BELLE FOURCHE RIVER WATERSHED MANAGEMENT AND PROJECT IMPLEMENTATION PLAN SEGMENT 5 WATERSHED PROJECT FINAL REPORT SECTION 319 NONPOINT SOURCE POLLUTION CONTROL PROGRAM

Topical Report RSI-2394

prepared for

Belle Fourche River Watershed Partnership
1837 5th Avenue South
Belle Fourche, South Dakota 57717

December 2013

RESPEC
CONSULTING & SERVICES

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by

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EXECUTIVE SUMMARY

Project Title:	Belle Fourche River Watershed Management and Project Implementation Plan Segment 5
Grant Number(s):	998185-09, 998185-10
Project Start Date:	July 1, 2011
Project Completion Date:	July 31, 2013
Funding:	
Total EPA 319 Grant Budget:	$564,000
Total Matching Funds Budget:	$931,926
Total Nonmatching Funds Budget:	$2,186,800
Total Budget:	**$3,682,726**
Budget Revisions:	
June, 2011 319 Award	$332,000
June, 2012 319 Award	$232,000
Total Expenditures of EPA Funds:	$564,000
Total 319 Matching Funds Accrued:	$1,262,172.89
Total Nonmatching Funds Accrued:	$1,798,927.47
Total Expenditures:	**$3,625,100.36**

The Belle Fourche River Watershed Management and Project Implementation Plan Segment 5 was sponsored by the Belle Fourche River Watershed Partnership (BFRWP) with support from agricultural organizations, federal and state agencies, and local governments. This project continued implementation of the best management practices (BMPs) identified in the Total Maximum Daily Load (TMDL) report for the Belle Fourche River. This project segment had the following objectives:

- Continue the implementation of BMPs in the watershed to reduce total suspended solids (TSS) to 28 milligrams per liter (mg/L) below the Belle Fourche Reservoir; 31 mg/L above the Belle Fourche Reservoir.

Conduct public education and outreach to stakeholders within the Belle Fourche River Watershed.

- Track progress made toward reaching the goals of the TMDL to help ensure that the BMPs are being implemented in an effective manner.

Several of the completed activities resulted in a reduction of sediment-laden irrigation waste water discharged from the Belle Fourche Irrigation District (BFID) delivery system into surrounding water by 4,300 acre-feet per year. This brings the total acre-feet reduction to 12,766, or 74 percent, of the 10-year goal. The BFID lined 4,100 feet of the South Canal and replaced open ditches with pipe on 6,985 feet of the laterals that deliver water from the BFID to the producers.

Several activities were completed to improve irrigation efficiencies after water was delivered to irrigated fields within the Belle Fourche River Watershed. A total of 19 center-pivot sprinkler systems were installed to replace existing surface irrigated fields. Ten farmers participated in an irrigation scheduling project to better time irrigation application on an estimated 985 acres.

Grazing/riparian areas were improved significantly within the watershed. Two livestock water development projects, one riparian deferment, and one streambank rehabilitation project were assisted with the 319 dollars affecting approximately 280 riparian acres. In addition to 319 projects, Natural Resources Conservation Service (NRCS) Environmental Quality Incentives Program- (EQIP-) funded projects in the watershed positively affected 48,000 acres that included improvement on 4,000 riparian acres. Eight new conservation plans were written for over 45,000 acres of grazing lands, and follow-up on existing conservation plans was conducted with four producers on over 33,000 acres.

Approximately 36 public education and outreach events were completed during this project segment in the form of public meetings, informational booths, website maintenance, radio sound bites, rainfall simulator demonstrations, and watershed tours. It is estimated that outreach and education efforts reached at least 14,500 people. A soil-quality demonstration trailer was purchased by the BFRWP in 2009 to demonstrate the effects of erosion on soils and how they relate to TSS. The trailer was used at several events sponsored by the BFRWP. Butte County, Lawrence County, and the Elk Creek Conservation District each sent out newsletters that included project updates. The BFRWP hosted nine meetings to provide updates on project work and progress being made. The BFRWP website continues to be updated with happenings and project status and is located at *www.bellefourchewatershed.org*. Outreach activities have helped to increase participation and support for the BFRWP and also gave the BFRWP several contacts for BMP installation. Several informative sound bites were broadcasted on local radio to increase public awareness of water-quality issues and to promote involvement with the project.

Preliminary estimates based on BMP installation indicate that TSS was reduced by 31 mg/L (or 7,467 tons) per year in this segment. This brings the cumulative TSS load reduction to 168,678 tons per year toward the goal of 289,910 tons per acre identified in the TMDL. Currently, the project is in the seventh year of implementation.

ACKNOWLEDGEMENTS

The BFRWP would like to thank all those involved with this segment of the implementation of practices recommended from the Belle Fourche River Watershed TMDL. The efforts of all those involved from the following organizations are greatly appreciated and have been essential to the success of this project:

- BFID
- Bureau of Land Management (BLM)
- Butte County Conservation District
- Crook County Conservation District
- Elk Creek Conservation District
- Individual ranchers, farmers, and landowners within the watershed
- Lawrence County
- Lawrence County Conservation District
- Natural Resources Conservation Service (NRCS)
- South Dakota Association of Conservation Districts (SDACD)
- South Dakota Conservation Commission
- South Dakota Department of Agriculture (SDDA)
- South Dakota Department of Environment and Natural Resources (SD DENR)
- South Dakota Game Fish and Parks (SDGFP)
- South Dakota Grassland Coalition
- South Dakota School of Mines and Technology (SDSM&T)
- South Dakota State University (SDSU)
- U.S. Army Corp of Engineers (USACE)
- U.S. Bureau of Reclamation
- U.S. Environmental Protection Agency (EPA)
- U.S. Fish and Wildlife Service (USFWS)
- U.S. Geological Survey (USGS)
- Wyoming Department of Environmental Quality (WDEQ).

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1.0 INTRODUCTION

The Belle Fourche River is a natural stream that drains parts of Butte, Lawrence, and Meade counties in South Dakota. The headwaters are located in Wyoming. The river flows into the Cheyenne River in southern Meade County and ultimately into the Missouri River. The watershed is shown in Figure 1-1. The Belle Fourche River Watershed encompasses approximately 2,100,000 acres (3,300 square miles) in South Dakota and includes Hydraulic Units 10120201, 10120202, and 10120203. The city of Spearfish, with a population of 10,718, is the largest municipality located in the South Dakota portion of the watershed. Other South Dakota communities in the watershed include Deadwood (population: 1,380), Lead (3,124), Sturgis (6,644), Belle Fourche (5,658), Fruitdale (64), Nisland (232), and Newell (603).

Land in the watershed is used primarily for grazing with some cropland and a few urban areas. Wheat, alfalfa, native and tame grasses, and hay are the main crops. Some corn is grown in the BFID. Gold mining (while reduced in scope from the past) and silviculture occur in the Black Hills portion of the watershed. Approximately 15 percent of the watershed is federally owned. Of this federally owned land, 11 percent is managed by the U.S. Forest Service (USFS) and 4 percent is managed by the BLM.

The Belle Fourche River from the Wyoming border to the mouth at the Cheyenne River is identified in the 1998 and 2002 *South Dakota 303(d) Waterbody Lists* and the 2004 and 2006 *Integrated Report for Surface Water Quality Assessment* as impaired because of elevated TSS concentrations. The 2008 Integrated Report (IR) shows that all segments of the Belle Fourche River, with the exception of the reach from the Wyoming border to Fruitdale, South Dakota, were delisted after water-quality standards for TSS were met. The 2010 IR once again showed that four of the segments impaired including the Wyoming border to Redwater River, Whitewood Creek to Willow Creek, Willow Creek to Alkali Creek, and Alkali Creek to the mouth at the Cheyenne River. Table 1-1 contains a summary of five impaired segments of the Belle Fourche River Watershed in the 2012 IR. The table also lists the impaired beneficial use, impairment parameter, water-quality criteria, and possible source.

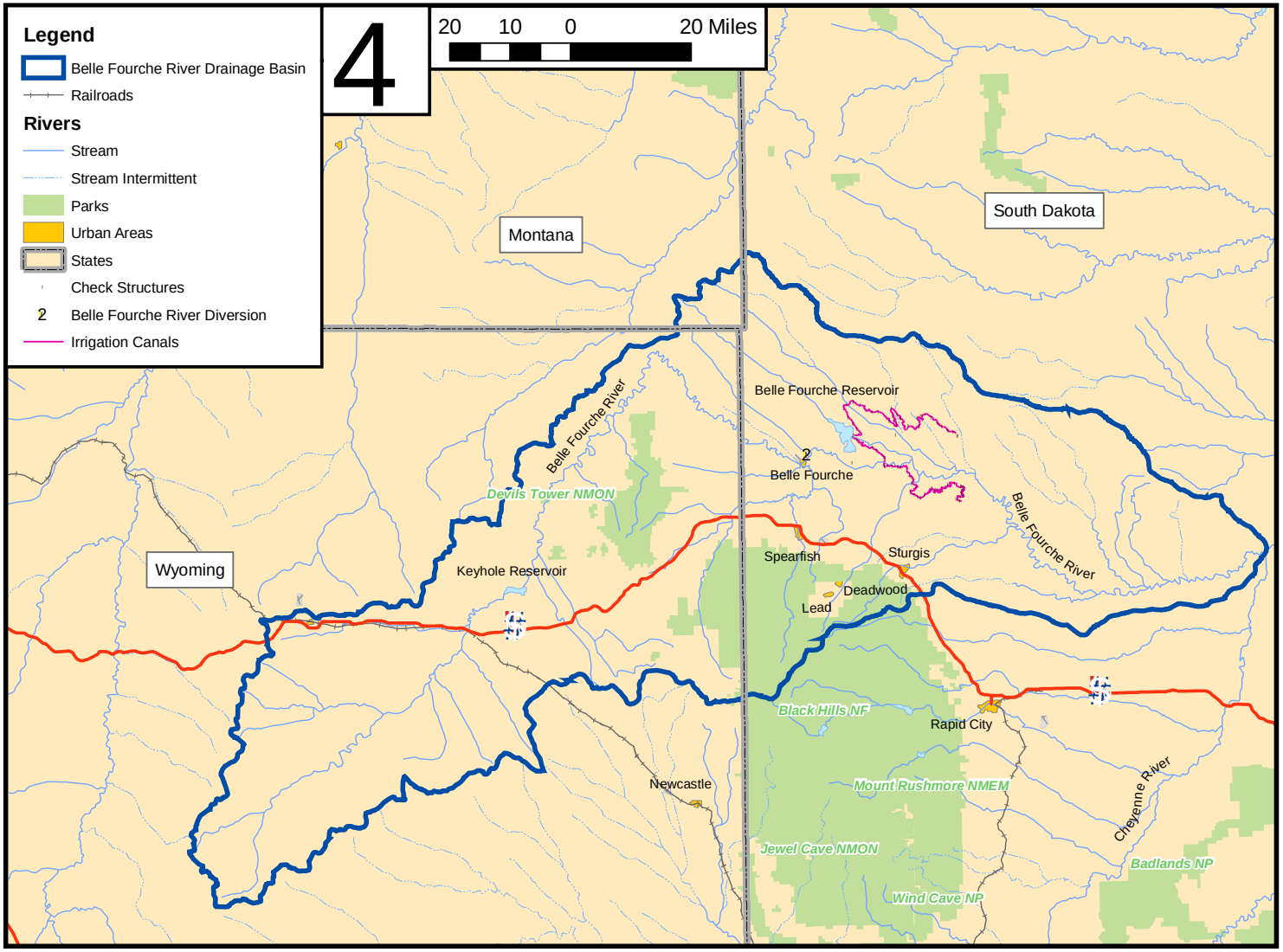

Figure 1-1. Belle Fourche River Watershed.

Table 1-1. Summary of Belle Fourche River Exceedance Water-Quality Data from 2012 Integrated Report

Stream	Stream Reach	Beneficial Use	Impairment Parameter	Water-Quality Criteria	Source
Belle Fourche River	Wyoming Border to Redwater River, South Dakota	Immersion Recreation	Fecal Coliform (per/100 mL)	200[a]/400[b]	Wildlife, Livestock
		Immersion Recreation	*E. coli*	126[a]/235[b]	Wildlife, Livestock
		Warm-Water Permanent Fish Life	TSS (mg/L)	90[a]/158[b]	Crop Production/ Livestock
Belle Fourche River	Redwater River to Whitewood Creek	Warm-Water Permanent Fish Life	TSS (mg/L)	90[a]/158[b]	Crop Production/ Livestock
Belle Fourche River	Whitewood Creek to Willow Creek	Warm-Water Permanent Fish Life	TSS (mg/L)	90[a]/158[b]	N/A[c]
Belle Fourche River	Willow Creek to Alkali Creek	Warm-Water Permanent Fish Life	TSS (mg/L)	90[a]/158[b]	N/A
Belle Fourche River	Alkali Creek to Mouth	Immersion Recreation	Fecal Coliform (per/100 mL)	200[a]/400[b]	Livestock
		Immersion Recreation	*E. coli*	126[a]/235[b]	Livestock
		Limited Contact Recreation	Fecal Coliform (per/100 mL)	1,000[a]/2,000[b]	Livestock
		Limited Contact Recreation	*E. coli*	630[a]/1,178[b]	Livestock
		Warm-Water Permanent Fish Life	TSS (mg/L)	90[a]/158[b]	N/A

(a) 30-day average.
(b) Daily maximum.
(c) N/A = Not available.

Horse Creek was listed in the 1998 impaired waterbody list for total dissolved solids (TDS), but this was later determined to be a listing error. The Horse Creek listing was corrected to conductivity during 2002. During this assessment, approximately 10 percent of the samples collected from Horse Creek exceeded the water-quality standard for TSS. The 2008 IR lists Horse Creek as nonsupporting for conductivity and delisted for TSS. Similar results were shown on the 2012 IR. The TMDL report for Horse Creek includes both TSS and conductivity.

The Belle Fourche River from the Wyoming border to the Redwater River was first listed for pathogens in the *2002 South Dakota Report to Congress 305(b) Water Quality Assessment* and continued to be listed for fecal coliform in successive IRs (2004, 2006, 2008, and 2010), failing to support its immersion recreation beneficial use because of elevated levels of *E. coli*. The SD DENR developed a TMDL in 2012 that identified livestock, wildlife, and stormwater from the city of Belle Fourche as potential sources of *E. coli* impairments in the watershed.

