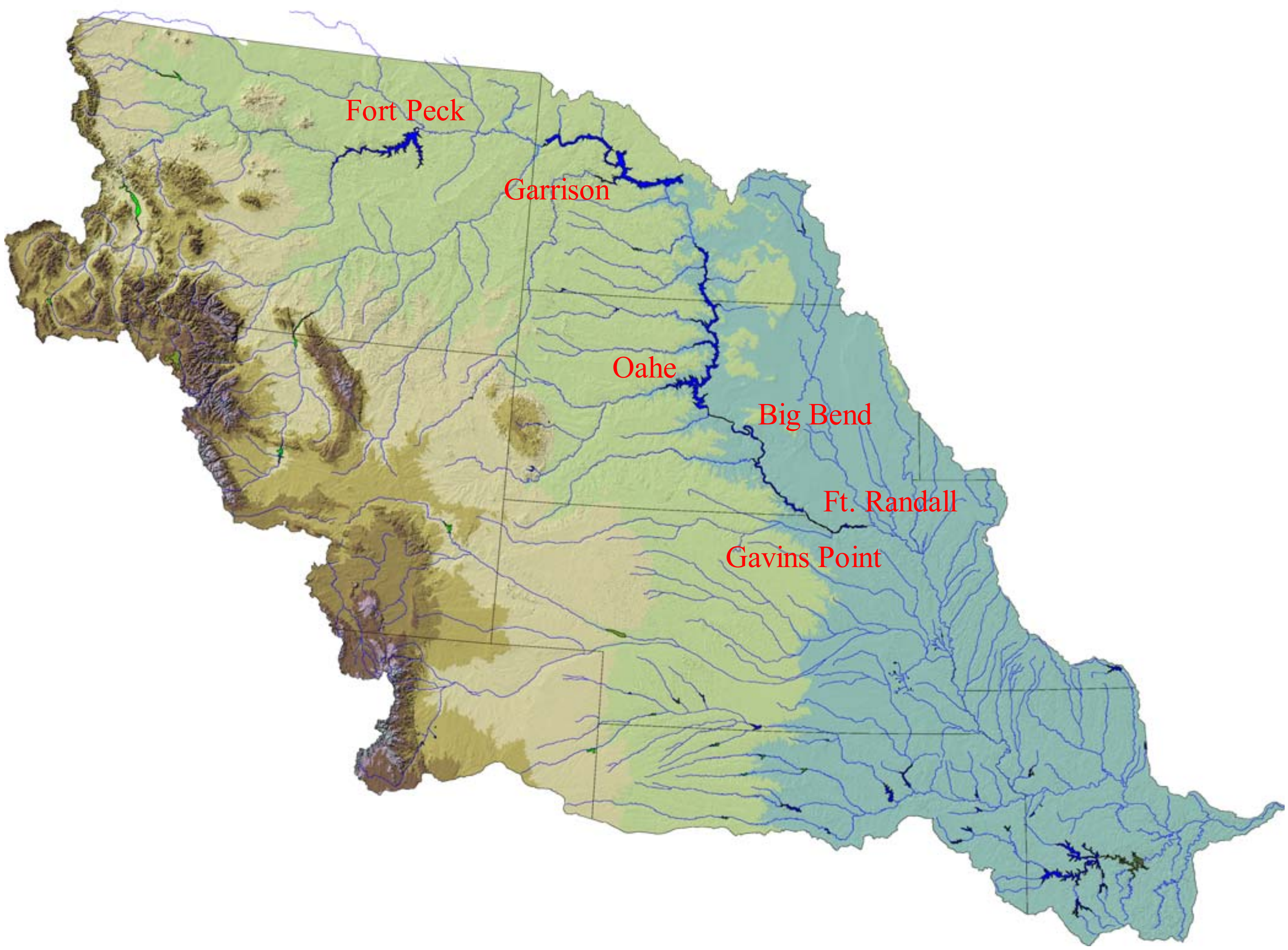
US Army Corps
of Engineers

Northwestern Division

Missouri River Mainstem Reservoir System

Summary of Actual 2004 Regulation

Missouri River Basin



Reservoir Control Center
U. S Army Corps of Engineers
Northwestern Division - Missouri River Basin
Omaha, Nebraska

April 2005

MISSOURI RIVER MAINSTEM RESERVOIRS

Summary of Actual 2004 Regulation

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LIST OF ABBREVIATIONS AND ACRONYMS

AOP -	annual operating plan
ac.ft. -	acre-feet
AF -	acre-feet
B -	Billion
cfs -	cubic feet per second
COE -	Corps of Engineers
CY -	calendar year (January 1 to December 31)
EA -	Environmental Assessment
EIS -	Environmental Impact Statement
elev -	elevation
ESA -	Endangered Species Act of 1978
ft -	feet
FWS -	U.S. Fish and Wildlife Service
FY -	fiscal year (October 1 to September 30)
GIS -	Geographic Information System
GWh -	gigawatt hour
KAF -	1,000 acre-feet
Kcfs -	1,000 cubic feet per second
kW -	kilowatt
kWh -	kilowatt hour
M -	million
MAF -	million acre-feet
MRBA -	Missouri River Basin Association
MRNRC -	Missouri River Natural Resources Committee
msl -	mean sea level
MW -	megawatt
MWh -	megawatt hour
NEPA -	National Environmental Policy Act
plover -	piping plover
pp -	powerplant
RM -	river mile
tern -	interior least tern
tw -	tailwater
USGS -	United States Geological Survey
yr -	year

DEFINITION OF TERMS

Acre-foot (AF, ac-ft) is the quantity of water required to cover 1 acre to a depth of 1 foot and is equivalent to 43,560 cubic feet or 325,850 gallons.

Cubic foot per second (cfs) is the rate of discharge representing a volume of 1 cubic foot passing a given point during 1 second and is equivalent to approximately 7.48 gallons per second or 448.8 gallons per minute. The volume of water represented by a flow of 1 cubic foot per second for 24 hours is equivalent to 86,400 cubic feet, approximately 1.983 acre-feet, or 646,272 gallons.

Discharge is the volume of water (or more broadly, volume of fluid plus suspended sediment) that passes a given point within a given period of time.

Drainage area of a stream at a specific location is that area, measured in a horizontal plane, enclosed by a topographic divide from which direct surface runoff from precipitation normally drains by gravity into the river above the specified point. Figures of drainage area given herein include all closed basins, or noncontributing areas, within the area unless otherwise noted.

Drainage basin is a part of the surface of the earth that is occupied by drainage system, which consists of a surface stream or body of impounded surface water together with all tributary surface streams and bodies of impounded water.

Gaging station is a particular site on a stream, canal, lake, or reservoir where systematic observations of hydrologic data are obtained.

Runoff in inches shows the depth to which the drainage area would be covered if all the runoff for a given time period were uniformly distributed on it.

Streamflow is the discharge that occurs in a natural channel. Although the term "discharge" can be applied to the flow of a canal, the word "streamflow" uniquely describes the discharge in a surface stream course. The term "streamflow" is more general than "runoff" as streamflow may be applied to discharge whether or not it is affected by diversion or regulation.

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MISSOURI RIVER MAINSTEM RESERVOIR SYSTEM

Summary of Actual 2004 Regulation

I. FOREWORD

This document contains a summary of the actual regulation of the Missouri River Mainstem Reservoir System (System) for the 2004 Calendar Year (CY). Two other reports related to System regulation are also available. All three reports, this "Summary of Actual Calendar Year 2004 Regulation," "System Description and Operation," and "Final 2004 Annual Operating Plan" can be obtained by contacting the Missouri River Basin Water Management Division at 12565 West Center Road, Omaha, Nebraska 68144-3869, phone (402) 697-2676. The reports will also be available on the Northwestern Division website at www.nwd-mr.usace.army.mil/rcc <http://www.nwd-mr.usace.army.mil/rcc>.

A basin map is presented on ***Plate 1*** and the pertinent data for the Missouri River System is shown on ***Plates 2A*** and ***2B***.

II. REVIEW OF REGULATION – JANUARY-DECEMBER 2004

A. General

During CY 2004, the System was regulated in accordance with the applicable provisions of the Final 2004 AOP, which was made available for review and comment by representatives of State and Federal agencies, the general public and specific interest groups. A summary of the significant events during this past year is given in the following paragraphs.

B. Precipitation and Water Supply Available in 2004

The 2004 runoff year was the fifth consecutive drought year experienced in the Missouri River basin. ***Table 1*** shows the runoff totals for CY 2004 above Sioux City, Iowa as well as runoff in reaches from Sioux City to Hermann, Missouri. ***Table 2*** shows the CY 2004 monthly runoff for selected reaches.

1. Plains Snowpack

In early November 2003 cold weather and light snow arrived to most of the Missouri River basin plains areas. Many daily record lows were set across Montana and North Dakota. By mid-month, mild weather returned, and soil moisture shortages continued. During the last part of the month, gradual warming melted the snow cover across most of the region. Great Falls had 8.5 inches of snow during the month, 115 percent of normal. Denver had its driest November since 1949.

Above normal temperatures continued in December with record high temperatures occurring early in the month in Nebraska. Mid-month brought two episodes of highly beneficial snowfall to parts of the plains. Sioux Falls, SD netted 8 inches of snow on December 9, a record for that date. Generally light snow blanketed the northern plains, but mostly dry weather and record warmth covered the central plains during the last half of the month. A late storm dumped heavy snow in parts of Montana. Glasgow, MT reported its snowiest December on record with 18.8 inches. Most of South Dakota ended the month with shallow patchy snow cover.

Table 1
2004 Calendar Year Runoff for Selected Reaches

Reach	1898 – 1998 Average Runoff Volume (in 1000 AF)	Calendar Year 2004 Runoff Volume (in 1000 AF)	Percent of Average Runoff
Above Fort Peck	7,395	4,279	58
Fort Peck to Garrison	10,840	6,608	61
Garrison to Oahe	2,430	1,630	67
Oahe to Fort Randall	910	358	39
Fort Randall to Gavins Point	1,675	1,438	86
Gavins Point to Sioux City	1,940	2336	120
TOTAL ABOVE SIOUX CITY	**25,190**	**16,649**	**66**
	1967–2004 Average Runoff		
Sioux City to Nebraska City*	7,550	5,990	79
Nebraska City to Kansas City*	11,720	7,440	63
Kansas City to Hermann*	23,950	22,840	95
TOTAL BELOW SIOUX CITY*	**43,220**	**36,270**	**84**

* Runoff in the reaches from Sioux City to Hermann is not adjusted to 1949 depletion levels. Averages are taken from USGS Water Data Reports for the period 1967-2004.

A second winter storm produced a band of snow from western Nebraska to northeastern Colorado in the first week of January 2004. Still only shallow snow cover existed in most areas from South Dakota southward into northeastern Colorado and northern Kansas.

The last week of January featured heavy snow in northeastern Montana and parts of North Dakota. However, mostly dry conditions persisted on the plains from eastern Colorado and western Kansas northward into southern Montana. Denver's precipitation was below normal for the second consecutive month. Williston, ND did set a record snow depth of 24 inches at the end of the month and had its second snowiest January on record with 25.4 inches. The last eight days of January produced 24.6 inches of snow in Glasgow, MT, capping the city's snowiest January on record with 32.9 inches (previous record was 28.8 inches in 1916). More significantly, Glasgow also set a record for its greatest seasonal snowfall - 61.1 inches through January 31, breaking the previous record of 60.9 inches set in 1951-1952. However, seasonal snowfall totals through January were as low as 13.7 inches in Denver, CO and 8.9 inches in Kansas City, MO. Average snow cover was 14 inches in North Dakota, nearly 5 inches in Nebraska, and 4 inches in South Dakota.

A sprawling early February storm system produced widespread snowfall across the central plains and blanketed previously bare areas as far south as Kansas. Early February snow depths reached 21 inches in Sioux Falls, SD and 26 inches in Sioux City, IA and Omaha, NE in the wake of three major storms in less than two weeks. It was Sioux Falls' greatest snow depth since 1969 and Sioux City's greatest snow depth since 1962. Omaha easily set a February snow depth record, surpassing the previous record of 18 inches in 1965. Omaha received 31.2 inches of snow in 13 days from January 26 to February 6. Glasgow, MT reported a snow depth of 29 inches on February 11, surpassing its all-time record of 26 inches set in 1916.

By mid-month, mild mostly dry weather melted most of the snow cover on the northern and central plains. Temperatures topped 70°F as far north as western Nebraska. By late February, warm temperatures spread into South Dakota. Despite the major storms during February, pockets of dryness persisted, most notably across parts of Montana and the central high plains. North Dakota's average snow cover depth was nearly 11 inches on February 29 compared to 3 inches the previous year. South Dakota's average snow depth was approximately 2 inches.

Snow continued to fall in the early part of March. Heavy snow blanketed the north central plains with Lander, WY receiving 12.8 inches and Rapid City, SD receiving 13.2 inches. Warm dry weather covered the plains for two consecutive weeks in mid-March. Record warmth reached Montana with temperatures in the 60's. A small snow storm developed and dropped 18.4 inches of snow on Sioux City, IA on March 15. During the last part of March, very warm weather prevailed on the plains, accompanied by mostly dry weather from eastern Colorado and northwestern Kansas northward into Montana. By late March, little plains snow cover remained except in northeastern Montana. Great Falls, MT experienced its driest October to March period on record, resulting in 1.15 inches of precipitation, 26 percent of normal.

2. Mountain Snowpack

a. Fall 2003

In Montana, mountain precipitation during December 2003 was 106 percent of average and 187 percent of 2002. Valley precipitation during December was 160 percent of average and 309 percent of the previous year. Mountain and valley water year precipitation, beginning October 1, 2003, was 107 percent of average and 169 percent of the previous year.

In Wyoming, precipitation for December 2003 varied from 28 percent above to 16 percent below average.

b. December 2003

In the headwaters of the Missouri River basin above Fort Peck, snowpack was 103 percent of average on January 1 compared to only 74 percent of average the previous year. This was a reflection of December precipitation which was 106 percent of normal in the mountains and 160 percent of normal in the Missouri River valley.

Table 2

Missouri River Basin
Calendar Year 2004
Historic Runoff

3-Jan-05

Reach Above	Fort Peck	Garrison	Oahe	Fort Randall	Gavins Point	Sioux City	Summation above Gavins Point	Summation above Sioux City	Accumulated Summation above Sioux City
				Values in 1000 Acre Feet					
JAN 2004	210	162	-24	-4	56	53	400	453	453
NORMAL	315	260	10	20	100	35	705	740	740
DEPARTURE	-105	-98	-34	-24	-44	18	-305	-287	-287
% OF NORM	67%	62%	-240%	-20%	56%	151%	57%	61%	61%
FEB 2004	247	225	27	80	186	145	765	910	1,363
NORMAL	365	360	90	50	125	85	990	1,075	1,815
DEPARTURE	-118	-135	-63	30	61	60	-225	-165	-452
% OF NORM	68%	63%	30%	160%	149%	171%	77%	85%	75%
MAR 2004	577	911	507	13	165	371	2,173	2,544	3,907
NORMAL	610	1,010	580	220	205	300	2,625	2,925	4,740
DEPARTURE	-33	-99	-73	-207	-40	71	-452	-381	-833
% OF NORM	95%	90%	87%	6%	80%	124%	83%	87%	82%
APR 2004	346	616	134	-5	118	191	1,209	1,400	5,307
NORMAL	665	1,115	500	145	180	340	2,605	2,945	7,685
DEPARTURE	-319	-499	-366	-150	-62	-149	-1,396	-1,545	-2,378
% OF NORM	52%	55%	27%	-3%	66%	56%	46%	48%	69%
MAY 2004	394	399	87	45	133	341	1,058	1,399	6,706
NORMAL	1,120	1,280	320	145	185	275	3,050	3,325	11,010
DEPARTURE	-726	-881	-233	-100	-52	66	-1,992	-1,926	-4,304
% OF NORM	35%	31%	27%	31%	72%	124%	35%	42%	61%
JUN 2004	772	1,364	253	58	118	503	2,565	3,068	9,774
NORMAL	1,655	2,715	435	160	180	270	5,145	5,415	16,425
DEPARTURE	-883	-1,351	-182	-102	-62	233	-2,580	-2,347	-6,651
% OF NORM	47%	50%	58%	36%	66%	186%	50%	57%	60%
JUL 2004	533	1,239	100	25	127	210	2,024	2,234	12,008
NORMAL	835	1,815	180	60	135	215	3,025	3,240	19,665
DEPARTURE	-302	-576	-80	-35	-8	-5	-1,001	-1,006	-7,657
% OF NORM	64%	68%	56%	42%	94%	98%	67%	69%	61%
AUG 2004	180	266	208	25	89	125	768	893	12,901
NORMAL	360	625	65	40	115	130	1,205	1,335	21,000
DEPARTURE	-180	-359	143	-15	-26	-5	-437	-442	-8,099
% OF NORM	50%	43%	320%	63%	77%	96%	64%	67%	61%
SEP 2004	236	337	198	118	125	151	1,014	1,165	14,066
NORMAL	345	470	115	40	110	95	1,080	1,175	22,175
DEPARTURE	-109	-133	83	78	15	56	-66	-10	-8,109
% OF NORM	68%	72%	172%	295%	114%	159%	94%	99%	63%
OCT 2004	271	495	106	-6	150	50	1,016	1,066	15,132
NORMAL	400	525	70	10	120	75	1,125	1,200	23,375
DEPARTURE	-129	-30	36	-16	30	-25	-109	-134	-8,243
% OF NORM	68%	94%	151%	-60%	125%	67%	90%	89%	65%
NOV 2004	294	424	72	-22	98	94	866	960	16,092
NORMAL	390	410	65	10	120	75	995	1,070	24,445
DEPARTURE	-96	14	7	-32	-22	19	-129	-110	-8,353
% OF NORM	75%	103%	111%	-220%	82%	125%	87%	90%	66%
DEC 2004	219	170	-38	31	73	102	455	557	16,649
NORMAL	335	255	0	10	100	45	700	745	25,190
DEPARTURE	-116	-85	-38	21	-27	57	-245	-188	-8,541
% OF NORM	65%	67%	9500%	310%	73%	227%	65%	75%	66%
				Calendar Year Totals					
	4,279	6,608	1,630	358	1,438	2,336	14,313	**16,649**	
NORMAL	7,395	10,840	2,430	910	1,675	1,940	23,250	**25,190**	
DEPARTURE	-3,116	-4,232	-800	-552	-237	396	-8,937	**-8,541**	
% OF NORM	58%	61%	67%	39%	86%	120%	62%	**66%**	

In Wyoming, snow water equivalent (SWE) across the state was generally above normal for this time of the year, approximately 103 percent of normal. The distribution of SWE across the state was uniform with all areas experiencing slightly above normal conditions. Precipitation for December varied from 28 percent above to 16 percent below average for the state. The Fort Peck to Garrison reach mountain snowpack accumulation was 95 percent of normal.

