Floods in North-Central and Eastern South Dakota, Spring 1997

INTRODUCTION

Heavy precipitation between September 1996 and February 1997 caused record-breaking spring flooding in north-central and eastern South Dakota. Most of the winter precipitation came during severe snowstorms driven by strong winds that created blizzard conditions over much of the area. The potential for extensive flooding was widely recognized and emergency action plans were put into effect in many communities. A relatively slow warming period during March probably kept the severe flooding from reaching more catastrophic proportions.

The 1997 flooding equaled or exceeded the 500-year recurrence interval at two streamflow-gaging stations and the 100-year recurrence interval at five other gaging stations. This followed 1993 and 1995 flooding, when several streamflow-gaging stations had peaks exceeding the 100-year recurrence interval. Peak-flow data for the spring of 1997 at selected gaging stations located on South Dakota streams are shown in table 1. The listed recurrence intervals are estimates based on a limited period of record.

The U.S. Geological Survey (USGS), one of the principal Federal agencies responsible for the collection and interpretation of water-resources data, works with other Federal, State, and local agencies to ensure that accurate and timely data are available for flood warning, damage assessment, and making decisions regarding the public's welfare.

WINTER OF 1996-97

Precipitation in South Dakota during the winter of 1996-97 was more than double the normal and was the highest on record, according to the State Climatologist (A.R. Bender, written commun., January 1998). During September 1996 through February 1997, Statewide precipitation averaged 10.8 inches, compared to a long-term average of 5.0 inches for September-February. Total snowfall for November 1996 through March 1997 ranged from near 20 inches at several locations in the southwestern part of the State to nearly 100 inches in areas of the east-central part of the State. The heavy snows were accompanied by persistent strong winds and cold temperatures creating blizzard conditions that closed roads, schools, and businesses many times throughout the winter. Livestock and agricultural losses were extensive. The winter storms killed more than 296,000 head of livestock (U.S. Department of Agriculture, Farm Service Agency, written commun., December 1997).

Due to severe winter storms, the Governor declared a State of Emergency on January 10, 1997. The President approved a Disaster Declaration for all counties of South Dakota the same day. As of September 30, 1997, the State had received slightly more than $314 million in Federal disaster-relief funds (Federal Emergency Management Agency, written commun., 1997).

In mid-March, estimated snow water content exceeded 4 inches in most of northeastern South Dakota. Areas in the northeastern and east-central parts of the State had snow water content greater than 5 inches (fig. 1).

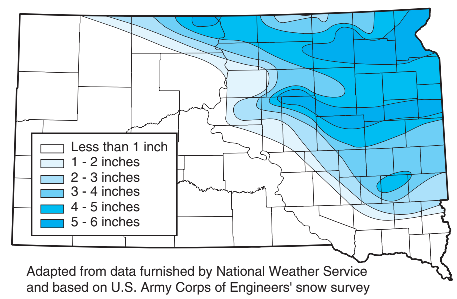

Figure 1. Water content of snow as of March 15-19, 1997.

FLOODS OF 1997

Ice jams on the White River and some nearby streams caused some flooding in late February in the central part of the State. Flooding began in mid-March in the north-central part of the State when runoff from melting snow

Flooding on the James River at the Huron streamflow-gaging station on April 8, 1997.

Discharge measurement on the James River near Scotland on April 3, 1997.

Table 1. Comparison of peak stage and streamflow data for February through May 1997, to previous maximums for period of record at selected gaging stations

[mi^2, square miles; ft, feet; ft^3/s, cubic feet per second; --, no data, not computed, or not determined; <, less than; >, greater than; BW, backwater; (-), reverse flow; e, estimated]

