US Army Corps
of Engineers

Northwestern Division
Missouri River Basin
Water Management Division

Missouri River Main Stem Reservoirs

Summary of Actual 2000 - 2001 Operations

February 2002

MISSOURI RIVER MAIN STEM RESERVOIRS

Summary of Actual 2000-2001 Operations

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LIST OF ABBREVIATIONS

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.

MISSOURI RIVER MAIN STEM RESERVOIRS

Summary of Actual 2000 – 2001 Operations

I. FOREWORD

This document contains a summary of the actual operation of the Missouri River main stem reservoirs for the 12-month period ending July 31, 2001. Previously, a comprehensive Annual Operating Plan (AOP) document was prepared that contained three sections. The first section, the blue pages, contained a system description and a discussion of the typical operation to meet authorized purposes. The second section, which this document replaces, reviewed the actual operation for the previous 12 months, through July of the current year. The third section, the yellow pages, presented the tentative plan for operating the reservoirs for the remainder of the current year through December of the following year. In an attempt to reduce reproduction and mailing costs, the AOP has been divided into three separate documents based on the descriptions above. All three reports, "System Description and Operation," "Summary of Actual 2000-2001 Operation," and "Annual Operating Plan, 2001-2002," can be obtained by contacting the Missouri River Basin Water Management Division (formerly the Reservoir Control Center) at 12565 West Center Road, Omaha, Nebraska 68144-3869, phone (402) 697-2676. The reports will also be available on our website at **www.nwd-mr.usace.army.mil/rcc** in early 2002.

A basin map is presented on ***Plate 1*** and the pertinent data table for the Missouri River Main Stem System (System) is shown on ***Plate 2***.

II. REVIEW OF REGULATION FROM AUGUST 2000 THROUGH JULY 2001

A. General. During this period, the Missouri River main stem reservoirs were regulated in accordance with the applicable provisions of the 2000-2001 Annual Operating Plan (AOP), which was discussed and reviewed by representatives of state and Federal agencies as well as 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 2000.

1. January - July 2000. Runoff during the first 7 months of 2000, as shown on ***Table I***, was considerably below normal totaling only 65 percent of normal for the calendar year by the end of July. By late summer, Montana, Wyoming and even much of Nebraska were feeling the effects of severe to extreme drought conditions. The only portion of the basin with moist soil conditions was southern North Dakota and western South Dakota. See last year's AOP for a detailed description of precipitation, snowpack, and runoff patterns for the period January through July 2000.

Table I
Upper Missouri River Basin Runoff
For Calendar Year 2000

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					
	(Historic)								
JAN 2000	248	232	-64	-7	128	199	537	736	736
NORMAL	315	260	10	20	100	35	705	740	740
DEPARTURE	-67	-28	-74	-27	28	164	-168	-4	-4
% OF NORM	79%	89%	-640%	-35%	128%	569%	76%	99%	99%
FEB 2000	319	342	99	84	201	98	1,045	1,143	1,879
NORMAL	365	360	90	50	125	85	990	1,075	1,815
DEPARTURE	-46	-18	9	34	76	13	55	68	64
% OF NORM	87%	95%	110%	168%	161%	115%	106%	106%	104%
MAR 2000	417	680	386	42	179	145	1,704	1,849	3,728
NORMAL	610	1,010	580	220	205	300	2,625	2,925	4,740
DEPARTURE	-193	-330	-194	-178	-26	-155	-921	-1,076	-1,012
% OF NORM	68%	67%	67%	19%	87%	48%	65%	63%	79%
APR 2000	417	367	406	120	179	183	1,489	1,672	5,400
NORMAL	665	1,115	500	145	180	340	2,605	2,945	7,685
DEPARTURE	-248	-748	-94	-25	-1	-157	-1,116	-1,273	-2,285
% OF NORM	63%	33%	81%	83%	99%	54%	57%	57%	70%
MAY 2000	473	635	400	27	222	340	1,757	2,097	7,497
NORMAL	1,120	1,280	320	145	185	275	3,050	3,325	11,010
DEPARTURE	-647	-645	80	-118	37	65	-1,293	-1,228	-3,513
% OF NORM	42%	50%	125%	19%	120%	124%	58%	63%	68%
JUN 2000	737	1,946	285	-115	199	220	3,052	3,272	10,769
NORMAL	1,655	2,715	435	160	180	270	5,145	5,415	16,425
DEPARTURE	-918	-769	-150	-275	19	-50	-2,093	-2,143	-5,656
% OF NORM	45%	72%	66%	-72%	111%	81%	59%	60%	66%
JUL 2000	549	1,062	223	-104	203	131	1,933	2,064	12,833
NORMAL	835	1,815	180	60	135	215	3,025	3,240	19,665
DEPARTURE	-286	-753	43	-164	68	-84	-1,092	-1,176	-6,832
% OF NORM	66%	59%	124%	-173%	150%	61%	64%	64%	65%
AUG 2000	207	236	48	-128	218	91	581	672	13,505
NORMAL	360	625	65	40	115	130	1,205	1,335	21,000
DEPARTURE	-153	-389	-17	-168	103	-39	-624	-663	-7,495
% OF NORM	58%	38%	74%	-320%	190%	70%	48%	50%	64%
SEP 2000	164	143	132	-158	187	97	468	565	14,070
NORMAL	345	470	115	40	110	95	1,080	1,175	22,175
DEPARTURE	-181	-327	17	-198	77	2	-612	-610	-8,105
% OF NORM	48%	30%	115%	-395%	170%	102%	43%	48%	63%
OCT 2000	276	550	143	-320	190	76	839	915	14,985
NORMAL	400	525	70	10	120	75	1,125	1,200	23,375
DEPARTURE	-124	25	73	-330	70	1	-286	-285	-8,390
% OF NORM	69%	105%	204%	-3200%	158%	101%	75%	76%	64%
NOV 2000	253	263	154	20	96	120	786	906	15,891
NORMAL	390	410	65	10	120	75	995	1,070	24,445
DEPARTURE	-137	-147	89	10	-24	45	-209	-164	-8,554
% OF NORM	65%	64%	237%	200%	80%	160%	79%	85%	65%
DEC 2000	237	183	-16	50	77	68	531	599	16,490
NORMAL	335	255	0	10	100	45	700	745	25,190
DEPARTURE	-98	-72	-16	40	-23	23	-169	-146	-8,700
% OF NORM	71%	72%	-4000%	500%	77%	151%	76%	80%	65%
alendar Year Totals									
	4,297	6,639	2,196	-489	2,079	1,768	14,722	16,490	
NORMAL	7,395	10,840	2,430	910	1,675	1,940	23,250	25,190	
DEPARTURE	-3,098	-4,201	-234	-1,399	404	-172	-8,528	-8,700	
% OF NORM	58%	61%	90%	-54%	124%	91%	63%	65%	

2. **August - December 2000.** Dry conditions that persisted during the spring and summer of 2000 continued into August, with August providing only 50 percent of normal runoff. Almost no rainfall fell in the drought stricken portion of the basin, which included Montana, Wyoming, Nebraska and northern Kansas during the period. Some significant precipitation fell in eastern North Dakota and Colorado. Record setting temperatures in Texas crept into the Missouri River Basin and produced much above average basin temperatures for the month.

September temperatures varied for the month with temperatures generally averaging near normal. Precipitation was generally normal in North Dakota, northwestern Montana, southern Wyoming and northern Colorado. Most of the basin, however, experienced much below normal precipitation with 50 to 75 percent of normal precipitation occurring in central Montana, South Dakota, Nebraska, Kansas and Missouri. Runoff for the month was the lowest of the year, only 48 percent of normal.

Most of October was very dry in the drought stricken portion of the upper basin but very wet elsewhere in the basin. Portions of Wyoming and southern Montana averaged only 50 percent of normal precipitation during October but most of North Dakota, Kansas, Nebraska and Colorado were 200 percent of normal or higher. Runoff during October for the reach above Sioux City, Iowa rebounded slightly to 76 percent of normal. Cold temperatures generally prevailed throughout the period with the upper plains averaging 15 degrees below normal in November. Lander, Wyoming set a new record low average monthly temperature of 16.0 degrees F. In Aberdeen, a record snowfall for the month of November occurred at 30.5 inches and both Aberdeen and Williston set new maximum November total monthly precipitation records. November runoff was 85 percent of normal, the highest runoff month since February.

Figure 1 shows the August through October precipitation distribution as a percent of normal. The last Palmer Drought Severity map for the 2000 growing season, dated October 21, 2000, ***Figure 2,*** indicates moderate to extreme drought in north central and eastern Montana and eastern Nebraska and western Iowa.

The cold streak continued into December with temperatures averaging 15 degrees below normal continuing into much of the upper basin. Plains snow pack accumulation during December was light except in the eastern Dakotas, Nebraska and western Iowa where over 20 inches was on the ground in some locations and remained in place due to the much below normal temperatures. Precipitation was less than half of normal except in eastern Dakota, northern North Dakota and northeastern Montana which was near normal to one and one-half times normal.

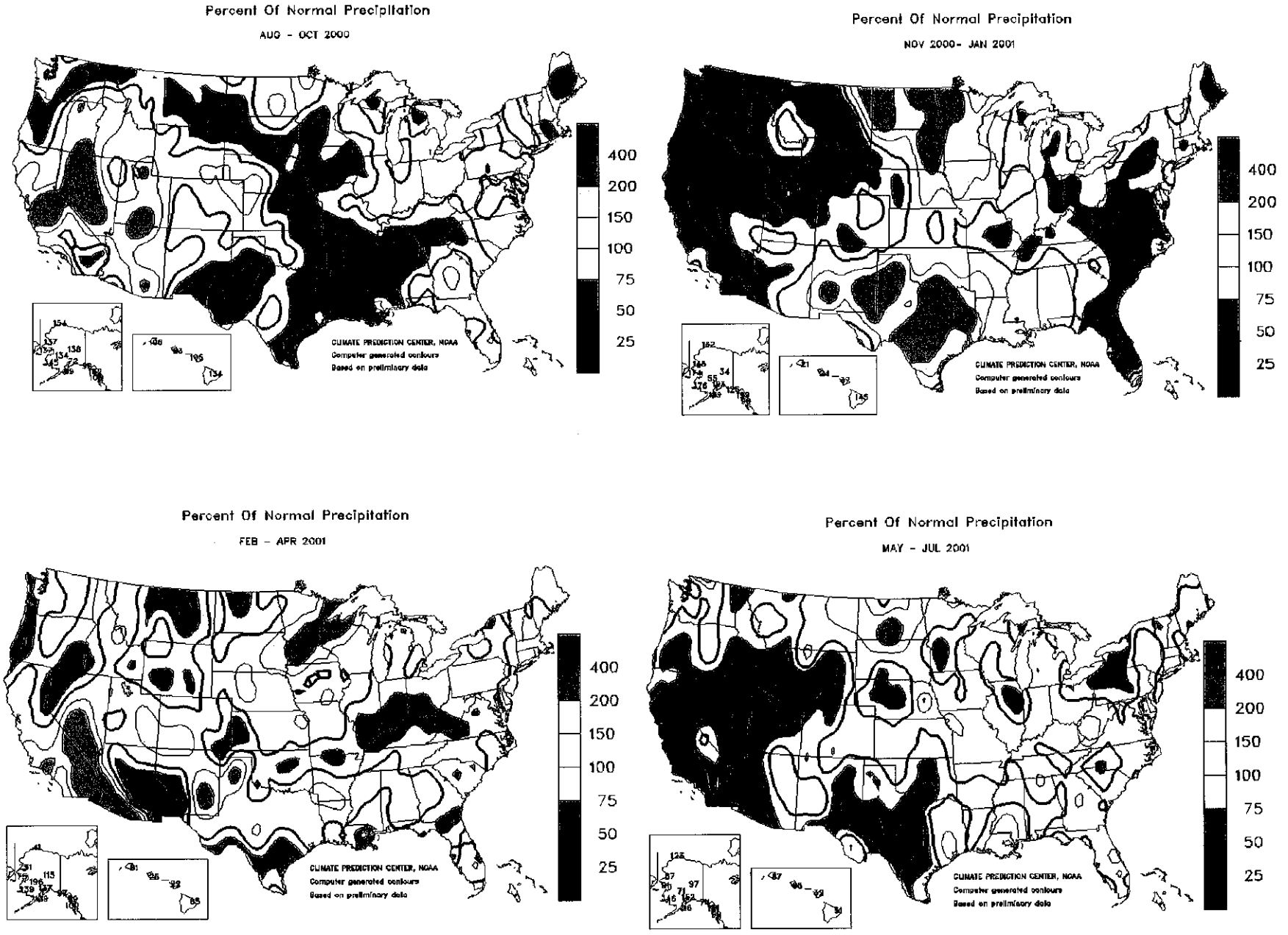
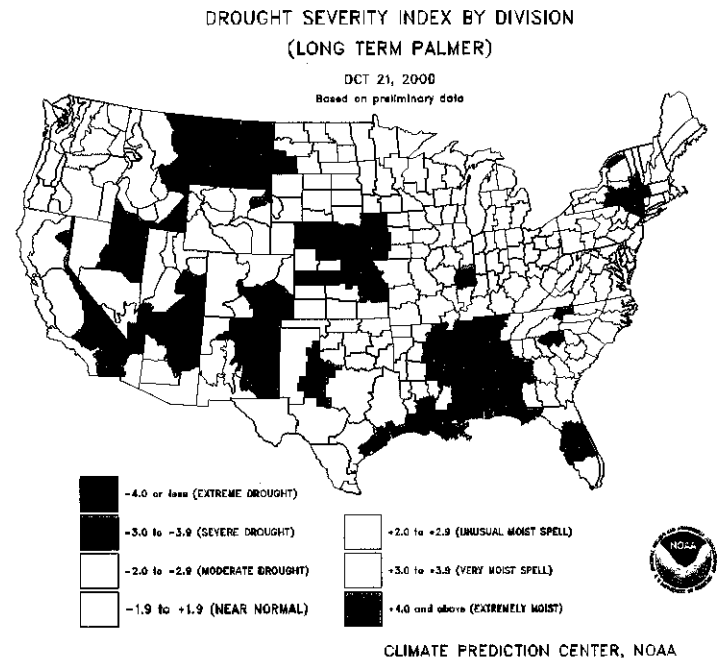
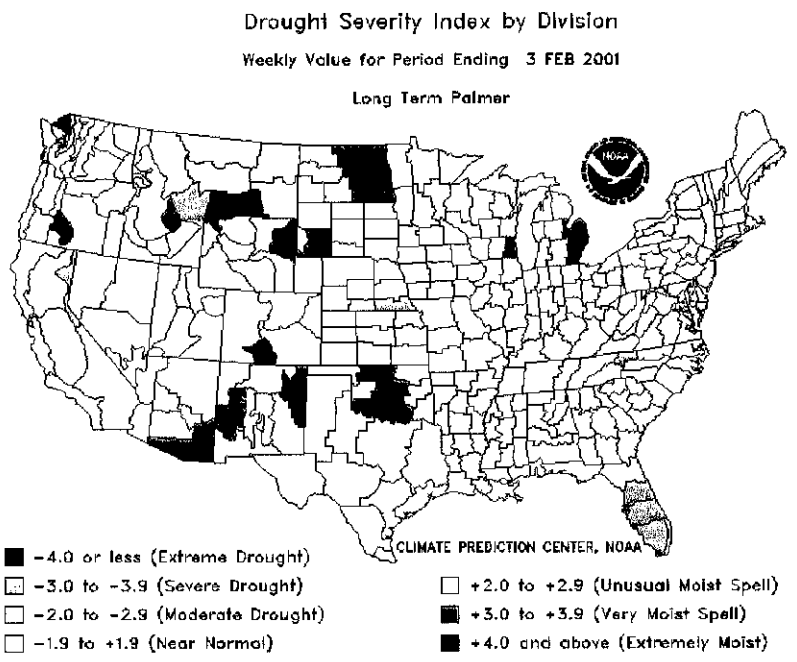
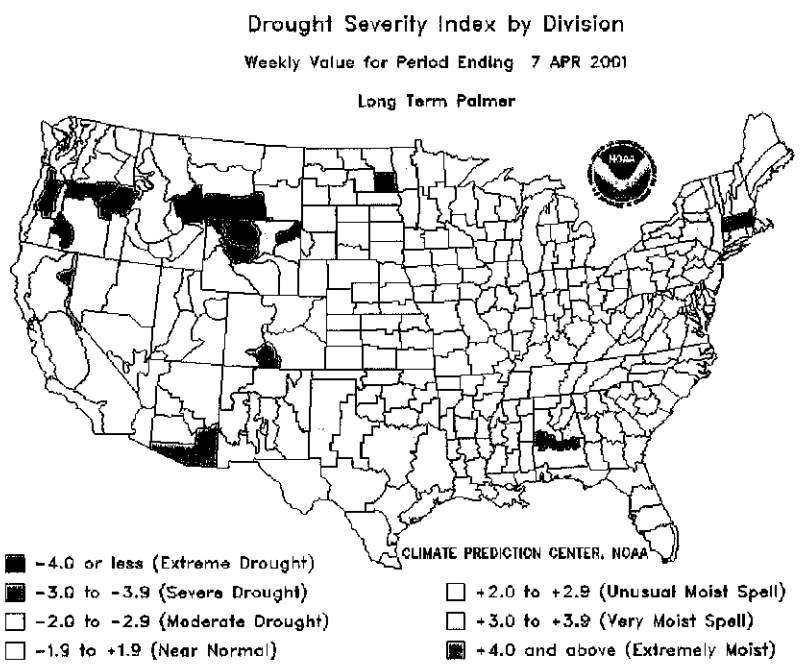

Percent Of Normal Precipitation
AUG - OCT 2000
400
200
150
100
75
50
25
CLIMATE PREDICTION CENTER, NOAA
Computer generated contours
Based on preliminary data
Percent Of Normal Precipitation
NOV 2000- JAN 2001
400
200
150
100
75
50
25
CLIMATE PREDICTION CENTER, NOAA
Computer generated contours
Based on preliminary data
Percent Of Normal Precipitation
FEB - APR 2001
400
200
150
100
75
50
25
CLIMATE PREDICTION CENTER, NOAA
Computer generated contours
Based on preliminary data
Percent Of Normal Precipitation
MAY - JUL 2001
400
200
150
100
75
50
25
CLIMATE PREDICTION CENTER, NOAA
Computer generated contours
Based on preliminary data

Figure 14


DROUGHT SEVERITY INDEX BY DIVISION
(LONG TERM PALMER)
OCT 21, 2000
Based on preliminary data
-4.0 or less (EXTREME DROUGHT)
-3.0 to -3.9 (SEVERE DROUGHT)
-2.0 to -2.9 (MODERATE DROUGHT)
-1.9 to +1.9 (NEAR NORMAL)
+2.0 to +2.9 (UNUSUAL MOIST SPELL)
+3.0 to +3.9 (VERY MOIST SPELL)
+4.0 and above (EXTREMELY MOIST)
CLIMATE PREDICTION CENTER, NOAA


Drought Severity Index by Division
Weekly Value for Period Ending 3 FEB 2001
Long Term Palmer
CLIMATE PREDICTION CENTER, NOAA
-4.0 or less (Extreme Drought)
-3.0 to -3.9 (Severe Drought)
-2.0 to -2.9 (Moderate Drought)
-1.9 to +1.9 (Near Normal)
+2.0 to +2.9 (Unusual Moist Spell)
+3.0 to +3.9 (Very Moist Spell)
+4.0 and above (Extremely Moist)


Drought Severity Index by Division
Weekly Value for Period Ending 7 APR 2001
Long Term Palmer
CLIMATE PREDICTION CENTER, NOAA
-4.0 or less (Extreme Drought)
-3.0 to -3.9 (Severe Drought)
-2.0 to -2.9 (Moderate Drought)
-1.9 to +1.9 (Near Normal)
+2.0 to +2.9 (Unusual Moist Spell)
+3.0 to +3.9 (Very Moist Spell)
+4.0 and above (Extremely Moist)

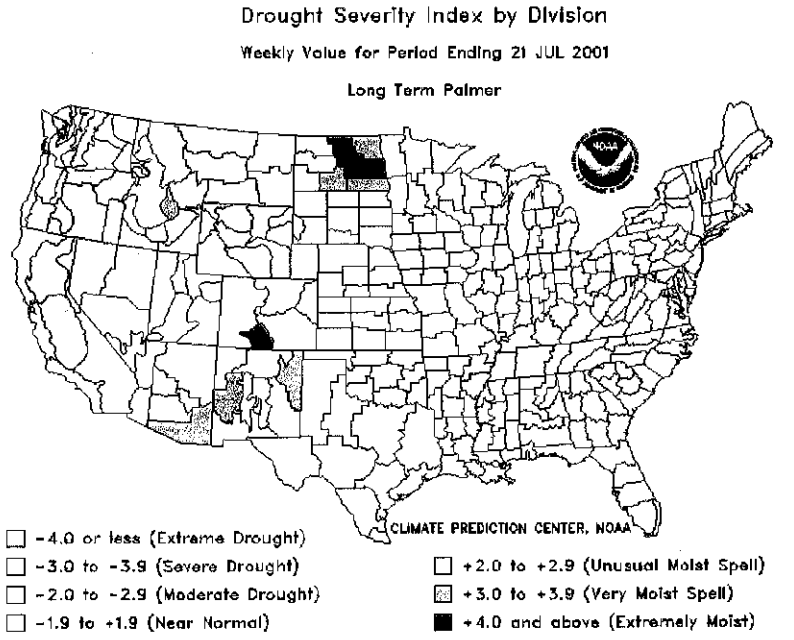

Drought Severity Index by Division
Weekly Value for Period Ending 21 JUL 2001
Long Term Palmer
CLIMATE PREDICTION CENTER, NOAA
-4.0 or less (Extreme Drought)
-3.0 to -3.9 (Severe Drought)
-2.0 to -2.9 (Moderate Drought)
-1.9 to +1.9 (Near Normal)
+2.0 to +2.9 (Unusual Moist Spell)
+3.0 to +3.9 (Very Moist Spell)
+4.0 and above (Extremely Moist)

Figure 2
5

3. **2000 Calendar Year Runoff.** The basin was well in the grips of severe drought during 2000, the annual runoff above Sioux City was only 16.5 MAF, 65 percent of the normal 1898-1998 average. Monthly runoff ranged from a high of 106 percent of normal in February to a low of 48 percent of normal in September as shown on ***Table I***. This table is prepared on the first of each month to indicate the historic and forecasted runoff for the year. The 2000 annual runoff at Sioux City is shown in historical perspective on ***Figure 3***, and ***Figure 4A*** displays the monthly distribution of runoff for 1999 and compares it with the 1898-1998 average.