The January 1 mountain snowpack conditions for the total Missouri River Mainstem were near average, with SWE 99 percent of average and almost twice the amount than the previous year.

c. January 2004

Mountain precipitation during January was 89 percent of average and only 81 percent of the previous year. Missouri River valley precipitation was 147 percent of average during January and 218 percent of last year's average. In the reach above Fort Peck the snowpack SWE fell 4 percent from the previous month to only 99 percent of normal on February 1. The snowfall during the month generally kept pace with the average rate of accumulation until the last week in January when very little snow fell all week.

In Wyoming, SWE amounts for the year across the state were just slightly better than normal. The snowpack varied from near 105 percent of normal in the western part of Wyoming to 101 percent of normal in the eastern portion of the state. In the Fort Peck to Garrison reach the snowpack SWE fell from 95 percent the previous month to only 86 percent of normal on February 1.

The February 1 mountain snowpack conditions for the total Missouri River Mainstem were near average, with SWE 92 percent of average and 124 percent greater than the previous year. This represents a 7 percent reduction from January's SWE average.

d. February 2004

Mountain precipitation during February was only 74 percent of average and 48 percent of the previous year. Missouri River valley precipitation during February was a very meager 40 percent of average and just 31 percent of the previous February's total. The mountain snowpack continued to fall in the Missouri River basin above Fort Peck reaching 96 percent of normal on March 1, the same as the previous year.

The snowpack in the reach between Fort Peck and Garrison improved to 89 percent of normal during the month of February, a 3 percent gain. The snowpack varied from near 90 percent of normal over most of the state to only 83 percent of normal in the southeast portion of the state.

The March 1 mountain snowpack conditions for the total Missouri River Mainstem were below average, with SWE being 92 percent of average the same as the previous month's and previous year's total.

e. March 2004

The mountain precipitation during March was only 68 percent of average but higher than the 57 percent of average precipitation experienced in the Missouri River valley. The mountain snowpack in the reach above Fort Peck reservoir peaked in mid-March. By 1 April it had declined to 82 percent of average, a reduction of 14 percent with respect to normal during the month.

The snowpack in the reach between Fort Peck and Garrison peaked in mid-March, then fell to 72 percent of normal by April 1, a reduction of 17 percent with respect to normal from the previous month. The snowpack in Wyoming varied from 74 percent of normal in the northwest part of the state to 64 percent of normal in the northeast. The southern part of the state was generally slightly below 70 percent.

The April 1 mountain snowpack conditions for the total Missouri River Mainstem were well below average. The snowpack peaked in mid-March and melted rapidly thereafter. This was about one month earlier than the normal peak and resulted in much below normal yield from the snow melt. The cooler temperatures during the melt resulted in much of the water infiltrating into the local soils reducing the much needed runoff into the Mainstem and tributary dams.

f. April 2004

The mountain precipitation during April was 101 percent of average but considerably higher than the 87 percent of average precipitation experienced in the Missouri River valley. Both were increases of near 30 percent from the previous month. The mountain snowpack however, continued to fall to 65 percent in the reach above Fort Peck reservoir. This represented a reduction of 17 percent during the month.

The snowpack in the reach between Fort Peck and Garrison fell to 62 percent of normal by May 1, a reduction of 10 percent from the previous month. The snowpack in Wyoming varied from just greater than 65 percent in the northern portion of the state to around 50 percent in the southern portion.

The May 1 mountain snowpack conditions for the total Missouri River Mainstem were well below average. The SWE was 64 percent of average, a reduction of 13 percent with respect to normal from the mid-March peak.

g. May 2004

The mountain precipitation during May was 127 percent of average and slightly lower than the 135 percent of average precipitation experienced in the Missouri River valley. This was an increase of 26 and 48 percent, respectively, from the previous month. The mountain snowpack however, continued to fall to 38 percent in the reach above Fort Peck reservoir. This represented a reduction of 27 percent during the month.

The snowpack in the reach between Fort Peck and Garrison fell to 26 percent of normal by June 1, a reduction of 36 percent from the previous month. The snowpack in Wyoming was fairly uniform but much below average throughout the state.

The May 1 mountain snowpack conditions for the total Missouri River Mainstem were well below average, with SWE being 32 percent of the peak which occurred in March.

h. Summary

Overall snow water content totals recorded during the entire snow season ending July 1, 2004 were much below normal. The mountain snowpack in the reach above Fort Peck peaked on March 17 at 84 percent of the normal peak accumulation. The mountain snowpack in the reach between Fort Peck and Garrison peaked on March 17 at 75 percent of the normal peak accumulation. The normal date for snow accumulation to peak is April 15. The much earlier than normal dates in March are a result of below normal snowpack and very warm temperatures experienced during the 2003-2004 season. The 2003-2004 mountain snow accumulation and melt for the reaches above Fort Peck and Fort Peck to Garrison are illustrated in ***Figure 1*.**

3. Weather Conditions

The following weather summaries are from the USDA Weekly Weather and Crop Bulletins. ***Figure 2*** displays the drought magnitude and ***Figure 3*** displays percent of normal precipitation experienced by the basin at 3-month increments during the calendar year.

a. January 2004

The year started with a severe blast of cold air across the Plains. January 5th daily-record lows were reported at Polebridge, MT (-45°F), West Yellowstone, MT (-43°F) and Gunnison, CO (-36°F). With a January 5 high temperature of -15°F, Helena, MT endured its lowest maximum reading since February 2, 1996. A day later, the minimum temperature of -15°F in Kearney, NE was the station's lowest since early 1996. During the last 10 days of the month the High Plains experienced mild temperatures ranging from 2 to 12°F above normal. Dry weather persisted until an Arctic cold front edged into Montana. Daily record snowfall totals for January 24 included 4.6 inches in Glasgow, MT and 4.5 inches in Williston, ND. The month ended with bitterly cold air making a strong push across the northern Plains and the Midwest. Weekly temperatures were held 10 to 30°F below normal and lowered readings to near -40°F in the Red River valley and adjacent areas. Extremely cold air reached the northern Plains by January 27, resulting in daily record lows in locations such as Grand Forks, ND (-31°F) and Sisseton, SD (-21°F). Low temperatures in much of North Dakota ranged from -40 to -20°F on four consecutive mornings from January 27-30.

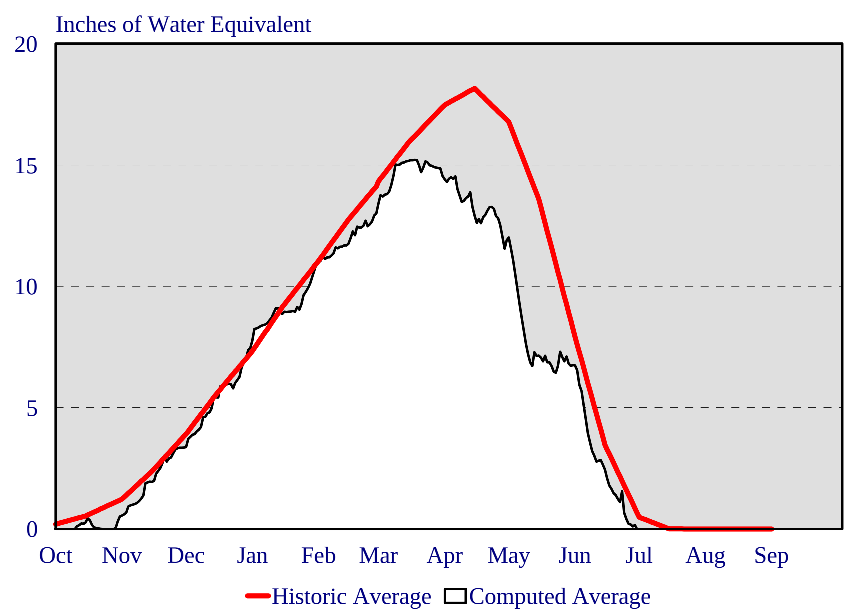
b. February 2004

February started with a sprawling, mid-week storm system producing widespread snowfall across the central Plains and Midwest. Colder-than-normal weather prevailed across much of the Nation, particularly from eastern Montana and the Dakotas southward onto the

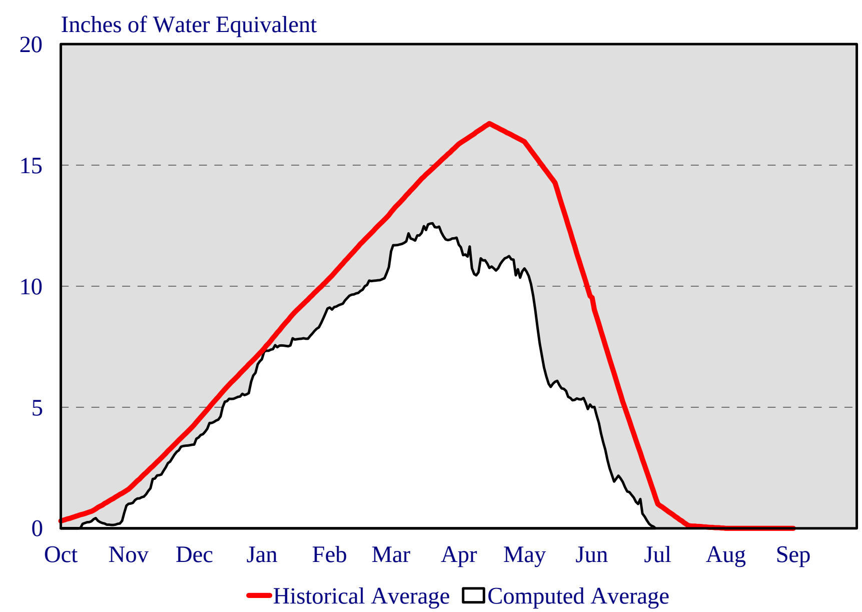
Figure 1

Missouri River Basin Mountain Snowpack Water Content 2003-2004

Total Above Fort Peck



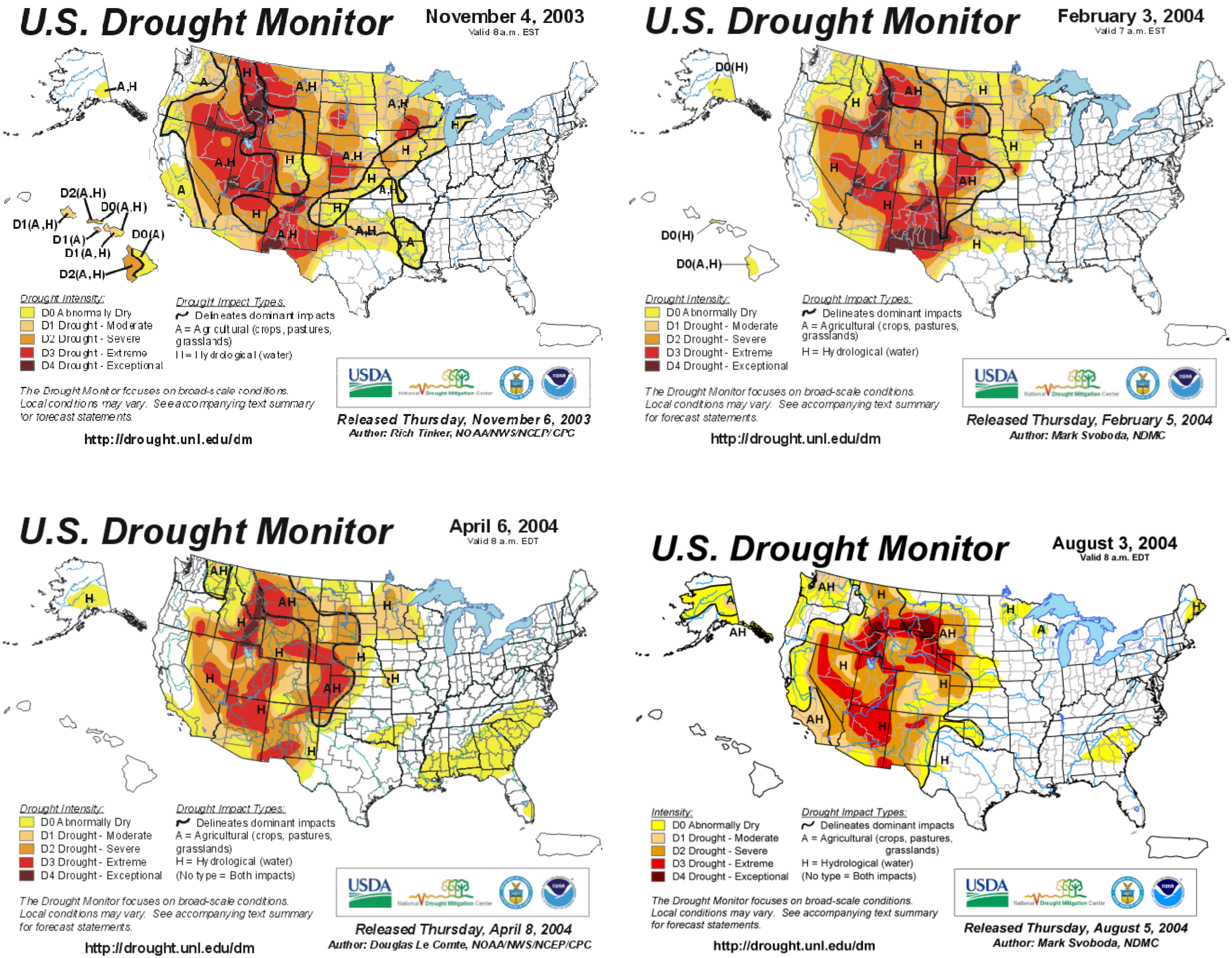
Total Fort Peck to Garrison



The Mountain Snowpack in the reach above Fort Peck peaked at 84% of the normal peak accumulation on March 17.
Currently 1% of this year's peak accumulation remains.
The Mountain Snowpack in the reach between Fort Peck and Garrison peaked at 75% of the normal peak accumulation on March 19.
Currently less than 1% of this year's peak accumulation remains.
The Missouri River basin Mountain Snowpack normally peaks near April 15 and 5% normally remains on July 1.

June 28, 2004

Provisional data subject to revision.



