SD Department of Environment & Natural Resources
Water Resources Assistance Program
Total Maximum Daily Load

Lower Bad River Watershed and Upper Lake Sharpe, Portions of Jones & Stanley Counties, South Dakota April, 2000

This TMDL was developed in accordance with Section 303(d) of the federal Clean Water Act and guidance developed by the US Environmental Protection Agency. The 1998 303(d) Waterbody List identified the Bad River as impaired by a measure of accumulated sediment in Lake Sharpe from the mouth of the Bad River past the point where Antelope Creek flows into Lake Sharpe. The sediment occurring from the flow of the Bad River into Lake Sharpe also includes a measure of impairment with an impact to recreation by limiting boat, fishing use days, and water contact sports and impairs warm water marginal fish life propagation by reducing the fish spawning opportunities and success. A TMDL for sediment reduction has been developed and is supported below.

TMDL Summary Table:

Waterbody Name	**Bad River/Lake Sharpe**
Hydrologic Unit Code (HUC)	10140102
TMDL Pollutant	**Accumulated Sediment**
Water Quality Target	Re-vegetate 45% of the Type F & G channels (Rosgen's Stream Channel Classification) in Jones, Stanley and portions of Haakon counties.
TMDL Goal	Reduce annual sediment delivery 30% by 2010.
303(d) Status	1998 303(d) Waterbody List, Priority 1, Page 19
Impaired Beneficial Uses	Warmwater marginal fish life propagation; limited contact recreation
Reference Documents	Lower Bad River Basin Study, Upper Bad River Basin Study, Phase I and IB of the Bad River Water Quality Project, Bad River Phase II Water Quality Final Report

I. Executive Summary:

- ***Waterbody Description and Impairments***

  The Bad River drains 3,173 square miles from the area known as the Badlands between Wall and Kadoka, to the Missouri River / Lake Sharpe between Pierre and Fort Pierre, South Dakota. The Bad River annually delivers about 3.25 million tons of sediment to Lake Sharpe (U.S Army Corps of Engineers'(COE) 1986 data). The sediment load causes decreased fish spawning success, decreased fish growth and fishing use days, as well as, reductions in other water-based recreation in the Pierre-Fort Pierre area.

The sediment accumulation (sediment built up at a given point since Lake Sharpe was created) below the mouth of the Bad River is creating a higher water elevation in the Pierre-Fort Pierre portion of Lake Sharpe. The increased water elevation is causing flooding and high water tables in parts of both towns during high water releases from Oahe Dam. Oahe Dam is located about six miles upstream from the mouth of the Bad River. The flooding and related problems are increasing and occur whenever large discharges of water are released from the dam. These problems have been especially troublesome when ice cover occurs on Lake Sharpe during the winter months. The ice builds up, causing reduced flows downstream and raising the water level in the upper portion of Lake Sharpe. This results in the need for reduced discharge from Oahe Dam to alleviate the flooding and related high water problems. These problems occur during very cold weather which is a peak power requirement time for Oahe Dam. Estimated economic losses from reduced power generation and recreation impairment exceed $13 million annually.

The sediment load delivered (sediment carried by the waters of the Bad River into Lake Sharpe pool area) is primarily due to eroding gullies and streambanks in grazing lands, especially in the lower third of the watershed. This statement is supported by two studies completed by the United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS). The Lower Bad River-River Basin Study was completed in March of 1994 and the Upper Bad River-River Basin Study was finished in October of 1998. Both studies indicate that sediment occurs from several sources of erosion, which include cropland, gullies, stream banks, rangeland, and the Badlands area. Cropland located in the upper portions of the watershed is the second largest source of sediment. The cropland erosion is severe but most of the eroded soil is trapped and remains in the uplands. Runoff from this cropland increases when the residual cover is low and does have a significant effect on the gully and stream bank erosion in the lower portions of the watershed.

The Badlands area also provides sediment to Lake Sharpe. The Badlands exist in the uppermost part (western end) of the watershed. A study completed in 1989 using 319 funds from South Dakota Department of Environment and Natural Resources (DENR) and sponsored by the North Central Resource Conservation and Development (RC&D) Council, indicated that about 11 percent of the sediment delivered to Lake Sharpe from the upper portion of the watershed originates in the Badlands. The majority of the Badlands erosion is geologic.

