US Army Corps
of Engineers

Northwestern Division
Missouri River Basin
Water Management Division

Missouri River Main Stem Reservoirs

Summary of Actual 1999 - 2000 Operations

February 2001

MISSOURI RIVER MAIN STEM RESERVOIRS

Summary of Actual 1999-2000 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 1999 – 2000 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, 2000. 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 1999-2000 Operation," and "Annual Operating Plan, 2000-2001," 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 2001.

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 1999 THROUGH JULY 2000

A. General. During this period, the Missouri River main stem reservoirs were regulated in accordance with the applicable provisions of the 1999-2000 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 1999.

1. January - July 1999. Runoff during the first 7 months of 1999, as shown on ***Table I***, was well above normal. By late summer most of the basin had normal to moist soil conditions with the exception of western Montana where moderate drought conditions had developed. See last year's AOP for a detailed description of precipitation, snowpack, and runoff patterns for the period January through July 1999.

Table I
Upper Missouri River Basin Runoff
For Calendar Year 1999

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 99	441	393	-43	158	215	134	1,164	1,298	1,298
NORMAL	315	260	10	20	100	35	705	740	740
DEPARTURE	126	133	-53	138	115	99	459	558	558
% OF NORM	140%	151%	-430%	790%	215%	383%	165%	175%	175%
FEB 99	418	506	207	78	317	178	1,526	1,704	3,002
NORMAL	365	360	90	50	125	85	990	1,075	1,815
DEPARTURE	53	146	117	28	192	93	459	558	1,187
% OF NORM	115%	141%	230%	156%	254%	209%	154%	159%	165%
MAR 99	504	1669	687	44	308	359	3,212	3,571	6,573
NORMAL	610	1010	580	220	205	300	2,625	2,925	4,740
DEPARTURE	-106	659	107	-176	103	59	459	558	1,833
% OF NORM	83%	165%	118%	20%	150%	120%	122%	122%	139%
APR 99	416	901	270	235	408	638	2,230	2,868	9,441
NORMAL	665	1115	500	145	180	340	2,605	2,945	7,685
DEPARTURE	-249	-214	-230	90	228	298	459	558	1,756
% OF NORM	63%	81%	54%	162%	227%	188%	86%	97%	123%
MAY 99	764	1431	811	736	360	589	4,102	4,691	14,132
NORMAL	1120	1280	320	145	185	275	3,050	3,325	11,010
DEPARTURE	-356	151	491	591	175	314	459	558	3,122
% OF NORM	68%	112%	253%	508%	195%	214%	134%	141%	128%
JUN 99	1472	3279	482	189	346	747	5,768	6,515	20,647
NORMAL	1655	2715	435	160	180	270	5,145	5,415	16,425
DEPARTURE	-183	564	47	29	166	477	459	558	4,222
% OF NORM	89%	121%	111%	118%	192%	277%	112%	120%	126%
JUL 99	766	2176	232	120	427	658	3,721	4,379	25,026
NORMAL	835	1815	180	60	135	215	3,025	3,240	19,665
DEPARTURE	-69	361	52	60	292	443	459	558	5,361
% OF NORM	92%	120%	129%	200%	316%	306%	123%	135%	127%
AUG 99	312	672	103	14	209	221	1,310	1,531	26,557
NORMAL	360	625	65	40	115	130	1,205	1,335	21,000
DEPARTURE	-48	47	38	-26	94	91	459	558	5,557
% OF NORM	87%	108%	158%	35%	182%	170%	109%	115%	126%
SEP 99	292	532	31	158	224	209	1,237	1,446	28,003
NORMAL	345	470	115	40	110	95	1,080	1,175	22,175
DEPARTURE	-53	62	-84	118	114	114	459	558	5,828
% OF NORM	85%	113%	27%	395%	204%	220%	115%	123%	126%
OCT 99	269	573	-79	60	168	170	991	1,161	29,164
NORMAL	400	525	70	10	120	75	1,125	1,200	23,375
DEPARTURE	-131	48	-149	50	48	95	459	558	5,789
% OF NORM	69%	110%	-111%	460%	141%	227%	88%	97%	125%
NOV 99	353	454	-41	-118	185	117	833	950	30,114
NORMAL	390	410	65	10	120	75	995	1,070	24,445
DEPARTURE	-37	44	-106	-128	65	42	459	558	5,669
% OF NORM	97%	119%	-54%	-600%	156%	156%	84%	89%	123%
DEC 99	373	238	48	37	191	174	887	1,061	31,175
NORMAL	335	255	0	10	100	45	700	745	25,190
DEPARTURE	38	-17	48	27	91	129	459	558	5,985
% OF NORM	115%	102%	10500%	30%	193%	387%	127%	142%	124%
				Calendar Year Totals					
	6,380	12,824	2,708	1,711	3,358	4,194	26,981	31,175	
NORMAL	7,395	10,840	2,430	910	1,675	1,940	23,250	25,190	
DEPARTURE	-1,015	1,984	278	801	1,683	2,254	3,731	5,985	
% OF NORM	86%	118%	111%	188%	200%	216%	116%	124%	

2. <u>August - December 1999</u>. Although dry conditions began to develop across much of the basin in the fall of 1999, August started off with the biggest rainfall event of the summer when 10.48 inches of rain fell in 24 hours at Omaha's Eppley Airfield on August 6-7. The runoff from the storm resulted in Missouri River rises ranging from over 7 feet at Rulo, Nebraska and St. Joseph, Missouri to 4 feet at Hermann, Missouri. For the month, precipitation was 200 percent of normal from Colorado to North Dakota and Montana, while Wyoming, Missouri, and eastern Kansas received well below normal rainfall. Temperatures during August were slightly above normal in the northwest and southeast and slightly below normal in Colorado and the eastern portions of the Dakotas and Nebraska. Summer precipitation is shown in ***Figure 1***.

