Phase II Sedimentation Assessment
for the
Upper Missouri River Basin

Assessment Report

Muddy Creek near Vaughn, Montana

USDA Natural Resources Conservation Service
Nebraska, South Dakota, North Dakota, Montana, and Wyoming

In Cooperation with
Missouri Sedimentation Action Coalition

June 2009

Phase II Sedimentation Assessment for the Upper Missouri River Basin

Assessment Report

Prepared for:
Missouri Sedimentation Action Coalition

Prepared by:

United States Department of Agriculture,
Natural Resources Conservation Service
Montana State Office
Nebraska State Office
North Dakota State Office
South Dakota State Office

In Consultation With:
U.S. Army Corps of Engineers
U.S. Geological Survey

Proposed Action:
To evaluate existing sedimentation data and qualitatively identify resource impacts from excessive sedimentation entering the six mainstem reservoirs in the Upper Missouri River Basin. To prioritize sub-basins based on existing resource assessments.

Project Location:
Gavin's Point Dam upstream to the headwaters of the Missouri River in Montana and Wyoming

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Plan Designation:
CONGRESSIONAL EARMARK SEDIMENTATION REPORT

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Phase II Sediment Assessment for the Upper Missouri River Basin

Introduction

This sediment assessment report is the second of a two part report developed for the Missouri Sedimentation Action Coalition (MSAC). The report addresses a MSAC request to identify subwatershed areas with the highest potential to deliver sediment into the Upper Missouri River Basin six mainstem reservoirs. This report analyzes the existing data identified in Phase I and uses analytical processes to identify and rate the storage capacity depletion for the reservoirs.

Sediment accumulates in these reservoirs at the approximate rate of 89,700 acre feet per year according to the US Army Corp of Engineers publication, “Missouri River Mainstem System 2008-2009 Annual Operating Plan”. In the 2007-2008 Annual Operating Plan, the sediment rate was estimated at 92,500 acre feet per year. In Phase I, negative impacts associated with high rates of sediment loading were identified as:

- Loss of flood storage.
- Sediment may impact hydropower production.
- Lost recreational opportunities.
- Increased water treatment costs for municipal, rural, and industrial (MR&I) water systems and loss of capacity, which in some cases leaves people with no suitable water source.
- Navigation relies on a water flow. Lost reservoir capacities may make river system operation difficult to provide adequate water supply.
- Personal property is being adversely affected by rising ground water in the upper reaches of the reservoirs.
- Irrigation and MR&I water intakes will be impacted and may need to be relocated.

The MSAC has determined the loss of flood storage and beneficial uses of the permanent pools are cause for this project study to be considered a high priority national and regional water resource issue. See Appendix A – Missouri Sedimentation Action Coalition Fact Sheet for a description of MSAC’s vision.

The reservoirs provide tremendous opportunity for environmental, economic, and social change in the Northern Great Plains. As a result – lives, structures (homes and businesses), infrastructures (roads and telecommunications), recreational opportunities, and MR&I and irrigation water supplies are at risk from excessive sediment. This basin sedimentation report documents the preliminary planning process and the technical assistance NRCS provided to the project sponsor in assessing sedimentation issues and concerns within the Upper Missouri River Basin.

Scope of the Sediment Assessment

Sedimentation concerns of the MSAC were recognized by the United States Congress in 2007. As a result of the passage of the Water Resources Development Act of 2000, legislation was passed for Title VII – Missouri River Protection and Improvement Act, North Dakota, and Title IX – Missouri River Restoration Act, South Dakota. A Congressional Earmark (CE) was passed to study excessive sedimentation and related natural resource issues as it relates to the six major U.S. Army Corps of Engineer's (COE) reservoirs in the Upper Missouri River Basin. The following map (Figure 1) shows the entire Upper Missouri River Basin and the individual subwatersheds that were evaluated

The area was reviewed at the 4 digit Hydrologic Unit Code (HUC) level, with the exception of the Missouri-Big Sioux, 4-digit HUC 1017. Only the portion (8-digit HUC 10170101) of the Missouri-Big Sioux, which includes Lewis and Clark Lake, was reviewed.

A technical team, comprised of NRCS employees from each of the four named states, was formed in February 2008, and directed to compile existing sediment studies and data from both internal and external sources. An employee from Wyoming was added to the team in 2009. Appendix C – Technical Specialists lists the specialists who contributed to this assessment report. A technical review of the studies and data was completed and a Phase I Preliminary Sedimentation Assessment Report was written in September 2008.

This Phase II report analyzes those sources and begins the process of identifying critical areas and natural resource stressors which may be increasing sediment loading into the Basins mainstem reservoirs (see Table A). Figure 2 on Page 4 displays the location of the dams and reservoirs.

Table A - Dams and Reservoirs

Dam	Reservoir
Gavins Point	Lewis & Clark Lake
Fort Randall	Lake Francis Case
Big Bend	Lake Sharpe
Oahe	Lake Oahe
Garrison	Lake Sakakawea
Fort Peck	Fort Peck Lake

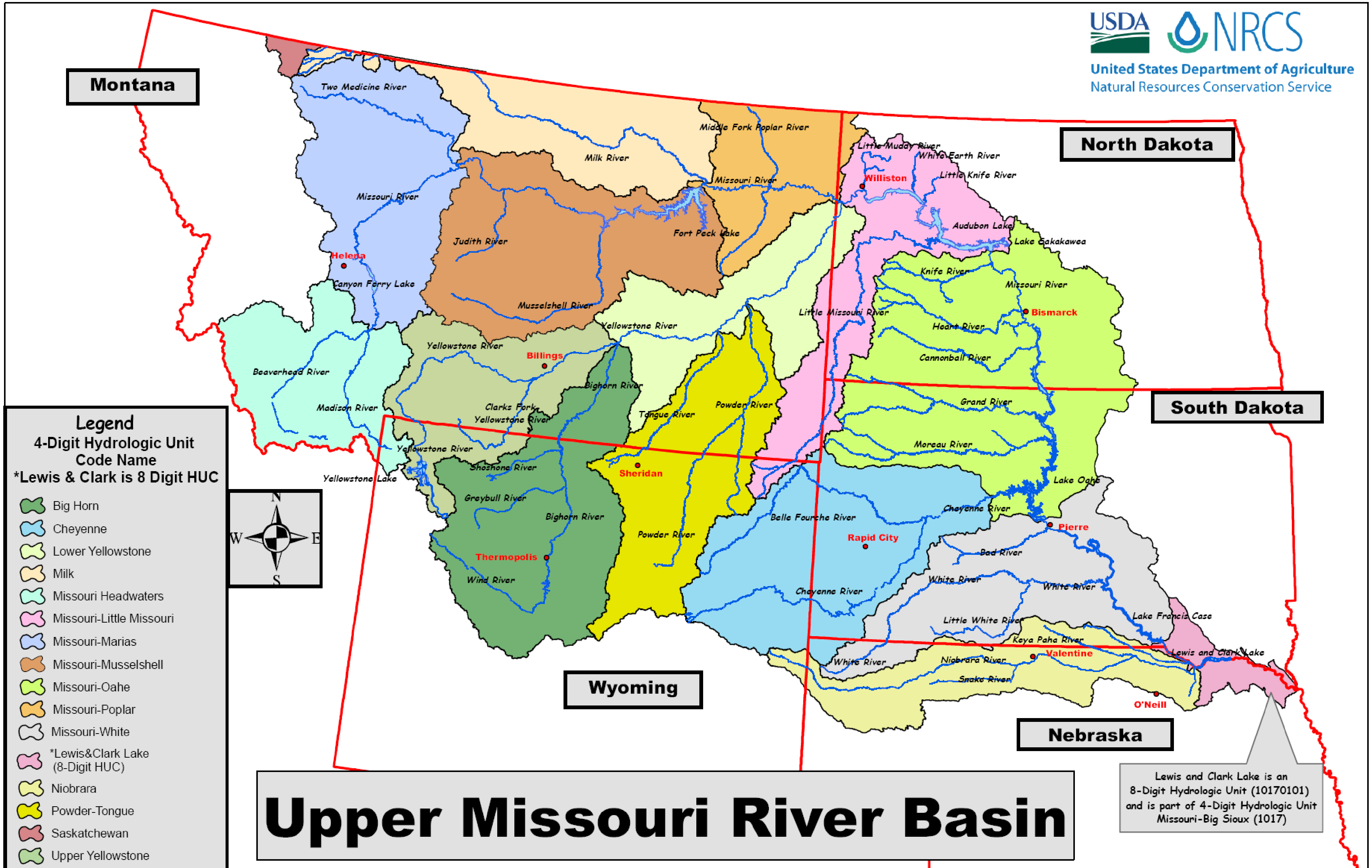

Figure 1 – Upper Missouri River Basin

Figure 2 - Dams and Reservoirs

Natural Resource Conservation

There are 167 resource or conservation districts located in the assessment area. These local units of government work in partnership with USDA Natural Resources Conservation Service and other natural resource agencies and groups to reduce erosion and sediment transport into the Basin reservoirs. Of the 167 districts, five of these districts are tribal conservation districts. The tribal district in Wyoming is in the developmental stage. Table B lists the number of districts in each State. Appendix B – Conservation Districts lists the name and address of each conservation district along with the county(ies) they serve.

Table B – Number of Conservation Districts within the Basin

State	Number of Districts	Number of Tribal Districts
Montana	49	3
Nebraska	5	0
North Dakota	28	1 *
South Dakota	46	1 *
Wyoming	34	1 **

Notes:

* The Standing Rock Tribal Conservation District operates in both North and South Dakota with the district office being located in North Dakota.

** Wind River Tribal Conservation District is in the process of forming.

Land Use

The Upper Missouri River Basin's land use and land cover, along with the basin's climate, geology, topography, and soils are the variables which most influence sediment delivery in the Basin. The following tables highlight the land use in the basin.

Table C is a summary of the acres for each land use within the assessment area as defined by the 1997 NRCS National Resources Inventory (NRI).

Table C - Land Use / Cover

Land Use / Cover	Acres	Percent
Federal Lands	34,046,500	19.7%
Cropland	27,287,900	15.8%
Tame Hayland	6,280,100	3.6%
Rangeland	82,513,900	47.8%
Pastureland	5,628,900	3.3%
Forestland	3,973,000	2.3%
CRP	5,339,600	3.1%
Urban	605,900	0.4%
Rural Transportation	1,463,100	0.8%
Minor land uses/cover	3,240,600	1.9%
Water	2,301,300	1.3%
Total	172,680,800	100.0%

Using 1997 NRI data, Table D lists the acres of cultivated cropland in each HUA along with the percent in relationship to the total cultivated cropland in the upper basin.

Table D - Cropland

HUA		Acres	Percent
1001	Saskatchewan	6,800	0.0%
1002	Missouri Headwaters	252,300	0.9%
1003	Missouri-Marias	3,586,300	13.1%
1004	Missouri-Musselshell	1,549,900	5.7%
1005	Milk	2,490,800	9.1%
1006	Missouri-Poplar	2,695,800	9.9%
1007	Upper Yellowstone	583,800	2.1%
1008	Big Horn	443,800	1.6%
1009	Powder-Tongue	273,900	1.0%
1010	Lower Yellowstone	927,400	3.4%
1011	Missouri-Little Missouri	2,731,800	10.0%
1012	Cheyenne	631,400	2.3%
1013	Missouri-Oahe	6,253,100	22.9%
1014	Missouri-White	2,657,000	9.7%
1015	Niobrara	1,158,500	4.2%
10170101	Lewis and Clark Lake	1,045,300	3.8%

Soil Loss

Water Erosion

Using 1997 NRI data, Table E lists the average sheet and rill water erosion for each 4-digit HUA. The water erosion is displayed in tons per acre per year (t/a/y).

Table E - Water Erosion

HUA		Water Erosion
10170101	Lewis and Clark Lake	4.0
1006	Missouri-Poplar	3.0
1010	Lower Yellowstone	2.0
1011	Missouri-Little Missouri	2.0
1013	Missouri-Oahe	1.8
1014	Missouri-White	1.8
1004	Missouri-Musselshell	1.7
1009	Powder-Tongue	1.7
1005	Milk	1.6
1003	Missouri-Marias	1.5
1007	Upper Yellowstone	1.5
1012	Cheyenne	1.4
1008	Big Horn	1.3
1015	Niobrara	1.0
1002	Missouri Headwaters	0.6
1001	Saskatchewan	0.4

The following Figure 3 shows the Upper Basin 4-digit sub-basins and the corresponding water erosion listed by t/a/y.

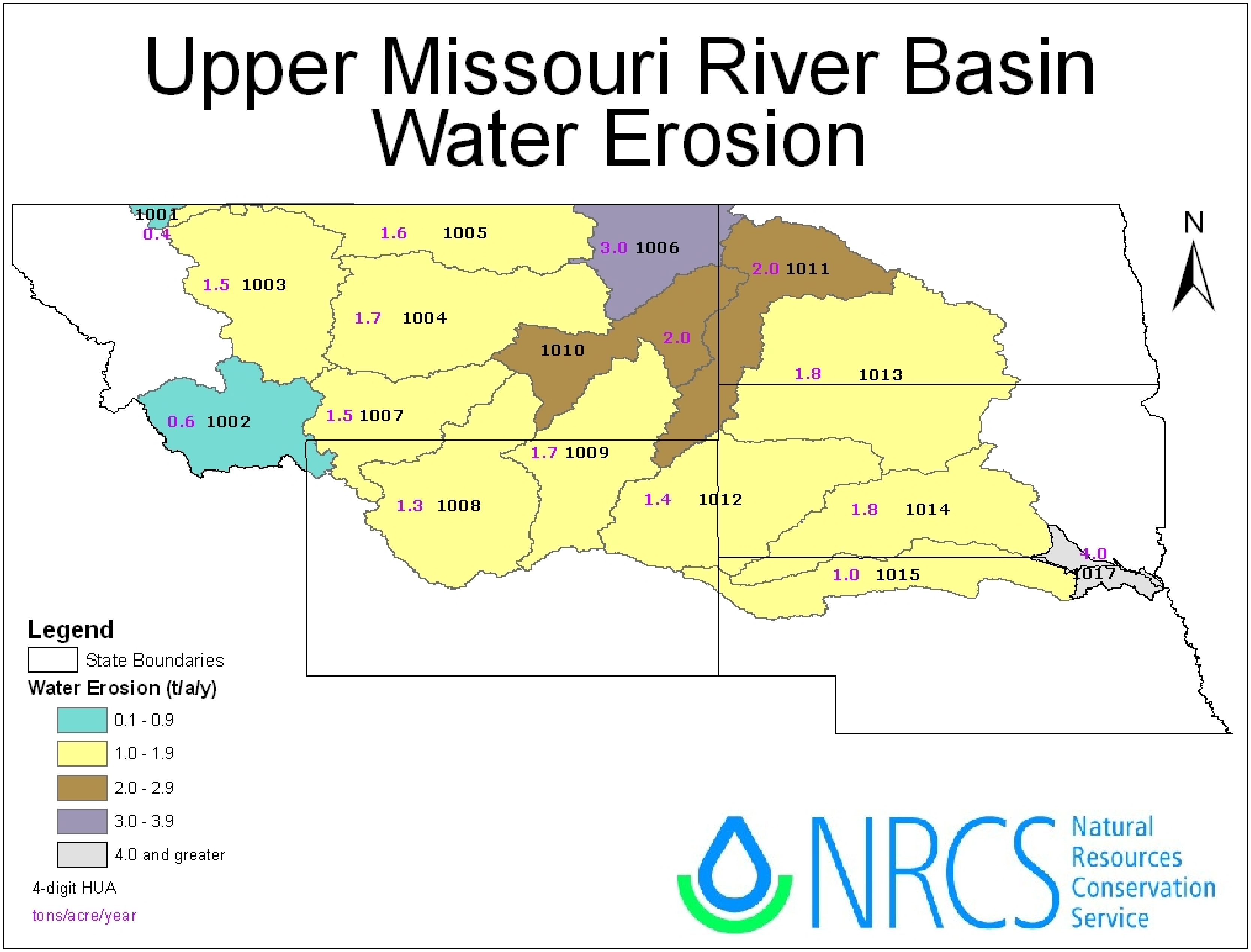

Figure 3 - Upper Basin Water Erosion

Wind Erosion

Using 1997 NRI data the following wind erosion for each 4-digit HUA is listed in Table F. The wind erosion is displayed in t/a/y.