The BFRWP completed a water-quality assessment project that led to the development of a TSS TMDL for the Belle Fourche River and Horse Creek. The project period extended from April 2001 through 2003. Six TMDLs were approved by the EPA for the Belle Fourche River and Horse Creek in 2005. Based on the results of the watershed study, the main sources of TSS were determined to be rangeland erosion, irrigation return flows, free cattle access to streams, riparian degradation, natural geologic processes, hydraulic alteration by irrigation, and reduced stream miles. The *Ten-Year Belle Fourche River Watershed Strategic Implementation Plan* [Hoyer, 2005] developed to implement the TMDL includes recommendations for reducing TSS concentrations using practices that include irrigation water management, riparian rehabilitation, and grazing management. As part of the Segment 4 implementation project, the fecal coliform TMDL has been developed for Whitewood Creek.

During the winter of 2004, the BFRWP applied for and received a Clean Water Act Section 319 Grant to begin implementation of the BMPs recommended in the TMDLs for the Belle Fourche River. Currently, the BFRWP is in its ninth year of implementing BMPs in the watershed and has been funded through Fiscal Year 2014 with the Segment 5 proposal. The project is supported by agricultural organizations, federal and state agencies, local governments, SDSU, and the SDSM&T.

Funding for the project included support from local ranchers and farmers, the BFRWP, the SD DENR, the USFWS, Lawrence County, the BFID, the WDEQ, the NRCS, the Bureau of Reclamation, the USGS, and the Clean Water Act Section 319 Grant. Products of the first implementation project segment were the *Ten-Year Belle Fourche River Watershed Strategic Implementation Plan* [Hoyer, 2005] and the *Belle Fourche Irrigation District Water Conservation Plan* [Rolland and Hoyer, 2005]. These plans outline BMP installation activities to be completed in this project for a 10-year time frame, and associated TSS and nonused water savings are presented for each action planned. The BMPs recommended by the TMDLs and the 10-year plan installed during this project segment include replacing open irrigation ditches with

pipeline, lining open irrigation ditches, installing pipelines to deliver water from the BFID system to the fields, installation of irrigation sprinkler systems within the BFID, scheduling irrigation events, and managed grazing. These BMPs were installed in the South Dakota portion of the Belle Fourche River Watershed (Figure 1-1).

2.0 PROJECT GOALS AND OBJECTIVES

The goal of the Belle Fourche River Watershed Management Project is to bring the Belle Fourche River and Horse Creek into compliance with water-quality standards within 10 years. To accomplish this goal, a 55 and 41 percent reduction of TSS load will be required on the Belle Fourche River and Horse Creek respectively.

In this project segment, the concentration reduction goal is 59 mg/L. To accomplish this goal, this project segment had the following three objectives:

1. Continue implementing BMPs in the watershed to reduce TSS concentration 28 mg/L below the Belle Fourche Reservoir; 31 mg/L above the Belle Fourche Reservoir.
2. Conduct public education and outreach to stakeholders within the Belle Fourche River Watershed.
3. Track progress toward meeting TMDL goals to help ensure that the BMPs are effective and that the proper BMPs are being implemented.

2.1 PLANNED AND ACTUAL MILESTONES, PRODUCTS, AND COMPLETION DATES

Objective 1. Implement BMPs Recommended to Reduce TSS. This objective was comprised of two tasks: improving irrigation water management and implementing riparian vegetation improvements. The products of this objective included replacing canals, laterals, and/or ditches with 6,985 feet of pipelines; 4,100 feet of lining on the BFID's South Canal; installing 19 sprinkler irrigation systems to replace existing flood irrigation; scheduled irrigation on 985 acres; rangeland implementation projects benefiting 4,280 riparian acres; and range planning and follow-up on 78,000 acres. The implementation of the BMPs is discussed further in Chapter 3.0.

Objective 2. Conduct Public Outreach and Education, Implementation Record Keeping, Report Writing, Writing Future Grants, and Federal Audit. There were approximately 36 outreach activities that involved approximately 14,550 participants; two Grant Tracking and Reporting System (GRTS) reports as well as this final report. These activities are further discussed in Chapter 5.0 of this report.

Objective 3. Complete Essential Water-Quality Monitoring and TMDL Development. Water-quality samples were collected by the USGS at real-time stream gaging sites and the SD DENR at several water-quality monitoring (WQM) sites in the watershed. A detailed statistical analysis is included in Chapter 4.0 of this report.

Table 2-1 lists the project objectives along with their products, planned milestone completion date, and actual milestone completion date. All BMPs were completed by the July 2013 deadline. Final reporting was completed by December 2013.

Table 2-1. Planned Versus Actual Milestone Completion Dates

BFRWP Implementation	Planned Completion	Actual Completion
Objective 1. Implement BMPs Recommended to Reduce TSS		
Product 1. Improve Irrigation Delivery and Application	July 2013	July 2013
Product 2. Complete and Install Riparian Area BMPs	July 2013	July 2013
Objective 2. Conduct Public Education and Outreach		
Product 3. Public Outreach, Report Writing, Federal Audit	July 2013	July 2013
Objective 3. Tracking Progress Toward Meeting Goals		
Product 5. GRTS and Final Reports	July 2013	November 2013

2.2 EVALUATION OF GOAL ATTAINMENT

Project success was evaluated by comparing project outputs and outcomes with the planned milestones. All of the goals within the control of the BFRWP were obtained. Not all of the objectives outlined in the Segment 5 Project Implementation Plan (PIP) were implemented. Funding limitations in NRCS's EQIP and changes in the BFID's goals for their canal lining project effected the outcome of the BMPs implemented during this segment. Further explanations of these changes are shown in Section 3.1 of this report. The following milestones were obtained:

- Implementation of several BMPs recommended within the Phase I Watershed Assessment Final Report and TMDL [Hoyer and Larson, 2004].
- Reductions, estimated as a result of BMP installation, of 31 mg/L (7,827 tons per year) were obtained.
- Completion of approximately 36 successful education and outreach activities which led to greater public participation in the project, completion of annual GRTS reports along with this final report, and two required federal audits.

This project successfully implemented BMPs to reduce sediments. All of the goals within the control of the BFRWP were obtained. Although the focus of BMP implementation by the BFID in canal lining was shifted from the original PIP, the alternative BMPs still made progress in reducing sediment. BMPs were implemented that are estimated to reduce TSS in the Belle Fourche River by approximately 7,827 tons per year.

3.0 BEST MANAGEMENT PRACTICES

The installation of the BMPs recommended in the Belle Fourche River TMDL was continued during this project segment. The BMP installation included funding from local ranchers and farmers, BFID, Bureau of Reclamation, USFWS, and NRCS along with the EPA's 319 program.

The following BMPs were installed:

- 4,100 feet of canal lining
- 6,985 feet of pipeline installed replacing open ditches delivering water to individual irrigators
- 19 irrigation sprinkler systems to replace flood irrigation
- Two livestock water development projects, one riparian deferment, and one streambank rehabilitation project involving four producers improving 280 riparian acres
- EQIP projects in the watershed positively affected 48,000 acres that included improvement on 4,000 riparian acres
- Completed conservation plans or conducted follow-up on over 78,000 acres of grazing lands.

Table 3-1 provides a track of the BMP implementation planned and implemented to date.

Table 3-1. Best Management Practices Implemented

Best Management Practice	10-Year Plan	Planned This Segment	Installed This Segment	Installed to Date
Flow Automation Units	42	0	0	37
Real-time Stage/Flow-Measuring Devices	15	0	0	24
Canal Operational Model	2	0	0	2
Water Card Ordering System	1	0	0	1
Line Open Canals and Laterals (Feet of Lining)	26,560	2,640	4,100	14,460
Replace Open Canals and Laterals With Pipeline (Feet of Pipeline)	25,000	3,500	6,985	21,499
Sprinkler Irrigation Systems	36	25	19	66
Managed Riparian Grazing (Acres)	34,000	5,000	4,280	26,838

3.1 REDUCING NONUSED IRRIGATION WATER AND IMPROVING EFFICIENCY

3.1.1 Automation

To reduce return flows of nonused irrigation waters, the project installed BMPs that will improve precision in water quantity delivered to irrigators. During the Segment 5 project, there were no new automated gate units installed in the BFID. As part of this final report, the BFRWP felt it was important to summarize what has been done to date. The installation of 37 units to measure and control flow within the BFID delivery system enables water levels to be measured, monitored, and adjusted from the BFID office in Newell, South Dakota. Figure 3-1 shows where the automated sites are located within the BFID. These automated units provide continual oversight of canal water levels and the ability to immediately adjust levels when necessary, thereby reducing waste and improving efficiency. Water-level data at each site are recorded every 10 minutes and stored in a database. This allows for easy summation of the total volume of water delivered during any given time period and calculation of efficiencies. Figure 3-2 shows an automated site within the BFID.

An upgraded water card ordering system was also implemented. The system allows BFID personnel to enter the timing and amount of water ordered for individual farmers on a given ride (or section of the irrigation district). Once this information is entered, the upgraded water card ordering system generates daily water delivery cards for the ditch riders that deliver the water to the fields. It also calculates the amount of lag time that it takes for the water to travel from the dam to all fields within the BFID and provides a daily estimate of the amount of water to release from the dam to meet the water order demands. This system eliminates mathematical and transcription errors from manual data entry and improves the overall efficiency of the system.

3.1.2 Lining and Piping

Approximately 4,100 feet of the South Canal was lined by the BFID during the Segment 5 implementation project. It was originally estimated that the BFID would line approximately 7,780 feet of the inlet canal. After further study of the project it was determined by the BFID along with Bureau of Reclamation to allocate the additional lining to other parts of the BFID in order to receive maximum benefit. It was concluded that the most benefit would be achieved by lining a portion of the South Canal instead of the inlet canal. To date, 5,860 feet of the inlet canal and 4,100 feet of the South Canal have been lined. The breakdown of the different phases of the inlet and south canal lining are shown in Figure 3-3. Figure 3-4 shows the South Canal Lining project. In addition to lining the South Canal a total of 6,718 feet of canal and open laterals within the BFID were replaced with pipeline during this segment. This was above the goal of 3,500 feet for this segment. Installation of pipeline eliminated water losses from infiltration and evaporation along these sections.

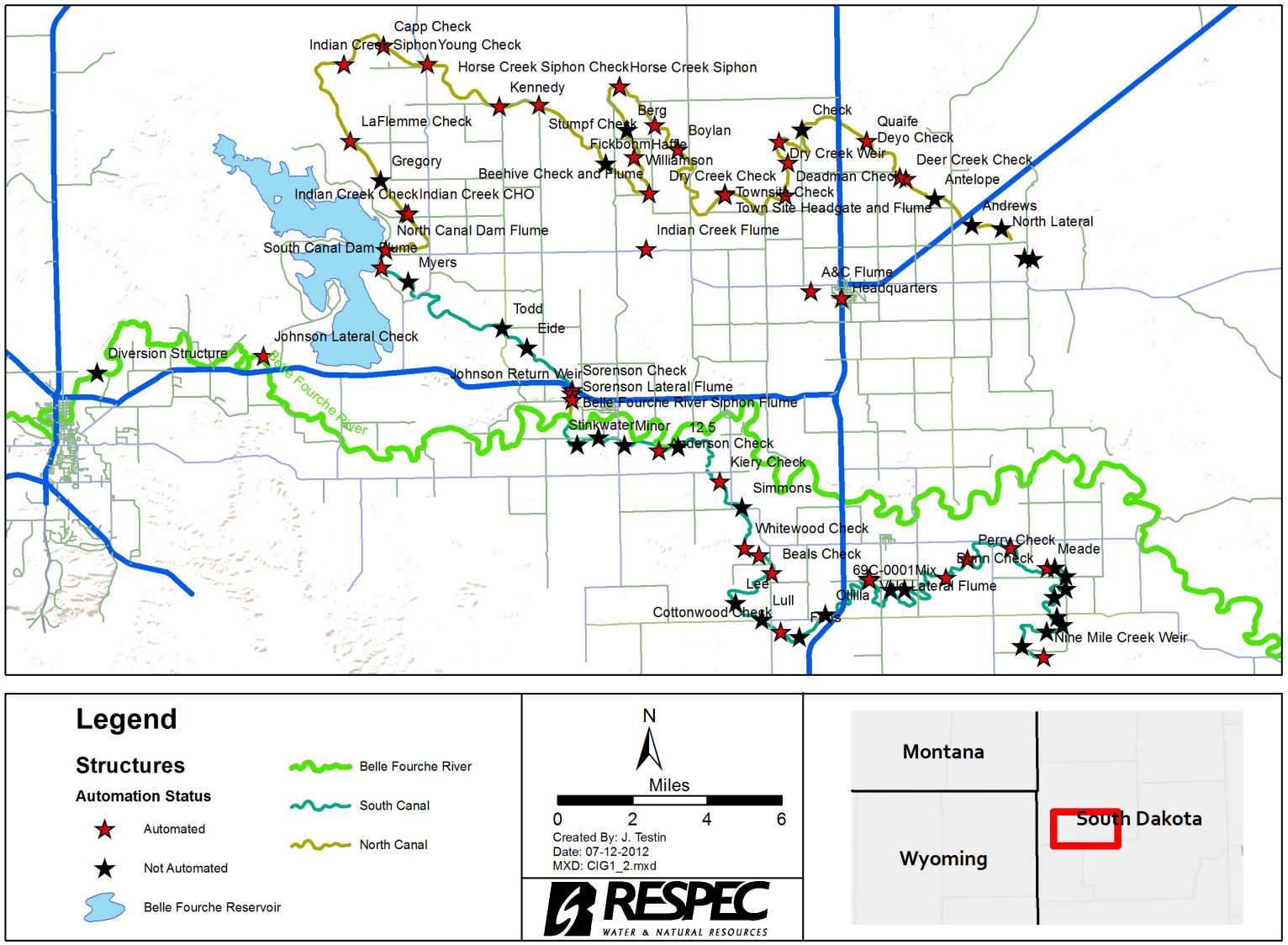

Figure 3-1. Location of Automated Sites in the Belle Fourche Irrigation District.

Figure 3-2. Gate Automation Unit Installed in the Belle Fourche Irrigation District.