U.S. Drought Monitor
November 4, 2003
Valid 8 a.m. EST
Drought Intensity:
D0 Abnormally Dry
D1 Drought - Moderate
D2 Drought - Severe
D3 Drought - Extreme
D4 Drought - Exceptional
Drought Impact Types:
Delineates dominant impacts
A = Agricultural (crops, pastures, grasslands)
H = Hydrological (water)
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.
http://drought.unl.edu/dm
Released Thursday, November 6, 2003
Author: Rich Tinker, NOAA/NWS/NCEP/CPC
U.S. Drought Monitor
February 3, 2004
Valid 7 a.m. EST
Drought Intensity:
D0 Abnormally Dry
D1 Drought - Moderate
D2 Drought - Severe
D3 Drought - Extreme
D4 Drought - Exceptional
Drought Impact Types:
Delineates dominant impacts
A = Agricultural (crops, pastures, grasslands)
H = Hydrological (water)
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.
http://drought.unl.edu/dm
Released Thursday, February 5, 2004
Author: Mark Svoboda, NDMC
U.S. Drought Monitor
April 6, 2004
Valid 8 a.m. EDT
Drought Intensity:
D0 Abnormally Dry
D1 Drought - Moderate
D2 Drought - Severe
D3 Drought - Extreme
D4 Drought - Exceptional
Drought Impact Types:
Delineates dominant impacts
A = Agricultural (crops, pastures, grasslands)
H = Hydrological (water)
(No type = Both impacts)
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.
http://drought.unl.edu/dm
Released Thursday, April 8, 2004
Author: Douglas Le Comte, NOAA/NWS/NCEP/CPC
U.S. Drought Monitor
August 3, 2004
Valid 8 a.m. EDT
Intensity:
D0 Abnormally Dry
D1 Drought - Moderate
D2 Drought - Severe
D3 Drought - Extreme
D4 Drought - Exceptional
Drought Impact Types:
Delineates dominant impacts
A = Agricultural (crops, pastures, grasslands)
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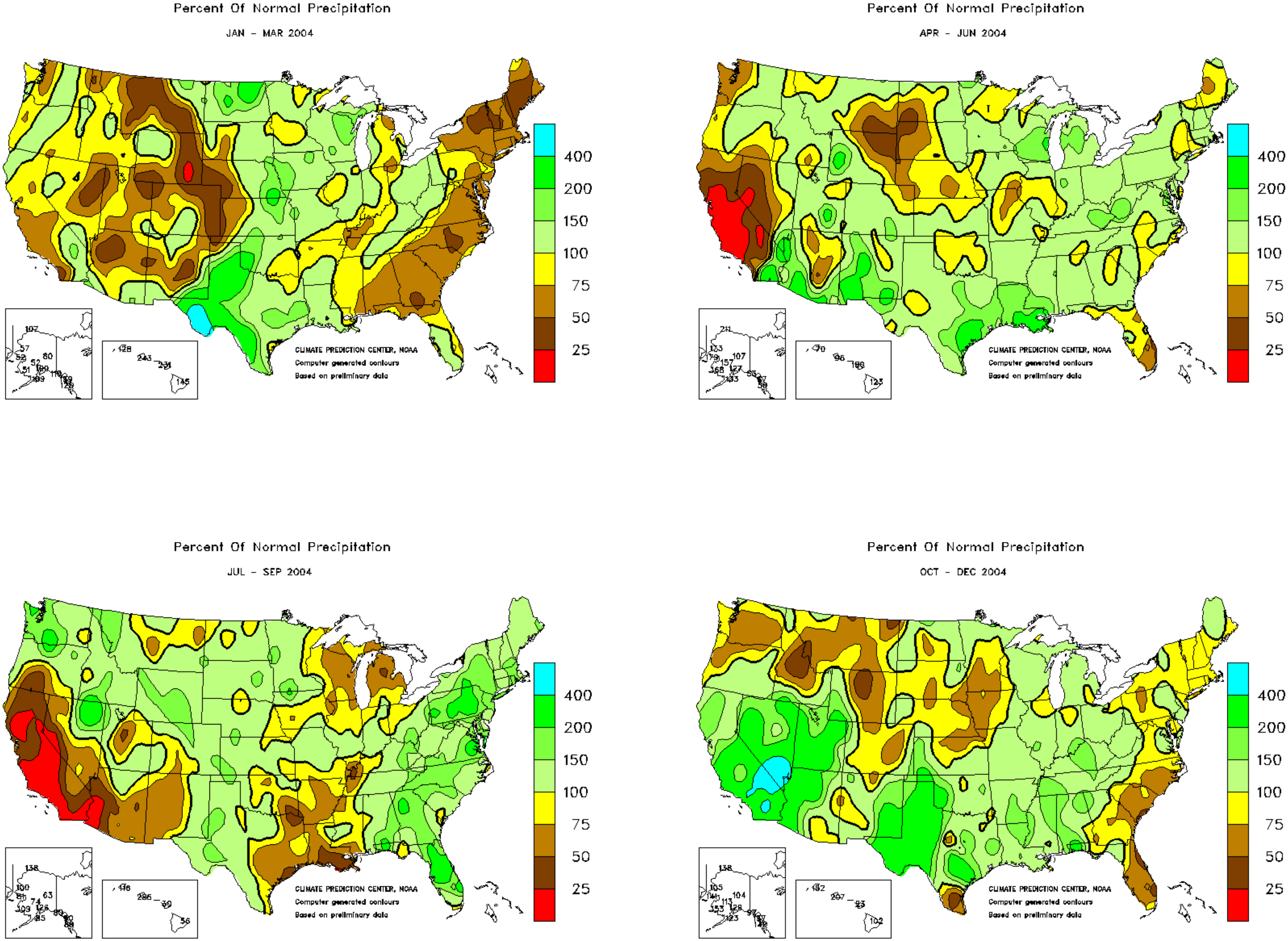
(No type = Both impacts)
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.
http://drought.unl.edu/dm
Released Thursday, August 5, 2004
Author: Mark Svoboda, NDMC

Figure 2

Figure 3



Percent Of Normal Precipitation
JAN - MAR 2004
Percent Of Normal Precipitation
APR - JUN 2004
Percent Of Normal Precipitation
JUL - SEP 2004
Percent Of Normal Precipitation
OCT - DEC 2004
400
200
150
100
75
50
25
CLIMATE PREDICTION CENTER, NOAA
Computer generated contours
Based on preliminary data

central Plains, where weekly temperatures ranged from 8 to 22°F below normal. The cold temperatures continued into the second week of February. Grand Island, NE noted a high of 36°F on February 9th, which ended the 16-day spell (January 24 – February 8) with readings below the freezing mark. Kansas City, MO registered below-normal average daily temperatures on 21 consecutive days (January 25 – February 14), its longest such streak since a 24-day cold spell in 2000. By mid-month, mild mostly dry weather melted most of the snow cover on the northern and central Plains, where weekly temperatures generally ranged from 4 to 10°F above normal. Midweek temperatures climbed to near 80°F on the southern Plains and topped 70°F as far north as western Nebraska. On February 18 a daily-record high was reached at Billings, MT (62°F). On February 19, a storm system crossing the central Plains produced some light rains and wet snow in eastern Colorado but provided little precipitation elsewhere. On that same day, daily-record highs were recorded in Joplin, MO (73°F) and Springfield, MO (71°F). The month ended with a rain-snow storm in the northern and central Plains. Weekly temperatures ranged from 3 to 11°F above normal.

c. March 2004

March began with heavy snow blanketing the North-Central U.S. February 28-March 1 snowfall totaled 12.8 inches in Lander, WY and 13.2 inches in Rapid City, SD. Mild weather prevailed into the second week of March on the Plains with temperatures as much as 10°F above normal. Record warmth reached Montana's High Plains on March 8, when daily records included 66°F in Great Falls and 63°F in Cut Bank. Elsewhere in Montana, Billings logged consecutive record highs (66 and 70°F) on March 8-9. Helena, MT, collected a daily-record high (63°F) on March 8 and again toward week's end (65°F on March 12). Warm weather continued in the basin through mid-March. Record warmth reached the High Plains when daily-record high included 70°F in Miles City and Havre on March 18th. A day later, highs soared to daily-record levels in location such as McCook, NE (87°F) and Mitchell, SD (80°F). March ended with heavy rains across the upper Midwest, including the Dakotas. Across the Plains, temperatures averaged generally 8 to 14°F above normal. Daily-record highs for March 24 in Nebraska included 82°F in North Platte and 80°F near Kimball. On March 27 Huron, SD received 1.52 inches, while Omaha, NE (2.44 inches) experienced its wettest March day on record, surpassing the standard establish with a 2.04-inch total on March 19, 1982. On March 30, record highs were reached in Montana in Havre (79°F), Great Falls (78°F) and Cut Bank (77°F). On March 31, additional monthly records were tied or broken in locations such as Miles City, MT (80°F) and Sheridan, WY (80°).

d. April 2004

Scattered showers developed on the High Plains, where daily records in Montana for April 1 included 0.76 inch in Great Falls and 0.59 inch in Helena. On April 4 a daily-record high of 75°F was recorded at Glasgow, MT. Goodland, KS netted 0.11 inch of rain on April 6, snapping a 32-day streak without measurable precipitation. More substantial precipitation, consisting of rain and snow, fell across the central High Plains April 9-10, when Goodland received an additional 0.73 inch. Denver, CO received 5.5 inches of snow in 48 hours from April 9-11, boosting its meager season-to-date total to 28.2 inches. Through March 31, Denver's season-to-date snowfall of 22.7 inches was the fourth-lowest total in more than 120 years. Snow also blanketed parts of Wyoming, where April 8 featured daily record amounts in Lander (9.0 inches) and Riverton (5.2 inches). Aided by daily-record total (0.93 inch on April 8), Lander's April 1-11 precipitation reach 2.08 inches (315 percent of normal). During the previous 51 months (January 2000 – March 2004), Lander's precipitation totaled just 33.93 inches, 61 percent of normal. On April 12 snow spread across the central High Plains, followed by a late-season cold outbreak. In Kansas, April 12 snowfall totaled 3.4 inches in Goodland and 2.9 inches in Dodge City. In contrast, on April 13 daily-record highs were recorded in Montana at Miles City (78°F) and Helena (76°F). Several locations, including Omaha, NE (90 and 89°F) and Waterloo, IA (88°F both days) notched daily record-highs on April 16-17. From April 18-24 there were nationally more than 800 reports of severe weather (tornadoes, thunderstorm wind damage, or hail at least three-quarters of an inch in diameter). Most of these were concentrated across the Plains and Midwest. On April 18 heavy precipitation soaked the central High Plains with Huron, SD receiving 1.34 inches. On April 21, Billings, MT recorded a record daily total of 0.93 inch. In Colorado, April 21-25 precipitation total 2.76 inches in Pueblo, 1.07 inches in Colorado Springs and 0.37 inch in Denver. The month ended with a push of cold air spreading over the Plains and Midwest.

e. May 2004

Record warmth reached the High Plains (more than 10°F above normal in some locations) to start the month. On May 5, daily-record highs included 97°F in Chadron, NE, and 100°F in Kennebec, SD. Highs reached 100°F on May 6 in Kansas locations such as Hays and Ness City. Exceptionally dry conditions persisted into mid-month across parts of the northern High Plains, especially in southeastern Montana, while long-term drought remained a major concern on the central High Plains. In the North Central states daily precipitation records for May 10 included 1.30 inches in East Rapid City, SD, 1.38 inches (on May 11) in Grand Forks, ND and 1.62 inches (also on May 11) in Valentine, NE. A late-season snowfall was reported in parts of the northern Plains. On May 11-12 totals in North Dakota included 1.0 inch in Williston and 0.2 inch in Bismarck. Williston's snow pushed its season-to-date total to 64.2 inches, the seventh-highest total in 100 years. Further south, on May 11, daily-record highs included 89°F in Sisseton, SD and Sidney, NE. A few days later a late-season cool snap held weekly temperatures as much as 15°F below normal on the northern Plains. Sharply colder air arrived across the northern Plains in Montana where Miles City (23 and 28°F) and Great Falls (20 and 26°F) collected consecutive daily-record lows. Elsewhere on May 14, lows of 19°F in Alamosa, CO, 22°F in Casper, WY, 24°F in Aberdeen, SD and 27°F in Goodland, KS, were among nearly two dozen daily-record lows. Much needed precipitation spread across the High Plains by mid-month. Great Falls, MT, netted 2.58 inches of precipitation from May 10-23, snapping a 12-month streak (May 2003- April 2004) with below normal monthly precipitation. It had been Great Falls' longest stretch of month with below-normal precipitation since a 15-month dry spell in 1936-37. The cool, wet weather continued in the northern Plains. Daily-record totals on May 23 included 1.05 inches in Great Falls, MT. On May 23, high temperatures in Montana were the lowest on record for the date in locations such as Great Falls (38°F) and Cut Bank (39°F). Two days later, daily-record lows in Montana for May 25 included 26°F in Lewistown and 32°F in Miles City. Storms on May 29-30 intensified across the eastern Plains and much of the Midwest resulting in heavy rains and local wind, hail and flood damage. Sioux Falls, SD, experienced its wettest May day on record (4.22 inches on May 29) edging the mark of 3.96 inches established on May 23, 1936. This 4.22-inch total in Sioux Falls was the third-wettest 24-hour period behind 4.59 inches on August 1, 1975 and 4.54 inches on October 9, 1973. The month ended with a chilly air pushing dry weather across the Plains. Daily-record lows for May 31 were recorded in Colorado at Pueblo (32°F) and Burlington (35°F).

f. June 2004

Early June saw a persistent feed of tropical moisture triggering torrential rainfall and local flooding from parts of Texas northward into eastern Kansas and western Missouri. Hot weather from the High Plains westward resulted in several daily-record highs. In Colorado, Pueblo registered consecutive daily records (98 and 101°F on June 6 and 7, respectively). Other daily-record high on the High Plains included 104°F (on June 6) in Chadron, NE and 103°F (on June 7) in Burlington, CO. Rapid City, SD, posted a high of 102°F on June 6, representing its earliest triple-digit heat (previously, June 7, 1988). In South Dakota, Winner collected 4.80 inches of rain on June 8, its second-wettest day on record behind 5.00 inches on June 12, 1977. In Montana, record precipitation totals for June 10 were established in Billings (1.45 inches), Bozeman (1.31 inches), and Glasgow (1.31 inches). For Billings, it was only the second time in 5 years that daily precipitation topped 1 inch; the other occasion was June 13, 2001, when 2.27 inches fell. A late-season freeze struck parts on the northern Plains on June 18. From June 17-19, Williston, ND notched three consecutive daily-record lows (34, 29, and 33°F). Record lows for June 18 were also established in locations such as Dickinson, ND (30°F), Miles City, MT (34°F), and Bismarck, ND (35°F). Bismarck (39°F) also set a record low the following day, along with Huron, SD (38°F), Casper, WY (39°F), and Goodland, KS (44°F). A final period of torrential rain (3.58 inches on June 16) capped the wettest 31-day period on record in Sioux Falls, SD. From May 17 - June 16, Sioux Falls' total of 12.74 inches edged its 31-day record of 12.23 inches, established from June 12 - July 12, 1909. The 31-day total also approached Sioux Falls' May-August normal rainfall of 12.82 inches. In contrast, showers provided only limited drought relief across the northern half of the High Plains. The last week of June saw chilly weather spreading across the upper basin. Kansas City, MO noted three record lows in 4 days (55, 53, and 52°F) on June 23, 25, and 26, respectively. Readings at or below 40°F were reported as far south as the central High Plains, where daily-record lows on June 22 included 37°F in Alliance, NE and 40°F in Colorado Springs, CO. June 24 was the coldest of several chilly mornings in eastern Montana and North Dakota, resulting in daily-record lows in locations such as Williston, ND (29°F), Dickinson, ND (33°F), and Glasgow, MT (37°F). Local heavy showers dotted the High Plains where daily-record totals reached 0.82 inch (on June 25) in Laramie, WY, and 0.87 inch (on June 26) in Butte, MT. Despite recent rainfall, 353-day (July 1, 2003 – June 27, 2004) precipitation ranged from 40 to 50 percent of normal in location such as Miles City, MT (5.54 inches, or 42 percent), Scottsbluff, NE (7.34 inches, or 46 percent), and Denver, CO (7.68 inches, or 49 percent). The chilly weather lingered through the end of the month across the Plains and Midwest. On June 27, a daily-record low was set in Dickinson, ND (39°F). A day later in Nebraska, lows of 39°F in Chadron, North Platte, and Valentine were record for that date. St. Joseph, MO (50, 55, 50 and 54°F), set or tied record lows on June 26 and 28-30. With a 65-day average temperature of 52.8°F (5.1°F below normal), Great Falls, MT, experienced its coldest May 1 – July 4 period on record (previously 53.5°F in 1995). Rain also overspread the Black Hills and the High Plains near the end of the month, producing a daily record in Chadron, NE (0.87 inch on June 30). In Wyoming, daily-record totals on June 30 included 0.61 inch in Cheyenne and 0.55 inch in Rawlins.

g. July 2004

Chilly conditions persisted in the northern Plains and upper Midwest. Fargo, ND (57°F) reported a record low temperature for July 6. Also on July 6, daily-record lows in Wyoming included 37°F in Laramie and 41°F Casper. Laramie posted another record low (37°F) the following day, along with locations such as Grand Forks, ND (44°F), and Kennebec, SD (46°F). Great Falls, MT (41°F on July 8 and 9) collected its first of two consecutive records. A daily-record precipitation total of 0.65 inch was registered on July 8 at Chadron, NE. In Huron, SD, 1.90 inches was recorded on July 11, a daily-record total for that location. Chilly weather settled across the northern Plains and gradually expanded across most areas east of the Rockies. In Montana, Great Falls (40°F) notched a daily-record low on July 12. Prior to the arrival of the cool air, Kansas City, MO (91°F on July 11) posted its second-latest observance of its first 90-degree reading of the year. Kansas City's record, established on July 15, 1904, remained intact. A brief heat wave expanded onto the Plains during the middle of July. Miles City, MT, tallied a high of 107°F on July 18. That temperature was still far below the monthly and all-time-record high of 113°F, established on July 18, 2003. The heat wave was soon replaced with chilly weather settling across the Plains and Midwest. On July 23, daily-record lows included 39°F in Williston, ND. In Scottsbluff, NE, maximums of 60°F on July 23 and 24 marked the city's first-ever July observance of consecutive days with high temperatures of 60°F or lower. Similarly, Cheyenne, WY, registered highs of 54 and 55°F on July 23-24, representing the first time its July maximum failed to reach 60°F on consecutive days since July 2-3, 1972. Heavy rain preceded and accompanied the arrival of the chilly weather, resulting in a daily-record total in Omaha, NE (2.66 inches on July 22). The cool weather lingered across the Plains through the end of the month. Record lows for July 29 included 43°F in Chadron, NE and 44°F in Mobridge, SD.

h. August 2004

The cool weather that ended July was replaced by hot weather in early August. Sidney, NE registered a daily-record high of 102°F on August 1. Local heavy showers across the basin resulted in daily-record totals in Helena, MT (1.06 inches on August 2) and Omaha, NE (2.84 inches on August 3). Another surge of cool air came across the upper basin during the second week of the month. Record lows where recorded in Great Falls, MT (40°F) and Rapid City, SD (43°F) on August 10. Rapid City followed with another record (40°F) the following day, while record lows in Nebraska for August 11 included 33°F in Alliance and 35°F in Chadron. Alliance's only other August readings below 35°F occurred on August 25 and 26, 1910, when lows were 30 and 34°F, respectively. On August 20, frost was reported in northern and eastern North Dakota. The following day, frost reached the remainder of northeastern South Dakota and the northern tier of Iowa. In Fargo, ND, the August 20 low of 34°F represented its lowest August reading since August 27, 1982, when it was 33°F. Similarly the low of 32°F in Grand Forks, ND marked its lowest August temperature since August 28, 1986, when it was 31°F. In South Dakota, Brookings (33°F on August 21) noted its lowest August reading since August 13, 1964, when the minimum temperature was also 33°F. On August 27 in Colorado, Denver's high of 55°F tied a record for the lowest maximum temperature on record during August (previously 55°F on August 29, 1946). Daily-record lows for August 28 were set in locations such as Casper, WY (34°F) and Denver, CO (42°F). Daily-record lows for August 29 were set in Alliance, NE (38°F) and Casper, WY (39°F).