The distribution of annual runoff in the six reaches above Sioux City varied from a low of 54 percent of normal in the Fort Randall reach, to a high of 124 percent of normal in the Gavins Point reach. Annual runoff in the Fort Peck and Garrison reaches was considerably below normal at 58, and 61 percent of normal, respectively. The Oahe and Sioux City reaches were 90 and 91 percent of normal, much closer to normal like the Gavins Point reach. These reaches were not affected by runoff from the below normal mountain snowpack. The 2000 annual reach runoff, expressed as a percentage of the historic 1898-1998 average, is presented in ***Table II***.

TABLE II
2000 CALENDAR YEAR RUNOFF FOR SELECTED REACHES
(In 1,000 Acre-Feet)

Reach	1898-1998 Normal Runoff-Volume	Calendar Year 2000 Runoff-Volume	Percent of Normal Runoff
Above Fort Peck	7,395	4,297	58
Fort Peck to Garrison	10,840	6,639	61
Garrison to Oahe	2,430	2,196	90
Oahe to Fort Randall	910	-489	-54
Fort Randall to Gavins Point	1,675	2,079	124
Gavins Point to Sioux City	1,940	1,768	91
TOTAL ABOVE SIOUX CITY	25,190	16,490	65
Sioux City to Nebraska City	7,760	4,920	63
Nebraska City to Kansas City	12,350	3,420	28
Kansas City to Hermann	24,560	8,690	35
TOTAL BELOW SIOUX CITY*	44,670	17,030	38

* Reaches from Sioux City to Hermann are not adjusted to 1949 depletions. Averages are taken from USGS Water-Data Reports for the period 1967-2000

Missouri River Main Stem
Annual Runoff at Sioux City, Iowa

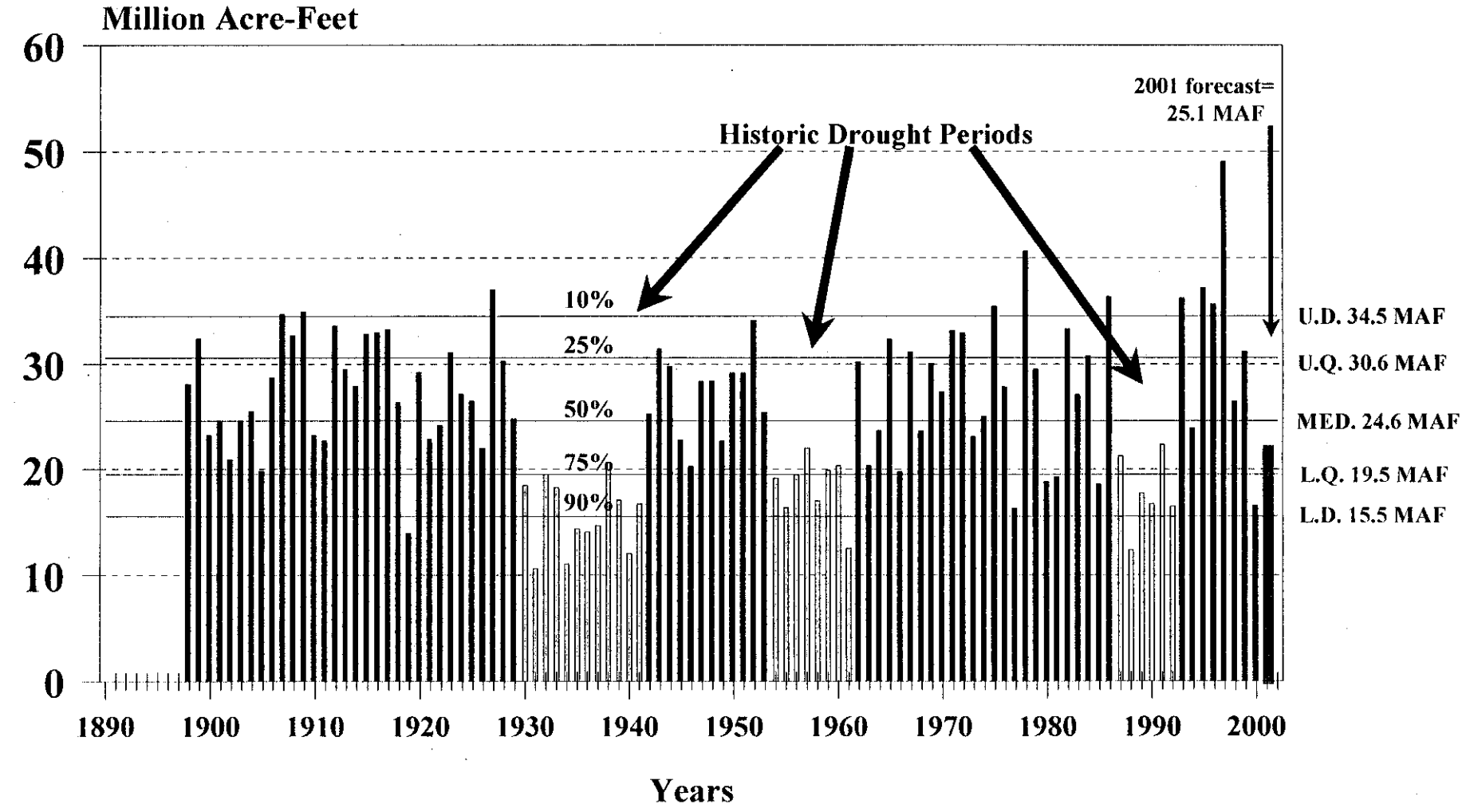


Figure 3
7

2000 Missouri River Runoff
Above Sioux City, Iowa

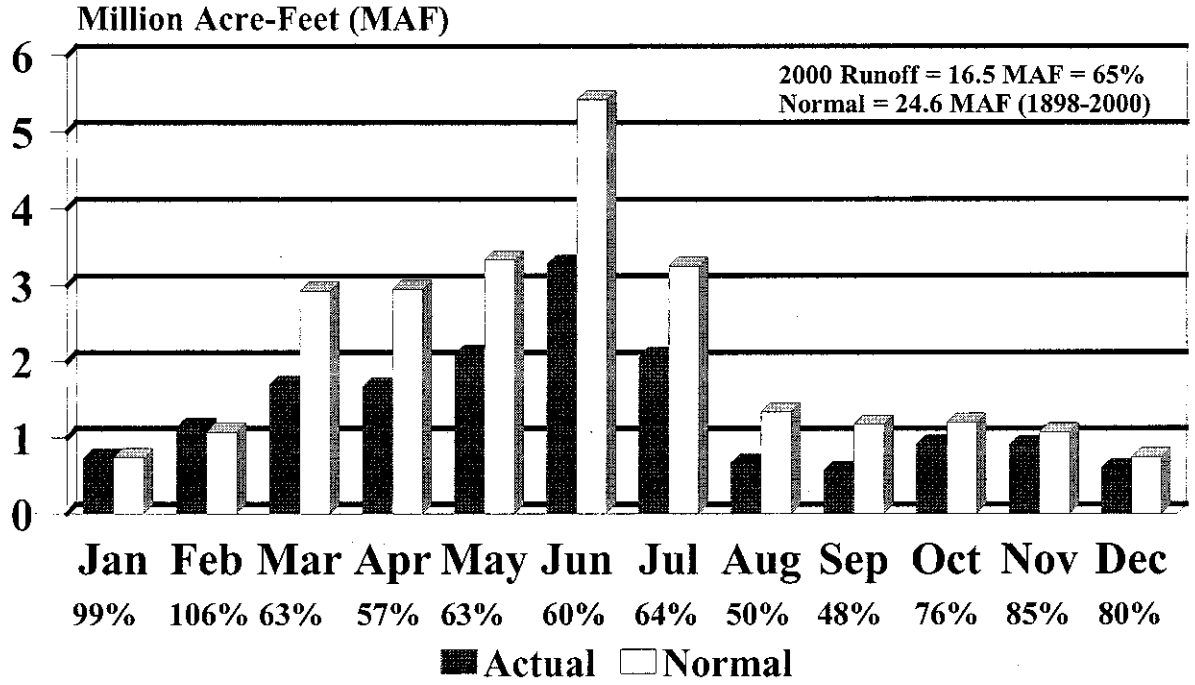


Figure 4A

2001 Missouri River Runoff
Above Sioux City, Iowa

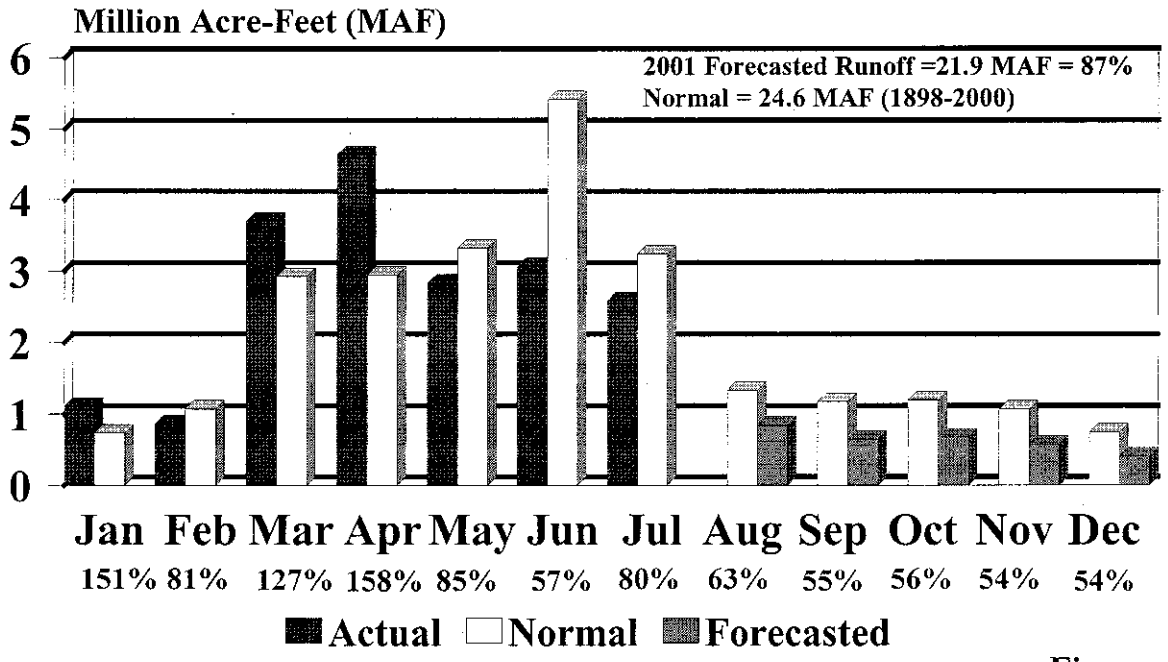


Figure 4B

C. Precipitation and Water Supply Available in 2001.

1. Plains Snowpack 2000-2001. The winter of 2000-2001 was extremely cold in most basin locations. Temperatures during the November to February period were generally 8 to 12 degrees below average throughout the basin. Springfield, Missouri and Des Moines, Iowa experienced the snowiest December on record. The eastern portion of the basin was receiving very heavy plains snow during December. Unlike last winter, the temperatures remained considerably below normal which allowed the plains snowpack to remain intact.

The first significant snow of the 2000-2001 winter season came in late October and the above normal snows continued in the northern and eastern portion of the basin through November. In Aberdeen, a record snowfall (30.5 inches) for the month of November occurred and both Aberdeen and Williston set new maximum November total monthly precipitation records. A trio of winter storms which began during the second week in December left an extensive snow cover across the whole Midwest ranging from 6 to 15 inches in depth. To the south of the Missouri River basin over 4 inches of rain fell and eased the long term drought for that region. The middle of December brought continued extreme cold and some continued accumulation to plains snowpack with the cornbelt averaging from 1 to 2 feet of snow. Springfield, Missouri experienced a low of 10 degrees F on December 22, the fourth lowest December reading in 113 years of record. Wichita, Kansas temperatures fell below 10 degrees F on 8 days from December 1 through December 23, their greatest total in the past ten years. All the cold temperatures did result in significant ice building and the associated problems that accompany ice formation in the river. At the close of 2000 another round of storms struck the basin, capping off a month of record accumulations at some locations and the snowfall was accompanied by a continuation of the much below normal temperatures, which maintained the snowpack. The upper basin had snow depths from 8 to 16 inches and further east even greater accumulations existed. With the much below normal basin temperatures, a plains snowpack even existed in Kansas and Missouri which does not normally persist. Iowa had over two feet of snow accumulation over much of the state.

The new year began with normal temperatures and some minor snow accumulations on the plains. By mid-month, the temperatures had warmed slightly especially in the north, but an extensive snow cover still existed. At month's end, the whole basin had a plain's snowpack with some of the greatest depths in Kansas (over 7 inches) and Iowa (over 10 inches). The snowpack in the Dakotas had mainly just consolidated. No significant runoff occurred even though the actual snow depths reported were not significant except in east central North Dakota (over 10 inches).

February's weather began with blizzard conditions over a significant portion of the basin. The conditions persisted and livestock was stressed and travel was restricted by the storms. Over 25 inches of snow existed in eastern South Dakota by February 5. During mid-month, bitterly cold weather preceded snow and freezing rain as temperatures dropped to –30 degrees F in portions of Wyoming. Snow accumulated again in the southern portion of the basin and in the northern portion totals reached as high as 30 inches in eastern South Dakota. The following week was very cold and just after mid-month, Huron, South Dakota's snow depth broke a 38-year old

record by reaching 30 inches on February 9 and climbed to 36 inches on February 25. This made their winter season snowfall total 80.7 inches exceeding the 77.7 inch previous record which occurred in 1962. This was the second snowiest February on record in Aberdeen, South Dakota with 21.0 inches compared to the 1969 total of 25.1 inches. The month ended with a warming trend that consolidated and reduced some of the plains snow depth.

Temperatures were above normal in much of the basin except where significant plains snowpack existed which held temperatures about 6 degrees below normal in the eastern Dakotas through central Iowa. Elsewhere by mid-month most of the plains snow had melted and was producing above normal runoff. By the last week of March only the eastern Dakota's had a plains snowpack, which in South Dakota still remained well over 10 inches. Des Moines had a one inch or greater snow cover from mid-December through March 19th for 99 days, breaking a previous record of 90 days. Aberdeen and Sioux Falls, South Dakota had a one inch or greater snow cover for 144 and 141 days consecutively (from mid-November to late March) breaking the old record of 125 consecutive days. Several late snows during April added to the significant accumulation of plains snow in the eastern Dakotas. A late snow in April brought Huron, South Dakota's seasonal snowfall to 89.6 inches which exceeded the previous record of 77.7 inches in 1961-1962. Most of the remaining plains snowpack melted during late March and April and resulted in very high flows in the James and Big Sioux river basins. The extra runoff helped alleviate the low storage situation in the System by allowing very low system releases for an extended time period.

2. **Mountain Snowpack 2000-2001.** Mountain snowpack in the Missouri River basin was well below normal throughout the winter of 2000-2001. On December 1, the snowpack was nearly normal in the reach above Fort Peck Dam but much below normal in the reach between Fort Peck and Garrison Dams.

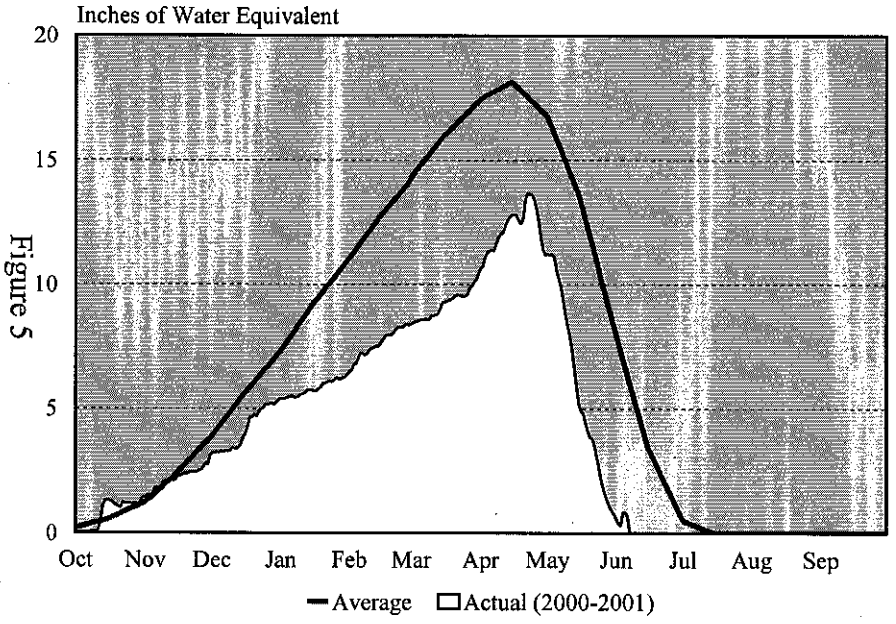
By January 1, both reaches actually gained but were still much below normal. Mountain snowpack in the Fort Peck reach was at 74 percent of normal, and the Garrison reach was at 66 percent of normal. Both reaches continued to accumulate at much less than a normal rate during all of January and February and, by March 1, were at 61 and 57 percent, respectively. In March a more normal pace of mountain snowpack accumulation occurred and by April 1 the snowpack in the two reaches was at 62 and 61 percent, respectively.

During April, the accumulation of mountain snowpack accelerated as significant storms occurred which did cause an improvement in Mountain snowpack accumulation. As a result, the peaks were just slightly later than the normal April 15th accumulation peak date. The Fort Peck reach peaked at 75 percent of the normal peak accumulation on April 22, 2001, and the reach between Fort Peck and Garrison peaked at 69 percent of the normal peak accumulation on April 17, 2001.

Above normal temperatures started the melt in early April and except for a small period of additional snow accumulation in late May, the snowmelt proceeded uneventfully and was essentially complete in late June. The 2000-2001 snow accumulation and melt are illustrated in ***Figure 5***.

Mountain Snowpack Water Content
Missouri River Basin
Winter 2000 - 2001

Total Above Fort Peck



Total Fort Peck to Garrison

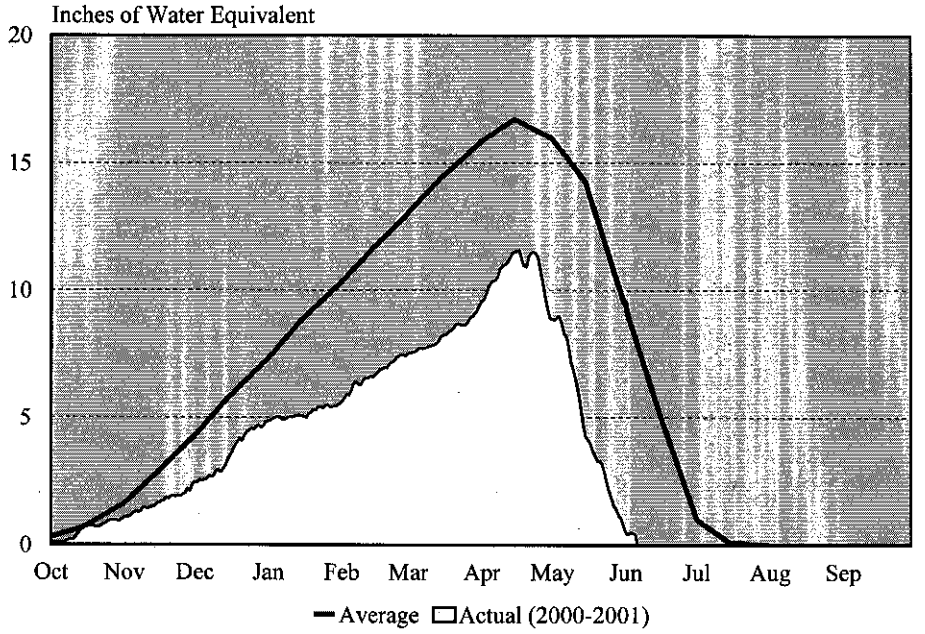


Figure 5
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Snowpack peaked on April 22, 2001 at 75 percent of the normal peak accumulation in the reach above Fort Peck, and at 69 percent of the normal peak accumulation in the reach between Fort Peck and Garrison

3. **January - July 2001.** Runoff during January through July of 2001 was basically normal but quite variable. Dry soil conditions persisted through the early winter into January following a pattern of drought in east central Montana and most of Wyoming. Extremely dry conditions also existed in Nebraska, northern Kansas and western Iowa. All of South Dakota and North Dakota were generally moist or slightly above average due to the above normal plains snowpack. The Palmer Drought Index map dated February 3, 2001 indicates the status of the below normal runoff areas in the Missouri River Basin in ***Figure 2***. As discussed previously, the plains snowpack generally was below normal except in the eastern Dakotas where it was heavy. Winter precipitation in most of the basin was either average or much above average except in the drought stricken areas of Montana and Wyoming where there continued to be below normal precipitation during the winter. ***Figure 1*** shows the November through January precipitation as a percent of normal.

Temperatures in March continued to average 4 to 8 degrees below normal resulting in continuous snow cover of one inch or more for record lengths of time as previously mentioned. Precipitation varied widely, from less than half of normal for all of the Dakotas, Wyoming and most of Nebraska to 150 percent of normal in parts of Iowa, Missouri and Kansas. The Palmer Drought Index map dated April 7, 2001, ***Figure 2,*** indicates normal to moist soil conditions throughout most of the basin except for the moderate drought conditions in Montana and part of Wyoming.

April air temperatures soared near month's end to as high as the 90's in Montana, and as a result, melted all but the heaviest plains snowpack in the central and eastern Dakotas. Three April snowstorms dumped record snowfalls into the upper plains areas contributing towards several monthly precipitation records. Sioux Falls precipitation totaled 6.97 inches during April, eclipsing the previous record of 5.98 inches in 1935 and greatly exceeding the normal of 2.52 inches. Huron, South Dakota also had a record 6.64 inches of precipitation during April, exceeding the previous record of 6.17 inches established in 1896. The extra runoff produced by the melt of the heavy plains snowpack resulted in significant flows in the James and Big Sioux rivers beginning in late March and extending through May. The much above normal flows were utilized to offset releases from the System, further preserving System storage for later use by other project purposes.

Moisture conditions during April and May in much of the basin changed to abnormally moist for the eastern half of the Dakotas, all of Iowa, eastern Nebraska, northern Missouri and most of Kansas. However, the drought in Montana and Wyoming began expanding much like the previous year. Montana in particular received only 0.5 inches or less of rain over a large portion of the basin. Precipitation for May was only 50 percent of normal over Montana and

Wyoming but over 200 percent of normal in eastern Nebraska, central Kansas and western Iowa. The states of North and South Dakota and Nebraska were essentially divided in half with the eastern half of each state receiving much above normal precipitation and the western half, much below normal precipitation. Portions of Iowa and Nebraska received over 8 inches of rain for the month. Temperatures for the month of May were generally 2 degrees above normal. ***Figure 1*** shows the February through April 2001 precipitation as a percent of normal.