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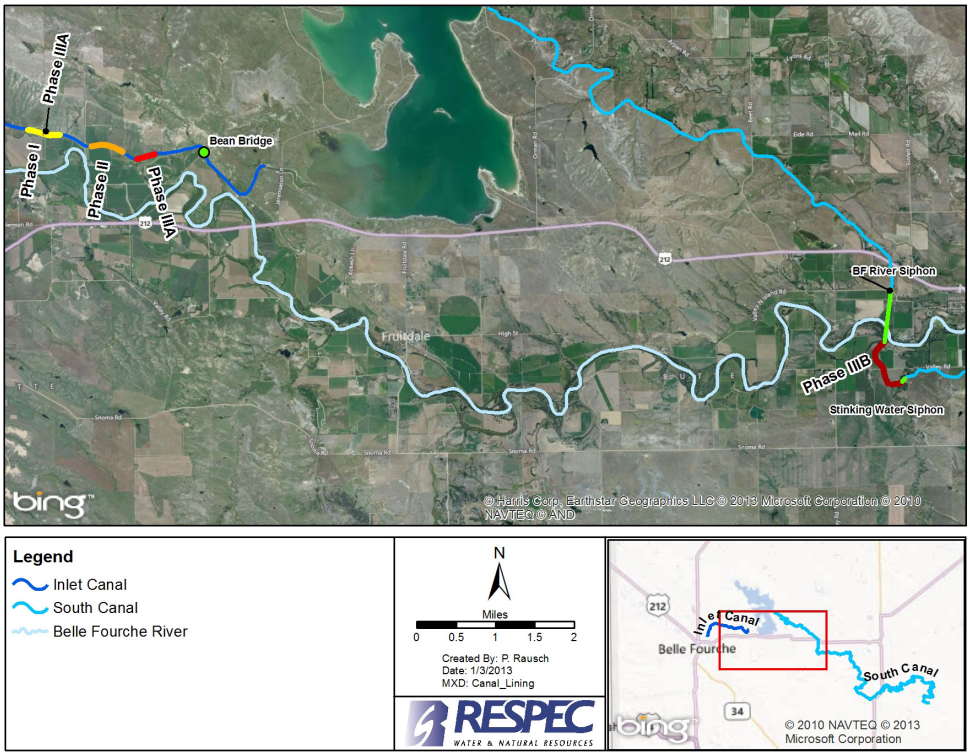

Figure 3-3. Location of the Lining Projects Within the Belle Fourche Irrigation District.

Figure 3-4. Lining the South Canal.

3.1.3 On-Farm Irrigation Improvements

Nineteen center-pivot sprinkler systems were installed to replace existing surface irrigation during this segment. This segment fell short of the goal of converting 25 fields from surface irrigation to sprinkler primarily because of the lack of EQIP funds in 2013. Typically, 319 funds are used in conjunction with EQIP funds to incentivize producers to install the practice. Although the demand to do more conversions existed, the lack of funds limited the total number of projects. Conversion from surface or flood irrigation to sprinkler irrigation reduces waste water which in turn reduces sediments reaching waterways that act as a drain for the BFID. Figure 3-5 shows sediment-laden waste water running off a flood irrigated field. Figure 3-6 shows an improved center-pivot irrigation system that was partially funded by the project which greatly reduces runoff of excess water. General locations of producer irrigation BMPs are shown in Figure 3-7.

3.1.4 Irrigation Scheduling

Sprinkler irrigation greatly reduces excess runoff improving water efficiencies and reducing sediments in waterways. Proper timing of irrigation events is imperative to maximize these benefits. The BFRWP has recognized this and has received funding in the past from a NRCS Conservation Innovation Grant (CIG) to work with producers in scheduling timely irrigation events. This CIG grant expired in 2010 and although local participating producers had gained knowledge from the project there was still a need for technical assistance to continue the

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Figure 3-5. Sediment-Laden Waste Water Running Off a Flood-Irrigated Field.

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Figure 3-6. Center-Pivot Irrigation System Installed in the Belle Fourche Irrigation District.

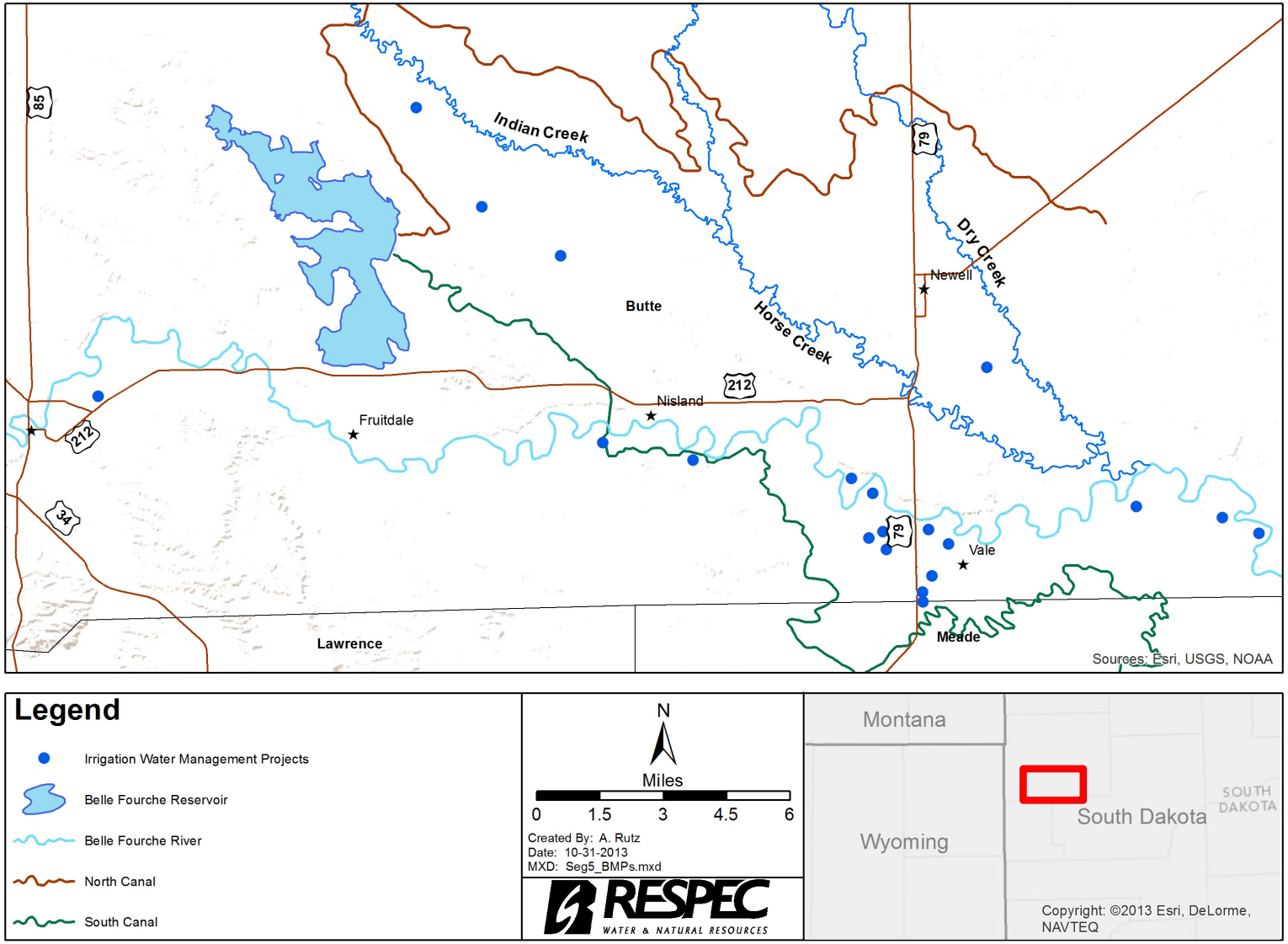

Figure 3-7. General Locations of Producer Irrigation Best Management Practices.

adoption of this technology. During this funding segment, technical service was provided to ten irrigators on approximately 985 acres. The participating farmers were provided sensors and a data logger to record soil moisture and technical assistance from project staff to schedule timely irrigation events. Figure 3-8 shows an example of a soil moisture graph provided to the farm producer. The two lines represent the two soil moisture sensors at different rooting depths. The number on the left represents moisture with zero being saturated and 200 being dry. As the moisture of the sensors reach different zones of soil saturation (represented by the colored bars), recommendations can be made for irrigation application. This practice greatly increased water efficiencies and reduced excess runoff.

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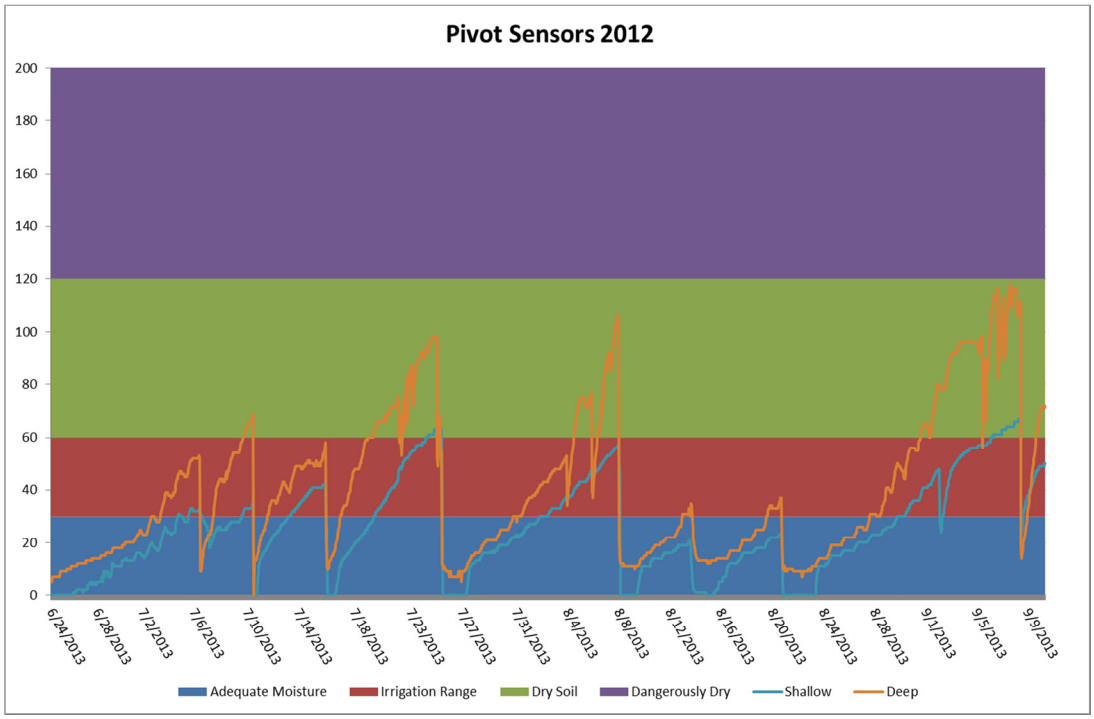

Figure 3-8. Soil Moisture Graph Provided to Producer.

3.2 MANAGED GRAZING

Improved grazing distribution maintains or improves the integrity of the riparian corridor of the watershed. Healthy riparian areas are integral to trapping sediment from rangeland runoff and reducing TSS entering the Belle Fourche River. Riparian/grazing BMPs installed with 319 funding assistance included two livestock water development projects, one riparian deferment, and one streambank rehabilitation project affecting approximately 280 riparian acres. Figure 3-9 shows the location of the riparian vegetation improvement projects funded with Segment 5 funds.

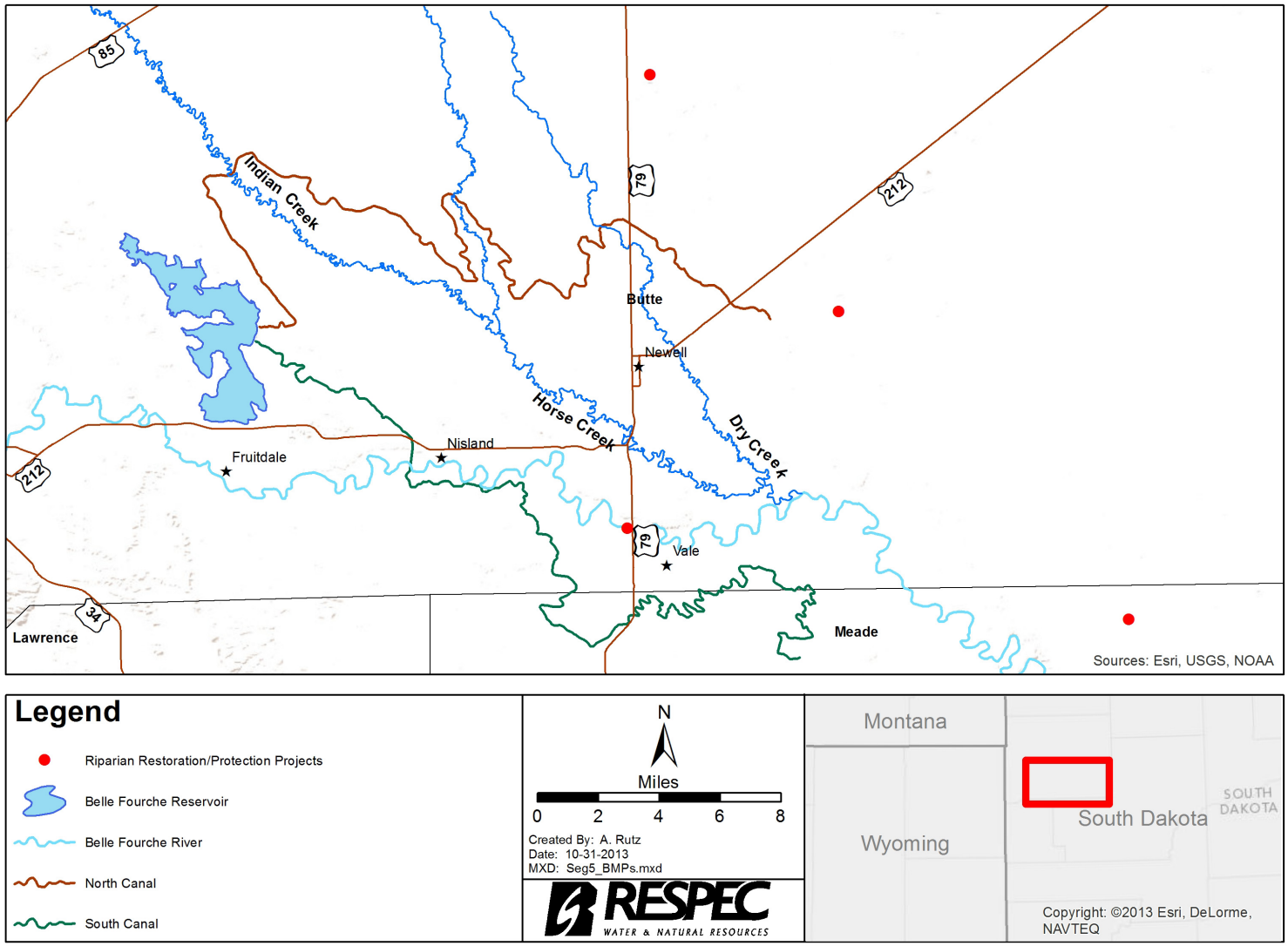

Figure 3-9. Location of Riparian Vegetation Improvement Projects in Segment 5.