September was a cool month throughout the basin with temperatures averaging 2 to 4 degrees below normal. Precipitation was generally above normal in the upper basin, although fall normals are quite low in the Dakotas, Montana, and Wyoming. Dry conditions began to develop in eastern Nebraska, northern Kansas, Iowa, and Missouri where less than half of normal rainfall was recorded.

October and November were both very dry with most of the basin receiving less than half of normal precipitation. Temperatures in October were normal to slightly above normal, but November was 8 to 10 degrees above normal for the entire basin. Many locations experienced their warmest November on record including Topeka, Kansas (8.3 degrees above normal), Omaha, Nebraska (8.0 degrees above normal), Sioux City Iowa (7.7 degrees above normal), Sioux Falls, South Dakota (9.1 degrees above normal), and Glasgow, Montana (10.7 degrees above normal). Despite the warm, dry conditions, the front range area in Colorado experienced the basin's first winter storm in late November. Totals in eastern Colorado included 10.6 inches in Colorado Springs and 8.4 inches in Denver.

The last Palmer Drought Severity map for the 1999 growing season, dated October 23, 1999, ***Figure 2***, indicates moderate to severe drought in western Montana and northwestern Wyoming and pockets of dryness in the lower basin. ***Figure 1*** shows the autumn precipitation distribution as a percent of normal.

The warm, dry streak continued into early December setting temperature and precipitation records throughout the basin. Finally in mid-December winter weather was briefly presented to the basin but was quickly replaced by more unseasonably warm, dry weather. For the month temperatures averaged from 6 degrees above normal in the lower basin to 14 degrees above normal along the Canadian border. Precipitation was less than half of normal except in eastern Kansas and most of Missouri, which had managed to collect above normal precipitation as storm systems passed along the southern edge of the basin.

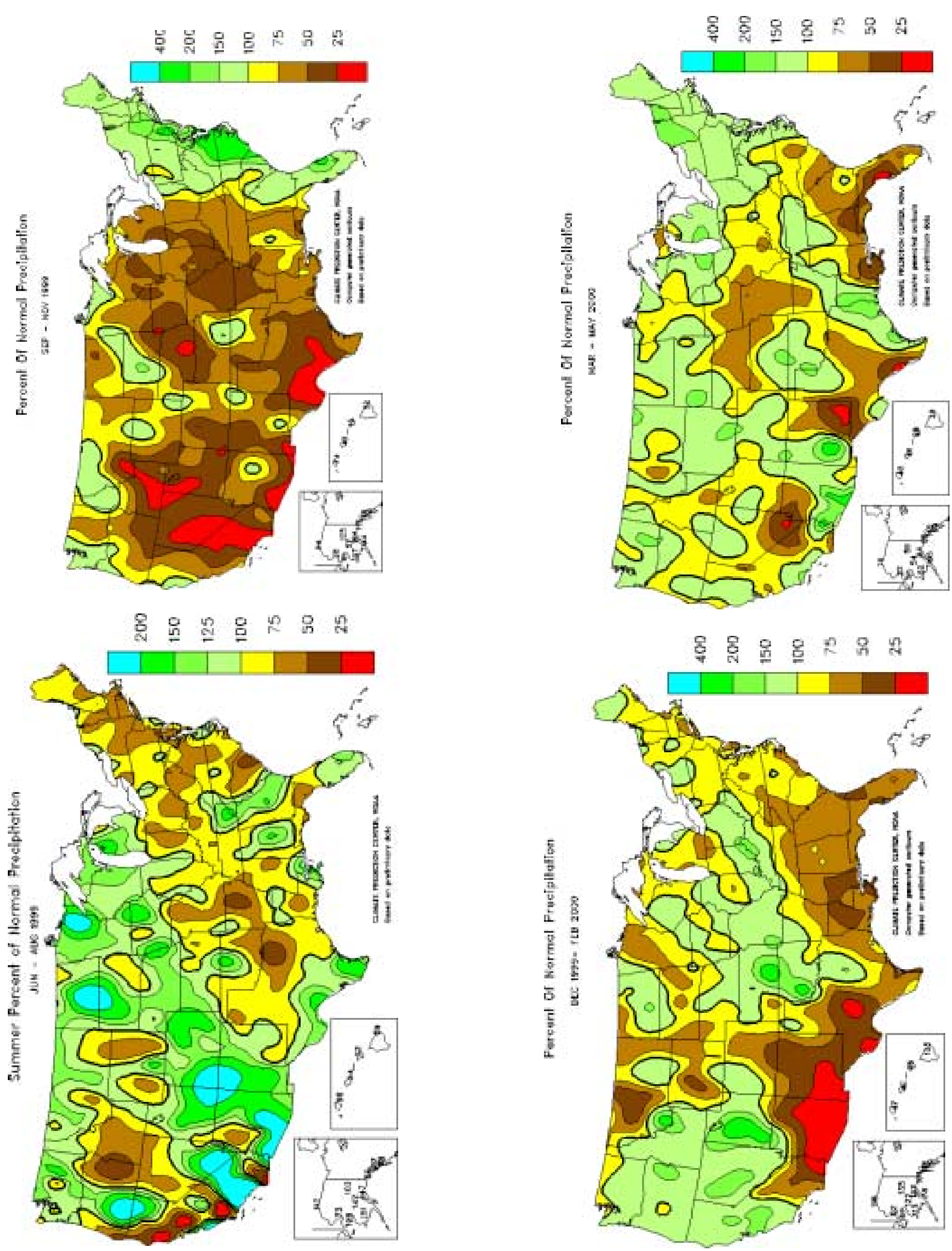

Summer Percent of Normal Precipitation
JUN - AUG 1999
200
150
125
100
75
50
25
Percent Of Normal Precipitation
SEP - NOV 1999
400
200
150
100
75
50
25
Percent Of Normal Precipitation
DEC 1999 - FEB 2000
400
200
150
100
75
50
25
Percent Of Normal Precipitation
MAR - MAY 2000
400
200
150
100
75
50
25
CLIMATE PREDICTION CENTER, NOAA