In June, western Missouri and eastern Kansas experienced much above normal precipitation. Kansas City's rainfall totaled 11.86 inches for the month of June, exceeding their June 1939 record of 10.99 inches. Temperatures in June generally averaged 3 to 10 degrees below normal but, as in May, daily temperatures fluctuated wildly throughout the basin.

Temperatures in July ranged from 2 to 8 degrees above normal over most of the basin. In mid-July rainfalls of 2 inches over Nebraska and Kansas produced relief from the above normal temperatures experienced during the month. Precipitation during July was over 200 percent of normal over Montana, North Dakota and northern South Dakota. In Montana, rains of over 4 inches for the month were offset by the very low runoff produced by the much below normal mountain snowmelt. Drought in Wyoming continued to expand and worsen as only 25 percent of normal precipitation occurred during July.

The Palmer Drought Severity map dated July 21, 2001, is shown in ***Figure 2***. As indicated, moderate to extreme drought conditions stretched from Montana through Wyoming. The severity of the drought indicates a worse condition than the previous year for the affected areas. However, much more of the basin was affected by drought the previous year (2000) so the aerial extent of the drought was much less in 2001 (only parts of Montana and Wyoming). In contrast, a large portion of North Dakota and the north central portion of South Dakota experienced significant moisture surpluses.

4. <u>2001 Calendar Year Runoff</u>. Runoff for the period January through July 2001 totaled 19.4 million acre-feet (MAF), 99 percent of the 1898-1998 normal. Monthly runoff above Sioux City varied from a low of 63 percent of normal in July to approximately 155 percent of normal in January and April. The August 1 forecast for CY 2001 runoff is 20.0 MAF, 87 percent of normal and 3.2 MAF below the 1898-1998 average, as shown in ***Figure 4B***.

The historic and forecasted monthly runoff for CY 2001 from Fort Peck downstream to Sioux City by major reach are presented in ***Table III***. The table describes the annual runoff by month and is the basic compilation of the month-by-month runoff in the upper basin by reach. This forecast forms a basis for intrasystem balancing of storage accumulated in the projects and is used by the Missouri River Basin Water Management Division on the first of each month to forecast the runoff for the remainder of the year. The monthly accumulation of actual runoff through July and the forecasts through December are shown under the "Summation above Sioux City" column. As the season progresses and the actual runoff accumulates, the forecast becomes more reliable. The majority of the annual runoff has normally occurred by the end of July and the remainder of the year can be estimated with a fair degree of accuracy.

Table III
Upper Missouri River Basin Runoff
For Calendar Year 2001
Historic and Forecasted

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					
	(Historic)								
JAN 2001	313	348	146	67	157	83	1,031	1,113	1,113
NORMAL	313	260	10	20	100	35	703	738	738
DEPARTURE	0	88	136	47	57	48	328	376	376
% OF NORM	100%	134%	1463%	335%	157%	236%	147%	151%	151%
FEB 2001	234	263	117	46	92	115	752	866	1,979
NORMAL	365	360	90	50	125	85	990	1,075	1,813
DEPARTURE	-132	-97	27	-4	-33	30	-239	-209	167
% OF NORM	64%	73%	130%	91%	74%	135%	76%	81%	109%
MAR 2001	392	1,054	1,085	375	360	436	3,266	3,702	5,682
NORMAL	610	1,010	580	220	205	300	2,625	2,925	4,738
DEPARTURE	-218	44	505	155	155	136	641	777	944
% OF NORM	64%	104%	187%	170%	176%	145%	124%	127%	120%
APR 2001	314	734	542	554	436	2,060	2,579	4,639	10,320
NORMAL	665	1,115	500	145	180	340	2,605	2,945	7,683
DEPARTURE	-352	-381	42	409	256	1,720	-26	1,694	2,638
% OF NORM	47%	66%	108%	382%	242%	606%	99%	158%	134%
MAY 2001	417	526	168	234	247	1,242	1,593	2,835	13,155
NORMAL	1,120	1,280	320	145	185	275	3,050	3,325	11,008
DEPARTURE	-703	-754	-152	89	62	967	-1,457	-491	2,147
% OF NORM	37%	41%	53%	162%	134%	451%	52%	85%	120%
JUN 2001	547	1,238	357	116	129	687	2,386	3,072	16,227
NORMAL	1,655	2,715	435	160	180	270	5,145	5,415	16,423
DEPARTURE	-1,108	-1,477	-78	-45	-51	417	-2,759	-2,343	-195
% OF NORM	33%	46%	82%	72%	72%	254%	46%	57%	99%
JUL 2001	453	1,026	426	29	187	464	2,122	2,586	18,813
NORMAL	835	1,815	180	60	135	215	3,025	3,240	19,663
DEPARTURE	-382	-789	246	-31	52	249	-903	-654	-850
% OF NORM	54%	57%	237%	49%	138%	216%	70%	80%	96%
	(Forecast)								
AUG 2001	180	300	90	25	100	150	695	845	19,658
NORMAL	360	625	65	40	115	130	1,205	1,335	20,998
DEPARTURE	-180	-325	25	-15	-15	20	-510	-490	-1,340
% OF NORM	50%	48%	138%	63%	87%	115%	58%	63%	94%
SEP 2001	170	230	100	25	65	55	590	645	20,303
NORMAL	345	470	115	40	110	95	1,080	1,175	22,173
DEPARTURE	-175	-240	-15	-15	-45	-40	-490	-530	-1,870
% OF NORM	49%	49%	87%	63%	59%	58%	55%	55%	92%
OCT 2001	200	310	40	5	70	50	625	675	20,978
NORMAL	400	525	70	10	120	75	1,125	1,200	23,373
DEPARTURE	-200	-215	-30	-5	-50	-25	-500	-525	-2,395
% OF NORM	50%	59%	57%	50%	58%	67%	56%	56%	90%
NOV 2001	200	220	35	5	70	45	530	575	21,553
NORMAL	390	410	65	10	120	75	995	1,070	24,443
DEPARTURE	-190	-190	-30	-5	-50	-30	-465	-495	-2,890
% OF NORM	51%	54%	54%	50%	58%	60%	53%	54%	88%
DEC 2001	180	130	0	5	60	30	375	405	21,958
NORMAL	335	255	0	10	100	45	700	745	25,188
DEPARTURE	-155	-125	0	-5	-40	-15	-325	-340	-3,230
% OF NORM	54%	51%	0%	50%	60%	67%	54%	54%	87%
				Calendar Year Totals					
	3,599	6,379	3,107	1,485	1,973	5,415	16,543	21,958	
NORMAL	7,393	10,840	2,430	910	1,675	1,940	23,248	25,188	
DEPARTURE	-3,794	-4,461	676	575	298	3,475	-6,705	-3,230	
% OF NORM	49%	59%	128%	163%	118%	279%	71%	87%	

D. System Operations.

1. System Operational Objectives - August 2000 to July 2001. Even with below normal runoff during the first half of 2000, the July 1 System storage check was above the level needed to provide a full length navigation season according to the guidelines in the Missouri River Main Stem Master Water Control Manual (Master Manual). The 2000 peak System storage, 57.7 MAF on March 19, 2000, was under the average peak of 62.6 MAF, and 14.0 MAF lower than 1997's peak storage. Runoff into the System during the late summer and fall remained below average. In accordance with the 1999-2000 AOP and based on the actual 57.0 MAF July 1 System storage, an 8-month navigation season with reduced service flows was scheduled for the remainder of the 2000 navigation season.

System storage declined to 54.4 MAF on September 1, 2000, 3.6 MAF under the amount needed to provide full service support to the power function during the winter season. According to the guidelines in the Master Manual, below average winter releases from the system were required to facilitate water conservation. Runoff into the System averaged 98 percent of normal for the period October 2000 through January 2001. System storage was reduced from 51.0 MAF on November 1, 2000 to 49.5 MAF on January 31, 2001. With February runoff at 82 percent of normal, system storage held steady at 49.5 MAF, 7.6 MAF below the desired 57.1 MAF top of the carryover multiple use zone, on March 1, 2001.

Support for the 2001 navigation season was in accordance with the plan presented in the 2000-2001 AOP. The plan included a normal season opening date with reduced service flows and a season length based on July 1 System storage. Flow support for the 2001 navigation season began on 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 of the Missouri River near St. Louis.

On April 1, System storage stood at 51.8 MAF, 5.6 MAF lower than the previous year. System storage made slight to moderate gains during two runoff periods in 2001. The plains snowmelt produced a March-April runoff of 8.4 MAF, higher than the normal 5.9 MAF inflow. Runoff from May, June, and July was 3.0 MAF, 3.4 MAF, and 2.5 MAF, respectively. Normal for that same time period is 3.3 MAF, 5.4 MAF, and 3.2 MAF, respectively. End-of-month System storage was 53.9 MAF for May, 54.7 MAF for June, and 54.6 MAF for July. System storage peaked at 54.7 MAF on July 5, 2001, 3.0 MAF lower than the 2000 peak. The end-of-July storage was 7.4 MAF below average.

Energy generation at the six main stem powerplants totaled 7.0 billion kilowatt hours (kWh) for the period August 1, 2000, to July 31, 2001, 3.2 billion kWh below the average since the System first filled in 1967. The below normal generation was due to the drought conservation during the winter.

2. Fort Peck Operation - August 2000 to July 2001. Fort Peck Reservoir, the third largest Corps of Engineers storage reservoir, serves all authorized purposes. Fort Peck's primary functions are: (1) to capture the mountain and plains snow and localized rainfall runoffs from the large drainage area above Fort Peck Dam. Captured floodwaters are metered out at

controlled release rates to meet the main stem 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 operations, thus helping to alleviate large pool increases in Garrison, Oahe, and Fort Randall projects; and (3) to provide the extra water needed to meet all main stem authorized purposes which draft storage during low water years.

Late Summer and Fall 2000. Fort Peck releases were below normal during the period, averaging 9,100 cubic feet per second (cfs) in August, 6,100 cfs in September, 5,000 in October, and 6,200 cfs in November. The releases for August through November were 1,600, 3,500, 3,900, and 3,100 cfs below average, respectively. Fort Peck pool elevation started the period 2.0 feet below the annual flood control and multiple use zone at 2232.0 feet above mean sea level (msl), 5.6 feet lower than a year earlier. The pool declined to elevation 2228.0 by the end of November, 6.0 feet below the annual flood control and multiple use zone and 8.5 feet below the previous year.

Winter 2000-2001. Fort Peck releases averaged 9,700 cfs for December, 11,300 cfs for January and 9,600 cfs for February. The project releases were increased from the 8,000 to 9,500 cfs on December 2, 2000 to prevent ice jam flooding during the winter freeze-in period on the Missouri River downstream from Fort Peck Dam. The freeze-in occurred around December 11, 2000 and once the ice conditions downstream stabilized, the releases were increased from 9,500 to 10,000 cfs on December 26, 2000. On January 5, 2001, the project releases were increased to 11,500 cfs and then were reduced on February 3, 2001 from 11,500 to 9,500 cfs. These changes were required for intrasystem storage balance and downstream flood control. This winter's daily releases were below the monthly average for a third consecutive year. December, January, and February average daily releases were 400, 200 and 2,500 cfs below average, respectively.

The Fort Peck Lake level began the winter season at elevation 2227.9 feet msl, 6.1 feet below the annual flood control zone and 8.6 feet below the previous year. By the end of February, the lake elevation declined to 2222.3 feet msl, this was 11.5 feet lower than one year ago. The lake reached the season low of 2222.2 feet msl on March 4, 2001, 11.8 feet below the base of the annual flood control zone.

Winter River and Ice Conditions Below Fort Peck Dam. Ice formation on the Missouri River began on December 11, 2000 when the stage rose over 4.8 feet in the Wolf Point, Montana area. The stage peaked near 7.7 feet on January 6, 2001. This was 3.3 feet below flood stage. The Culbertson, Montana gage rose over 2.5 feet as the ice formed in this portion of the Missouri over December 13–16, 2000. The stage peaked at 10.3 feet on the January 8, 2001. This was 0.7 feet above last year's peak stage. No reports of ice-affected flooding on the Missouri River below Fort Peck Dam were recorded during this winter season.

Spring and Summer 2001. Releases from Fort Peck averaged 4,700 cfs in March and 4,100 cfs in April, which is below the 6,000 cfs recommended to support fish spawning below the dam. In May, releases from Fort Peck averaged below normal at 6,200 cfs. Summer releases from Fort

Peck were held constant around 5,900 cfs to 6,000 cfs. June and July's release averages were well below normal at 5,900 and 6,000 cfs, respectively.

The elevation of Fort Peck Lake was at 2222.7 feet msl at the beginning of the 2001 navigation season, 11.8 foot lower then the beginning of the 2000 navigation season. The pool peaked on April 29 at 2222.9 feet msl, 11.7 feet lower than the 2000 peak. Fort Peck Lake in 2001 did not occupy the annual flood control storage zone, which extends from 2234 to 2250 feet msl. By the end of July the pool had fallen to 2222.5 feet msl, 11.5 feet below the base of the annual flood control pool.

3. **Garrison Operation - August 2000 to July 2001.** Garrison, the largest Corps of Engineers storage reservoir, is another key player in the operation of the main stem System. Its primary functions are (1) to capture the snowmelt runoff and localized rainfall runoffs from the large drainage area between Fort Peck and Garrison Dam. Captured floodwaters are metered out at controlled release rates to meet the main stem 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 operations, thus helping to alleviate large pool increases in Oahe and Fort Randall projects; and (3) to provide the extra water needed to meet all main stem authorized purposes which draft storage during low water years.

Late Summer and Fall 2000. Daily releases from Garrison varied between 13,100 cfs and 27,200 cfs with monthly average releases of 23,100, 18,000, 14,200, and 20,900 cfs for August through November. The releases were 2,500, 3,900, 6,400, and 500 cfs below average August through November, respectively. Lake Sakakawea began the period at elevation 1837.3 feet msl, 0.2 feet below the base of the flood control pool and 9.8 feet lower than at the same time a year earlier. By the end of November it was at 1830.5 feet msl, 11.5 foot lower than a year earlier.

Winter 2000-2001. Releases from Garrison were below normal for a second winter season, December through February. The releases remained near 18,000 cfs from November 25, 2000, to January 4, 2001 when releases were increased to 19,000 cfs to comply with the Temporary Restraining Order (TRO) prohibiting Lake Oahe from falling below the 1597.0 feet msl, minus 6-inches. In late January, the releases were reduced to 18,000 cfs and by February 3, 2001 releases were down to 17,000 cfs and remained there until February 25, 2001, when they were reduced by 1,000 cfs to 16,000 cfs. On February 28th, the releases were cut by 1,000 cfs to 15,000 cfs. These adjustments were made following the Annual Operating Plan for balancing the intrasystem storage and complying with the TRO. Garrison monthly averages of 18,100, 18,800, and 15,700 cfs for December 2000, January 2001, and February 2001 were below the monthly averages by 3,300, 5,500 and 10,000 cfs, respectively.

Lake Sakakawea began the season near elevation 1830.4 feet msl, 7.1 feet below the annual flood control zone and 12 feet below the previous year. The lake declined throughout the winter season to an elevation of 1828.3 feet msl by February 28, 2001, which was 9.2 feet below the top of the carryover and multiple use zone.

Winter River and Ice Conditions Below Garrison Dam. During this past winter season the Missouri River in the Bismarck area was free of ice problems. The ice cover once established in mid-December remained stable until mid-March when it went out. Stages at Bismarck rose over 4 feet during the formation of an ice cover between December 11 through 14, 2000. The peak ice-affected stage was near 10.68 feet on December 20, 2000. This was well below both the flood stage of 16 feet and the critical ice stage of 14 feet. Falling below 10 feet by January 8, 2001, it continued to fall gradually through the winter season to about 8.3 feet on February 27, 2001. Following its formation in mid-December, the ice cover remained fairly stable with few open leads off and on through the winter season.

Spring and Summer 2001. Releases from Garrison during the spring and summer were below normal. Releases in March and April were 12,900 and 12,500 cfs, respectively. No water was transferred to Lake Audubon in the timeframe. Releases during May averaged 12,300 cfs, June averaged 13,800, and July averaged 13,800 cfs. Pool elevations for Lake Sakakawea were 1830.4 feet msl on April 1, 1831.0 on May 1, 1831.5 on June 1, 1833.8 on July 1, and 1834.4 at the end of July. Lake Sakakawea peaked at an elevation of 1834.4 on July 31, 2001, down 4.0 feet from last year's peak. Pumping costs associated with the Buford-Trenton project for the period August 1, 2000 through July 31, 2001 were $15,625; the total pumping costs to date are $190,528.

4. **Oahe and Big Bend Operation - August 2000 to July 2001.** Oahe Reservoir, the second largest Corps of Engineers storage reservoir, serves all authorized purposes. The Oahe project's primary functions are: (1) to capture plains snow and localized rainfall runoffs from the large drainage area between Garrison and Oahe Dams. Captured floodwaters are metered out at controlled release rates to meet the main stem 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 operations, thus helping to alleviate large pool increases in Big Bend, Fort Randall, and Gavins Point projects; and (3) to provide the extra water needed to meet all main stem authorized purposes which 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 Lake Francis Case. 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.

Late Summer and Fall 2000. Monthly releases at Oahe and Big Bend ranged from 6 percent below normal in August to 25 percent below normal in October. The Big Bend pool fluctuated between elevations 1419.6 and 1421.5 feet. Lake Oahe began the period at elevation 1604.7 feet msl, 2.8 feet below the annual flood control pool and 12.2 feet lower than at the same time a year earlier. By the end of November it was at 1597.3, 10.1 feet lower than a year earlier.

Winter 2000-2001. Oahe Lake began the winter season at elevation 1597.1 feet msl and only fluctuated between 1596.8 and 1598.41 feet msl following the TRO at Lake Oahe. This winter's season low was 8.1 feet below last winter's season's low of 1604.9 feet msl on February 5, 2000. The average release for the winter period was 16,700 (6,500 cfs lower than the previous winter's average). Oahe's daily average releases varied from 7,600 to 29,500 cfs during the winter period December 2000 to February 2001.

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 in the LaFramboise Island area, cause 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 as needed to prevent flooding at other locations.

Big Bend was operated to follow power peaking requirements with hourly releases varying widely. The daily average flow varied between 0 and 28,100 cfs. The level of Lake Sharp varied in a narrow range from elevation 1419.7 to 1420.9 feet msl.

Spring and Summer 2001. Releases from Oahe were well below normal from April through July. The daily average release for April was 4,200 cfs, down from the 22,600 cfs normal release. May's releases averaged 1,200 cfs, 22,600 cfs below normal; June was 14,300 cfs below average at 12,200 cfs; and July was below the 31,000 cfs average at 18,700 cfs. Big Bend's releases generally mimic releases from Oahe.

Releases from Oahe are usually considerably lower during weekends than on weekdays. The normal plan is to maintain Oahe's releases above 3,000 cfs during weekend daylight hours beginning in early April. This minimum release criterion is scheduled to enhance downstream fishing and boating use during the recreation season. There have been complaints relating to zero releases from Big Bend on the weekends. However, during the recreation season, Lake Francis Case extends into the Big Bend tailwater area and establishment of minimum release rates for Big Bend would be of little value to boating or fishing in the tailwaters.

Lake Oahe began the spring period on March 1, 2001 near elevation 1598.4 feet msl and crested at an elevation of 1608.8 feet msl on June 30, 9.9 feet below the 1618.71 feet msl maximum of record experienced on June 25, 1995. The normal 1-foot weekly fluctuation of Lake Sharpe was scheduled and the lake fluctuated between elevation 1419.7 and 1421.2 feet msl during the period.

5. <u>Fort Randall Operation - August 2000 to July 2001</u>. Fort Randall Dam, the fourth largest Corps of Engineers 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 Dam to Fort Randall Dam. Captured floodwaters are metered out at controlled release rates to meet the main stem 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 the Oahe project for water

accumulated in the System when System releases are reduced due to major downstream flood control operations, 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 lake to occur with a winter refilling operation which is unique to this project; and (4) to provide the extra water needed to meet all main stem authorized purposes, particularly navigation and downstream water supply, which draft storage during low water years.

Late Summer and Fall 2000. Releases averaged 28,800, 31,300, 30,400, and 26,400 cfs during the August through November period; 6,600, 4,500, 4,800 and 5,500 cfs lower than normal, respectively. Lake Francis Case was near elevation 1354.7 feet msl, 4.7 feet into the flood control and multipurpose pool zone at the beginning of August and down from the 1360.3 feet msl pool that occurred in August 1999. The annual fall drawdown caused the lake to decline 18.1 feet to 1336.6 feet msl by December 1, 2000. This drawdown is accomplished each year near the end of the navigation season to provide space for storing winter power releases from the upstream projects.

Winter 2000-2001. Fort Randall releases were reduced from autumn navigation support (normally the autumn floodwater evacuation) rate to the winter conservation release rate in early December 2000. Fort Randall releases ranged narrowly from 10,000 to 16,900 cfs in December 2000, 9,700 to 13,300 cfs in January 2001, and 10,100 to 12,900 cfs in February 2001. These were the releases necessary to maintain the Lewis and Clark pool elevation near 1207 feet msl.

Fort Randall releases averaged 13,800, 11,100, and 11,100 cfs during December, January, and February, respectively, and all were well below the normal winter release of 15,000 cfs. These winter releases were below the long-term average by 4,700, 4,900 and 3,200 cfs for December, January, and February, respectively. The releases varied from 75 percent of normal in December to 64 percent in January, and 78 percent in February. Lake Francis Case rose from an elevation of 1337.1 feet msl on the first of December to 1350.8 feet msl by the end of February. This was 0.8 feet into the flood control and multipurpose pool zone that begins at an elevation of 1350.0 feet msl.

Spring and Summer 2001. Releases from Fort Randall generally paralleled those from Gavins Point and averaged 9,600 cfs in March, 3,500 in April, 12,700 cfs in May, 17,700 in June, and 20,300 cfs in July. Daily average releases varied between 2,000 and 22,600 cfs during this period. Lake Francis Case was at an elevation of 1358.3 on April 1, 2001, 1364.8 on May 1, 2001, and peaked at elevation 1365.3 on April 29, 2001, up 7.4 feet from the previous year's peak. The lake level declined to 1359.4 by June 1, 2001 and was at elevation 1355.5 feet msl at the end of July.