In addition to installed practices shown in Figure 3-9, conservation plans and follow up visits to those plans were conducted on over 78,000 acres of grazing lands in the watershed. This was done in cooperation with the South Dakota Grassland Coalition (SDGLC) and their 319 project titled *Grassland Management and Planning Project Implementation Plan*. The continued success of this partnership between the SDGLC and the BFRWP has provided a solution to reduce TSS coming from range riparian sites as well as adjacent uplands. Figure 3-10 shows a site on a ranch where grazing plans and riparian exclusion and water development were implemented to improve range/riparian health and reduce sediments reaching the waterway.

Outside of grazing projects, the BFRWP teamed up with the Belle Fourche Weed Management group to provide funds for native plant rehabilitation along the Belle Fourche River after the control of the locally noxious plant phragmites. This streambank stabilization project is an ongoing effort that has received funds from the USFWS, the Wild Turkey Federation, the South Dakota Conservation Commission, local county governments, and other private entities. Watershed staff assisted in this effort by helping the group find alternative funding sources to fund the rehabilitation efforts.

In addition to 319 projects, EQIP-funded projects in the watershed positively affected 48,000 acres that included improvement on 4,000 riparian acres. Many of the producers that participated in EQIP received technical assistance from watershed staff to help with their grazing plans.

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Figure 3-10. Riparian Exclusion Site on a Ranch Where Grazing Plans and Water Development Were Used to Improve the Range and Riparian Health.

4.0 SUMMARY OF PUBLIC PARTICIPATION AND OUTREACH

Approximately 36 public education and outreach events were completed during this project segment. The outreach activities are shown in Table 4-1. Outreach activities were in the form of public meetings, informational booths, a project website, radio sound bites, watershed tours, range riparian workshops, and youth range camps. It is estimated that outreach and education efforts reached over 14,500 people. The Butte County, Lawrence County, and Elk Creek Conservation Districts each sent out newsletters which included project updates. The BFRWP hosted 9 meetings to provide updates on project work and progress being made. The BFRWP Web site, *www.bellefourchewatershed.org*, continues to be updated with events and project status. Sound bites were used on local radio stations to provide overviews of BFRWP happenings and guide listeners to the website for additional information. The BFRWP used their soil-quality demonstration trailer to educate audiences of all ages about the importance of good stewardship on soil health. Figure 4-1 shows a soil-quality demonstration at one of the BFRWP's tours.

The BFRWP sponsored/cosponsored five tours in the watershed during Segment 5. These tours included local producers; state and federal agency staff; local, state, and federal government officials; and the interested public. Partners in these tours included Butte, Lawrence, and Elk Creek Conservation Districts, the South Dakota Association of Conservation Districts, the SDSU Cooperative Extension, the South Dakota Society for Range Management, the NRCS, and the Bureau of Reclamation. These tours showcased projects sponsored by the BFRWP that included irrigation demonstrations in the BFID and rangeland demonstrations on ranches in the watershed. These outreach activities helped increase participation and support for the BFRWP and also gave the BFRWP several contacts for BMP installation.

Figure 4-1 shows a soil-quality demonstration conducted at the Fall River County Natural Resource Day south of Hot Springs. Figure 4-2 show a tour of the phragmites control project. The BFRWP assisted with rehabilitating the control plots to revegetate the stream banks with native plants.

Table 4-1. Summary of Public Outreach and Education During Segment 5

Type of Education and Outreach	Date	Number of Participants
BFRWP Meetings (9 Meetings)	June 2011–July 2013	180
Belle Fourche Weed Management Group, Phragmites Project Tour	2012, 2013	50
Butte/Lawrence County Fair, Booth	2011, 2012	400
Watershed Tour Open to Public	2012	25
SDACD Annual Meeting, Booth	2011, 2012	500
Society for Range Management (SRM) Range Tour	2013	40
South Dakota Grasslands Coalition Grazing School, Rainfall Simulator Demo	2011	50
South Dakota SRM Annual Meeting, Presentation	2012	60
Vale Ag Show, Booth	2012, 2013	300
South Dakota Grasslands Coalition Bird Tour, Rainfall Simulator Demo	2012	60
Sturgis Key City Pen of 3, Booth	2012	300
NRCS Indicators of Rangeland Health Training, Rainfall Simulator Demo	2012	75
Ranchers Roundup, Union Center, Booth	2012	300
Leopold Conservation Award Tour, Rainfall Simulator Demo	2013	100
Rapid City Chamber of Commerce Ag Appreciation, Rainfall Simulator Demo	2013	50
South Dakota High School Range Camp	2011, 2012, 2013	150
Fall River County Natural Resource Day, Rainfall Simulator Demo	2012	400
SD DENR Watershed Tours	2012,2013	10
Informational Radio Sound Bites	2012, 2013	10,000
Website	2011–2013	1,500

RSI-1870-12-010

Figure 4-1. Fall River County Natural Resource Day, Rainfall Simulator Demonstration.

RSI-1870-12-011

Figure 4-2. Phragmites Control Project Tour Showing Different Test Plots Being Used to Revegetate the Banks Along the Belle Fourche River.

5.0 MONITORING RESULTS

The following sections outline and summarize all applicable, pertinent, and relevant water-quantity and water-quality data within the BFRWP in South Dakota.

5.1 303(d) IMPAIRED WATERBODIES AND U.S. ENVIROMENTAL PROTECTION AGENCY-APPROVED TOTAL MAXIMUM DAILY LOADS

There are 15 impaired stream reaches within the BFRW in South Dakota. These waterbodies are listed as nonsupportive of their assigned beneficial uses as specified in South Dakota's 2012 303(d) list of impaired waterbodies [South Dakota Department of Environment and Natural Resources, 2012]. Five of the listed impairments are located on the Belle Fourche River, while the remaining ten impaired stream reaches are located on tributaries to the Belle Fourche River.

Table 5-1 provides a summary of all 303(d) listed waterbodies within the project area, their number of years on the 303(d) list, impairments, TMDL status, and respective water-quality criteria threshold values.

5.2 WATER-QUANTITY ANALYSES

Flow in the Belle Fourche River can be significantly impacted by meteorological events and periods of wet and dry climatic conditions as observed through seasonality within the watershed. Discharge rates observed within the Belle Fourche River are not only influenced by seasonal climatic conditions and storm events but are also heavily dependent upon irrigation activities within the BFID.

The typical irrigation season in the BFID begins in June and lasts until the end of September. Historical observations have shown that the region receives very little precipitation during the irrigation season; therefore, increases in observed discharge within the Belle Fourche River during seasonally dry periods can be attributed to losses or waste within the irrigation system's transport and delivery infrastructure. Water quantity within the watershed will be elaborated on in further detail through two analyses regarding mainstem Belle Fourche River streamflow gaging station operations, as well as historical and recent streamflow gaging operations on Horse Creek, an irrigation dominated tributary to the Belle Fourche River.

5.2.1 Belle Fourche River Discharge Analysis

Discharge data collected by the USGS at gaging locations on the Belle Fourche River within the South Dakota portion of the watershed was obtained for analysis. Acquired data consists of

Table 5-1. 303(d) Listed Impaired Waterbodies in the Belle Fourche River Watershed in South Dakota (Page 1 of 3)

Waterbody Name/ Description	Assessment Unit I.D.	Years Listed	Impaired Beneficial Use(s)	303(d) Listing Parameter	TMDL Status	Water-Quality Criteria Threshold Values (Bacteria Criteria Apply From May 1 Through September 30)
Bear Butte Creek (Headwaters to Strawberry Creek)	SD-BF-R-BEAR_BUTTE_01	2012 2010 2008 2006	Cold-Water Permanent Fish Life	Water Temperature	Assessment Initiated[a]	Maximum temperature of < 65 degrees Fahrenheit (°F).
Bear Butte Creek (Strawberry Creek to S2, T4N, R4E)	SD-BF-R-BEAR_BUTTE_02	2012 2010 2008	Cold-Water Permanent Fish Life	Water Temperature	Assessment Initiated	Maximum temperature of < 65°F.
Belle Fourche River (Wyoming Border to Redwater River, South Dakota)	SD-BF-R-BELLE_FOURCHE_01	2012 2010 2008 2006 2004	Immersion Recreation	*E. coli* Bacteria	May 2012 Public Noticed[b]	*E. coli*: Daily maximum of 235 most probable number per 100 milliliters (mpn/100 mL) and a geometric mean of at least five samples over a 30-day period 126 mpn/100 mL. Fecal Coliform: Daily maximum of 400 mpn/100 mL and a geometric mean of at least five samples over a 30-day period 200 mpn/100 mL.
				Fecal Coliform Bacteria	Approved October 2011[c]	
		2012 2010 2008 2006 2004	Warm-Water Permanent Fish Life	TSS	Approved February 2005	Maximum daily concentration of 158 mg/L and a 30-day average of at least three consecutive grab or composite samples taken on separate weeks in a 30-day period of 90 mg/L.
Belle Fourche River (Redwater River to Whitewood Creek)	SD-BF-R-BELLE_FOURCHE_02	2012 2006 2004	Warm-Water Permanent Fish Life	TSS	Approved February 2005	Maximum daily concentration of 158 mg/L and a 30-day average of at least three consecutive grab or composite samples taken on separate weeks in a 30-day period of 90 mg/L.
Belle Fourche River (Whitewood Creek to Willow Creek)	SD-BF-R-BELLE_FOURCHE_03	2012 2010 2006 2004	Warm-Water Permanent Fish Life	TSS	Approved February 2005	Maximum daily concentration of 158 mg/L and a 30-day average of at least three consecutive grab or composite samples taken on separate weeks in a 30-day period of 90 mg/L.
Belle Fourche River (Willow Creek to Alkali Creek)	SD-BF-R-BELLE_FOURCHE_04	2012 2010 2006 2004	Warm-Water Permanent Fish Life	TSS	Approved February 2005	Maximum daily concentration of 158 mg/L and a 30-day average of at least three consecutive grab or composite samples taken on separate weeks in a 30-day period of 90 mg/L.
Belle Fourche River (Alkali Creek to Mouth)	SD-BF-R-BELLE_FOURCHE_05	2012 2010	Immersion Recreation	*E. coli* Bacteria	Approved October 2011	**Immersion Recreation:** *E. coli*: Daily maximum of 235 mpn/100 mL and a geometric mean of at least five samples over a 30-day period 126 mpn/100 mL. Fecal Coliform: Daily maximum of 400 mpn/100 mL and a geometric mean of at least five samples over a 30-day period 200 mpn/100 mL. **Limited Contact Recreation:** *E coli*: Maximum daily concentration of 1,178 mpn/100 mL and a geometric mean of at least five samples over a 30-day period of 630 mpn/100 mL. Fecal Coliform: Maximum daily concentration of 2,000 mpn/ 100 mL and a geometric mean of at least five samples over a 30-day period 1,000 mpn/100 mL.
			Limited Contact Recreation	Fecal Coliform Bacteria	Approved October 2011	
		2012 2010 2006 2004	Warm-Water Permanent Fish Life	TSS	Approved February 2005	Maximum daily concentration of 158 mg/L and a 30-day average of at least three consecutive grab or composite samples taken on separate weeks in a 30-day period of 90 mg/L.

Table 5-1. 303(d) Listed Impaired Waterbodies in the Belle Fourche River Watershed in South Dakota (Page 2 of 3)

Waterbody Name/ Description	Assessment Unit I.D.	Years Listed	Impaired Beneficial Use(s)	303(d) Listing Parameter	TMDL Status	Water-Quality Criteria Threshold Values (Bacteria Criteria Apply From May 1 Through September 30)
Horse Creek (Indian Creek to mouth)	SD-BF-R-HORSE_01_USGS	2010 2008 2006 2004	Irrigation Waters	Specific Conductance	Approved February 2005	Maximum daily concentration of 4375 µmhos/cm and a 30-day average of at least three consecutive grab or composite samples taken on separate weeks in a 30-day period of 2,500 µmhos/cm.
Redwater River (WY Border to US HWY 85)	SD-BF-R-REDWATER_01_USGS	2012 2010 2008	Cold-Water Permanent Fish Life	Water Temperature	Not Initiated[(d)]	Maximum temperature of < 65°F.
Strawberry Creek (Bear Butte Creek to S5, T4N, R4E)	SD-BF-R-STRAWBERRY_01	2012 2010 2008 2006 2004	Fish/Wildlife Prop. Rec. Stock Waters	Cadmium	Approved April 2010	Cadmium: Maximum concentration of < (1.136672 – [(ln(hardness) × 0.041838] × exp[1.128 × (ln(hardness)] – 3.828) in mg/L.
West Strawberry Creek (Headwaters to mouth)	SD-BF-R-STRAWBERRY_01	2010 2008	Limited Contact Recreation	Fecal Coliform Bacteria	Approved April 2011	Fecal Coliform: Maximum daily concentration of 2,000 mpn/ 100 mL and a geometric mean of at least five samples over a 30-day period 1,000 mpn/100 mL.
Whitewood Creek (Whitetail Summit to Gold Run Creek)	SD-BF-R-WHITEWOOD_01	2012 2010 2008 2006	Cold-Water Permanent Fish Life	Water Temperature	2001 Assessment Initiated	Maximum temperature of < 65°F.
Whitewood Creek (Deadwood Creek to Spruce Gulch)	SD-BF-R-WHITEWOOD_03	2012 2010 2008 2006 2004	Immersion Recreation	*E. coli* Bacteria	Approved July 2011	**Immersion Recreation:** *E. coli*: Daily maximum of 235 mpn/100 mL and a geometric mean of at least five samples over a 30-day period 126 mpn/100 mL. Fecal Coliform: Daily maximum of 400 mpn/100 mL and a geometric mean of at least five samples over a 30-day period 200 mpn/100 mL. **Limited Contact Recreation:** *E. coli*: Maximum daily concentration of 1,178 mpn/100 mL and a geometric mean of at least five samples over a 30-day period of 630 mpn/100 mL. Fecal Coliform: Maximum daily concentration of 2,000 mpn/100 mL and a geometric mean of at least five samples over a 30-day period 1,000 mpn/100 mL.
			Limited Contact Recreation	Fecal Coliform Bacteria	Approved July 2011	
Whitewood Creek (Spruce Gulch to Sandy Creek)	SD-BF-R-WHITEWOOD_04	2012 2006	Immersion Recreation	*E. coli*	Not Initiated	Daily maximum of 235 mpn/100 mL and a geometric mean of at least five samples over a 30-day period 126 mpn/100 mL.
Whitewood Creek (Sandy Creek to I-90)	SD-BF-R-WHITEWOOD_05	2012 2010 2008 2006	Cold-Water Marginal Fish Life	pH	Not Initiated	6.5–9.0 standard units (SU)
Whitewood Creek (I-90 to Crow Creek)	SD-BF-R-WHITEWOOD_06	2012 2010 2008	Warm-Water Permanent Fish Life	pH	Not Initiated	6.5–9.0 SU
Whitewood Creek (Crow Creek to Mouth)	SD-BF-R-WHITEWOOD_07	2012 2010	Warm-Water Permanent Fish Life	TSS	Not Initiated	Maximum daily concentration of 158 mg/L and a 30-day average of at least three consecutive grab or composite samples taken on separate weeks in a 30-day period of 90 mg/L.