Table F - Wind Erosion

HUA		Wind Erosion
1008	Big Horn	5.9
1009	Powder-Tongue	5.8
1007	Upper Yellowstone	4.9
1010	Lower Yellowstone	4.8
1004	Missouri-Musselshell	4.4
1006	Missouri-Poplar	4.3
1012	Cheyenne	3.8
1005	Milk	3.5
1003	Missouri-Marias	3.4
1014	Missouri-White	2.9
1011	Missouri-Little Missouri	2.5
1002	Missouri Headwaters	2.3
1015	Niobrara	2.3
1013	Missouri-Oahe	2.1
10170101	Lewis and Clark Lake	1.2
1001	Saskatchewan	0.3

Wind erosion may have localized secondary impacts to potential sediment loading in small streams within the basin. While wind erosion is a significant resource concern for cropland, it is not a major source of sediment and was not evaluated in any detail for this report.

Sedimentation Assessments and Data Reviewed

Nearly all the existing resource inventory data was collected by or funded by Federal agencies, primarily the United States Geological Survey (USGS) and U.S. Army Corps of Engineers (COE). The technical team initially did literature searches to identify reasonable and reliable sediment data sets.

The following section describes COE information for each of the six mainstem reservoirs and the future anticipated sedimentation rates.

The US Army Corps of Engineers develops an annual operating plan for the Missouri River Mainstem System, with the latest being the Missouri River Mainstem System 2008-2009 Annual Operating Plan. This operating plan presents pertinent information and plans for regulating the dams and reservoirs under varying water supply conditions. The operating plan provides detailed schedules for operating the six individual dams during the year to serve the congressionally authorized project purposes; to fulfill the Corps' responsibility to Native American Tribes; and to comply with environmental laws.

Analysis of sediment data and drainage area information taken from the U.S. Army Corps of Engineers 2008–2009 Annual Operating Plan, Summary of Engineering Data, illustrates the size of each sub-basin. Figure 4 indicates the drainage area in square miles above each of the six mainstem dams.

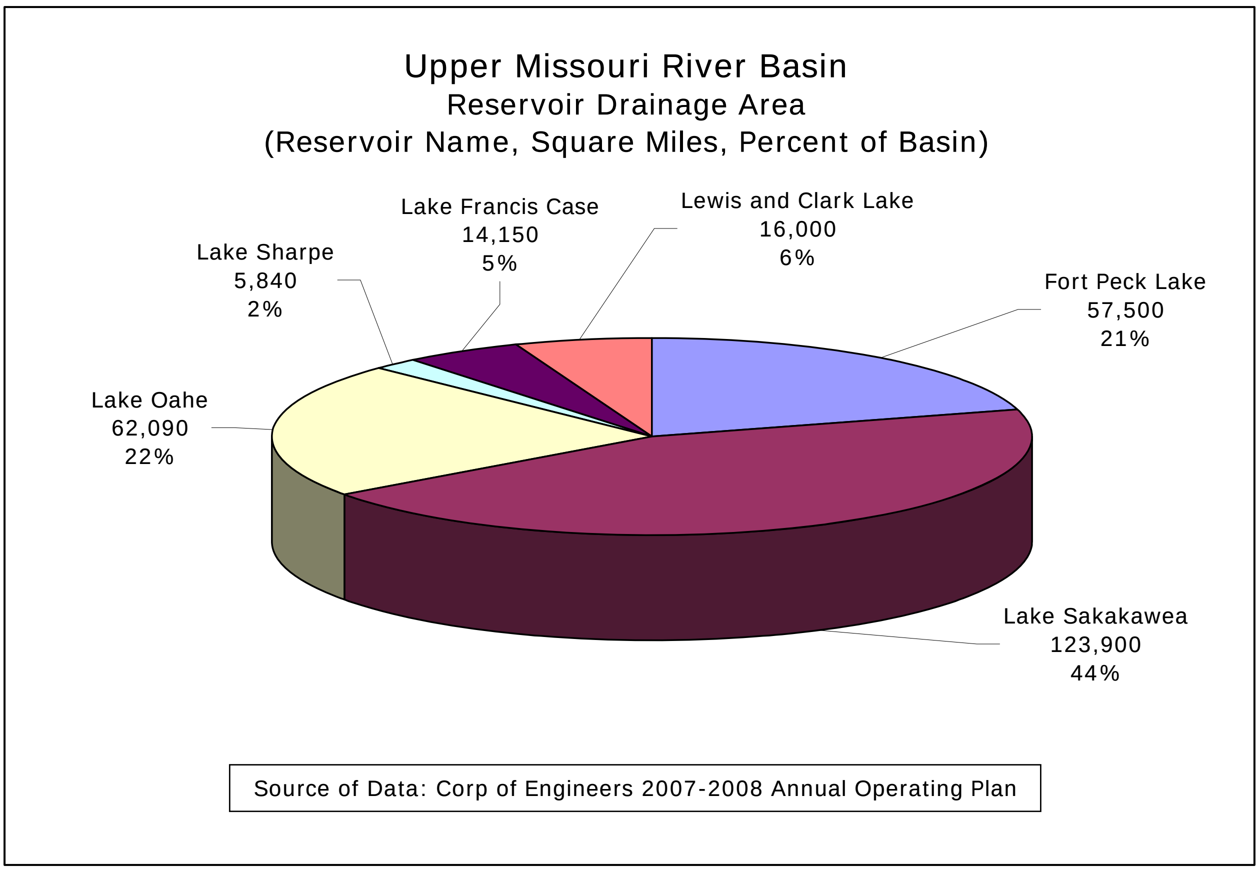

Figure 4 - Drainage Area Above Each of the Six Missouri River Dams.

Based on the COE engineering data, the Lake Francis Case reservoir was expected to have the highest sediment loading per square mile of the six mainstem reservoirs. Figure 5 illustrates the acre-feet of sediment expected to enter each reservoir annually (based on design criteria and not actual measured data).

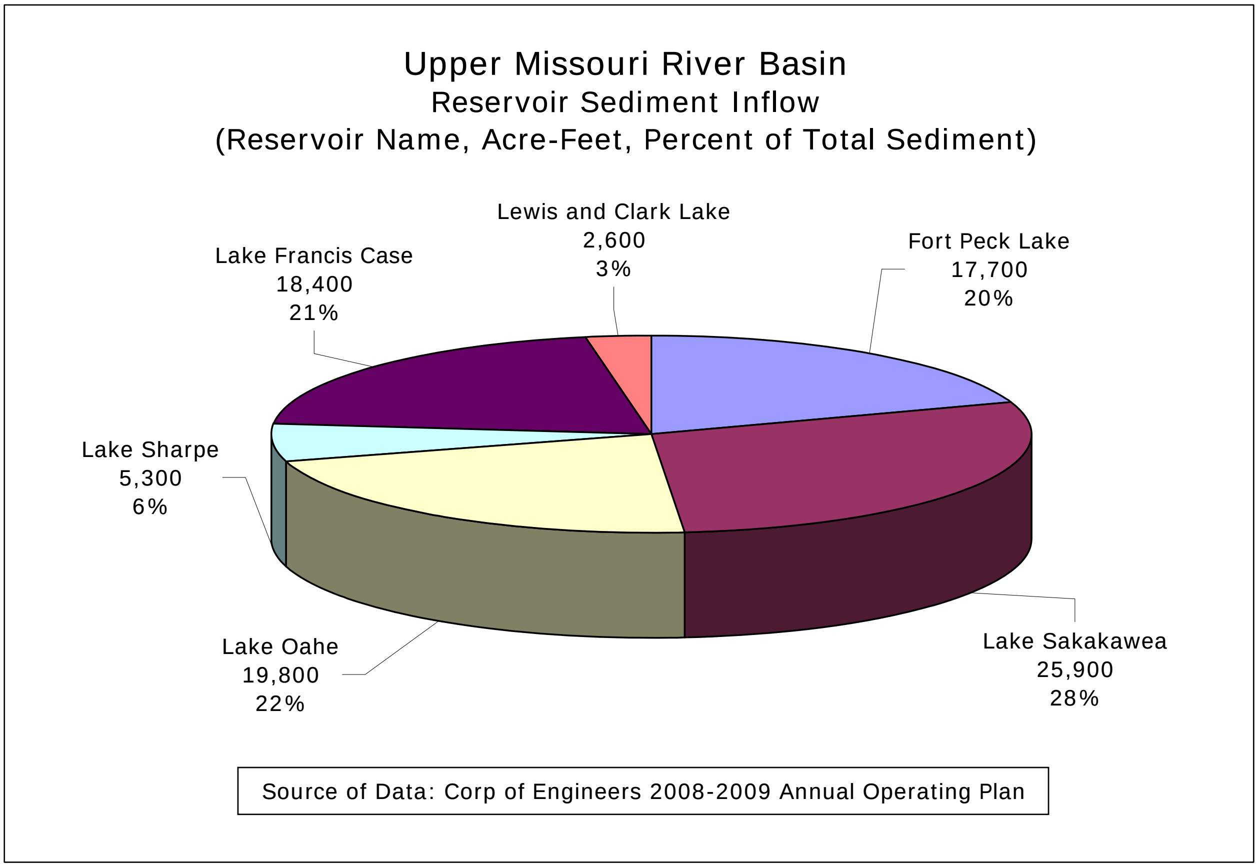

Figure 5- Estimated Inflow of Sediment into the Six Missouri River Reservoirs.

While the information within the operating plan is helpful in understanding the operation of the Missouri River system, the sediment information is based on initial planning documents and may not completely reflect current conditions. The following figures and table displays the reservoir storage loss calculations based on sediment surveys conducted by the COE.

Figure 6 displays NRCS storage loss projections using historical COE data to depict the storage loss for each of the six mainstem reservoirs as of 2009. The three smaller reservoirs, located in the lower end of the Upper Basin, have by far the highest storage losses. Lewis and Clark Lake has the highest storage loss of almost 30 percent projected to 2009. In contrast, the three largest reservoirs, located in the upper end of the Upper Basin, have much lower storage losses of less than 7 percent.

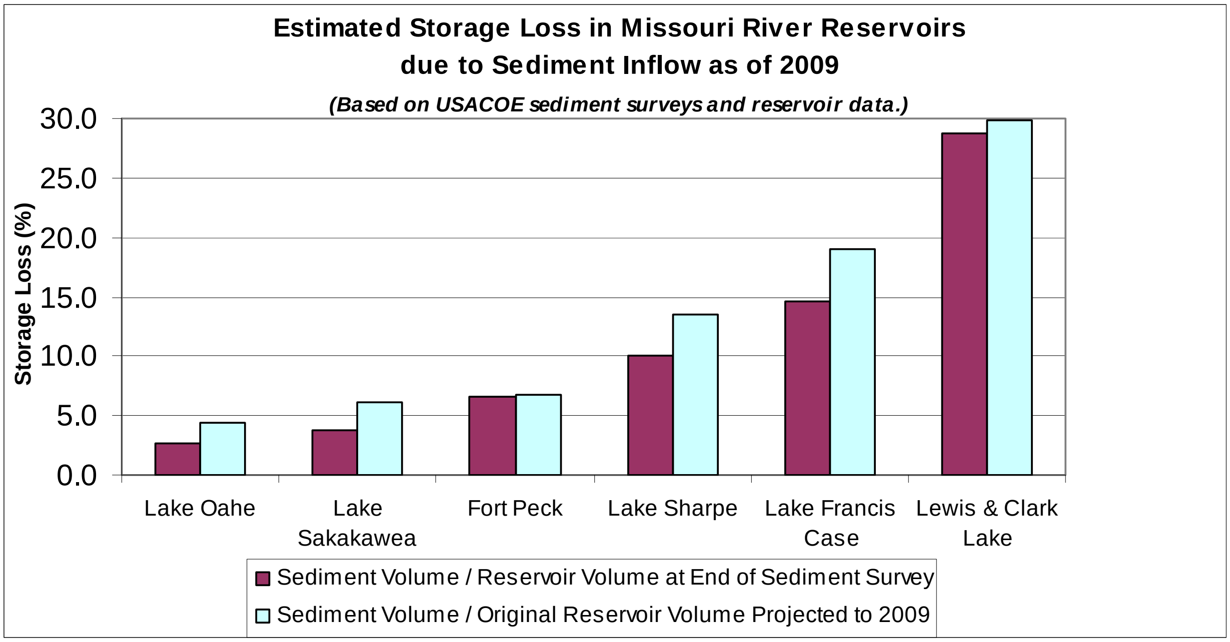

Figure 6 - Estimated Storage Loss

Table G below displays the year of the most recent sediment survey conducted by COE and the average annual storage loss (percent).

Table G - Corp of Engineers Sediment Survey Data

Dam	Reservoir	Initial Filling of Reservoir (year)	Most Recent Sediment Survey (year)	Annual Loss (%)
Gavins Point	Lewis & Clark Lake	1955	2007	0.42
Fort Randall	Lake Francis Case	1953	1996	0.30
Big Bend	Lake Sharpe	1963	1997	0.27
Oahe	Lake Oahe	1958	1989	0.08
Garrison	Lake Sakakawea	1953	1988	0.11
Fort Peck	Fort Peck Lake	1937	2007	0.08

Figure 7 displays the storage loss rate in the six reservoirs as measured in acre-feet/year. The annual storage loss for the Lake Francis Case has varied significantly in the period 1953-1997. The average annual storage loss was 18,400 acre-feet/year for the period 1953-1997 in contrast to 12,800 acre-feet/year for the period 1958-1997.

Table H (page 13) displays the estimated number of years to fill up the reservoirs based on COE historical rates of sediment inflow. Lewis and Clark Lake, Lake Francis Case, and Lake Sharpe are filling up the fastest, ranging from 181 to 339 years, respectively. In contrast, Lake Sakakawea, Fort Peck Lake, and Lake Oahe are filling up at a significantly slower rate, ranging from 920 to 1,169 years.

