its watershed; specifically to reduce sediments, nutrients, and fecal coliform bacteria loadings to the stream. Field investigations and analysis have found water quality characteristic that have exceeded EPA standards with DO, biological demand oxygen, total coliform bacteria, fecal coliform bacteria, TSS, total phosphorous, nitrogen, and total alkalinity.

The beneficial uses of streams, lakes, and reservoirs in the Lower James River as listed by SD-DENR Integrated Report for 2010 are listed in Table 1-2, James River Beneficial Uses for Targeted Project Waterbodies.

Table 1-2: Beneficial Uses for Targeted Waterbodies. DENR-IR 2010				
Waterbody	**From**	**To**	**Beneficial Uses**	**County**
Beaver Lake - L2			6,7,8,9	Yankton
Dawson Creek -R1	James River	Lake Henry	6,8,9,10	Bon Homme
Enemy Creek	Enemy Creek	S18-T103N-R60W	6,8	Davison
Enemy Creek North Fork	Enemy Creek	S36-T103N-R61W	6,8	Davison
Firesteel Creek -R3	James River	Confluence with West Fork Firesteel Creek	1,4,8,9,10	Davison
James River -R16	Sand Creek	Interstate 90	5,8,9,10	Sanborn
James River -R7	Interstate 90	Yankton County Line	5,8,9,10	Hutchinson
James River -R8	Yankton County Line	Missouri River	5,8,9,10	Yankton
Lake Hanson -L16			6,7,8,9	Hanson
Lake Mitchell -L22			1,4,7,8,10	Davison
Menno Lake -L20			5,7,8,9	Hutchinson
Pierre Creek -R20	James River	S11-T102N-R58W	8,9,10	Hanson
Rock Creek -R21	S9-T103N-R59W	Headwaters	9,10	Miner
Twin Lakes -L35			5,7,8,9	Sanborn
Wilmarth Lake -L37			4,7,8,9	Aurora
Wolf Creek -R27	Wolf Creek Colony	S5-T103N-R56W	6,8,9,10	McCook
Wolf Creek -R29	Wolf Creek Colony	Mouth	6,8,9,10	Hutchinson

Numerical Key to Beneficial Uses listed in Table 1-2:

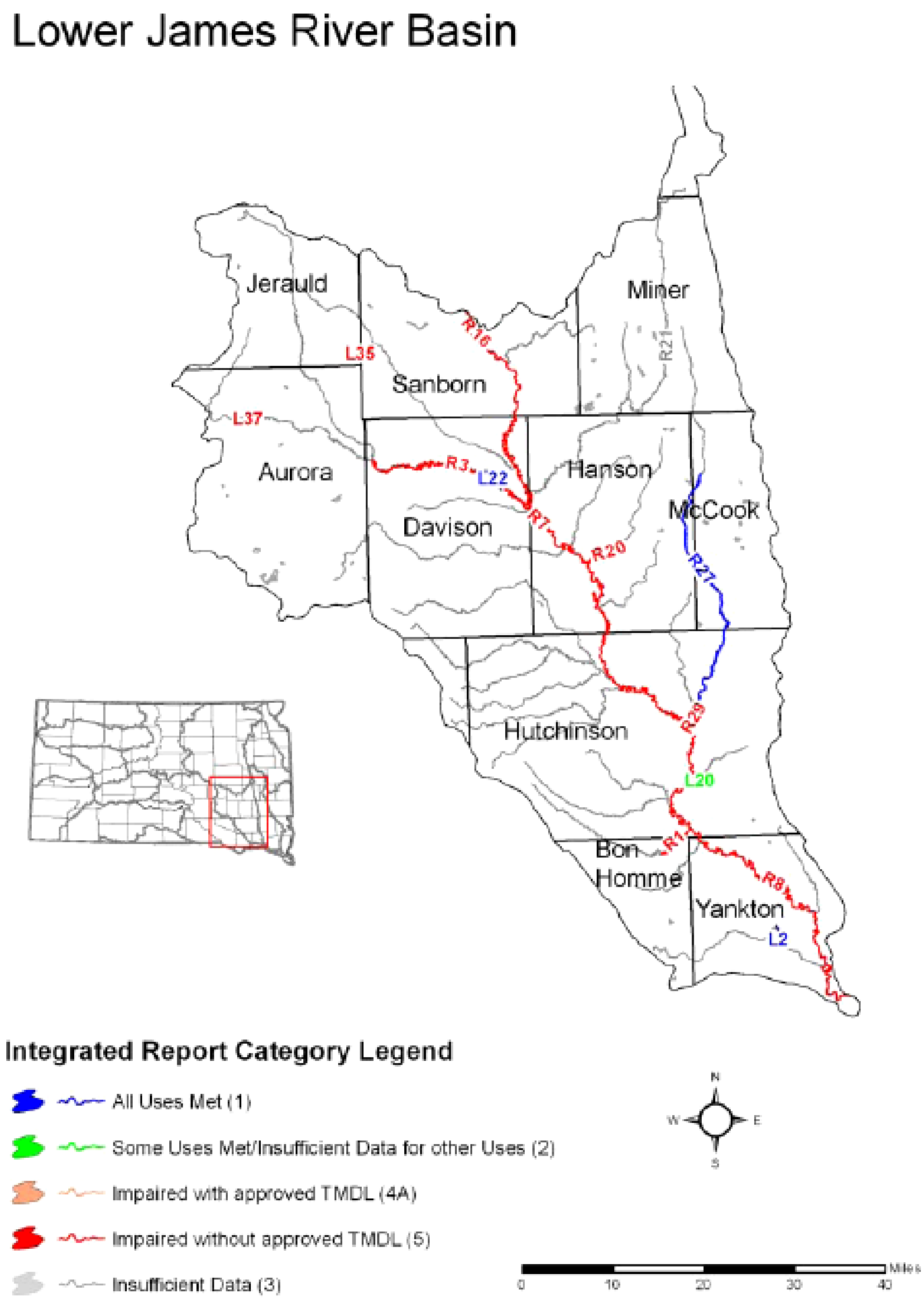
(1) Domestic water supply waters;
(2) Coldwater permanent fish life propagation waters;
(3) Coldwater marginal fish life propagation waters;
(4) Warm water permanent fish life propagation waters;
(5) Warm water semi-permanent fish life propagation waters;
(6) Warm water marginal fish life propagation waters;
(7) Immersion recreation waters;
(8) Limited contact recreation waters;
(9) Fish and wildlife propagation, recreation, and stock watering waters;
(10) Irrigation waters; and
(11) Commerce and industry waters.

The *2010 South Dakota Integrated Report for Surface Water Quality Assessment* lists the impaired waterbodies with the beneficial uses impaired and the cause for the impairment; shown in Table 1-3. The location of the impaired waterbodies is shown in Figure 1-2.

Table 1-3: Lower James River Watershed Project Waterbodies Listed as Impaired, on the 303(d) list and a Priority, and their Source of Impairment. (Data from "*The 2010 South Dakota Integrated Report for Surface Water Quality Assessment*".)

Waterbody Impaired	Beneficial Use Impaired	Listed Cause
Dawson Creek - R1	Limited Contact Recreation (8)	Fecal Coliform *Escherichia coli*
Firesteel Creek - R3	Domestic Water Supply (1) Limited Contact Recreation (8)	Total Dissolved Solids *Escherichia coli*
James River - R16	Warm water Semi-Permanent Fish Life (5)	Total Suspended Solids
James River - R7	Warm water Semi-Permanent Fish Life (5)	Total Suspended Solids
James River - R8	Warm water Semi-Permanent Fish Life (5)	Total Suspended Solids
	Limited Contact Recreation (8)	Fecal Coliform *Escherichia coli*
Pierre Creek - R20	Limited Contact Recreation (8)	Fecal Coliform *Escherichia coli*
Twin Lakes - L35	Immersion Recreation (7)	Chlorophyll-*a*
	Limited Contact Recreation (8)	Chlorophyll-*a*
	Warm water Permanent Fish Life (4)	Chlorophyll-*a*
Wilmarth Lake - L37	Immersion Recreation (7)	Chlorophyll-*a*
	Limited Contact Recreation (8)	Chlorophyll-*a*
	Warm water Permanent Fish Life (4)	Chlorophyll-*a*
Wolf Creek - R29	Warm water Marginal Fish Life (6)	Total Suspended Solids

Figure 1-2: Lower James River Watershed Impaired Use Status, SD-DENR 2010-IR.



1.4 GOALS OF THE LOWER JAMES RIVER WATER QUALITY PROJECT

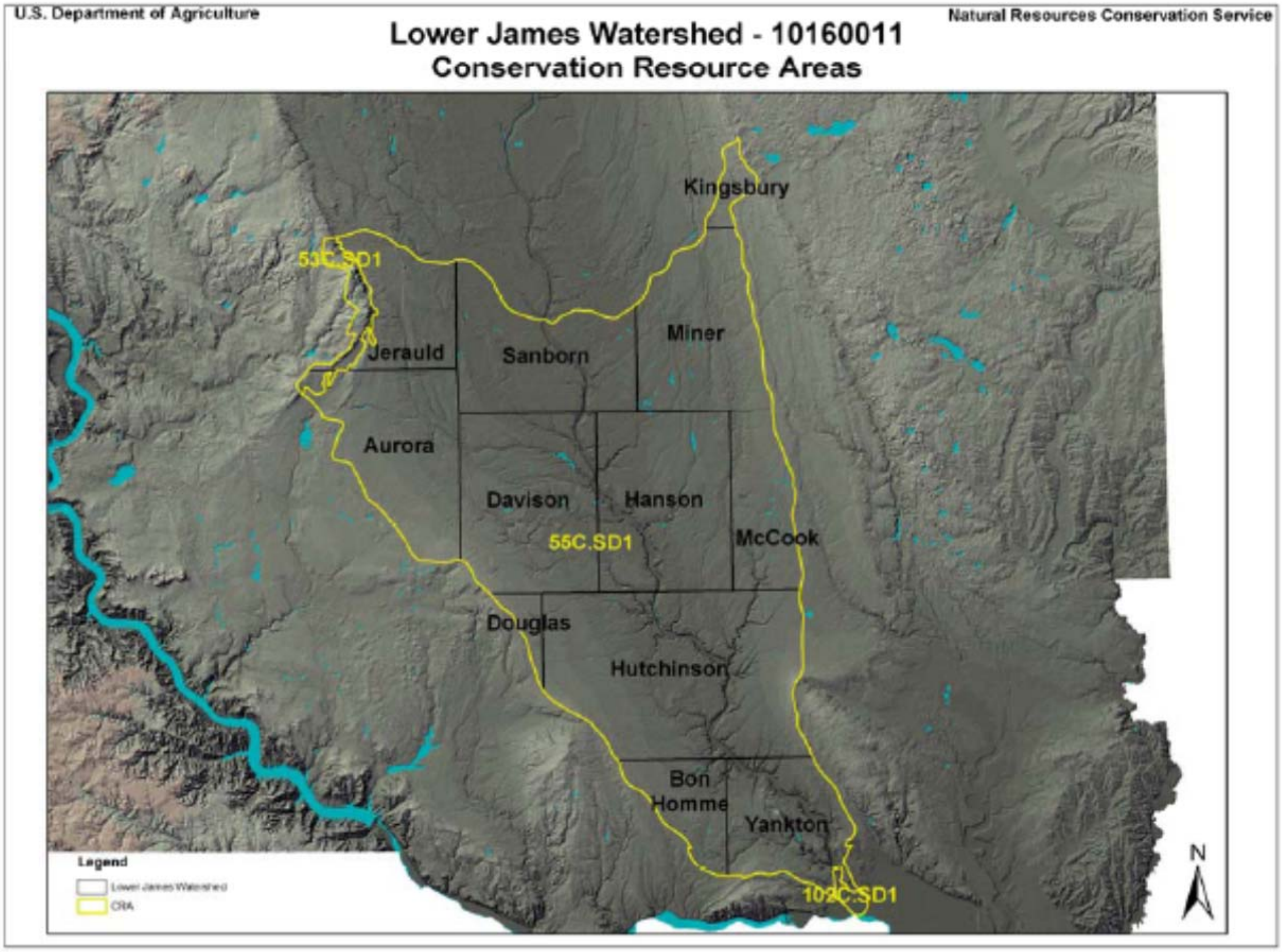
The goals of the Lower James River water quality project efforts were to locate and document the sources of both point and nonpoint pollution and produce feasible restoration recommendations. Field studies utilizing water quality monitoring, stream gauging, stream channel analysis, and land use analysis have resulted in the identification of waterbodies in the 2010 South Dakota Integrated Report for Surface Water Quality Assessment 303(d) list for TSS, TDS, fecal coliform bacteria, and nutrients. These impairments are largely influenced by the agricultural land use of the watershed as described in section 2.1 of this document. The Strategic Plan will detail a watershed implementation work schedule with the objective of decreasing erosion, sedimentation, and fecal coliform loading in the river/stream miles and nutrients in the lakes within the project area. Completion of this project will help attain the designated beneficial uses of water resources in the watershed and allow for continued use of the watershed for agricultural production, swimming, boating, recreation, wildlife, and residential living.