Table 5-1. 303(d) Listed Impaired Waterbodies in the Belle Fourche River Watershed in South Dakota (Page 3 of 3)

Waterbody Name/ Description	Assessment Unit I.D.	Years Listed	Impaired Beneficial Use(s)	303(d) Listing Parameter	TMDL Status	Water-Quality Criteria Threshold Values (Bacteria Criteria Apply From May 1 Through September 30)
Willow Creek (Near Vale, SD)	SD-BF-R-WILLOW_01_USGS	2010 2008 2006	Irrigation Waters	Specific Conductivity	Not Initiated	Specific Conductance: Maximum daily concentration of 4,375 µmhos/cm and a 30-day average of at least three consecutive grab or composite samples taken on separate weeks in a 30-day period of 2,500 µmhos/cm.

(a) Assessment Initiated = Data for developing the TMDL is being collected.
(b) TMDL in Public Notice = A TMDL has been developed and is ready for public review and comment.
(c) TMDL Approved = EPA approved a TMDL as submitted by the state.
(d) Not Initiated = Projects are proposed and awaiting final funding to begin assessment.

average daily discharge rates for the period of record at four USGS streamflow gaging locations on the Belle Fourche River that are currently active. Table 5-2 displays a basic summary of these four USGS streamflow gaging stations and the data and records of data obtained for analyses from their operation.

Table 5-2. U.S. Geological Survey Gaging Stations on the Belle Fourche River in South Dakota

USGS Gaging Station	Period of Record	Period of Record Average Discharge (cfs[a])	Range of Discharge (cfs)
Belle Fourche River at WY-SD State Line (06428500)	12/01/1946–03/20/2013	97	0.1–5510
Belle Fourche River Near Fruitdale, SD (06436000)	11/01/1945–03/20/2013	101	0.01–11,100
Belle Fourche River Near Sturgis, SD (06437000)	11/07/1945–03/20/2013	297	0.1–29,700
Belle Fourche River Near Elm Springs, SD (06438000)	08/19/1928–03/20/2013	394	0.01–40,800

(a) cfs = cubic feet per second

Historical monthly mean discharge rates were computed for the four USGS gaging stations on the Belle Fourche River. These historical monthly flows are displayed in Figure 5-1. As can be seen from this plot, peak monthly mean discharge rates occur within the months of March through September. Elevated flows on the Belle Fourche River observed within these months are a product of seasonal precipitation patterns and corresponding runoff events, as well as a by-product of activities performed by the BFID throughout the irrigation season.

5.2.2 Horse Creek Discharge Analysis

Real-time discharge data collected by the USGS at Horse Creek was analyzed over a period of record that spans from October of 1980 through September of 2012. Horse Creek is an irrigation-dominated tributary, as it delivers overland return flows from fields within the BFID delivery system, back to the Belle Fourche River. BMPs implemented within the BFID delivery system, along with on-farm improvements, are designed to reduce the volume of sediment-laden return flows impacting Horse Creek and ultimately the Belle Fourche River. Figure 5-2 shows the relation of Horse Creek to the delivery system and fields located within the BFID.

The influence that waste from the BFID delivery system and fields have on flows in Horse Creek is evident when observing historical monthly median discharge rates for Horse Creek and historical monthly precipitation averages for Newell, South Dakota, which is the nearest meteorological gage to the streamflow gaging station on Horse Creek. This plot is displayed in Figure 5-3. As can be seen, historical median discharge rates in the months of July, August,

and September are elevated, while the historical monthly precipitation totals trend downward from 2.8 inches in June to 0.99 inches in September. While this relationship may be counterintuitive upon initial observance, it clearly illustrates the impact of the BFID's delivery system upon Horse Creek.

RSI-2196-13-014

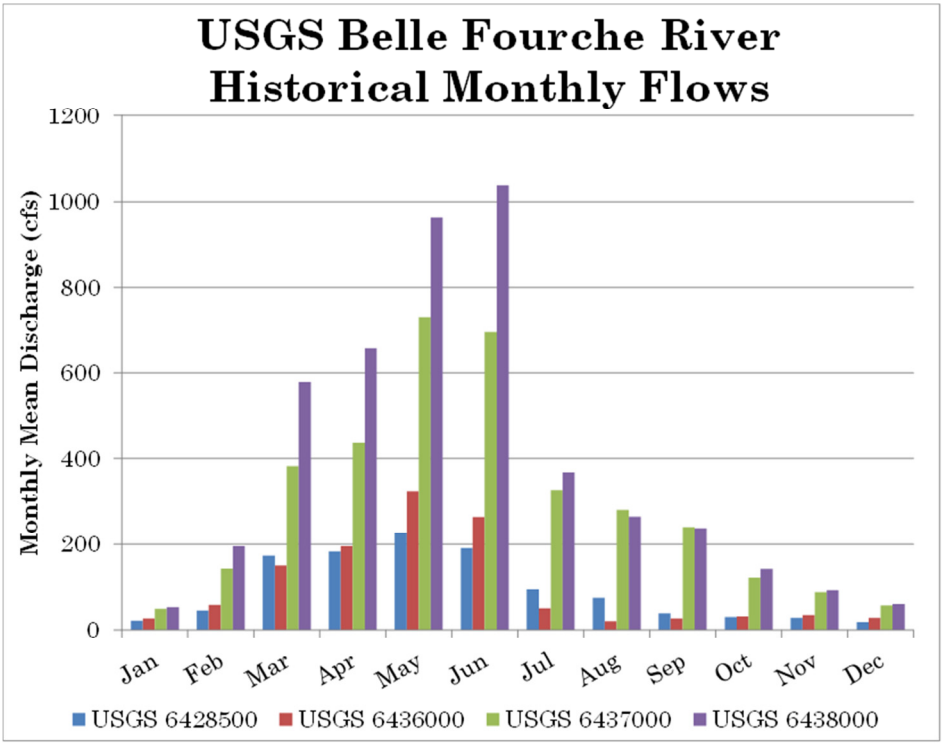

Figure 5-1. Historical Monthly Flows on the Belle Fourche River at U.S. Geological Survey Gaging Locations Within the Belle Fourche River Watershed in South Dakota.

The typical irrigation season in the BFID begins in June and lasts until the end of September. This is demonstrated in Figure 5-3 as the median flow jumps from 16 cfs in May to 30 cfs in June. The median flow increases to a maximum of 44 cfs in July and drops nearly one order of magnitude lower by October, where a median value of 4.5 cfs is reported. As the region receives little precipitation during the irrigation season, much of the elevated discharge rates observed in Horse Creek over the irrigation season can be attributed to inefficiencies or waste within the irrigation system's transport and delivery on individual fields.

To gain insight regarding the impact of irrigation activities on Horse Creek, and subsequently the Belle Fourche River, observed discharge rates for Horse Creek were analyzed for pre and postBMP implementation conditions. The preBMP condition refers to data before the year 2005, while postBMP condition refers to data applicable to the years 2005 through 2012, when BMP implementation began within the watershed. Figure 5-4 displays a plot of median flows during the irrigation season in Horse Creek for pre and postBMP implementation.

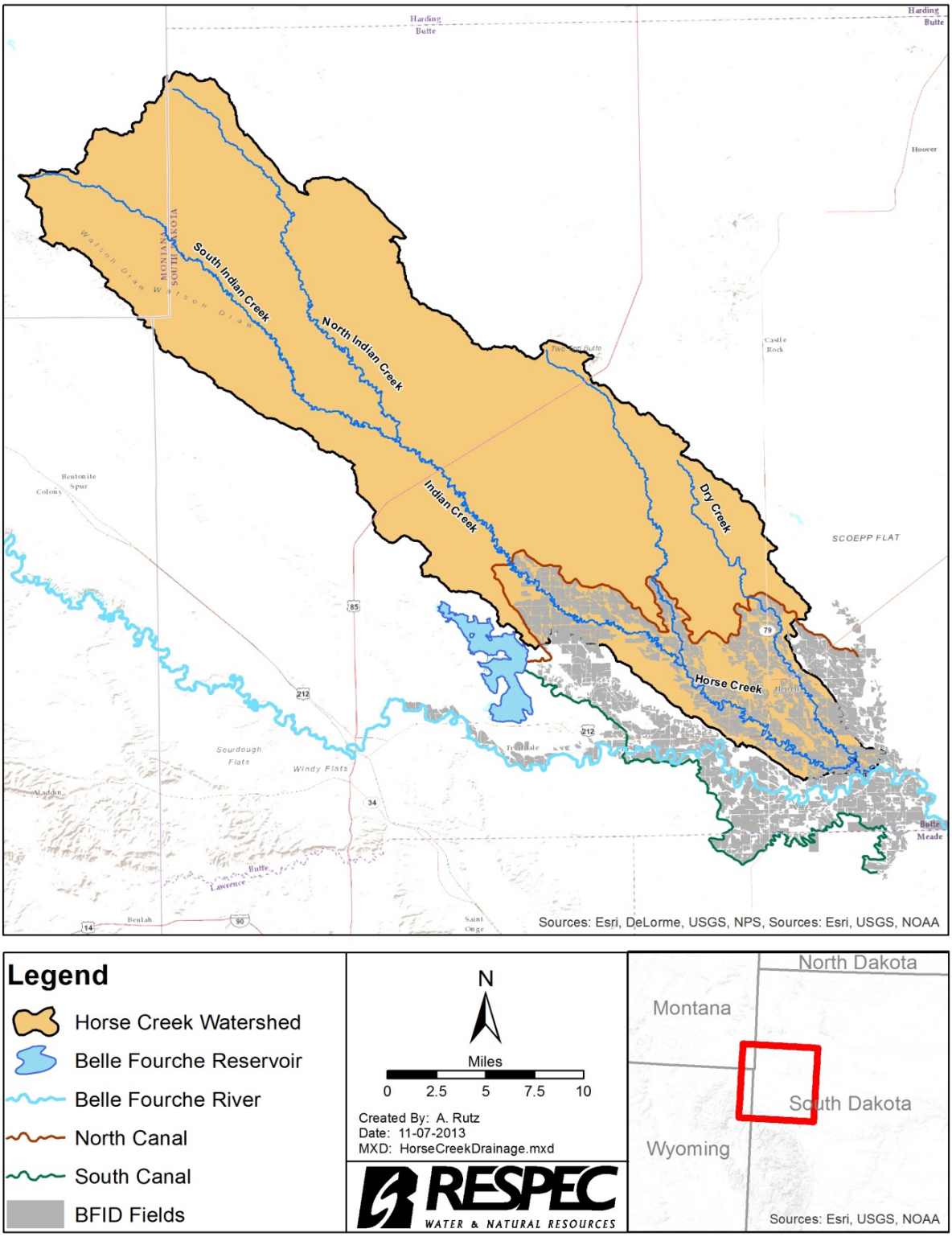

Figure 5-2. Location of Horse Creek in Relation to the Fields and Main Delivery System Within the Belle Fourche Irrigation District.

RSI-2196-13-016

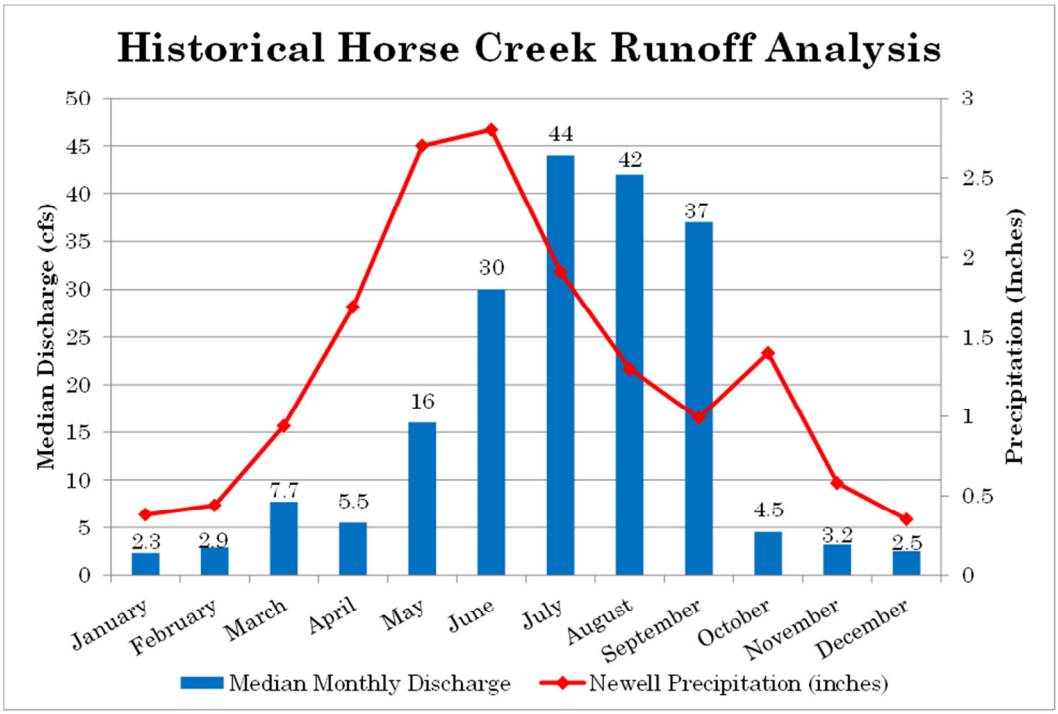

Figure 5-3. Horse Creek Historical Monthly Discharge and Historical Monthly Precipitation for Newell, South Dakota.