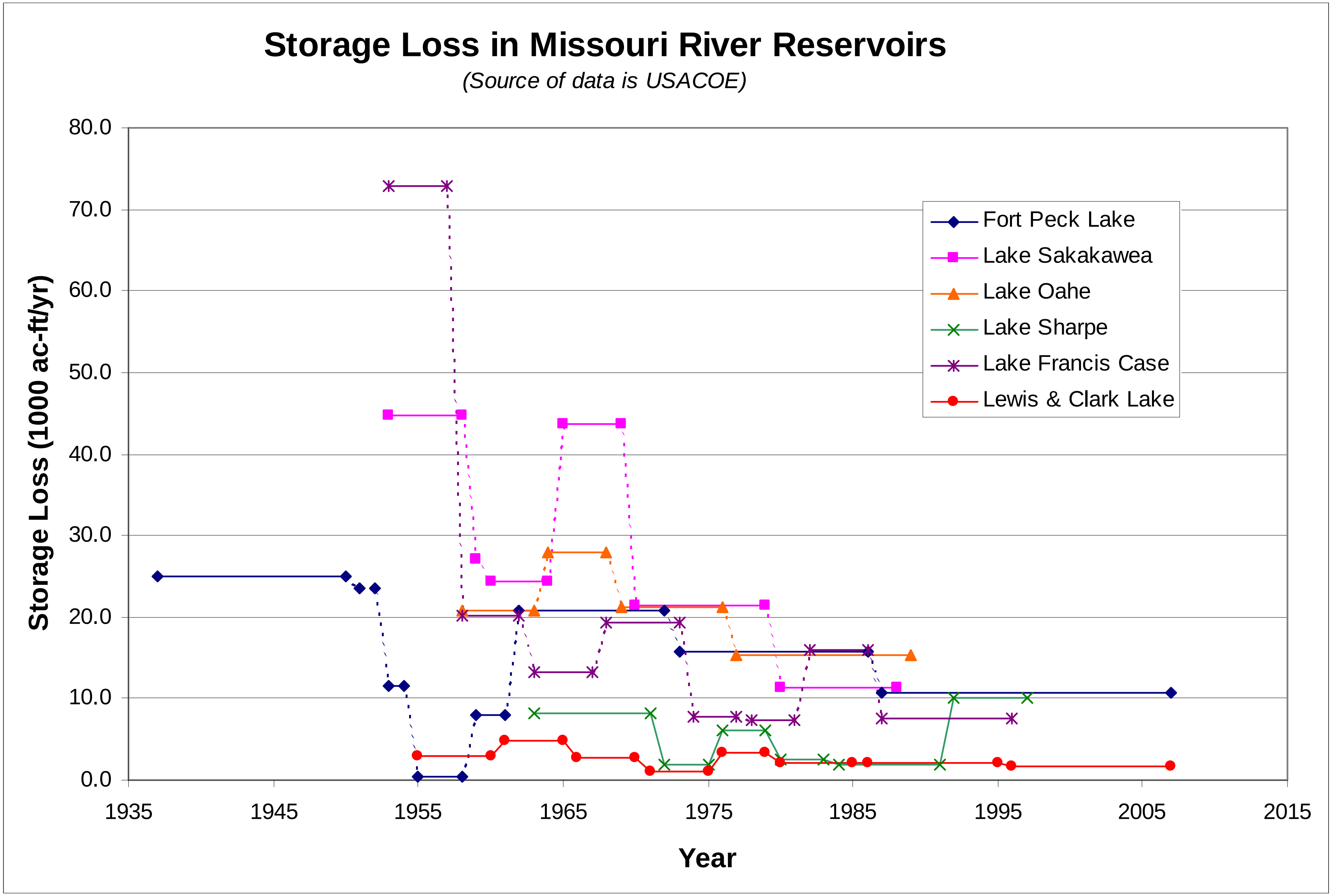

Figure 7 - Reservoir Storage Loss

Table H - Rate of Storage Loss from Sediment Inflow in the Missouri River Reservoirs

Missouri River Reservoir	Period of Sediment Survey	Annual Sediment Inflow *	Design Storage	USACOE Estimated Sediment Volume as Percent of Total Storage at end of Sediment Survey	Length of time in years from completion to fill reservoir to specified percent of design volume								
					2.5	5	10	15	20	25	50	75	100
	(years)	(ac-ft)	(ac-ft)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
Fort Peck Lake	70	17,700	18,688,000	6.6	26	53	106	158	211	264	528	792	1,056
Lake Sakakawea	35	25,900	23,821,000	3.8	23	46	92	138	184	230	460	690	920
Lake Oahe	31	19,800	23,137,000	2.7	29	58	117	175	234	292	584	876	1,169
Lake Sharpe	34	5,300	1,798,000	10.0	9	17	34	51	68	85	170	254	339
Lake Francis Case	43	18,400	5,418,000	14.6	7	15	29	44	59	74	147	221	295
Lewis & Clark Lake	52	2,600	470,000	28.8	5	9	18	27	36	45	90	136	181

Based on COE supplied data.
** Initial Design Estimate*

Table I shows the estimated time, in years, to fill the reservoirs to 25 and 50 percent of the design volumes. Lewis and Clark Lake, Lake Francis Case, and Lake Sharpe are projected to be filled up to 50 percent of the design volume in 2045, 2100, and 2133, respectively. In contrast, Lake Sakakawea, Fort Peck Lake, and Lake Oahe are projected to be filled up to 50 percent of the design volume in 2413, 2465, and 2542, respectively.

Table I - Estimated Time to Fill Reservoirs to the 25 and 50 Percent of Storage Capacity

Missouri River Reservoir	Year Completed	Length of time in years from 2009 to fill reservoir to 25 or 50 percent of design volume		Year when reservoir will be filled to 25 or 50% of design volume	
		25	50	25	50
		(%)	(%)		
Ft. Peck	1937	192	456	2201	2465
Lake Sakakawea	1953	174	404	2183	2413
Lake Oahe	1958	241	533	2250	2542
Lake Sharpe	1963	39	124	2048	2133
Lake Francis Case	1953	18	91	2027	2100
Lewis & Clark Lake	1955	-9	36	2000	2045

Based on COE supplied data.

State Summaries of USGS Sediment Data

In the study area, the USGS collected and determined suspended sediment concentrations from samples collected during storm events at various stations along with measuring streamflow discharges. Using sediment concentration and streamflow discharge, the daily-mean suspended sediment discharge was computed by multiplying the concentrations by the streamflow discharges. The parameters included in the measurements are daily-mean streamflow (cfs), daily-mean suspended sediment concentration (mg/l), and daily-mean suspended sediment discharge (tons/day).

The USGS collected samples and determined suspended sediment size and bed-size distributions for selected stations in the project area. This data is very periodic in nature and available for a limited number of USGS stations.

The USGS has collected instantaneous suspended sediment data at numerous stations throughout the basin. This data is available on the USGS web site, http://nwis.waterdata.usgs.gov/sd/nwis/qwdata. The following is a USGS precaution on the NWIS web site that should be considered when using this data:

> *The data you have secured from the USGS NWISWeb database may include data that have not received Director's approval and as such are provisional and subject to revision. The data are released on the condition that neither the USGS nor the United States Government may be held liable for any damages resulting from its authorized or unauthorized use.*

A discussion of this data is presented in the next section of the report.

Nebraska

The following graph (Figure 8) shows the sediment loads in the Niobrara River Basin. These loads have been impacted by the operation of the Spencer Hydro Dam.

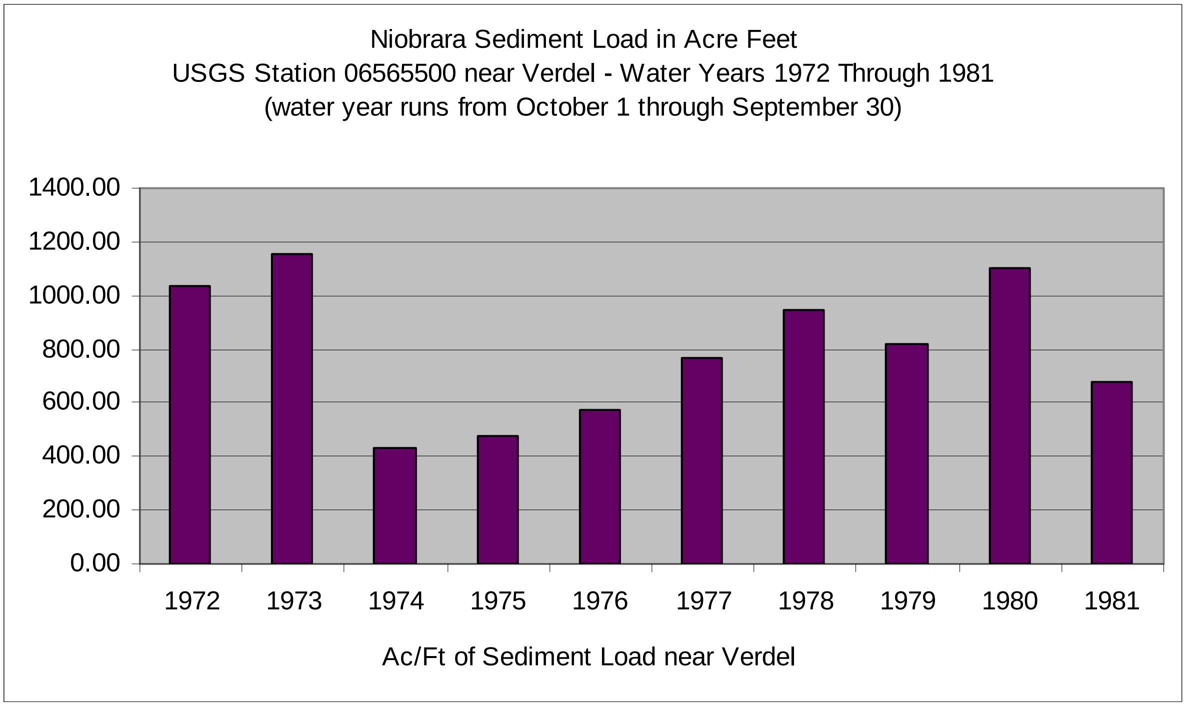

Figure 8 - Niobrara River Sediment Load

Table J illustrates the sub-basins of the Niobrara River Basin and the average annual sediment in acre feet. Further sedimentation data is currently being collected by the U.S. Corps of Engineers and their consulting group Ayers and Associates. This data is anticipated to be available in 2010.

Table J - Nebraska Sediment Table

Station Number	Station Name	Sediment Data Period of Record	Average Annual Suspended Sediment (tons/year)	Average Annual Volume of Suspended Sediment (ac-ft /year)[1]	Contributing Drainage Area (mi^2)[2]
06465500	Niobrara River near Verdel, NE	1972-1981	1,566,200	799	12,600

South Dakota

USGS Sediment Data

A summary of the U.S. Geological Survey (USGS) gaging stations in South Dakota with daily-mean suspended data is shown in Table K. The locations of these gaging stations are shown in Figure 9. Sediment data is available near the mouth for all of the major tributaries to the Missouri River in South Dakota, including the Grand River, Moreau River, Cheyenne River, Bad River, and White River. Little or no sediment data is available for drainage areas east of the Missouri River. Figure 10 illustrates the magnitude of the daily-mean suspended sediment data for USGS gaging stations in Table K.

Table K - Summary of U.S. Geological Stations with Daily Suspended Sediment Data – South Dakota

Station Number	Station Name	Sediment Data Period of Record	Average Annual Suspended Sediment (tons/year)	Average Annual Volume of Suspended Sediment (ac-ft /year)[1]	Contributing Drainage Area (mi^2)[2]
06357500	Grand River at Shadehill, SD	1945-1950	455,781	380	3,120
06357800	Grand River at Little Eagle, SD	1971-1976	970,905	811	5,370
06359500	Moreau River near Faith, SD	1945-1949	607,536	507	2,660
06360500	Moreau River near Whitehorse, SD	1971-1976	1,431,475	1,195	4,880
06400000	Hat Creek near Edgemont, SD	1949-1954	111,501	93	1,044
06400500	Cheyenne River near Hot Springs, SD	1945-1968	1,577,107	1,317	8,710
06437000	Belle Fourche River near Sturgis, SD	1955-1958	648,127	541	5,870
06439300	Cheyenne River at Cherry Creek, SD	1971-1976	5,459,641	4,558	23,900
06440200	South Fork Bad River near Cottonwood, SD	1989-1995	123,622	103	250
06441110	Plum Creek below Hayes, SD	1989-1995	271,133	226	252
06441400	Willow Creek near Fort Pierre, SD	1989-1990	59,762	50	---
06441500	Bad River near Fort Pierre, SD	1971-2007	1,661,452	1,387	3,107
06446000	White River near Oglala, SD	1946-1952	263,476	220	340 (2,200 total)
06447000	White River near Kadoka, SD	1948-1954	6,629,566	5,534	5,000
06449100	Little White River near Vetal, SD	1990-1991	24,850	21	415 (590 total)
06449300	Little White River above Rosebud, SD	2002-1903	25,897	22	630 (890)
06449500	Little White River near Rosebud, SD	1990-1991	142,680	119	760 (1,020)
06450500	Little White River below White River, SD	1957-1958	83,182	69	1,310 (1,570 total)
06452000	White River near Oacoma, SD	1971-2007	7,603,931	6,348	9,940 (10,200 total)

[1]Volume of sediment was calculated assuming a sediment specific weight of 55 lb/ft^3. (tons/year multiplied by a factor (0.0008347) to calculate ac-ft/yr)