2. CAUSES AND SOURCES OF IMPAIRMENT

2.1 GEOGRAPHY, SOILS, AND LAND USE

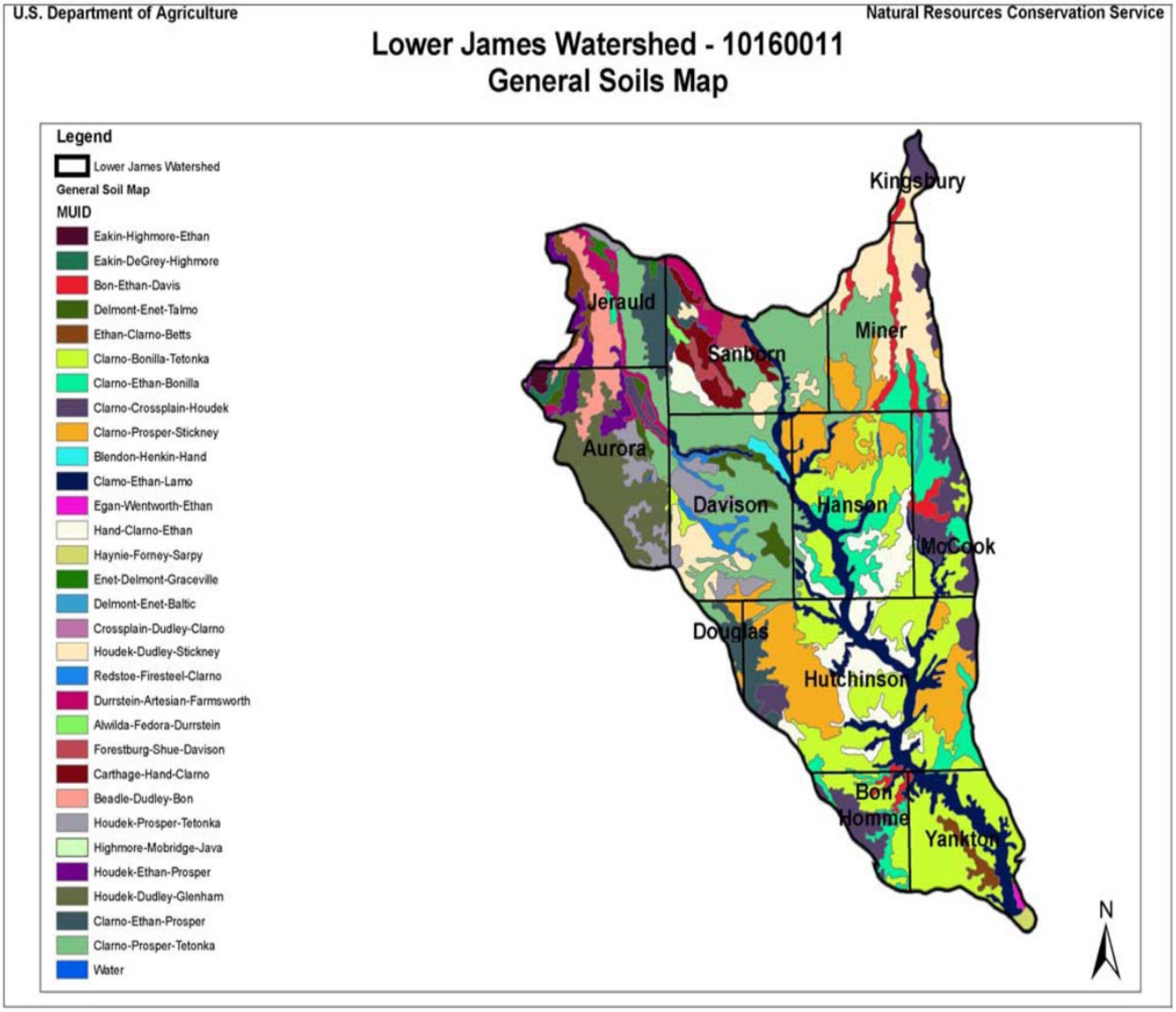
The Lower James River basin lies with the Northern Great Plains Spring Wheat Region, Land Resource Region F. The Major Land Resource Areas (MLRA) are part of a USDA classification system that defines land as a resource for farming, ranching, forestry, engineering, and other uses. The MLRA is a broad-based geographic area characterized by a uniform pattern of soils, elevation, topography, climate, water resources, potential natural vegetation, and land use. The large MRLA's are subdivided into smaller more homogeneous resource areas referred to a Common Resource Area's (CRA). The Southern Black Glaciated Plains, area 55C, is the major CRA within the Lower James River basin comprising over 90 percent of the acres. Two additional CRA's are the Southern Dark Brown Glaciated Plains and the Loess Uplands; area's 53C and 102C, respectively. See Figure 2-1.

Figure 2-1 Lower James Watershed Conservation Resource Areas



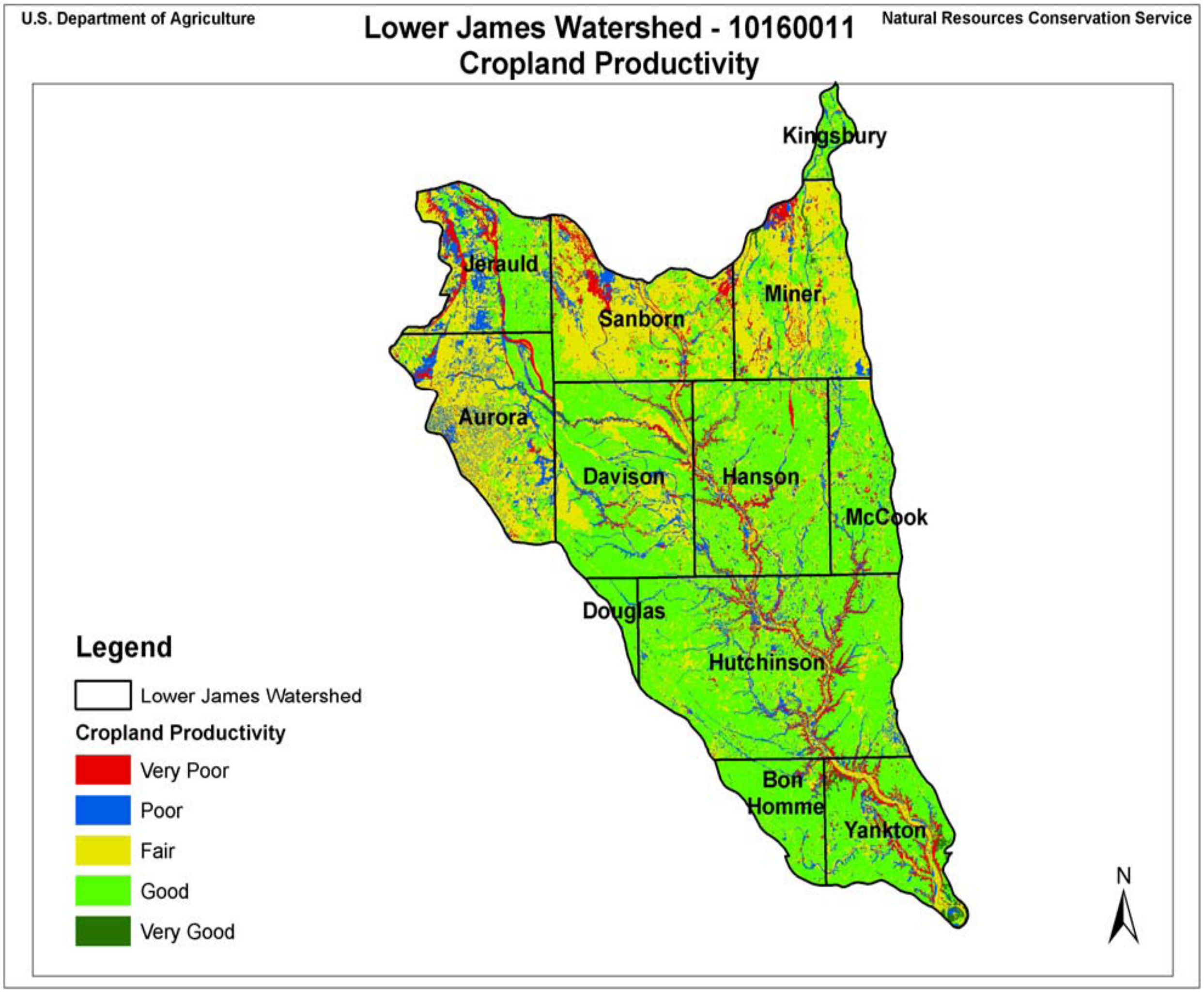
The predominant soils in CRA 55C consist of deep, well drained, and moderately well drained, nearly level, loamy, and silty soils and have a mesic temperature regime. They formed in glacial till on the uplands, loamy soils over sand and gravel on the outwash plains, and clayey and silty soils formed in alluvium on the floodplains and low terraces. See Figure 2-2, General Soils Map. The soils have medium to high fertility and moderate to high organic-matter content. The available water capacity is high and permeability is moderate to moderately slow. Runoff is slow to medium, and the hazard of erosion is slight; however, the drainage patterns are better defined adjacent to tributaries.

Figure 2-2. General Soils Map



The dominant land use is cultivated cropland with approximately 1,307,000 acres or 58 percent of the watershed comprised of corn, soybeans, grain sorghum, and sunflowers. Cropland productivity is largely ranked as good; see Figure 2-3, Cropland Productivity. Areas not suitable for row crop farming are utilized as pasture, range, and hay land and comprise approximately 32 percent of the watershed. The Land Use Cover Summary from the National Resource Inventory, 1997, NRCS-USDA is listed in Table 2-1.

Figure 2-3. Cropland Productivity



Land Capability Classes I and II, have slight and moderate erosion limitations, respectively, and consist of 1,504,100 acres or 66.5 percent of the total watershed acres. Land classes III – IV are listed as having some severe land use limitations; while land classes VI-VII are listed as very severe land use limitations. Land classes III-IV and VI-VII consist of 436,000 acres or 19.2 percent of the watershed.

The use limitations of the soils for crops are slight, which results in a large percentage of the watershed being used for intensive crop production. Maintaining fertility and tilth is the main concern of management; however, this results in the application of chemicals, fertilizers, and animal manures. Based on the acreages listed in Table 2-1; the Land Use Cover of cropland, rangeland, pastureland, hayland, and CRP account for 92 percent of the land uses. These same land uses have the potential for the application of pesticides, fertilizer, and manures to maintain fertility and soil tilth. The Lower James River basin is well suited to farming and the Land Use

Summary indicates the residents of this basin are utilizing the land resources for agricultural production. However, this maximum utilization of the watershed acres has resulted in the impairment of waterbodies where the land uses are not managed well to reduce pollution.

Table 2-1. Land Use Cover Summary. NRCS-USDA 1997 NRI

Land Use Cover	Acres	Percent
Cropland	1,307,000	58
Rangeland	518,600	23
Pastureland	153,100	7
Hayland	51,600	2
Forestland	3,700	0
CRP	47,300	2
Farmsteads	61,900	3
Wetlands	15,000	1
Water	11,400	1
Urban	10,800	0
Rural Transportation	50,500	2
Minor land uses/cover	27,900	1
Total	**2,258,800**	**100**

2.2 DEFINING THE CAUSES OF IMPAIRMENTS FOR 303(d) WATERBODIES

The *2010 South Dakota Integrated Report for Surface Water Quality Assessment* for the Lower James River basin SD-DENR reported that dissolved oxygen (DO), high pH, TSS, TDS, and bacteria were the main impairments observed within the James River basin. This report is summarized in Table 2-2. Substantial organic loading from nonpoint sources occurred throughout the watershed during storm run-off events. Decay of this organic matter was attributed to low DO, especially during low or base flow conditions. Agricultural activities such as livestock operation, grazing in riparian zones, lack of riparian vegetation, and row crop production heavily contributed to the amount of suspended sediments and bacteria in the James River basin. Lakes in this area are also highly eutrophic because of nutrient enrichment and siltation. Agricultural activities such as livestock operations and row crops are considered primary pollution sources.

Table 2-2. Lower James River Basin Information, SD 2010 IR for Surface Water Quality Assessment Category (1) All uses met; (2) Some uses met but insufficient data to determine support of other uses; (3) Insufficient data; (4a) Water impaired but has an approved TMDL; (5) Water impaired/requires a TMDL. *Waterbody has an EPA approved TMDL.