Figure 1

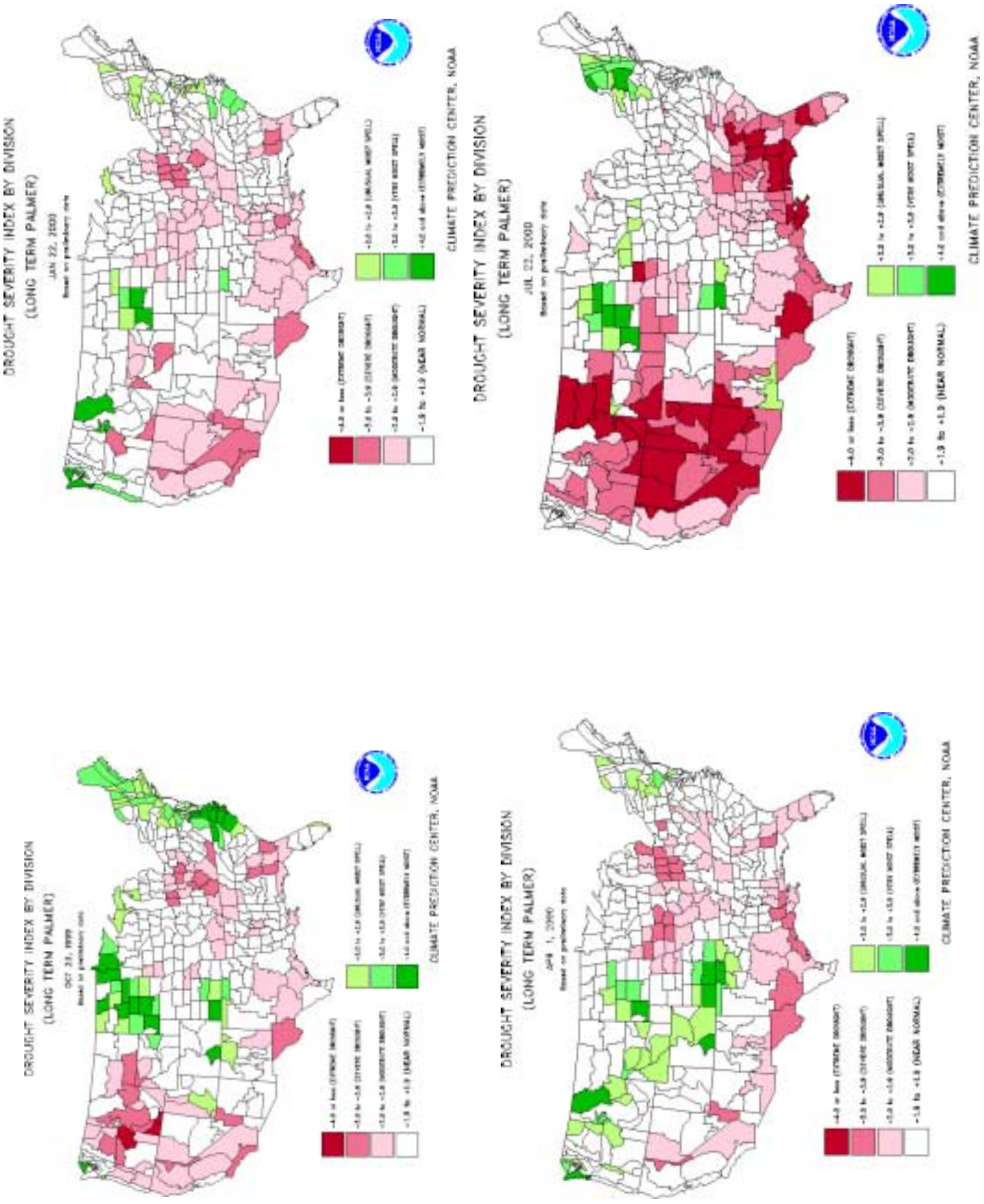

DROUGHT SEVERITY INDEX BY DIVISION
(LONG TERM PALMER)
CLIMATE PREDICTION CENTER, NOAA
DROUGHT SEVERITY INDEX BY DIVISION
(LONG TERM PALMER)
CLIMATE PREDICTION CENTER, NOAA
DROUGHT SEVERITY INDEX BY DIVISION
(LONG TERM PALMER)
CLIMATE PREDICTION CENTER, NOAA
DROUGHT SEVERITY INDEX BY DIVISION
(LONG TERM PALMER)
CLIMATE PREDICTION CENTER, NOAA

Figure 2

3. 1999 Calendar Year Runoff. Boosted in large part by high runoff in the spring and summer months of 1999, the annual runoff was 31.2 MAF, 124 percent of the 1898-1998 average. Monthly runoff ranged from a high of 175 percent of normal in January to a low of 89 percent of normal in November as shown on ***Table I***. This table is prepared on the first of each month to indicate the historic and forecast runoff for the year. The 1999 annual runoff at Sioux City is shown in historical perspective on ***Figure 3***, and ***Figure 4A*** displays the monthly distribution of runoff for 1998 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 86 percent of normal in the Fort Peck reach, to a high of 216 percent of normal in the Sioux City reach. Annual runoff in the Garrison and Oahe reaches was slightly above normal at 118 and 111 percent of normal, respectively. As in the Sioux City reach, the Fort Randall and Gavins Point reaches were much above normal at 188 and 200 percent of normal, respectively. The 1999 annual reach runoff, expressed as a percentage of the historic 1898-1998 average, is presented in ***Table II***.