i. September 2004

The cool weather of August was replaced with warmer temperatures in September. Rapid City, SD (99°F on September 1) notched a daily record-tying high. On September 5, Chadron, NE (2.92 inches) experienced its fifth-wettest day on record and wettest day since 4.40 inches fell on September 18, 1986. Elsewhere on September 5, daily-records totaled of 2.23 inches in Sisseton, SD and 1.65 inches in Scottsbluff, NE. Despite the rain across the northern half of the High Plains, year-to-date precipitation remained significantly below normal. For example, January-August precipitation totaled 6.50 inches in Scottsbluff, NE, and 5.36 inches in Miles City, MT, just 51 percent of normal in both locations. On September 18, a daily-record high of 91°F was recorded in Grand Forks, ND. In Montana, Missoula tied its September record with measurable precipitation on 10 consecutive days (totaling 1.57 inches) from September 11-20. Missoula also received measurable rain on 10 days in a row from September 13-22, 1959. Significant rainfall also dampened the Plains, where daily-record totals on September 22 included 2.36 inches in Dodge City, KS and 2.30 inches in Hastings, NE. Sioux Falls, SD had a higher average temperature in September than August for the first time since 1908. Sisseton, SD (6.51 inches, or 334 percent of normal), completed its wettest September, and Spencer, IA (14.10 inches, or 522 percent) closed its wettest month on record. Record-setting September wetness was also observed in Laramie, WY, where the 3.03-inch monthly total was 306 percent of normal. In Colorado, Denver completed a 4-month streak of above-normal monthly precipitation totals for the first time since April-July 1965. Farther north, however, drought persisted on the northern High Plains. In Montana, Billings came to the end of its fifth consecutive drier-than-normal water year. Billings' October-September precipitation totaled 11.54 inches (79 percent of normal), leaving its October 1999 – September 2004 sum at 50.09 inches (68 percent of normal).

j. October 2004

Cooler temperatures resulted in record lows being established for October 4 at Williston, ND (19°F) and Fargo, ND (22°F). Scattered daily-record precipitation totals included 1.07 inches on October 6 in Goodland, KS. Goodland's daily sum exceeded its normal October rainfall of 1.05 inches. In Montana, daily-record precipitation amounts on October 14 reached 0.51 inch in Cut Bank and 0.30 inch in Billings. In North Dakota, the season's first measurable snowfall occurred on October 17 in locations such as Bismarck (0.8 inch) and Williston (0.2 inch). The surge in colder air that brought the snow to the upper Plains area resulted in a daily-record low (17°F on October 16) in Mobridge, SD. Rain fell in the northeastern South Dakota area resulting in a daily-record at Watertown, SD (1.15 inches on October 22). Fargo, ND collected consecutive daily-record totals (1.56 and 1.05 inches on October 29 and 30). In South Dakota, daily records included 2.08 inches (on October 28) in Watertown and 1.65 inches (on October 29) in Mobridge.

k. November 2004

Warmth returned to the Plains. On November 5, daily-record highs included 69°F in Glasgow, MT, and 80°F in Pueblo, CO. A day later a record for November 6 was established in Sioux City, IA (80°F). It was Sioux City's second-latest autumn observance of a maximum temperature of 80°F or higher, behind November 8, 1999. On November 10 in northwestern Kansas, Goodland's 1.08-inch rainfall ensured its first wetter-than-normal year since 1999 and highest annual precipitation total since 1995. In Montana, record highs for November 8 were set in locations such as Great Falls (71°F) and Cut Bank (67°F). Widespread rain fell mid-month in the northern Plains. Daily-record totals for November 18 included 0.75 inch in Waterloo, IA, and 0.72 inch in Hastings, NE. Two days later, the 0.86-inch sum in Dodge City, KS, was a record for November 20. No measurable snow fell in Rapid City, SD through November 22. Its record-late date for the season's first accumulation is November 24, 1952. Mild weather prevailed in the Plains, but there was some stormy weather in the west portion of the basin. Casper, WY received a daily-record snowfall of 6.5 inches on November 26. While further east, Huron, SD was still waiting for its first snow of the season and eclipsed its former record for the date of first snow, which was November 26, 2001. Snow intensified across parts of the West on November 28, resulting in another record total in Casper (7.1 inches) and many other locations, including Lander, WY (13.0 inches), Cheyenne, WY (9.7 inches) and North Platte, NE (9.7 inches). North Platte's total represented its snowiest day since March 28, 1980, when 11.6 inches fell. On the central High Plains, snow lingered into November 29, when Dodge City, KS (5.5 inches), received a daily-record total. The last day of November featured cold weather in Alliance, NE (-18°F) and Grand Junction, CO (-4°F, breaking the record of -2°F established on November 28, 1976).

l. December 2004

Grand Junction, CO also achieved daily-record lows (2, -4, -2, 0, 0, and 2°F) on 6 consecutive days from November 29 – December 4, its second-longest such streak behind a 10-day cold snap in February 1903. On December 11, a wind gust was clocked to 76 m.p.h. in Stark County, ND, near Richardton. A day later, peak wind gusts to 58 m.p.h. were recorded in Sisseton, SD. Record highs were set on December 11 in Billings, MT (67°F) and Pueblo, CO (79°F). Long-term precipitation deficits persisted in parts of Montana, where year-to-date precipitation totals through December 12 included 7.63 inches (62 percent of normal) in Cut Bank and 11.67 inches (68 percent of normal) in Lewistown. Temperatures remained above the freezing mark for 3 consecutive days (December 17-19) in Cut Bank, MT, with lows of 38, 39, and 34°F. Wintry conditions were also largely absent elsewhere on the northern Plains, including South Dakota, where Aberdeen's season–to-date snowfall of 0.6 inch was its second-lowest total on record through December 18, behind only 0.2 inch in 1923. Record highs were set on December 20 across the northern High Plains, where readings in Montana reach 60°F in Miles City and 59°F in Great Falls. Also on the 20th, the season's first measurable snow (0.2 inch) fell in Sioux Falls, SD. The previous record for the latest first measurable snow in Sioux Falls was established on December 7, 1963. Cold weather followed this warm spell. On December 23, Havre, MT posted a low of -25°F, just 4 days after an early-week high of 60°F. Record warmth arrived on the central Plains by December 29, when Valentine, NE, posted a daily-record high of 63°F. Warmth expanded the following day, resulting in more than two dozen daily-record highs. December 30 highs reached 70°F in locations such as St. Joseph, MO, and Topeka, KS. In Montana, Glasgow measured daily-record snowfalls on December 30 (4.0 inches) and 5.8 inches in Great Falls. In North Dakota, 4.8 inches of snowfall was measured in Grand Forks on December 30.

4. 2004 Calendar Year Runoff

Calendar Year runoff for the period January through December 2004 for the area above Sioux City, Iowa, totaled 16.6 MAF, 66 percent of normal runoff based on the historical period of 1898-1997, as shown in ***Table 1***. The 16.6 MAF in 2004 represents a runoff between the lower decile (15.5 MAF) and the lower quartile (19.5 MAF) runoff as shown on ***Figure 4***. Monthly runoff during 2004 above Sioux City, Iowa varied from a low of 42 percent of normal in May to a high 99 percent of normal in September. ***Figure 5*** indicates the monthly variation of runoff for CY 2004.

The actual and normal monthly runoffs for CY 2004 from Fort Peck downstream to Sioux City, Iowa by major river reach are presented in ***Table 2***. The monthly accumulation of actual runoff is shown under the "Summation above Sioux City" column. The table describes the annual runoff by month and is the basic compilation of the month-by-month runoff into the System. This table is also used on a monthly basis to forecast runoff into the System for the remainder of the year. This forecast forms a basis for intrasystem balancing of storage accumulated in the projects. As the season progresses and the actual runoff accumulates, the forecast becomes more reliable. The majority of the annual runoff has usually occurred by the end of July, and the remainder of the year can be estimated with a greater degree of accuracy.

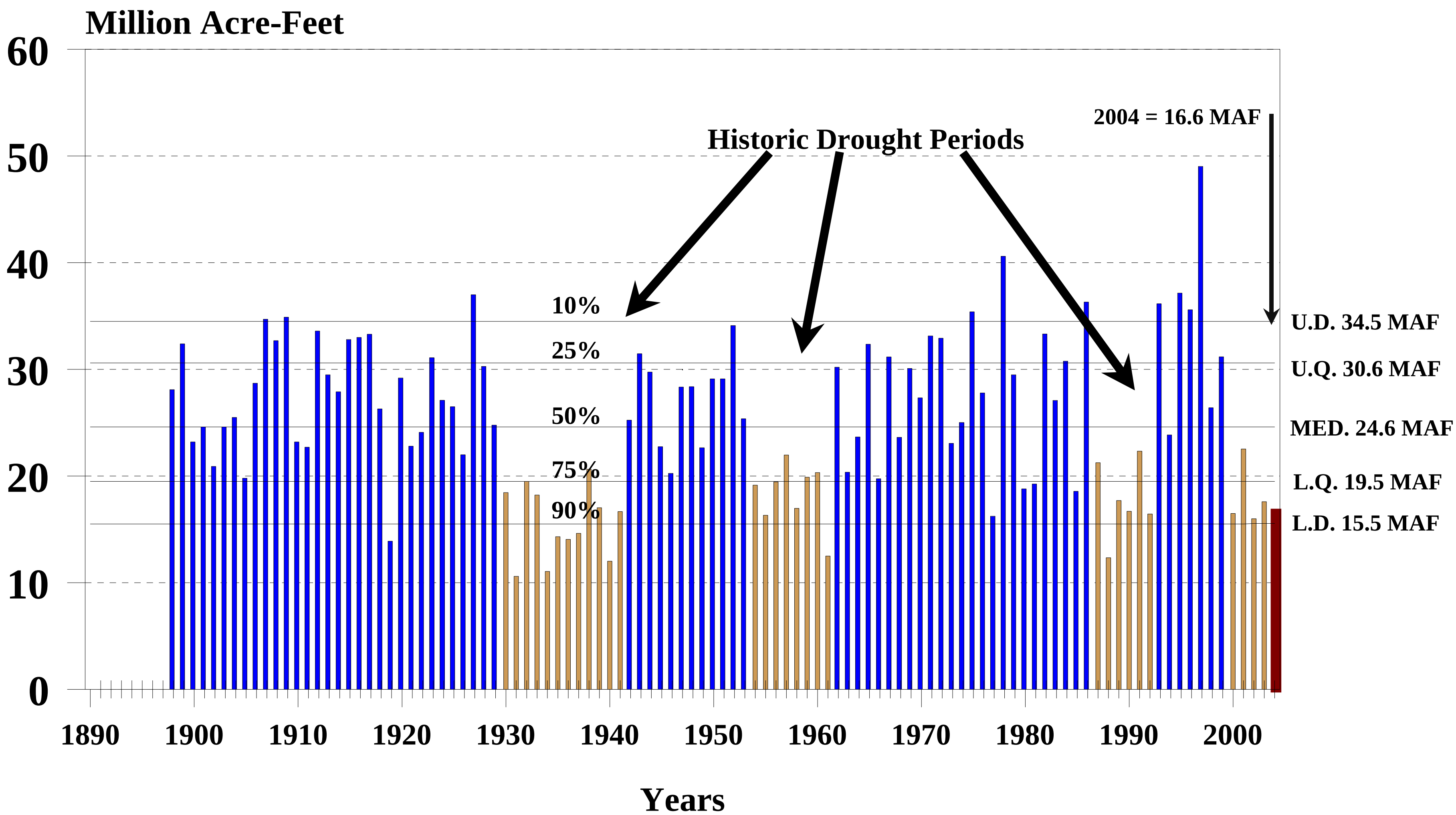
C. <u>System Regulation</u>

1. System Regulation – January to December 2004

System storage on January 1, 2004 was 38.7 MAF, 4.0 MAF less than the System storage on January 1, 2003. Winter System releases were established at 12,000 cfs, the minimum releases necessary to provide adequate water supply downstream of the System. The System storage dropped slightly during January, with storage of 38.1 MAF on February 1. The System storage on March 1 was 38.3 MAF, 18.8 MAF below the desired 57.1 MAF top of carryover multiple use zone level.

The plan for the rate of System release to support the 2004 navigation season was the result of a consultation between the Corps and U.S. Fish and Wildlife Service (Service) in response to the Service's 2003 Biological Opinion. This steady release-flow-to target plan is discussed in detail in Section II.D.4 of this report. Based on 2003 nesting season results, it was anticipated that sufficient habitat would be available above the release rates to provide for successful nesting. An analysis of previous drought years indicated a 30,000 cfs System release would provide minimum service or greater flows at Kansas City 90 percent of the time.

Missouri River Mainstem
Annual Runoff at Sioux City, Iowa



Minimum service flow support for the 2004 navigation season began on March 23 at Sioux City, Iowa; March 25 at Omaha, Nebraska; March 26 at Nebraska City, Nebraska; March 28 at Kansas City, Missouri; and April 1 at the mouth of the Missouri River near St. Louis, Missouri. System releases on March 21 were set at 18,000 cfs. Since the industry indicated that they would not be navigating upstream of Omaha in April 2004, minimum service flows were not provided to meet a Sioux City target. Minimum service flow targets were met at the other three downstream target locations - Omaha (25,000 cfs), Nebraska City (31,000 cfs) and Kansas City (35,000 cfs). Releases were increased to 27,000 cfs on May 1 when the interior least terns and piping plovers began to initiate nesting activities below Gavins Point Dam.

On April 1 System storage was 39.7 MAF, 4.3 MAF less than the previous year's April 1 System storage of 44.0 MAF. The plains snowmelt produced a March-April runoff of 3.9 MAF above Sioux City, 67% of normal. Runoff volumes above Sioux City for May, June and July were 1.4, 3.2, and 2.2 MAF, respectively. Normal runoff for those months is 3.3, 5.4, and 3.2 MAF. The actual May-July runoff above Sioux City was 56% of normal.

For the 2004 calendar year, System storage peaked on April 4 at 39.8 MAF. The System storage peak for the previous year was 45.2 MAF. The end-of-July System storage was 37.8 MAF, 23.0 MAF less than average (60.8 MAF). System storage began a steady decline through the late summer and fall months. End-of-month storages were: August, 36.6 MAF; September, 35.8 MAF; October, 35.7 MAF; November, 35.7 MAF; and December, 35.2 MAF. The end of December System storage was 3.5 MAF less than the previous year and 19.3 MAF less than average. The end of month water storage for December was the lowest end of year System storage since the system filled in 1967. The lowest System storage during the calendar year occurred on December 29 at 35.2 MAF. Based on the July 1 System storage check, per the Master Manual, the navigation season was shortened by 47 days from the normal ending data of December 1 at St. Louis, Missouri. This shortening was a reduction of an additional 30 days more than required under the previous Master Manual. The shortening resulted in the conservation of additional water in the System.

Energy generation at the six System powerplants totaled 6.5 billion kilowatt hours (kWh) for the period January 1, 2004 to December 31, 2004, 3.5 billion kWh hours below the average since the System first filled in 1967. The below normal generation was due to the drought conservation during the winter and low system releases to support minimum service downstream flows during the shortened navigation season.

2. Fort Peck Regulation – January to December 2004

a. General

Fort Peck, the third largest Corps of Engineers (Corps) storage reservoir, serves all authorized purposes. Fort Peck's primary functions are: (1) to capture the mountain and plains snow and localized rainfall runoff from the large drainage area above Fort Peck, which are metered out at controlled release rates to meet the System-authorized purposes while reducing flood damages in the Fort Peck to Garrison reach; (2) to serve as a secondary storage location for water accumulated in the System from reduced System releases due to major downstream flood control regulation, thus helping to alleviate large pool increases in Garrison, Oahe, and Fort Randall; and (3) to provide the extra water needed to meet all System authorized purposes that draft storage during low-water years.

b. Winter 2004

The Fort Peck reservoir level began 2004 at elevation 2206.80 feet msl, 27.2 feet below the annual flood control zone and 7.7 feet below the elevation for this same date the previous year. By the end of February, the reservoir elevation declined to 2204.0 feet msl, which was 7.1 feet lower than on the same date the previous year. The Fort Peck reservoir was free of ice on April 2nd. ***Table 3*** lists the average monthly releases and inflows in cfs and the end-of-month (EOM) pool elevation in feet msl for January, February and March for the last three years as well as the averages since the system closed.

Table 3
Fort Peck - Winter Inflows, Releases and Elevations

Year	January			February			March		
	Inflow	Release	Elev.	Inflow	Release	Elev.	Inflow	Release	Elev.
2004	5,200	8,900	2205.3*	5,400	8,800	2204.0*	9,700	5,700	2205.5*
2003	4,500	9,800	2212.6	5,700	10,100	2211.1	10,000	5,100	2212.8
2002	3,900*	5,000*	2218.8	4,500	5,100*	2218.6	4,600*	4,600	2218.5
1967-2004	7,400	11,200	2230.7	9,000	11,700	2229.9	12,400	8,400	2231.0

* monthly minimum of record

c. Winter River and Ice Conditions Below Fort Peck

No special release reductions were required to prevent ice-jam flooding, because ice jams were not a threat due to the low flows downstream from Fort Peck. Ice cover formation on the Missouri River began on December 31, 2003, when the Missouri River stage rose over 3.5 feet in the Wolf Point, Montana area. The stage peaked near 8.3 feet on January 10, 2004, which is 2.6 feet below flood stage. The Missouri River at Culbertson, Montana had a steady rise from early January to peak at a stage of 5.16 feet on January 14 and 15. However, this was not the peak for the winter season. The peak occurred on February 21, 2004 when the stage rose to 5.28 feet on the Missouri River at Culbertson, Montana, 5.12 feet lower then the previous year's peak stage. No reports of ice-affected flooding on the Missouri River below Fort Peck Dam were recorded during the 2004 winter season.

d. Spring 2004

Table 4 lists the average monthly releases and inflows in cfs and the EOM pool elevation in feet msl for April, May and June for the last three years as well as the averages since the System closed.