WATERBODY Lake/AUID	LOCATION	MAP ID	BASIS	USE	SUPPORT	CAUSE	SOURCE	EPA CATEGORY	303(d) Priority
Beaver Lake	Yankton	L2	DENR	Fish/Wildlife Prop, Rec, Stock	FULL			1	NO
SD-JA-L-BEAVER_01	County			Immersion Recreation	FULL				
				Limited Contact Recreation	FULL				
				Warmwater Marginal Fish Life	FULL				
Lake Hanson	Hanson	L16	DENR	Fish/Wildlife Prop, Rec, Stock	FULL			1*	NO
SD-JA-L-HANSON_01	County			Immersion Recreation	FULL				
				Limited Contact Recreation	FULL				
				Warmwater Semipermanent Fish Life	FULL				
Menno Lake	Hutchinson	L20	DENR	Fish/Wildlife Prop, Rec, Stock	FULL			1*	NO
SD-JA-L MITCHELL_01	County			Immersion Recreation	NA				
				Limited Contact Recreation	NA				
				Warmwater Semipermanent Fish Life	FULL				
Lake Mitchell	Davison	L22	DENR	Domestic Water Supply	FULL			1*	NO
SD-JA_l-MITCHELL_01	County			Immersion Recreation	FULL				
				Irrigation Waters	FULL				
				Limited Contact Recreation	FULL				
				Warmwater Permanent Fish Life	FULL				
Twin Lakes	Sanborn	L35	DENR	Fish/Wildlife Prop, Rec, Stock	FULL			5	YES-2
SD-JA-L-TWIN_01	County			Immersion Recreation	NON	Chlorophyll-a	Unknown		
				Limited Contact Recreation	NON	Chlorophyll-a	Unknown		
				Warmwater Semipermanent Fish Life	NON	Chlorophyll-a	Unknown		
Wilmarth	Aurora	L37	DENR	Fish/Wildlife Prop, Rec, Stock	FULL			5	YES-2
SD-JA-L-WILMARTH_01	County			Immersion Recreation	NON	Chlorophyll-a	Unknown		
				Limited Contact Recreation	NON	Chlorophyll-a	Unknown		
				Warmwater Permanent Fish Life	NON	Chlorophyll-a	Unknown		
Dawson Creek	James River	R1	DENR	Fish/Wildlife Prop, Rec, Stock	FULL			5	YES-1
SD-JA-R-DAWSON_01	to Lake Henry			Irrigation Waters	FULL				
				Limited Contact Recreation	NON	E.coli, Fecal Coliform	Livestock		
				Warmwater Marginal Fish Life	FULL				

WATERBODY Lake/AUID	LOCATION	MAP ID	BASIS	USE	SUPPORT	CAUSE	SOURCE	EPA CATEGORY	303(d) Priority
Firesteel Creek	West Fork	R3	DENR	Domestic Water Supply	NON	Total Dissolved Solids		5*	YES-2
SD-JA-R-FIRESTEEL_01	Firesteel		USGS	Fish/Wildlife Prop, Rec, Stock	FULL				
	Creek to mouth			Iriggation Waters	FULL				
				Limited Contact Recreation	NON	Escherichia coli			
				Warmwater Permanent Fish Life	FULL				
James River	Sand Creek	R16	DENR	Fish/Wildlife Prop, Rec, Stock	FULL			5	YES-1
SD-JA-R-JAMES-09	to I-90		USGS	Irrigation Waters	FULL				
				Limited Contact Recreation	FULL				
				Warmwater Semipermanent Fish Life	NON	Total Suspended Solids	Livestock		
							Crop		
							Production		
James River	I-90 to	R7	DENR	Fish/Wildlife Prop, Rec, Stock	FULL			5	YES-1
SD-JA-R-JAMES-10	Yankton		USGS	Irrigation Waters	FULL				
	County Line			Limited Contact Recreation	FULL				
				Warmwater Semipermanent Fish Life	NON	Total Suspended Solids			
James River	Yankton	R8	DENR	Fish/Wildlife Prop, Rec, Stock	FULL			5	YES-1
SD-JA-R-JAMES-11	County Line			Irrigation Waters	FULL				
	to mouth			Limited Contact Recreation	FULL-TH	Fecal Coliform			
				Warmwater Semipermanent Fish Life	NON	Total Suspended Solids	Grazing		
							Crop		
							Production		
Pierre Creek	James River to	R20	DENR	Fish/Wildlife Prop, Rec, Stock	FULL			5*	YES-1
SD-JA-R-Pierre_01	S11			Irrigation Waters	FULL				
	T102N-R58W			Limited Contact Recreation	NON	E.coli, Fecal Coliform	Livestock		
							Feedlot		
				Warmwater Semipermanent Fish Life	FULL				
Wolf Creek	Wolf Creek	R27	DENR	Fish/Wildlife Prop, Rec, Stock	FULL			1	NO
SD-JA-R-WOLF_01	Colony to		USGS	Irrigation Waters	FULL				
	S5-T103N-R56W			Limited Contact Recreation	FULL				
				Warmwater Marginal Fish Life	FULL				
Wolf Creek	Just above Wolf	R29	DENR	Fish/Wildlife Prop, Rec, Stock	FULL			5	YES-1
SD-JA-R-WOLF_02	Creek Colony			Irrigation Waters	FULL				
	to mouth			Limited Contact Recreation	FULL				
				Warmwater Marginal Fish Life	NON	Total Suspended Solids	Non-Point		

2.3 DESCRIPTION OF THE CAUSES OF IMPAIRMENTS FOR 303(d) LISTED WATERS IN DENR INTEGRATED REPORT 2010

2.31 Chlorophyll-a

Chlorophyll-*a* is the primary photosynthetic pigment found in oxygen producing plants and blue-green algae. The measurement of Chlorophyll-*a* is an indirect indicator of the nutrient levels in a lake, the lake's productivity, and its state of eutrophication. Waters that have high chlorophyll conditions are typically high in nutrients, generally phosphorus and nitrogen. These two nutrients cause the algae to grow or bloom. High levels of nitrogen and phosphorus are indicators of pollution from man-made sources, such as animal wastes, septic system leakage, poorly functioning wastewater treatment plants, soil erosion, or fertilizer runoff. Chlorophyll measurement is utilized as an indirect indicator of these nutrient levels.

Nitrogen is difficult to limit in aquatic environments because of its highly soluble nature. Due to the many environmental sources of nitrogen (atmospheric, soil, fertilizer, and fecal matter), nitrogen is difficult to remove from a water system. Blue green algae can also convert nitrogen for their own growth making it even more difficult to control. For these reasons, the focus on nutrient reduction is usually on phosphorous instead of nitrogen.

Phosphorus is easier to control in the environment, making it the primary nutrient targeted for reduction when attempting to control lake eutrophication. The large algal blooms in studied lakes typically coincided with large phosphorus concentrations. Chlorophyll levels significantly increase due to algae blooms that occur during periods of higher water temperature. Levels may also increase due to the stratification of the water column (Rose Hill Lake/Sand Creek, DENR, 2002), which may cause anoxic conditions in the hypolimnion. The anoxia is accompanied by low pH values and results in the release of nutrients, particularly phosphorus, from the bottom sediments. This release of total nitrogen, total phosphorous and total dissolved phosphorous concentration can result in the algal blooms that persist throughout the summer.

When algae populations bloom and then die in response to changing environmental conditions, they deplete DO levels - a primary cause of most fish kills. Methods to eliminate the existing nutrients by artificial oxygenation of lake bottoms could result in fewer and less intense algal blooms. However, little data exists on circulators, oxygenators, and other types of equipment that eliminate stratification of the water column and the affect they will have on the frequency or intensity of nuisance algal blooms. The reduction of nutrient inputs, primarily phosphorous, into the Lower James River waterbodies would be the preferred method to prevent algal blooms, reduce Chlorophyll-*a* concentrations, and meet 303(d) impairment standards.

2.32 *Escherichia coli* and Fecal Coliform

Fecal coliform are bacteria that are found in the waste of warm-blooded animals. Common types of bacteria associated with livestock, wildlife, and human feces are *E. coli*, Salmonella, and Streptococcus. These fecal indicators are microbes whose presence indicates that the water is contaminated with human or animal wastes. Microbes in these wastes can cause short-term health effects, such as diarrhea, cramps, nausea, headaches, or other symptoms. They also pose a special health risk for infants, young children, some of the elderly, and people with severely compromised immune systems. Sources of fecal contamination to surface waters include wastewater treatment plants, on-site septic systems, domestic and wild animal manure, and storm runoff. The presence of elevated levels of fecal bacteria can also cause cloudy water, unpleasant odors, and an increased oxygen demand.

2.33 Total Dissolved Solids

The TDS are solids in water that can pass through a filter and are a measure of the amount of material dissolved in the water. This material can include carbonate, bicarbonate, chloride, sulfate, phosphate, nitrate, calcium, magnesium, sodium, organic ions, and other ions. A certain level of these ions in water is necessary for aquatic life. Sources for TDS in receiving waters are agricultural and residential runoff, soil erosion, fertilizer and pesticide runoff, livestock wastes, leaching of soil contamination, and point source water pollution discharge from industrial or sewage treatment plants. Changes in TDS concentrations can be harmful because the density of the water determines the flow of water into and out of an organism's cells. When TDS concentrations are too high or too low, the growth of aquatic life can be limited and death may occur. High concentrations of TDS may also reduce water clarity, contribute to a decrease in photosynthesis, attach to toxic compounds and heavy metals, and lead to an increase in water temperature.

2.34 Total Suspended Solids (TSS)

Solids present in water are addressed separately as total solids, dissolved solids, suspended solids, and volatile suspended solids. The TSS are the sum of all forms of material including suspended and dissolved solids that will not pass through a filter. The TSS can include a wide variety of material, such as silt, decaying plant and animal matter, industrial wastes, and sewage. High concentrations of suspended solids can cause many problems for stream health and aquatic life by blocking light from reaching submerged vegetation. As the amount of light passing through the water is reduced, photosynthesis slows down. Reduced rates of photosynthesis causes less DO to be released into the water by plants. If light is completely blocked from bottom dwelling plants, the plants will stop producing oxygen and die. Bacteria uses up additional oxygen from the water as the plants decompose resulting in lower DO and can lead to fish kills. High TSS can also cause an increase in surface water temperature because the suspended particles absorb heat from sunlight. This can cause DO levels to fall even further as warmer waters hold less DO.

The decrease in water clarity caused by TSS can affect the ability of fish to see and catch food. Suspended sediment can also clog fish gills, reduce growth rates, decrease resistance to disease, and prevent egg and larval development. When suspended solids settle to the bottom of a waterbody, they can smother the eggs of fish and aquatic insects, as well as suffocate newly hatched insect larvae. Settling sediments can fill in spaces between rocks which could have been used by aquatic organisms. High TSS in a waterbody can mean high concentrations of bacteria, nutrients, pesticides, and metals in the water. These pollutants attach to sediment particles on the land, are carried into waterbodies with storm events, and are then released from the sediment or travel farther downstream.

2.4 DEFINING THE SOURCES OF IMPAIRMENTS FOR 303(d) WATERBODIES

The general sources of impairment have been listed in the *2010 South Dakota Integrated Report for Surface Water Quality Assessment* (SD DENR), see Table 2-3; however, further identification of the sources is required for the land application of BMPs to be successful. The implementation of BMPs that address the impairments of the listed waterbodies would more specifically solve the water quality issues. Investigations of both point and nonpoint sources were completed within the James River watersheds that have been referenced by DENR to identify the main sources of these impairments.

2.41 Point Sources of Impairment

Point sources of pollution were evaluated in several studies within the Lower James River Basin. The municipalities within the watershed that discharge from sanitary waste facilities have NPDES/Surface Water Discharge permits. The Dawson Creek study (DENR 2011) evaluated the City of Tripp’s wastewater treatment facility that had periodic discharges to an unnamed tributary in the headwaters of the Dawson Creek drainage, approximately 17 miles upstream of the 303(d) listed segment. The SD DENR determined that Tripp's minor discharge would not impact the segment of Dawson Creek designated limited contact recreation due to the sufficient distance from the creek. The second facility, at the City of Scotland, was required to collect fecal coliform samples during discharge events as part of their NPDES permit. The maximum fecal coliform concentration reported by the Scotland facility over the past ten years was 20 colony forming units (cfu)/100ml. This information suggests that the bacterial waste load contributed by the Scotland and Tripp facilities was insignificant and did not contribute to the impairment of the classified segment of Dawson Creek.

The community of Alexandria (DENR 2011) is the largest municipality located within the Pierre Creek watershed and has a zero discharge waste treatment permit. The DENR found, from a 2008 inspection, that there was no evidence of excessive seepage from the lagoons and the system was properly operated and maintained. In 2009, the DENR awarded the city of Alexandria an Excellent Operation and Maintenance Award for its wastewater treatment system. There was no evidence to suggest the city of Alexandria's wastewater treatment facility was impacting the groundwater or surface water resources in this area.

Point source discharges for the municipalities of Scotland, Tabor, Utica, and Lesterville, were evaluated for potential loadings to the listed segments R1 and R8 of the James River by DENR (2011 James River, Yankton County). The cities of Lesterville, Tabor, and Utica were found to not contribute any significant nutrient loadings to the impaired downstream R1 and R8 segments. The City of Scotland was evaluated in the Dawson Creek study and determined that the bacterial waste load contributed by the Scotland facility was also insignificant and did not contribute to the impairment of the classified R1 segment of Dawson Creek nor segment R8 of the James River. The entire watershed of this segment, including these communities, has a combined population of 3,000 people within the 250,000 acre drainage area. These communities account for about 660 of the approximately 3,000 people in the watershed. Septic systems were assumed to be the primary human source for the rest of the population in the watershed. Table 2-3 includes all human produced fecals that are not delivered to a community waste system. The remaining human population produced fecals accounting for approximately 0.3 percent of all fecal coliform produced in the watershed. These bacteria should all be delivered to a septic system, which if functioning correctly, would result in no fecal coliforms entering the river.