[2] Source U.S. Geological Survey; ( ), total drainage area in mi^2

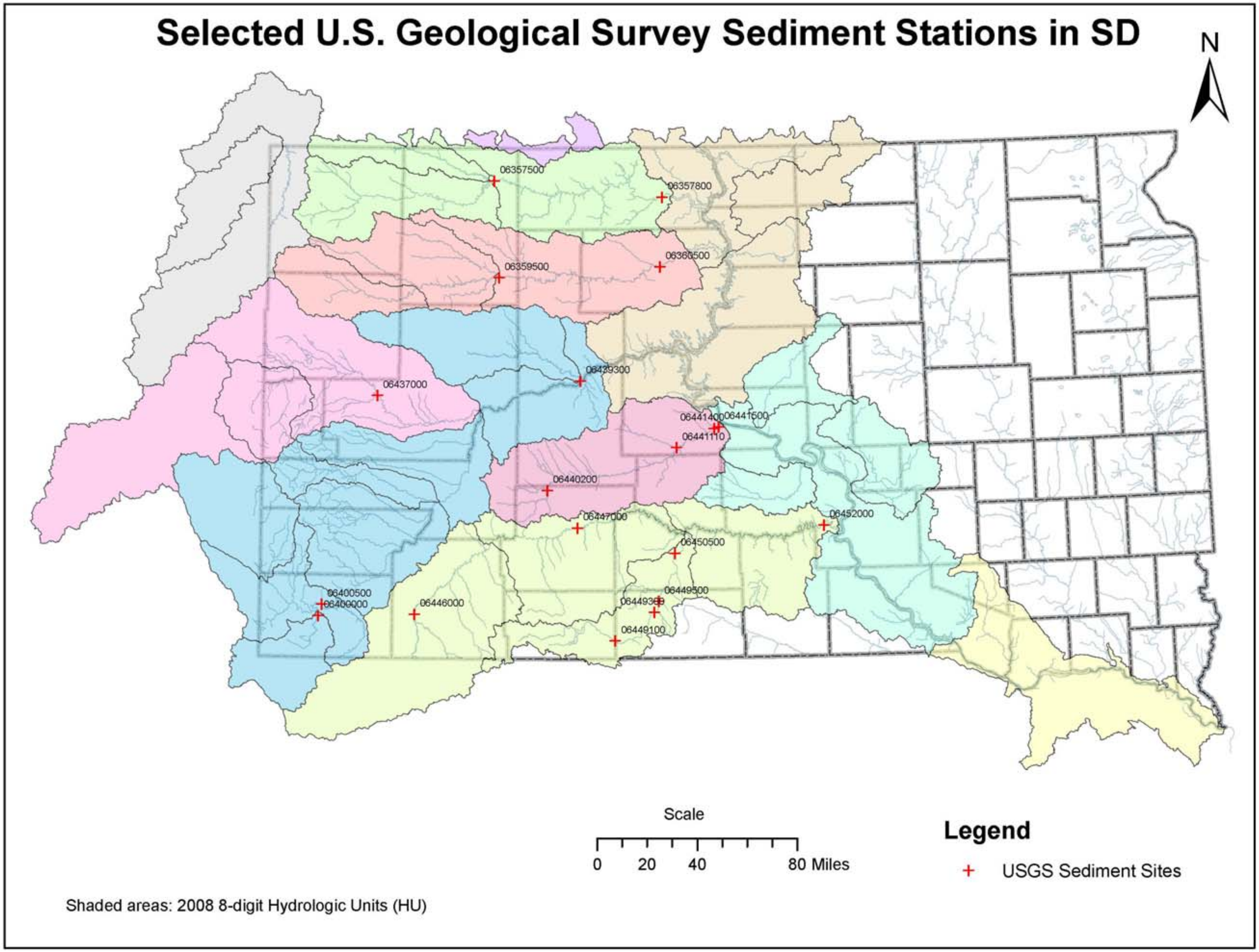

Figure 9 - Location of Gaging Stations in South Dakota

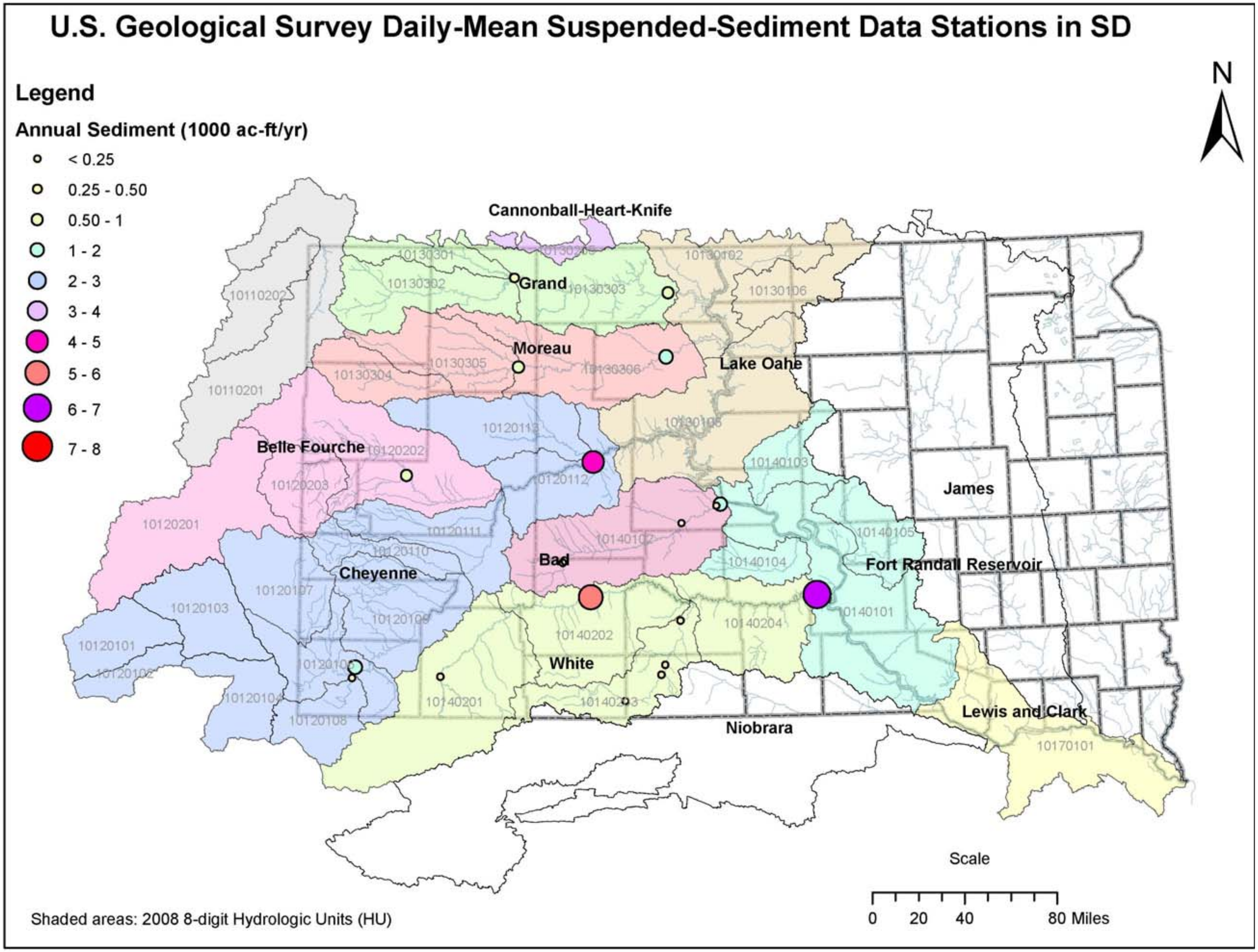

Figure 10 – Daily Mean Suspended Sediment Data in South Dakota

Sediment Budget

Utilizing the USGS suspended sediment data and COE reservoir sediment surveys, a sediment budget was prepared for the Missouri River Reservoirs in South Dakota, as shown in Table L. For Lake Oahe, the USGS gaged major components of the COE measured sediment deposition was Cheyenne River (23%) and the Missouri River at Bismarck, ND (22%). Unaccounted sediment for Lake Oahe made up 36% of the total measured COE sediment storage. For Lake Sharpe, the USGS gaged major components of the COE measured sediment storage was the Bad River (26%) with unaccounted sediment of 70%. For Lake Francis Case, the USGS gaged major components of the COE measured sediment storage was the White River (50%) with unaccounted sediment of 46%. Figure 11 (page 21) further illustrates the magnitude of the annual sediment loads for Lake Oahe, Lake Sharpe, and Lake Francis Case.

In connection with the sediment budget, sediment inflows for ungaged areas in South Dakota were estimated as displayed in Table M (page 22) using a correlation with watershed slope (Figure 12 – page 23). For Lake Oahe in South Dakota, Lake Sharpe, and Lake Francis Case, the Grand and Moreau River sediment data was used for the watershed slope correlations. The portions of the ungaged drainage areas of Lake Oahe, Lake Sharpe, and Lake Francis Case with watershed slopes similar to the Grand and Moreau Rivers drainage areas were multiplied by the annual sediment yield (ac-ft/yr) of the Grand and Moreau Rivers to estimate the sediment inflows for the ungaged areas. The sediment inflow for the ungaged drainage area for Lake Oahe in North Dakota was not estimated and instead was included with the unaccounted sediment in the sediment budget.

Table L - Sediment Budget for Missouri River Reservoirs in South Dakota

Missouri River Reservoir	COE Reservoir Surveys: Sediment Storage (ac-ft/yr)	COE Reservoir Surveys: Survey Period	Watershed[5]	Drainage Area (mi^2)	USGS Sediment Data: Sediment Inflow[2] (ac-ft/yr)	USGS Sediment Data: Applicable Gage Station[4]	USGS Sediment Data: Period of Record	USGS Sediment Data: Percent of USACOE Sediment Storage
Lake Oahe	19,800	1958-1989		62,090[1]				
			Missouri River at Bismarck, ND	5,000[6]	4,370	06342500	1972-1981	22
			Heart River	3,310[2]	232	06349000	1972-1976	1
			Cannonball River	4,100[2]	566	06354000	1972-1976	3
			ungaged Lake Oahe in ND	no data	no data	---	---	no data
			Grand River	5,370[2]	811	06357800	1971-1976	4
			Moreau River	4,880[2]	1,195	06360500	1971-1976	6
			Cheyenne River	23,900[2]	4,558	06439300	1971-1976	23
			ungaged Lake Oahe in SD	7,000	970	---	---	5
			Unaccounted Sediment for Lake Oahe + ungaged Lake Oahe - ND	---	7,098	---	---	36
Lake Sharpe	5,300	1963-1997		5,840[1]				
			Bad River	3,107[2]	1,387	06441500	1971-2007	26
			ungaged Lake Sharpe	2,700	220	---	---	4
			Unaccounted Sediment for Lake Sharpe	---	3,693	---	---	70
Lake Francis Case	18,400 12,800	1953-1997 1958-1997		14,150[1]				
			White River	10,200[2]	6,348	06452000	1971-2007	50
			ungaged Lake Francis Case	4,300	620	---	---	5
			Unaccounted Sediment for Lake Francis Case	---	5,832	---	---	46

[1]Source USACOE; [2]Source USGS; [3]Volume of sediment estimated assuming a specific weight of 55 lb/ft^3; [4]See Table K and Table N for list of USGS gage stations in South Dakota and North Dakota respectively; [5]See Figure 9 for location of watersheds in South Dakota and [6]Between gage and Lake Sakakawea

Note: Annual sediment loads for Lake Oahe - SD, Lake Sharpe, and Lake Francis Case were estimated using the Grand and Moreau measured sediment data and land slope comparisons. 1958-1997 was used for sediment budget for Lake Francis Case because 1953-1957 was deemed not representative of long term sediment loads.

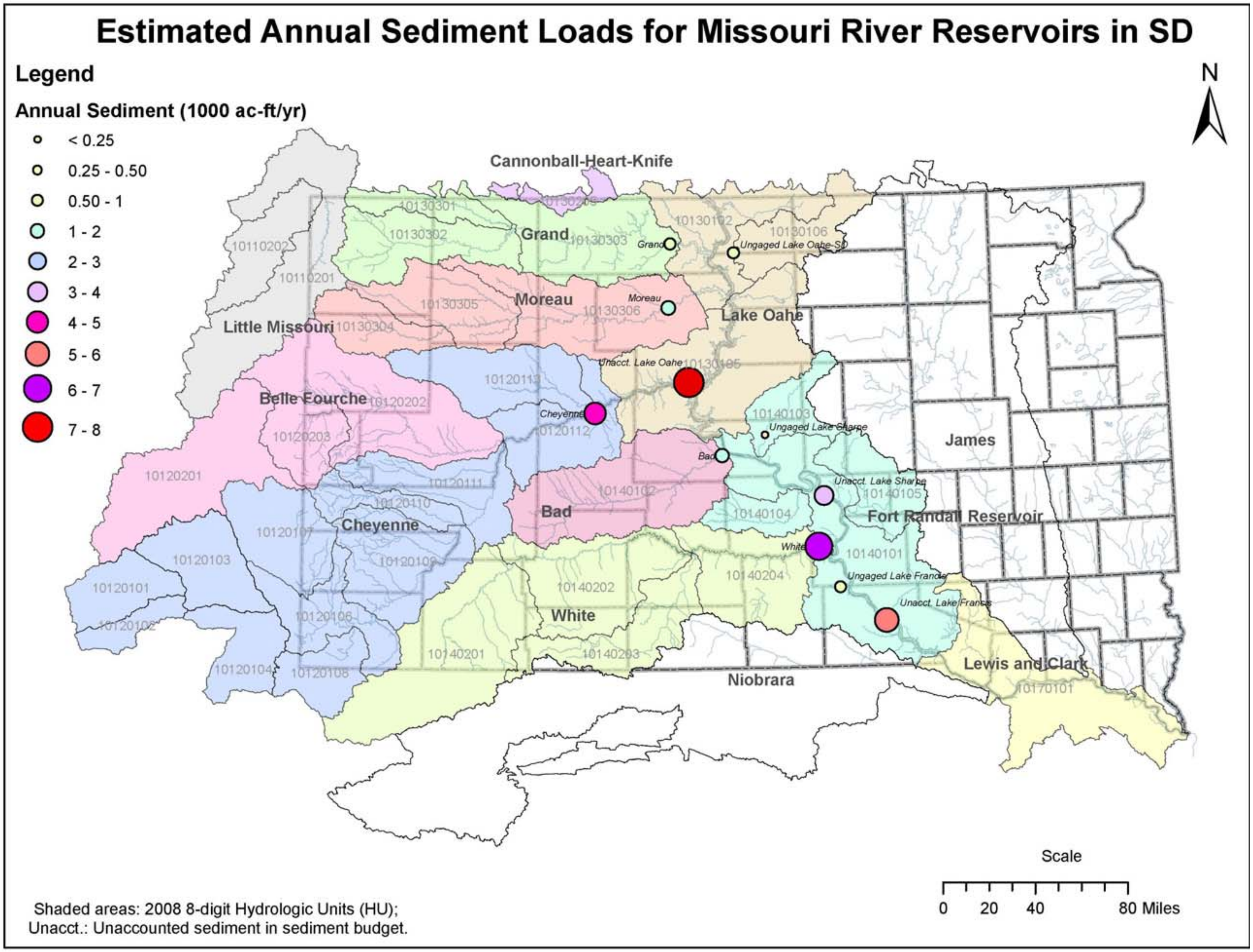

Figure 11 – Estimated Annual Sediment Loads for Missouri River Reservoirs in South Dakota

Table M - Estimation of Annual Sediment for Ungaged Areas of Lake Oahe, Lake Sharpe, and Lake Francis in South Dakota

Ungaged Area	HU Name	HUC	Drainage Area (mi^2)	Average Annual Volume of Suspended Sediment (ac-ft/yr)	Average Annual Volume of Suspended Sediment per mi^2 (ac-ft/yr/mi^2)	Estimated Average Annual Volume of Suspended Sediment Based on Watershed Slope (ac-ft/yr)		
						Using Moreau	Using Grand	Average
Lake Oahe	Lake Oahe		7,032		0.138	764	1,180	970
		10130102	2,009					
		10130105	3,834					
		10130106	1,189					
Lake Sharpe	Fort Randall Reservoir		2,666		0.083	170	263	220
		part of 10140101	1,136					
		10140103	837					
		10140104	693					
Lake Francis Case	Fort Randall Reservoir		4,291		0.144	491	759	620
		part of 10140101	3,128					
		10140105	1,163					
	Grand		4,731		---			
		10130301	684	380	0.156			
		10130302	1,745	380	0.156			
		10130303	2,302	811	0.352			
	Moreau		5,239	1,195	0.228			
		10130304	1,013	507	0.196			
		10130305	1,568	507	0.196			
		10130306	2,658		---			
	Bad		3,176	1,387	0.437			
		10140102	3,176	1,387	0.437			