The Bad River is an intermittent stream throughout most of the watershed. Water flow has been measured at the Fort Pierre site since 1929. There is only one year when flow was continuous for a year long period. The Bad River provides some limited warm water fishing, stock water and irrigation along the main channel and major tributaries. The sediment in the Bad River runoff negatively effects these uses during periods of high flow. However, this TMDL only addresses the sediment that is being delivered to Lake Sharpe.

- ***Stakeholder Description***

The Stanley County Conservation District in cooperation with the DENR was the sponsor for the Lower Bad River -River Basin Study (LBRRBS). Cooperative river basin studies are made under the authority of Section 6 of Public Law 83-566, as amended, (the Watershed Protection and Flood Prevention Act, and was funded through the USDA Soil Conservation Service (SCS), and Forest Service (FS). Table 1 lists the participants and stakeholders in the LBRRBS.

Table 1.
Lower Bad River Basin Study Stakeholders

USDA Soil Conservation Service	SD Dept. of Agriculture
USDA Forest Service	SD Dept. of Game, Fish, and Parks
SD Dept. of Environment and Nat. Resources	SD State University
Stanley Co. Conservation District	North Central RC&D Council
Jones Co. Conservation District	City of Pierre
Jackson Co. Conservation District	City of Fort Pierre
Haakon Co. Conservation District	Pierre Chamber of Commerce
American Creek Conservation District	SD Great Lakes Association
SCS Offices in Jones, Jackson, Haakon, Stanley	USDA Ag. Stab. and Conservation Service
& Lyman Counties	USDA Cooperative Extension Service
U.S. Army Corps of Engineers	U.S. Fish and Wildlife Service
U.S. Environmental Protection Agency	U.S. Geological Service

The Upper Bad River-River Basin Study (UBRRBS) was sponsored by the Badlands Resource Conservation and Development (BRC&D) Area Council, Inc. and the conservation districts in East Pennington, Haakon, Jackson, Jones, Lyman, and Stanley Counties. This cooperative river basin study used the same authority and funding as the LBRRBS however, the Soil Conservation Service was now renamed the Natural Resource Conservation Service. Table 2 lists the sponsors and participants in the UBRRBS.

Table 2.
Upper Bad River Basin Study Stakeholders

USDA Natural Resource Cons. Service USDA Forest Service SD Dept. of Env. and Nat. Resources SD Dept. of Agriculture, Division of Nat. Resources and Forestry Badlands RC&D North Central RC&D Cities of Fort Pierre, Kadoka, Midland, Murdo, Philip, Pierre, and Wall American Creek, East Pennington,	Haakon, Jackson, Jones, and Stanley Counties Conservation Districts SD Dept. of Game, Fish, and Parks SD Great Lakes Association South Dakota State University USDA Cooperative Extension Service USDA Farm Service Agency US Army Corps of Engineers US Environmental Protection Agency US Fish and Wildlife Service US Geological Service

- ***Intent to Submit as a Clean Water Act Section 303(d) TMDL***

  In accordance with Section 303(d) of the Clean Water Act, the South Dakota Department of Environment and Natural Resources submits for EPA, Region VIII review and approval, the sediment accumulation total maximum daily load (TMDL) for the Lower Bad River\Lake Sharpe as provided in this summary and attached document. This TMDL has been established at a level necessary to protect assigned beneficial uses of Lake Sharpe with consideration of seasonal variation and a margin of safety. Beneficial uses that may benefit by the general improvement in water quality are: cold and warm water fishery, immersion recreation, wildlife propagation and stock watering, irrigation, commerce and industry.

II. Problem Characterization:

- ***Waterbody Description/Maps***

  The Bad River is the smallest of five major river basins in western South Dakota that drain into the Missouri River. It originates in the Badlands near Wall, South Dakota and flows to the east approximately 100 miles where it then discharges into Lake Sharpe of the Missouri River System near the communities of Pierre and Fort Pierre. The Bad River watershed encompasses 3,173 square miles in Haakon, Jackson, Jones, Lyman, Pennington and Stanley Counties. The U.S. Army Corps of Engineers' gauge data from 1948 to 1986 estimates that the Bad River discharges an average annual sediment load of 3,250,000 tons of sediment delivered into Lake Sharpe.