Table 4
Fort Peck - Spring Inflows, Releases and Elevations

Year	April			May			June		
	Inflow	Release	Elev.	Inflow	Release	Elev.	Inflow	Release	Elev.
2004	5,300	6,800	2204.9*	6,700	10,200	2203.4*	8,200	6,600	2203.8*
2003	7,000	7,000	2212.8	9,900	9,100	2213.0	11,000	8,700	2213.6
2002	5,200	4,100	2218.8	5,500	7,300	2218.1	15,000	8,600	2219.9
1967-2004	10,600	7,700	2231.8	15,600	9,400	2233.3	19,100	10,200	2235.5

* monthly minimum of record

The releases were increased to 5,500 cfs on April 1 for intrasystem reservoir balancing purposes. The reservoir level at the beginning of the navigation season (April 1) was 2205.5 feet msl, 7.3 feet lower than the level at the start of the 2003 navigation season.

e. Summer 2004

Table 5 lists the average monthly releases and inflows in cfs and the EOM pool elevation in feet msl for July, August and September for the last three years as well as the averages since the system closed.

Table 5
Fort Peck - Summer Inflows, Releases and Elevations

Year	July			August			September		
	Inflow	Release	Elev.	Inflow	Release	Elev.	Inflow	Release	Elev.
2004	4,500	7,200	2202.4*	4,200	6,900	2200.9*	5,100	6,100	2199.8*
2003	5,700	8,100	2212.3	4,500	7,100	2210.8	4,600	6,300	2209.6
2002	9,200	8,600	2219.0	6,500	8,800	2218.5	6,000	6,800	2217.6
1967-2004	12,600	10,400	2235.7	8,100	10,300	2234.6	8,000	9,200	2233.7

* monthly minimum of record

f. Fall 2004

Table 6 lists the average monthly releases and inflows in cfs and the EOM pool elevation in feet msl for October, November and December for the last three years as well as the averages since the system closed.

Table 6
Fort Peck - Fall Inflows, Releases and Elevations

Year	October			November			December		
	Inflow	Release	Elev.	Inflow	Release	Elev.	Inflow	Release	Elev.
2004	5,400	4,100	2199.8*	5,400	4,300	2199.8*	4,100	5,500	2198.9*
2003	5,300	4,600	2209.3	4,500*	5,700	2208.3	5,700	8,900	2206.8
2002	5,200	4,700	2217.3	5,400	5,600	2216.8	4,500	9,900	2214.6
1967-2004	7,400	8,500	2233.0	7,300	8,800	2232.3	6,700	9,800	2231.1

* monthly minimum of record

g. Summary

The highest Fort Peck reservoir level during 2004 occurred on January 1, 2004 at 2206.8 feet msl. The lowest reservoir level during 2004, which was also a new record low, occurred on December 31, 2004 at 2198.9 feet msl. The previous record low before the current 5-year drought was 2208.7 feet msl in April 1991. The average monthly inflow of 5,800 cfs during calendar year 2004 was 56% of normal (1967-2004). The average monthly release of 6,800 cfs during calendar year 2004 was 71% of normal. In 2004, Fort Peck did not rise into the annual flood control zone, which extends from 2234.0 to 2250.0 feet msl.

3. Garrison Regulation – January to December 2004

a. General

Garrison, the largest Corps storage reservoir, is another key player in the regulation of the System. Its primary functions are (1) to capture the snowmelt runoff and localized rainfall runoff from the large drainage area between Fort Peck and Garrison, which are metered out at controlled release rates to meet the System authorized purposes, while reducing flood damages in the Garrison to Oahe reach, particularly the urban Bismarck area; (2) to serve as a secondary storage location for water accumulated in the System from reduced System releases due to major downstream flood control regulation, thus helping to alleviate large pool increases in Oahe and Fort Randall; and (3) to provide the extra water needed to meet all mainstem authorized purposes that draft storage during low water years.

b. Winter 2004

Releases from Garrison were below normal for a fifth consecutive winter season. Garrison began 2004 at a record low elevation of 1818.41 feet msl, over 19 feet below the annual flood control zone and 4 feet below the reservoir level a year earlier. The reservoir declined throughout the winter season to a record low elevation of 1813.8 feet msl on March 11th. This elevation is 23.7 feet below the base of the annual flood control zone. Garrison reservoir was free of ice on April 14th. ***Table 7*** lists the average monthly releases and inflows in cfs and the EOM pool elevation in feet msl for January, February and March for the last three years as well as the averages since the system closed.

Table 7
Garrison - Winter Inflows, Releases and Elevations

Year	January			February			March		
	Inflow	Release	Elev.	Inflow	Release	Elev.	Inflow	Release	Elev.
2004	12,300	19,200	1816.7*	13,600	23,100	1814.3*	21,900	16,700	1815.6*
2003	12,600	18,400	1821.1	15,900	22,300	1819.7	28,600	17,300	1822.4
2002	8,700*	13,100*	1828.3	10,300*	13,200*	1827.6	10,200*	12,500	1826.9
1967-2004	15,700	23,600	1834.1	19,400	25,000	1833.0	28,100	20,100	1834.5

* monthly minimum of record

c. Winter River and Ice Conditions Below Garrison

The Missouri River in the Bismarck, North Dakota area rose over 5.5 feet on January 2, 2004 during ice cover formation. The ice-cover conditions were stable and continuous from January 2 through March 9. A round of warm weather in early March caused the ice to melt out and the channel was temporarily cleared of ice. On March 10, another round of cold weather and ice formation followed. By March 15, the Missouri River at Bismarck was ice-free and remained ice-free for the remainder of the winter season. The peak ice-affected Missouri River stage at Bismarck was 11.96 feet on January 10 and 11, 2004. This was well below both the established Bismarck flood stage of 16 feet and the Corps' winter freeze-in stage target of 13 feet.

d. Spring 2004

Table 8 lists the average monthly releases and inflows in cfs and the EOM pool elevation in feet msl for April, May and June for the last three years as well as the averages since the system closed.

Table 8
Garrison - Spring Inflows, Releases and Elevations

Year	April			May			June		
	Inflow	Release	Elev.	Inflow	Release	Elev.	Inflow	Release	Elev.
2004	13,600	16,900	1814.7*	18,300	15,800	1815.3*	23,600	18,000	1816.5*
2003	16,100	18,600	1821.7	22,700	18,700	1822.6	41,800	21,300	1827.0
2002	13,800	10,800	1827.5	16,700	12,800	1828.3	36,100	20,900	1831.4
1967-2004	23,200	19,500	1835.1	28,600	21,700	1836.3	46,100	23,600	1840.2

* monthly minimum of record

The releases were decreased from 26,000 to 20,000 cfs on April 1 for intrasystem reservoir balancing purposes. The reservoir level at the beginning of the navigation season (April 1) was 1815.6 feet msl, 6.9 feet lower than the level at the start of the 2004 navigation season.

e. Summer 2004

Table 9 lists the average monthly releases and inflows in cfs and the EOM pool elevation in feet msl for July, August and September for the last three years as well as the averages since the system closed.

Table 9
Garrison - Summer Inflows, Releases and Elevations

Year	July			August			September		
	Inflow	Release	Elev.	Inflow	Release	Elev.	Inflow	Release	Elev.
2004	18,300	17,900	1816.5*	11,100	17,200	1814.3*	12,600	15,000	1813.3*
2003	18,400	21,400	1826.1	9,600	21,100	1822.9	10,600	16,900	1820.9
2002	21,100	20,800	1831.4	14,000	21,100	1829.2	12,500	17,500	1827.5
1967-2004	33,100	25,100	1841.4	18,700	24,800	1839.7	17,000	21,200	1838.5

* monthly minimum of record

f. Fall 2004

Table 10 lists the average monthly releases and inflows in cfs and the EOM pool elevation in feet msl for October, November and December for the last three years as well as the averages since the system closed.

Table 10
Garrison - Fall Inflows, Releases and Elevations

Year	October			November			December		
	Inflow	Release	Elev.	Inflow	Release	Elev.	Inflow	Release	Elev.
2004	12,400	11,500	1813.1*	11,600	12,700	1812.3*	8,400*	15,200	1810.0*
2003	9,400	10,800	1820.1	9,300	11,700	1819.1	14,500	15,900	1818.4
2002	11,900	13,800	1826.6	10,700	18,000	1824.6	12,300	19,600	1822.5
1967-2004	17,700	19,600	1837.8	16,300	20,500	1836.6	14,200	20,800	1835.0

* monthly minimum of record

g. Summary

No water was transferred to Lake Audubon during the 2004 calendar year. Buford-Trenton pumping costs totaled $13,579.21 for 2004. The highest Garrison reservoir level during 2004 occurred on January 1, 2004 at 1818.41 feet msl. The lowest reservoir level during 2004, which was also a new record low, occurred on December 29, 2004 at 1809.99 feet msl. The previous record low before the current 5-year drought was 1815.0 feet msl in May 1991. The average monthly inflow of 14,800 cfs during calendar year 2004 was 64% of normal (1967-2004). The average monthly release of 16,600 cfs during calendar year 2004 was 75% of normal. In 2004, Garrison did not rise into the annual flood control zone, which extends from 1837.5 to 1850.0 feet msl.

4. Oahe and Big Bend Regulation – January to December 2004.

a. General

Oahe, the second largest Corps storage reservoir, serves all authorized purposes. The Oahe Project's primary functions are (1) to capture plains snow and localized rainfall runoff from the large drainage area between Garrison and Oahe, which are metered out at controlled release rates to meet the System authorized purposes, while reducing flood damages in the Oahe to Big Bend reach, especially in the urban Pierre and Fort Pierre areas; (2) to serve as a primary storage location for water accumulated in the System from reduced System releases due to major downstream flood control regulation, thus helping to alleviate large reservoir level increases in Big Bend, Fort Randall and Gavins Point and (3) to provide the extra water needed to meet all System authorized purposes that draft storage during low-water years, particularly downstream water supply and navigation. In addition, hourly and daily releases from Big Bend and Oahe fluctuate widely to meet varying power loads. Over the long term, their release rates are geared to back up navigation releases from Fort Randall and Gavins Point in addition to providing storage space to permit a smooth transition in the scheduled annual fall drawdown of Fort Randall. Big Bend, with less than 2 MAF of storage, is primarily used for hydropower production, so releases from Oahe are generally passed directly through Big Bend.

b. Winter 2004

Flooding in the Pierre-Fort Pierre area, especially at street intersections in the Stoeser Addition, has been a recurring problem since 1979. High Oahe releases, coupled with the formation of river ice cover in the LaFrambois Island area, have historically caused water to back up into a storm sewer outlet flooding street intersections. The city of Pierre installed a valve on the Stoeser Addition storm sewer in the fall of 1998 to prevent winter flooding; however, Oahe releases will continue to be constrained at times to prevent flooding at other locations. No flooding problems were experienced in this area during the winter of 2004. Oahe reservoir was free of ice on March 19th.

Big Bend was regulated to follow power peaking requirements with hourly releases varying widely. The daily average flow varied between 0 and 28,400 cfs. Lake Sharpe was free of ice on March 16th.

A settlement agreement was approved in an order of dismissal by the United States District Court, District of South Dakota on August 8, 2003, in the case of Lower Brule Sioux Tribe et al. v. Rumsfeld, et al. (Civil No. 02-3014 (D.S.D.)). The agreement provides that the Corps will consult with the Lower Brule Tribe and the Crow Creek Sioux Tribe during any review and revision of the Missouri River Master Water Control Manual. This agreement also provides that the Corps will coordinate the regulation of the Big Bend Project and the water level of Lake Sharpe with the two Tribes to include the following: the Corps will normally strive to maintain an operating level at Lake Sharpe between elevation 1419 feet msl and 1421.5 feet msl; when the level of Lake Sharpe drops below elevation 1419 feet msl or exceeds elevation 1421.5 feet msl, the Chief of the Water Management Division will provide notice to such persons as the Tribes shall designate in writing; when it is anticipated that the water level will drop below 1418 feet msl or rise above 1422 feet msl, or in the event the water level falls below 1418 feet msl or rises above 1422 feet msl, the Commander, Northwestern Division, or his designee, shall immediately contact the Chairpersons of the Tribes or their designees to notify them of the situation and discuss proposed actions to remedy the situation. During 2004, the Big Bend reservoir level varied in a narrow range from elevation 1419.5 to 1421.5 feet msl. As per the settlement agreement with the Lower Brule Sioux Tribe, no additional coordination was necessary.

Table 11 lists the Oahe average monthly releases and inflows in cfs and the EOM pool elevations in feet for January, February and March for the last three years as well as the averages since the system closed.

Table 11
Oahe - Winter Inflows, Releases and Elevations

Year	January			February			March		
	Inflow	Release	Elev.	Inflow	Release	Elev.	Inflow	Release	Elev.
2004	18,200	15,400	1577.6*	23,900	18,400	1579.2*	24,800	14,700	1582.1*
2003	17,800	16,000	1585.3	23,100	15,400	1587.2	24,200	19,700	1588.2
2002	13,900*	13,200	1598.6	14,200*	12,700*	1598.9	14,100*	16,900	1598.2
1967-2004	24,000	21,600	1600.8	28,600	18,900	1602.6	32,000	19,000	1605.2

* monthly minimum of record

Table 12 lists the Big Bend average monthly releases and inflows in cfs and the EOM pool elevation in feet msl for January, February and March for the last three years as well as the averages since the system closed.

Table 12
Big Bend - Winter Inflows, Releases and Elevations

Year	January			February			March		
	Inflow	Release	Elev.	Inflow	Release	Elev.	Inflow	Release	Elev.
2004	14,100	13,900	1420.6	17,400	16,800	1421.1	13700	14,300	1420.4
2003	14,800	15,100	1420.3	14,400	14,300	1420.2	18500	18,000	1420.6
2002	12,400	12,400	1420.5	11,800*	11,800*	1420.4	16400	15,900	1420.8
1967-2004	21,400	21,400	1420.5	19,100	19,000	1420.4	19,800	19,700	1420.3

* monthly minimum of record

c. Spring 2004

Releases from Oahe are generally set lower during weekends than on weekdays. The normal regulation is to maintain Oahe’s releases above 3,000 cfs during weekend daylight hours beginning in early April. This minimum release is scheduled to enhance downstream fishing and boating use during the recreation season. During the spring of 2004, no minimum release rate criteria were established for Oahe. Due to the ongoing drought conditions and ensuing low reservoir levels, making large releases during shorter periods of the day rather than a constant lower release maximized power-producing capability.

Table 13 lists the Oahe average monthly releases and inflows in cfs and the EOM pool elevation in feet msl for April, May and June for the last three years as well as the averages since the System closed.

Table 13
Oahe - Spring Inflows, Releases and Elevations

Year	April			May			June		
	Inflow	Release	Elev.	Inflow	Release	Elev.	Inflow	Release	Elev.
2004	18,700	19,300	1581.6*	16,600	27,800	1578.4*	20,200	24,600	1576.8*
2003	19,600	22,600	1587.5	23,800	18,500	1588.7	22,600	25,600	1587.4
2002	11,900*	20,600	1596.2	12,800*	15,700	1595.3	21,600	32,500	1592.7
1967-2004	27,300	22,000	1606.0	28,500	22,900	1606.8	28,900	26,200	1606.7

* monthly minimum of record

The Oahe releases were increased to 19,600 cfs on April 1 for intrasystem reservoir balancing purposes. The reservoir level at the beginning of the navigation season (April 1) was 1582.1 feet msl, more than 6 feet lower than the level at the start of the 2003 navigation season.

Table 14 lists the Big Bend average monthly releases and inflows in cfs and the EOM pool elevation in feet msl for April, May and June for the last three years as well as the averages since the System closed.

Table 14
Big Bend - Spring Inflows, Releases and Elevations

Year	April			May			June		
	Inflow	Release	Elev.	Inflow	Release	Elev.	Inflow	Release	Elev.
2004	17,900	18,100	1420.0	26,100	25,200	1420.8	22,800	23,500	1419.7*
2003	21,200	21,300	1420.3	17,500	17,700	1420.0	24,300	23,700	1420.4
2002	19,600	20,100	1420.1	14,600	16,200	1418.2	31,000	28,200	1421.0
1967-2004	22,500	22,200	1420.5	23,400	23,200	1420.4	26,500	26,200	1420.3

* monthly minimum of record

The Big Bend releases were increased to 17,000 cfs on April 1 for intrasystem reservoir balancing purposes.

d. Summer 2004

Table 15 lists the Oahe average monthly releases and inflows in cfs and the EOM pool elevation in feet msl for July, August and September for the last three years as well as the averages since the System closed.

Table 15
Oahe - Summer Inflows, Releases and Elevations

Year	July			August			September		
	Inflow	Release	Elev.	Inflow	Release	Elev.	Inflow	Release	Elev.
2004	17,500	24,800	1574.3*	19,500	23,900	1572.1*	18,400	12,900	1573.2*
2003	21,600	25,400	1586.5	20,900	25,900	1584.4	17,900	28,000	1581.0
2002	20,600	27,200	1590.8	21,300	29,200	1588.1	18,900	24,800	1586.4
1967-2004	27,800	30,300	1605.9	26,200	33,300	1604.0	22,600	30,300	1602.0

* monthly minimum of record

Table 16 lists the Big Bend average monthly releases and inflows in cfs and the EOM pool elevation in feet msl for July, August and September for the last three years as well as the averages since the System closed.