TABLE II
1999 CALENDAR YEAR RUNOFF FOR SELECTED REACHES
(In 1,000 Acre-Feet)

Reach	1898-1998 Normal Runoff-Volume	Calendar Year 1999 Runoff-Volume	Percent of Normal Runoff
Above Fort Peck	7,395	6,380	86
Fort Peck to Garrison	10,840	12,824	118
Garrison to Oahe	2,430	2,708	111
Oahe to Fort Randall	910	1,711	188
Fort Randall to Gavins Point	1,675	3,358	200
Gavins Point to Sioux City	1,940	4,194	216
TOTAL ABOVE SIOUX CITY	25,190	31,175	124
Sioux City to Nebraska City	7,840	9,880	126
Nebraska City to Kansas City	12,630	14,660	116
Kansas City to Hermann	25,040	28,930	115
TOTAL BELOW SIOUX CITY*	45,510	53,470	117

* Reaches from Sioux City to Hermann are not adjusted to 1949 depletions. Averages are taken from USGS Water-Data Reports for the period 1967-1999

Missouri River Main Stem
Annual Runoff at Sioux City, Iowa

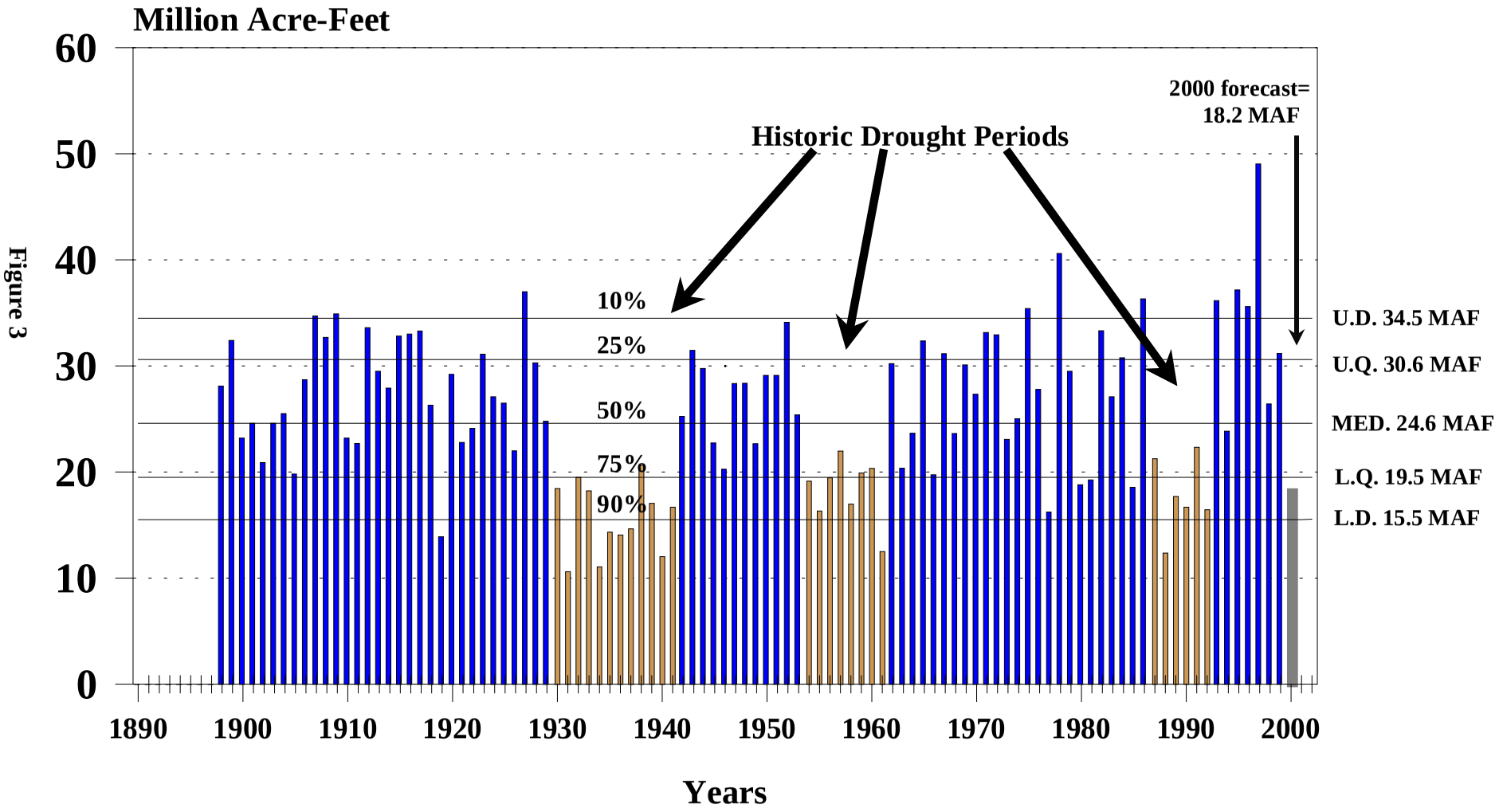


Figure 3
7

1999 Missouri River Runoff
Above Sioux City, Iowa

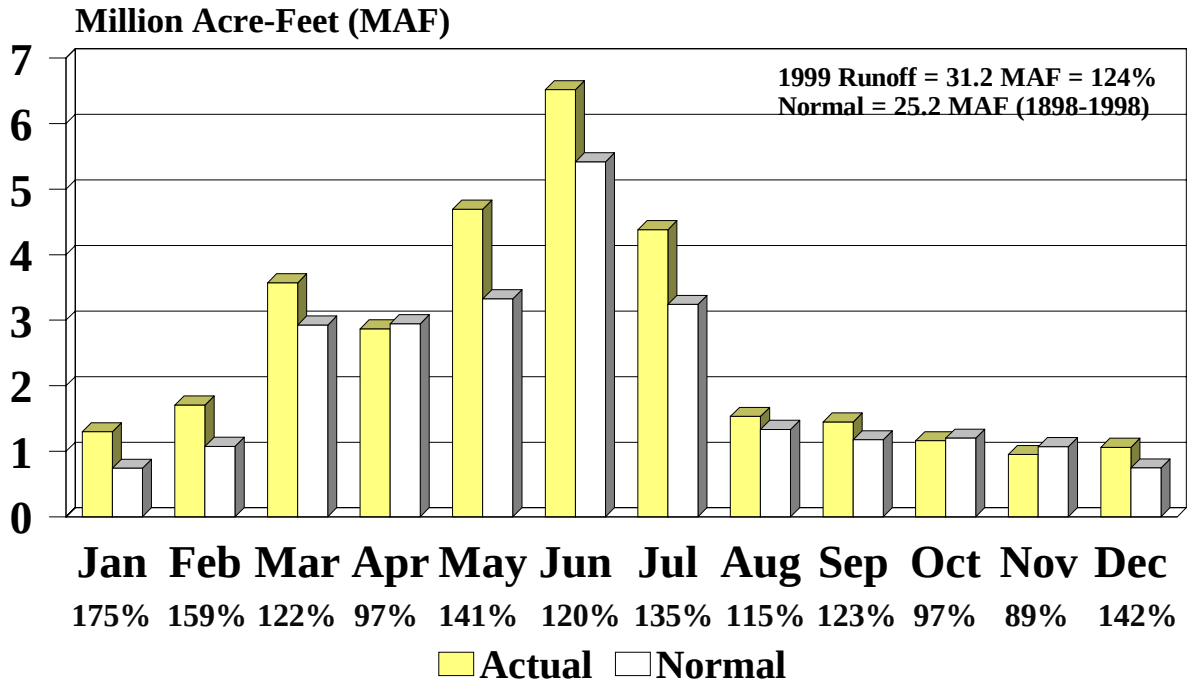


Figure 4A

2000 Missouri River Runoff
Above Sioux City, Iowa

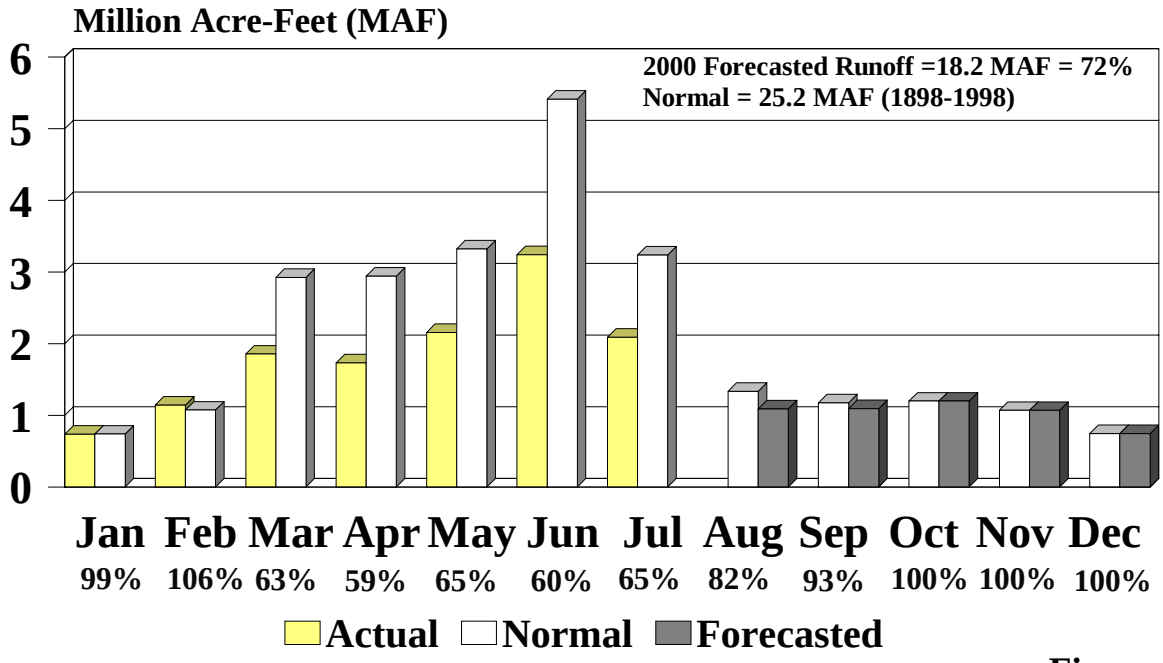


Figure 4B

C. Precipitation and Water Supply Available in 2000.

1. Plains Snowpack 1999-2000. The winter of 1999-2000 was mild by all accounts. Temperatures during the December to February period averaged 6 to 8 degrees above normal, and the plains never developed a significant snowpack. Rather, snow on the plains came in brief spurts and tended to melt within a week or two as temperatures rebounded to well above normal.

The first significant snow of the 1999-2000 winter season came in late November when up to 10 inches of snow fell along the front range in Colorado. Another winter storm moved across the southern edge of the basin in early December dumping 4 to 8 inches of snow from south-central Kansas to northern Missouri. In mid-December cold weather was finally able to end the long streak of above normal temperatures and the remainder of the basin received its first measurable snowfall of the season. Eastern Nebraska and western Iowa received 4 to 6 inches just before Christmas, one of only two significant snowfalls of the winter. At the close of 1999, record high temperatures eliminated virtually all of the snow from the northern plains, leaving a scant 1 to 4 inches in the upper basin. The lower basin was essentially snow-free.