Station number	Station name	Period of record (water years)	Contributing drainage area, (mi^2)	Flood of February-May 1997				Previous maximum		
				Peak stage (ft)	Peak flow (ft^3/s)	Date	Recurrence interval range[1] (years)	Peak stage (ft)	Peak flow (ft^3/s)	Date
05051650	La Belle Creek near Veblen	1988-97	8.74	12.57 10.60	BW [2]100	4/1 4/4	--		BW 664	3/26/89 5/18/96
05289985	Big Coulee Creek near Peever	1988-97	12.1	9.43 7.72	BW 358	3/27 4/5	--	9.08 8.21	BW 456	3/11/95 6/21/91
05292704	North Fork Yellow Bank River near Odessa, MN	1992-97	208	18.02 15.94	BW 4,760	3/29 3/31	--		2,580	7/8/94
05299700	Cobb Creek near Gary	1993-97	70.3	13.99	[2]2,100	3/31	--	12.09	860	6/17/92
06354860	Spring Creek near Herreid	1963-86, 1989-96	220	12.64	2,680	4/1	10-25		1,570 1,630	7/27/93 3/15/95
06354882	Oak Creek near Wakpala	1985-97	356	19.62	[2]7,500	3/27	50-100	18.62 17.73	BW 3,780	3/14/95 3/4/86
06357800	Grand River at Little Eagle	1959-97	5,370	19.58 16.96	BW 20,900	3/24 3/27	25-50		BW 31,000	3/18/66 3/23/87
06360500	Moreau River near Whitehorse	1955-97	4,880	27.68 26.93	BW 29,700	3/21 3/23	25-50	26.20 26.00	BW 27,700	3/14/72 5/24/82
06442000	Medicine Knoll near Blunt	1950-97	317	13.15	e4,000	3/28	25-50		--	6/5/91
06442718	Campbell Creek near Lee's Corner	1988-97	54.1	14.40	[2]800	3/21	--	15.01	3,260	7/24/93
06452000	White River near Oacoma	1929-97	9,940	23.84 --	BW [2]29,100	2/20 2/21	10-25		BW 51,900	3/4/94 3/30/52
06452320	Platte Creek near Platte	1989-97	741	12.67 9.13	BW 1,680	5/8 2/20	--	11.29	2,600	5/11/95
06471000	James River at Columbia		2,481		BW [2]4,130 (-2,430	4/19 4/30 3/30)	25-50		BW 2,340 (-1,320	5/13/95 5/3/79 3/16/95)
06471200	Maple River at North Dakota-South Dakota State line	1957-97	384	16.19	[2]5,300	3/29	25-50	16.05	[2]5,930	4/11/69
06471500	Elm River at Westport	1946-97	1,049	21.56	[2]9,380	3/30	10-25		12,600	4/10/69
06472000	James River near Stratford	1950-72, 1977, 1995, 1997	4,860	19.48	8,400	4/6	50-100	19.86 --	-- 5,580	5/18/95 5/14/50
06473000	James River at Ashton		5,673	26.64 25.03	BW [2]9,150 (-8,400	4/6 4/23 3/31)	>100		BW [2]5,680 (-2,100	5/18/95 4/24/69 4/9/69)
06473700	Snake Creek near Ashton	1956-72, 1977-79, 1985-89, 1997	2,609	20.74	15,000	4/1	>100	[3]17.21	6,980	4/10/69
06474000	Turtle Creek near Tulare		1,124	19.32 18.80	BW 13,500	3/26 3/28	25-50		[2]6,000	4/5/69
06474500	Turtle Creek at Redfield	1946-72	1,481	18.32	13,500	3/29	50-100	15.94	7,660	4/7/69
06475000	James River near Redfield	1950-97	9,793	31.10 29.92	BW 17,000	4/6 4/3	>100		9,800	5/15/95
06476000	James River at Huron	1929-32, 1944-97	11,721	21.28	23,400	4/6	>500	16.86	10,000	5/19/95
06476500	Sand Creek near Alpena		261	13.45	[2]2,000	3/23	10-25		BW 2,240	3/28/50 3/28/60

Table 1. Comparison of peak stage and streamflow data for February through May 1997, to previous maximums for period of record at selected gaging stations—Continued