Table 16
Big Bend - Summer Inflows, Releases and Elevations

Year	July			August			September		
	Inflow	Release	Elev.	Inflow	Release	Elev.	Inflow	Release	Elev.
2004	23,300	22,200	1420.5	22,500	22,100	1420.3	12,700	12,400	1420.1
2003	23,800	23,800	1419.8	24,200	23,200	1420.4	26,400	26,200	1420.2
2002	25,800	26,500	1419.6	27,500	26,500	1420.3	23,500	22,500	1420.8
1967-2004	29,800	29,400	1420.3	32,900	32,400	1420.2	30,100	29,600	1420.3

* monthly minimum of record

e. Fall 2004

Table 17 lists the Oahe average monthly releases and inflows in cfs and the EOM pool elevation in feet msl for October, November and December for the last three years as well as the averages since the System closed.

Table 17
Oahe - Fall Inflows, Releases and Elevations

Year	October			November			December		
	Inflow	Release	Elev.	Inflow	Release	Elev.	Inflow	Release	Elev.
2004	13,300	7,000*	1574.8*	13,500	7,700	1576.0*	14,300	13,900	1575.8*
2003	11,900	19,000	1578.2	11,200*	15,500	1576.7	16,100	14,700	1576.9
2002	14,800	17,300	1585.1	19,200	23,500	1583.4	19,800	13,800*	1584.8
1967-2004	21,000	25,200	1600.7	21,900	23,900	1600.0	21,100	21,700	1599.6

* monthly minimum of record

Table 18 lists the Big Bend average monthly releases and inflows in cfs and the EOM pool elevation in feet msl for October, November and December for the last three years as well as the averages since the System closed.

Table 18
Big Bend - Fall Inflows, Releases and Elevations

Year	October			November			December		
	Inflow	Release	Elev.	Inflow	Release	Elev.	Inflow	Release	Elev.
2004	6,600*	5,600*	1421.0	7,200	7,200	1421.0	12,900	13,300	1420.3
2003	17,900	17,500	1420.2	14,800	13,900	1421.0	13,500	14,000	1420.3
2002	16,300	16,600	1420.0	21,800	21,200	1420.5	12,800*	12,600*	1420.6
1967-2004	25,100	24,600	1420.5	25,700	23,700	1420.4	21,600	21,400	1420.5

* monthly minimum of record

f. Summary

The highest Oahe reservoir level during the 2004 calendar year occurred on April 28 at 1582.2 feet msl. The lowest reservoir level during the 2004 calendar year, which is also the new record low, occurred on August 8 at 1572.0 feet msl. The previous record low before the current 5-year drought was 1580.7 feet msl in November 1989. The average monthly inflow to Oahe of 18,200 cfs was 71% of average. The average monthly release from Oahe (17,500 cfs) and Big Bend (16,200 cfs) were 71% and 66% of average, respectively. In 2004, Oahe did not rise into its annual flood control zone, which extends from 1607.5 to 1617.0 feet msl. Big Bend ended the year at 1420.3 feet msl, within the normal operating range.

5. Fort Randall Regulation – January to December 2004

a. General

Fort Randall, the fourth largest Corps storage reservoir, serves all authorized purposes. Fort Randall's primary functions are: (1) to capture plains snow and localized rainfall runoffs in the drainage area from Big Bend to Fort Randall, which are metered out at controlled release rates to meet the System authorized purposes while reducing flood damages in the Fort Randall reach, where several areas have homes and cabins in close proximity to the river; (2) to serve as a primary storage location along with Oahe for water accumulated in the System when System releases are reduced due to major downstream flood control regulation, thus helping to alleviate large pool increases in the very small Gavins Point Project; (3) to provide a location to store the water necessary to provide increased winter energy to the basin by allowing an annual fall drawdown of the reservoir to occur with a winter reservoir refilling that is unique to Fort Randall; and (4) to provide the extra water needed to meet all System authorized purposes, particularly navigation and downstream water supply, that draft storage during low water years.

b. Winter 2004

Table 19 lists the average monthly releases and inflows in cfs and the EOM pool elevation in feet msl for January, February and March for the last three years as well as the averages since the System closed. The March releases were reduced to reach the target elevation of 1206 feet msl at Gavins Point. The Fort Randall reservoir was free of ice by March 16th.

Table 19
Fort Randall - Winter Inflows, Releases and Elevations

Year	January			February			March		
	Inflow	Release	Elev.	Inflow	Release	Elev.	Inflow	Release	Elev.
2004	15,100	14,600	1343.8	19,400	10,600	1350.6	15,800	10,400	1354.6
2003	16,300	12,900	1345.3	17,000	11,000	1349.7	20,400	15,100	1353.6
2002	14,400	10,900	1346.9	13,200*	10,700	1348.7	17,900	15,900	1350.3
1967-2004	22,700	15,600	1347.4	20,700	13,900	1352.3	22,400	16,600	1356.3

* monthly minimum of record

c. Spring 2004

Table 20 lists the average monthly releases and inflows in cfs and the EOM pool elevation in feet msl for April, May and June for the last three years as well as the averages since the System closed.

Table 20
Fort Randall - Spring Inflows, Releases and Elevations

Year	April			May			June		
	Inflow	Release	Elev.	Inflow	Release	Elev.	Inflow	Release	Elev.
2004	19,600	19,900	1354.3	27,900	25,700	1355.7	26,100	26,600	1355.0
2003	24,000	22,800	1354.5	20,600	23,800	1351.9	26,000	24,400	1352.8*
2002	22,800	20,200	1352.1*	17,900	20,600	1349.8*	30,800	24,100	1354.5
1967-2004	24,800	22,500	1357.6	26,100	26,200	1357.4	28,800	28,200	1357.5

* monthly minimum of record

d. Summer 2004

Table 21 lists the average monthly releases and inflows in cfs and the EOM pool elevation in feet msl for July, August and September for the last three years as well as the averages since the System closed.

Table 21
Fort Randall - Summer Inflows, Releases and Elevations

Year	July			August			September		
	Inflow	Release	Elev.	Inflow	Release	Elev.	Inflow	Release	Elev.
2004	24,000	25,400	1353.9	23,700	24,300	1352.8	14,500	22,900	1345.5
2003	25,900	24,300	1353.9	25,300	24,500	1353.8	28,000	28,100	1353.1
2002	28,300	26,300	1355.4	29,300	28,800	1355.2	25,100	30,400	1350.7
1967-2004	30,800	31,700	1356.5	33,600	34,400	1355.7	30,500	34,800	1351.7

* monthly minimum of record

e. Fall 2004

Table 22 lists the average monthly releases and inflows in cfs and the EOM pool elevation in feet msl for October, November and December for the last three years as well as the averages since the System closed.

Table 22
Fort Randall - Fall Inflows, Releases and Elevations

Year	October			November			December		
	Inflow	Release	Elev.	Inflow	Release	Elev.	Inflow	Release	Elev.
2004	5,800*	12,000*	1339.0	7,300	7,700	1338.3	14,700	11,200	1341.8
2003	18,300	27,100	1345.3	14,700	20,300	1339.8	15,400	11,800	1343.2
2002	16,100	29,400	1338.2	23,900	22,900	1339.0	14,200	10,800	1342.2
1967-2004	24,500	34,000	1343.3	23,500	30,600	1336.3	22,500	17,700	1341.1

* monthly minimum of record

f. Summary

The highest Fort Randall reservoir level during the 2004 calendar year occurred on May 28 at 1356.37 feet msl. The lowest reservoir level during the 2004 calendar year occurred on November 15 at 1337.90 feet msl. The average monthly inflow to Fort Randall of 17,800 cfs was 68% of average. The average monthly release from Fort Randall of 17,600 cfs was 69% of average. In 2004, Fort Randall did rise into its annual flood control zone, which extends from 1350.0 to 1365.0 feet msl. However, the normal summer operating pool level at Fort Randall is 1355.0 feet msl. Normal regulation of Fort Randall includes the lowering of the pool level at the end of the navigation season to 1337.5 feet msl, 17 feet below the top of the flood control zone, to make room for winter generation releases from the upper reservoirs. The navigation season was shortened by a record 47 days in the 2004 season, as per the new Master Manual. This earlier-than-normal drawdown of the Fort Randall reservoir caused some concern that the city of Oacoma's water supply intake may be "out of the water". These concerns were not realized; the Oacoma water supply intake levels are affected by Big Bend releases and by the "upper pool" created by the White River delta rather than the pool levels at the Fort Randall dam. The earlier-than-normal drawdown of Fort Randall was also coordinated with events commemorating the 200th anniversary of the Lewis and Clark expedition. The start of the drawdown was delayed to avoid lowering the reservoir during the signature event in Chamberlain in late August.

6. Gavins Point Regulation – January to December 2004

a. General

Gavins Point, the most downstream of the System dams, is primarily used as a re-regulating dam to level out the release fluctuations of the upper dams to serve downstream purposes. With a total storage of only 500,000 acre-feet, it provides very little flood control and is generally maintained in a narrow reservoir elevation band between 1205.0 and 1208.0 feet msl. Due to the limited storage, releases from Gavins Point must be backed up with releases out of the upper reservoirs. Gavins Point is the key location in the initiation of release reductions for downstream flood control. Even though it has only a small amount of storage space for flood control, this volume is usually adequate to perform significant downstream flood control by coordinating Gavins Point release reductions with Fort Randall's. Releases greater than the powerplant capacity, near 35,000 cfs, are passed through the spillway.

b. Winter 2004

On January 1, 2004, the System release rate was at 15,000 cfs until January 11 when the releases were stepped up to 16,000 cfs for a day and half, in the anticipation of forecasted cold temperatures. This forecast never materialized so System releases were returned to 15,000 and 14,000 cfs by the 13th and 14th, respectively. System releases were increased to 16,000 cfs on January 17 and increased to 18,000 cfs on January 22, in anticipation of forecasted cold temperatures. The cold temperatures materialized with highs reaching the single digits by January 28. The System release remained at 18,000 cfs until February 2 and 3 when the releases were reduced to 17,000 and 16,000 cfs, respectively. The System release remained at 16,000 cfs through February 8. As the warmer temperatures returned to the lower basin, the System release was reduced in 1,000 cfs increments and held for 3 to 4 days. By February 22, the System release was at 11,000 cfs and was kept at that rate though the end of the month. In early March, following warmer weather and timely localized rains, the System releases were further reduced to 9,000 cfs on March 2 and to 8,000 cfs by March 5, and remained at that level until March 11. Beginning on March 12 releases were increased to 10,000 cfs and were held until the 19th. On March 19, the System release was increased in 2,000 to 3,000 cfs increments on a daily basis until a rate of 21,500 cfs was reached to support the 2004 minimum service navigation season.

The 21,500 cfs release was reached on March 26 and was held for 3 days. Timely rains and high downstream tributary flows allowed the System release to be reduced over the last three days of the March and ending the month at 18,200 cfs.

The Gavins Point average daily release was below the normal winter release rate for the entire winter season. The minimum reservoir level of the period of 1205.8 feet msl occurred on January 30 and February 1. The Gavins Point reservoir was free of ice by March 19.

Table 23 lists the average monthly releases and inflows in cfs and the EOM pool elevation in feet msl for January, February and March for the last three years as well as the averages since the system closed.

Table 23
Gavins Point - Winter Inflows, Releases and Elevations

Year	**January**			**February**			**March**		
	Inflow	Release	Elev.	Inflow	Release	Elev.	Inflow	Release	Elev.
2004	15,400	16,100	1205.8*	14,300	13,700	1207.1	12,800	13,100	1206.3
2003	13,600	13,700	1206.7	13,200	13,300	1206.3	17,400	17,500	1205.9
2002	13,300	13,400	1207.2	13,200	13,600	1206.2	18,100	17,800	1206.8
1967-2004	17,800	17,700	1207.6	17,100	18,000	1205.5	20,700	20,700	1205.4

* monthly minimum of record

c. Winter River and Ice Conditions Below Gavins Point

The Gavins Point winter release rate was varied between 11,000 cfs and 18,100 cfs in January and February. In March the average daily releases ranged between 8,000 and 21,500 cfs. The first 2004 ice reports were made on January 6, when 50 to 80 percent floating ice with pads ranging from 3 - 15 feet in the Sioux City, IA to Nebraska City, NE. A week later on January 11, another round of warm temperatures melted the river ice and the Missouri River was ice-free downstream from Sioux City, Iowa until January 17. Another round of cold weather created ice in the Missouri River from Sioux City downstream to Fort Calhoun, Nebraska, on January 20. The river had 20 - 50 percent floating ice with 5 - 15 foot pads. The largest volume of floating ice for January was made on January 28 and 29, with 50 - 90 percent floating ice and ice pads in the 5 - 25 foot range. Floating ice was reported as far downstream as Glasgow, Missouri. The cold air continued through the February 18. The Missouri River had floating ice reports ranging from 5 - 80 percent with ice pads ranging from 5 - 15 feet in size. The largest reports of river ice in the Kansas City, Missouri reach occurred on February 2 and 3, 2004 with 80 percent floating ice for both days. The ice diminished over the following two weeks and by February 19 no more ice was reported on the Missouri River below Sioux City, Iowa.

d. Spring 2004

Flow support for the 2004 navigation season began on the normal dates: March 23 at Sioux City, March 25 at Omaha, March 26 at Nebraska City, March 28 at Kansas City and April 1 at the mouth near St. Louis. The decision was made, for water conservation purposes, not to support navigation at Sioux City and Omaha in early April since there was no barge traffic in those reaches. System releases ranged from 18,000 to 23,500 cfs in late March and April. This resulted in flows at Sioux City and Omaha ranging from 21,000 to 29,000 cfs. The minimum service levels of 31,000 cfs and 35,000 cfs at Nebraska City and Kansas City, respectively, were met for the entire navigation season. The service level at Omaha was met for the entire except for the first couple weeks of the season.

On May 1 System releases were increased to 27,000 cfs. On May 10 System releases were varied – 25,000 cfs for two days and then 30,000 for one day – to entice the nesting Threatened and Endangered (T&E) species to form their nests on higher ground while conserving as much water as possible while meeting downstream navigation targets. This release pattern was continued through the rest of May. On June 4 a steady release of 30,000 cfs was maintained.

As part of the 2003 Biological Opinion, the Fish and Wildlife Service required that the Corps create 1200 acres of shallow water habitat downstream of Gavins Point Dam by July 1 or maintain the System release at 25,000 cfs. It was collectively determined in mid-June by the two agencies that the 1200 acres of shallow water habitat had been created and the Corps was not limited to a 25,000 maximum System release nor was the navigation season split. By mid-June downstream runoff was sufficient to allow the Corps to reduce System releases to 28,000 cfs.

Table 24 lists the average monthly releases and inflows in cfs and the EOM pool elevation in feet msl for April, May and June for the last three years as well as the averages since the System closed.

Table 24
Gavins Point - Spring Inflows, Releases and Elevations

Year	April			May			June		
	Inflow	Release	Elev.	Inflow	Release	Elev.	Inflow	Release	Elev.
2004	21,600	21,600	1205.8	27,800	27,000	1207.2	28,200	28,600	1205.8
2003	24,700	24,600	1206.0	26,000	26,000	1205.6	26,600	26,000	1206.6
2002	23,000	23,200	1206.2	22,700	22,700	1205.8	24,700	24,900	1204.8*
1967-2004	26,600	26,400	1205.6	30,100	29,800	1205.9	31,400	31,100	1206.2

* monthly minimum of record

e. Summer 2004

Table 25 lists the average monthly releases and inflows in cfs and the EOM pool elevation in feet msl for July, August, and September for the last three years as well as the averages since the System closed.

Table 25
Gavins Point - Summer Inflows, Releases and Elevations

Year	July			August			September		
	Inflow	Release	Elev.	Inflow	Release	Elev.	Inflow	Release	Elev.
2004	27,000	26,100	1207.2	25,300	25,000	1207.3	24,800	24,700	1207.1
2003	25,500	25,500	1206.4	25,100	24,900	1206.4	29,100	28,500	1207.4
2002	25,900	25,500	1205.2	28,600	27,600	1207.2	29,900	29,700	1207.1
1967-2004	34,000	33,500	1206.8	36,200	35,700	1207.4	36,900	36,600	1207.7

* monthly minimum of record

f. Fall 2004

Table 26 lists the average monthly releases and inflows in cfs and the EOM pool elevation in feet msl for October, November, and December for the last three years as well as the averages since the System closed.

Table 26
Gavins Point - Fall Inflows, Releases and Elevations

Year	October			November			December		
	Inflow	Release	Elev.	Inflow	Release	Elev.	Inflow	Release	Elev.
2004	14,500*	14,100*	1207.5	9,400	9,400	1207.6	12,400	12,400*	1207.4
2003	28,300	28,000	1207.6	22,500	22,400	1207.6	13,700	13,700	1207.4
2002	30,000	29,500	1207.8	24,400	24,200	1208.0	12,600	13,000	1207.0
1967-2004	36,300	36,100	1207.8	32,900	32,900	1207.6	19,900	19,900	1207.4

* monthly minimum of record

g. Summary

The highest Gavins Point reservoir level during the 2004 calendar year occurred on September 23 at 1208.6 feet msl. The lowest reservoir level during the 2004 calendar year occurred on May 8 at 1205.2 feet msl. The average monthly inflow to Gavins Point of 19,500 cfs was 69 percent of average. The average monthly release from Gavins Point of 19,300 cfs was 68 percent of average.