The new year began much the same way the old year had ended, with a continuation of warm, dry conditions. What little snow fell usually melted within a short time resulting in no accumulation of a plains snowpack. At the end of January most of the basin had a 1- to 4-inch snow cover except the Black Hills of South Dakota and portions of Wyoming where depths ranged from 3 to 8 inches.

February's weather was like a roller coaster ride. The month started out very dry with record warmth. Mid-month a winter storm delivered the coldest weather of the winter along with widespread snow. Snow depths on the plains of Montana, Wyoming, and North Dakota reached their highest levels of the winter, averaging from 5 to 13 inches. But temperatures quickly rebounded back to record high levels toward the end of the month, which melted virtually all of the plains snow. In addition, significant rain fell from North Dakota southward to Kansas and Missouri. The late-month rain pushed Bismarck, North Dakota's monthly precipitation total to a new February record of 1.74 inches, or 405 percent of normal.

Temperatures continued to average above normal through March and although most of the month's precipitation fell in the form of rain, a powerful storm the second week of March brought blizzard conditions to the northern plains and heavy snow as far south as central Missouri. But warm weather after mid-month melted the remaining plains snowpack and spring was in full bloom.

2. Mountain Snowpack 1999-2000. Mountain snowpack in the Missouri River basin was well below normal throughout the winter of 1999-2000. On December 1, the snowpack was 52 percent of normal in the reach above Fort Peck Dam and 57 percent of normal in the reach between Fort Peck and Garrison Dams.

By January 1, both reaches had made some headway but were still well below normal. Mountain snowpack in the Fort Peck reach was at 76 percent of normal, and the Garrison reach was at 71 percent of normal. Both reaches gained slowly during January and February and, by March 1, were at 82 and 87 percent, respectively. In March the pace of mountain snowpack accumulation kept up with the normal accumulation and by April 1 the snowpack in the two reaches was at 83 and 87 percent, respectively.

Little gain was made in early April and the peak accumulations were seen on April 8, about 1 week ahead of normal. The Fort Peck reach peaked at 82 percent of the normal peak accumulation, and the reach between Fort Peck and Garrison peaked at 81 percent of the normal peak accumulation.

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 1999-2000 snow accumulation and melt are illustrated in ***Figure 5***.

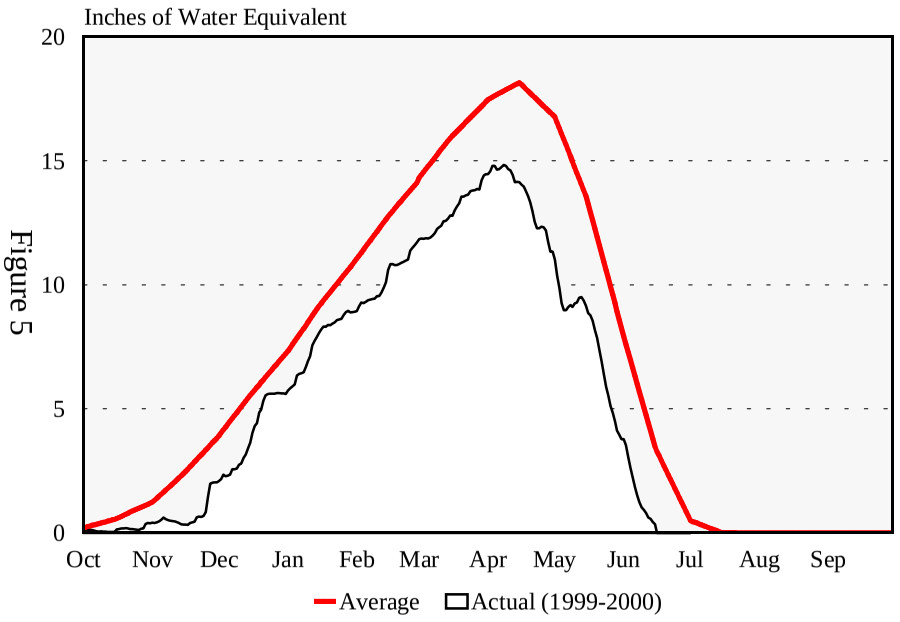
3. <u>January - July 2000</u>. Runoff during January and February of 2000 was near normal, but March through July were well below normal due to the lack of plains and mountain snowpack during the winter of 1999-2000 and very limited spring and summer rains. In late January soil conditions were quite dry in the lower basin but varied widely in the upper basin. A large portion of South Dakota still had unusually moist soil conditions, but Wyoming showed expanding areas of moderate to severe drought. The remainder of the upper basin was near normal as indicated on the Palmer Drought Index map dated January 22, 2000, ***Figure 2***. As discussed previously, the plains snowpack was very light and intermittently melted during warm periods. Winter precipitation in the lower basin was well below normal in Nebraska, western Kansas, Iowa, and Missouri. ***Figure 1*** shows the winter precipitation as a percent of normal.

Temperatures in March continued to average much above normal for the fifth consecutive month. Precipitation varied widely, from less than half of normal in southeastern South Dakota, eastern Nebraska, and Iowa, to more than twice normal in western Kansas and Colorado. Southwestern Montana was also much drier than normal during March. The Palmer Drought Severity map dated April 1, 2000, ***Figure 2,*** indicates normal to moist soil conditions throughout the upper basin but moderate drought in eastern Nebraska, western Iowa, and much of Missouri.