The conclusions repeated by the various studies on the Lower James River on potential point sources of loadings were that municipalities had either (1) zero discharge NPDES permits, (2) discharges that were NPDES permitted were controlled or the discharges were so minor and/or infrequent as to be negligible, and (3) the remaining human produced fecals not delivered to a municipal treatment facility had a minimal impact on total loading as represented in Table 2-3.

Table 2-3: Nonpoint Sources of Bacteria, James River, Yankton County, DENR 2011

Species	#/mile	#/acre	FC/Animal/Day	FC/Acre	Percent
Dairy cow	0.00	0.0E+00	4.46E+10	0	0.0%
Beef	73.00	1.1E-01	3.90E+10	4448437500	83.8%
Hog	34.00	5.3E-02	1.08E+10	573750000	10.8%
Sheep	4.00	6.3E-03	1.96E+10	122500000	2.3%
Horse	0.25	3.9E-04	5.15E+10	20109375	0.4%
Poultry	100.00	1.6E-01	1.36E+08	21250000	0.4%
Humans1	5.85	9.1E-03	1.95E+09	17824219	0.3%

2.42 Nonpoint Sources of Impairment

The TMDL studies concluded that the point sources of impairment had minimal impact on the waterbodies of the Lower James River. The nonpoint sources were then evaluated using several computer programs including AGNPS, the Annualized Agricultural Nonpoint Pollution System (AnnAGNPS), Spreadsheet Tool for Estimation Pollutant Loads (STEPL), BATHTUB, and FLUX. Nonpoint sources that were identified were AFOs/CAFOs, overgrazed cattle pastures, lack of bank vegetation, livestock's direct use of waterbodies, crop production immediately adjacent to waterbodies, and bank degradation.

The AGNPS version 5.0 was used to assess the nonpoint source loadings throughout several watersheds. Watersheds were divided into 40 acres cells for which the model predicted various parameters for single storm events. An important aspect of AGNPS analysis was to identify certain critical NPS cells that delivered higher proportions of pollutants. These critical cells had elevated sediments, nitrogen, and phosphorus; this data was then used to rank and prioritize each concentrated feeding area and quantify the nutrient loadings from each feeding site.

These analyses concluded that agricultural activities were the major nonpoint source of excessive nutrients to the watershed and that all other potential sources were minimal. The following pollutants, as identified by the DENR 2010 Integrated Report, are discussed by each listed 303(d) impairment.

2.43 *Escherichia coli* and Fecal Coliform Sources - Dawson Creek, Pierre Creek, Firesteel Creek, James River in Yankton County

Nonpoint sources of fecal coliform and *E. coli* bacteria came primarily from agricultural operations. Sources of impairment included feeding areas, pastures, and crop ground with manure spread on it. There were approximately 1,500 feeding operations screened within the Lower James River Assessment Project area. The main source of fecal coliform and *E. coli* bacteria in the watersheds was livestock from a combination of feedlots and grazing as shown in Table 2-4. Beef cattle and hogs were found to contribute the most significant amount of bacteria to the watershed.

Fecal decay rates suggested that sources within 10 kilometers of the listed segments were most likely to contribute the largest portions of the load. Limiting the data set to lots located within this distance produced a list of 242 feeding operations in the watershed. These 242 lots were evaluated based on their size and proximity to a watercourse. Bacteria migration from feedlots and upland grazing was occurring during major run-off events, while the direct use of the stream by livestock was the source of bacteria at low flows. The relatively high fecal coliform concentrations and associated exceedance rate of both acute and chronic standards across flow zones suggested that the bacterial source was continual. The majority of *E. coli* samples were reported at the upper level of detection.

Livestock grazing in the riparian zone was also identified as a source of fecal coliform and *E. coli* bacteria loading to waterbodies. The majority of grassland pastures are located in close proximity to the stream corridors, which increases the chances that fecal material may be washed off into the streams. Livestock grazing in the riparian zone was identified as the main source of bacterial loading to the main stem of Dawson Creek. Livestock from both feedlots or on grass pastures represented 99.6 percent of the source of fecal coliform and *E. coli* bacteria.

Table 2-4. Fecal Source Allocation for Dawson Creek

Source	Percentage
Feedlots	62.2
Livestock on Grass	37.4
Wildlife	0.4

2.44 Total Suspended Soil Sources - James River Main Stem, Firesteel Creek, Wolf Creek

The entire reach of the James River in the Lower James River basin is impaired because of TSS, DENR IR 2010. Excessive TSS concentrations were present in the main stem of the James River during all flow regimes in the river's lower reaches. The source of high TSS in the Lower James basin is associated with the increased slope of the river channel, increased erodibility of the soil, and changes in land use compared to upstream reaches. Agricultural activities such as livestock feeding operations, grazing in riparian zones, lack of riparian vegetation, and row crop production heavily contributed to the amount of suspended sediments and bacteria in the James River basin. Rain events and snowmelt runoff were the major delivery systems of suspended solids for the entire watershed, not just the impaired listed segments.

The Wolf Creek study completed individual Rapid Geomorphic Assessments (RGAs) along the stream corridor to identify conditions of the banks where either stable or unstable stream bank conditions existed. These RGAs helped local coordinators find areas that contributed higher amounts of suspended solids during large rainstorm events. Elevated levels of suspended solids from bed and bank failures were linked to these reaches. Banks that were aggravated during high flow events were most likely to fail after high flows when water levels are dropping. The southernmost segment of the James River has a greater percentage of row crops planted within 30 meters of the river than upstream segments, which increased bank instability and sedimentation.

The yearly seasonal variation in the suspended solids load were documented as different seasons of the year yielded differences in water quality due to changes in precipitation and agricultural practices. The data indicated that elevated TSS levels were directly linked to high flow conditions, which most often occurred during the spring months.

Agricultural pressures in and around the stream riparian area are the main causes of unstable portions of the waterbodies in the Lower James River Basin. The AFOs/CAFOs and grazing, in close enough proximity to the stream, had a higher potential for contributing suspended solids. These factors in addition to natural channel erosion processes were the main contributing TSS factors in the watershed.

2.45 Storm Sewers

Storm sewers are not numerous in the rural communities of the Lower James River Basin, but they were evaluated in the Lake Mitchell / Firesteel Creek watershed study for their load contribution to Lake Mitchell. Storm sewers typically have very little watershed area in comparison to the larger watershed of their receiving waterbody. The City of Mitchell storm sewers contributed four percent of the phosphorus, eight percent of the total nitrogen, and eight percent of the TSS percentages of the total load to Lake Mitchell; which was high, as their drainage area comprised one percent of the total drainage of the watershed. The storm sewers were also considered a significant source of TSS as the average concentrations for the three sample sites were 43,243, and 96 mg/L, which were extremely high for the size of the watershed. Possible sources of these high solids were from sanding winter roads and dirt and gravel carried on cars from rural roads in the area.

The pounds of phosphorus delivered per acre from urban areas are high in comparison to a typical agricultural watershed. This phosphorous loading is assumed to come from the application of lawn fertilizers to individual lawns. Contributions of phosphorus from the storm sewers via lawn fertilization can be reduced by the use of non-phosphate fertilizers, especially on lawns in areas of a city with steeper slopes. Zero phosphorus fertilizers are currently available with formulations such as 26-0-7 and 6-0-6; nitrogen, phosphorous, potash, respectively.

While the loadings from the storm sewers were only a fraction of the Firesteel Creek watershed, the storm sewers are critical as they are direct conduits to the lake. The paved surfaces of urban areas do not allow any filtering of the water to take place nor do they reduce the velocity of water to allow sediment to drop out. Two storm sewer sample sites also recorded maximum fecal coliform concentrations of 510,000 and 400,000 colonies/100 ml; averaging 130,653 and 133,370 colonies/100 ml. respectively. The high fecal coliform concentrations were a result of flooding when the sewage from the city sanitary sewers backed into the city storm sewers. The standard deviation values of the fecal coliform for these sample sites were high; indicating loading from the storm sewers was related to the severity of the storm event.

As conduits, the storm sewers also present the possibility of hazardous material spill in an urban area reaching waterbodies. Other parameters typically present in urban runoff are oil and grease, chlorides, trash, and debris; which can all have varying degrees of degradation on the receiving waterbody. The impervious surfaces of urban areas result in a complete change of hydrology. Paved surfaces absorb less rainfall and increase the velocity of storm water runoff. This increase in velocity transports sediment and other pollutants more rapidly and with more force, which can also result in stream bank erosion. With the increased velocity, sediment and other pollutants are not allowed to settle out as they naturally would in a wetland and grassed waterway. The sediment load is completely discharged into the receiving waterbody which can severely degrade the aquatic habitat.

Urban storm sewer systems should include BMPs that will reduce the velocity and improve the quality of water entering stream and lake watersheds. Storm water retention basins can be constructed to reduce the impact or reduce the velocity of the water to allow sediment and nutrients to drop out prior to the water entering the main tributaries. An aggressive and regular street cleaning campaign to remove sand and gravel from streets would eliminate the source of pollutants before they are delivered to the lake by storm events. These preventative measures would reduce loadings to the lake and improve water quality.

2.46 TDS Sources – Firesteel Creek

The Firesteel Creek/Lake Mitchell watershed was evaluated using AGNPS modeling. The watershed was divided into 8,774 individual 40-acre cells. The primary source of elevated nutrients and TDS in the Firesteel Creek study was from AFOs/CAFOs. The total nutrient loading to Lake Mitchell was high with the 25-year event loading equivalent of 156.1 tons of nitrogen and 60.4 tons of phosphorus delivered. The sedimentation rate to Lake Mitchell was low, identifying the most likely source of the high nutrients from AFOs/CAFOs within the watershed. Not only were the nutrient estimates close when comparing loadings, higher nutrient loading from the water quality sampling coincided with large feedlot operations. The excessive nutrients (TDS) from concentrated animal feeding areas and/or intense season long grazing were also the main causes of eutrophication in Lake Mitchell. A total of 37 animal feeding areas with an AGNPS ranking of greater than 50 were identified as contributing 37 percent of the total phosphorus load to Lake Mitchell. These identified critical feeding operations should be targeted for implementation of appropriate BMPs to reduce nutrient loading.

Although sedimentation was not a serious problem in the watersheds, certain subwatersheds contained 34.4 percent of the AGNPS critical erosion cells and comprised only 8.3 percent of the watershed area. The sediment yield analysis revealed 270 cells (3.1 percent) had sediment erosion rates greater than 4.0 tons/acre/year for an expected 25 year rainfall event. The primary source of elevated sedimentation within the critical cells was from croplands that had land slopes of 5 percent or more and overgrazed rangelands that have slopes 8 percent or greater. Water quality samples collected found elevated suspended sediment loads in the same locations as the AGNPS model. These findings were repeated in several of the James River watersheds as water quality monitoring sites with higher concentrations of phosphorus and fecal coliform were areas also identified as critical cells by the AGNPS models. The targeting of these identified critical cells throughout the Lower James River Basin with appropriate BMP's to reduce sediment erosion should be implemented to provide the most cost effective means at reducing sediment erosion.

2.47 Chlorophyll-*a* - Twin Lakes, Wilmarth Lake

High levels of chlorophyll-*a* are indicators of pollution from man-made sources and are used as an indirect indicator of nitrogen and phosphorous levels. Since nitrogen is difficult to limit in aquatic environments, the focus on nutrient reduction is usually on phosphorus instead of nitrogen.

The large algal blooms in Lake Mitchell typically coincided with large phosphorus concentrations. By dramatically reducing the amount of phosphorus entering Lake Mitchell, the duration and intensity of the algal blooms would be reduced. According to the AGNPS model, correcting the feedlots with AGNPS ratings over 50 would have a significant impact on the reducing the phosphorus loading to Lake Mitchell. The model also estimated that 51 percent of the total phosphorus load to the lake would be eliminated if all 116 feedlots with a feedlot rating >30 were corrected.

Eleven feeding areas within the Lake Wilmarth watershed were evaluated with AGNPS as part of the March 1997 *Phase I, Diagnostic Feasibility Study, Final Report, Lake Mitchell/Firesteel Creek, Davison County, South Dakota, SD-DENR*. Based upon the accuracy of the watershed information gathered and entered into the model, the total nutrients being deposited from the watershed into Lake Wilmarth were very high. The ratings were then adjusted by factors based upon the distance from major streams and Lake Wilmarth. The sources for the elevated nutrients were from AFOs/CAFOs. It is generally recommended that feeding areas with an AGNPS rating in excess of 30, or those with a distance corrected rating greater than 20, be targeted for treatment. Of the eleven evaluated feeding areas, five had a corrected AGNPS rating >20. Four feeding areas appeared to be contributing significant levels of nutrients to the watershed with a corrected AGNPS rating greater than 30. It was recommended that the identified 116 animal feeding areas be evaluated for potential operational or structural modifications in order to minimize future nutrient releases.

3.0 NONPOINT SOURCE MANAGEMENT MEASURES

The management measures needed to address the causes and sources of pollution impairments are strongly interrelated. The nonpoint impairments have been identified as agricultural activities linked to livestock feeding operations, nutrients from livestock manure, direct use of water bodies by livestock, and soil erosion from both adjacent cropland and pasture. Practice effectiveness will overlap in many instances and these nonpoint measures will result in load reductions that affect several sources. Load reduction predictions from other studies are presented in Table 3-1. The Nonpoint Source Measures will be described and referenced to BMPs as defined by the Natural Resources Conservation Service (NRCS), USDA; however, any related NRCS practices may be added to supplement these identified BMPs.