RSI-2196-13-017

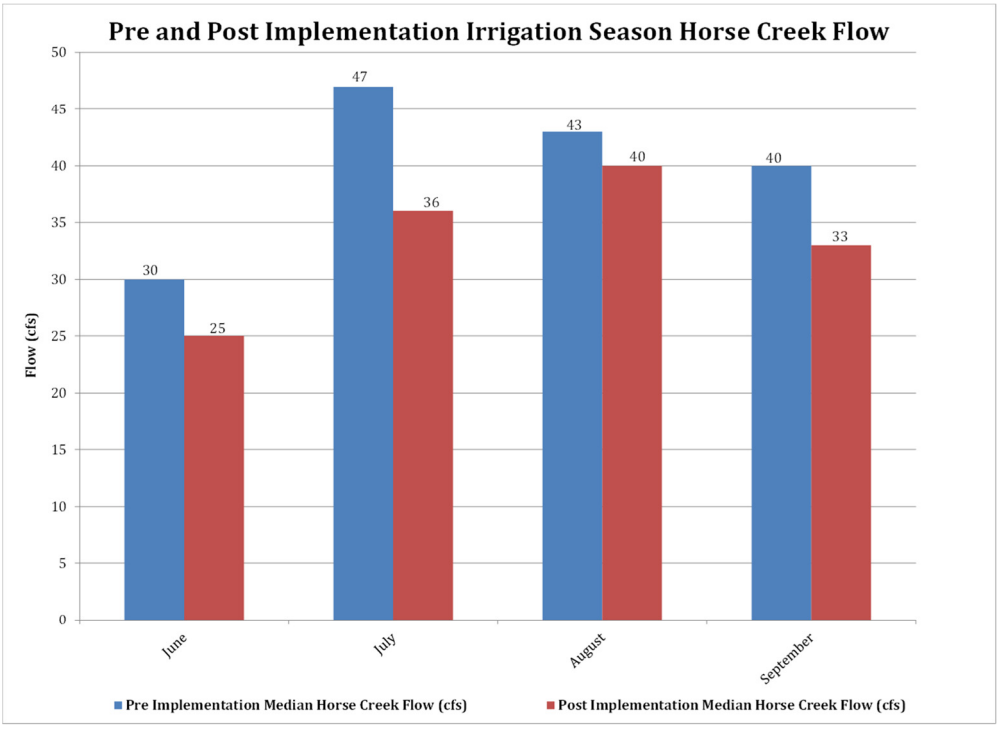

Figure 5-4. Median Daily Flows on Horse Creek During the Belle Fourche Irrigation District Irrigation Season; Before and After Best Management Practice Implementation.

The plot shows that the flows are being reduced significantly, especially within the months of July (17 percent reduction), August (7 percent reduction), and September (18 percent reduction) which are typically months with the greatest amount of irrigation deliveries within the district.

In addition to the continuous USGS streamflow gaging data acquired and analyzed for Horse Creek, regular site visits to Horse Creek above Vale, South Dakota, were performed over the 2012 monitoring season. This monitoring site was deemed HCR02 and its location is near the USGS gaging location historically operated on Horse Creek. Because the USGS has discontinued operation of the Horse Creek above Vale, South Dakota, gaging location as of September 30, 2012, the development of a stage-discharge relationship at this location was a key component of monitoring objectives slated for Horse Creek.

Biweekly site visits were performed from May 16, 2012, through October 13, 2012. Tasks performed per visit, pertaining to the development of the stage-discharge rating equation for HCR02, consisted of collecting manual stage measurements and manual discharge measurements as well as downloading logged pressure readings that were collected via a pressure transducer housed on-site that continuously logged pressure and temperature readings in 15-minute intervals. This data was adjusted to obtain the depth of water at each 15-minute interval. Using manual stage and discharge measurements collected throughout the monitoring season, a stage-discharge rating curve equation was developed for HCR02. This rating equation was then used to adjust the 15-minute logged transducer depths into 15-minute stream discharge measurements for the 2012 monitoring season. Figure 5-5 displays the hydrograph developed at HCR02 for the 2012 monitoring season.

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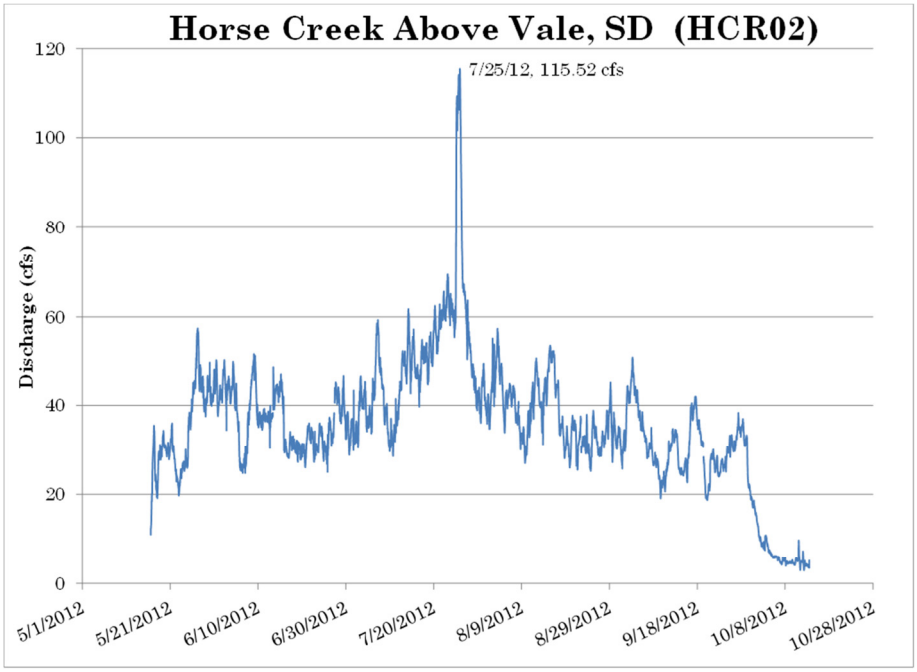

Figure 5-5. Hydrograph for Horse Creek Above Vale, South Dakota for the 2012 Monitoring Season.

Implemented BMPs are continuing to show that they are achieving their goals. The BMPs used within the BFID to date include automated gate controls and flow monitoring, replacing open ditches with pipeline, lining open canals and laterals, replacing flood irrigation techniques with sprinkler irrigation, and irrigation scheduling for BFID operators. Along with the implementation of physical BMPs, public meetings and project tours have helped extend public outreach and awareness within the watershed.

5.3 WATER-QUALITY ANALYSES

To gain insight regarding the effectiveness of the current implementation plan, statistical analyses were performed on multiple aspects of data collected at five sites located on the Belle Fourche River in South Dakota, as well as monitoring that was conducted at one site on a key tributary to the Belle Fourche River, Horse Creek. Figure 5-6 displays the location of the five monitoring sites on the Belle Fourche River and the monitoring site on Horse Creek, HCR02.

RSI-2196-13-019

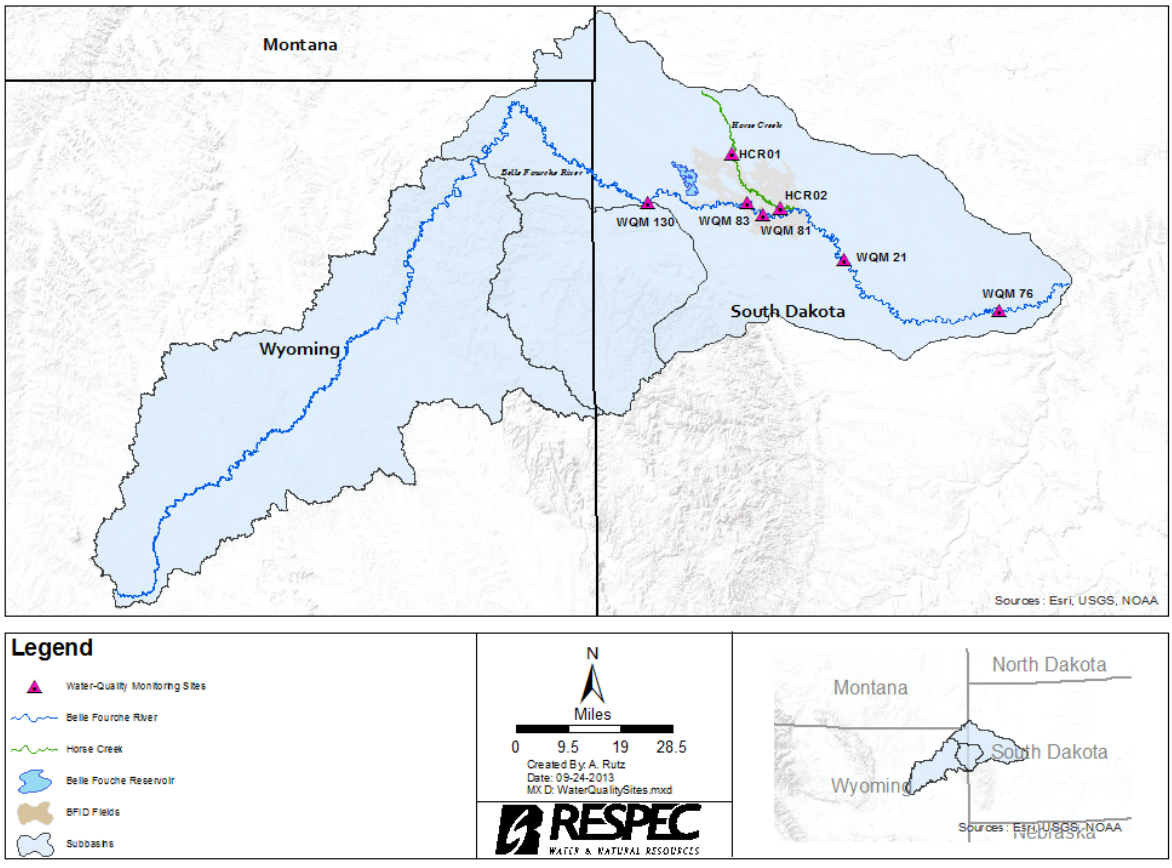

Figure 5-6. Location of the Five South Dakota Department of Environmental Quality Water-Quality Monitoring Sites and the Horse Creek Monitoring Sites within the South Dakota Portion of the Belle Fourche River Watershed.

Water-quality data collected by the SD DENR at WQM sites on the main stem of the Belle Fourche River on which analyses were performed consists of *E. coli*, fecal coliform, and TSS concentration data, which dates back to 1967. Water-quality data collected by the USGS and RESPEC on the tributary Horse Creek consists of specific conductivity and *E. coli* concentration data, with the oldest of these records dating back to 2004. The USGS initiated monitoring for specific conductivity on Horse Creek in May of 2004 and continued through October of 2011, collecting daily mean values. RESPEC began monitoring on Horse Creek in May of 2012 and continued through October of 2012, collecting continuous specific conductivity measurements as well as biweekly grab samples for *E. coli* and specific conductivity at Horse Creek above Vale, SD (HCR02). Grab samples were analyzed by Energy Laboratories in Rapid City, South Dakota. It should be noted that throughout the 2012 monitoring season, efforts to sample above the BFID on Horse Creek (HCR01) were employed; however, there was no flow recorded at the site so no samples were collected.

The sites shown in Figure 5-6 and given in Tables 5-3 through 5-5 are listed in order from upstream to downstream. Analyzed data was grouped into two categories: preBMP and postBMP implementation. PreBMP implementation data refers to data collected before the year 2005 before rigorous BMP implementation began, while postBMP implementation data refers to data collected after, and including, the year 2005. It should be noted that data pertaining to Horse Creek dates back to 2004 and inclusion of a preBMP condition to the analysis for this monitoring location would contain only one year of record on which the analysis would be based. Therefore there will be no pre and postBMP water-quality implementation conditions analyzed for Horse Creek.

5.3.1 BELLE FOURCHE RIVER

5.3.1.1 *E. coli* Water-Quality Data

Statistics generated for *E. coli* bacteria sampling data collected from the five SD DENR WQM sites on the Belle Fourche River during the recreation season (May 1 through September 30) are displayed in Table 5-3. Let it be noted that for the *E. coli* data analyzed in Table 5-3, no record of data exists before the year 2009. Because no preBMP data are available, no comparison for *E. coli* reduction can be made within this segment of the implementation plan and the summary provided will be used as a comparison for future BMP implementation progress. It should also be noted that BMP implementation to date focused on TSS reductions rather than bacteria, although many of the practices will have a positive impact on the loadings for both constituents.

The data collected during the recreation season (May 1 through September 30) from each monitoring site from 2009 to 2012 was used to calculate the percent exceedance of the single sample *E. coli* bacteria criterion of 235 mpn/100 mL. Note that not all monitoring sites are

Table 5-3. *E. coli* Statistics for South Dakota Department of Environment and Natural Resources Monitoring Sites on the Mainstem of the Belle Fourche River

Site	BMP Status	Period of Record	Mean (mpn/100 mL)	Median (mpn/100 mL)	Number of Samples Exceeding Criterion	Total Samples	Percent Exceedance (%)	Site Applicability to 235 mpn/100 mL Criterion
WQM 130	PostBMP	05/05/2009–09/18/2012	251.45	88.50	2	20	10	X
WQM 83	PostBMP	05/05/2009–08/22/2012	40.88	36.50	0	8	0	
WQM 81	PostBMP	05/05/2009–08/22/2012	56.75	44.00	0	8	0	
WQM 21	PostBMP	05/05/2009–08/22/2012	62.25	21.00	1	8	13	
WQM 76	PostBMP	05/05/2009–09/18/2012	213.00	28.00	4	20	20	X

located on waters with a criterion of 235 cfu/100 mL, which is applicable to those waters with an assigned immersion recreation beneficial use. These locations are designated accordingly in Table 5-3.