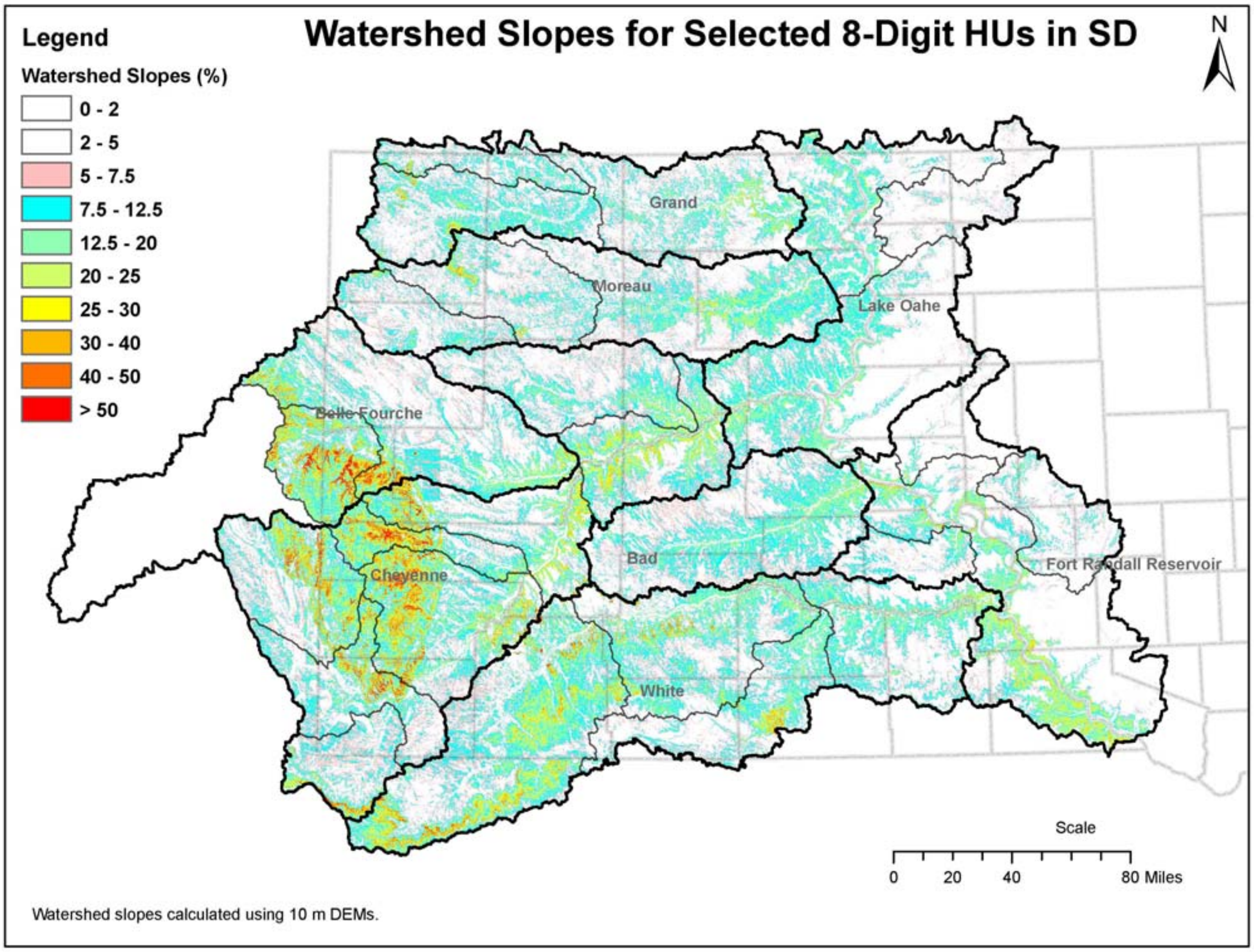

Figure 12 - Watershed Slopes in South Dakota

North Dakota

Sediment Loads

Utilizing the U.S. Geological Survey suspended sediment data from their gaging stations, the following Table N was generated to illustrate which Lake Oahe sub-basins in North Dakota had the highest annual sediment (measured in acre-feet/year).

Table N - Summary of U.S. Geological Stations with Daily Suspended Sediment Data – North Dakota

Station Number	Station Name	Sediment Data Period of Record	Days of Record	Average Annual Suspended Sediment (tons/year)	Average Annual Volume of Suspended Sediment (ac-ft/year)[1]	Contributing Drainage Area (mi^2)[2]	ac-ft sediment per sq-mi
06339500	Knife River near Golden Valley, ND	1946-1965	1,730	138,328	115	1,230	0.09
06340500	Knife River at Hazen, ND	1946-1948	297	230,175	192	2,240	0.09
06342500	Missouri River at Bismarck, ND	1972-1981	3,653	5,235,130	4,370	186,400	0.02
06345500	Heart River near Richardton, ND	1946-1952	2,275	311,014	260	1,240	0.21
06346500	Heart R below Heart Butte Dam near Glen Ullin, ND	1951	365	22,026	18	1,710	0.01
06349000	Heart River near Mandan, ND	1972-1976	1,826	277,545	232	3,310	0.07
06350000	Cannonball River at Regent, ND	1965-1966	730	57,340	48	580	0.08
06352500	Cedar Creek near Pretty Rock, ND	1946-1949	1,197	44,851	37	1,340	0.03
06354000	Cannonball River at Breien, ND	1972-1976	1,827	677,984	566	4,100	0.14

[1]Volume of sediment was calculated assuming a sediment specific weight of 55 lb/ft^3.

[2] Source U.S. Geological Survey.

Watershed Slopes

The North Dakota sediment estimates are very dependent on the basin's ability to transport sediment once soil has become detached and is able to be transported by rain or snowmelt runoff. The following map (Figure 13) displays the impact topography and land slope have in sediment transport.

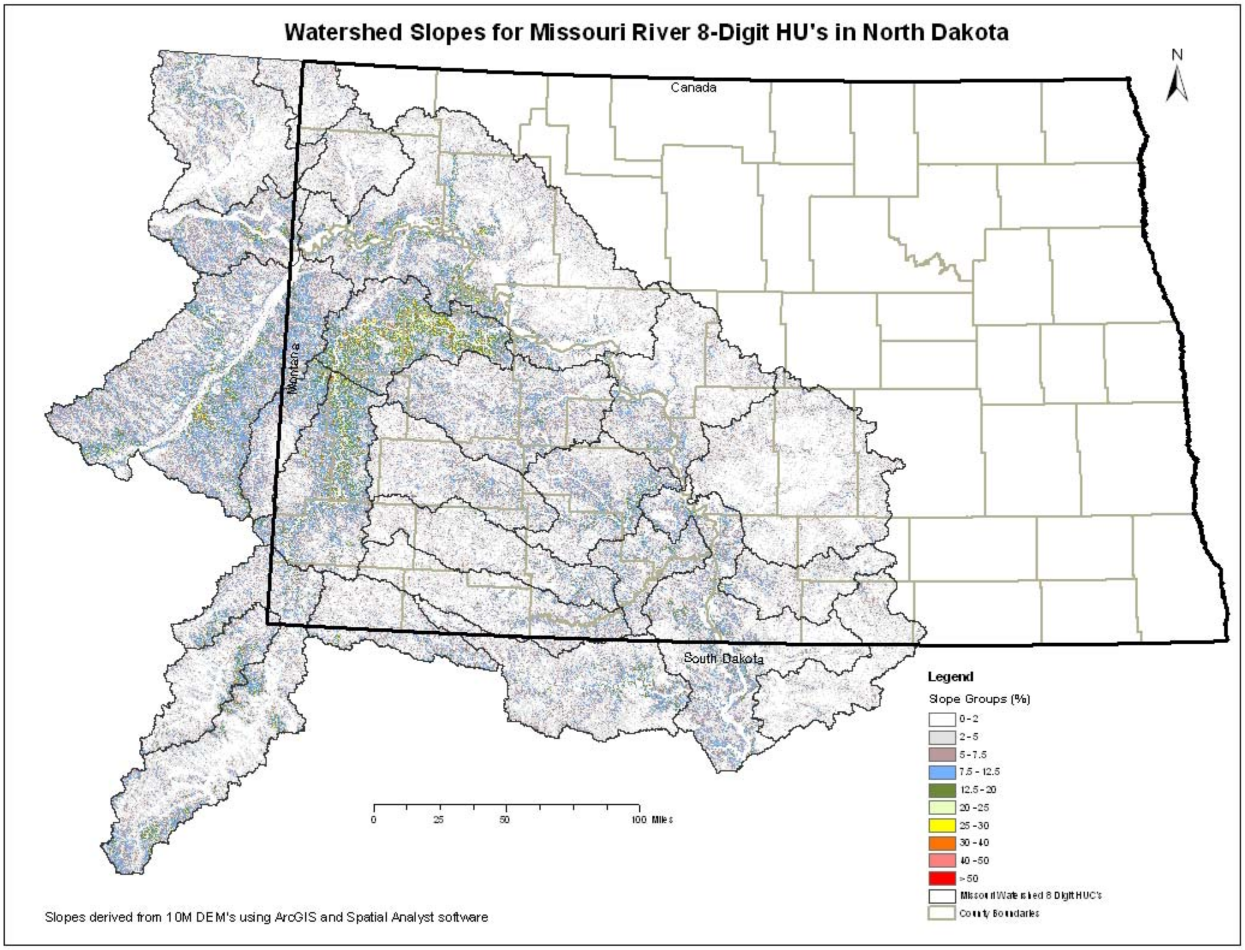

Figure 13 - Watershed Slopes in North Dakota

Montana

Sediment Loads

Utilizing the U.S. Geological Survey suspended sediment data from their gaging stations, the following table (Table O) was generated to illustrate which sub-basins draining into Fort Peck Lake and Lake Sakakawea had the highest annual sediment (measured in acre-feet/year). The two sections following the table include sub-basins located not only in Montana, but also in Wyoming and North Dakota.

Table O - Summary of U.S. Geological Stations with Daily Suspended Sediment Data – Montana

Station Number	Station Name	Sediment Data Period of Record	Days of Record	Average Annual Suspended Sediment (tons/year)	Average Annual Volume of Suspended Sediment (ac-ft/year)[1]	Contributing Drainage Area (mi²)[2]	ac-ft sediment per sq-mi
06309500	Middle Fork Powder River above Kaycee, WY	1951-1970	1,927	137,240	115	450	0.25
06313000	South Fork Powder River near Kaycee, WY	1950-1984	1,771	1,119,820	935	1,150	0.81
06313500	Powder River at Sussex, WY	1951-1984	1,250	2,784,950	2,325	3,090	0.75
06315000	North Fork Crazy Women near Greub, WY	1965-1968	1,096	39,785	33	174	0.19
06316400	Crazy Women Creek at Upper Station near Arvada, WY	1950-1953	730	186,880	156	945	0.17
06324500	Powder River at Moorehead, MT	1975-1994	4,431	4,464,680	3,727	8,088	0.46
06324710	Powder River at Broadus,MT	1975-1992	4,063	3,850,020	3,214	8,789	0.37
06326500	Powder River at Locate, MT	1974-1984	3,330	4,072,670	3,400	13,189	0.26
06207500	Clark Fork Yellowstone near Belfry, MT	1984	178	551,515	460	1,154	0.40
06208500	Clark Fork Yellowstone at Edgar, MT	1972-1973	365	489,465	409	2,032	0.20
06208800	Clark Fork Yellowstone near Silesia, MT	1984	214	723,795	604	2,093	0.29
06259500	Big Horn River at Thermopolis, WY	1946-52	2,428	4,041,645	3,374	8,020	0.42
06268600	Big Horn River at Worland, WY	1965-1969	1,322	3,358,000	2,803	10,810	0.26
06269000	Big Horn River near Manderson, WY	1949-1956	1,952	3,589,775	2,997	11,020	0.27
06269500	Big Horn River at Manderson, WY	1946-1949	1,191	9,704,620	8,101	11,048	0.73
06279500	Big Horn River at Kane, WY	1946-1964	6,282	6,584,235	5,496	15,765	0.35
06290500	Little Big Horn River below Pass Creek near Wyola, MT	1969-1973	1,096	98,185	82	428	0.19
06294000	Little Big Horn River near Hardin, MT	1969-1977	2,557	350,035	292	1,294	0.23
06294700	Big Horn River near Big Horn, MT (average)	1959-1972	4,114	4,131,800	3,449	22,885	0.15
	Big Horn River near Big Horn, MT (1959-January 1, 1968) before dam closed	1959-1967	2,863	5,280,820	4,408	22,885	0.19
	Big Horn River near Big Horn, MT (after dam closed)	1968-1972	1,251	1,502,705	1,254	22,885	0.05
06307830	Tongue River near Ashland, MT	1974-1981	2,557	137,970	115	4,062	0.03
06308500	Tongue River at Miles City, MT	1977-1985	3,018	233,600	195	5,379	0.04
06191500	Yellowstone River at Corwin Springs, MT	1985-1992	1,628	401,135	335	2,623	0.13
06192500	Yellowstone River near Livingston, MT	1985-1986	301	880,015	735	3,551	0.21
06195600	Shields River near Livingston, MT	1999-2003	1,825	21,100	18	852	0.02
06197500	Boulder River near Contact, MT	1971-1972	366	9,490	8	226	0.04
06200000	Boulder River at Big Timber, MT	1999-2003	1,825	8,870	7	523	0.01

Station Number	Station Name	Sediment Data Period of Record	Days of Record	Average Annual Suspended Sediment (tons/year)	Average Annual Volume of Suspended Sediment (ac-ft/year)[1]	Contributing Drainage Area (mi^2)[2]	ac-ft sediment per sq-mi
06202610	Stillwater River at Beehive, MT	1971-1973	731	9,125	8	371	0.02
06205000	Stillwater River near Absarokee, MT	1999-2003	1,825	7,790	7	975	0.01
06214500	Yellowstone River at Billings, MT	1976-1981	1,826	1,703,820	1,422	11,795	0.12
06295000	Yellowstone River at Forsyth, MT	1976-1981	1,059	4,514,685	3,769	40,339	0.09
06329500	Yellowstone River near Sidney, MT	1971-1994	7,459	10,209,050	8,522	63,103	0.14
06025500	Big Hole River near Melrose, MT	1960-1964	1,522	24,820	21	2,476	0.01
06018500	Beaverhead River near Twin Bridges, MT	1962-1974	4,475	29,930	25	3,619	0.01
06052500	Gallatin River at Logan, MT	1999-2003	3,285	70,200	59	1,795	0.03
06026500	Jefferson River near Twin Bridges, MT	1960-1972	3,075	114,245	95	7,632	0.01
06027200	Jefferson River at Silver Star, MT	1972-1974	730	254,405	212	7,683	0.03
06036650	Jefferson River near Three Forks, MT	1999-2003	2,190	77,000	64	9,532	0.01
06038800	Madison River near Cameron, MT	1959-1960	366	315,360	263	1,065	0.25
06054500	Missouri River at Toston, MT	49-53,99-03	11,680	128,000	107	14,669	0.01
06061500	Prickly Pear Creek near Clancy	1999-2003	1,825	417	0	192	0.00
06073500	Dearborn River near Craig	1999-2003	2,190	3,700	3	325	0.01
06089000	Sun River near Vaughn	1999-2003	12,775	41,500	35	1,320	0.03
06090800	Missouri River at Fort Benton, MT	1980	79	119,355	100	27,749	0.00
06108800	Teton River at Loma, MT	1998-2003	1,825	9,760	8	2,010	0.00
06114700	Judith River near mouth, near Winifred, MT	1998-2003	1,095	73,500	61	2,731	0.02
06115200	Missouri River near Landusky, MT	1971-1994	7,681	8,345,725	6,967	40,987	0.17
06130500	Musselshell River at Mosby, MT	1982-1994	3,808	275,940	230	7,846	0.03
06174500	Milk River	1999-2003	12,775	319000	266	22,332	0.01
06181000	Poplar River near Poplar, MT	1999-2003	1,825	23,600	20	3,174	0.01
06185500	Missouri River near Culbertson, MT	1971-1976, 1999-2003	3,650	5,612,605	4,685	15,377	0.30
06337000	Little Missouri River near Watford City, ND	1947-1948, 1971-1976	2,229	21,645	18	8,310	0.00

[1]Volume of sediment was calculated assuming a sediment specific weight of 55 lb/ft^3.