6. **Gavins Point Operation - August 2000 to July 2001.** Gavins Point Dam, the most downstream of the main stem dams, is primarily used as a reregulating 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 band between 1205 and 1207 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, by coordinating Gavins release reductions with Fort Randall, this volume is usually adequate to perform significant downstream flood control. Releases greater than the powerplant capacity, near 35,000 cfs, are passed through the spillway.

Late Summer and Fall 2000. The primary operational objective of Gavins Point during the late summer and fall of 2000 was navigation support and endangered species protection. In response to the diminished storage, Gavins Point releases were augmented with the Kansas River projects to meet flow targets at Kansas City. Average monthly releases were 31,600 cfs for August, 5,300 cfs below average; 33,600 cfs for September, 1,100 cfs below average; 33,500 cfs for October, 3,900 cfs below average; and 28,600 cfs for November, 5,800 cfs below average. In mid to late November, releases were stepped down, reaching 12,000 cfs on December 1, 2000. Releases were increased to 16,000 cfs by December 14, 2000 to deal with the threat of much colder weather and in anticipation of ice formation later in the month. The official closing of the 2000 navigation season at the mouth of the Missouri occurred on December 1, 2000.

Lewis and Clark Lake was operated to maintain a pool elevation near 1207 feet msl throughout the period, varying between 1205.8 and 1207.6 feet msl.

Winter 2000-2001. The plan for Gavins Point during the winter of 2000-2001 was to maintain releases near 12,000 cfs as a water conservation measure, and would be increased only when necessary. This was 8,000 cfs below the average winter release and lower than the previous 7 winters.

The Gavins Point release was incrementally increased beginning on December 5 from 12,000 cfs up to 12,500 cfs; on December 6 to 13,000 cfs; December 8 to 15,000 cfs; and by December 12 to 16,000 cfs. Gavins Point release remained at the 16,000 cfs level until January 3, 2001, except for a five-day period, December 15-19, 2001. Gavins Point releases were gradually decreased by 1,000 cfs increments to 13,000 cfs by January 16, 2001 and remained at this release throughout the remainder of the winter season. There were a few days in February that the releases were at the 14,000 cfs (4 days), and 15,000 cfs (2 days), level when required to maintain a 9-foot stage at Sioux City, Iowa. These fine adjustments in the winter releases were made in anticipation of the sub-zero temperatures and loss of water because of additional ice formation.

The Gavins Point average daily release was below the normal winter release rate for the entire winter season. Average monthly releases were 14,800 cfs for December, 5,900 cfs below average; 13,800 cfs for January, 4,300 cfs below average; and 13,300 cfs for February, 5,300 cfs below average.

During the winter period, Lewis and Clark Lake was near 1207 feet msl, the same target as the previous nine winter seasons. The target elevation was lowered to 1206 feet msl at the end of February for flood control. The maximum pool level reached during the winter period

was 1207.3 feet msl on December 28, 2000. The minimum pool level of the season occurred on February 26, 2001 when Lewis and Clark Lake reached 1205.8 feet msl. The biggest change in elevation occurred when Lewis and Clark Lake fell more than a foot during the week of December 11-18, 2000 as a result of the higher Gavins Point release accompanied with colder temperatures and the formation of ice in the Missouri River in the Fort Randall to Gavins Point reach.

Winter River and Ice Conditions Below Gavins Point Dam. The Gavins Point winter release rate of 12,000 cfs was reached on December 1, 2000. During the first week of December, reports were made of problems at water intakes along the Missouri River from Gavins Point to the mouth. The combination of conservation measures, degradation of the channel, and the loss of tributary runoff were the main contributing factors for insufficient head and vortex problems at the Neal North Power Plant intakes in the Sioux City, Iowa area. The first reports of ice on the Missouri River were made on December 5, 2001 with 15% floating slush, at Sioux City, Iowa with little to no floating ice downstream. The ice reports in the Sioux City, Iowa to the Rulo, Nebraska reach through December ranged from 5 to 90 percent floating ice with pad sizes ranging from 5 to 30 feet. Normally this portion of the Missouri River has the largest volume and size of floating ice.

An ice bridge developed below Gavins Point and above Sioux City during December 11-13, 2000, resulting in a temporary reduction in river stages at Sioux City. On December 11, 2000, Unit 3 at the Neal North Power Plant tripped off line and the other two units were operating in a restricted mode. Also the Fort Calhoun, Nebraska, Nuclear Power Plant was close to reducing generation because of the low water levels. Their critical stage relative to the Blair gage (BLNE) is 7.25-7.5 feet. The Missouri River dropped to a record low of 6.65 feet on December 12, 2000. The temporary dip in the river traveled down to Kansas City, Missouri, where the Missouri River reached a record low on December 19 of 4.8 feet. A second temporary drop in the Missouri River at Sioux City occurred on December 18, 2000 with a low stage of 7.85 feet and this dip arrived at Kansas City on December 23, 2000 where the Missouri River dropped to a stage of 5.39 feet.

An aerial reconnaissance was made of the Missouri River, on December 22, 2000, from Gavins Point Dam downstream to Sioux City, Iowa. There were about 12 miles of open leads in the unchannelized reach upstream from Sioux City, Iowa. Beginning about 5 miles downstream from Yankton, South Dakota, there was an ice cover that continued downstream to about one mile upstream from the confluence of the Big Sioux River in Iowa.

Twice in December, the Missouri River had two significant sags in stages that traveled from Sioux City, Iowa downstream to the mouth at St Louis, Missouri, causing problems to water intakes along the way. Also, the reports of floating ice from St Joseph, Missouri on downstream were higher than normal for December. Reports of 10 to 80 percent of the channel had floating ice with pad sizes ranging from 2 to 25 feet. This, in combination with the lower Missouri River stages, caused the Nearman Power Plant, at River Mile 378.7, to completely shut down on December 14, 2000 and remain down until December 22, 2000, when it started generating at partial capacity of 115 MW. The Nearman Power Plant started generating at

235 MW, full capacity, on December 27, 2000. On December 21, 2000, the Kansas District Corps, along with other state and federal officials, met with the Kansas City, Kansas, Board of Public Utilities (BPU), owners of the Nearman Power Plant. The purpose the meeting was to report on the Corps reservoir operations and studies regarding the Missouri River bed degradation at Kansas City and possible solutions for water intake problems. The Corps of Engineer's coordinated closely with municipal and other water users from Gavins Point downstream to the mouth throughout this critical period and provided additional information on the Corps of Engineer's web site at (http//www.nwd-mr.usace.army.mil/rcc).

Unlike the December, 2000 ice events, the remainder of the winter was relatively mild. January and February ice reports showed much smaller volumes of floating ice in the Missouri River, about 10 to 40 percent floating ice and very small 2 to 3-foot size pads.

Spring and Summer 2001. Following the much below normal winter inflows into the System, Gavins Point releases were increased beginning on March 14, 2001 in preparation for the start of the 2001 navigation season. The March average release rate was 15,300 cfs, 5,900 cfs below normal. The first tow of 2001, the "Omaha," entered the river on March 6. Four tows were operating on the Missouri River on April 1, the first official day of flow support for the 2001 navigation season.

With below normal mountain snowpack, a light plains snowpack, and a reduced System storage from the previous year, Gavins Point releases were set to reduced service navigation targets from late March through the July 1 storage check. A decreased System storage prompted April and May's average releases from Gavins Point to be below normal. April's average of 10,800 cfs was 16,400 cfs below normal, and the May average of 16,300 cfs was 14,300 cfs below normal. In late May, releases were increased to the 19,000 cfs summer release rate for the endangered species nesting season and slowly increased to as high as 24,500 cfs in July. June's average release rate was 19,200 cfs and July's rate was 22,600 cfs, which is 12,700 cfs and 11,900 cfs below average.

There were no reductions in System releases to provide downstream flood control during the spring and summer of 2001. Due to the lack of runoff in the basin, releases were set to maintain the reduced navigation targets and endangered species levels through the season. Based on the July 1, 2001 System storage, navigation targets remained at the reduced navigation target levels.

Average daily outflows were 19,200 cfs in June, 12,700 cfs below average, and 22,800 cfs in July, 11,900 cfs below average.

Lewis and Clark Lake was targeted for elevation 1206 feet msl throughout the spring and summer of 2001. The lake elevation ranged from 1205.3 to 1208.0 feet msl.

E. <u>Non-Routine Operations and Other Items Pertaining to Main Stem Regulation</u>. Numerous operations are performed each year that, although at one time may have been considered special, are now considered almost routine. These include the release restrictions

from a particular project for a period of time to permit soundings or 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 operations 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. **Fort Peck.** The Fort Peck "mini-test" and the unbalancing of the three large upper reservoirs described in last year's AOP did not occur due to low runoff in the upper basin in 2001. The endangered species modified flow "mini-test," which was designed to monitor the effects of higher spring releases and warmer water released from the spillway, required pool elevations of approximately 2229 feet msl to avoid unstable flows over the spillway. The "mini-test" was cancelled as maximum pool elevations during May and June were approximately two feet below the spillway crest elevation of 2225 feet msl. The Missouri River Natural Resources Committee establishes guidelines (Table V, 2000-2001 AOP) for implementing unbalancing the upper three reservoirs to benefit reservoir fishery and the endangered interior lease tern and threatened piping plover. As a result of the continuing drought conditions, low pool elevations and below normal mountain snow pack on March 1, the guidelines did not recommend implementation measures to unbalance the reservoirs.

2. **Garrison.** Releases were increased from 13,000 cfs in early November to as high as 27,000 cfs by November 9 to comply with a TRO that prohibited Lake Oahe from lowering below elevation 1597 and limited the pool to a variance of six inches downward, as prescribed under the TRO amended on November 7, 2000 by U.S. District Judge Charles B. Kornmann from South Dakota.

3. **Oahe.** The Standing Rock Sioux Tribe and the lineal descendants of Mato Chanzeka, a.k.a. Chief Mad Bear, filed a Motion for a TRO in the United States District Court, District of South Dakota, Northern Division on October 20, 2000 to prohibit the Corps of Engineers from fluctuating Lake Oahe and further disturbing cultural and historic sites important to the tribe. U.S. District Judge Charles B. Kornmann heard arguments on November 6, 2000 and orally ordered the Defendants be restrained from further reducing the water level of Lake Oahe below elevation 1597.7 feet msl, plus or minus a 6-inch variance. This Order was followed by an Amended Order on November 7, 2000 that changed the elevation from 1597.7 to 1597 and limited the variance to six inches downward, without upward limitation. Both parties reached a Settlement Agreement on April 23, 2001 and the Court dismissed the action without prejudice. The Settlement Agreement addressed three major issues: 1) stabilization of the Leavenworth site; 2) specification of an interim monitoring plan for the sites which have the potential to contain buried human remains; and 3) preparation of a Cultural Resources Management Plan for the Lake Oahe project that includes a long term monitoring strategy.

The channel capacity of the Missouri River in the reach between Oahe Dam and Lake Sharpe has been declining since the construction of the System due to sediment accumulation, mainly from the Bad River. Although major flooding in the Pierre-Fort Pierre area has been avoided since the construction of Oahe Dam, the threat of shallow flooding, especially

during river ice-in periods, has increased. This has prompted operational constraints on Oahe hydropower production during the most critical river ice-in conditions. The loss in generation due to these operational constraints has been offset by additional power purchases on the open market by Western Area Power Administration (Western). Western replaces the lost generation to meet contractual obligations to electrical distributors.

The Corps of Engineers is addressing the problem on two fronts. Under authority of Section 136 of the Omnibus Consolidated and Emergency Supplemental Appropriation Act of 1999, the Corps is relocating and/or flood proofing the lowest homes in the Pierre-Fort Pierre area. These homes are potentially at risk of periodic flooding due to Oahe hydropower production during the most critical river ice-in periods on the Missouri River. Section 136 has already been utilized to purchase 78 of the lowest properties in the area. To date, 102 property owners have been contacted regarding flood proofing and/or relocations. Approximately 120 properties will eventually be purchased and/or flood proofed along with infrastructure improvements to reduce the operational constraints on Oahe Dam during ice conditions. Second, Section 441 of the Water Resources Development Act of 1996 directs the Secretary of the Army to investigate potential solutions to the recurring flooding and related problems due to sedimentation in the area of Pierre and Fort Pierre, South Dakota. The Final report was signed September 27, 2000. The final recommendation is for an environmental assessment (EA) of potential alternatives to reduce the rate of sediment deposition in the Pierre area.

F. **Reservoir Releases and Storage** Pool elevations and storage contents of the main stem reservoirs at the end of July 2001 are presented in ***Table IV***.

TABLE IV
PROJECT POOL LEVELS AND STORAGES

	Pool Elevation feet msl		Water in Storage - 1,000 AF July 31, 2001		
	July 31, 2001	12-Month Change	Total	Above Min. Pool*	12-Month Change
Fort Peck	2222.3	- 9.8	12,712	8,501	- 1,868
Garrison	1834.4	- 3.0	17,179	12,199	- 908
Oahe	1608.7	+ 3.9	19,147	13,774	+ 1,157
Big Bend	1420.6	0.0	1,713	31	+ 5
Fort Randall	1355.2	+ 0.7	3,566	2,049	+ 71
Gavins Point	1205.7	+ 0.1	351	30	- 2
			54,668	36,584	- 1,545

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

G. Summary of Results.

1. **Flood Control.** System storage in the main stem reservoirs on August 1, 2000 was 56.2 MAF and 5.6 MAF less than the 34-year average of 61.8 MAF, 15.0 MAF lower than in the record runoff year of 1997 and 9.0 MAF lower than on 1 August 1999. After peaking at 57.7 MAF on March 15, 2000, System storage was down 1.5 MAF from the crest on August 1 due to severe drought conditions. Releases during the late summer, fall, and early winter were directed at water conservation as main stem System storage diminished. Since the crest was actually less than the base of the annual flood control zone and mountain snowpack was much below average, the expectation was for a much below normal runoff and water conservation measures were implemented to conserve the remaining water in storage as much as possible.

Dry conditions which had developed in the fall of 1999 continued through all of 2000 and resulted in a much below normal mountain snowpack accumulation during the winter of 2000 and 2001. The plains snowpack was very light over most of the upper basin except in the James and Big Sioux River basins which had a much above normal plains snowpack during the spring of 2001. System storage was reduced to 49.3 MAF on January 3, 2001 and rose very slightly to 49.6 by March 1, 2001. Even though the mountain snowmelt was much below normal with the implementation of water conservation measures at the onset of the navigation season, System storage began to recover during 2001. The water conservation measures, which included a reduced navigation support level of 3,000 cfs less than full service, in combination with taking advantage of the prolonged plains snowmelt runoff on the Big Sioux and James Rivers which further reduced system releases resulted in some progress being made in recovering system storage. This recovery was accomplished even though the upper basin was experiencing much below normal runoff. System storage peaked at 54.7 MAF on July 8, 2001. As releases were maintained for navigation support at 3,000 cfs less than full service, System storage remained steady at 54.7 MAF by August 1.

The 2001 System storage peak was 3.0 MAF lower than the previous year's peak and 7.8 MAF below the average peak storage for the period 1967-2000. The estimated total flood damage prevented by the main stem reservoirs during Fiscal Year (FY) 2001 is $173.0 million. The $173.0 million total damages prevented in the Missouri River basin includes $137.7 million in the Kansas City District and $35.3 million in the Omaha District. The damages prevented by the Missouri River main stem reservoirs along the Mississippi River are not yet available. The flood damage 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 main stem dams. Although the reservoirs prevent enormous amounts of damage, they are not capable of totally eliminating flooding along the Missouri River. The estimated actual flood damages incurred in the Omaha District along the Missouri River from above Fort Peck Dam to Rulo, Nebraska, for 2001 were $ 2,945,500 during 2001. The estimated flood damages incurred along the Missouri River in the Kansas City District have not yet been provided for FY 2001. Runoff in 2001 resulted in approximately 21,500 acres being affected along the Missouri River in the reach from Gavins Point to St. Joseph, Missouri. This figure is much higher than 357 acres affected in 2000 but much less than the 69,500 acres in 1999.

Missouri River Main Stem

Cumulative Flood Damages Prevented

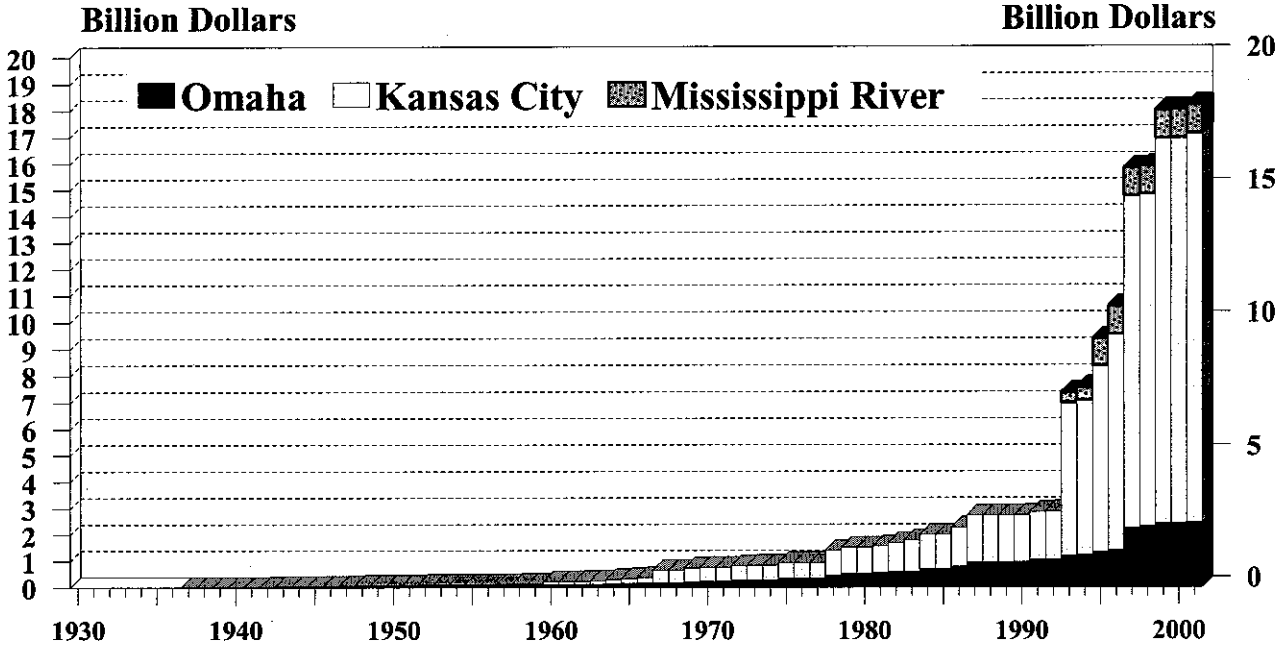


Figure 6A

Annual Flood Damages Prevented

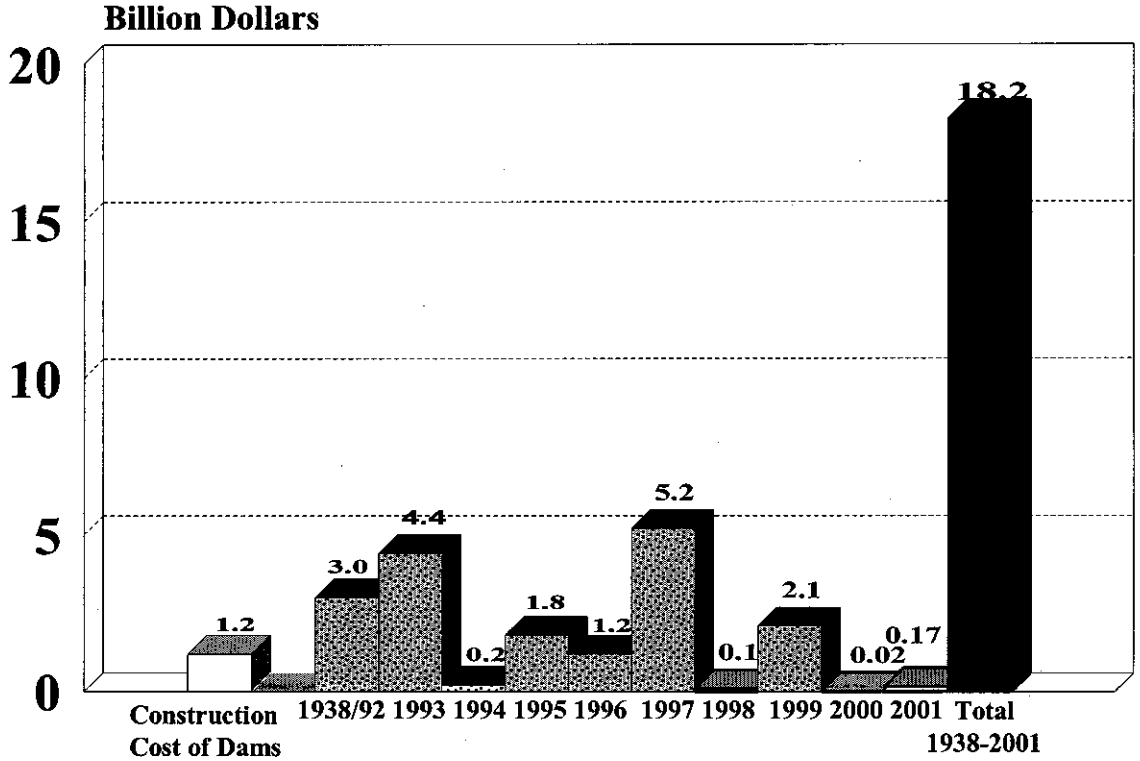
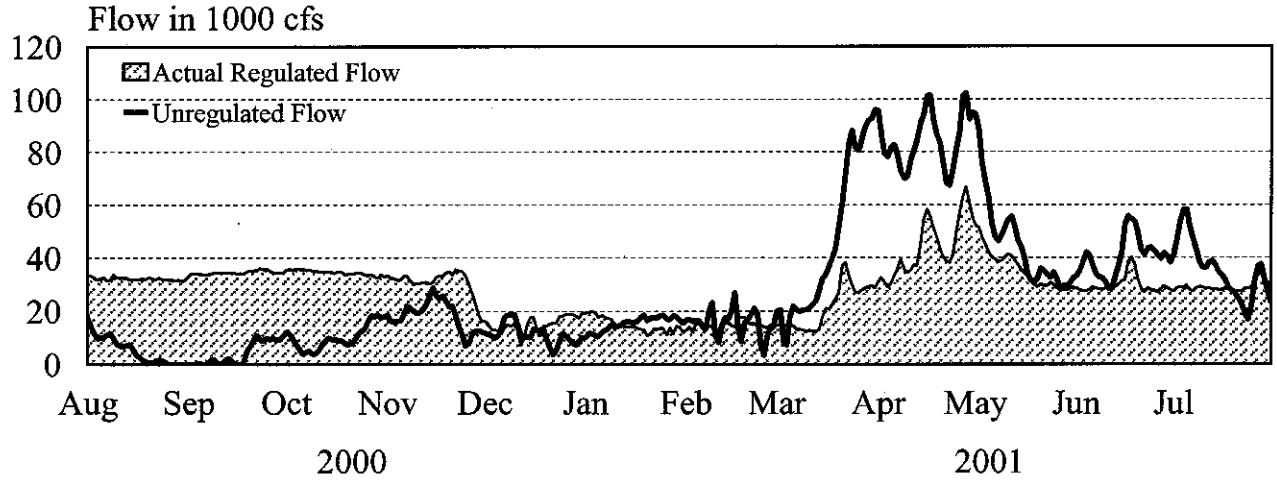
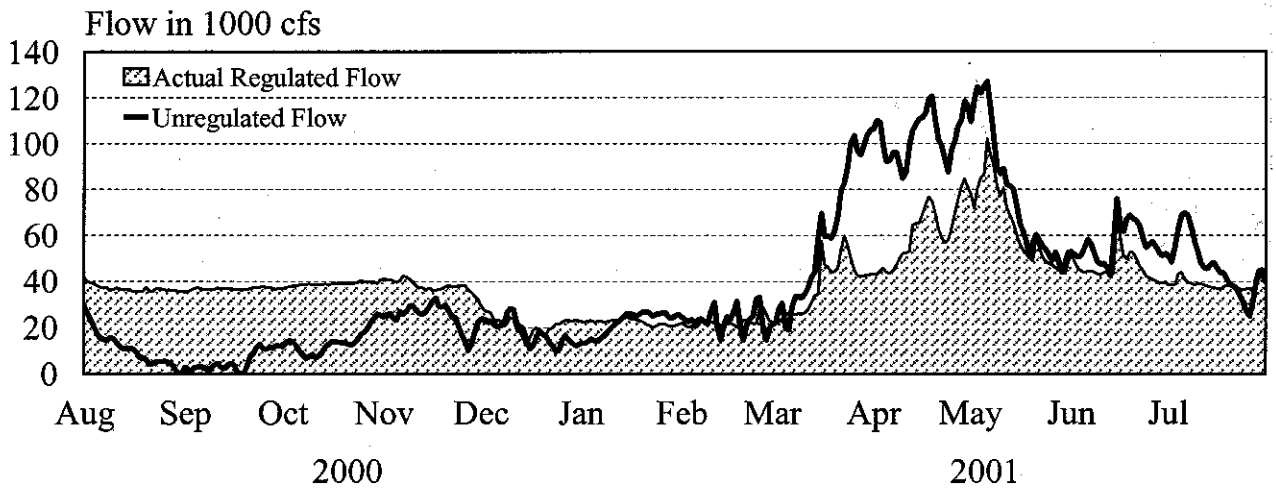