Dryness in the lower basin worsened during April when eastern Kansas and all of Missouri received less than half of normal precipitation. Kansas City, Missouri received only 0.65 inch of rain during the month, breaking their April record of 0.80 inch. The western portion of the basin, however, received well above normal precipitation, some of which fell in the form of snow during several brief outbreaks of winter-like weather. An especially severe storm in the Black Hills dumped 14 inches of snow on Rapid City on April 19. Temperatures for the month of April were 2 to 4 degrees above normal in the west, and near normal in the east; however, the near normal averages in the eastern half of the basin were the result of wild fluctuations in daily temperatures throughout the month.

Mountain Snowpack Water Content
Missouri River Basin
Winter 1999 - 2000

Total Above Fort Peck



Total Fort Peck to Garrison

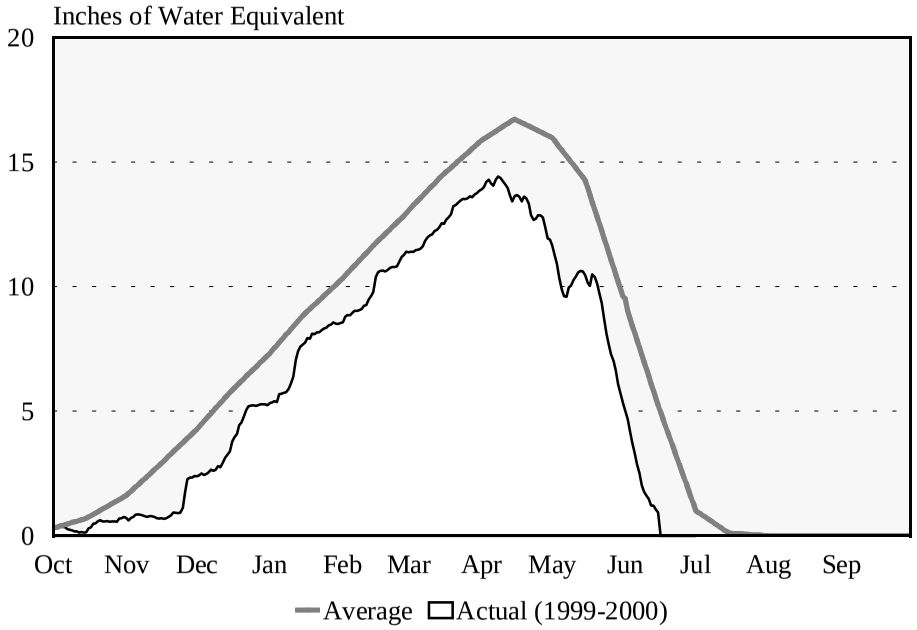


Figure 5
11

Snowpack peaked on April 8, 2000 at 82 percent of the normal peak accumulation in the reach above Fort Peck, and at 81 percent of the normal peak accumulation in the reach between Fort Peck and Garrison

Drought conditions worsened in the lower basin during May despite several widespread rainfall events. The hardest hit areas included eastern Colorado, northern Kansas, and southern Nebraska where less than half of normal precipitation fell during the month. The upper basin generally had near normal precipitation except in central and western Montana where dry soil conditions were beginning to develop. Temperatures for the month of May were generally 2 to 4 degrees above normal. ***Figure 1*** shows the spring precipitation as a percent of normal.

In June, the eastern portion of the basin received much needed rainfall including the very dry portions of eastern Kansas and western Missouri where monthly totals in excess of 8 inches were recorded. However, in the western two-thirds of the basin drought conditions began to develop over a wide area. Temperatures in June generally averaged 2 to 4 degrees below normal but, as in May, daily temperatures fluctuated wildly. For example, Valentine, Nebraska noted a daily record high of 102 degrees on June 8, just 3 days after setting a daily record low of 32 degrees.

Temperatures in July ranged from 2 to 4 degrees above normal in the western half of the basin to 2 degrees below normal in the east. Likewise, precipitation was quite variable across the basin. Wyoming and western Montana were much drier than normal during the month but eastern Montana and North Dakota were much wetter than normal. July rainfall in the lower basin was also quite variable as summer storms brought locally heavy rain to some areas while other nearby areas were missed entirely.

The Palmer Drought Severity map, dated July 22, 2000, is shown in ***Figure 2***. As indicated, moderate to extreme drought conditions stretched from Montana and Wyoming, through Nebraska and northern Kansas into western Iowa. In contrast, portions of the Dakotas developed significant moisture surpluses.

4. <u>2000 Calendar Year Runoff</u>. Runoff for the period January through July 2000 totaled 13.0 million acre-feet (MAF), 66 percent of the 1898-1998 normal. Monthly runoff above Sioux City varied from a low of 59 and 60 percent of normal in April and June, respectively, to 106 percent of normal in February. The August 1 forecast for CY 2000 runoff is 18.2 MAF, 72 percent of normal and 7.0 MAF below the 1898-1998 average, as shown in ***Figure 4B***.