[2] Source U.S. Geological Survey.

Fort Peck Lake Drainage Area

The average annual sediment inflow into Fort Peck Lake since Fort Peck Dam was constructed in 1937 is 15,600 ac-ft/yr. In the COE 2008-2009 AOP, they estimate the sediment inflow into Fort Peck Lake for 2009 will be 17,700 ac-ft/yr. USGS stream gage data was used to determine the amount of the sediment discharged into Fort Peck Lake. A statewide monitoring network of 38 sites was operated from 1999-2003 by USGS in cooperation with the Montana Department of Environmental Quality to provide a broad geographic base of water-quality information on Montana streams. Additional USGS stream gage data with varying periods of record were also available.

There is some concern with using stream gage data from various time periods and various lengths of measurement when trying to determine the source of sediment into Fort Peck Lake; however, this is the best available data. Table O summarizes the stream gage data for suspended sediment concentrations.

The Madison, Jefferson, and Gallatin Rivers combine near Three Forks, Montana to form the Missouri River. There is no stream gage on the Madison River near its confluence with the Jefferson River. The stream gage data near Cameron is above Ennis Lake which would capture any suspended sediment measured at Cameron.

The suspended sediment of the Missouri River at Toston (107 ac-ft/yr) is less than the sum of the suspended sediments from the Gallatin and Jefferson Rivers (59 + 64 = 123 ac-ft/yr). Prickly Pear Creek near Clancy (south of Helena) contributes no sediment. Any sediment above Prickly Pear Creek on the Missouri is probably captured by Canyon Ferry, Hauser, and Holter dams. Downstream from these three dams there are small amounts of sediment from the Dearborn (3 ac-ft/yr) and Sun Rivers (35 ac-ft/yr).

The next stream gage data station on the Missouri is at Fort Benton. The suspended sediment is nearly the same as was measured at Toston (100 versus 107 ac-ft/yr). Eleven miles below Fort Benton the Teton River flows into the Marias River which flows into the Missouri. The Marias and Teton Rivers are deeply incised. The Teton River contributes little sediment (8 ac-ft/yr). The Judith River flows into the Missouri from the south and also contributes little sediment (61 ac-ft/yr). Arrow Creek, a perennial stream, flows into the Missouri River from the south and Cow Creek, an intermittent stream, flows into the Missouri River from the north. The last stream gage before the Missouri flows into Fort Peck Lake is near Landusky which recorded a suspended sediment load of 6,967 ac-ft/yr. The Musselshell River flows directly into Fort Peck Lake but contributes little sediment (230 ac-ft/yr).

The question is “Where does the sediment come from?” The USGS gage station on the Missouri River at Fort Benton measured only 100 ac-ft/yr sediment load. By the time the Missouri reaches Landusky, approximately 150 miles downstream, the sediment load has increased to 6,967 ac-ft/yr.

From Great Falls to Fort Peck Lake the Missouri River runs though a reach that was established at the end of the last glacial advance. This reach has not reached equilibrium and is still actively eroding. This is exacerbated by bedrock composed of soft sandstone and shales that commonly weather into dispersive soils.

The semi-arid prairie at Fort Benton is underlain by sedimentary rocks and deposits. The sparse vegetative cover and erodible soils in the basins and plains areas contribute to larger suspended sediment concentrations in basin and plains streams than in mountain streams.

The surface of this area is underlain by Cretaceous and Tertiary shales and sandstones that are poorly consolidated and rapidly weather into fine grained soils. The bedrock formations tend to be high in sodium and the soils tend to inherit the sodium content. The high sodium content of the soils commonly results in poor vegetative cover and dispersive soils combine with high stream gradients generated by the glacial disruption of the Missouri-Yellowstone drainages produce high sediment yields for these drainages.

The local geology and soils, topography, vegetation, and land use determine the susceptibility of the landscape to erosion and rate of delivery of sediment to the streams. With the lack of stream gages to identify the sources of sediment in the Missouri River below Fort Benton, local NRCS staff working in this part of the State, were consulted.

Cropland is more than three miles from the Missouri River. Most of the land is under a no-till system and results in little erosion and sediment movement offsite. The grazing land is in good condition with acceptable stocking rates.

Below Loma the Missouri River flows through high banks with steep slopes. Similar features also occur around Fort Peck Lake. It is estimated that over half of the sediment deposited into Fort Peck Lake is natural geologic. The Marias River flows into the Missouri River at Loma. There is no stream gage data available for this river, but it is estimated that it contributes 15 percent of the sediment. Farther downstream, Arrow Creek a perennial stream, flows into the Missouri River from the south. It contributes 10 percent of the sediment. Cow Creek is the next tributary and it flows into the Missouri River from the north. It is an intermittent stream and contributes 5 percent of the sediment. The last 5 percent of sediment is a result of sloughing of the banks around Fort Peck Lake.

Lake Sakakawea Drainage Area

The average annual sediment inflow into Lake Sakakawea since Garrison Dam was constructed in 1953 is 25,900 ac-ft/yr. USGS stream gage data was used to determine the source of the sediment inflow into Lake Sakakawea.

The Missouri River drainage below Fort Peck Dam and the Yellowstone River are the major drainages into Lake Sakakawea. The Yellowstone River originates in Yellowstone National Park. Table O summarizes the stream gage data for suspended sediment concentrations. The first USGS stream gage outside the Park is at Corwin Springs.

The sediment load in the river at this point is 335 ac-ft/yr. The next stream gage in the Yellowstone River is at Livingston which has a sediment load of 735 ac-ft/yr, an increase of 400 ac-ft/yr. The Shields (18 ac-ft/yr), Boulder (7 ac-ft/yr), and Stillwater (7 ac-ft/yr) Rivers flow into the Yellowstone below Livingston but contribute little sediment load.

The next major river entering the Yellowstone is the Clarks Fork of the Yellowstone at Laurel. It contributes 255 ac-ft/yr of sediment load. The stream gage in the Yellowstone River at Billings has a sediment load of 1,422 ac-ft/yr, an increase 687 ac-ft/yr above the Livingston stream gage value.

The Yellowstone River past the Eagle sandstone outcrop at Billings has been reactivated by channel changes established at the end of the last glacial maximum. This was when the Missouri River drainage was permanently captured by the Mississippi River drainage system rather than flowing into the Hudson Bay. In addition, the river valleys are cut into soft and poorly consolidated Cretaceous and Tertiary sediments that tend to produce sodic soils. Sodic soils are nonsaline soil containing sufficient exchangeable sodium to adversely affect crop production and soil structure. These soils generally have a pH of 8.5 or higher and tend to have poor vegetative cover; thus soil particles tend to disperse into water and remain suspended. The natural factors of steep stream gradients, sodic soils, and poor vegetation combine to produce a high sediment output in this region.

The Big Horn River flows into the Yellowstone about 50 miles east of Billings. The stream gage data was collected from 1959-1972. The average sediment load for the period is 3,449 ac-ft/yr. This figure is misleading since the Yellowtail Dam was constructed in 1968 which has since trapped all sediment upstream of the dam. The average sediment load from 1968-1972 is 1,254 ac-ft/yr. Stream gage data from 1999-2003 showed a reduction in sediment load from the Big Horn River to only 167 ac-ft/yr.

The next stream gage in the Yellowstone River is 44 miles downstream at Forsyth. The average sediment load is 3,769 ac-ft/yr, an increase of 2,347 ac-ft/yr above the Billings stream gage value. The Tongue River flows into the Yellowstone River at Miles City and has a sediment load of 195 ac-ft/yr.

The Powder River flows into the Yellowstone between Miles City and Glendive. It has a sediment load of 3,400 ac-ft/yr. This is based on stream gage data from 1974-84. Using stream gage data from 1999-2003 the sediment load was only 1,168 ac-ft/yr. These five years were below average mean annual stream flows, which could explain the reduced sediment load.

The last stream gage on the Yellowstone, before it flows into the Missouri, is at Sidney. The sediment load is 8,522 ac-ft/yr, an increase of 4,753 ac-ft/yr above the Forsyth stream gage value. The Yellowstone River flows into the Missouri River just above Lake Sakakawea.

Three rivers flow into the Missouri River below Fort Peck Dam. The Poplar River contributes little sediment (20 ac-ft/yr) and the Milk River contributes 266 ac-ft/yr of sediment load. There are numerous creeks and rivers that enter the Missouri River below Fort Peck Dam that have no stream gage information. After the Milk River on the north side of the Missouri are Wolf Creek, Tule Creek, and Box Elder Creek. Below the Poplar River is Big Muddy Creek and below Culbertson is Little Muddy Creek. On the south side of the Missouri are Prairie Elk Creek, Sand Creek, and the Redwater River. The last stream gage on the Missouri River, before it discharges into Lake Sakakawea, is at Culbertson, MT. The sediment load is 4,685 ac-ft/yr.

The US Army Corps of Engineers published Technical Report CHL-98-7 in March 1998, titled "Cumulative Erosion Impacts Analysis for the Missouri River Master Water Control Manual Review and Update Study." The study addressed the cumulative impacts of erosion on changing the operation of the mainstem dams and adding additional streambank erosion control measures. The following two paragraphs summarize results from the study.

The study evaluated stream reaches between Fort Peck Dam and Lake Sakakawea. In 1995, 57 percent of the banks in the Fort Peck Reach exhibited evidence of bank instability and mass wasting. Bank materials were weakly cohesive sandy-silts. Planar failure due to toe scour and over steepening by fluvial bank erosion was the most common mechanism of collapse in the study reach. Mean rates of bed scour and bank erosion were low, indicating that the channel was at, or approaching, a condition of dynamic equilibrium. Between 1958 and 1980, the average annual bed material load at Culbertson was 825 acre feet per year.

From 1955-1966, characterized as low flow years, there was channel bed filling and bank erosion. From 1966-1978, characterized as high flow years, there was channel bed scour and less bank erosion. From 1955-1966, there was 1,639 acre feet of bank material eroded. From 1966-1978, there was 870 acre feet of bank material eroded. From 1933-1983, the volume of material scoured from the banks was 75,342 acre feet. Approximately eight percent of the storage capacity lost in Lake Sakakawea behind Garrison Dam came from the banks in the Fort Peck Reach. The rest of the storage loss came from material delivered to the reservoir from the channel bed, tributaries, and other sources. These sources include bank erosion, channel bed scour, and geologic erosion due to poor vegetative cover caused by sodic soils.

The Little Missouri River flows directly into Lake Sakakawea and contributes 18 ac-ft/yr of sediment load. The Little Muddy River, White Earth River, and Little Knife River flow into Lake Sakakawea from the north but there are no sediment gages on these rivers.

Drawing conclusions on the source of sediment in Lake Sakakawea is difficult. Stream gages at Culbertson and Sidney show about 50 percent of the sediment inflow into the lake as compared to actual measurements of sediment in the lake. The Little Missouri River sediment load as well, as bank erosion within the lake itself, account for much of the remaining sediment.

Upper Missouri River Basin Sediment Summary

Table P illustrates the impact that sediment inflow is having on the Missouri River Reservoirs. The Lewis and Clark Lake, Lake Francis Case, and Lake Sharpe have the highest annual storage loss ranging from 0.55 to 0.29%. Lake Sakakawea, Fort Peck Lake, and Lake Oahe have annual storage losses of less than 0.11%.

Table P - Summary of Sediment Inflow for Missouri River Reservoirs

Missouri River Reservoir	COE Estimated Annual Sediment Inflow (ac-ft/yr)	Reservoir Storage Capacity (ac-ft)	Annual Storage Loss (%)
Lewis and Clark Lake	2,600	470,000	0.55%
Lake Francis Case	18,400	5,418,000	0.34%
Lake Sharpe	5,300	1,798,000	0.29%
Lake Sakakawea	25,900	23,821,000	0.11%
Fort Peck Lake	17,700	18,688,000	0.09%
Lake Oahe	19,800	23,137,000	0.09%

Table Q on the following page displays the amount of sediment measured for each of the sub-basins at the USGS gaging station located nearest to each of the six mainstem reservoirs. The table shows there is a considerable amount of unaccounted sediment based on the USGS measured sediment and the COE sediment estimates is in each of the six mainstem reservoirs. It appears there may be considerable bed and bank erosion occuring on the lower end of the tributaries entering into the Missouri and the reservoirs. It is also probable there is a certain level of bank erosion occuring on the mainstem reservoirs themselves.

There is an obvious need to complete additional sediment budgets to account for the measured sediment in the reservoirs. Completing such a prediction of sediment yield is extremely complex and all significant variables must be considered to evaluate any future effects from land use, land treatment, and geologic erosion.