Table 3-1. Estimated BMP Reduction Efficiencies by Pollutant Type Evan et al. 2003/2008.

BMP System/Type	NRCS Practice Code	Percent Nitrogen	Percent Phosphorus	Percent Sediment	Percent Fecal
Crop Residue Manage	329 & 345	50	38	64	-
Vegetated Buffer	390	54	52	58	70
Grazing Land Manage	528	43	34	13	-
Streambank Protect	580	65	78	76	-
Nutrient Manage Plan	590	70	28	-	-
Grassed Waterways	428	54	52	58	-
Constructed Ponds/Wetlands	378 & 657	88	53	51	71
Waste Storage Facility	313	75	75	-	75

3.1 ANIMAL WASTE MANAGEMENT SYSTEM. NRCS PRACTICE CODE 313, WASTE STORAGE FACILITY

A Waste Storage Facility is part of an Animal Waste Management Systems (AWMS) and designed for the full containment of animal wastes by the proper handling, storage, and utilization of wastes generated from animal confinement operations. The waste storage facility should reduce any discharge of animal wastes into the waters of the State. Therefore, the potential nutrient reduction in loading should be significant. Wastes would only be applied, through a Nutrient Management Plan (NMP), when growing crops can use the accompanying nutrients and soil and weather conditions are appropriate.

Approximately 1,500 feeding operations were surveyed in the Lower James River watershed. The results indicated that the most likely sources of the nutrient loading were AFOs/CAFOs and intense season long grazing. These operations were mostly comprised of beef cattle and were also identified as a source of *E. coli*, fecal coliform, and TSS in the impaired waters (DENR James River- Yankton 2011). Feedlots were scored and ranked for implementation assessment. The analysis found that if the animal feeding areas, with an AGNPS non-corrected rating over 30 were treated, the soluble phosphorus concentrations delivered to Lake Mitchell would be reduced by approximately one half. This would reduce in-lake phosphorus by 17 percent and decrease chlorophyll-*a* concentrations sufficient to reduce the Trophic State Index (TSI) for chlorophyll-*a* to a mesotrophic level (DENR Firesteel Creek 1997.) The 18 AWMS systems reported as installed by Kringen (2010) reduced nitrogen by 49,409 pounds/year and phosphorous by 11,117 pounds per year.

3.2 NUTRIENT MANAGEMENT SYSTEM. NRCS PRACTICE CODE 590

A NMP is a required component of the AWMS. The purpose of an NMP is to utilize manure or organic byproducts as a plant nutrient source and minimize agricultural nonpoint source pollution of surface and ground water resources. A nutrient budget is developed for nitrogen, phosphorus, and potassium that considers all potential sources of nutrients including, but not limited to animal manure and organic by-products, waste water, commercial fertilizer, crop residues, legume credits, and irrigation water. This should result in reduced nutrient loading from manure spread on fields as estimated in Table 3-1 of 70 percent for nitrogen and 28 percent for phosphorous.

3.3 GRAZING – RIPARIAN AREAS. NRCS PRACTICE CODE 528

The DENR Rosehill (2002) analysis of its watershed indicated that the most likely source of the nutrient loading, in addition to the AFOs/CAFOs, was intense season long grazing. The DENR James River-Yankton study (2011) had approximately one third of the watershed in grassland; however the majority of the grassland was located in close proximity to the stream corridors, increasing the chances that fecal material may be washed off into the streams. Evan et. al., (2008), estimated a 34 percent reduction in phosphorous and a 43 percent reduction in nitrogen through proper grazing management. Kringen reported (2010) rotational grazing systems on 14,421 acres to have reduced nitrogen by 2,575 pounds/year, phosphorous by 342.9 pounds/year, and sediment by 151 tons/year.

Rotational grazing and exclusion of livestock from critical areas (steep slopes adjacent to the lake and stream) will provide benefits that are difficult to simulate in modeling. Estimates of 20 percent to 40 percent of the rangeland in Hand County were identified in the watershed report

(DENR, Lake Louise 2001) as needing some type of improved grazing management practices. Using these estimates for the entire Lower James River Basin watershed would indicate that approximately 134,352 to 268,704 acres could benefit from grazing management practices. Phosphorus was reported to be reduced by 0.4 tons/year in the Firesteel Creek 319 Application (2006) by improved grazing management on 13,000 acres of grassland. The estimated P load reduction used for grazing management systems was 0.06 pounds of phosphorus reduction per acre improved. The improvements of 0.4 ton/year and resultant 0.06 pounds/acre load reduction over the James River Basin would be substantial. Application of this practice basin wide would manipulate the intensity, frequency, duration, and season of grazing to: (1) improve water infiltration, (2) maintain or improve riparian and upland area vegetation, (3) protect stream banks from erosion, (4) manage for deposition of fecal material away from waterbodies.

The Rosehill/Sand Creek study (2002) reported that shoreline erosion occurred where the bank vegetation had been reduced or removed by domestic livestock. Banks that were void of vegetative cover are prone to erosion even by small waves. Livestock use of the riparian area also erodes portions of the bank into the lake. Restoring the shoreline vegetation along these sections would reduce the suspended solids in the lake and improve the water clarity. Lake reduction response modeling (Rosehill Lake) was conducted with BATHTUB, an Army Corps of Engineers Eutrophication Response Model. System responses were calculated using reductions in the loading of phosphorus to the lake from Sand Creek. Loading data for Sand Creek was taken directly from the results obtained from the FLUX modeling data calculated for the inlet to the lake. A large portion of the total phosphorus load was produced where bank erosion problems occurred along the creek and the shoreline of the lake. These areas had the highest discharge coefficient and the highest percentage of dissolved phosphorus, which indicated expected reductions in phosphorus of 20 percent to 40 percent. However, the authors felt these percentages were high, suggesting there were additional sources of phosphorus located in this area. To make a conservative estimate, they predicted bank stabilization practices to reduce loads by at least 10 percent.

Grazing along shoreline could be restricted by fencing the stream corridors off and keeping cattle out of the stream channel area or by limiting grazing to drier periods of the season, like late summer or early fall during low flow periods. Conservation Reserve Program (CRP) vegetative buffer strips could also be enrolled to protect streams and stream banks. Current CRP buffer practices allow up to 120 feet of perennial herbaceous vegetation to be protected from grazing along intermittent streams to benefit water quality. Other practices along riparian areas would be Stream Bank Restoration and Riparian Forest Buffers.

3.4 CROPLAND CONSERVATION TILLAGE & NO-TILL. NRCS PRACTICE CODES 329 AND 345

The Mulch Tillage BMP (NRCS Practice Code 345) applies to all cropland and includes tillage methods commonly referred to as mulch tillage, where a majority of the soil surface is disturbed by tillage operations. Mulch tillage includes vertical tillage, chiseling, disking, and also includes tillage/planting systems with relatively minimal soil disturbance. No Till or Strip Till (NRCS Practice Code 329) applies to limiting the soil disturbing activities to only those necessary to place nutrients, condition residue, and plant crops. Surface residue is left evenly distributed and no full width tillage is implemented.

Several Lower James River basin studies utilized the AGNPS to evaluate their watersheds. The Rosehill/Sand Creek watershed was divided up into 552 equally sized cells of 40 acres. Each of these cells required 26 parameters to be collected and entered into the program. The targeted or "critical" cells were identified by the amount of nutrients that they produced and that ultimately reached the outlet of the watershed. Forty-two cells were identified as needing or having reduced tillage, which represented 7.6 percent of the total watershed acres in this study. Loading reductions began to significantly decrease when BMP's, including grassed waterways and buffer strips, were applied to 10 percent – 20 percent of the cropland acres.

Similarly, the Firesteel Creek/Lake Mitchell report (DENR 1997) evaluated the Lake Mitchell watershed with 8,774 individual 40 acre cells. The sediment yield analysis revealed 270 cells (3.1 percent) had sediment erosion rates greater than 4.0 tons/acre/year. The primary source of elevated sedimentation within the critical cells was from croplands that had land slopes of 5 percent or overgrazed rangelands that had slopes 8 percent or greater. The Firesteel Creek 319 Application (2006) reported 0.8 ton/year of phosphorus reduced from the improvement of 1,100 acres of cropland. The estimated P load reduction for cropland was 0.5 pounds of phosphorus reduction per ton of soil saved.

Applying this data from both the Rose Hill/Sand Creek (DENR Rosehill 2002) and Firesteel/Lake Mitchell (DENR Firesteel 1997) studies to the entire Lower James River Watershed; approximately 40,517 acres (3.1 percent) to 99,332 acres (7.6 percent) cropland acres may be needing treatment by conservation tillage practices such as Mulch Tillage and No Till. The emphasis for BMPs should be targeted to cropland identified in these critical cells.

3.5 GRASSED WATERWAYS. NRCS PRACTICE CODE 412

The Sand Creek TMDL 2002 identified critical cells where the construction of grassed waterways and/or buffer strips would be the most effective treatment to reduce nutrient loadings from these cells. The PRediCT model, Evans et. al. (2008), estimates a 54 percent reduction in nitrogen, a 52 percent reduction in phosphorous, and a 58 percent reduction in sediment by installing grassed waterways.

The Little Minnesota River (Jensen 2001) reductions for grassed waterways were documented with RUSLE II software using average values for the dominant soil types for the area. Total soil loss from the contributing waterways was reduced approximately 0.77 tons/acre/year.

The AnnAGNPS (Yuban et. al. 2006) estimated that ephemeral gully erosion accounted for approximately 85 percent of the total landscape erosion in the watershed, while sheet and rill erosion amounted to the remaining 15 percent. The simulation of ephemeral gullies for delivery of sediments and associated nutrients is an important process captured in AnnAGNPS; which is not an element of many other watershed models and highlights the importance of grassed waterways and buffer strips in load reductions. Gullies are some of the more serious forms of erosion on slight to moderate slopes where contour farming and terraces are not practical. Grassed waterways need to be implemented basin wide in the identified critical cells in conjunction with conservation tillage and no-till.

3.6 WETLAND RESTORATION AND POND CONSTRUCTION - SEDIMENT/NUTRIENT TRAPPING. NRCS PRACTICE CODES 357 & 378

Concave slopes often occupied by wetlands serve as sediment traps on the landscape and act as a filter for adjacent aquatic systems (NDSU 2006). Excessive deposition in wetland landscapes, where erosion has been accelerated substantially, has reduced the wetlands capabilities to store sediments. The problem of sedimentation is then passed downstream, eventually impacting aquatic systems such as lakes and streams. Wetlands have evolved to transform the soluble and adsorbed chemical load delivered in surface runoff into nontoxic forms that allow diverse biotic conditions to flourish. When wetlands are removed from the landscape, soluble and adsorbed chemicals are delivered directly to aquatic systems. Streams, rivers and lakes have not evolved the capacity to withstand increased chemical inputs, particularly at the rates delivered due to accelerated erosion. The result is hyper-eutrophic conditions and chemical toxicity that reduces the biotic diversity and value of aquatic water resources.

Nitrogen levels in Northern Prairie Pothole Region (NPPR) wetlands, lakes and tributaries have been observed to vary seasonally. Generally the highest concentrations of nitrites and nitrates are found during spring runoff from agricultural activities. These concentrations subside substantially by biological activity as temperatures increase later in the spring and summer. Total nitrogen concentrations in NPPR lakes are lowest in the fall, increase in the winter, remain the same or decrease in the spring, and increase in the summer. The periods of highest total nitrogen concentrations are the summer and winter. In the summer, the predominant form of nitrogen is organic due to flourishing populations of aquatic organisms. In the winter, the predominant form of nitrogen is ammonia. This is because decomposition of organic material only proceeds through the ammonification step of mineralization due to the reduced environment. By the end of winter, toxic levels of ammonia may become a water quality problem, particularly in smaller lakes.

Phosphorus also is distinctly less mobile in the environment, compared with nitrogen. An important aspect of phosphorus control is related to the release of PO4 -3 from lake sediments, known as internal nutrient loading. Anoxic or low redox potentials in lake or wetland sediments will contribute to environmental conditions that maintain soluble PO4 -3 in the water at relatively high levels. The oxidation state of iron in iron oxides is reduced when the redox potential is lowered. Under these conditions PO4-3 is not readily adsorbed to iron oxide surfaces and is released to solution. Mineralization also continues to release PO4 -3 from organic matter. Therefore, aquatic systems that have accumulated a significant layer of eroded sediment likely will not see much reduction in PO4 -3 concentrations for extended periods after the implementation of management practices.

Load reductions for sediment and phosphorus were documented in both restored wetlands with vegetated buffers and constructed ponds for the Little Minnesota River (Jensen 2007) project. Sediment and phosphorous reductions were reported as 91,579 tons/pond lifespan and 174,000 lbs/pond, respectively. For this reason, wetland restoration and pond construction will be part of the Lower James River's strategic plan. The purpose for these BMPs is to create multi-purpose ponds in the watershed to trap sediment, phosphorous, nitrogen, benefit wildlife, and serve as an alternative water source for grazing management systems.