Figure 6B

Sioux City
Regulated and Unregulated Flows



Nebraska City
Regulated and Unregulated Flows



St. Joseph
Regulated and Unregulated Flows

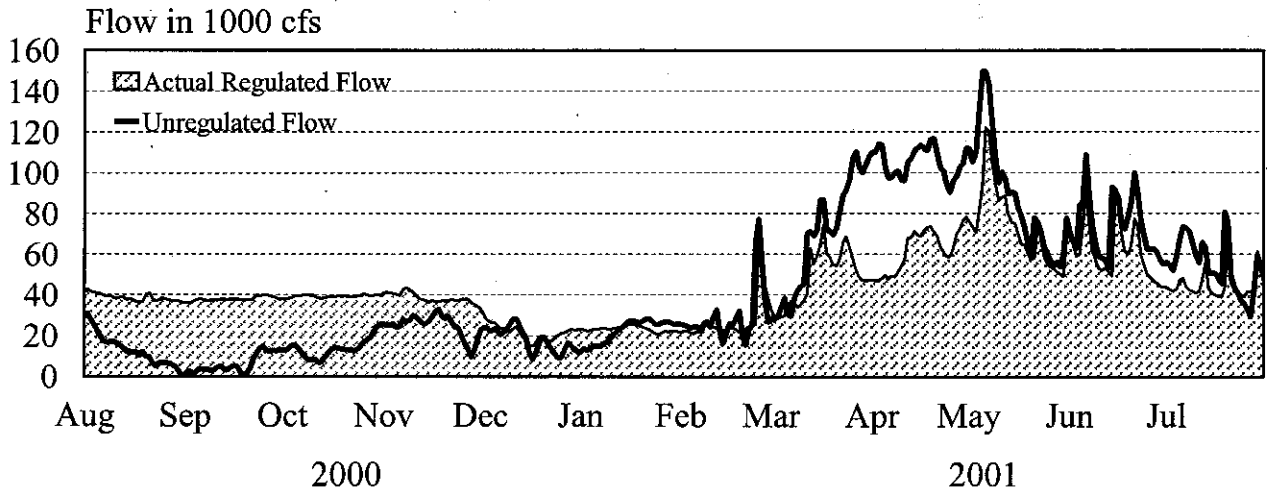


Figure 7

The Kansas City District tributary reservoirs also prevented a significant amount of flood damages during this past year. The total damages prevented in the Kansas City District, exclusive of the Missouri River main stem dams, was $320 million, with the Perry Reservoir project located near Kansas City resulting in approximately one-half the total value of damages prevented.

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 main stem and tributary reservoirs had not been in operation.

2. Irrigation. Federally developed irrigation projects are not being served directly from main stem reservoirs. However, releases from the reservoirs 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 reservoirs. Releases from the reservoirs during 2000 and 2001 generally met the needs of irrigators except in the reach below Fort Peck where access problems existed because of the very low releases due to the drought and reduced releases to reduce the impacts of the very low runoff into Fort Peck.

3. Water Supply and Water Quality Control. Daily flows exceeded minimum requirements for water supply and water quality control purposes throughout the System for the entire 2000-2001 period. This was the first time since 1992 that lower winter release rates from the main stem projects had been implemented because of the high runoff years from 1993 through 1999. With reduced winter releases to further conserve water in storage, access problems existed downstream of several of the main stem projects during the winter of 2000-2001. Of note are the reaches below Garrison where the Heskitt power plant experienced problems and the Pickstown water intake below Fort Randall was out of service during a prolonged period when system releases were reduced because of high downstream plains snowmelt runoff. Also during the winter, Neal North Power Plant near Sioux City Iowa and Nearman Bottoms Power Plant near Kansas City were off line at times due to low river stages caused by river ice conditions. Intake owners today are generally better prepared to handle periods of low water due to adjustments made to intakes or operating procedures as a result of the drought experienced from 1986 through 1992. Some of these adjustments involved using warm water to keep ice formation from building up on intake screens, installing new pumps, lowering intakes and installing sediment redirection vanes, installing ice deflectors, obtaining or arranging to obtain alternate sources of water, and cleaning screens more thoroughly and frequently. These remedial actions were expensive but have significantly improved the ability of the intakes to tolerate low river stages.

Figure 8 shows the end-of-July pool elevation for Fort Peck, Garrison, and Oahe plus total main stem System end-of-July storage for 2000 and 2001. An individual table with the maximum, average, and minimum end-of-July pool elevations for each major reservoir is also shown on this figure. The end-of-July 2001 pool elevations varied from the previous year with Fort Peck being significantly below the year before, Garrison slightly lower and Oahe significantly higher. On July 31, 2001, Fort Peck (2222.5 feet msl) was 11.5 feet below the top of the carryover multiple use zone and 9.5 feet lower than the 2000 end-of-July level. Garrison

(1834.4 feet msl) was 3.1 feet lower than the top of the carryover multiple use zone and 3.0 feet lower than 2000. Oahe (1608.7 feet msl) was 1.2 feet above the top of the carryover multiple use zone and 3.9 feet higher than in 2000. Also shown in ***Figure 8*** are the minimum, maximum, and average pool elevations for the periods since the System closed in 1967.

Specific water quality problems and issues detected in the Missouri River main stem projects in 2000 are listed in ***Table V.***

Analysis of the data and the listing of parameters exceeding state water quality standards in 2000 were stored in a local database called "Dasler". Water Quality data collected in 2000 were not stored in the EPA STORET system. Dasler will act as a "front end" to submit the data to STORET, however this feature of Dasler in not yet in place. It is expected that the upload capability of Dasler will be online in the Fall of 2001.

TABLE V
WATER QUALITY ISSUES AND PROBLEMS
IN MAIN STEM LAKES - 2000

Project	Algal Blooms	Fish Kills	Potential Problem Areas	State Standard Exceedance
Fort Peck Lake	No	No	Coal & oil development, algal blooms	*Inflow*: none identified *Reservoir*: arsenic, mercury, dissolved oxygen *Release*: arsenic
Lake Sakakawea	Yes	No	Oil drilling, strip mining, algal blooms, metribuzin	*Inflow*: none identified *Reservoir*: arsenic, mercury, dissolved oxygen *Release*: none identified
Lake Oahe	No	No	Agricultural runoff,metribuzin bioaccumulation of mercury	*Inflow*: none identified *Reservoir*: mercury, sulfate, iron, total phosphorus *Release*: arsenic, mercury, sulfate, total phosphorus
Lake Sharpe	No	No	Agricultural runoff , atrazine	*Inflow*: none identified *Reservoir*: mercury, sulfate, dissolved oxygen *Release*: sulfate
Lake Francis Case	No	No	Intrusion of the White River delta, metribuzin, atrazine	*Inflow*: none identified *Reservoir*: mercury, sulfate, arsenic, total phosphorus dissolved oxygen *Release*: sulfate mercury
Lewis and Clark Lake	No	No	Emergent aquatic vegetation, atrazine, cyanazine	*Inflow*: sulfate,mercury *Reservoir*: mercury, sulfate dissolved oxygen, arsenic *Release*: sulfate, arsenic, total phosphorus

In certain years, a potential exists for low dissolved oxygen levels in Garrison Reservoir. Garrison has had problems in the past with low dissolved oxygen during low water supply years when hypolimnetic volume is small. The oxygen demand exerted by the bottom sediments and within-lake organic matter reduces the hypolimnetic oxygen levels. The hypolimnetic dissolved

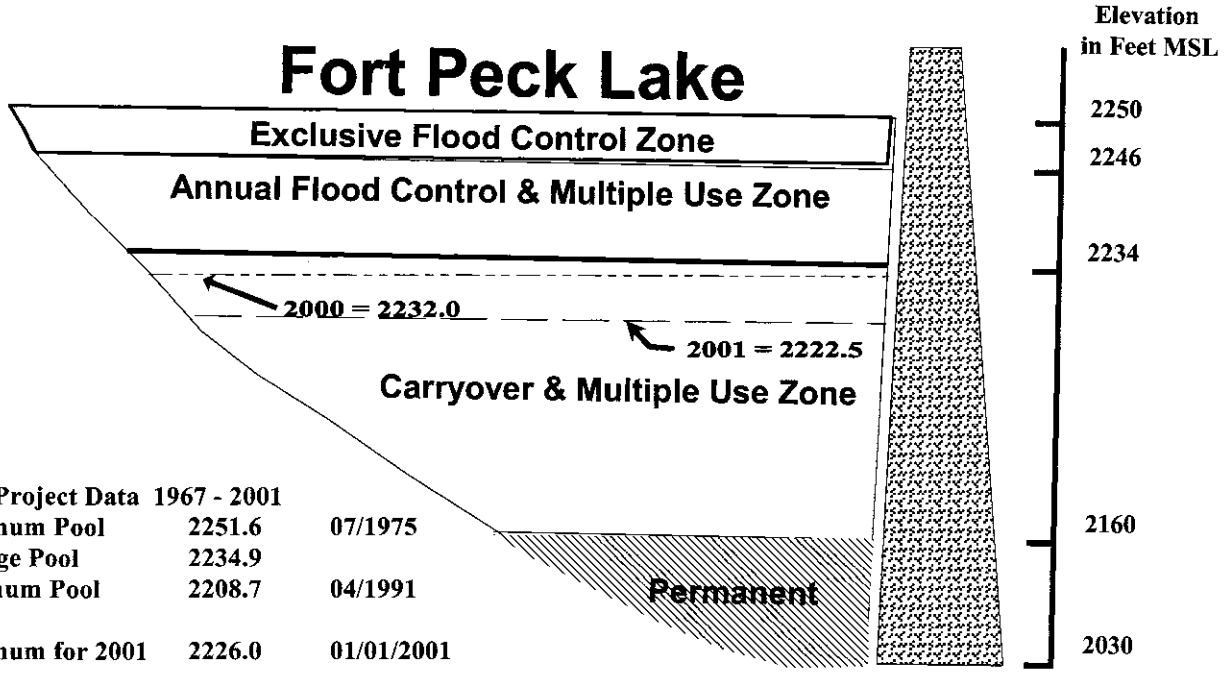
oxygen levels may remain below state standards until the fall turnover. The dissolved oxygen levels in the releases from Garrison Reservoir have never been below state standards. Low dissolved oxygen levels were detected in the hypolimnion by the U.S. Geological Survey (USGS) in their 1993 studies; however, levels returned to above state standards at the next sampling period. The project will continue to be sampled for this problem. If a problem is detected, increased sampling will be initiated to determine the severity and extent of the low dissolved oxygen. The higher pool and increased volume since 1993 have diminished considerably the chance of a problem occurring. Lake Oahe has experienced problems similar to those at Garrison during low volume years, but the higher lake levels have alleviated the problem since 1993.

The North Dakota Department of Health and Consolidated Laboratories (NDDHCL) in Bismarck has annually issued since 1993 an advisory on consumption of fish caught in some streams and lakes in North Dakota. Lake Sakakawea was included in this advisory. The advisory was not intended to discourage anglers from eating fish but offers advice on how fish caught in these impoundments could be eaten safely. The NDDHCL analyzed fish fillets in 1996 and collected tissue samples again in 1997. The fish eating advisory continues to remain in effect.

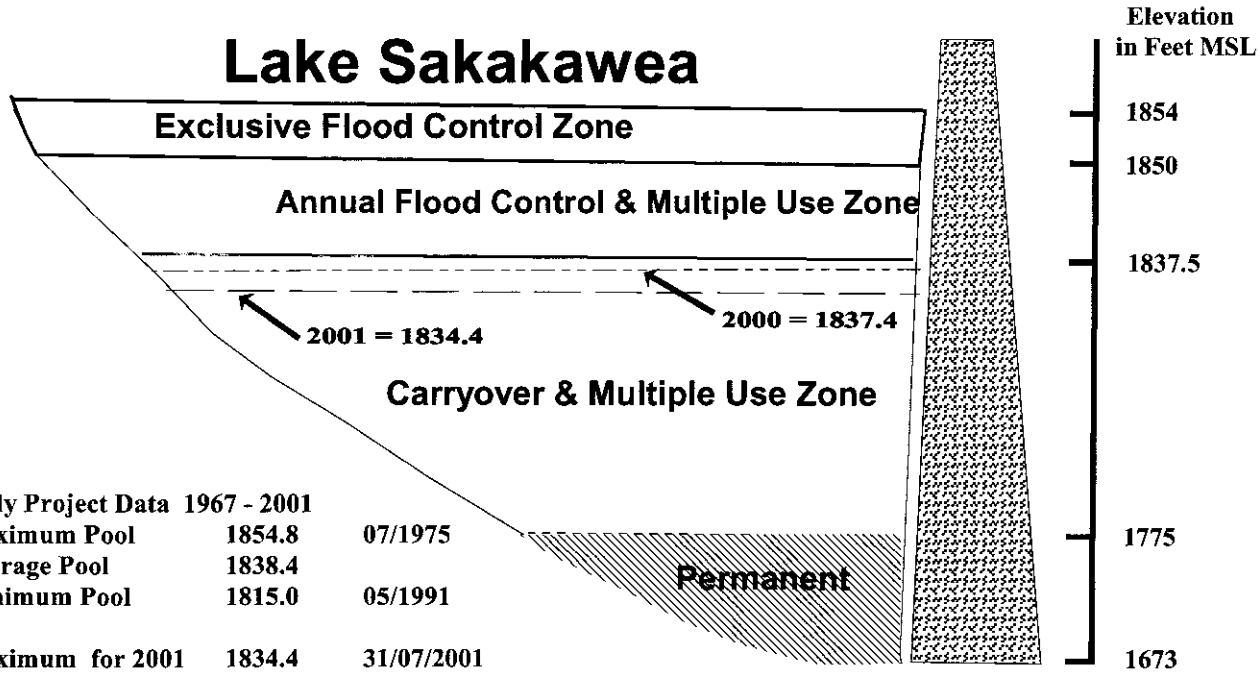
4. Navigation. A discussion of the first half of the 2000 navigation season is included in last year's AOP. The second half of the 2000 navigation season began with flows at reduced levels. With System storage at 57.0 MAF on July 1, 2000, support to navigation was reduced 1,500 cfs for the remainder of the 2000 navigation season as a water conservation measure. This marked the first time since the drought of the late 80's and early 90's that less than full service flows were provided. In addition, the season was concluded on the normal closing dates of November 22 at Sioux City, November 24 at Omaha, November 27 at Kansas City and December 1 at the mouth. This was the first time since 1994 that the season was not extended 10 days to provide additional navigation service and the evacuation of additional water accumulated in storage.

The lower Missouri River basin was in a drought that lasted through the summer to the end of the 2000 navigation season. This resulted in the downstream tributaries barely providing adequate flows to sustain navigation from Kansas City to the mouth. The river below Kansas City was challenging to all commercial navigators especially at River Miles 9.0, 54.5, 90.0, 39.4, 144.5 and 167.4. The most challenging reach through the summer period was near river mile 90.0. This problem was solved by repairing existing structures and constructing an emergency dike. The emergency dike was completed at the end of August 2000. The channel greatly improved following the construction. From September 1 through the rest of the 2000 navigation season, river mile 9 became the most challenging. Tows were double and triple tripping to get through the reach. The Kansas City District's reconnaissance crew stayed close to the reach to help tows find the best channel. The solution was one or two new dikes constructed to move and control the shoaling that was restricting the channel. Because no emergency was declared, the building of the new work required the normal design and notification process with other federal and state agencies. No construction was initiated in CY 2000, so the navigation industry finished the year still challenged at river mile 9. The last tow to leave the river was the "Jamie Leigh," Jefferson River Terminal, on December 8, 2000.

Missouri River Main
End-of-July Lake Elevations and



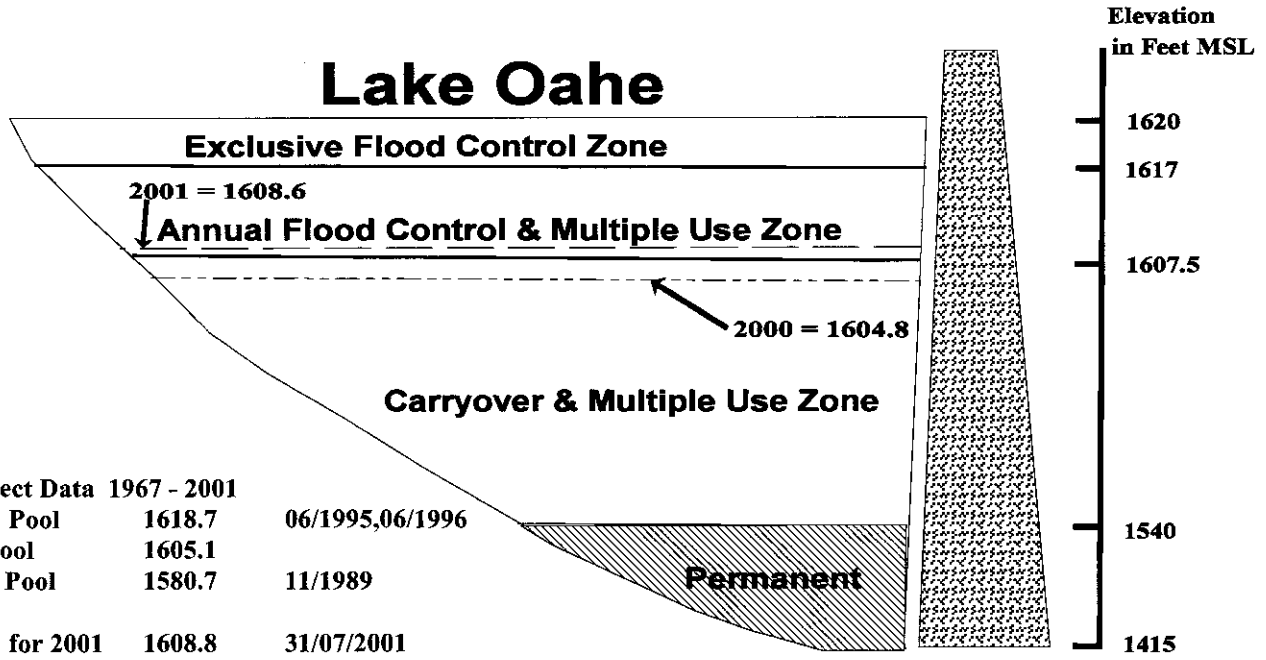
Daily Project Data 1967 - 2001		
Maximum Pool	2251.6	07/1975
Average Pool	2234.9	
Minimum Pool	2208.7	04/1991
Maximum for 2001	2226.0	01/01/2001



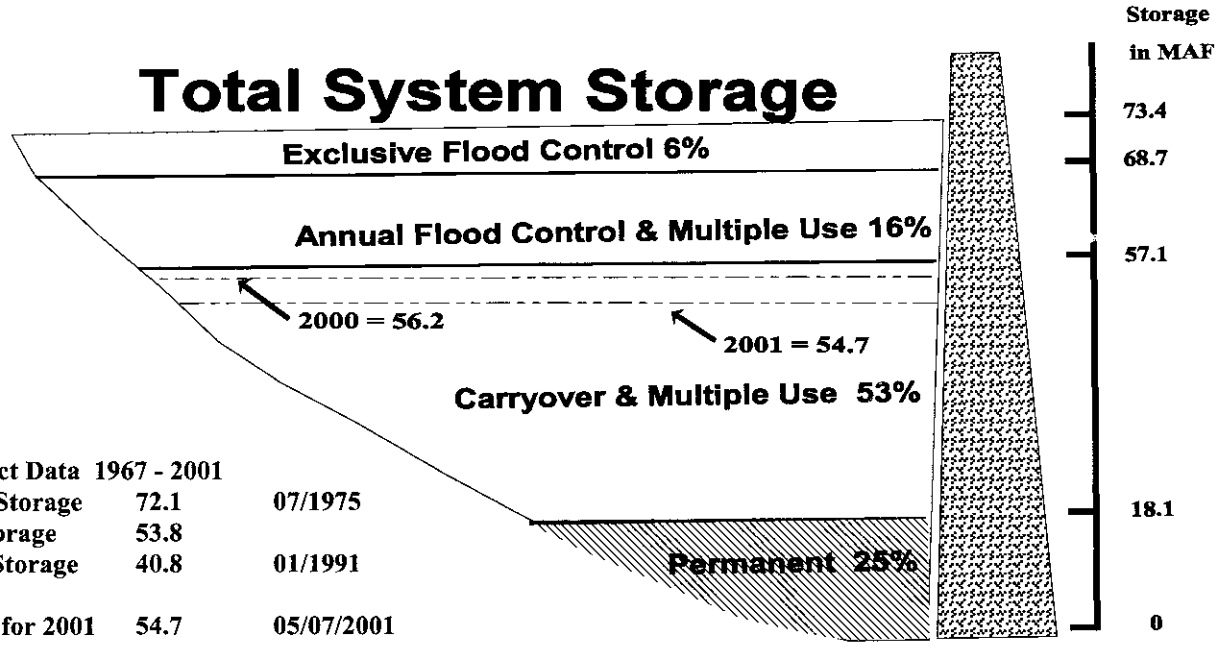
Daily Project Data 1967 - 2001		
Maximum Pool	1854.8	07/1975
Average Pool	1838.4	
Minimum Pool	1815.0	05/1991
Maximum for 2001	1834.4	31/07/2001

Figure 8 A

Stem Reservoirs
Total System Storage



Daily Project Data 1967 - 2001		
Maximum Pool	1618.7	06/1995,06/1996
Average Pool	1605.1	
Minimum Pool	1580.7	11/1989
Maximum for 2001	1608.8	31/07/2001



Daily Project Data 1967 - 2001		
Maximum Storage	72.1	07/1975
Average Storage	53.8	
Minimum Storage	40.8	01/1991
Maximum for 2001	54.7	05/07/2001

Figure 8 B

Preliminary navigation commodity tonnage of 8.7 million total tons and 1.3 million commercial tons for 2000 has been provided by the Waterborne Commerce Statistics Center (WCSC). The WCSC final data for the Missouri River are not normally available until nearly a year after the end of the season. The WCSC final estimate of commercial navigation tonnage on the Missouri River for 1999 is 1.6 million tons. This number does not include sand, gravel, and waterway materials. Principal commodities transported downstream were corn, wheat, sorghum, soybeans, oilseeds, and animal feeds. Major commodities moved upstream were fertilizer, cement, salt, molasses, petroleum products, iron, and steel. The WCSC final estimate of total tonnage indicates approximately 9.3 million tons were transported, the highest tonnage ever reported for the Missouri River. The 1999 record tonnage was primarily due to 7.5 million tons of sand and gravel. Several companies mine sand and gravel from the Missouri River. Mining of the sand and gravel is usually within a few miles of the nearest loading facility. The WCSC estimate for 2000 is 8.7 million tons of which 7.2 million tons is sand and gravel. The largest commercial tonnage season, excluding sand, gravel, and waterway material used to maintain the navigation and bank stabilization structures, occurred in 1977 when 3.3 million tons were moved on the Missouri River. Tonnages of commodities shipped during 1999 and 2000 are shown in ***Table VI***.