As can be seen from Table 5-3, two of the five WQM sites on the Belle Fourche River (WQMs 83 and 81) reported zero exceedances of the 235 mpn/100 mL criterion. WQM sites 130, 21, and 76 reported percent exceedance values of 10, 13 and 20 percent respectively. Note that WQM sites 130 and 76 are located on waterways in which the 235 mpn/100 mL criterion is applicable, whereas WQM sites 83, 81, and 21 have been referenced to this criterion for comparative purposes explicitly.

5.3.1.2 Fecal Coliform Water-Quality Data

Fecal coliform bacteria sampling data collected from the five SD DENR WQM sites on the Belle Fourche River during the recreation season (May 1 through September 30) was statistically analyzed for pre and postBMP conditions, as provided in Table 5-4. Median fecal coliform concentrations at all but two WQM sites (WQM 81 and WQM 76) dropped after significant BMP implementation began in 2005 (postBMP). The largest percent reduction in median concentration from the preBMP to postBMP condition was observed at WQM 130, at 19 percent. The smallest percent reduction was observed at WQM 76, where the site was shown to increase 43 percent. This gain may be attributed to an error in sampling, an error in analysis of the sample, or a heavy storm event, as it appears as if an outlier within the dataset is present. This outlier value, occurring in July of 2009, ranges nearly three orders of magnitude higher than that of the next highest observed value.

As can be seen from Table 5-4 WQM sites 83, 81, and 21 in the postBMP condition reported zero exceedances of the 400 mpn/100 mL criterion. Again, let it be noted that WQM sites 130 and 76 are located on waterways in which the daily maximum criteria of 400 mpn/100 mL is applicable, whereas WQM sites 83, 81, and 21 have been compared to this criterion for comparative purposes only and should be referenced so accordingly.

5.3.1.3 Total Suspended Solids Water-Quality Data

TSS sampling data statistics produced from data collection at the five SD DENR WQM sites on the Belle Fourche River are given in Table 5-5.

The median TSS concentration at WQM 21 was the only WQM site that displayed a decrease in concentration from the preBMP to postBMP condition, reporting a 38 percent reduction. Note that when assessing changes in median concentration from the preBMP to postBMP condition, consideration of the spatial location of the WQM sites in relation to the location of TSS BMP implementation projects within the watershed must be taken into account. For

Table 5-4. Fecal Coliform Statistics for South Dakota Department of Environment and Natural Resources Monitoring Sites on the Mainstem of the Belle Fourche River

Site	BMP Status	Period of Record	Mean (mpn/100 mL)	Median (mpn/100 mL)	Number of Samples Exceeding Criterion	Total Samples	Percent Exceedance (%)	Site Applicability to 400 mpn/100 mL Criterion
WQM 130	PreBMP	07/21/1999–09/14/2004	419.35	185	6	26	23	X
	PostBMP	05/24/2005–09/18/2012	338.30	150	5	40	13	X
WQM 83	PreBMP	05/02/1978–07/14/2004	307.73	70	5	30	17	
	PostBMP	07/13/2005–08/22/2012	62.91	64	0	11	0	
WQM 81	PreBMP	11/07/1990–07/14/2004	285.52	87	3	27	11	
	PostBMP	07/13/2005–08/22/2012	119.33	96	0	12	0	
WQM 21	PreBMP	06/28/1967–07/14/2004	869.21	45	41	150	27	
	PostBMP	07/13/2005–08/22/2012	84.00	39	0	12	0	
WQM 76	PreBMP	09/29/1976–09/16/2004	1,108.15	60	10	80	13	X
	PostBMP	06/23/2005–09/18/2012	3,829.26	86	5	38	13	X

Table 5-5. Total Suspended Solids Statistics for South Dakota Department of Environment and Natural Resources Monitoring Sites on the Mainstem of the Belle Fourche River

Site	BMP Status	Period of Record	Mean (mg/L)	Median (mg/L)	Number of Samples Exceeding Criterion	Total Samples	Percent Exceedance (%)	Site Applicability to 158 mg/L Criterion
WQM 130	PreBMP	04/29/1999–12/08/2004	244.29	21	6	39	15	X
	PostBMP	02/17/2005–08/16/2012	274.94	88	21	62	34	X
WQM 83	PreBMP	06/27/1977–10/12/2004	80	37	10	101	10	X
	PostBMP	04/18/2005–08/22/2012	80.74	38	3	23	13	X
WQM 81	PreBMP	06/27/1977–10/12/2004	197.48	18	12	102	12	X
	PostBMP	01/19/2005–08/22/2012	98.24	32	1	25	4	X
WQM 21	PreBMP	06/28/1967–10/12/2004	538.00	42	57	194	29	X
	PostBMP	01/19/2005–08/22/2012	86.48	26	4	27	15	X
WQM 76	PreBMP	09/29/1976–11/22/2004	372.00	39	27	127	21	X
	PostBMP	01/20/2005–09/18/2012	632.33	44.5	21	78	27	X

instance, WQM sites 130 and 83 are influenced greater by upstream controls outside of the South Dakota portion of the watershed than by sediment-saving BMPs that have been implemented within the watershed. Counter to this occurrence, WQM sites 81 and 21 report significant TSS reductions from the preBMP to postBMP condition and are located within regions of the watershed in which numerous TSS BMP projects have been implemented since 2005.

As can be seen from Table 5-5, all five WQM sites reported exceedances of the 158 mg/L criterion. WQM 81 in the postBMP condition reported the smallest percent exceedance (4 percent) of the standard with only one sample exceeding the daily maximum value of 158 mg/L. The greatest percentage of exceedances was observed at WQM 130 in the postBMP condition, where 21 of 62 samples (34 percent) exceeded the daily maximum criterion of 158 mg/L. All WQM sites are located on waterways in which the daily maximum criterion of 158 mg/L applies and, as the data suggests, the TSS impairment status for the Belle Fourche River is justly reinforced.

5.3.2 HORSE CREEK

Horse Creek is a key tributary within the watershed. Horse Creek contributes significant volume of irrigation return flows to the Belle Fourche River during the BFID irrigation season. Water-quantity aspects pertinent to Horse Creek were previously identified, therefore the following discussion will outline water-quality parameters which have historically and more recently prompted monitoring efforts on Horse Creek.

5.3.2.1 Specific Conductance Water-Quality Data

Horse Creek is listed as impairing its Irrigation Waters beneficial use within South Dakota's 2010 303(d) list of impaired waterbodies. The 2012 303(d) list of impaired waterbodies lists Horse Creek in full compliance of its Irrigation Waters beneficial use; however, throughout the 2012 season monitoring efforts continued to focus on sampling pertinent to conductivity parameters within Horse Creek.

From May 2012 through October 2012, continuous measurements as well as biweekly grab samples for specific conductivity were collected at Horse Creek above Vale, South Dakota. Biweekly grab samples were analyzed by Energy Laboratories in Rapid City, South Dakota. In addition to monitoring performed by RESPEC on Horse Creek over the 2012 monitoring season, the USGS conducted monitoring for specific conductance at USGS 06436760 Horse Creek above Vale, South Dakota, from May 2004 through October 2011. Data from this period, along with data collected over the 2012 monitoring season, were analyzed for comparison to the daily maximum criterion of 4,375 µmhos/cm at 25° C, as designated for Irrigation Waters. Table 5-6 summarizes all specific conductivity data collected on Horse Creek from May of 2004 through October of 2012.

Table 5-6. Specific Conductivity Statistics for Horse Creek within the Belle Fourche River Watershed in South Dakota

Time Period	Mean of Daily Maximum Values (µmhos/cm)	Median of Daily Maximum Values (µmhos/cm)	Number of Samples Exceeding Criterion	Total Number of Samples	Percent Exceedance (%)	Site Applicability to 4,375 µmhos/cm Criterion
05/28/2004–10/13/2012	2,472	2,100	147	1,588	9.3	X

As displayed in Table 5-6, monitoring performed on Horse Creek from May of 2004 through October of 2012 reported 147 exceedances of the 4,375 µmhos/cm at 25° C criterion. Figure 5-7 displays a plot of all daily maximum specific conductivity values collected for the period of record on Horse Creek. As can be observed from this plot, daily maximum values in exceedance of the Irrigation Waters beneficial use criteria occur within the months of March, April, May, and June, all before the 2008 monitoring season. All data collected following the 2007 monitoring season reported zero exceedances of the daily maximum criterion.

RSI-2196-13-020

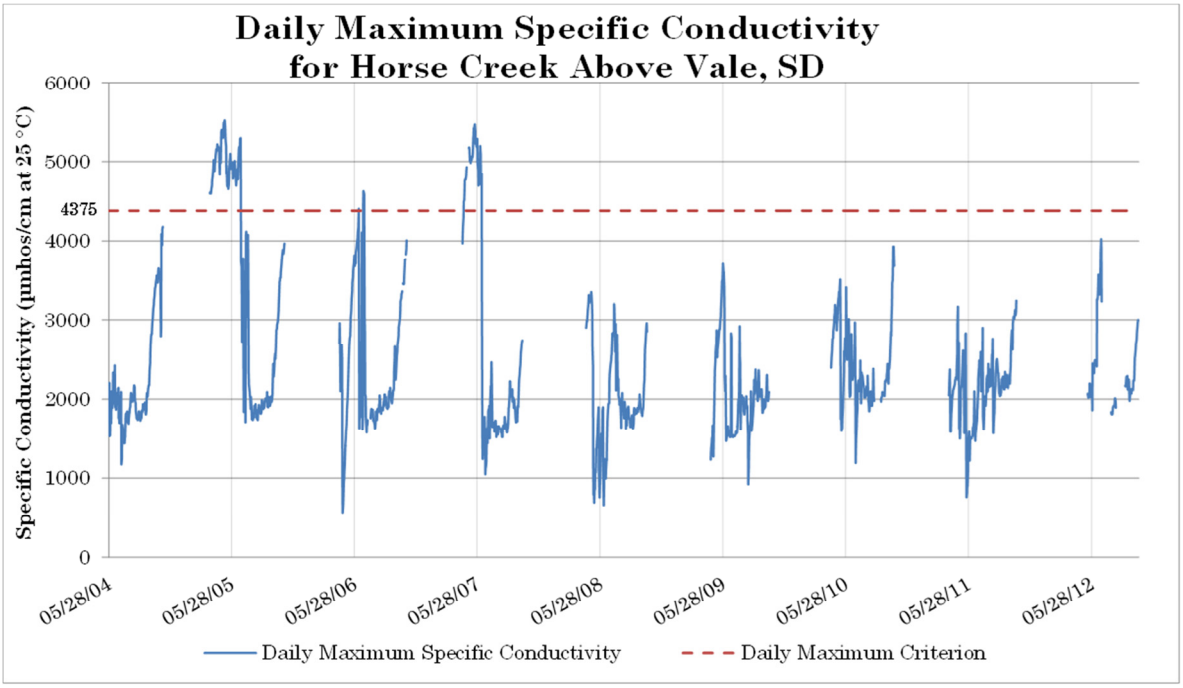

Figure 5-7. Daily Maximum Specific Conductivity Values for Horse Creek Within the Belle Fourche River Watershed in South Dakota.

5.3.2.2 *E. coli* Water-Quality Data

Horse Creek has been assigned a Limited Contact Recreation beneficial use, however in the South Dakota 2012 303(d) list of impaired waterbodies it is stated that support of this designation is inconclusive because of insufficient data available for determination. From May 2012 through October 2012, biweekly *E. coli* grab samples were collected and analyzed by

Energy Laboratories in Rapid City, South Dakota. A total of 12 grab samples were collected over this period reporting *E. coli* concentrations ranging from 34 mpn/100 mL to 3,450 mpn/100 mL. Collected *E. coli* concentration data has been compared to the single sample *E. coli* bacteria criterion of 1,178 mpn/100 mL as designated for waterbodies with an assigned Limited Contact Recreation beneficial use. Note that two of the samples (October 3, 2012, and October 13, 2012) included within this comparison were collected outside of the summer recreation season (May 1 through September 30). These samples have been included for comparative purposes only and hold no justification in potential contribution to exceedances of the *E. coli* criterion as it applies to Horse Creek.

Figure 5-8 displays the results of *E. coli* bacteria sampling performed on Horse Creek during the 2012 monitoring season. This plot shows that one of the twelve *E. coli* grab samples obtained was in excess of the single sample *E. coli* bacteria criterion of 1,178 mpn/100 mL, thus resulting in an eight percent exceedance of the *E. coli* bacteria criterion for Limited Contact Recreation waters for the 2012 monitoring season. This exceedance occurred on July 25, 2012, and is nearly seven times greater than that of the next greatest *E. coli* concentration observed for the season. The 2012 Horse Creek hydrograph (Figure 5-5) displays that peak discharge for the 2012 monitoring season was observed on July 25, 2012, therefore corroborating a direct relationship between elevated discharge and *E. coli* bacteria observed within Horse Creek on this date. The Belle Fourche National Weather Service Cooperative Observation Program (COOP) meteorological station reports 1.22 inches of precipitation fell on this date as well. These observations indicate that precipitation overland runoff and washoff potentially had the capacity to transport accumulated bacteria near or within the confines of the riparian area to Horse Creek.

RSI-2196-13-021

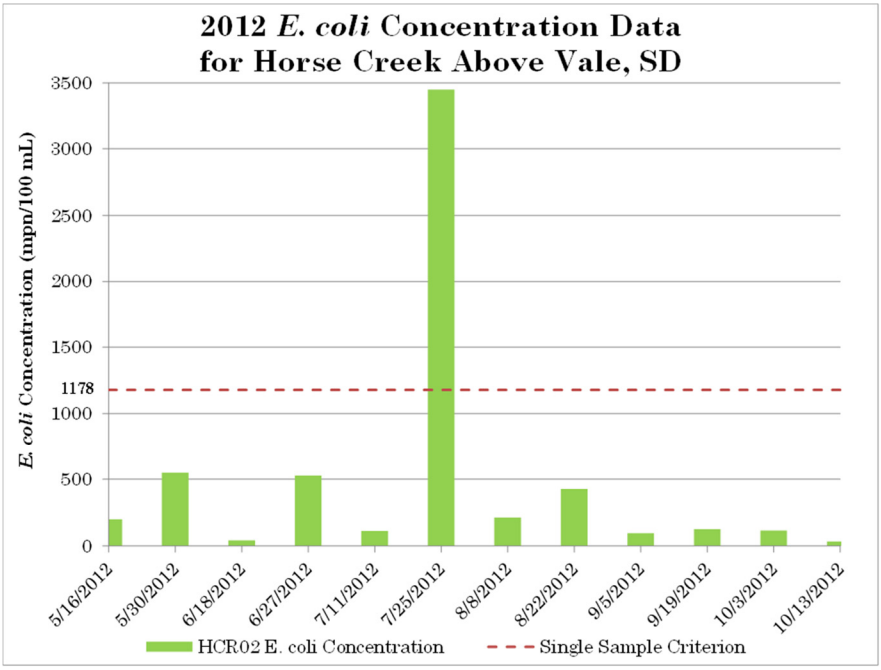

Figure 5-8. 2012 *E. coli* Concentrations for Horse Creek Within the Belle Fourche River Watershed in South Dakota.