3.7 CONVERSION OF CROPLAND TO FORAGE AND BIOMASS PLANTINGS. NRCS PRACTICE CODE 512

An alternative to conservation residue management within critical watershed cells would be the conversion of cropland to vegetative species suited to pasture, hayland, or biomass production. This would be a conversion without retiring the land from production completely, as with the CRP. The benefits would be to reduce erosion and improve soil and water quality, while increasing forage production or energy production and improving livestock nutrition.

The conversion to grassland was reported to reduce total soil erosion by approximately 1.6 tons/acre/year in the Little Minnesota River (Jensen 2007) study. This equated to a sediment delivery reduction to the Little Minnesota River watershed of approximately 0.6 tons/acre/year (37.5 percent). Reductions were calculated for each field in this study with RUSLE II using the dominant soil type.

The AnnAGNPS model (Yuan et al. 2006) estimated a suspended sediment loading reduction of 54 percent with a conversion of 10 percent of the highest eroding cropland to grassland. A 60 percent reduction was achieved for a combined management scenario involving conservation tillage, conversion of crop to grassland, and improved nutrient management. One scenario which converted 25 percent of the highest eroding cropland in the watershed to grassland, reduced the sediment loads at the watershed outlet by 80 percent. Converting the highest eroding cropland cells to grassland was more efficient in sediment reductions than converting the highest eroding cropland cells from reduced tillage to no tillage practice (Yuan et. al. 2006). The data clearly implies the importance of identifying critical cells throughout the Lower James River basin and evaluating them before BMP's are installed.

4.0 LOAD REDUCTIONS

4.1 ANIMAL WASTE STORAGE FACILITIES

The James River-Yankton (2011) TMDL stated over 1,500 AFO's were screened in the entire Lower James River Basin. The James River-Yankton project identified 242 AFOs in 250,000 acre watershed with 37 (15.3 percent) as seriously contributing nutrient loads. The projected number of AFOs within the entire Lower James River watershed needing treatment is 230 (15.3 percent x 1,500). By completing an average of ten AWSF each year, it would take 23 years to meet load reduction requirements from these AFOs. See Table 4-1 for projected load reductions.

4.2 NUTRIENT MANAGEMENT SYSTEM LOAD REDUCTIONS

The NMPs are designed to spread the manure from the Animal Waste Storage Facilities. The NMPs need approximately one acre per animal unit to safely spread the manure over time. The manure is spread on approximately 10 percent of these acres annually to meet crop nutrient needs. Ten facilities with 500 animal units constructed each year would require 5,000 acres in the NMPs; however, only 500 acres would receive the manure each year. See Table 4-2 for the estimated nitrogen and phosphorous load reductions associated with NMPs.

Table 4-1. Estimated N and P Load Reductions Associated with AWSF

Year	# Goal	AU	N #/AU/YR	Total N #/YR LR	P #/YR/AU	Total P #/YR LR
1	0	0	16.5	0	3.7	0
2	6	3,000	16.5	49,500	3.7	11,100
3	8	4,000	16.5	66,000	3.7	14,800
4	8	4,000	16.5	66,000	3.7	14,800
5	8	4,000	16.5	66,000	3.7	14,800
6-10	54	25,000	16.5	412,500	3.7	92,500
11-15	50	27,000	16.5	445,500	3.7	99,900
16-23	96	48,000	16.5	792,000	3.7	177,600
Totals	230	115,000		1,897,500		425,500

Nutrient reduction estimates from STEPL: Spreadsheet Tool for the Estimation of Pollutant Load v. 4.0. Kringen 2010

Table 4-2. Estimated N and P Load Reductions for NMP with AWSFs

Year	# Goal	Acre	N #/AC/YR	Total N #/YR LR	P #/YR/AC	Total P #/YR LR
1	0	0	9.81	0	0.6	0
2	6	300	9.81	2,943	0.6	180
3	8	400	9.81	3,924	0.6	240
4	8	400	9.81	3,924	0.6	240
5	8	400	9.81	3,924	0.6	240
6-10	50	2,500	9.81	24,525	0.6	1,500
11-15	54	2,700	9.81	26,487	0.6	1,620
16-23	96	4,800	9.81	47,088	0.6	2,880
Totals	230	11,500		112,815		6,900

Nutrient reduction estimates from STEPL: Spreadsheet Tool for the Estimation of Pollutant Load v. 4.0. Kringen 2010

4.3 PRESCRIBED GRAZING SYSTEMS

The Hand County project estimated 20-40 percent of the rangeland in Hand County needing improvement on grassland management practices (DENR Lake Louise 2001). Extrapolating 20 percent of the Lower James River Basin grassland acreage as needing improved grazing management practices; 134,000 acres of rangeland and pastureland would benefit from prescribed grazing plans. Nitrogen, phosphorous, and sediment load reductions are presented in Table 4-3 using load reduction estimates by Firesteel Creek/Lake Mitchell Watershed Project, Segment II, September 2010. Prescribed grazing systems are figured on 500 acres per system, with a rural water hook-up, one tank, water pipeline footage of 2,000 feet, and 2,500 feet of fencing per system.

Table 4-3. Estimated N, P, and Sediment Load Reductions for Prescribed Grazing on Pasture and Rangeland

Year	% Goal	Acres	N #/Ac/Yr	Total #N/YR-LR	P #/Ac/YR	Total #P/YR-LR	Sed T/Ac/YR	Total T/YR-LR
1	4	5,000	1.33	6,650.0	0.18	900.0	0.08	400.00
2	4	5,000	1.33	6,650.0	0.18	900.0	0.08	400.00
3	4	5,000	1.33	6,650.0	0.18	900.0	0.08	400.00
4	4	5,000	1.33	6,650.0	0.18	900.0	0.08	400.00
5	4	5,000	1.33	6,650.0	0.18	900.0	0.08	400.00
6-10	25	33,500	1.33	44,555.0	0.18	6,030.0	0.08	2,680.00
11-15	25	33,500	1.33	44,555.0	0.18	6,030.0	0.08	2,680.00
16-20	30	42,340	1.33	56,312.2	0.18	7,621.2	0.08	3,387.20
	100	134,340		178,672.2		24,181.2		10,747.20

Nutrient reduction estimates from STEPL: Spreadsheet Tool for the Estimation of Pollutant Load v. 4.0. Kringen 2010

4.4 RIPARIAN AREAS

Grazing management systems will be implemented on 5,000 acres of riparian areas to reduce nutrient and sediment transport to waterbodies. This grazing management plan can be as simple as fencing off the riparian zones to isolate grazing periods during less erosive periods. The Continuous CRP will be used to provide landowners an incentive to establish buffer strips along streams to improve the water quality. This program will assist landowners with exclusion of livestock from the riparian areas through planning and installation of grazing systems that utilize 10-15 year land use agreements. Table 4-4 presents the load reductions for nitrogen, phosphorous, and sediment for 5,000 acres of riparian management for the Lower James River watershed by Bartel 2008.

Table 4-4. Riparian Area Management Program and Conservation Reserve Program Load Reductions

Year	Acres Planned	N Reduction Lbs/Acres	Total N Reduction	P Reduction Lbs/Acre	Total P Reduction Lbs/Year	Sediment Reduction Tons/Acre	Total Sediment Tons/Year
1	500	3.65	1,825.0	2.52	1,260.0	0.087	43.5
2	500	3.65	1,825.0	2.52	1,260.0	0.087	43.5
3	500	3.65	1,825.0	2.52	1,260.0	0.087	43.5
4	500	3.65	1,825.0	2.52	1,260.0	0.087	43.5
5	500	3.65	1,825.0	2.52	1,260.0	0.087	43.5
6-10	2,500	3.65	9,125.0	2.52	6,300.0	0.087	217.5
	5,000		18,250.0		12,600.0		435.0

Nutrient reduction estimates from STEPL: Spreadsheet Tool for the Estimation of Pollutant Load v. 4.0. Kringen 2010

4.5 STREAMBANK STABILIZATION

Stream bank stabilization projects were installed as part of the Firesteel Creek project and reported in the Segment 2 report. Extrapolating the planned bank stabilization footage and the watershed size of Firesteel Creek to the needs of the Lower James River Basin; the potential for 22,000 linear feet of stream bank stabilization exists. Table 4-5 presents load reductions for nitrogen, phosphorus, and sediment as calculated using STEPL for projects installed as reported by Kringen in 2010. Kringen noted that the STEPL estimates were on-site reductions and not necessarily delivered reductions, because it is difficult to estimate a percent delivered from BMPs installed.

Table 4-5. Stream Bank Stabilization Load Reductions

Year	Linear Feet Planned	N Reduction Lbs/Acre	Total N Reduction Lbs/Year	P Reduction Lbs/Acre	Total P Reduction Lbs/Year	Sediment Reduction Tons/Acre	Total Sediment Tons/Year
1	1,000	0.00884	8.84	0.00326	3.26	0.00651	6.51
2	2,000	0.00884	17.68	0.00326	6.52	0.00651	13.02
3	2,000	0.00884	17.68	0.00326	6.52	0.00651	13.02
4	3,000	0.00884	26.52	0.00326	9.78	0.00651	19.53
5	3,000	0.00884	26.52	0.00326	9.78	0.00651	19.53
6-10	11,000	0.00884	97.20	0.00326	35.86	0.00651	71.61
	22,000		194.44		71.7		143.2

Nutrient reduction estimates from STEPL: Spreadsheet Tool for the Estimation of Pollutant Load v. 4.0. Kringen 2010

4.6 CROPLAND CONSERVATION TILLAGE & NO-TILL

The use of AGNPS cells identified that certain cells had cropland soil erosion in excess of 4.0 tons/acre/year. Extrapolating the 7.6 percent of the critical cells in the Lake Mitchell/Firesteel Creek Diagnostic Study (1997) to the entire Lower James River watershed, approximately 99,932 cropland acres would need treatment. The critical cells identified averaged 8.6 tons/acre/year of soil erosion. Applying Evans estimate of soil reductions by conservation tillage practices, soil loss could be reduced by 64 percent to 3.1 ton/acre/year; saving 5.5 tons/acre/year. This is a sediment load reductions of 2.2 tons/acre/year using an estimated 40 percent delivery rate to a water course.

The Firesteel Creek 319 Application (2006) reported P load reduction for cropland was 0.5 pounds of phosphorus reduction per ton of soil saved; saving 2.75 pounds of P per acre. Nitrogen load reductions along the Big Sioux River were calculated at 9.81 pounds/acre/year (Berg, 2010) on cropland management practices.

Table 4-6. Estimated N, P, and Sediment Load Reductions for Cropland Conservation Tillage on the Critical Cell Cropland Acres

Year	% Goal	Acres	N #/Ac/Yr	Total #N/YR-LR	P #/Ac/YR	Total #P/YR-LR	Sed T/Ac/YR	Total T/YR-LR
1	10	10,000	9.81	98,100.0	2.75	27,500.0	2.2	22,000.0
2	10	10,000	9.81	98,100.0	2.75	27,500.0	2.2	22,000.0
3	10	10,000	9.81	98,100.0	2.75	27,500.0	2.2	22,000.0
4	10	10,000	9.81	98,100.0	2.75	27,500.0	2.2	22,000.0
5	10	10,000	9.81	98,100.0	2.75	27,500.0	2.2	22,000.0
6-10	50	50,000	9.81	490,500.0	2.75	137,500.0	2.2	110,000.0
	100	100,000		981,000.0		275,000.0		220,000.0

4.7 GRASSED WATERWAYS

Grassed waterways are estimated on the acres of cropland (99,932) identified in the critical cropland cells. An estimate of one waterway, 1,000 feet in length, per section would require 156,143 linear feet of waterway construction for the Lower James River Basin. This would require 15,600 linear feet to be constructed each year over a 10 year period as presented in Table 4-7.

Table 4-7. Grassed Waterway Load Reductions for N, P, and Sediment

Year	Linear Feet Planned	N Reduction Lbs/LF	Total N Reduction	P Reduction Lbs/LF	Total P Reduction Lbs/LF	Sediment Reduction Tons/LF	Total Sediment Ton
1	8,000	0.15900	1,272.0	0.04176	334.08	0.02148	171.84
2	17,500	0.15900	2,782.5	0.04176	730.80	0.02148	375.90
3	17,500	0.15900	2,782.5	0.04176	730.80	0.02148	375.90
4	17,500	0.15900	2,782.5	0.04176	730.80	0.02148	375.90
5	17,500	0.15900	2,782.5	0.04176	730.80	0.02148	375.90
6-10	78,000	0.15900	12,402.0	0.04176	3,257.28	0.02148	1675.40
	156,000		24,804.0		6,514.6		3350.84

Nutrient reduction estimates from STEPL: Spreadsheet Tool for the Estimation of Pollutant Load v. 4.0. Kringen 2010

4.8 WETLAND RESTORATION AND POND CONSTRUCTION

Bartel (2008) projected the needed restoration of 5,500 acres of wetlands in the Lower James River Basin. Results from multi-purposed ponds constructed in the Little Minnesota River project (2007) calculated total sediment reduction expected from the constructed ponds and restored wetlands over a projected 20 year lifespan. The phosphorous and sediment load reductions were based on restored watershed acres around the constructed ponds. Table 4-8 projects these phosphorous and sediment load reductions based on the restoration of 27,500 watershed acres over a ten year period in the Lower James River Basin. Ponds and wetlands to be restored were estimated to have five acres of watershed each.