Waters Covered by TMDL

Lake Sharpe is the main benefactor of this TMDL. The principal sediment source for this problem area of Lake Sharpe is the Bad River Watershed drainage located in Jones and Stanley Counties. Antelope Creek and several other small watersheds between the Bad River and Antelope Creek also contribute sediment to the problem area in Lake Sharpe. Data has not been collected to establish the amount of sediment entering Lake Sharpe from Antelope Creek or the other small unnamed watersheds, but COE information indicates that this area is having a minor impact on sediment build up below the mouth of the Bad River. Existing projects have also targeted reduction of sediment inputs from these areas.

- ***Rationale for Geographic Coverage***

  The Lower Bad River-River Basin Study was requested by the Stanley County Conservation District as the result of public concern about the adverse effects sediment deposition from the Bad River has on water quality, recreation, and fish and wildlife habitat in Lake Sharpe. The Bad River was on the priority list for Section 319 Nonpoint Source Pollution Control projects. DENR had provided funds to implement Phase I and IB of the Bad River Water Quality Project. This North Central RC&D Project, completed in 1989, monitored sediment along different reaches of the Bad River with the objective of identifying major sediment sources. Phase I and IB indicated that the lower portion of the Bad River was responsible for the majority of the sediment. One of the principal efforts of the LBRRBS was to identify and quantify areas needing treatment for sediment reduction. The LBRRBS found that approximately two thirds of the sediment that the Bad River delivered to Lake Sharpe originated in the lower one third of the watershed.

  The Upper Bad River-River Basin Study (UBRRBS) was sponsored by the Badlands Resource Conservation and Development (BRC&D) Area Council, Inc. and the conservation districts in East Pennington, Haakon, Jackson, Jones, Lyman, and Stanley Counties. The Upper Bad River Basin Study further broke down the various subwatersheds into the different types of channels based on Rosgen's Stream Classification Method. This study accounted for the remaining tons of sediment that originate in the upper portion of the Bad River Watershed. The Upper Bad River Watershed contributed one third of the sediment to Lake Sharpe annually (34%). The study further estimated that about 63 percent of this sediment originates from geologic erosion.

- ***Pollutant(s) of Concern***

  Sediments originating in the Bad River, Antelope Creek and several small tributaries lying between these two watersheds that is delivered to Lake Sharpe.

- ***Use Impairments or Threats***

  Sediment has a negative effect on fishing and recreation use of Lake Sharpe. When the Bad River is running and discharging large sediment loads during the summer months, immersion recreation is severely impaired and use of the Lake from the mouth of the Bad River past Antelope Creek is almost non existent.

Fishing is even more impaired during high sediment discharges resulting from intense summer storms or early spring snowmelt. South Dakota Game, Fish, and Parks has conducted angler surveys each years since 1991 and estimate that the sport fishing value from the Bad River to DeGrey is somewhere between $1,087,000 to $2,556,000 annually. From these surveys they have determined that the average fishing pressure has been about 49,000 hours. If the sediment discharge were not a factor, the pressure for this reach of the Lake would be about 125,000 hours which more than doubles the sport fishing value of the area.

Sediment also affects the access to Lake Sharpe in the Pierre - Ft. Pierre area. Dredging has to be performed about every four years below Farm Island and LaFramboise Island to provide access for boats to the main channel of Lake Sharpe. Sediment reduction through this TMDL would provide beneficial results - more immersion recreation use days, more fishing days and a decrease in the required dredging for boat access - when the target is reached.

There are three factors that must be understood about the implementation of this TMDL:

1. ***There is no way to totally eliminate the production of sediment from the Bad River and the other tributaries that drain into Lake Sharpe. There will always be a sediment load delivered. Lake Sharpe has a finite amount of storage. At some point in time this reservoir will be filled with sediment. Implementation of this TMDL will delay the time needed to fill Lake Sharpe and thereby, extend the duration of the reservoir's benefits.***

2. ***The impacts from the Bad River on beneficial uses will only be lessened when this TMDL is implemented. There will always be times during high discharge from the Bad River when the assigned beneficial uses of Lake Sharpe will not be met.***