6.0 SUCCESSES OF THE PROJECT AND ASPECTS OF THE PROJECT THAT DID NOT WORK WELL

Continued public awareness of this ongoing project greatly enhances the effort being put into improved water quality in the watershed. Combined efforts of radio advertisements, brochures, outreach booths, tours, the BFRWP website, and the soil-quality demonstration trailer were measured as a success. Many comments and questions were received from the public mentioning they heard about the BFRWP from radio advertisements and sound bites. These activities increased interest and awareness from the general public in addition to the producers directly involved in an implementation project. Buy-in from the general public is a huge asset when making watershed wide improvements in water quality.

Something new that was provided for in the Segment 5 funding round was the technical assistance provided for irrigation scheduling. This effort was a continuation of the BFRWP CIG funded by NRCS. With the framework set up with the original CIG, the BFRWP was able to effectively work with several producers. Continued effort focused on irrigation scheduling will provide water saving and sediment reductions in the watershed for years to come.

The BFRWP has an ongoing NRCS grant that augmented efforts being made to achieve project goals set out in the 10-year plan. Cooperative Conservation Partnership Initiative (CCPI) is part of the NRCS' existing EQIP program that provides targeted funds for rangeland improvement practices in the watershed. These range improvement practices include off stream water development and cross fencing for better livestock distribution that in turn lead to sediment reduction in the Belle Fourche River. The CCPI provided nearly $1.2 million for these types of improvement projects during this segment. Currently, the CCPI grant is in its fifth and final year of funding.

To further incentivize irrigation BMP installation, the BFRWP typically "piggy backs" 319 funds on top of EQIP funds. There was a dramatic cut in 2013 EQIP funding statewide in South Dakota. This lack of funds created challenges in reaching the original goal of 25 pivots in the watershed for Segment 5. Although the demand for conversion from flood irrigation to sparkler irrigation was high with the limited budget made it difficult to reach all of the interested producers.

7.0 PROJECT BUDGET/EXPENDITURES

The BFRWP received a $564,000 EPA section 319 Grant through DENR to continue installing the BMPs recommended in the *Phase I Watershed Assessment Final Report and TMDL* [Hoyer and Larson, 2004]. In addition to the EPA 319, $250,000 in State Revolving Funds were provided to fund BMPs. Tables 7-1a, 7-2a, and 7-3a show the budgets of 319, 319/matching funds and nonmatching funds, respectively. The budgets were the final budgets after the approval of the Segment 5 amendment. Tables 7-1b, 7-2b and 7-3b are the final expenditure budgets for 319, 319/matching funds and nonmatching funds, respectively. Changes in these budgets were documented as exhibits amendments to the budget as they were made.

7.1 319 BUDGET

The total 319 budget remained the same with some changes between tasks. From Task 1 Product 1c Irrigation Scheduling, $3,000 was transferred to Task 3 Product 4 Outreach and Education to cover the cost of the soil moisture sensors; from Task 2 Product 3, $10,897 was transferred to Task 3 Product 4 Outreach and Education to cover the expense of a Federal Audit; from Task 2 Product 3, $175 was transferred to Task 1 Product 1b to balance out the project budget. No other changes were made to the 319 budget.

7.2 MATCHING FUNDS BUDGET

All federal match requirements were met in this project. Final match dollars were higher than originally estimated. The rising cost of constructing BMPs created a situation where producer cash match was higher than expected. Also, $250,000 of State Revolving Funds were received that were used as match for the project.

7.3 NONMATCHING FEDERAL FUNDS BUDGET

Overall nonmatching funds were overestimated for the project by approximately $400,000. Federal dollars, including NRCS EQIP, can be variable from year to year depending on the demand making it a challenge to estimate actual numbers. 2013 EQIP funds were dramatically cut in the watershed creating this deficit. Changes occurred in all areas of the nonmatching budget to reflect what was actually spent.

Table 7-1a. Planned Budget of 319 Funds

Project Description	Consultants ($)	Producer ($)	BFID ($)	Butte Conservation District ($)	Totals
Objective 1. Implement BMPs Recommended in the Belle Fourche River Watershed TMDL					
Task 1. Reduce Nonused Water					
Product 1. Improved Irrigation Water Delivery and Application					
1a. Line and Pipe Open Canals and Laterals	–	–	–	–	
1b. Install 25 Sprinkler Systems	–	175,000			175,000
1c. Irrigation Scheduling	15,000	3,000			18,000
Task 2. Range and Riparian Area BMP Implementation					
Product 2. Implement Riparian BMPs					
Product 3. Implement Riparian BMPs		23,000			23,000
Objective 2. Conduct Public Outreach and Education, Implementation Record Keeping, Report Writing, Writing Future Grants					
Task 3. Project Management and Administration					
Product 4. Public Outreach and Education Implementation Record Keeping, Report and Future Grant Writing	292,000	–	–	40,000	332,000
Objective 3. Complete Essential Water-Quality Monitoring and TMDL Development					
Task 4. Water-Quality Monitoring to Assess BMPs					
Product 5. Water-Quality Monitoring	16,000		–		16,000
Total	**323,000**	**201,000**	**0**	**40,000**	**564,000**

Table 7-1b. Actual Budget of 319 Funds

Project Description	Consultants ($)	Producer ($)	BFID ($)	Butte Conservation District ($)	Totals
Objective 1. Implement BMPs Recommended in the Belle Fourche River Watershed TMDL					
Task 1. Reduce Nonused Water					
Product 1. Improved Irrigation Water Delivery and Application					
1a. Line and Pipe Open Canals and Laterals	–	–	–	–	
1b. Install 25 Sprinkler Systems	–	175,105			175,105
1c. Irrigation Scheduling	15,000				15,000
Task 2. Range and Riparian Area BMP Implementation					
Product 2. Implement Riparian BMPs					
Product 3. Implement Riparian BMPs		11,928			11,928
Objective 2. Conduct Public Outreach and Education, Implementation Record Keeping, Report Writing, Writing Future Grants					
Task 3. Project Management and Administration					
Product 4. Public Outreach and Education Implementation Record Keeping, Report and Future Grant Writing	305,967	–	–	40,000	345,967
Objective 3. Complete Essential Water-Quality Monitoring and TMDL Development					
Task 4. Water-Quality Monitoring to Assess BMPs					
Product 5. Water-Quality Monitoring	16,000		–		16,000
Total	**336,967**	**187,033**	**0**	**40,000**	**564,000**

Table 7-2a. Planned U.S. Environmental Protection Agency 319 and Matching Funds Budget

Project Description	EPA 319 ($)	Matching Funds ($)						Sum of Matching Funds ($)
		SRF Loan ($)	SRF Grant ($)	Producer (Cash and In-kind) ($)	Lawrence County (Cash) ($)	BFID (Cash and In-kind) ($)	WDEQ (Cash)	
Objective 1. Implement BMPs Recommended in the Belle Fourche River Watershed TMDL to Reduce TSS								
Task 1. Reduce Nonused Water								
Product 1. Improved Irrigation Water Delivery and Application								
1a. Line and Pipe Open Canals and Laterals								
1b. Install 25 Sprinkler Systems	175,000	200,000	50,000	610,000				860,000
1c. Irrigation Scheduling	18,000			10,000				10,000
Task 2. Riparian Area BMP Implementation								
Product 2. Implement Riparian BMPs								
Product 3. Implement Riparian BMPs	23,000			8,000				8,000
Objective 2. Conduct Public Education and Outreach, Implementation Record Keeping, Report Writing, Writing Future Grants								
Task 3. Project Management and Administration								
Product 4. Public Outreach and Education, Implementation Record Keeping, Report and Future Grant Writing	332,000							
Objective 3. Complete Essential Water-Quality Monitoring								
Task 4. Water-Quality Monitoring to Assess BMPs								
Product 5. Compile Water-Quality Monitoring Data	16,000				28,900	10,726	14,300	53,926
Total	**564,000**	**200,000**	**50,000**	**628,000**	**28,900**	**10,726**	**14,300**	**931,926**

Table 7-2b. Actual U.S. Environmental Protection Agency 319 and Matching Funds Budget

Project Description	EPA 319 ($)	Matching Funds ($)						Sum of Matching Funds ($)
		SRF Loan ($)	SRF Grant ($)	Producer (Cash and In-kind) ($)	Lawrence County (Cash) ($)	BFID (Cash and In-kind) ($)	WDEQ (Cash)	
Objective 1. Implement BMPs Recommended in the Belle Fourche River Watershed TMDL to Reduce TSS								
Task 1. Reduce Nonused Water								
Product 1. Improved Irrigation Water Delivery and Application								
1a. Line and Pipe Open Canals and Laterals								
1b. Install 25 Sprinkler Systems	175,105	200,000	50,000	968,728				1,218,728
1c. Irrigation Scheduling	15,000			0				0
Task 2. Riparian Area BMP Implementation								
Product 2. Implement Riparian BMPs								
Product 3. Implement Riparian BMPs	11,928			3,845				3,845
Objective 2. Conduct Public Education and Outreach, Implementation Record Keeping, Report Writing, Writing Future Grants								
Task 3. Project Management and Administration								
Product 4. Public Outreach and Education, Implementation Record Keeping, Report and Future Grant Writing	345,967							
Objective 3. Complete Essential Water-Quality Monitoring								
Task 4. Water-Quality Monitoring to Assess BMPs								
Product 5. Compile Water-Quality Monitoring Data	16,000				14,400	10,800	14,400	39,600
Total	**564,000**	**200,000**	**50,000**	**972,573**	**14,400**	**10,800**	**14,400**	**1,262,173**

Table 7-3a. Planned Nonmatching Funds Budget

EPA 319 and Nonmatching Funds Budget	Nonmatching Funds					Sum of Nonmatching Funds ($)
	SD DENR (Federal) ($)	NRCS EQIP (Federal) ($)	COE (Federal) ($)	BOR (Federal) ($)	USGS (Federal) ($)	
Objective 1. Implement BMPs Recommended in the Belle Fourche River Watershed TMDL to Reduce TSS						
Task 1. Reduce Nonused Water						
Product 1. Improved Irrigation Water Delivery and Application						
1a. Line and Pipe Open Canals and Laterals				150,000		150,000
1b. Install 20 Sprinkler Systems		374,000				374,000
1c. Irrigation Scheduling						
Task 2. Range and Riparian Area BMP Implementation						
Product 2. Implement Range BMPs		1,400,000				1,400,000
Product 3. Implement Riparian BMPs						
Objective 2. Conduct Public Outreach and Education, Implementation Record Keeping, Report Writing, and Writing Future Grants						
Task 3. Project Management and Administration						
Product 4. Public Outreach and Education, Implementation Record Keeping, Report and Future Grant Writing						
Objective 3. Complete Essential Water-Quality Monitoring						
Task 4. Water-Quality Monitoring to Assess BMPs						
Product 5. Water-Quality Monitoring	71,500		14,300	7,148	169,852	262,800
Total	**71,500**	**1,774,000**	**14,300**	**157,148**	**169,852**	**2,186,800**

Table 7-3b. Actual Nonmatching Funds Budget

EPA 319 and Nonmatching Funds Budget	Nonmatching Funds					Sum of Nonmatching Funds ($)
	SD DENR (Federal) ($)	NRCS EQIP (Federal) ($)	COE (Federal) ($)	BOR (Federal) ($)	USGS (Federal) ($)	
Objective 1. Implement BMPs Recommended in the Belle Fourche River Watershed TMDL to Reduce TSS						
Task 1. Reduce Nonused Water						
Product 1. Improved Irrigation Water Delivery and Application						
1a. Line and Pipe Open Canals and Laterals				104,488		104,488
1b. Install 20 Sprinkler Systems		208,271				208,271
1c. Irrigation Scheduling						
Task 2. Range and Riparian Area BMP Implementation						
Product 2. Implement Range BMPs		1,220,868				1,220,868
Product 3. Implement Riparian BMPs						
Objective 2. Conduct Public Outreach and Education, Implementation Record Keeping, Report Writing, and Writing Future Grants						
Task 3. Project Management and Administration						
Product 4. Public Outreach and Education, Implementation Record Keeping, Report and Future Grant Writing						
Objective 3. Complete Essential Water-Quality Monitoring						
Task 4. Water-Quality Monitoring to Assess BMPs						
Product 5. Water-Quality Monitoring	72,000		14,400	7,200	171,700	265,300
Total	**72,000**	**1,429,139**	**14,400**	**111,688**	**171,700**	**1,798,927**

8.0 FUTURE ACTIVITY RECOMMENDATIONS

During the next 3 years, additional project segments are planned to continue installing the BMPs outlined in the *Phase I Watershed Assessment Final Report and TMDL* [Hoyer and Larson, 2004] and the *Ten-Year Belle Fourche River Watershed Strategic Implementation Plan* [Hoyer, 2005]. This will ensure that the overall goal for the watershed is met, which is to bring the Belle Fourche River and Horse Creek into compliance with state TSS standards. As additional TMDLs are completed for other lakes and tributaries in the watershed, the implementation of TMDLs developed will be added to the Belle Fourche River Watershed project.

9.0 REFERENCES

Hoyer, D. P. and A. Larson, 2004. *Phase I Watershed Assessment Final Report and TMDL*, prepared for the state of South Dakota, Pierre, SD.

Hoyer, D. P., 2005. *Ten-Year Belle Fourche River Watershed Strategic Implementation Plan*, RSI-1821, prepared by RESPEC, Rapid City, SD, for the Belle Fourche Irrigation District, Newell, SD.

Rolland, C. and D. P. Hoyer, 2005. *Belle Fourche Irrigation District Water Conservation Plan*, RSI-1824, prepared by RESPEC, Rapid City, SD, for the Belle Fourche Irrigation District, Newell, SD.

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