D. Non-Routine Regulation and Other Items Pertaining to System Regulation

Numerous regulation activities are performed each year that, although at one time may have been considered special, are now considered routine. These include release restrictions from a particular project for a period of time to permit soundings; to facilitate limited construction within, or adjacent to, the downstream channel; and to pattern releases to facilitate measurements of downstream discharges and water surface profiles. Events that occurred in connection with regulation activities during the past year that may be considered unusual or recently have come to the attention of the Missouri River Basin Water Management Division are discussed in the following paragraphs.

1. Lawsuits

The following paragraphs summarize the litigation cases which either were resolved by means of a final ruling or settlement agreement or which had a direct impact on the regulation of the System in 2004.

a. Multi-district Litigation

On June 21, 2004 Judge Paul A Magnuson issued his decision in 5 of the 6 consolidated cases before his court. The six original consolidated cases are as follows: American Rivers 2003, North Dakota 2002, North Dakota 2003, Blaske Marine 2003, South Dakota 2002, and Nebraska 2002.

The case concerning the Corps' compliance with the Clean Water Act (North Dakota 2003) was dismissed prior to Judge Magnuson's ruling on the five remaining consolidated cases dealing with the Master Manual and ESA compliance, and is now on appeal to the Eighth Circuit.

In his Memorandum and Order concerning the five remaining consolidated cases, Judge Magnuson granted the Corps' and USFWS' Motions for Summary Judgment on the 1944 Flood Control Act (FCA), Endangered Species Act (ESA), and the National Environmental Policy Act (NEPA). He also granted the government's motion for Summary Judgment regarding claims of Blaske Marine and the Mandan, Hidatsa, and Arikara Nations. A flavor of the Court's opinion is set forth in a portion of Judge Magnuson's concluding remarks:

"… The Missouri River cannot be operated in a vacuum, but rather the Corps must consider, evaluate, and balance all interests in its operation of the Missouri River. This obligation is further compounded by the uncertainty of the weather and its unpredictable effect on river conditions. It is inevitable that the Corps' decisions will not be perfect, as evidenced by this extensive litigation. But, the 'standard for agency action is not one of perfection' … Moreover, a guiding principle behind the APA is to 'protect agencies from undue judicial interference with their lawful discretion, and to avoid judicial entanglement in abstract policy disagreements which courts lack both expertise and information to resolve' … While the Court acknowledges the competing interests of the parties, the Court finds that the Federal Defendants have not acted arbitrarily and capriciously throughout their development of the 2004 Master Manual and 2004 AOP. Therefore the 2004 Master Manual and 2004 AOP are valid, and the Corps must operate the Missouri River accordingly …"

In his ruling Judge Magnuson also concluded that the 1944 Flood Control Act does not impose a non-discretionary duty to maintain minimum navigation flows or season length and that the Corps' prioritization of river interests is discretionary and subject to the ESA. Regarding the ESA, the court found that the 2003 Amended BiOp was consistent with the provisions of the ESA and the Corps actions in operating the system did not result in a prohibited take of the listed species. The Court also found that the Corps had complied with the provisions of the National Environmental Policy Act in evaluating and discussing alternative water control plans. Other collateral claims raised by the parties were also denied by Judge Magnuson or ruled moot. In concluding his opinion, Judge Magnuson noted that, "While the Court acknowledges the competing interests of the parties, the Court finds that the Federal Defendants have not acted arbitrarily and capriciously throughout their development of the 2004 Master Manual and 2004 AOP. Therefore, the 2004 Master Manual and 2004 AOP are valid, and the Corps must operate the Missouri River accordingly."

b. Other Litigation

American Rivers and other environmental groups filed a case on July 9, 2004 challenging the actions of the Corps and the USFWS under the Endangered Species Act (ESA). The plaintiffs allege that river operations were not in compliance with the 2003 Amended Biological Opinion with regard to the development of 1200 acres of shallow water habitat. In his decision Judge Magnuson granted the Corps motion for summary judgment and denied the Plaintiff's motion. Their complaint was dismissed without prejudice. In his opinion, he concluded that American Rivers did not provide the 60-day notice required under the ESA and that he did not have jurisdiction. He also found that their claims were moot and that those elements of their claims that are not moot should not be reviewed at this time because they are on appeal. This case, as well as the five consolidated cases involving the 2004 Master Manual and 2004 AOP, and the North Dakota Water Quality case are now pending before the Eighth Circuit, U.S. Court of Appeals.

2. Release of Final Environmental Impact Statement and Revised Master Manual

On March 19, 2004, the Northwestern Division Engineer, Brigadier General William T. Grisoli, signed a Record of Decision approving a revised water control plan for the Missouri River Mainstem Reservoir System. The Final Environmental Impact Statement (FEIS), revised Master Manual, and 2004 Annual Operating Plan were released simultaneously. This event marked the completion of 14 years of study and debate on the long-term management of the System. The selected plan included several changes from the previous Master Manual's water control plan. These modifications included:

- drought conservation measures;
- unbalancing of the upper three reservoirs;
- non-navigation flows, and
- an adaptive management process.

These features are believed to provide the best balance in meeting the contemporary needs of the basin, serve the Congressionally authorized purposes of the System, meet the Corps' treaty and trust obligations to Federally recognized tribes, and comply with other Federal laws including the National Environmental Policy Act (NEPA) and the Endangered Species Act (ESA).

3. Biological Opinion Implementation Activities: Creation of 1200 acres of Shallow Water Habitat

In its 2003 Amended Biological Opinion (2003 BiOp), the U.S. Fish and Wildlife Service (USFWS) recommended a summer flow of no greater than 25 kcfs beginning no later than July 1, 2004 and lasting for a minimum of 30 days. The 2003 BiOp also indicated that when approximately 1,200 acres of new shallow water habitat had been made available (approximately the amount that would be developed through flow management) the Corps, in consultation with the USFWS, could modify flows to take advantage of that habitat and more fully meet project purposes. In response to this element of the Reasonable and Prudent Alternative for pallid sturgeon, the Corps, USFWS, other Federal agencies, and the states of Nebraska, Iowa, Kansas and Missouri successfully constructed more than 1,200 acres of shallow water habitat prior to July 1, 2004. This hard work and unprecedented cooperation ensured that all authorized purposes could be met during the summer, including maintaining minimum flows on the Missouri River without a split navigation season.

4. Fort Peck Mini-Test and Intrasystem Unbalancing

As described in last year's (2004) AOP, the Fort Peck "mini-test" and the unbalancing of the three large upper reservoirs were not implemented due to low System storage. When System storage recovers sufficiently, the Corps anticipates that both these operations will be implemented. The endangered species modified flow "mini-test," which was designed to monitor the effects of higher spring releases and warmer water released from the Fort Peck spillway, requires a reservoir elevation of approximately 2229 feet msl to avoid unstable flows over the spillway. The "mini-test" was not possible in 2004 because reservoir elevations during May and June were approximately 21 feet below the spillway crest elevation of 2225 feet msl.

The MRNRC provided recommended guidelines (Table VII, 2004 AOP) for unbalancing the upper three reservoirs to benefit reservoir fishery and the endangered interior least tern and threatened piping plover. As a result of the continuing drought conditions, low reservoir elevations, and below normal mountain snow pack on March 1, the guidelines did not recommend implementation measures to unbalance the reservoirs.

5. Summary of Drought Impacts

Calendar year 2004 was the fifth consecutive year of drought in the Missouri River basin. After falling below the previous record low in October 2003, System storage continued its downward trend in 2004 setting new record lows throughout the year. It ended the year at 35.2 MAF, 5.6 MAF below the previous record low of 40.8 MAF established in January 1991. Because the bulk of the carryover multiple use storage is in the upper three reservoirs, Fort Peck, Garrison and Oahe reservoirs also continued to set new individual record lows. Impacts of the drought have been felt across the basin. Municipal, rural, industrial, and irrigation water intakes in the reservoirs and along the river reaches have been forced to make modifications to maintain access to the water. Boat ramps have been extended, relocated or closed as the reservoir levels declined. Cold water habitat in the reservoirs has been dramatically reduced threatening the viability of the cold water fisheries. Cultural resources, once covered by water, are now exposed and vulnerable to additional erosion and looting. Noxious weeds have become even more problematic as thousands of acres of bare shoreline appear. Hydropower generation in 2004 was the third lowest on record since the System first filled in 1967, and the 2004 navigation season was shortened a record 47 days.

The only authorized purpose that is not impacted by the drought is flood control, which is actually enhanced during drought conditions. The negative impacts of drought will be felt even after runoff returns to normal because of the time that will be required to refill the evacuated storage. Full service project releases to meet all authorized purposes will not resume until the System storage has recovered to near normal levels, however, as system storage increases, improved service would be provided. On the contrary, if the drought persists, further reductions in service to authorized purposes will occur, and the lower the System storage declines, the more stringent the conservation measures become. Users who rely on the Missouri River need to closely monitor current and forecasted river and reservoir conditions and take necessary steps to ensure they can function through a wide range of river flows and reservoir levels.

6. Special Regulation of Garrison for Bismarck Excursion Boat

Releases were increased from Garrison reservoir for two days in early November 2004 to provide sufficient water for the docking of the excursion boat “Lewis and Clark” in Bismarck. The higher releases also allowed the docking of several boats associated with the Lewis and Clark bicentennial commemoration. The increase from an average daily release of 11,500 cfs to 16,000 cfs resulted in a stage increase of about 1.5 feet in Bismarck.

E. Reservoir Releases and Storage

Reservoir elevations and storage contents of the System reservoirs at the end of July 2004 are presented in ***Table 27*** and the same information for CY 2004 is presented as ***Table 28***.

Table 27
Reservoir Levels and Storages - July 31, 2004

	Reservoir Elevation – feet msl		Water in Storage – 1,000 AF		
	Elevation	12-Month Change	Total	Above Min. Level*	12-Month Change
Fort Peck	2202.4	-9.9	9,357	5,146	-1,593
Garrison	1816.5	-9.6	12,401	7,421	-2,456
Oahe	1574.3	-12.2	10,540	5,167	-2,597
Big Bend	1420.5	+0.7	1,710	28	28
Fort Randall	1353.9	-0.0	3,428	1,911	-6
Gavins Point	1207.2	+0.8	390	69	22
			37,826	**19,742**	**-6,602**

*Net usable storage above minimum reservoir levels established for power, recreation, irrigation diversions, and other purposes.

Table 28
Reservoir Levels and Storages – December 31, 2004

	Reservoir Elevation – feet msl		Water in Storage – 1,000 AF		
	Elevation	12-Month Change	Total	Above Min. Level*	12-Month Change
Fort Peck	2198.9	-7.9	8,829	4,618	-1,220
Garrison	1810.0	-8.4	10,936	5,956	-1,945
Oahe	1575.8	-1.1	10,824	5,451	-225
Big Bend	1420.3	-0.0	1,701	19	-4
Fort Randall	1341.8	-1.4	2,549	1,032	-94
Gavins Point	1207.4	0.0	395	74	0
			35,234	**17,150**	**-3,488**

*Net usable storage above minimum reservoir levels established for power, recreation, irrigation diversions, and other purposes.

F. Summary of Results

1. Flood Control

Releases during 2004 were directed at a continuation of the drought conservation measures and were implemented to conserve System water in storage. The water-in-storage crest was less than the base of the annual flood control zone, and mountain snowpack was below average. The expectation was, therefore, for a much below normal runoff, and water conservation measures were implemented to conserve the remaining storage as much as possible.

The estimated total flood damages prevented by the System during 2004 was less than one million dollars ($720,000). The $720,000 total damages prevented in the Missouri River basin by the System was entirely in the Corps' Kansas City District, which normally has the higher flood damages prevented because of the larger damage centers located on the Missouri River. The damages prevented by the System along the Mississippi River are not yet available. The unindexed flood damages prevented by the System since construction now totals $18.2 billion, the bulk of which was prevented between 1993 and 1999 (see ***Figure 6A***). ***Figure 6B*** indicates the $1.2 billion cost to construct the System dams. Although the System prevents enormous amounts of damage, it is not capable of totally eliminating flooding along the Missouri River. No flood damages were incurred along the Missouri River in the Omaha District in CY2004.

The Kansas City District tributary reservoirs prevented flood damages during this past calendar year. The total damages prevented in the Kansas City District, exclusive of those prevented by the Missouri River System, was $20,512,000.

Figure 7 shows the actual regulated flows that were experienced at Sioux City, Iowa; Nebraska City, Nebraska; and St. Joseph, Missouri and the unregulated flows that would have been experienced if the System and tributary reservoirs had not been in regulation.

2. Irrigation

Federally developed irrigation projects are not being served directly from System reservoirs. Releases from the reservoirs, however, are being utilized by numerous private irrigators as well as Federally financed projects that take water from the river. Over 400 private irrigators have been granted permits to pump directly from the reservoir or river reaches. Releases from the reservoirs during 2004 generally met the needs of irrigators.

3. Water Supply and Water Quality Control

Daily flows generally exceeded minimum requirements for water supply throughout the System during 2004. Intakes, both along the open river and in the reservoir, were adequately served during 2004. The 47-day shortened navigation season resulted in earlier than normal reduced flows in October 2004. The System release was lowered to 12,000 cfs on October 10th and then lowered by 500 cfs increments every 5 or 6 days until the System release was 9,000 cfs on November 15th. The gradual reduction in System release was made to ensure that intakes in the downstream reach from Gavins Point Dam to Kansas City were not adversely impacted.

Intake owners today are generally better prepared to handle periods of low water due to adjustments made to intakes or regulations procedures. The intake owners have made various adjustments to their operations to account for low water levels. Some of these adjustments involve using warm water to keep ice formation from building up on intake screens, installing new pumps, lowering intakes, installing sediment redirection vanes and ice deflectors, obtaining, Blank page for Figure 6A and 6B

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or arranging to obtain, alternate sources of water; and cleaning screens more thoroughly and frequently. While these remedial actions were expensive, they have significantly improved the ability of the intakes to operate at lower river stages.

Record low reservoir levels have resulted in difficulties at several water intakes on the upper three reservoirs. The intake at Fort Yates failed in November 2003 leaving the community without water for several days. The intake, which under normal circumstances is in Lake Oahe, is in river conditions due to the reservoir receding as the pool level declined. The Bureau of Reclamation (BOR) installed a temporary intake and drilled a well at Fort Yates to ensure the community maintains its water supply. The BOR has also lowered the intake at Wakpala on Oahe reservoir. The Corps has used its emergency authority each of the past two years to lower the intake at Parshall on Garrison reservoir. Other intakes that have been identified as having problems or potential problems include Mandaree, Twin Buttes, Mni Waste' and Oacoma.

Figures 8A and ***8B*** show the end-of-July pool elevations for Fort Peck, Garrison, and Oahe plus total System end-of-July storage for 2001 through 2004. An individual table with the maximum, average and minimum end-of-July pool elevations for each reservoir is also shown on ***Figures 8A*** and ***8B***. Each of the three large reservoirs has shown a steady decline in storage over the last four years. All three reservoirs experienced their minimum record pool during 2004. On July 31, 2004 Fort Peck Lake was at elevation 2202.4 feet msl, 9.9 feet lower than at the same time in 2003 and 20.1 feet lower than at the same time in 2001. On July 31, 2004 Lake Sakakawea was at elevation 1816.5 feet msl, 9.6 feet lower than at the same time in 2003 and 17.9 feet lower than at the same time in 2001. Lake Oahe was at elevation 1574.3 on July 31, 2004, 12.2 feet lower than at the same time in 2003 and 34.3 feet lower than at the same time in 2001.

During 2004, the Omaha District conducted long-term, fixed station ambient water quality monitoring at the System projects and the lower Missouri River. Intensive water quality surveys were conducted at Garrison and Fort Peck.

The Omaha District has identified eight priority water quality issues that have relevance to the System projects. These identified priority issues and their relative ranking are (1=highest):

(1) Determine how Division regulation of the Missouri River mainstem dams affects water quality in the impounded reservoir and downstream river. Utilize the CE-QUAL-W2 hydrodynamic and water quality model to facilitate this effort.

(2) Evaluate how eutrophication is progressing in the Missouri River mainstem reservoirs, especially regarding the expansion of anoxic conditions in the hypolimnion during summer stratification.

(3) Determine how flow regime, especially the release of water from Missouri River mainstem projects, affects water quality in the Missouri River.

(4) Provide water quality information to support Corps reservoir regulation elements for effective water quality and aquatic habitat management.

(5) Provide water quality information and technical support to the States in the development of their Section 303(d) lists and development and implementation of TMDLs.

(6) Identify existing and potential water quality problems at District projects, and develop and implement appropriate solutions.

(7) Evaluate water quality conditions and trends at District projects.

(8) Determine how current water quality conditions in the Missouri River (e.g., water temperature, turbidity, etc.) may be affecting pallid sturgeon populations in the Missouri River System.

Table 29 provides a summary of water quality issues and concerns at each of the System reservoirs, based on Omaha District monitoring and a review of current State water quality reports.

Maintaining coldwater habitat in the Garrison reservoir (Lake Sakakawea) during late summer is being compromised by the continuing drought in the interior western United States. If the drought persists and reservoir level continues to drop, it will become increasing more probable that coldwater habitat will not be maintainable in the Garrison reservoir. The pool elevation of the Garrison reservoir is reaching a point where the reduced hypolimnetic volume of cold water, in concert with the degradation of dissolved oxygen in the deeper water of the reservoir, likely will not allow for the maintenance of coldwater habitat through the end of the summer, thermal lake stratification period. Water temperature and dissolved oxygen levels are primary water quality factors that determine the suitability of water for coldwater aquatic life.