Table Q - Sediment Summary of the Upper Missouri River Reservoirs

Reservoir	Reservoir Drainage Area (square miles)	Tributaries with Measured Sediment Discharge to the Reservoir	USGS Gage Station Location	USGS Delivered Sediment (ac-ft/yr)	COE Sediment Survey Average Annual Sediment Accumulation (ac-ft/yr)	Available Storage (ac-ft)	Annual Rate of Storage Capacity Loss from All Sediment Sources (%)	Annual Rate of Storage Capacity Loss from Gaged Watershed Sediment (%)
Fort Peck	57,500				17,700	18,688,000	0.09	0.04
		Missouri River	Landusky, MT	6,967				
		Musselshell	Moseby, MT	230				
Delivered Sediment (USGS) Subtotal				7,197 (46%)				
Unidentified Source Contribution[1]					10,500 (59%)			
Sakakawea	123,900				25,900	23,821,000	0.11	.06
		Missouri River	Culburtson, MT	4,685				
		Yellowstone River	Sidney, MT	8,522				
		Little Muddy	Ungaged					
		White Earth	Ungaged					
		Little Knife	Ungaged					
		Little Missouri	Watford City, ND	18				
Delivered Sediment (USGS) Subtotal				13,225 (51%)				
Unidentified Source Contribution [1, 2]					12,675 (49%)			
Oahe	62,090				19,800	23,137,000	0.09	0.05
		Missouri River	Bismarck, ND	4,370				
		Heart River	Mandan, ND	232				
		Cannonball	Breien, ND	566				
		Grand	Little Eagle, SD	811				
		Moreau	Whitehorse, SD	1,195				
		Cheyenne River	Cherry Creek	4,558				
Delivered Sediment (USGS) Subtotal				11,732 (59%)				
Unidentified Source Contribution[1]					8,068 (41%)			

Reservoir	Reservoir Drainage Area (square miles)	Tributaries with Measured Sediment Discharge to the Reservoir	USGS Gage Station Location	USGS Delivered Sediment (ac-ft/yr)	COE Sediment Survey Average Annual Sediment Accumulation (ac-ft/yr)	Available Storage (ac-ft)	Annual Rate of Storage Capacity Loss from All Sediment Sources (%)	Annual Rate of Storage Capacity Loss from Gaged Watershed Sediment (%)
Lake Sharpe	5,800				5,300	1,798,000	0.29	0.08
		Bad River	Fort Pierre, SD	1,387 (26%)				
		Medicine Creek	Ungaged					
Unidentified Source Contribution[1]					3,913 (74%)			
Lake Francis Case	14,150				18,400	5,418,000	0.34	0.12
		White River	Oacoma	6,348 (35%)				
Unidentified Source Contribution[1]					11,950 (65%)			
Lewis and Clark	16,000				2,600	470,000	0.55	0.17
		Niobrara River	Verdel, NE	799 (31%)				
Unidentified Source Contribution[1]					1,800 (69%)			

[1] Unidentified Source Contribution – Ungaged tributaries discharging directly to the reservoirs, stream bank and channel erosion, bedload concentrations, in-lake shoreline and bank erosion, gullies and channels in the breaks surrounding the reservoirs, land area between the last gaging station and the reservoirs, etc

[2] The COE estimated that approximately 8% (1,500 ac-ft/yr from 1933-1983) of the storage capacity loss in Lake Sakakawea can be attributed to bank erosion in the Fort Peck reach of the Missouri River (below the Ft. Peck dam to the tailwaters of Lake Sakakawea). The COE also determined that between 1958 – 1980 the average annual bed load concentration measured at Culbertson was 825 ac-ft/year. These two measurements would account for an additional 9% of the capacity loss still leaving 40% of the sediment with no known source.

Additional Sediment Assessment Tools

Following are other resource tools and assessments that could be used to develop a project implementation plan to address sediment reduction:

Performance Results Systems (PRS)

NRCS reports all conservation practices planned and applied by county and State. Starting in 2005, NRCS also began reporting practices by 8-digit HUC watershed. The information obtained from PRS will identify those basins which currently have the greatest number of practices installed. While PRS tracks all conservation practices, only those practices that relate to erosion or sediment control will be analyzed in any future study. The PRS data can be compared to both the NRI and USGS information to identify and develop watershed priorities.

Bank Stability and Toe-Erosion Model (BSTEM)

The USDA Agricultural Research Service (ARS) has developed the Bank Stability and Toe Erosion Model (BSTEM) that could be used to evaluate and quantify bank erosion along the streams in the most vulnerable 4-digit HUAs. Using this model would assist in completing a more accurate sediment budget for the entire Upper Basin. Simulating potential sediment load reductions could be done using the model results. Identifying the source of sediment loading and identifying potential mitigation measures to address excessive sedimentation could result from this ARS model.

The ARS model uses Rapid Geomorphic Assessments (RGAs) along the river or stream to rapidly analyze many sites and assign stages of channel evolution. This process highlights the erosion processes taking place along the stream and identifies bank stability and toe erosion concerns in that particular stream segment and system.

Missouri Water Resource Region 10 6-digit HUC Watersheds

The USDA National Agricultural Statistics Service (NASS) has compiled significant farm, land use, commodity, and livestock data on the 6-digit HUA. This data can be further evaluated and analyzed to support environmental stressors which could impact sediment delivery in the Upper Basin.

National Resources Inventory (NRI)

NRCS has post 1997 NRI data waiting to be compiled and certified for public use. Considerable rangeland and grazing land data has been collected since 2000. This data, along with updates to past (1982 – 1997) primary sampling unit (PSU) data should be evaluated for its applicability in addressing sedimentation impacts within each of the 4-digit sub-basins.

Integrated Data for Enterprise Analysis (IDEA)

Natural resource data collected and analyzed by NRCS's application IDEA should be explored for applicability to address Upper Missouri River Basin sedimentation issues. This tool provides a one stop location to find integrated agency reports and analysis tools for NRCS employees. The fundamental concepts for IDEA surround the need and goal to provide a corporately recognized strategy for data access, analysis, and reporting of NRCS data.

The purpose of the IDEA application and supporting technology is to facilitate enterprise analysis by providing the integration of multiple databases, thereby allowing users to compare various types of related information side-by-side that is not currently available in one application.

Summary and Conclusions

Although all six of the Missouri River Reservoirs in the Upper Missouri River Basin are experiencing storage losses due to sediment, the three smallest reservoirs (Lewis and Clark Lake, Lake Francis Case, and Lake Sharpe) located in the lower part of the basin have been far more significantly impacted than the other reservoirs. As of 2009, Lewis and Clark Lake has a storage loss of almost 30 percent. Using COE supplied sediment data, Lewis and Clark Lake, Lake Francis Case, and Lake Sharpe are projected to be at 50% of their design volume in the years 2045, 2100, and 2133, respectively.

Sediment budgets were prepared for the six Missouri River Reservoirs using COE and USGS sediment data. An analysis of these sediment budgets showed that additional data needs to be collected; the sediment inflow that could not be accounted for ranged from 41 to 74% of the total sediment in the reservoirs.

Until all sediment sources have been identified and quantified, a comprehensive sediment budget cannot be developed. Any watershed treatment/sediment reduction plan will need a sediment budget to ensure the proposed strategies will be effective.

The technical team recommends any future proposals focus on the unidentified source contributions that cannot be quantified using existing databases. This includes, but is not limited to, stream channel bed and bank sediment loads, in-lake bank and shoreline sedimentation, and un-gaged land areas that discharge sediment directly to a reservoir.

These types of evaluations are complex and require specialized sediment assessment/evaluation tools, resources, and sediment transport specialists. Resource agencies and groups, such as USGS, ARS Sedimentation Lab, and COE have developed professionally accepted procedures, have the specialized staff and resources available, and routinely collect and analyze sediment data.

In order for MSAC to achieve their objectives they may need to call upon other agency expertise. A phase III study will likely include sediment data collection or analysis which will require one or more of the agencies identified above as the key project leader.

Future Phases

Future Phases III and IV will need to address sediment budgets, and identify environmentally and economically feasible mitigation plans to reduce the sediment loads in the six mainstem reservoirs.

Continued interagency coordination will be essential to address sediment availability and erosion in the sub-basin watersheds. Transport and deposition of sediment in the Missouri River and six mainstem reservoirs will need to be addressed through an interagency and landowner approach. The Corps of Engineers will need to be the lead agency when addressing resource issues that directly impact the reservoirs and their operation. USGS and ARS should be involved in measuring and assessing sediment transport within the stream systems. NRCS and the conservation districts from each State need to play a key role in getting the necessary land treatment on the most critical and vulnerable sub-watersheds that are contributing significant sediment to the stream systems and reservoirs.

The NRCS Technical Team recommends in phase III or IV the development of a matrix to identify and prioritize the Upper Basin’s 4-digit HUAs as they relate to potential sedimentation resource issues. This matrix would utilize NRI soil erosion data from NRCS and USGS and COE sediment data, along with other sediment studies from agencies, such as ARS that could assist local conservation decision-makers to prioritize their conservation needs and resources.

Need for Continued Study

As was highlighted in the Phase I Report, the following is a general list of opportunities that could be gained through the continued evaluation, planning, and implementation of local ordinances, conservation practices, and land treatment systems within the upper basin:

- Retention of flood storage capacity to reduce downstream flood impacts from large rainfall events.
- Restoration of riparian zones.
- Protect public safety.
- Maintain recreational opportunities.
- Reduce or prevent increased encroachment along the river and stream system and in the floodplain.
- Protect prime and important farmlands.
- Protect real estate values.
- Protect transportation infrastructure.
- Protect fish and wildlife habitats.
- Maintain biodiversity along and within Missouri River reservoirs.
- Protect Federally listed threatened and endangered species, as well as, State listed threatened and endangered species or State list of Species on Conservation Priority.

These opportunities and other resource issues are reflected in MSAC's updated fact sheet located in Appendix A – Missouri Sedimentation Action Coalition Fact Sheet.

Appendix A – Missouri Sedimentation Action Coalition Fact Sheet

MISSOURI SEDIMENTATION ACTION COALITION

Following are some facts about the serious problem of sediment accumulation in the Missouri River mainstem reservoirs, and the MSAC position on this problem. The six dams, Fort Peck, Garrison, Oahe, Big Bend, Fort Randall and Gavins Point provide many benefits to people in many states over the entire U.S. Sediment accumulation in the reservoirs is a serious problem, which is not being sufficiently addressed, although studies are being done.

FACTS

- Sediment accumulates in these reservoirs at the approximate rate of 89,700 acre feet per year. That is the equivalent of 10 square miles of mud 14 feet deep.
- Sediment accumulation in the six reservoirs of the system has totaled over 4,800,000 acre feet since the dams were completed. This is the equivalent of a lake 100 miles long, 10 miles wide, and having an average depth of over 71/2 feet. That is storage we can not afford to lose.
- Flood control averages approximately 500 million dollars per year in benefits, and flood control benefits alone have paid for the dams. Sediment accumulation will ultimately destroy most of that benefit.
- Hydropower produced by the dams is sold by WAPA and these sales average 240 million dollars per year. Sediment will destroy much of that benefit, and has already affected some power production. The eight year drought has hurt hydropower production, resulting in increased power costs to many users, which is an indicator of what the loss of hydropower benefits will be if there are no reservoirs.
- Irrigation and drinking water intakes have been affected already, and this will get worse. In many areas, there is no other suitable water source. Storage lost to sediment each year is enough to provide 800,000 people 100 gallons per person per day for an entire year
- Navigation relies on a water flow in the river adequate to float barges. The reservoirs can not provide enough water if they are filled with sediment,
- Recreation is a major industry, but is being affected by sediment accumulation and low water levels.
- Sediment is causing environmental degradation in the reservoirs and on the tributary streams, with a loss of wildlife habitat.
- Personal property is being affected, and the federal government is in the process of spending millions of dollars in a “Buy Out’ program which does not deal with the problems. It only addresses the symptoms.
- The drought has been major issue, but the droughts always end. Sediment will not, unless we do something to reduce and remove sediment from the reservoirs.

MSAC POSITION

- ✓ These Dams are a National Resource, and must be recognized as such.
- ✓ Sediment is a problem now, and that problem can only get worse unless it is addressed
- ✓ The technology exists to alleviate this problem. It is not a technical issue, it is a political issue. Congress must act to start and continue the correction process.
- ✓ The current criteria for computation of a benefit / cost ratio analysis must be modified or, preferably, eliminated altogether. Full credit of benefits must be included in calculations.
- ✓ The dams and reservoirs are too valuable to lose to sediment. They must be preserved.

For more information, contact Howard Paul, Executive Director
1511 Holiday Drive, Canton, SD 57013 tel. 605-987-4165, or cellular 605-770-0998
Email hpaul@sio.midco.net

Appendix B – Conservation Districts

The following table indicates the name, address, and county(ies) served by each conservation district within the Upper Missouri River Basin. The Tribal Conservation Districts are shown at the end of the table.

District Name	County(ies)	Contact Address
Montana Conservation Districts		
Beaverhead County Conservation District	Beaverhead	420 Barrett St. Dillon, MT 59725
Big Horn County Conservation District	Big Horn	724 W. 3rd St. Hardin, MT 59034
Big Sandy Conservation District	Big Sandy	PO Box 218 Big Sandy, MT 59520
Bitterroot Conservation District	Bitterroot	1709 N. 1st St. Hamilton, MT 59840
Blaine County Conservation District	Blaine	P.O. Box 189 Chinook, MT 59523
Broadwater County Conservation District	Broadwater	415 S. Front Street Townsend, MT 59644
Carbon County Conservation District	Carbon	PO Box 510 Jolliet, MT 59041
Carter County Conservation District	Carter	P.O. Box 313 Ekalaka, MT 59324
Cascade County Conservation District	Cascade	12-3rd St. NW, Upper Level Great Falls, MT 59404
Chouteau County Conservation District	Chouteau	P.O. Box 309 Fort Benton, MT 59442
Custer County Conservation District	Custer	3120 Valley Dr. E. Miles City, MT 59301
Daniels County Conservation District	Daniels	P.O. Box 605 Scobey, MT 59263
Dawson County Conservation District	Dawson	102 Fir St. FP Glendive, MT 59330
Deer Lodge Valley Conservation District	Deer Lodge, Powell	1 Hollenback Rd Deer Lodge, MT 59722
Fergus County Conservation District	Fergus	211 McKinley, Suite 3 Lewistown, MT 59457
Gallatin County Conservation District	Gallatin	3710 W. Fallon St., Box B Bozeman, MT 59718
Garfield County Conservation District	Garfield	P.O. Box 369 Jordan, MT 59337
Glacier County Conservation District	Glacier	#1 Third Street NE Cutbank, MT 59427
Hill County Conservation District	Hill	206 25th St. West Havre, MT 59501

District Name	County(ies)	Contact Address
Jefferson Valley Conservation District	Jefferson & Upper Madison	PO Box 890 Whitehall, MT 59759
Judith Basin County Conservation District	Judith Basin	P.O. Box 386 Stanford, MT 59479
Lewis & Clark County Conservation District	Lewis & Clark	790 Colleen St. Helena, MT 59601
Liberty County Conservation District	Liberty	P.O. Box 669 Chester, MT 59522
Little Beaver Conservation District	Fallon	P.O. Box 917 Baker, MT 59313
Lower Musselshell Conservation District	Musselshell & Golden Valley	109 Railroad Ave. E. Roundup, MT 59072
Madison Conservation District	Eastern Madison	PO Box 606 Ennis, MT 59729
McCone County Conservation District	McCone	P.O. Box 276 Circle, MT 59215
Meagher County Conservation District	Meagher	P.O. Box 589 White Sulphur Springs, MT 59645
Mile High Conservation District	Silver Bow	PO Box 890 Whitehall, MT 59759
Park County Conservation District	Park	5242 Hwy 89 South Livingston, MT 59047
Petroleum County Conservation District	Petroleum	P.O. Box 118 Winnett, MT 59087
Phillips Conservation District	Phillips	HC 72 Box 7615 Malta, MT 59538
Pondera County Conservation District	Pondera	406 N. Main Conrad, MT 59425
Powder River County Conservation District	Powder River	P.O. Box 180 Broadus, MT 59317
Prairie County Conservation District	Prairie	P.O. Box 622 Terry, MT 59349
Richland County Conservation District	Richland	HCR 89 Box 5165A Sidney, MT 59270
Roosevelt County Conservation District	Roosevelt	P.O. Box 517 Culbertson, MT 59218
Rosebud County Conservation District	Rosebud	P.O. Box 1200 Forsyth, MT 59327
Ruby Valley Conservation District	Western Madison	P.O. Box 295 Sheridan, MT 59749
Sheridan County Conservation District	Sheridan	119 N. Jackson Plentywood, MT 59254
Stillwater County Conservation District	Stillwater	P.O. Box 48 Columbus, MT 59019