TABLE VI
TONNAGE BY COMMODITIES
MISSOURI RIVER

COMMODITY CLASSIFICATION GROUP	TOTAL (Thousand Tons)	
	1999	2000
Grain (Wheat, Corn, Sorghum)	356	245
Other Food and Farm Products (incl soybeans)	373	284
Fertilizers and Other Chemicals	343	289
Petroleum Products	278	256
Primary Manufactured Goods	156	233
Other	69	36
Subtotals	1,576	1,344
Sand and Gravel	7,532	7,225
Waterway Material	145	164
Totals	**9,252**	**8,733**

A summary of tonnage by major commodities for 1960 through 2000 is displayed on the bar graphs shown on ***Figure 9***. The bottom graph shows the commercial commodity tonnage, excluding sand and gravel and waterway materials, while the top graph shows the total Missouri River tonnage. This includes sand and gravel moved on the river plus waterway materials for navigation project construction and maintenance. As the navigation project has been completed,

waterway materials moved have diminished, but the sand and gravel moved has increased greatly over the past years.

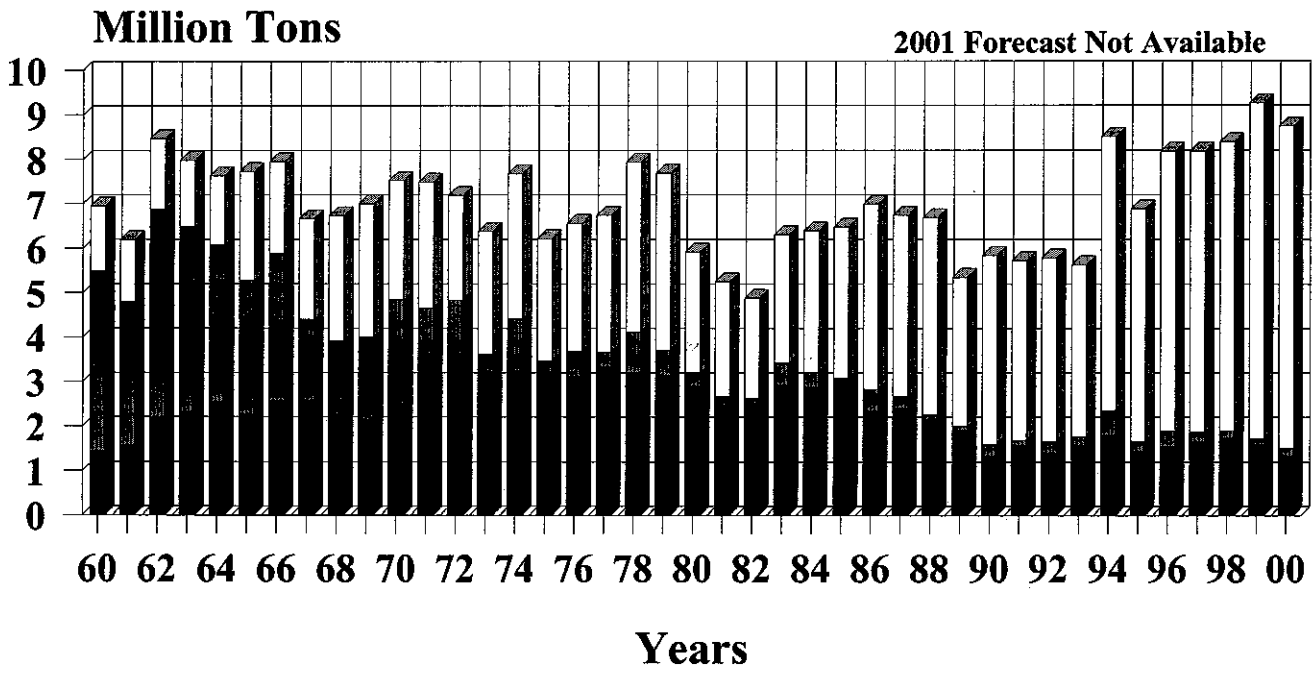
The official 2001 flow support for navigation began on the normal scheduled opening dates of March 23 at Sioux City, March 25 at Omaha, March 28 at Kansas City, and April 1 at the mouth near St. Louis. Releases from Gavins Point Dam were increased from 12,500 on March 13 to 19,000 cfs on March 21, 2001 to meet a Sioux City navigation target 3,000 cfs less than full service. The Big Sioux and James rivers were swollen from the heavy plains snowmelt over the eastern Dakotas and further release increases were not really necessary until the first week in June when tributary flows finally receded.

The first towboat on the Missouri River in 2001 was the "Omaha," owned by Blaske Marine Services, which entered on March 10, 2001. On April 1, the first official day of flow support for the 2001 navigation season at St. Louis, four tows were operating on the river. The first tow to arrive in Sioux City was the "Harry Waddington," owned by Phoenix Towing, on March 29, 2001. The season progressed normally though the summer. Releases were not increased during May in anticipation of higher release requirements later in the summer and the need to have endangered species nest at higher elevations because of this future increase. Adequate habitat was felt to exist to preclude this requirement and the additional water conservation measures were warranted with respect to the expanded drought. System storage peaked at 54.7 MAF on July 8, 2001. The 1 July storage check indicated that navigation support should be reduced to 3,000 cfs less than full service or intermediate flow support levels. Releases were maintained for navigation support at 3,000 cfs less than full service as an additional water conservation measure. System storage remained steady at 54.7 MAF by 1 August.

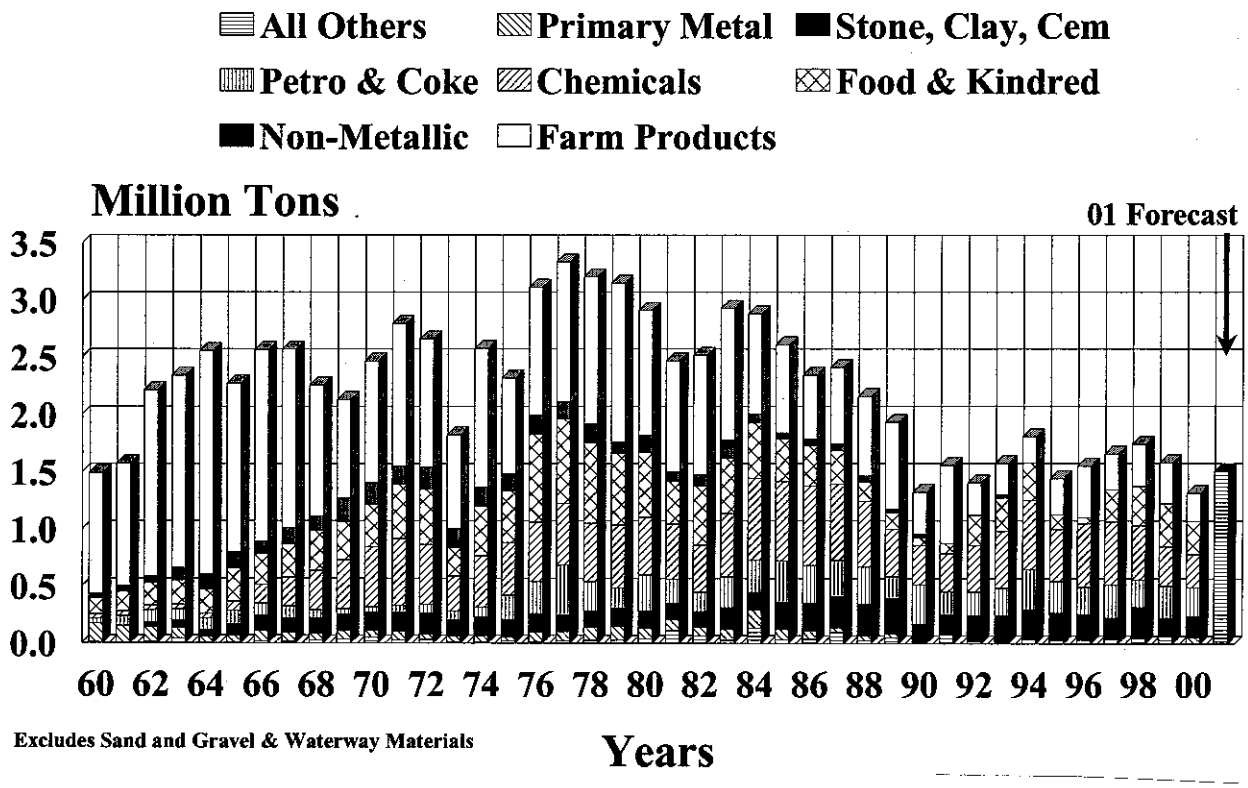
During the second week in August 2001, river stages below Kansas City dropped by approximately 4 feet. This relatively rapid change caused channel shoaling within the buoyed channel line. From about August 10 to August 24, 2001 the river had shoaling problems at river miles; 11.4, 28.3, 51.8, 60.3, 67.9, 108.0, 110.0, 118.6, 133.0, 213.3, and 217.4. The towboat "Hal D. Miller," ran aground at river mile 11.4 on August 14, 2001. The towboat "Lauren D.," had to double trip at river mile 217 on August 15, 2001. The towboat "Jennie Dehmer," with two barges of asphalt was aground at river mile 133 on August 17, 2001 for about 6 hours. The Kansas City District responded by providing two channel reconnaissance crews to help the industry find a suitable channel through the restrictions. The Coast Guard responded by accelerating its buoy tending schedule, and brought the "Cheyenne" from the Mississippi River to rebuoy the channel. Of note is that the Missouri River at river mile 9, that gave so many navigation problems late in the 2000 navigation season, was not a problem during 2001. The completion of the new dike structure on August 1, 2001 had worked to control the shoaling.

Missouri River

Total Navigation Tonnage



Commercial Navigation Tonnage



Excludes Sand and Gravel & Waterway Materials

(Revised)

Figure 9

Navigation season target flows for past years are given in ***Table VII***. System storage peaked at 54.7 MAF on July 8, 2001, 3.0 MAF lower than the previous year's peak and 7.8 MAF below the average peak storage for the period 1967-2000. Reduced service flows were provided at all target locations until the July 1 System storage check.

Table VIII shows the scheduled lengths of past navigation seasons with total tonnage and ton-miles for each year. A full 8-month season will be provided during 2001, but for the second consecutive year, a 10-day extension to the navigation season will not occur. The commercial tonnage figure for 2001 is a preliminary estimate and will likely change once final WCSC tabulations are available. Missouri River commercial tonnage in 2001 may total about 1.5 million tons based on estimates from daily reports of towboat activity.

Figure 10 presents discharge data at Sioux City, Nebraska City, and Kansas City for the August 2000 through July 2001 period. The three graphs demonstrate that actual flows at these locations are influenced considerably by main stem releases. Flows during the second half of the 2000 navigation season were at the full service level at all locations. The flows were relatively stable and correlated well with System releases. During the first half of the 2001 navigation season, releases were very low due to plains snowmelt runoff providing sufficient flows to meet the intermediate service navigation target flow requirement at Sioux City (3,000 cfs less than full service). Unlike most years since 1984 when endangered species operations began, flows below Gavins Point were not automatically increased early in May in anticipation of navigation requirement support in August but rather followed current navigation target flow requirements through the summer period. Runoff was sufficient during the first half of the year to allow the flows to remain at 3,000 cfs less than full service support for the remainder of the 2001 navigation season.

5. <u>Power - Eastern Division, Pick-Sloan Missouri Basin Program (P-S MBP)</u>. The CY 2000 generated energy was transmitted over a Federal transmission system traversing 7,745 circuit miles. This past year, service was provided to 342 customers in a six-state area. Those receiving direct service include 187 municipalities, 5 Federal agencies, 36 state agencies, 29 U.S. Bureau of Reclamation projects, 3 irrigation districts, 34 rural electric cooperatives, 7 public utility districts, 40 private utilities, and 1 interproject 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 2000 by the Federal power system could have supplied all of the yearly needs of 930,000 residential OPPD customers for a retail value of about $870 million.

TABLE VII
NAVIGATION SEASON TARGET FLOWS
Target Flows, 1,000 cfs

Year	Months	Sioux City	Omaha	Nebraska City	Kansas City
1967	Apr-Jun	28.0	28.0	34.0	38.0
	Jul-Nov	31.0	31.0	37.0	41.0
1968	Apr-Nov	31.0	31.0	37.0	41.0
1969	Apr-Jun (1)	35.0-40.0	35.0-40.0	41.0-46.0	45.0-50.0
	Jul (1)	36.0	36.0	42.0	46.0
	Aug-Sep (1)	50.0-55.0	50.0-55.0	55.0-60.0	55.0-60.0
	Oct-Nov (1)	40.0-45.0	40.0-45.0	45.0-50.0	50.0-55.0
1970	Apr-May	31.0	31.0	37.0	41.0
	May-Sep (1)	36.0	36.0	42.0	46.0
	Oct-Nov (1)	40.0	40.0	46.0	50.0
1971	Apr-May (1)	36.0	36.0	42.0	46.0
	May-Nov (1)	45.0-50.0	45.0-50.0	50.0-55.0	55.0-60.0
1972	Apr-Nov (1)	40.0-50.0	40.0-50.0	45.0-55.0	50.0-60.0
1973-74	Apr-Nov	31.0	31.0	37.0	41.0
1975	Apr	31.0	31.0	37.0	41.0
	May-Nov (1)	35.0-60.0	35.0-60.0	41.0-66.0	45.0-70.0
1976	Apr-Jul (1)	34.0-38.0	34.0-38.0	40.0-44.0	44.0-48.0
	Aug-Dec (1)	31.0-34.0	31.0-34.0	37.0-40.0	41.0-44.0
1977	Apr-Nov	31.0	31.0	37.0	41.0
1978	Apr	31.0	31.0	37.0	41.0
	May-Jul (1)	35.0-46.0	35.0-46.0	41.0-52.0	45.0-56.0
	Aug-Nov (1)	46.0-51.0	46.0-51.0	52.0-57.0	56.0-61.0
1979	Apr-Jul (1)	36.0-42.0	36.0-42.0	42.0-48.0	46.0-52.0
	Aug-Nov (1)	31.0-36.0	31.0-36.0	37.0-42.0	41.0-46.0
1980	Apr-Nov	31.0	31.0	37.0	41.0
1981	Apr-Nov (2)	31.0	31.0	37.0	41.0
1982	Apr-Sep	31.0	31.0	37.0	41.0
	Oct	31.0-36.0	31.0-36.0	37.0-42.0	41.0-46.0
	Nov-Dec (1)	36.0-46.0	36.0-46.0	42.0-52.0	46.0-56.0
1983	Apr-Jun	31.0	31.0	37.0	41.0
	Jul	31.0-36.0	31.0-36.0	37.0-42.0	41.0-46.0
	Aug-Nov (1)	36.0	36.0	42.0	46.0
1984	Apr-Jun	31.0	31.0	37.0	41.0
	Jul-Dec (1)	31.0-44.0	31.0-44.0	37.0-50.0	41.0-54.0
1985	Apr-Dec	31.0	31.0	37.0	41.0
1986	Apr (1)	36.0-41.0	36.0-41.0	42.0-47.0	46.0-51.0
	May-Dec (1)	41.0-46.0	41.0-46.0	47.0-52.0	51.0-56.0
1987	Apr-Nov	31.0	31.0	37.0	41.0
1988	Apr-Nov (2)	31.0	31.0	37.0	41.0
1989	Apr-Aug (3)	28.0	28.0	34.0	38.0
	Sep-Oct (3)	28.0	28.0	34.0	35.0
1990-93	Apr-Oct (4)	25.0	25.0	31.0	35.0
1994	Apr-Dec	31.0	31.0	37.0	41.0
1995	Apr-May	31.0	31.0	37.0	41.0
	Jun-Dec (1)	46.0-56.0	46.0-56.0	52.0-62.0	56.0-66.0
1996	Apr (1)	41.0	41.0	47.0	51.0
	May (1)	41.0-51.0	41.0-51.0	47.0-57.0	51.0-61.0
	Jun-Dec (1)	56.0	56.0	62.0	66.0
1997	Apr - Dec (5)	*	*	*	*
1998	Apr - Dec	31.0	31.0	37.0	41.0
1999	Apr-Dec (1)	31.0-43.0	31.0-43.0	37.0-49.0	41.0-53.0
2000	Apr-Jun	31	31	37	41
	Jul-Dec (3)	29.5	29.5	35.5	39.5
2001	Apr-Dec(3)	28	28	34	38

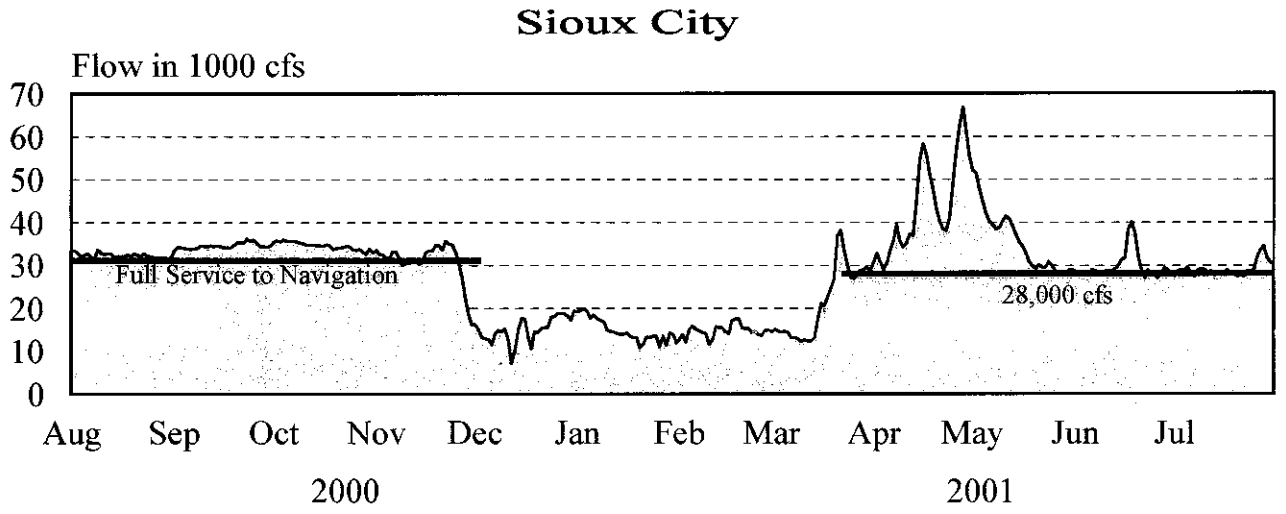
(1) Downstream flow targets above full-service navigation level as a flood control storage evacuation measure.
(2) Full service flows provided for shortened season.
(3) Navigation targets below full service as a water conservation measure.
(4) Navigation targets at minimum service as a water conservation measure.
(5) Releases determined by flood control storage evacuation criteria and not adjusted to meet specific navigation targets.