3. ***The planned treatment to improve the vegetation in the riparian zones and adjacent upland is a part of a natural process based on improvement by vegetative and livestock management over time. This is not a quick fix. The 30 percent reduction in sediment delivery by 2010 is a goal. Weather, climate and other variables will influence achievement of this goal. There will be years when sediment delivery will still be high. Existing projects have already improved the vegetation in some of the eroding riparian zones. Total average tons of sediment delivered to Lake Sharpe already appear to be lower, even though the last several years have been periods of higher than normal runoff.***

- ***Probable Sources***

The river basin studies conducted by NRCS indicate that the River Breaks landform is the principal contributor of sediment from the Bad River Watershed with gully and channel erosion the major problem. The Upper Bad River Basin Study further indicates that the Rosgen classification can be used to estimate sediment delivery from the various types of stream channels. Type F & G channels appear to provide significant sediment throughout the watershed. Type B & C channels also can provide considerable sediment and should be considered especially when the health of the riparian area is functioning at risk or degraded to a non-functioning condition.

Gully and streambank erosion should be the principal focus of correction in an effort to reduce sediment delivery to Lake Sharpe. Those areas with the greatest potential to deliver sediment to the main Bad River channel will be considered as areas of priority for treatment. The Breaks landform contains the major amount of gully and streambank erosion areas. The most serious condition to deliver sediment to the Bad River occurs where the riparian zone has degraded starting at the Bad River channel and remains unvegetated or in a nonfunctioning condition up through the subwatershed. In some cases the gullies may continue into the Upland landform. Re-vegetation of these areas must be accomplished to significantly reduce the sediment delivery. The area of effort will be in those watersheds that enter the Bad River in Jones and Stanley Counties.

Re-vegetation of the degraded riparian zones will require a variety of applied conservation practices. Resource management systems must be implemented that address all the factors that are causing the degradation of the riparian zones. Some of the common practices that will be implemented to achieve the resource management systems will include; grazing management systems, fencing, livestock water, wind breaks, pipelines, tanks, livestock crossings, tree planting, grass seeding, grade stabilization structures and furrowing.

III. TMDL Endpoint:

- ***Description***

The TMDL endpoint will be based on the annual tons of sediment delivered at the Ft. Pierre gauging station. The goal is a 30% reduction of the 3.25 million tons of sediment delivered annually, based on Corps of Engineers data, by 2010. Although treatment will be applied in the Antelope Creek Watershed, there will not be any effort to gauge the sediment load of this area. Progress in this area will be documented through photo points over time. Trend for sediment delivered at the mouth of the Bad River will be computed on a 10 year running average in order to eliminate the possible problems created by a spike in yield per acre foot because of an abnormal year.

- ***Endpoint Link to Surface Water Quality Standards***

A measurable improvement in fishing and recreation use days may not be achievable for many years. When large runoff events occur from the Bad River Watershed, the clarity and turbidity of the Bad River entering Lake Sharpe will still cause a loss of fishing and recreation use. The biggest benefit will be to runoff from lesser storm events. Bad River clarity is influenced by colloidal matter and any flow tends to cause discoloration in Lake Sharpe. This plume is usually held to the south and west shore of the lake and doesn't significantly affect use until the flow becomes large enough to encompass the entire lake surface in the Pierre - Ft. Pierre section.

With a 30 percent reduction in sediment, the number of times that the access lanes to the main channel of Lake Sharpe have to be dredged will decrease. This will be a great improvement from both the user perspective (dredging stops access) and economic factors (costs to remove the sediment).

There is a possibility that a significant decrease in sediment delivery could lower the amount of sediment to an equilibrium state where the discharges from Lake Oahe would transport the Bad River sediment far enough down into Lake Sharpe that the deposition would not be a problem. The Corps is conducting a study to determine what amount of sediment can be transported annually in this method but has not developed any firm figures to date.

IV. TMDL Analysis and Development:

- ***Data Sources***

SD DENR Ambient Water Quality Monitoring Data.
USGS runoff and sediment data from the Fr. Pierre gauging station.
USCOE sediment data.
North Central Resource Conservation and Development Phase I & II Bad River Sediment Monitoring Study.
USDA NRCS Lower Bad River-River Basin Study.
USDA NRCS Upper Bad River-River Basin Study.
Stanley County Conservation District Phase II (Plum Creek) Demonstration Project.
Stanley County Conservation District Lower Bad River Implementation Project Phase III.
SDGF&P Creel and Angler Surveys 1991 to 1996.
SDDENR Bad River National Monitoring Study.