Table 4-8. Wetland Restoration and Pond Construction Load Reductions

Year	Acres Ponds Planned	Watershed Ares Restored	P Reduction Lbs/Acre WS Lifespan	Total Lbs P Reduction Lifespan	Sediment Reduction Tons/Acre WS	Total Sediment Reduction
1	350	1,750	29.76	52,080.0	15.67	27,422.5
2	600	3,000	29.76	89,280.0	15.67	47,010.0
3	600	3,000	29.76	89,280.0	15.67	47,010.0
4	600	3,000	29.76	89,280.0	15.67	47,010.0
5	600	3,000	29.76	89,280.0	15.67	47,010.0
6-10	2,750	13,750	29.76	409,200.0	15.67	215,462.5
	5,500	27,500		818,400.0		430,925.0

4.9 CONVERSION OF CROPLAND TO FORAGE AND BIOMASS PLANTINGS

The conversion of the highest eroding cropland to vegetative species suited to pasture, hayland, or biomass production was estimated at 1,000 acres for the Lower James River Basin by Bartel (2008). This would require 100 acres of cropland to be converted to grassland each year over a 10 year period. The calculated load reductions of nitrogen, phosphorous, and sediment for practices implemented in the Firesteel Creek project by Kringen using STEPL are presented in Table 4-9.

Table 4-9. Estimated N, P, and Sediment Load Reductions for Cropland Conversion to Perennial Vegetation

Year	Acres	N #/Ac/Yr	Total #N/YR-LR	P #/Ac/YR	Total #P/YR-LR	Sed T/Ac/YR	Total T/YR-LR
1	50	4.01	200.5	1.23	61.5	0.7170	35.9
2	100	4.01	401.0	1.23	123.0	0.7170	71.7
3	125	4.01	501.3	1.23	153.8	0.7170	89.6
4	125	4.01	501.3	1.23	153.8	0.7170	89.6
5	100	4.01	401.0	1.23	123.0	0.7170	71.7
6-10	500	4.01	2,005.0	1.23	615.0	0.7170	358.5
	1,000		4,010.0		1,230.0		717.0

Nutrient reduction estimates from STEPL: Spreadsheet Tool for the Estimation of Pollutant Load v. 4.0. Kringen 2010

5.0 TECHNICAL AND FINANCIAL ASSISTANCE NEEDED

The James River Water Development District (JRWDD) will be administratively responsible for the project implementation and will be the lead sponsor. A project coordinator will coordinate all water quality project activities among the watershed counties which will include will include all the local, state and federal conservation personnel. The counties supporting the project will appoint members to serve on a steering committee. The CD Managers and NRCS District Conservationists will assist the project coordinator with cost-share reimbursement, file maintenance, and other financial transactions. Technical expertise from these office staff persons will be necessary to implement the BMPs in each local county. Both financial programs and technical expertise will be provided through existing partnerships with SD Association of CDs; SD Game, Fish and Parks (SD GF&P); SDDENR; SD Department of Agriculture (SD DOA); SD Extensions Service; U.S. Fish and Wildlife Service; USDA Farm Service Agency; and USDA NRCS. Additional funding for the implementation of the BMPs will be solicited from these partners through their programs such as: the NRCS Environmental Quality Incentive Program and Wetland Reserve Program; FSA Conservation Reserve Program and Conservation Reserve Enhancement Program; SD GF&P Wildlife Partnership Program and Wetland and Grassland Habitat Program; US-FWS Grassland and Wetland Easement Programs and Private Land Programs.

Funding and technical assistance needs for BMP implementation are based on extrapolations of several detailed completed subwatershed analyses. The Lower James River Basin land use is fairly homogenous and the impairment problems have been consistently identified as agricultural in nature for both cropland and animal uses. The extrapolations have been conservative and the expected outcome to be consistent. The assistance needed is intended to fund the first segment of the watershed need through a Five Year Strategic Plan. Several of the tasks have been identified as requiring additional years to fully implement. Most are prorated on a ten year schedule with the AWMS and NMPs prorated on a 23 year schedule. The estimated costs are based on the 2012 NRCS cost share docket and actual costs from similar local projects. Tables 5-1 through 5-5 summarize the costs of the BMP and associated practice components per each year. Administrative costs, including personnel, office equipment and supplies, and vehicles are summarized by year and presented in Table 5-6.

Table 5-1. Technical and Financial Resources Needed					Year 1			
Year	**BMP - Animal Waste management System**				**BMP - Prescribed Grazing**			
1	**Components**	**Costs**	**Quantity**	**Total Costs**	**Components**	**Costs**	**Quantity**	**Total Costs**
	Engineer Design	$ 20,000	3	$ 60,000	**Grazing System, EA**	$ -	10	$ -
	AWSF	$ 200,000	0	$ -	**Rural Water, EA**	$ 2,000	10	$ 20,000
	Const Mgmt	$ 18,750	0	$ -	**Pipeline, LF**	$ 5	20,000	$ 100,000
	NMP	$ 2,500	0	$ -	**Tanks, EA**	$ 1,000	10	$ 10,000
	Cultural Study	$ 500	3	$ 1,500	**Fencing, LF**	$ 1	25,000	$ 25,000
				$ 61,500				$ 155,000
Year	**BMP - Riparian Areas**				**BMP - Bank Stabilization**			
1	**Components**	**Costs**	**Quantity**	**Total Costs**	**Components**	**Costs**	**Quantity**	**Total Costs**
	Grazing AC	$ -	500	$ -	**Rock, Fabric/LF**	$ 110	1,000	$ 110,000
	Fencing LF	$ 1	10,560	$ 10,560				$ -
				$ 10,560				$ 110,000
Year	**BMP - Cropland Conservation Tillage & No-Till**				**BMP - Grassed Waterways**			
1	**Components**	**Costs**	**Quantity**	**Total Costs**	**Components**	**Costs**	**Quantity**	**Total Costs**
	Cost Incentive/AC	$ 10	10,000	$ 100,000	**Dirt Work, Seed/ LF**	$ 1.70	8,000	$ 13,600
				$ 100,000				$ 13,600
Year	**BMP - Wetland Restoration and Pond Construction**				**BMP - Cropland Conversion to Forage Plantings**			
1	**Components**	**Costs**	**Quantity**	**Total Costs**	**Components**	**Costs**	**Quantity**	**Total Costs**
	Dirt Work/Seed EA	$ 1,000	70	$ 70,000	**Tillage/Seeding AC**	$ 100	50	$ 5,000
				$ 70,000				$ 5,000
		TOTAL BMP COSTS				**$525,660**		

Table 5-2. Technical and Financial Resources Needed					Year 2			
Year	BMP - Animal Waste management System				BMP	- Prescribed Grazing		
2	Components	Costs	Quantity	Total Costs	Components	Costs	Quantity	Total Costs
	Engineer Design	$ 20,000	6	$ 120,000	Grazing System, EA	$ -	10	$ -
	AWSF	$ 200,000	6	$ 1,200,000	Rural Water, EA	$ 2,000	10	$ 20,000
	Const Mgmt	$ 18,750	6	$ 112,500	Pipeline, LF	$ 5	20,000	$ 100,000
	NMP	$ 2,500	6	$ 15,000	Tanks, EA	$ 1,000	10	$ 10,000
	Cultural Study	$ 500	6	$ 3,000	Fencing, LF	$ 1	25,000	$ 25,000
				$ 1,450,500				$ 155,000
Year	BMP - Riparian Areas				BMP	- Bank Stabilization		
2	Components	Costs	Quantity	Total Costs	Components	Costs	Quantity	Total Costs
	Grazing AC	$ -	500	$ -	Rock, Fabric/LF	$ 110	2,000	$ 220,000
	Fencing LF	$ 1	10,560	$ 10,560				$ -
				$ 10,560				$ 220,000
Year	BMP - Cropland Conservation Tillage & No-Till				BMP -	Grassed Waterways		
2	Components	Costs	Quantity	Total Costs	Components	Costs	Quantity	Total Costs
	Cost Incentive/AC	$ 10	10,000	$ 100,000	Dirt Work, Seed/ LF	$ 1.70	17,500	$ 29,750
				$ 100,000				$ 29,750
Year	BMP - Wetland Restoration and Pond Construction				BMP - Cropland	Conversion to Forage Plantings		
2	Components	Costs	Quantity	Total Costs	Components	Costs	Quantity	Total Costs
	Dirt Work/Seed EA	$ 1,000	120	$ 120,000	Tillage/Seeding AC	$ 100	100	$ 10,000
				$ 120,000				$ 10,000
		TOTAL BMP COSTS			$ 2,095,810			

Table 5-3. Technical and Financial Resources Needed					Year 3			
Year	BMP - Animal Waste management System				BMP	- Prescribed Grazing		
3	Components	Costs	Quantity	Total Costs	Components	Costs	Quantity	Total Costs
	Engineer Design	$ 20,000	9	$ 180,000	Grazing System, EA	$ -	10	$ -
	AWSF	$ 200,000	8	$ 1,600,000	Rural Water, EA	$ 2,000	10	$ 20,000
	Const Mgmt	$ 18,750	8	$ 150,000	Pipeline, LF	$ 5	20,000	$ 100,000
	NMP	$ 2,500	8	$ 20,000	Tanks, EA	$ 1,000	10	$ 10,000
	Cultural Study	$ 500	9	$ 4,500	Fencing, LF	$ 1	25,000	$ 25,000
				$ 1,954,500				$ 155,000
Year	BMP - Riparian Areas				BMP	- Bank Stabilization		
3	Components	Costs	Quantity	Total Costs	Components	Costs	Quantity	Total Costs
	Grazing AC	$ -	500	$ -	Rock, Fabric/LF	$ 110	2,000	$ 220,000
	Fencing LF	$ 1	10,560	$ 10,560				$ -
				$ 10,560				$ 220,000
Year	BMP - Cropland Conservation Tillage & No-Till				BMP -	Grassed Waterways		
3	Components	Costs	Quantity	Total Costs	Components	Costs	Quantity	Total Costs
	Cost Incentive/AC	$ 10	10,000	$ 100,000	Dirt Work, Seed/ LF	$ 1.70	17,500	$ 29,750
				$ 100,000				$ 29,750
Year	BMP - Wetland Restoration and Pond Construction				BMP - Cropland	Conversion to Forage Plantings		
3	Components	Costs	Quantity	Total Costs	Components	Costs	Quantity	Total Costs
	Dirt Work/Seed EA	$ 1,000	125	$ 125,000	Tillage/Seeding AC	$ 100	125	$ 12,500
				$ 125,000				$ 12,500
		TOTAL BMP COSTS			$ 2,607,310			

Table 5-4. Technical and Financial Resources Needed					Year 4			
Year	BMP - Animal Waste management System				BMP	- Prescribed Grazing		
4	Components	Costs	Quantity	Total Costs	Components	Costs	Quantity	Total Costs
	Engineer Design	$ 20,000	9	$ 180,000	Grazing System, EA	$ -	10	$ -
	AWSF	$ 200,000	8	$ 1,600,000	Rural Water, EA	$ 2,000	10	$ 20,000
	Const Mgmt	$ 18,750	8	$ 150,000	Pipeline, LF	$ 5	20,000	$ 100,000
	NMP	$ 2,500	8	$ 20,000	Tanks, EA	$ 1,000	10	$ 10,000
	Cultural Study	$ 500	9	$ 4,500	Fencing, LF	$ 1	25,000	$ 25,000
				$ 1,954,500				$ 155,000
Year	BMP - Riparian Areas				BMP	- Bank Stabilization		
4	Components	Costs	Quantity	Total Costs	Components	Costs	Quantity	Total Costs
	Grazing AC	$ -	500	$ -	Rock, Fabric/LF	$ 110	3,000	$ 330,000
	Fencing LF	$ 1	10,560	$ 10,560				$ -
				$ 10,560				$ 330,000
Year	BMP - Cropland Conservation Tillage & No-Till				BMP -	Grassed Waterways		
4	Components	Costs	Quantity	Total Costs	Components	Costs	Quantity	Total Costs
	Cost Incentive/AC	$ 10	10,000	$ 100,000	Dirt Work, Seed/ LF	$ 1.70	17,500	$ 29,750
				$ 100,000				$ 29,750
Year	BMP - Wetland Restoration and Pond Construction				BMP - Cropland	Conversion to Forage Plantings		
4	Components	Costs	Quantity	Total Costs	Components	Costs	Quantity	Total Costs
	Dirt Work/Seed EA	$ 1,000	120	$ 120,000	Tillage/Seeding AC	$ 100	125	$ 12,500
				$ 120,000				$ 12,500
		TOTAL BMP COSTS			$ 2,712,310			