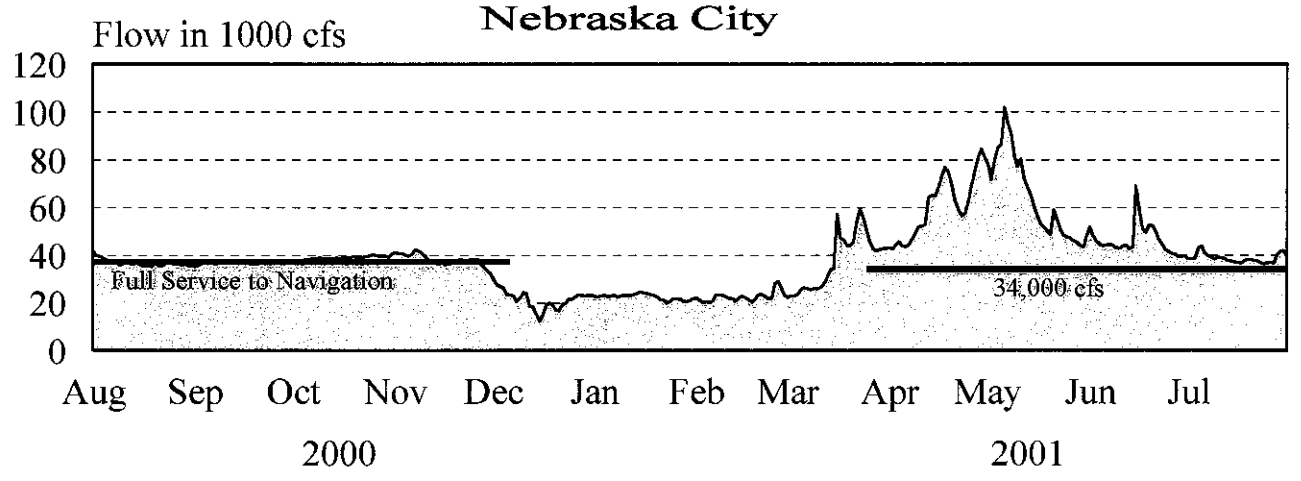
TABLE VIII
MISSOURI RIVER NAVIGATION
TONNAGE AND SEASON LENGTH

Year	Scheduled Length of Season (Months)	Commercial (Tons) (1)	Total Traffic (Tons) (2)	Total Traffic (1000 Ton-Miles) (1)
1967 (3)	8	2,562,657	6,659,219	1,179,235
1968	8 (4)	2,254,489	6,724,562	1,047,935
1969	8 (4)	2,123,152	7,001,107	1,053,856
1970	8 (5)	2,462,935	7,519,251	1,190,232
1971	8 (4)	2,791,929	7,483,708	1,329,899
1972	8 (4)	2,665,579	7,182,841	1,280,385
1973	8	1,817,471	6,370,838	844,406
1974	8	2,576,018	7,673,084	1,227,525
1975	8 (4)	2,317,321	6,208,426	1,105,811
1976	8 (4)	3,111,376	6,552,949	1,535,912
1977	8	3,335,780	6,734,850	1,596,284
1978	8 (4)	3,202,822	7,929,184	1,528,614
1979	8 (4)	3,145,902	7,684,738	1,518,549
1980	8	2,909,279	5,914,775	1,335,309
1981	7-1/4 (6)	2,466,619	5,251,952	1,130,787
1982	8 (4)	2,513,166	4,880,527	1,131,249
1983	8 (4)	2,925,384	6,301,465	1,300,000
1984	8 (4)	2,878,720	6,386,205	1,338,939
1985	8 (4) (7)	2,606,461	6,471,418	1,201,854
1986	8 (4) (7)	2,343,899	6,990,778	1,044,299
1987	8	2,405,212	6,735,968	1,057,526
1988	7-1/2	2,156,387	6,680,878	949,356
1989	6-3/4	1,906,508	5,352,282	796,799
1990	6-3/4	1,329,000	5,841,000	552,509
1991	6-3/4	1,563,000	5,729,000	
1992	6-3/4	1,403,000	5,783,000	
1993	8 (8)	1,570,000	5,631,000	615,541
1994	8	1,800,000	8,501,000	774,491
1995	8 (4) (8)	1,439,000	6,884,000	604,171
1996	8 (4)	1,547,000	8,165,000	680,872
1997	8 (4)	1,651,000	8,172,000	725,268
1998	8 (4)	1,735,000	8,379,000	777,727
1999	8 (4) (8)	1,576,000	9,252,000	
2000	8	1,344,000 (9)	8,733,000(9)	
2001	8	1,500,000 (9)		

(1) Includes commercial tonnage except for sand and gravel or waterway materials. Tonnage compiled by Waterborne Commerce Statistics Center (WCSC)
(2) Includes commodities; sand, gravel and crushed rock; and waterway improvement materials. Tonnage by WCSC.
(3) Main stem reservoir system reached normal operating storage level in 1967.
(4) 10-day extension of season provided.
(5) 10-day extension and 10-day early opening provided.
(6) Full service flows for shortened season in preference to reduced service.
(7) 10-day extension provided for 1985 season in trade for 10-day delayed support of 1986 season.
(8) Lower Missouri River closed: 57 days in 1993, 20 days in 1995, and 18 days in 1999.
(9) Preliminary estimate.

Missouri River Flows at Sioux City, Nebraska City and Kansas City





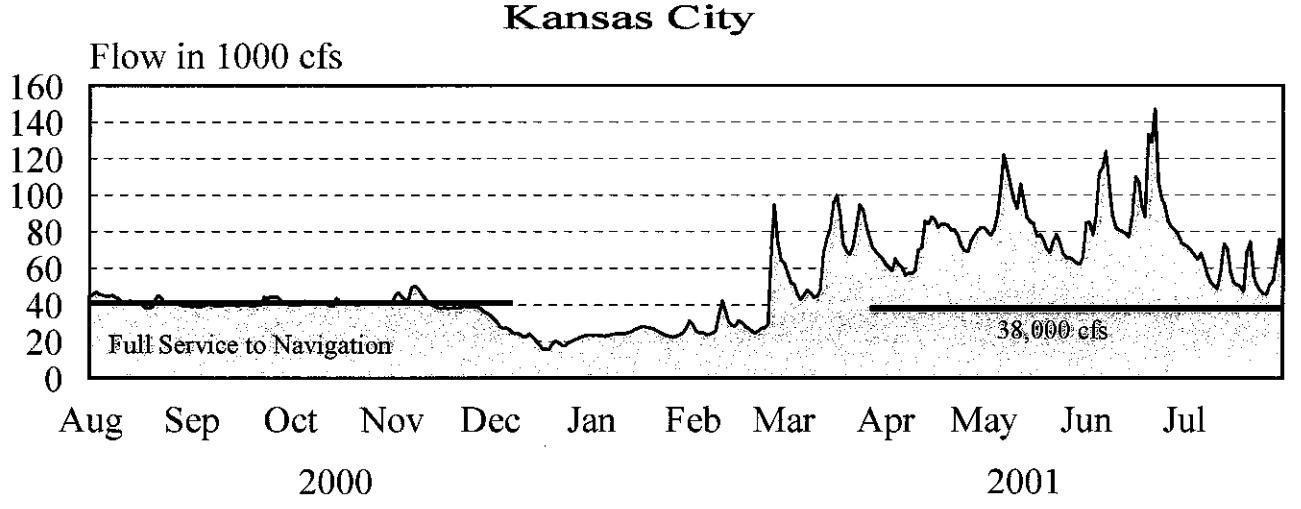


Figure 10

In addition to the clean, renewable power and energy transmitted to the Midwest area, the hydropower system provided an added measure of stability to the regional power system with the ability to meet full load in 5 seconds or less. These units can be reinforced by idle hydro 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 10 percent reserve while thermal power must maintain 15 percent reserve. Although the Federal hydropower system accounts for only 9 percent of the region's power, it is large enough to fill gaps and provide a positive benefit to the integrated system.

CY 2000 generation was 95 percent of the average since the System first filled in 1967. Below normal releases at all powerplants except Oahe resulted in the below normal generation. CY main stem generation with individual project distribution since 1954 is shown on ***Figure 11***.

Generation was 1.6 billion kWh for the December-through-February (2000-2001) winter energy period, 74 percent of the past 34-year average. Western purchased about 1.5 billion kWh between December 1, 2000 and February 28, 2001 at a cost of $66.5 million to supplement main stem hydropower production.

Energy production was below normal August 2000 through July 2001 due to below normal runoff and reduced system releases. April through June 2001 generation set new record lows for the month, a result of substantially below normal releases from all six powerplants. Western's energy purchases exceeded sales by 786 million kWh for the August 2000 through July 2001 period, but revenue from sales exceeded purchased energy cost by $53 million.

Total generation for the period August 2000 - July 2001 was 7.0 billion kWh, 68 percent of the 34-year average dating back to 1967. The gross generation from the Federal system (peak capacity and energy sales) for the August 2000 through July 2001 operating period is shown in ***Table IX***.

Western markets firm main stem hydropower to customers based on the capacity that would have been available in 1961 if the system had been operational at that time and based on long term average energy. The year 1961 was the last and most severe year of an 8-year drought.

Main Stem Power Generation
1954 - 2001

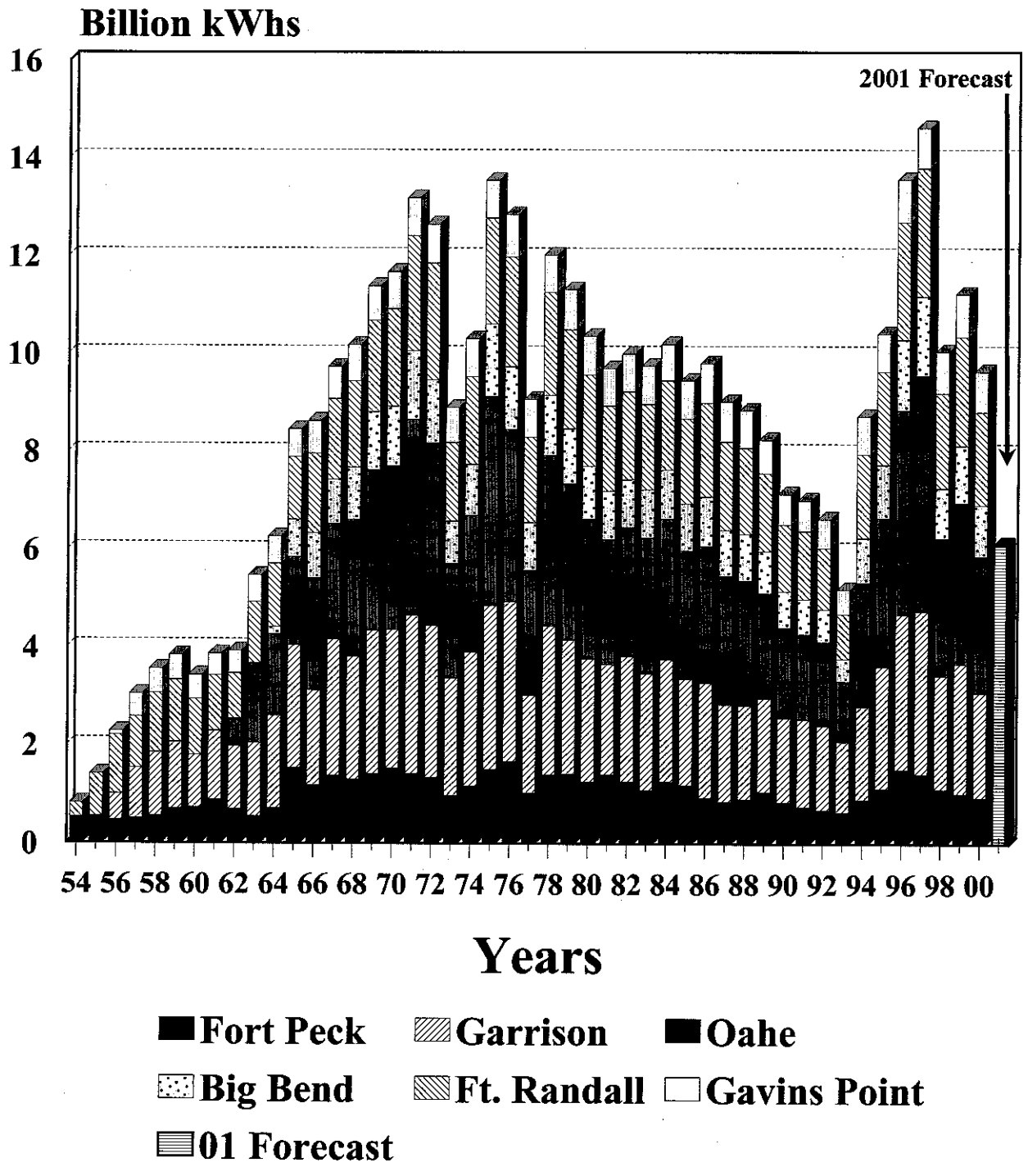


Figure 11

TABLE IX
GROSS POWER SYSTEM GENERATION
(August 2000 through July 2001)

	Energy Generation 1,000 kWh	Peak Hour kW	Generation Date
Corps Powerplants - Main Stem			
Fort Peck	815,723	194,000	8/24/00
Garrison	1,655,956	450,000	9/1&4/00
Oahe	1,797,314	679,000	8/9/00
Big Bend	694,271	480,000	8/30/00
Fort Randall	1,333,746	343,000	6/30/01
Gavins Point	661,895	117,000	9&10/00
Subtotal	6,958,905	2,073,000	8/11/00
USBR Powerplants			
Canyon Ferry	247,977	50,000	8&10/00
Yellowtail*	287,051	93,000	7/01
USBR Subtotal	535,028		
FEDERAL SYSTEM TOTAL	7,493,933		

*Includes one half of total Yellowtail generation which is marketed by Eastern Division.

The tabulations in ***Tables X*** and ***XI*** summarize the total gross generation and power operations for the Eastern Division, P-S MBP, marketing area system for the past operating year. Actual settlement figures at the end of the billing periods differ somewhat from the calendar month figures shown.

Energy production in 2001 will only be 60 percent of normal due to low system releases from Gavins Point and the continued drought in the upper basin that has reduced generation at Fort Peck and Garrison.

6. **Fish Management.** Walleye harvest on Lake Sakakawea was again high in 2001. High numbers of northern pike, white bass, and smallmouth bass were also caught. Very good salmon fishing was noted in the lower portion of the lake.

TABLE X

HISTORICAL GENERATION AND LOAD DATA
EASTERN DIVISION, PICK-SLOAN MISSOURI BASIN PROGRAM*
Data at plant - 1,000 kW
August 1, 2000 through July 31, 2001

Period	Corps of Engineers Peak Hour Generation (Gross)	(plus)	USBR Hourly Generation (Gross)	(equals)	Federal Peak Hour Generation (Gross)	(plus)	Interchange and Purchases Received**	(equals)	Total System Load**
2000									
August	2,073		33		2,106		1336		3,442
September	1,940		34		1,974		894		2,868
October	1,694		32		1,726		666		2,392
November	1,811		34		1,845		697		2,542
December	1,582		33		1,615		1106		2,721
2001									
January	1,597		34		1,631		1305		2,936
February	1,494		35		1,529		1090		2,619
March	1,457		34		1,491		815		2,306
April	941		34		975		906		1,881
May	947		31		978		1159		2,137
June	1,266		32		1,298		1025		2,323
July	1,741		31		1,772		853		2,625

* This tabulation summarizes the total gross generation and power operations for the Eastern Division marketing area system shown on Table XV.
** During hour of Federal peak hour generation.

TABLE XI

HISTORICAL GENERATION AND LOAD DATA
EASTERN DIVISION, PICK-SLOAN MISSOURI BASIN PROGRAM*
Data at plant - 1,000 kWh
August 1, 2000 through July 31, 2001

Period	Corps of Engineers Generation (Gross)	(plus)	USBR Generation (Gross)	(equals)	Federal Generation (Gross)	(plus)	Scheduled Interchange and Purchases Received	(equals)	Total System Load
2000									
August	967,458		50,000		1,017,458		122,000		1,139,458
September	853,031		39,000		892,031		163,000		1,055,031
October	683,573		44,000		727,573		192,000		919,573
November	740,905		44,000		784,905		189,000		973,905
December	564,549		45,000		609,549		522,000		1,131,549
2001									
January	585,752		46,000		631,752		462,000		1,093,752
February	478,692		43,000		521,692		464,000		985,692
March	433,245		43,000		476,245		367,000		843,245
April	250,587		41,000		291,587		492,000		783,587
May	317,271		41,000		358,271		461,000		819,271
June	483,242		40,000		523,242		365,000		888,242
July	600,330		43,000		643,330		175,000		818,330

*Powerplants from Table XV

Rainbow smelt are the primary forage species in both Lake Sakakawea and Oahe. Successful rainbow smelt reproduction is highly dependent on stable lake levels. Most eggs are laid in water less than one foot deep and are subject to desiccation through wave action and slight drops in water elevation. Rainbow smelt spawning was again very good in Lake Sakakawea during spring 2001. Early indications are that walleye spawning was also successful.

The walleye fishery continues to be in poor condition in Lake Oahe. Large numbers of small walleye in poor condition dominate the fishery. Poor smelt populations coupled with good walleye recruitment during the past years are thought to be primarily responsible. Regulations providing for liberal daily limits of walleye on Oahe in 2001 resulted in the highest ever documented April-May harvest. Rainbow smelt recruitment in the spring of 2001 was again thought to be poor in spite of stable water levels through the spawning period.

7. **Endangered and Threatened Species.** This is the 16th year of operation since the interior least terns and piping plovers were Federally listed as endangered and threatened species, respectively. Both the least tern and piping plover nest on sparsely vegetated sandbars, islands, and shoreline on the Missouri River. 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. Daily updated report data includes nest records, census and productivity data, site descriptions, field journals, and messages. This database again provided vital information during the 2001 nesting season and proved to be a valuable tool in aiding release decisions benefiting endangered and threatened birds.

Although the Corps prevented inundation of nests where possible and accomplished habitat creation, fledging continued to be lower than predicted by the U.S. Fish and Wildlife Service 1990 Biological Opinion until 1998 when fledge ratios exceeded the goal for both species. Predation, habitat degradation, severe weather, nest inundation, recent record runoff, and other factors contributed to the previous disappointingly 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 main stem projects.

For 2001, the majority of piping plovers were found on Lake Sakakawea 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, 1054, were found on the Missouri

River System this year. The majority of least terns were found on the Missouri River reaches below Garrison, and Gavins Point Dams.

Table XII shows the population distribution and productivity for terns and plovers for 1989 through 2001. Productivity estimates for these birds on the Missouri River in 2001 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" means 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 Missouri River main stem reservoirs provide outstanding opportunities for boating, fishing, swimming, camping, and other outdoor recreation pursuits. Tourism related to the lakes is a major economic factor in all the states adjoining the main stem. During 2001, public use at these lakes was 59,665,900 visitor hours, a 2.0 percent decrease from 2000. Visitor attendance at the lake projects for 1999, 2000, and 2001 is shown in ***Table XIII.*** ***Figure 12*** displays recreation-related visitor hours at each of the six projects for the years 1954 through 2001. 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 of Engineers projects. All Corps projects, including the main stems, are now reporting visitation using the Visitation Estimation Reporting System (VERS).

TABLE XIII
VISITATION IN VISITOR HOURS

MAIN STEM PROJECT	YEAR			PERCENT INCREASE OR DECREASE
	1999	2000	2001	
Fort Peck	5,250,300	5,946,100	6,206,400	+4.4
Garrison	16,312,100	16,555,900	15,318,200	-7.5
Oahe	15,372,500	14,623,200	14,308,300	-2.2
Big Bend	5,215,300	5,261,800	5,057,400	-3.9
Fort Randall	10,811,200	9,752,300	10,128,400	+3.9
Gavins Point	8,826,800	8,756,400	8,647,200	-1.2
SYSTEM TOTAL	61,788,200	60,895,700	59,665,900	-2.0

Figures computed using the Visitation Estimating Reporting System

Table XII
Missouri River Main Stem
Least Tern and Piping Plover Survey Data

	Interior Least Tern													Piping Plover											
	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Fort Peck Lake																										
Adults	4	6	10	0	7	9	2	0	0	4	0	0	0	12	22	25	26	30	4	5	0	0	4	2	0	4
Fledglings/Pair	3.00	0	0.40	0	0	0.44	0	0	0	0	0	0	0	1.50	3.18	1.20	1.00	0.60	1.50	1.20	0	0	0	2.00	0	1
Fort Peck to Lake Sakakawea																										
Adults	48	92	66	110	31	58	95	128	162	25	40	13	39	11	17	13	0	4	9	20	24	23	4	5	4	3
Fledglings/Pair	0	0.17	0.55	0.25	0.45	1.41	0.99	0.33	0.53	.1.52	1.70	0.15	0.97	0.18	0	0	0	0	0	3.50	1.00	0.87	1.00	0	0	1.33
Lake Sakakawea																										
Adults	15	6	8	29	17	35	7	27	2	23	9	10	34	57	132	150	108	8	45	24	70	3	119	83	277	424
Fledglings/Pair	0	0	0	0.83	0.12	0	0	0.15	0	1.04	0.67	0.20	0.76	0	0	0	1.50	8.50	1.24	0	0.57	0.67	1.24	1.25	1.61	1.25
Garrison to Lake Oahe																										
Adults	121	174	195	198	145	217	284	105	41	141	105	105	125	84	71	124	77	127	119	261	45	6	74	139	99	149
Fledglings/Pair	0.43	0.44	0.58	0.48	0.28	0.54	0.91	0.08	0.39	1.52	1.50	1.03	1.26	0.26	1.04	1.13	1.06	0.54	0.87	0.87	0.09	0	1.84	0.88	1.41	1.53
Lake Oahe																										
Adults	97	100	143	124	125	160	84	74	101	110	57	85	94	140	88	87	143	66	85	30	21	31	98	46	141	184
Fledglings/Pair	0	0	0	0.42	0	0.06	0	0.24	0.16	1.29	0.88	1.01	1.34	0	0	0	0.97	0.33	0.09	0.93	0.29	1.29	1.06	0.30	1.45	1.41
Ft. Randall to Niobrara																										
Adults	4	26	32	13	38	43	10	2	0	64	124	72	71	0	12	25	8	12	17	0	3	0	33	51	62	38
Fledglings/Pair	0	0.31	0.63	0.46	0	0	0	0	0	0.94	1.03	1.26	0.14	0	0.67	0.48	0.75	0	0	0	0	0	1.27	1.02	0.87	0.74
Lake Lewis and Clark																										
Adults	29	63	55	29	76	44	16	28	60	120	76	44	58	18	30	33	6	32	12	4	6	32	84	67	28	34
Fledglings/Pair	0.62	0.35	0	1.59	0.97	0	0	0	1.57	2.33	0.21	0.38	1.17	0.56	0.67	0	0	0.06	0.33	0	0	1.25	2.45	0.30	0.5	0.71
Gavins Point to Ponca																										
Adults	210	167	193	187	272	211	93	82	115	148	161	149	232	122	148	166	112	109	62	63	22	22	49	141	186	218
Fledglings/Pair	0.55	0.46	0.26	0.21	0.83	0.48	0.49	0.27	0.90	2.27	2.41	1.72	1.09	0.21	0.39	0.35	0.34	1.06	0.61	0.16	0	0	2.20	1.60	2.17	1.85
Total Adults	528	634	702	690	711	777	591	446	481	635	572	551	653	444	521	623	480	388	353	407	191	117	465	534	797	1054
Fledglings/Pair	0.54	0.38	0.41	0.42	0.50	0.41	0.67	0.21	0.66	1.73	1.42	1.22	1.04	0.32	0.76	0.62	0.94	0.76	0.61	0.84	0.39	0.87	1.61	1.01	1.58	1.41