Station number	Station name	Period of record (water years)	Contributing drainage area, (mi^2)	Flood of February-May 1997				Previous maximum		
				Peak stage (ft)	Peak flow (ft^3/s)	Date	Recurrence interval range[1] (years)	Peak stage (ft)	Peak flow (ft^3/s)	Date
06477000	James River near Forestburg	1950-97	13,442	20.61	25,600	4/6	>100	17.26 17.08	BW 13,000	4/22/95 5/18/95
06477150	Rock Creek near Fulton		240	13.74	3,120	3/29	10-25		2,040	4/7/69
06478000	James River near Mitchell	1954-58, 1966-72, 1995, 1997	14,916	23.14	28,000	4/7	50-100	20.43	16,200	4/23/95
06478500	James River near Scotland	1929-97	16,505	19.87	28,000	4/9	50-100		29,400	6/23/84
06478513	James River near Yankton	1982-97	16,794	22.94	28,800	4/9	10-25	24.34	26,400	6/23/84
06478535	East Fork Vermillion River near Ramona	1987-89, 1996-97	508	8.50	1,600	4/30	--		BW 350	2/12/96 11/4/95
06478540	Little Vermillion River near Salem	1967-97	78.6	10.01	1,560	3/28	10-25	11.95	3,300	7/4/93
06478600	East Fork Vermillion River near Parker	1996-97	973	12.75 12.73	BW 4,210	3/22 3/29	--		1,380	6/3/96
06479000	Vermillion River near Wakonda	1946-97	1,676	16.93	6,150	3/30	10-25	17.62	17,000	6/23/84
06479010	Vermillion River near Vermillion	1984-97	1,808	22.10	6,070	4/2	5-10		21,400	6/23/84
06479215	Big Sioux River near Florence	1984-97	68	9.52 9.32	BW 2,000	4/2 4/4	10-25	9.18 9.08	1,280 1,810	7/25/93 3/29/86
06479430	Still Lake Outflow near Florence	1996-97	--	7.43 [4]6.67	BW [4]408	4/7 4/19	--			
06479438	Big Sioux River near Watertown	1973-97	228	12.09	7,820	4/5	25-50	11.13 11.08	BW 4,970	6/21/91 3/30/86
06479450	Lake Kampeska inlet/outlet near Watertown	1994-97	28.8	25.78 [4]24.87	5,890 [4]1,410	4/6 into lake 4/10 out of lake	--		--	--
06479500	Big Sioux River at Watertown	1946-72, 1997	350	12.49	5,800	4/6	>500	11.40 10.30	BW 2,220	4/8/69 4/9/52
06479515	Willow Creek near Watertown		110	10.93	3,650	4/5	10-25		BW 4,040	3/28/78 6/15/84
06479520	Big Sioux River below Watertown	1995-97	511	13.13 12.99	BW 6,300	4/2 4/11	--	11.78 11.74	BW [2]1,600	3/13/96 3/12/95
06479525	Big Sioux River near Castlewood	1977-97	570	13.19 12.87	BW [2]4,300	4/7 4/11	>100		2,250	3/30/86
06479980	Medary Creek near Brookings	1981-97	200	13.02	[2]3,500	3/28	10-25	11.78	3,710	7/4/93
06480000	Big Sioux River near Brookings	1954-97	2,419	13.29 13.02	BW 11,100	4/8 4/2	10-25		33,900	4/9/69
06481000	Big Sioux River near Dell Rapids	1949-97	3,004	15.54	16,500	4/7	10-25	16.47	41,300	4/9/69
06482020	Big Sioux River at North Cliff Avenue at Sioux Falls	1972-97	3,729	23.11	17,700	4/7	25-50		21,600	6/22/84
06485500	Big Sioux River at Akron, IA	1929-97	6,937	22.63	31,300	4/9	5-10	23.05 22.99	66,700 80,800	5/10/93 4/9/69

[1]Recurrence intervals given for stations with 10 or more years of record through 1996.
[2]Stage-flow relation affected by backwater.
[3]Site and datum then in use.
[4]Mean daily.

filled ice-covered river channels. The Grand and Moreau Rivers experienced lowland flooding from high flows and backwater from ice jams. The Moreau River near Whitehorse had a record flow of 29,700 ft^3/s (cubic feet per second) and record stage of 27.68 ft (feet), as shown in table 1. Another record occurred on Oak Creek, which peaked at 19.62 ft, inundating most of the community of Wakpala.

When snowmelt began in late March in the eastern part of the State, ice thickness on rivers exceeded 3 ft. At the city of Westport in the James River Basin, heavy accumulations of ice created jams causing backwater on the Elm River that forced evacuation of several neighborhoods and caused the river to spill into the Moccasin Creek Basin, which then affected the city of Aberdeen. Snake Creek near Ashton had a recorded peak flow with a recurrence interval greater than 100 years. Tributary flows entering the main stem of the James River caused extreme backwater from Columbia to near Redfield. Record reverse flows were measured on the James River at Columbia (-2,430 ft^3/s on March 30) and at Ashton (-8,400 ft^3/s on March 31), when excessive tributary inflows flowed upstream in the river. Accumulating downstream inflows caused evacuation of James Valley Christian School when dikes failed on April 6 and the school was inundated with 5-7 ft of flood water. The James River at Huron rose to a record stage of 21.28 ft with a corresponding peak flow of 23,400 ft^3/s on April 6, exceeding the 500-year recurrence interval. Peak-flow recurrence intervals downstream on the James River ranged from greater than 100 years at Forestburg to greater than 50 years at Scotland.