Table 5-5. Technical and Financial Resources Needed					Year 5			
Year	BMP - Animal Waste management System				BMP	- Prescribed Grazing		
5	Components	Costs	Quantity	Total Costs	Components	Costs	Quantity	Total Costs
	Engineer Design	$ 20,000	3	$ 60,000	Grazing System, EA	$ -	10	$ -
	AWSF	$ 200,000	8	$ 1,600,000	Rural Water, EA	$ 2,000	10	$ 20,000
	Const Mgmt	$ 18,750	8	$ 150,000	Pipeline, LF	$ 5	20,000	$ 100,000
	NMP	$ 2,500	8	$ 20,000	Tanks, EA	$ 1,000	10	$ 10,000
	Cultural Study	$ 500	3	$ 1,500	Fencing, LF	$ 1	25,000	$ 25,000
				$ 1,831,500				$ 155,000
Year	BMP - Riparian Areas				BMP	- Bank Stabilization		
5	Components	Costs	Quantity	Total Costs	Components	Costs	Quantity	Total Costs
	Grazing AC	$ -	500	$ -	Rock, Fabric/LF	$ 110	3,000	$ 330,000
	Fencing LF	$ 1	10,560	$ 10,560				$ -
				$ 10,560				$ 330,000
Year	BMP - Cropland Conservation Tillage & No-Till				BMP -	Grassed Waterways		
5	Components	Costs	Quantity	Total Costs	Components	Costs	Quantity	Total Costs
	Cost Incentive/AC	$ 10	10,000	$ 100,000	Dirt Work, Seed/ LF	$ 1.70	17,500	$ 29,750
				$ 100,000				$ 29,750
Year	BMP - Wetland Restoration and Pond Construction				BMP - Cropland	Conversion to Forage Plantings		
5	Components	Costs	Quantity	Total Costs	Components	Costs	Quantity	Total Costs
	Dirt Work/Seed EA	$ 1,000	120	$ 120,000	Tillage/Seeding AC	$ 100	100	$ 10,000
				$ 120,000				$ 10,000
		TOTAL BMP COSTS			$ 2,586,810			

TABLE 5-6. SUMMARY OF 5 YEAR COSTS LOWER JAMES RIVER						
BMP IMPLEMENTATION COSTS	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	TOTALS
Animal Waste Management System	$61,500	1,450,500	$1,954,500	$1,954,500	$1,831,500	$7,252,500
Prescribed Grazing	$155,000	155,000	$155,000	$155,000	$155,000	$775,000
Riparian Area	$10,560	$10,560	$10,560	$10,560	$10,560	$52,800
Bank Stabilization	$110,000	$220,000	$220,000	$330,000	$330,000	$1,210,000
Cropland Conservation Mulch Tillage	$100,000	$100,000	$100,000	$100,000	$100,000	$500,000
Grassed Waterways	$13,600	$29,750	$29,750	$29,750	$29,750	$132,600
Wetland/Pond Restoration	$70,000	$120,000	$125,000	$120,000	$120,000	$555,000
Cropland Conversion to Grass	$5,000	$10,000	$12,500	$12,500	$10,000	$50,000
BMP TOTAL COST IMPLEMENTATION	$525,660	$2,095,810	$2,607,310	$2,712,310	$2,586,810	$10,527,900
PERSONNEL SUPPORT						
Project Coordinator	$60,000	$61,200	$62,424	$63,672	$64,946	$312,242
SDACD Contract Management	$7,600	$7,600	$7,600	$7,600	$7,600	$38,000
OPERATIONS						
Vehicle, Fuel, Travel, Insurance	$10,000	$10,200	$10,404	$10,612	$10,824	$52,040
ADMINISTRATION						
Computer, Telephone, Offce, Postage	$6,000	$6,120	$6,242	$6,367	$6,495	$31,224
PERSONNEL AND SUPPORT TOTAL COSTS	$83,600	$85,120	$86,670	$88,252	$89,865	$433,507
TOTAL DOLLARS PER YEAR	$609,260	$2,180,930	$2,693,980	$2,800,562	$2,676,675	$10,961,407

6.0 PUBLIC OUTREACH

Efforts for public outreach have been ongoing since the year 2007 through early subwatershed projects like the Firesteel Creek/Lake Mitchell project sponsored by the Davison County CD. This outreach momentum continued when the project was combined with the Lower James River Implementation Project sponsored by the JRWDD. The USDA NRCS offices are usually co-located with the CD and staff from these offices will be utilized to disseminate the information to producers. Updates and achievements will be emailed to these field offices on a quarterly basis by the project coordinator. Annual meetings with be held by the Lower James River Watershed Project Coordinator and the District Managers of each CD to provide them with information on the BMPs available to each county.

A project steering committee will meet twice each year to provide input for project management and coordination of resources. The committee will consist of representatives from Aurora, Bon Homme, Davidson, Douglas, Hanson, Hutchinson, Jerauld, Kingsbury, McCook, Miner, Sanborn, and Yankton CDs; County Commissions; SD GF&P; SD DENR; SD DOA; SDACD, SDSU Extension Service; USDA NRCS and FSA County Field Offices; US FWS; and the projects sponsor, the JRWDD. Watershed assessment needs are determined by Local Work Groups (LWG). These LWGs are sponsored by each of the twelve counties Soil and Water CDs encompassed by the implementation project. The LWGs meet annually gathering input on critical resource concerns and solutions within each county. The LWGs then come together on a watershed basis to share their priorities and recommendations.

Public outreach will come through:

- Newsletters from the CDs
- Articles in the local newspapers of Mitchell, Salem, and Yankton
- Public service radio announcements from Mitchell and Yankton
- Contact with the Lake Mitchell Association
- CRP/RAM postcard sent to landowners along tributaries
- WEB page articles by several CDs
- Personal contact of landowners by Project staff
- Develop a display for the local county fairs

7.0 IMPLEMENTATION SCHEDULE

The implementation of this project will be through voluntary programs over a 12 county-wide watershed area and will be coordinated by the project coordinator. The implementation of the practices is targeted at the agricultural sector. The unique delivery systems of the SD CDs will be utilized to implement the voluntary tasks scheduled. The County's CD has an office located in each county that does business with the landowners and agricultural producers in the county. The BMPs will be implemented with funding as available from local funding sources, SD Consolidated Funds, the USDA programs, and EPA 319. The implementation schedule for BMPs, project outreach, and project reports is detailed semi-annually in Table 7-1.

TABLE 7-1: BMP AND OUTREACH IMPLEMENTATION SCHEDULE

Task	Group	Quantity	Year 1		Year 2		Year 3		Year 4		Year 5	
			Jan - June	June - Dec	Jan - June	June - Dec	Jan - June	June - Dec	Jan - June	June - Dec	Jan - June	June - Dec
OBJECTIVE 1: BMP IMPLEMENTATION												
Task 1: Animal Waste Manage Systems												
Product 1: Animal Waste Manage Systems	1,2,3											
Engineering Studies		30		3	3	3	3	6	6	3	3	
Animal Waste Storage Facilities		30			3	3		8		8		8
Construction Management		30			3	3		8		8		8
Nutrient Management Plan		30				6		8		8		8
Cultural Resource Study		30		3	3	3	3	6	6	3	3	
Task 2: Grassland Management	1,2,4											
Product 2: Prescribed Grazing Systems		25,000 AC		5,000		5,000		5,000		5,000		5,000
Product 3: Riparian Areas		2,500 AC		500		500		500		500		500
Task 3: Streambank Stabilization	2,4											
Product 4: Streambank Stablization		11,000 LF		1,000		2,000		2,000		3,000		3,000
Task 4: Cropland Management	1,2,4											
Product 5: Residue Management		50,000 AC		10,000		10,000		10,000		10,000		10,000
Product 6: Grassed Waterways		78,000 LF		8,000		17,500		17,500		17,500		17,500
Product 7: Wetland & Pond Construction		2,750 WSAc		350		600		600		600		600
Product 8: Conversion of Crop to Grass		500 AC		50		100		125		125		100

Groups
1. Project Coordinator/LRRWDDD
2. NRCS/USFWS/LJRWDD
3. SDGF&P/SDSU/SDRCF/DENR/SDDOA
4. CDs/Producers

TABLE 7-1 (Continued): BMP AND OUTREACH IMPLEMENTATION SCHEDULE

Task	Group	Quantity	Year 1		Year 2		Year 3		Year 4		Year 5	
			Jan - June	June - Dec	Jan - June	June - Dec	Jan - June	June - Dec	Jan - June	June - Dec	Jan - June	June - Dec
OBJECTIVE 2: INFORMATION OUTREACH												
Task 5: Information Distribution												
Product 9: Articles, Newsletter, Radio, WEB	1,2,3,4											
CD Newsletters		15		3		3		3		3		3
Newspaper Articles		15	2	1	2	1	2	1	2	1	2	1
Radio Spots		10	1	1	1	1	1	1	1	1	1	1
Fair Demonstrations		10		2		2		2		2		2
WEB Site Listing		10	2		2		2		2		2	
OBJECTIVE 3: PROJECT REPORTS												
Task 6: Semi-annual, Annual, Final												
Product 10: Reports	1,2											
Semi-Annual		5	1		1		1		1		1	
Annual		5		1		1		1				1
Final		1										1

Groups

1. Project Coordinator/LRRWDDD
2. NRCS/USFWS/LJRWDD
3. SDGF&P/SDSU/SDRCF/DENR/SDDOA
4. CDs/Producers

8.0 SHORT-TERM CRITERIA AND MILESTONES FOR BMP IMPLEMENTATION PROGRESS

The milestones to determine progress will be by the implementation of the BMPs as the selected BMPs have been documented as reducing bacteria, nutrients, and TSS by previous studies. Although this method of measuring progress is not the same as testing water quality; it is assumed that the successful implementation of the practices will have a positive impact on water quality of the Lower James River Watershed. The short-term progress of the project will be measured annually in the last quarter of each project year.

The project coordinator will be responsible for tabulating the number of BMPs installed, the number of acres treated, and the public outreach campaign efforts made in each county as identified in Table 8-1. This information will be published in an annual report sent to all cooperation agencies and made available to residents of the watershed. The project steering team will examine the achievements to determine if adequate progress has been made by the current BMP implementations. If they determine that adequate progress has not been made, they can readjust the implementation projects in order to achieve the five year BMP goals.

9.0 MONITORING AND EVALUATION PLAN

Monitoring and evaluation efforts will include analyzing water quality changes from BMP installation compared to water quality changes since the 2003 watershed assessment on selected sites. The completion of the TMDL studies cited in Section 1.2 of this document has also provided a solid baseline of water quality data to use as BMPs are installed. The AGNPS modeling has identified specific cells where the BMPs should be implemented and the models can again be used to quantify the changes in load reductions. The SD DENR also maintains water quality monitoring stations at five sites within counties of the Lower James River basin. Sites in Davison and Hanson counties are sampled quarterly and sites in Hutchinson (2) and Yankton counties are sampled monthly. Data sampling from these stations can also be used by the project director to make comparisons of installed practices. This data can be collected from DENR on an annual basis as BMPs are installed and results anticipated.

The effectiveness of BMPs installed relative to the improvement in water quality will be evaluated using the appropriate tools and models available such as AnnAGNPS, RUSLE2, and STEPL models. The AnnAGNPS model will be used for changes in loadings due to BMP installation, while STEPL will be used to estimate annual load reductions in the watershed. Water sampling, testing, and test result evaluations for water quality changes will be completed with technical assistance from DENR. They will also assist to develop a sampling and analysis plan, train project staff, and help in data storage and evaluation. Sampling will be completed according to the “Standard Operating Procedures for Field Samplers, Volumes I & II, Tributary and In-Lake Sampling Techniques”, SD DENR, 2005.

Table 8-1. Shortterm Criteria & Milestones BMP or Activity	Quantity	Year 1	Year 2	Year 2 Subtotal	Year 3	Year 3 Subtotal	Year 4	Year 4 Subtotal	Year 5	Final Totals
Engineering Studies - AWMS	30	3	6	9	9	18	9	27	3	30
Animal Waste Storage Facilities	30		6	6	8	14	8	22	8	30
Construction Management - AWMS	30		6	6	8	14	8	22	8	30
Nutrient Management Plan	30		6	6	8	14	8	22	8	30
Cultural Resource Study - AWMS	30	3	6	9	9	18	9	27	3	30
Prescribed Grazing Systems	25,000	5,000	5,000	10,000	5,000	15,000	5,000	20,000	5,000	25,000
Riparian Areas	2,500 AC	500	500	1,000	500	1,500	500	2,000	500	2,500
Streambank Stabilization	11,000 LF		2,500	2,500	2,500	5,000	3,000	8,000	3,000	11,000
Residue Management	50,000 AC	10,000	10,000	20,000	10,000	30,000	10,000	40,000	10,000	50,000
Grassed Waterways	78,000 LF	8,000	17,500	25,500	17,500	43,000	17,500	60,500	17,500	78,000
Wetland & Pond Construction	2,750 WSAc	350	600	950	600	1,550	600	2,150	600	2,750
Conversion of Crop to Grass	500 AC	50	100	150	125	275	125	400	100	500
CD Newsletters	15	3	3	6	3	9	3	12	3	15
Newspaper Articles	15	3	3	6	3	9	3	12	3	15
Radio Spots	10	2	2	4	2	6	2	8	2	10
Fair Demonstrations	10	2	2	4	2	6	2	8	2	10
WEB Site Listing	10	2	2	4	2	6	2	8	2	10
Semi-Annual Reports	5	1	1	2	1	3	1	4	1	5
Annual Reports	5	1	1	2	1	3	1	4	1	5
Final	1	0	0	0	0	0	0	0	1	1

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