- ***Analysis Techniques or Models***

The Lower and Upper Bad River Basin Studies used the Universal Soil Loss Equation (USLE), Pacific Southwest Interagency Committee (PSIAC) sediment yield method, Ephemeral Gully Erosion Model (EGEM), the Direct Volume Method and direct measurements to determine the sediment yield to Lake Sharpe from the study areas.

The Upper Bad River Basin Study divided the Bad River Watershed into six representative subwatershed areas based on similar landform features, soil associations, land use, and management history. Then in each representative area a smaller subwatershed was selected in which to inventory field data and classify channels. The classified channels incorporated the Rosgen Stream Classification System of stream typing and Schema's Channel Evolution Model to evaluate each of these methods as a tool for watershed planning and evaluation of watershed health. These two methods have different base criteria so it is impossible to compare the data determined. The Rosgen system appears to provide the better material for determining sediment yield. Both methods provide good data to evaluate the health of the riparian zones.

Erosion rates were assigned to the types of channels in the inventoried watersheds and extrapolated to the whole Bad River Watershed. Gross erosion rates from the different sources within the study area were multiplied by an estimated sediment delivery ratio to calculate sediment loading.

- ***Seasonality***

  Runoff data measured at Ft. Pierre by USGS indicates that the major sediment yields may be delivered anytime of the year with the period from late February through the middle of July the most likely period of high sediment discharges. This gauging station has been in existence since 1929 and present conditions indicate it will continue to operate well into the future. Runoff and sediment yield will continue to be monitored on a daily basis with annual sediment delivered being a significant factor.

- ***Margin of Safety***

  The US Forest Service has been in the process of changing the management for grazing of the Fort Pierre and the Buffalo Gap National Grasslands the last three or four years. The new plans are more effective because an effort has been completed to join together the grazing unit for each permittee by implementing land trades and changing the location of their permits. All the new plans implement a grazing management system on each individual unit. This is a significant improvement as these units were managed for season long grazing in prior years. Forest Service personnel indicate that they are already seeing improved health and vigor in the vegetative cover and an increase in the woody and herbaceous vegetation in the riparian zones of the public lands. This will provide a decrease in overall water yield from this portion of the watershed.

Treatment will continue to be planned and applied in the Antelope Creek area. This effort will result in additional sediment reduction to Lake Sharpe.

The National Park Service has developed a plan for the Badlands National Monument which addresses the resources in the park area. This effort will have positive effects on reducing runoff for the vegetated areas of the park and will provide positive benefits to sediment reduction to that portion of the Bad River watershed that receives runoff from the monument area.

Western South Dakota has shown a continued interest in developing grazing systems. This is true in the Bad River Watershed and it is anticipated that the interest will continue. Grazing systems result in better vegetative cover that improves infiltration and reduces runoff which has a positive effect on reducing erosion and sediment delivery. These additional practices have not been considered as a part of the TMDL.

V. *Allocation of TMDL Loads or Responsibilities:*

- ***Wasteload Allocation***

  There are no significant point sources of sediment in this watershed, therefore the "wasteload allocation" component of the TMDL is considered a zero value. The TMDL is considered wholly included in the "load allocation" component of the TMDL.

- ***Load Allocation***

  The TMDL target is a 30% reduction in tons of sediment delivered annually to Lake Sharpe based on sediment measured at the USGS Bad River gage above Fort Pierre. Improving the water quality in the Bad River watershed involves implementing Best Management Practices (BMP's) to re-vegetate Type F & G channels in the watersheds of the Bad River, Antelope Creek and small drainages that lie between to reduce sediment delivered to Lake Sharpe. These BMP's will reestablish woody and herbaceous vegetation in the non-functioning riparian areas, maintain the health and vigor of functioning riparian areas, increase the health and vigor of herbaceous vegetation in the breaks landform and encourage revegetation of gullied areas, improve vegetative cover of the native rangeland and encourage reduced tillage with improved residue management of cropland residue in the upland landform. The BMP's in the breaks landform will reduce erosion and improve water infiltration into the soil profile while the BMP's in the upland will be mainly an effort to improve water infiltration and reduce total runoff yield per storm event. The BMP's will be implemented using whole unit planning as much as possible.