District Name	County(ies)	Contact Address
Sweet Grass County Conservation District	Sweet Grass	P.O. Box 749 Big Timber, MT 59011
Teton County Conservation District	Teton	RT2, Box 240 Choteau, MT 59422
Toole County Conservation District	Toole	1125 Oilfield Ave. Shelby, MT 59474
Treasure County Conservation District	Treasure	PO Box 231 Hysham, MT 59038
Upper Musselshell Conservation District	Wheatland	P.O. Box 201 Harlowton, MT 59036
Valley County Conservation District	Valley	54062 Hwy 2 W. #2 Glasgow, MT 59230
Wibaux County Conservation District	Wibaux	502 2nd Ave NW Wibaux, MT 59353
Yellowstone County Conservation District	Yellowstone	1629 Ave. D, Bldg A, Suite 4 Billings, MT 59102
Nebraska Resource Districts		
Lewis & Clark Natural Resources District	Cedar, Dixon, Knox	608 N. Robinson Avenue P.O. Box 518 Hartington, NE 68739-0518
Lower Niobrara White Natural Resources District	Boyd, Holt, Knox, Keya Paha	410 Walnut Street P.O. Box 350 Butte, NE 68722-0350
Middle Niobrara White Natural Resources District	Brown, Cherry, Keya Paha, Rock	526 E. 1st Street Valentine, NE 69201
Upper Elkhorn Natural Resources District	Antelope, Holt, Rock, Wheeler	301 North Harrison Street O'Neill, NE 68763
Upper Niobrara White Natural Resources District	Dawes, Rock Butte, Sheridan, Sioux	430 East Second Street Chadron, NE 69337
North Dakota Soil Conservation Districts		
Adams County Soil Conservation District	Adams	602 2nd Ave N, Box 872 Hettinger, ND 58639-0872
Bowman-Slope Soil Conservation District	Bowman, Slope	111 2nd Ave NW, Box 920 Bowman, ND 58623-0920
Burke Soil Conservation District	Burke	5 Roosevelt Ave., Box 336 Bowbells, ND 58721-0336
Burleigh County Soil Conservation District	Burleigh	1511 E Interstate Ave Bismarck, ND 58503-0560
Cedar Soil Conservation District	Sioux	21 N Main St, Box 47 Selfridge, ND 58568-0047
Central Stark County Soil Conservation District	Stark	2493 4th Ave W, Room C Dickinson, ND 58601-2623
Divide County Soil Conservation District	Divide	106 Main St, Box 66 Crosby, ND 58730-0066

District Name	County(ies)	Contact Address
Dunn County Soil Conservation District	Dunn	105 Rodeo Drive, Box 359 Killdeer, ND 58640-0359
Emmons County Soil Conservation District	Emmons	318 South Milwaukee Avenue Linton, ND 58552-7612
Golden Valley Soil Conservation District	Golden Valley, Billings	PO Box 490 Beach, ND 58621-0490
Grant County Soil Conservation District	Grant	103 Dakota St., Box 257 Carson, ND 58533-0257
James River Soil Conservation District	Dickey	51 N 1st St, Box 190 Ellendale, ND 58436-0190
Kidder County Soil Conservation District	Kidder	515 Hwy. 10 West Steele, ND 58482
Logan County Soil Conservation District	Logan	103 E. Lake St., Box 240 Napoleon, ND 58561-0240
McIntosh County Soil Conservation District	McIntosh	118 E Main, Box 389 Ashley, ND 58413
McKenzie County Soil Conservation District	McKenzie	109 5th St SW, Box 583 Watford City, ND 58854-0583
Mercer County Soil Conservation District	Mercer	1400 Hwy. 49 N, #102 Beulah, ND 58523-6066
Morton County Soil Conservation District	Morton	2540 Overlook Lane Mandan, ND 58554
Mountrail Soil Conservation District	Mountrail	21 1st St SE, Box 355 Stanley, ND 58784-0715
Oliver Soil Conservation District	Oliver	345 Center Ave. S, Box 87 Center, ND 58530-0087
Sheridan County Soil Conservation District	Sheridan	123 Main, Box 346 McClusky, ND 58463
Slope-Hettinger Soil Conservation District	Slope, Hettinger	319 Brown Ave. Mott, ND 58646-0190
South McLean County Soil Conservation District	McLean	24 2nd Ave. E, Box 537 Turtle Lake, ND 58575-0537
Stutsman County Soil Conservation District	Stutsman	1301 Business Loop East Jamestown, ND 58401-5946
Ward Soil Conservation District	Ward	1920 13th Street SE Minot, ND 58701
West McLean County Soil Conservation District	McLean	140 5th Ave, SW, Box 598 Garrison, ND 58540-0598
Western Soil Conservation District	Stark, Billings	2493 4th Ave. W, Room C Dickinson, ND 58601-2623
Williams County Soil Conservation District	Williams	1106 W 2nd St Williston, ND 58801-5804

District Name	County(ies)	Contact Address
South Dakota Conservation Districts		
American Creek Conservation District	Lyman	P.O. Box 156 Kennebec, SD 57544
Aurora Conservation District	Aurora	P.O. Box 277 Plankinton, SD 57368
Bennett County Conservation District	Bennett	103 E Bennett Ave Martin, SD 57551
Bon Homme Conservation District	Bon Homme	P.O. Box 45 Tyndall, SD 57066
Brule/Buffalo Conservation District	Brule, Buffalo	200 S. Paul Gust Rd, Ste 111 Chamberlain, SD 57325
Butte Conservation District	Butte	1837 5th Ave Belle Fourche, SD 57717
Campbell County Conservation District	Campbell	P.O. Box 153 Mound City , SD 57646
Charles Mix Conservation District	Charles Mix	P.O. Box 249 Lake Andes, SD 57356
Clay County Conservation District	Clay	121 W. Kidder #103 Vermillion, SD 57069
Clearfield/Keyapaha Conservation District	Tripp	113 S. Madison Winner, SD 57580
Corson Conservation District	Corson	P.O. Box 47 McIntosh, SD 57641
Custer Conservation District	Custer	25365 US Hwy 385 Custer, SD 57730
Davison Conservation District	Davison	1820 N. Kimball St. Suite B Mitchell, SD 57301
Dewey County Conservation District	Dewey	P.O. Box 66 Timber Lake, SD 57656
Douglas County Conservation District	Douglas	P.O. Box 28 Armour, SD 57313
East Pennington Conservation District	Pennington	P.O. Box 308 Wall, SD 57790
Edmunds County Conservation District	Edmunds	P.O. Box 25 Ipswich, SD 57451
Elk Creek Conservation District	Meade	2202 W. Main Sturgis, SD 57785
Fall River Conservation District	Fall River	341 S. Chicago Street Hot Springs, SD 57747
Faulk Conservation District	Faulk	P.O. Box 489 Faulkton, SD 57438
Gregory County Conservation District	Gregory	P.O. Box 339 Burke, SD 57523
Haakon County Conservation District	Haakon	P.O. Box 130 Philip, SD 57567

District Name	County(ies)	Contact Address
Hamill Conservation District	Tripp	113 S. Madison Winner, SD 57580
Hand County Conservation District	Hand	19821 359th Ave Miller, SD 57362
Harding County Conservation District	Harding	P.O. Box 265 Buffalo, SD 57720
Hughes County Conservation District	Hughes	1717 N Lincoln Ave Ste. 103 Pierre, SD 57501
Hutchinson Conservation District	Hutchinson	415 North Access Road Menno, SD 57045
Hyde County Conservation District	Hyde	P.O. Box 484 Highmore, SD 57354
Jackson County Conservation District	Jackson	P.O. Box 457 Kadoka, SD 57543
Jerauld County Conservation District	Jerauld	P.O. Box H Wessington Springs, SD 57382
Jones County Conservation District	Jones	P.O. Box 298 Murdo, SD 57559
Lawrence Conservation District	Lawrence	1140 N. Main Suite 6 Spearfish, SD 57783
McPherson County Conservation District	McPherson	P.O. Box 60 Leola, SD 57456
Mellette County Conservation District	Mellette	P.O. Box 1 White River, SD 57579
Pennington Conservation District	Pennington	1530 Samco Rd Ste 3 Rapid City, SD 57702
Perkins County Conservation District	Perkins	P.O. Box 189 Bison, SD 57620
Potter County Conservation District	Potter	205 W Commercial #102 Gettysburg, SD 57442
Shannon County Conservation District	Shannon	103 E Bennett Ave Martin, SD 57551
Stanley County Conservation District	Stanley	1717 N Lincoln Ave Ste 103 Pierre, SD 57501
Sully Conservation District	Sully	P.O. Box 203 Oneida, SD 57564
Todd County Conservation District	Todd	P.O. Box 268 Mission, SD 57555
Tri-County Conservation District	Meade, Perkins, Ziebach	P.O. Box 399 Faith, SD 57626
Union County Conservation District	Union	P.O. Box 458 Elk Point, SD 57025
Walworth Conservation District	Walworth	P.O. Box 139 Selby, SD 57472

District Name	County(ies)	Contact Address
Yankton County Conservation District	Yankton	2914 Broadway Ave Yankton, SD 57078
Ziebach County Conservation District	Ziebach	HC 73 Box 9 Dupree, SD 57623
Wyoming Districts		
Campbell County Conservation District	Campbell	PO Box 2577 Gillette, WY 82717
Cody Conservation District	Park	808 Meadow Lane Av Cody, WY 82414
Converse County Natural Resource District	Converse	911 Windriver Dr Douglas, WY 82633
Crook County Natural Resource District	Crook	PO Box 1070 Sundance, WY 82729
Dubois-Crowheart Conservation District	Fremont	PO Box 27 Dubois, WY 82513
Hot Springs Conservation District	Hot Springs	601 Broadway, Suite A Thermopolis, WY 82443
Lake DeSmet Conservation District	Johnson	621 W Fetterman Buffalo, WY 82834
Laramie County Conservation District	Laramie	11221 US Highway 30 Cheyenne, WY 82009
Laramie Rivers Conservation District	Albany	5015 Stone Road Laramie, WY 82070
Lincoln Conservation District	Lincoln	PO Box 98 Cokeville, WY 83114
Lingle-Fort Laramie Conservation District	Goshen	1441 East M, Suite B Torrington, WY 82240
Little Snake River Conservation District	Carbon	PO Box 355 Baggs, WY 82321
Lower Wind River Conservation District	Fremont	508 No. Broadway Riverton, WY 82501
Medicine Bow Conservation District	Carbon	PO Box 6 Medicine Bow, WY 82324
Meeteetse Conservation District	Park	PO Box 237 Meeteetse, WY 82433
Natrona County Conservation District	Natrona	5880 Enterprise Dr, Suite 100 Casper, WY 82609
Niobrara Conservation District	Niobrara	PO Box 659 Lusk, WY 82225
North Platte Valley Conservation District	Goshen	1441 East M, Suite B Torrington, WY 82240
Platte County Resource District	Platte	1502 Progress Court Wheatland, WY 82201

District Name	County(ies)	Contact Address
Popo Agie Conservation District	Framont	221 So. 2nd St Lander, WY 82520
Powder River Conservation District	Johnson	PO Box 48 Kaycee, WY 82639
Powell-Clarks Fork Conservation District	Park	1017 Highway 14A Powell, WY 82435
Saratoga-Encampment-Rawlins Conservation District	Carbon	PO Box 633 Saratoga, WY 82331
Sheridan County Conservation District	Sheridan	1949 Sugarland Dr, Suite 102 Sheridan, WY 82801
Shoshone Conservation District	Big Horn	359 Nevada Ave Lovell, WY 82431
South Big Horn Conservation District	Big Horn	408 Greybull Ave Greybull, WY 82426
South Goshen Conservation District	Goshen	1441 East M, Suite B Torrington, WY 82240
Star Valley Conservation District	Lincoln	PO Box 216 Afton, WY 83110
Sublette County Conservation District	Sublette	PO Box 36 Pinedale, WY 82941
Sweetwater County Conservation District	Sweetwater	79 Winston Dr., Suite 110 Rock Springs, WY 82901
Teton Conservation District	Teton	PO Box 1070 Jackson, WY 83001
Uinta County Conservation District	Uinta	PO Box 370 Lyman, WY 82937
Washakie County Conservation District	Washakie	208 Shiloh Road Worland, WY 82401
Weston County Natural Resource District	Weston	1225 Washington Blvd #3 Newcastle, WY 82701
Tribal Conservation Districts		
Crow Conservation District	Carbon, Yellowstone (MT)	P.O. Box 159 Crow Agency, MT 59022
Blackfeet Conservation District	Glacier, Pondera (MT)	P.O. Box 850 Browning, MT 59417
Fort Belknap Indian Community Conservation District	Blaine, Phillips (MT)	R.R. 1 Box 66 Harlem, MT 59526
Standing Rock Tribal Conservation District	Sioux (ND), Corson (SD)	SR Administrative Service Center, Building 1, Room 303 P.O. Box 483 Fort Yates, ND 58538-0483
Wind River Tribal Conservation District	Fremont, Hot Springs (WY) (in development)	PO Box 217 Fort Washakie, WY 82514

Appendix C – Technical Specialists

Name	**Discipline**	**Location**
Montana		
Jerry Schaefer	Economist	Bozeman
Joe Little	GIS Specialist	Bozeman
Julie Tesky	State NRI Coordinator	Bozeman
Tom Pick	Water Quality Specialist	Bozeman
Nebraska		
Dave Griffith	Water Resources Planner	Lincoln
Doug Christensen	Assistant State Conservationist for Water Resources	Lincoln
Kelly Klenke	GIS Specialist	Lincoln
North Dakota		
Clarence Clayton	ICCS Leader	Bismarck
Dennis Reep	State Conservation Engineer	Bismarck
JoDean Nichols	Economist	Bismarck
Keith Weston	Water Quality Specialist	Bismarck
South Dakota		
Barbara Hall	Soil Database Specialist	Huron
Cindy Steele	Natural Resources Planning Engineer	Huron
Colin Niehus	Hydraulic Engineer	Huron
Daniel Shurtliff	Assistant State Soil Scientist	Huron
Doug Vik	Economist	Huron
Mike Kuck	Assistant State Conservationist for Programs	Huron
Rodney Voss	Soil Conservationist (Conservation Security Program Coordinator)	Huron
Wyoming		
Jerry Jasmer	State Resource Conservationist	Casper

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