The State of North Dakota has determined that reservoir water should be ≤15°C and have dissolved oxygen levels ≥ 5 mg/l to optimally support coldwater fish habitat in the Garrison reservoir. The measured water temperature and dissolved oxygen concentration depth profiles, that were obtain through the intensive surveys conducted at the Garrison reservoir during 2003 and 2004, were used to estimate the volume of water in the reservoir that meets the coldwater habitat conditions as defined by the State of North Dakota. ***Plates 3*** and ***4*** show the reservoir's Class 1 and Class 2 coldwater habitat volumes for 2003 and 2004. Class 2 coldwater habitat is described as water that has temperatures > 15°C and ≤ 18°C and a dissolved oxygen concentration of ≥ 5 mg/l.

Comparatively, the State of Montana has defined in their criteria for growth and propagation of salmonid fishes and associated aquatic life (Class A-1) as dissolved oxygen concentration ≥ 5 mg/l and water temperatures ≤ 67°F (19.4°C). The State of South Dakota has defined in their criteria for coldwater permanent fish life propagation as dissolved oxygen concentration ≥ 6 mg/l and water temperatures ≤ 65°F (18.3°C).

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4. Navigation

The first towboat to enter the Missouri River from the Mississippi River in 2004 was the OMAHA, owned by Sun-DE Transportation and managed by Blaske Marine Service. The towboat entered the Missouri River on March 19, 2004. On April 1, the first official day of flow support for the 2004 navigation season at St. Louis, Missouri, two tows were operating on the river. The first tow to arrive in Sioux City was the DARIAN ADRIAN, of Marquette Transportation, on April 23, 2004. The DARIAN ADRIAN brought up a dredge as far as Sioux City, IA that was later used to construct shallow water habitat near Ponca, NE.

Previous 2002 and 2003 river operations, involving lawsuits and endangered shore birds, impacted reliability. With the continuation of the drought, the navigation industry was again impacted in 2004. On May 3, 2004 the towboat OMAHA left the Missouri River for the last time. Sun-DE Transportation and Blaske Marine Service closed their businesses after 25 years of serving Missouri River navigation. MEMCO towing announced early in 2004 that they would not serve the Missouri River, because of the unreliability of flow on the Missouri River. However, they did make a few opportunistic trips to Brunswick, MO through their contract carrier Marquette Transportation. No commercial products such as grains, cement or asphalt were moved on the river upstream of Kansas City. Only specialized movements went upstream of Kansas City. Besides the dredge movement previously stated there were approximately 10 specialized barge movements during September and October carrying oversized equipment to the MidAmerican Energy Power Station at Council Bluffs, IA for a new power station construction.

The Waterborne Commerce Statistics Center (WCSC) data for 2003 has total Missouri River tonnage at 8.05 million tons of which 7.38 million tons is sand and gravel. The largest total tonnage year is 2001 at 9.73 million tons. The largest long-haul commercial tonnage year, excluding sand, gravel and waterway material, occurred in 1977 when 3.3 million tons were moved on the Missouri River. Tonnages of commodities shipped during 2000 through 2003 are shown in ***Table 30***. ***Figure 9*** shows tonnage of commodities since 1960.

Navigation season target flows for past years are given in ***Table 31***. ***Table 32*** shows the scheduled lengths of past navigation seasons with total tonnage and ton-miles for each year. An 8-month season less 47 days was provided in 2004 as per the criteria in the new Master Manual. This was the shortest navigation season on record since the System first filled in 1967. The navigation season was 31 days shorter than it would have been under the previous Master Manual. The commercial tonnage figure for 2004 is an estimate and will change once final WCSC tabulations are available late in 2005 or early 2006. Missouri River commercial tonnage in 2004 is currently estimated to total about 0.5 million tons, based on daily reports of towboat activity.

Figure 10 presents discharge data at Sioux City, Iowa; Nebraska City, Nebraska; and Kansas City, Missouri for the August 2003 through December 2004 period. The three graphs demonstrate that actual flows at these locations are influenced considerably by System releases. Downstream tributaries upstream of Nebraska City did not provide much inflow during the navigation season. Between Nebraska City and Kansas City, however, tributary inflows did provide additional flow, especially in the months of May, June and July. Refer to Section II.C of this report for further discussion on System releases during the 2004 navigation season.

Table 30
Missouri River Tonnage by Commodities (In Thousands of Tons)

Commodity Classification Group	2000	2001	2002	2003
Farm Products	488	471	352	105
Corn	198	151	126	70
Wheat	21	39	28	15
Soybeans	153	164	167	19
Misc Farm Product	116	117	31	1
Nonmetallic Minerals	7254	8435	7145	7381
Sand/Gravel	7225	8410	7129	7375
Misc Nonmetallic	29	25	16	6
Food and Kindred	42	37	36	23
Pulp and Paper	1	0	0	0
Chemicals	289	334	246	118
Fertilizer	281	328	241	114
Other Chemicals	8	6	5	4
Petroleum (including coke)	256	217	173	213
Stone/Clay/Glass	163	193	189	203
Primary Metals	69	5	13	2
Waterway Materials	165	34	112	5
Other	6	4	0	0
Total Commercial	**8733**	**9730**	**8266**	**8050**
Total Long Haul Commercial	**1343.6**	**1287.6**	**1009.0**	**669.6**

5. Power-Eastern Division, Pick-Sloan Missouri Basin Program (P-S MBP)

The CY 2004 energy generated by basin hydropower units was transmitted over a Federal transmission system traversing 7,745 circuit miles. This past year, service was provided to 365 customers in a 6-state area. Those receiving direct service include 195 municipalities, 1 Federal agency, 33 state agencies, 29 U.S. Bureau of Reclamation projects, 5 irrigation districts, 37 rural electric cooperatives, 7 public utility districts, 31 private utilities, 26 Native American Service Areas, and 1 inter-project sale. Additional benefits were provided by the interconnections to the Southwestern and Bonneville Power Administrations and other areas of the Western Area Power Administration (Western). Statistics from the Omaha Public Power District (OPPD) show that the average customer uses approximately 11,000 kilowatt hours (kWh) of energy annually. Based upon these numbers, the energy generated in CY 2004 by the portion of the Federal power system could have supplied all of the yearly needs of 590,000 residential OPPD customers for a retail valued of about $37 million.

In addition to the clean, renewable energy transmitted to the Midwest area, the hydropower system provides an added measure of stability to the regional power system with the ability to meet full load in 5 seconds or less. Large coal-fired and nuclear units are reinforced by

Figure 9

Table 31

Table 32

Figure 10

idle hydropower units, typically in 30 seconds. Outside utilities can have access to the hydropower capability within several minutes of a known problem. The reliability of the hydropower system is indicated by having to maintain a 10 percent reserve, while thermal power must maintain a 15 percent reserve. Although the Federal hydropower system that serves the Missouri River region accounts for only 9 percent of the region's energy, it is large enough to fill gaps and provide a positive benefit to the integrated system.

Calendar Year 2004 generation of 6.5 billion kWh was 65 percent of average since the System first filled in 1967. Energy generation was below normal due to below normal runoff and below normal releases at all powerplants. Western purchased about 2.8 billion kWh between January 1, 2004 and December 31, 2004 at a cost of $90.5 million to supplement mainstem hydropower production.

Mainstem generation with individual project distribution for each calendar year since 1954 is shown on ***Figure 11***. The gross generation from the Federal system (peak capacity and energy sales) for 2004 is shown in ***Table 33***. The tabulations in ***Table 34*** and ***Table 35*** summarize the total gross generation and power regulation for the Eastern Division, Pick-Sloan Missouri Basin Program (P-S MBP) marketing area system for the past operating year, respectively. Actual settlement figures at the end of the billing periods differ somewhat from the calendar month figures shown.

Table 33
Gross Federal Power System Generation
(January 2004 through December 2004)

	Energy Generation 1,000 kWh	Peak Hour kWh	Generation Date
Corps Power Plants – Mainstem			
Fort Peck	700,155	145,000	5/11&5/18/2004
Garrison	1,568,612	340,000	2/1/2004
Oahe	1,598,228	538,000	6/27/2004
Big Bend	710,893	463,000	3/8&8/24/2004
Fort Randall	1,313,821	351,000	5/2004
Gavins Point	624,130	109,000	5 & 6/2004
Corps Subtotal	**6,515,839**	**1,714,000**	8/24/2004
USBR Powerplants			
Canyon Ferry	346,020	37,000	2 & 3/2004
Yellowtail*	227,215	87,000	12/2004
USBR Subtotal	**573,235**		
Federal System Total	7,089,074		

* Includes only half of total Yellowtail generation, which is marketed by the Eastern Division, P-S MBP.

Figure 11

Tables 34+35

6. Fish Management

Rainbow smelt are the primary forage species in both Garrison and Oahe. Successful rainbow smelt reproduction is dependent on many factors including stable reservoir levels. Most eggs are laid in water less than 1 foot deep and are subject to desiccation through wave action and slight drops in water level. Reservoir levels rose in the spring of 2004 in both Garrison and Oahe reservoirs during the rainbow smelt spawning period. Oahe smelt larval densities were the highest since 1995. Cold water habitat at Lake Sakakawea, helped by the lower than normal temperatures during the summer of 2004, continues to support the rainbow smelt forage base.

7. Threatened and Endangered Species

CY2004 was the 19th year of regulation since the piping plover and interior least tern were Federally listed as threatened and endangered species, respectively. Both bird species nest on sparsely vegetated sandbars, islands, and shoreline of the Missouri River and System reservoirs. Stream gages have been installed on the Missouri River to monitor stream flows during the nesting season. These gages provide a check, as well as a stage history, throughout the season to help relate the effects of regulation and natural events at intervals along the river. The gaging data must be supplemented with observations of nesting activities and conditions to provide the information that is needed for regulation. A dynamic flow routing model has been developed to closely predict maximum river stages along the river for different combinations of daily discharge and hourly power peaking characteristics.

Beginning in 1999, the Omaha District created a computerized Threatened and Endangered Species Data Management System. Report data, which is updated daily, includes nest records, census and productivity data, site descriptions, field journals, and messages. This database provided vital information again during the 2004 nesting season and proved to be a valuable tool in aiding release decisions benefiting threatened and endangered birds. Weekly conference calls between the Corps and the Service were also held during the nesting season.

Although the Corps prevented inundation of nests following the listing, where possible, and accomplished habitat creation, fledging continued to be lower than predicted by the USFWS 1990 Biological Opinion until 1998 when fledge ratios exceeded the goal for both species. Predation, habitat degradation, severe weather, nest inundation, and other factors contributed to the previously disappointing low fledging. The record fledging that occurred for both species in 1998 and the subsequent above average fledge ratios achieved since then can be attributed to the large amount of habitat created by the high flows of 1997. The creation of additional habitat has also allowed greater flexibility in the release levels at the lower two System projects.

During CY2004, the majority of piping plovers were again found on the Garrison and Oahe reservoirs and below Gavins Point Dam. Excellent shoreline habitat existed due to the lower reservoir levels caused by the reduced runoff. A record number of piping plover adults, 1,587, were found on the Missouri River System this year, which yielded a fledge ratio of 1.49 chicks per pair of adults. A total of 722 adult terns nested on the System in 2004. The majority of least terns were found on the Missouri River reaches below Garrison and Gavins Point Dams. Tern nesting also was very successful. The fledge ratio for terns was 0.95 fledglings per pair.

One plover egg was incidentally flooded due to the operations of Gavins Point Dam. To save water in the upper reservoirs while preserving the ability to meet downstream targets, releases were cycled every third day. One plover nest with one egg was laid on the day discharge was low and inadvertently flooded.

Tables 36 and **37** show the population distribution and productivity for terns and plovers for the period of 1986 through 2004. Productivity estimates for these birds on the Missouri River include only natural nesting. Adult birds in this table are considered breeders even though they may not have had nesting success. The term "fledglings/pair" refers to the number of young birds produced per breeding pair. This ratio is an estimate, as the fate of every single fledgling is impossible to obtain.

8. Recreation and Resource Management

The System reservoirs provide outstanding opportunities for boating, fishing, swimming, camping, and other outdoor recreation pursuits. Tourism related to the reservoirs is a major economic factor in all of the states adjoining the mainstem. However, during extended drought periods, such as the Missouri River basin is currently experiencing, recreation is adversely affected. The pool levels at the upper three large-storage reservoirs, Fort Peck, Garrison and Oahe, have been the most affected by the drought. Due to their relatively small size, the lower three reservoirs are operated in a consistent manner year-to-year and are not impacted by the drought. The low pool levels at the upper three reservoirs make boat ramps unusable, expose large areas of beach and sometimes make areas of the reservoirs unreachable. Thus, the low pools adversely affect recreation activities such as boating, fishing, swimming and camping.

During 2004 the Corps spent approximately $600,000 extending and relocating Category 1 and 2 boat ramps (ramps that are owned by the Corps and are operated either by the Corps or other party) to maintain public access where such work was feasible. Of the 10 Corps boat ramps on the Fort Peck reservoir, 8 were in operation for all or most of the 2004 recreation season. At Garrison, 6 of the total 17 Corps boat ramps in 8 recreation areas were available in 2004. In 2002, many of the Federal recreation areas and boat ramps were turned over in fee title to the State of South Dakota through the Title VI process, thus the Corps no longer owns many boat ramps on the Oahe reservoir. Of the 30-plus current or former Corps boat ramps on the Oahe reservoir, 20 were usable throughout all or most of the 2004 recreation season. All three reservoirs also have other private, Tribal and/or State owned boat ramps that have been impacted by the drought. Considerable effort has been required by all parties involved to maintain recreation access to the reservoirs as the drought progresses. However, in some locations it is impossible to extend or relocate boat ramps due to the local topography.

During 2004, public use at these reservoirs totaled 39,904,100 visitor hours, an 8 percent decrease from 2003. Visitor attendance figures at the reservoir projects from 2001 through 2004 are shown in ***Table 38***. ***Figure 12*** displays recreation related visitor hours at each of the six projects for the years 1954 through 2004. Although the drought has had an impact on visitation during the past five years, much of the drop shown is attributed to the South Dakota land transfer mentioned previously. Since the title transfer occurred, the Corps has not collected visitation data consistent with previous years at the recreation sites in South Dakota. The 2004 visitation

Table 36

Table 37

in South Dakota presented reflects water-related use on the reservoirs but not the visitation at the campgrounds that were turned over to the State of South Dakota.

The reporting method was changed from recreation days to visitor hours in 1987, and the reporting period was changed from calendar year to fiscal year in 1989 for all Corps projects. All Corps projects, including those on the Missouri River mainstem, are now reporting visitation using the Visitation Estimation Reporting System (VERS).

Between 2003 and 2006, the nation commemorates the 200th anniversary of the Lewis and Clark Expedition. Because the Corps has management responsibilities on more of the route than any other entity (90%) and because of its Army heritage of exploring and mapping the western United States, the Corps has played a key leadership role in the observance of the Lewis and Clark Expedition Bicentennial. The Corps has worked with other Federal, Tribal, State, and local governments; the National Bicentennial Council, and the Lewis and Clark Trial Heritage Foundation to ensure that adequate facilities and information are available to accommodate the increased visitation, to ensure a safe visitor experience, to protect the natural and cultural resources, and to plan and coordinate commemorative activities.

Table 38
Visitation at System Reservoirs (in Visitor Hours)

Mainstem Project	2001	2002	2003	2004	Percent Change 2003-2004
Fort Peck	6,206,400	5,183,100	5,128,000	5,252,800	+2
Garrison	15,318,200	17,303,600	14,626,600	13,894,500	-5
Oahe	14,308,300	10,242,100	7,933,300	7,140,000	-10
Big Bend	5,057,400	5,706,800	5,701,600	3,433,500	-40
Fort Randall	10,128,400	2,529,800	1,265,500	1,275,400	+1
Gavins Point	8,647,200	8,358,200	8,744,400	8,907,900	+2
System Total	59,665,900	49,323,600	43,399,400	39,904,100	-8

In 2000, the National Council for the Lewis and Clark Bicentennial decided to highlight some of the more nationally significant festivals and events commemorating the journey of Lewis and Clark and the members of the Expedition. The Council designated these significant events as “Signature Events”. These Signature Events are those commemorations that are of nationwide historical significance, have the potential of high visitation, and are multicultural in nature. The year 2004 saw the beginning of the Lewis and Clark Bicentennial Commemorations in the Missouri River basin. There were seven Lewis and Clark Signature Events held; each had a different theme and focus.

The 2004 Missouri Basin Signature Events were as follows: “Three Flags Festival” (St. Louis, MO; March); “Departure from Wood River” (Alton/Hartford/Wood River, Il; May); “The Adventure Begins” (St. Charles, MO; May); “A Journey Fourth” (Kansas City, MO; Atchison, Leavenworth, Kansas City, KS; June/July); “First Council” (Omaha, Fort Calhoun, NE; July/August); “Oceti Sakowin: Remembering and Educating” (Chamberlain, Eagle Butte,

Figure 12

Pierre, Fort Pierre, SD; August/September); and “The Circle of Cultures” (Bismarck, ND; October).

These events were all very well attended from not just local residents but people from all over the United States, Canada, and Europe. Visitation to these multi-day events ranged from a low of 7,500 to a high of 300,000. The Corps participated in these events by offering a variety of venues. The Corps National Lewis and Clark team provided school programs, recreated a Lewis and Clark camp complete with period-uniformed re-enactors, set up and manned several different displays, as well as gave performances and lectures.

Because the original expedition was working its way to the Pacific Coast, there will be only one Signature Event in the Missouri River basin in 2005. That event will be “Explore! Big Sky” (Great Falls, June/July). However, there will be three additional Signature Events in the Missouri Basin in 2006 in Billings, MT, New Town, ND, and St. Louis, MO.