- ***Allocation of Responsibility***

The Lower Bad River Basin Study used the Pacific Southwest Interagency Committee (PSIAC) sediment yield method to determine the sediment yield to Lake Sharpe from the Lower Bad River Area. The Study broke the watershed into three separate landforms which were:

> Bad River Flats - the Bad River and adjacent floodplain.
> River Breaks - a steep to excessively steep rangeland area positioned below the Tablelands and above the Bad River valley floor.
> Tablelands - the upper portions of the lower watershed generally above elevation 1950 feet with level to sloping (0 to 15 percent) land area.

The area of the study was 792,000 acres, (flats 22,000 acres, breaks 200,000 acres, and tablelands 570,000 acres). The study used COE sediment data which was estimated at 3.25 million ton delivered annually to Lake Sharpe. The PSIAC sediment yield model computed sediment yield delivered to Lake Sharpe from the flats 28,600 tons, breaks 1,800,000 tons, and tablelands 239,400 tons. A sediment yield from the Bad River channel was also figured at 62,000 tons. The lower one third of the Bad River Watershed generated 2,130, 000 tons of sediment to Lake Sharpe annually (66 percent). The breaks delivered 85% of the sediment from the lower area.

The Upper Bad River-River Basin Study further broke down the various subwatersheds into the different types of channels based on Rosen's Stream Classification Method. This study accounted for the remaining tons of sediment that originate in the upper portion of the Bad River Watershed. Again the study broke the area into four separate landforms which were:

> Valley - the Bad River and adjacent floodplain.
> River Breaks - a steep to excessively steep rangeland area positioned below the Tablelands and above the Bad River valley floor.
> Uplands - the upper portions of the watershed generally above elevation 2000 feet with level to sloping (0 to 15 percent) land area.
> Badlands - located at the upper end of the watershed in gently rolling to vertical slopes. The vertical slopes are usually not vegetated.

The area of study was 1,236,720 acres (valley 60,200 acres, breaks 399,374 acres, uplands 657,146 acres, and badlands 122,000 acres). The PSIAC models computed annual sediment yield delivered to Lake Sharpe from the valley 2,408 tons, breaks 328,592 tons, uplands 492,730 tons and badlands 134,731 tons. Sediment yield from the upper Bad River channel was computed at 69,00 tons. So the upper Bad River watershed contributed 1,182,060 tons of sediment to Lake Sharpe annually (34%). The study further estimated that about 63 percent of this sediment originates from geologic erosion.

The study then expanded the data to determine the numbers of each type of channel in the upper and lower portions of the Bad River Watershed. Table 3 displays the findings from this study.

The major amount of sediment comes from the Type F & G classified channels in the Breaks landform and the Type F & G classified channels in the Upland landform of the lower Bad River watershed. These channel types account for 55 percent of the sediment originating from all the channel types in the entire watershed. Economics indicates that this would be the area that should receive the major effort to reduce the sediment delivery.

VI. Schedule of Implementation:

DENR has been working with two groups of sponsors on different projects in the Bad River watershed. Stanley County Conservation District has been involved with implementation of sediment reducing projects in the lower portion of the Bad River since 1989. Projects include:

1. Phase I and IA Bad River Water Quality Project which mainly tried to determine the sources of sediment in the Bad River watershed. Completed in 1990.
2. Bad River Phase II Water Quality Project which was an effort to see if the landowners would participate in a water quality project and if so what practices and management systems would they accept. This project proved that we could achieve a significant reduction in sediment delivery. The project was a learning process for all involved and led to the determination by project end that the emphasis needed to be applied to re-vegetation of non functioning riparian zones to get the most reduction in sediment delivery. Completed in 1996.
3. Bad River Phase III Water Quality Project which targeted that portion of the Bad River watershed below War Creek and the Antelope Creek area with increased emphasis on riparian management. This project was expanded to include the entire lower Bad River area in Stanley County. Project still in progress.

The Upper Bad River Demonstration Project with sponsors from Lyman, Jones, Jackson, Haakon, and East Pennington Conservation Districts has been in existence since 1995. This project also included portions of the White River and Cheyenne River watersheds that were contained in these conservation districts. The project was set up to implement grazing and cropland residue management practices as demonstrations of resource management systems that could be installed to reduce downstream sediment delivery. The demonstration project is scheduled for completion in February, 2000.