Additional severe flooding occurred in April as the heavy snowpack began to melt in the northeastern part of the State. The most adversely affected area was the upper Big Sioux River Basin near Watertown and the surrounding glacial-lakes area. The record levels reached by the Big Sioux River exceeded the 500-year recurrence interval at Watertown and forced the evacuation of many low-lying neighborhoods. Lake Kampeska residents suffered extensive damage to shoreline properties from record-high lake levels, which were caused by inflows from the Big Sioux River.

Residual soil moisture and high base flows during 1993-96, coupled with the large winter 1996-97 snow accumulations, resulted in record total flows throughout eastern South Dakota for water year 1997. The total flow for water year 1997 was 17 times the long-term median streamflow at the James River near Scotland gaging station (fig. 2).

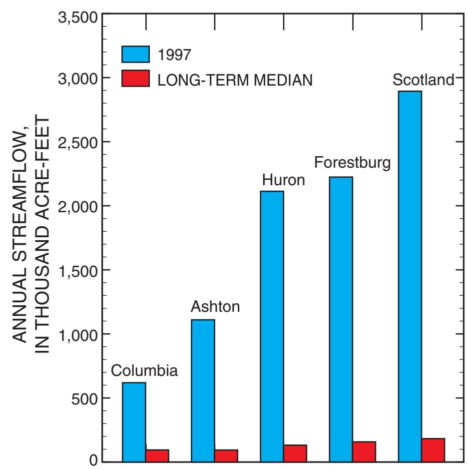

Figure 2. Comparison of 1997 streamflow to long-term median annual streamflow at selected James River gaging stations.

MONITORING OF STREAMFLOW

The USGS operates a network of 123 continuous-record streamflow-gaging stations and 23 high-flow partial-record gages in South Dakota. Miscellaneous annual streamflow measurements also are made at several additional sites throughout the State.

The data for about 50 of the continuous-record stations are relayed by satellite telemetry to computers in Rapid City, Huron, and Pierre. Data are transmitted every 4 hours, and within 15 minutes these data generally are available to decision makers in the agencies involved in flood management. In addition, data from selected stations within various river basins are displayed via the South Dakota District Homepage on the World Wide Web at: http://wwwsd.cr.usgs.gov. The flood-tracking page that was maintained during the extreme 1997 flooding for the James River Basin is shown in figure 3.

This flood-tracking page, and similar ones for the Vermillion and Big Sioux Basins, made timely data readily accessible to the public, media, and cooperating agencies. The USGS and cooperating agencies also operate a network of telephone-accessible gages where critical stage data are available on a real-time basis.

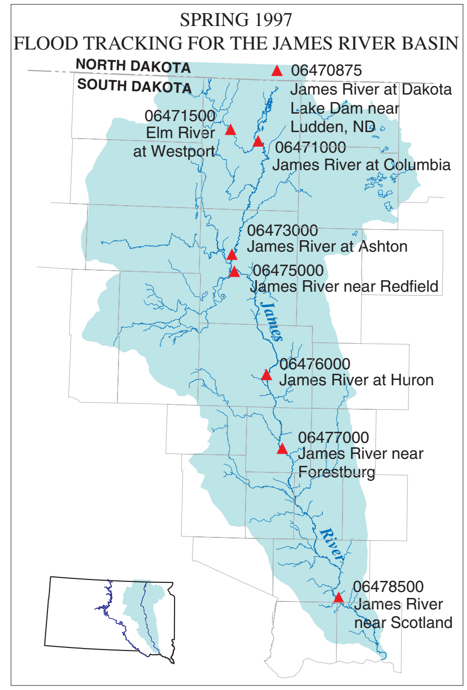

Figure 3. Flood-tracking page.

Rainfall and streamflow data in this report are provisional and subject to revision upon further review by personnel of the National Weather Service and the USGS.

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