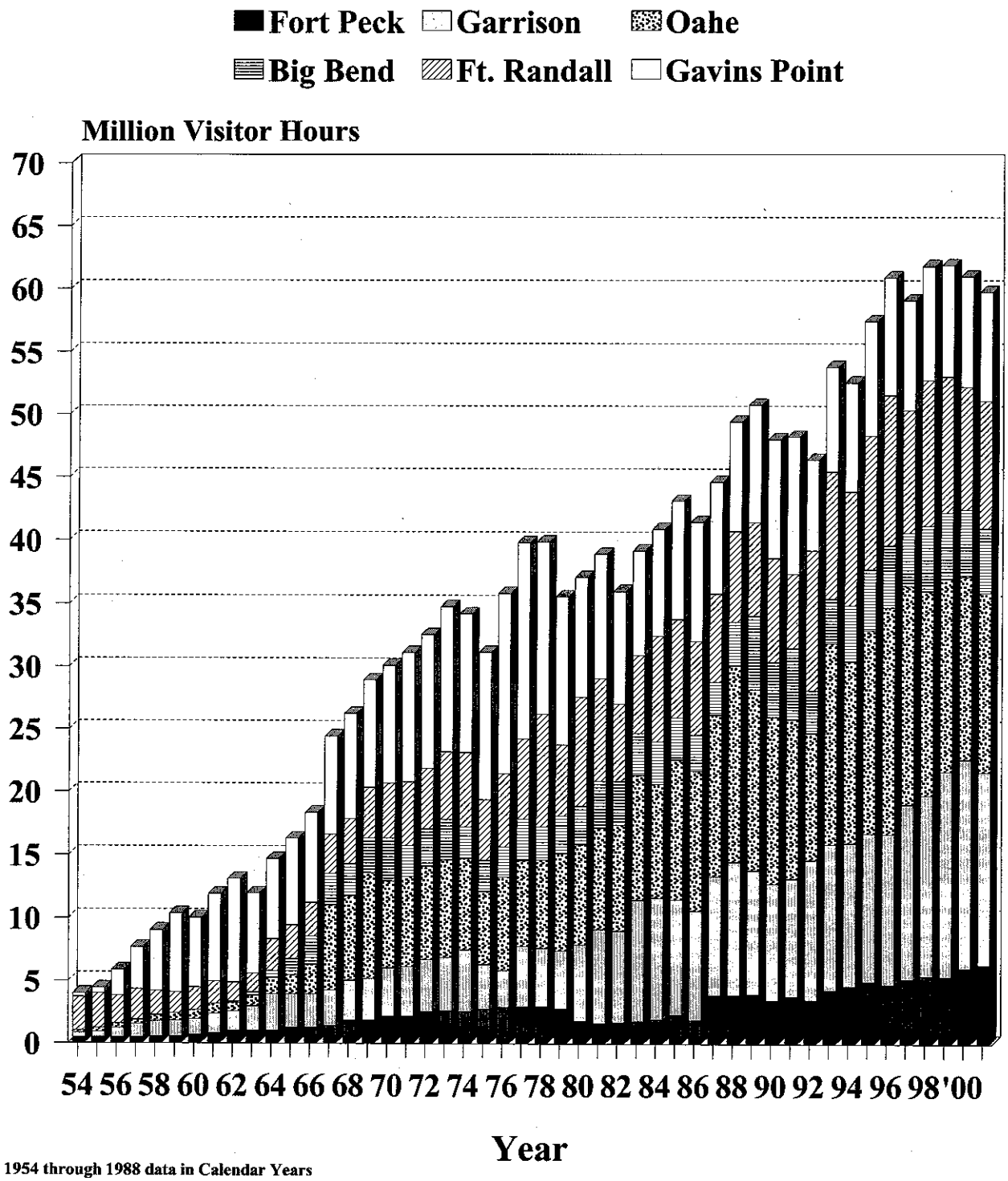
Ten Year Interior Least Tern Fledge Ratio Goal = 0.70

Fifteen Year Piping Plover Fledge Ratio Goal = 1.13

- Data not collected
* Partial Survey Results
{} No Birds Found
\+ Subsampling of Selected Nesting Areas

The data does not include least terns and piping plovers raised in captivity. The data represents only wild fledged birds.

Missouri River Main Stem
Project Visitor Hours
1954 to 2001



1954 through 1988 data in Calendar Years
1989 to 1991 in Fiscal Years
1992 to present in VERS System.

Figure 12

Between 2003 and 2006, the nation will commemorate the 200th anniversary of the Lewis and Clark Expedition. A significant increase in visitation is expected at points of interest along the trail of Lewis and Clark's journey. Because the Corps manages more of the trail than any other entity (more than 90 percent), and because of its Army heritage of exploring and mapping the western United States, the Corps will play a key leadership role in the observance of the Lewis and Clark Expedition Bicentennial. The Corps is working with other Federal, Tribal, State, and local governments and the National Bicentennial Council to ensure that adequate facilities and information are available to accommodate the increased visitation, to ensure a safe visitor experience, to protect natural and cultural resources, and to plan and coordinate commemorative activities.

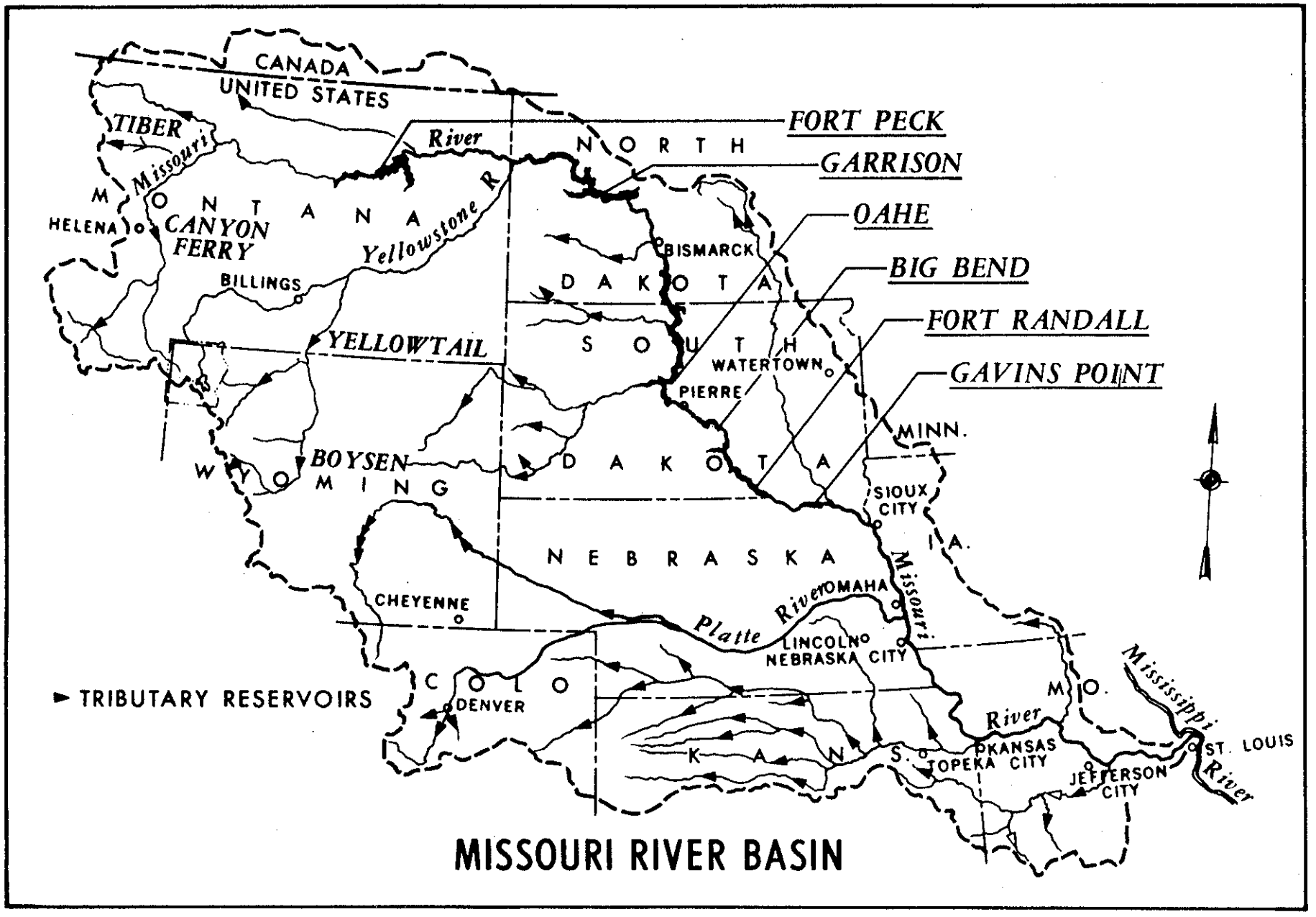

CANADA
UNITED STATES
TIBER
Missouri
River
FORT PECK
GARRISON
OAHE
BIG BEND
FORT RANDALL
GAVINS POINT
M O N T A N A
HELENA
CANYON FERRY
Yellowstone R.
BILLINGS
YELLOWTAIL
BISMARCK
N O R T H
D A K O T A
S O U T H
D A K O T A
WATERTOWN
PIERRE
MINN.
BOYSEN
W Y O M I N G
SIOUX CITY
IA.
N E B R A S K A
CHEYENNE
Platte River
OMAHA
Missouri
LINCOLN
NEBRASKA CITY
MO.
Mississippi River
C O L O
DENVER
K A N S
TOPEKA
KANSAS CITY
JEFFERSON CITY
ST. LOUIS
► TRIBUTARY RESERVOIRS
MISSOURI RIVER BASIN

PLATE 1

Summary of Engineering Data -- Missouri River Main Stem System

Item No.	Subject	Fort Peck Lake	Garrison Dam - Lake Sakakawea	Oahe Dam - Lake Oahe
1	Location of Dam	Near Glasgow, Montana	Near Garrison, ND	Near Pierre, SD
2	River Mile - 1960 Mileage	Mile 1771.5	Mile 1389.9	Mile 1072.3
3	Total & incremental drainage areas in square miles	57,500	181,400 (2) 123,900	243,490 (1) 62,090
4	Approximate length of full reservoir (in valley miles)	134, ending near Zortman, MT	178, ending near Trenton, ND	231, ending near Bismarck, ND
5	Shoreline in miles (3)	1520 (elevation 2234)	1340 (elevation 1837.5)	2250 (elevation 1607.5)
6	Average total & incremental inflow in cfs	10,200	25,600 15,400	28,900 3,300
7	Max. discharge of record near damsite in cfs	137,000 (June 1953)	348,000 (April 1952)	440,000 (April 1952)
8	Construction started - calendar yr.	1933	1946	1948
9	In operation (4) calendar yr.	1940	1955	1962
	Dam and Embankment			
10	Top of dam, elevation in feet msl	2280.5	1875	1660
11	Length of dam in feet	21,026 (excluding spillway)	11,300 (including spillway)	9,300 (excluding spillway)
12	Damming height in feet (5)	220	180	200
13	Maximum height in feet (5)	250.5	210	245
14	Max. base width, total & w/o berms in feet	3500, 2700	3400, 2050	3500, 1500
15	Abutment formations (under dam & embankment)	Bearpaw shale and glacial fill	Fort Union clay shale	Pierre shale
16	Type of fill	Hydraulic & rolled earth fill	Rolled earth filled	Rolled earth fill & shale berms
17	Fill quantity, cubic yards	125,628,000	66,500,000	55,000,000 & 37,000,000
18	Volume of concrete, cubic yards	1,200,000	1,500,000	1,045,000
19	Date of closure	24 June 1937	15 April 1953	3 August 1958
	Spillway Data			
20	Location	Right bank - remote	Left bank - adjacent	Right bank - remote
21	Crest elevation in feet msl	2225	1825	1596.5
22	Width (including piers) in feet	820 gated	1336 gated	456 gated
23	No., size and type of gates	16 - 40' x 25' vertical lift gates	28 - 40' x 29' Tainter	8 - 50' x 23.5' Tainter
24	Design discharge capacity, cfs	275,000 at elev 2253.3	827,000 at elev 1858.5	304,000 at elev 1644.4
25	Discharge capacity at maximum operating pool in cfs	230,000	660,000	80,000
	Reservoir Data (6)			
26	Max. operating pool elev. & area	2250 msl 246,000 acres	1854 msl 380,000 acres	1620 msl 374,000 acres
27	Max. normal op. pool elev. & area	2246 msl 240,000 acres	1850 msl 364,000 acres	1617 msl 360,000 acres
28	Base flood control elev & area	2234 msl 212,000 acres	1837.5 msl 307,000 acres	1607.5 msl 312,000 acres
29	Min. operating pool elev. & area	2160 msl 90,000 acres	1775 msl 128,000 acres	1540 msl 117,000 acres
	Storage allocation & capacity			
30	Exclusive flood control	2250-2246 975,000 a.f.	1854-1850 1,489,000 a.f.	1620-1617 1,102,000 a.f.
31	Flood control & multiple use	2246-2234 2,717,000 a.f.	1850-1837.5 4,222,000 a.f.	1617-1607.5 3,201,000 a.f.
32	Carryover multiple use	2234-2160 10,785,000 a.f.	1837.5-1775 13,130,000 a.f.	1607.5-1540 13,461,000 a.f.
33	Permanent	2160-2030 4,211,000 a.f.	1775-1673 4,980,000 a.f.	1540-1415 5,373,000 a.f.
34	Gross	2250-2030 18,688,000 a.f.	1854-1673 23,821,000 a.f.	1620-1415 23,137,000 a.f.
35	Reservoir filling initiated	November 1937	December 1953	August 1958
36	Initially reached min. operating pool	27 May 1942	7 August 1955	3 April 1962
37	Estimated annual sediment inflow	18,100 a.f. 1030 yrs.	25,900 a.f. 920 yrs.	19,800 a.f. 1170 yrs.
	Outlet Works Data			
38	Location	Right bank	Right Bank	Right Bank
39	Number and size of conduits	2 - 24' 8" diameter (nos. 3 & 4)	1 - 26' dia. and 2 - 22' dia.	6 - 19.75' dia. upstream, 18.25' dia. downstream
40	Length of conduits in feet (8)	No. 3 - 6,615, No. 4 - 7,240	1529	3496 to 3659
41	No., size, and type of service gates	1 - 28' dia. cylindrical gate 6 ports, 7.6' x 8.5' high (net opening) in each control shaft	1 - 18' x 24.5' Tainter gate per conduit for fine regulation	1 - 13' x 22' per conduit, vertical lift, 4 cable suspension and 2 hydraulic suspension (fine regulation)
42	Entrance invert elevation (msl)	2095	1672	1425
43	Avg. discharge capacity per conduit & total	Elev. 2250 22,500 cfs - 45,000 cfs	Elev. 1854 30,400 cfs - 98,000 cfs	Elev. 1620 18,500 cfs - 111,000 cfs
44	Present tailwater elevation (ft msl)	2032-2036 5,000 - 35,000 cfs	1670-1680 15,000- 60,000 cfs	1423-1428 20,000-55,000 cfs
	Power Facilities and Data			
45	Avg. gross head available in feet (14)	194	161	174
46	Number and size of conduits	No. 1-24'8" dia., No. 2-22'4" dia.	5 - 29' dia., 25' penstocks	7 - 24' dia., imbedded penstocks
47	Length of conduits in feet (8)	No. 1 - 5,653, No. 2 - 6,355	1829	From 3,280 to 4,005
48	Surge tanks	PH#1: 3-40' dia., PH#2: 2-65' dia.	65' dia. - 2 per penstock	70' dia., 2 per penstock
49	No., type and speed of turbines	5 Francis, PH#1-2: 128.5 rpm, 1-164 rpm , PH#2-2: 128.6 rpm	5 Francis, 90 rpm	7 Francis, 100 rpm
50	Discharge cap. at rated head in cfs	PH#1, units 1&3 170', 2-140' 8,800 cfs, PH#2-4&5 170'-7,200 cfs	150' 41,000 cfs	185' 54,000 cfs
51	Generator nameplate rating in kW	1&3: 43,500; 2: 18,250; 4&5: 40,000	3 - 109,250, 2 - 95,000	112,290
52	Plant capacity in kW	185,250	517,750	786,030
53	Dependable capacity in kW (9)	181,000	388,000	534,000
54	Avg. annual energy, million kWh (12)	1,156	2,462	2,905
55	Initial generation, first and last unit	July 1943 - June 1961	January 1956 - October 1960	April 1962 - June 1963
56	Estimated cost September 1999 completed project (13)	$158,428,000	$305,274,000	$346,521,000

Summary of Engineering Data -- Missouri River Main Stem System

Big Bend Dam - Lake Sharpe	Fort Randall Dam - Lake Francis Case	Gavins Point Dam - Lewis & Clark Lake	Total	Item No.	Remarks
21 miles upstream Chamberlain, SD	Near Lake Andes, SD	Near Yankton, SD		1	(1) Includes 4,280 square miles of non-contributing areas.
Mile 987.4	Mile 880.0	Mile 811.1		2	
249,330 (1) 5,840	263,480 (1) 14,150	279,480 (1) 16,000		3	(2) Includes 1,350 square miles of non-contributing areas.
80, ending near Pierre, SD	107, ending at Big Bend Dam	25, ending near Niobrara, NE	755 miles	4	
200 (elevation 1420)	540 (elevation 1350)	90 (elevation 1204.5)	5,940 miles	5	(3) With pool at base of flood control.
28,900	30,000 1,100	32,000 2,000		6	
440,000 (April 1952)	447,000 (April 1952)	480,000 (April 1952)		7	(4) Storage first available for regulation of flows.
1959	1946	1952		8	(5) Damming height is height from low water to maximum operating pool. Maximum height is from average streambed to top of dam.
1964	1953	1955		9	
1440	1395	1234		10	
10,570 (including spillway)	10,700 (including spillway)	8,700 (including spillway)	71,596	11	(6) Based on latest available storage data.
78	140	45	863 feet	12	
95	165	74		13	(7) River regulation is attained by flows over low-crested spillway and through turbines.
1200, 700	4300, 1250	850, 450		14	
Pierre shale & Niobrara chalk	Niobrara chalk	Niobrara chalk & Carlile shale		15	(8) Length from upstream face of outlet or to spiral case.
Rolled earth, shale, chalk fill	Rolled earth fill & chalk berms	Rolled earth & chalk fill		16	
17,000,000	28,000,000 & 22,000,000	7,000,000	358,128,000 cu. yds	17	(9) Based on 8th year (1961) of drought drawdown (From study 8-83-1985).
540,000	961,000	308,000	5,554,000 cu. yds.	18	
24 July 1963	20 July 1952	31 July 1955		19	
Left bank - adjacent	Left bank - adjacent	Right bank - adjacent		20	(10) Affected by level of Lake Francis case. Applicable to pool at elevation 1350.
1385	1346	1180		21	
376 gated	1000 gated	664 gated		22	(11) Spillway crest.
8 - 40' x 38' Tainter	21 - 40' x 29' Tainter	14 - 40' x 30' Tainter		23	(12) 1967-2000 Average
390,000 at elev 1433.6	620,000 at elev 1379.3	584,000 at elev 1221.4		24	(13) Source: Annual Report on Civil Works Activities of the Corps of Engineers. Extract Report Fiscal Year 1999.
270,000	508,000	345,000		25	
1423 msl 61,000 acres	1375 msl 102,000 acres	1210 msl 31,000 acres	1,194,000 acres	26	(14) Based on Study 8-83-1985
1422 msl 60,000 acres	1365 msl 95,000 acres	1208 msl 28,000 acres	1,147,000 acres	27	
1420 msl 57,000 acres	1350 msl 77,000 acres	1204.5 msl 24,000 acres	989,000 acres	28	
1415 msl 51,000 acres	1320 msl 38,000 acres	1204.5 msl 24,000 acres	450,000 acres	29	
1423-1422 60,000 a.f.	1375-1365 985,000 a.f.	1210-1208 59,000 a.f.	4,670,000 a.f.	30	
1422-1420 117,000 a.f.	1365-1350 1,309,000 a.f.	1208-1204.5 90,000 a.f.	11,656,000 a.f.	31	
	1350-1320 1,607,000 a.f.		38,983,000 a.f.	32	
1420-1345 1,682,000 a.f.	1320-1240 1,517,000 a.f.	1204.5-1160 321,000 a.f.	18,084,000 a.f.	33	
1423-1345 1,859,000 a.f.	1375-1240 5,418,000 a.f.	1210-1160 470,000 a.f.	73,393,000 a.f.	34	
November 1963	January 1953	August 1955		35	
25 March 1964	24 November 1953	22 December 1955		36	
4,300 a.f. 430 yrs.	18,300 a.f. 250 yrs.	2,600 a.f. 180 yrs.	92,500 a.f.	37	
	Left Bank			38	
None (7)	4 - 22' diameter	None (7)		39	
	1013			40	
	2 - 11' x 23' per conduit, vertical lift, cable suspension			41	
1385 (11)	1229	1180 (11)		42	
	Elev 1375			43	
	32,000 cfs - 128,000 cfs				
1351-1355(10) 25,000-100,000 cfs	1228-1239 5,000-60,000 cfs	1155-1163 15,000-60,000 cfs		44	
70	117	48	764 feet	45	
None: direct intake	8 - 28' dia., 22' penstocks	None: direct intake		46	
	1,074		55,083	47	
None	59' dia, 2 per alternate penstock	None		48	
8 Fixed blade, 81.8 rpm	8 Francis, 85.7 rpm	3 Kaplan, 75 rpm	36 units	49	
67' 103,000 cfs	112' 44,500 cfs	48' 36,000 cfs		50	
3 - 67,276, 5 - 58,500	40,000	44,100		51	
494,320	320,000	132,300	2,435,650 kw	52	
497,000	293,000	74,000	1,967,000 kw	53	Corps of Engineers, U.S. Army
1,054	1,862	758	10,197 million kWh	54	Compiled by
October 1964 - July 1966	March 1954 - January 1956	September 1956 - January 1957	July 1943 - July 1966	55	Northwestern Division
				56	Missouri River Region
$107,498,000	$199,066,000	$49,617,000	$1,166,404,000		May 2001

Plate 2