Table 3.
Channel Sediment Yield

Bad River Channel Sediment Yield

Area	Landform		Channel Type	Miles	Tons Delivered	Tons/ Mile	% Total
Lower	Valley	Main Channel	Main	20	62000	3100	2.4
Upper	Valley	Main Channel	Main	45	69000	1533	2.7
Lower	Breaks	Channel & Gully	g	482	395350	820	15.4
Lower	Uplands	Channel & Gully	g	450	322602	717	12.6
Lower	Breaks	Channel & Gully	f	766	547081	714	21.3
Upper	Breaks	Channel & Gully	g	16	10280	643	0.4
Upper	Uplands	Channel & Gully	g	9	5442	605	0.2
Upper	Badlands	Channel & Gully	f	70	40145	574	1.6
Lower	Uplands	Channel & Gully	f	248	139270	562	5.4
Upper	Breaks	Channel & Gully	f	164	69362	423	2.7
Upper	Uplands	Channel & Gully	f	208	86394	415	3.4
Lower	Breaks	Channel & Gully	d	5	1324	265	0.1
Lower	Breaks	Channel & Gully	c	390	76163	195	3.0
Lower	Uplands	Channel & Gully	b	64	12319	192	0.5
Lower	Uplands	Channel & Gully	c	666	96483	145	3.8
Lower	Breaks	Channel & Gully	b	409	54408	133	2.1
Upper	Breaks	Channel & Gully	c	563	72711	129	2.8
Upper	Badlands	Channel & Gully	c	205	25692	125	1.0
Upper	Uplands	Channel & Gully	c	2343	286447	122	11.2
Upper	Badlands	Channel & Gully	b	126	13459	107	0.5
Upper	Breaks	Channel & Gully	b	409	43352	106	1.7
Upper	Uplands	Channel & Gully	b	545	56073	103	2.2
Upper	Badlands	Channel & Gully	a	2	160	80	0.0
Lower	Breaks	Channel & Gully	e	42	2804	67	0.1
Upper	Badlands	Channel & Gully	e	116	6475	56	0.3
Upper	Breaks	Channel & Gully	e	361	19296	53	0.8
Upper	Uplands	Channel & Gully	e	256	12819	50	0.5
Lower	Uplands	Channel & Gully	e	740	36986	50	1.4
Total				**9720**	**2563897**		

Both groups are awaiting the completion of the TMDL target and goal to determine what implementation actions should be developed. Cooperation of landowners within the Bad River Watershed has been good. The implementation plan will be developed as soon as the TMDL is approved. The data in Table 10 and the Land Treatment Alternatives Table from the Upper Bad River Basin Study will be used to plan and guide implementation efforts.

VII. Post-Implementation Monitoring:

The Bad River National Monitoring Plan is already in operation and monitoring of the paired watersheds will provide a lot of data to measure effectiveness of installed resource management systems - BMP's. Photo points will also be established to determine effectiveness of efforts to improve riparian health and upland vegetation cover.

VIII. Public Participation:

- ***Summary of Public Review***

Four stakeholder meetings were held to discuss available data on the Bad River and TMDL requirements. Meetings were held in Pierre, Murdo and Midland. People attending included state and federal agency representatives, city, county and conservation district people.

- ***Project Information and Education Efforts***

Public Meetings/ Personal Contact	***Articles/ Fact Sheets***	***Document Distribution***
See project reports	See project reports	See project reports
Electronic media	***Mailings***	***Public Comments Received***
May 2000 TMDL Summary advertised on department website	**Interested parties** May 5, 2000 **Stakeholders** May 5, 2000 **Daily Newspapers** May 5, 2000	Comments received during project meetings and review of the draft report and findings were considered

IX. Supporting Development Documents:

LOWER BAD RIVER-RIVER BASIN STUDY FINAL REPORT, Project #4380. . United States Department of Agriculture, Soil Conservation Service and Forest Service. March 1994. As revised June 1994.

UPPER BAD RIVER BASIN STUDY, Project #5005. United States Department of Agriculture, Natural Resources Conservation Service and Forest Service. October 1998.

PHASE I AND IB OF THE BAD RIVER WATER QUALITY PROJECT

Thelen, J. P. and Noeske, L. BAD RIVER PHASE II WATER QUALITY PROJECT FINAL REPORT. Stanley County Conservation District. Project period March 12, 1990 through June 30, 1996.