The historic and forecasted monthly runoff for CY 2000 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 2000
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 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		34	76	13	55	68	64
% OF NORM	87%	95%	110%	168%	161%	115%	106%	106%	104%
MAR 2000	424	680	386	42	179	145	1,711	1,856	3,735
NORMAL	610	1,010	580	220	205	300	2,625	2,925	4,740
DEPARTURE	-186	-330	-194	-178	-26	-155	-914	-1,069	-1,005
% OF NORM	70%	67%	67%	19%	87%	48%	65%	63%	79%
APR 2000	417	399	439	119	178	183	1,552	1,735	5,470
NORMAL	665	1,115	500	145	180	340	2,605	2,945	7,685
DEPARTURE	-248	-716	-61	-26	-2	-157	-1,053	-1,210	-2,215
% OF NORM	63%	36%	88%	82%	99%	54%	60%	59%	71%
MAY 2000	472	645	446	33	222	340	1,818	2,158	7,628
NORMAL	1,120	1,280	320	145	185	275	3,050	3,325	11,010
DEPARTURE	-648	-635	126	-112	37	65	-1,232	-1,167	-3,382
% OF NORM	42%	50%	139%	23%	120%	124%	60%	65%	69%
JUN 2000	702	1,914	328	-108	186	220	3,022	3,242	10,870
NORMAL	1,655	2,715	435	160	180	270	5,145	5,415	16,425
DEPARTURE	-953	-801	-107	-268	6	-50	-2,123	-2,173	-5,555
% OF NORM	42%	70%	75%	-68%	103%	81%	59%	60%	66%
JUL 2000	518	1,075	250	-87	203	131	1,959	2,090	12,960
NORMAL	835	1,815	180	60	135	215	3,025	3,240	19,665
DEPARTURE	-317	-740	70	-147	68	-84	-1,066	-1,150	-6,705
% OF NORM	62%	59%	139%	-145%	150%	61%	65%	65%	66%
	(Forecast)								
AUG 2000	300	450	80	10	160	90	1,000	1,090	14,050
NORMAL	360	625	65	40	115	130	1,205	1,335	21,000
DEPARTURE	-60	-175	15	-30	45	-40	-205	-245	-6,950
% OF NORM	83%	72%	123%	25%	139%	69%	83%	82%	67%
SEP 2000	320	450	115	25	110	75	1,020	1,095	15,145
NORMAL	345	470	115	40	110	95	1,080	1,175	22,175
DEPARTURE	-25	-20	0	-15	0	-20	-60	-80	-7,030
% OF NORM	93%	96%	100%	63%	100%	79%	94%	93%	68%
OCT 2000	400	525	70	10	120	75	1,125	1,200	16,345
NORMAL	400	525	70	10	120	75	1,125	1,200	23,375
DEPARTURE	0	0	0	0	0	0	0	0	-7,030
% OF NORM	100%	100%	100%	100%	100%	100%	100%	100%	70%
NOV 2000	390	410	65	10	120	75	995	1,070	17,415
NORMAL	390	410	65	10	120	75	995	1,070	24,445
DEPARTURE	0	0	0	0	0	0	0	0	-7,030
% OF NORM	100%	100%	100%	100%	100%	100%	100%	100%	71%
DEC 2000	335	255	0	10	100	45	700	745	18,160
NORMAL	335	255	0	10	100	45	700	745	25,190
DEPARTURE	0	0	0	0	0	0	0	0	-7,030
% OF NORM	100%	100%	0%	100%	100%	100%	100%	100%	72%
				Calendar Year Totals					
	4,845	7,377	2,214	141	1,907	1,676	16,484	18,160	
NORMAL	7,395	10,840	2,430	910	1,675	1,940	23,250	25,190	
DEPARTURE	-2,550	-3,463	-216	-769	232	-264	-6,766	-7,030	
% OF NORM	66%	68%	91%	15%	114%	86%	71%	72%	

D. System Operations.

1. System Operational Objectives - August 1999 to July 2000. With near normal runoff during the first half of 1999, the July 1 System storage check was well 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 1999 peak System storage, 65.4 MAF on July 22, 1999, was over the average peak of 62.6 MAF, but 6.3 MAF lower than 1997's peak storage. Runoff into the System during the late summer and fall was below average; but, with excess storage in the System, the 1999 navigation season was extended 10 days and the service level was increased to evacuate flood water stored in the System.

System storage declined to 63.7 MAF on September 1, 1999, 5.7 MAF over the amount needed to provide full service support to the power function during the winter season. According to the guidelines in the Master Manual, above average winter releases from Fort Randall were required to continue the evacuation of flood control storage and to provide support for the extended navigation season. Gavins Point winter releases were scheduled to evacuate flood control storage while preventing downstream flooding. Runoff into the System averaged more than 102 percent of normal for the period October 1999 through January 2000. System storage was reduced from 60.2 MAF on November 1, 1999 to 56.8 MAF on January 31, 2000. With February runoff at 127 percent of normal, storage increased to the desired 57.1 MAF top of the carryover multiple use zone, on March 1, 2000.

Support for the 2000 navigation season was in accordance with the plan presented in the 1999-2000 AOP. The plan included a normal season opening date with full service flows for the fifth consecutive year and a season length based on July 1 System storage. Flow support for the 2000 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 57.4 MAF, 2.1 MAF lower than the previous year. System storage made slight to moderate gains during two runoff periods in 2000. The plains snowmelt produced a March-April runoff of 3.6 MAF, lower than the normal 5.9 MAF inflow. Runoff from May, June, and July was 2.2 MAF, 3.2 MAF, and 2.1 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 56.8 MAF for May, 57.0 MAF for June, and 56.2 MAF for July. System storage peaked at 57.7 MAF on March 18, 2000, 7.7 MAF lower than the 1999 peak. The end-of-July storage was 5.8 MAF 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.

Energy generation at the six main stem powerplants totaled 10.7 billion kilowatt hours (kWh) for the period August 1, 1999, to July 31, 2000, 0.5 billion kWh above the average since

the System first filled in 1967. The above normal generation was due to the evacuation of excess flood storage in the fall of 1999.

2. Fort Peck Operation - August 1999 to July 2000. 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 1999. Fort Peck releases were below normal levels during the period, averaging 9,000 cubic feet per second (cfs) in August, 5,500 cfs in September, 4,600 in October, and 4,900 cfs in November. The releases for August through November were 1,700, 4,200, 4,500, and 4,500 cfs below average, respectively. Fort Peck pool elevation started the period 3.6 feet into the annual flood control and multiple use zone at 2237.6 feet above mean sea level (msl), 2.5 feet lower than a year earlier. The pool declined to elevation 2236.5 by the end of November, 2.5 feet into the annual flood control and multiple use zone and 1.3 feet below the previous year.

Winter 1999-2000. Fort Peck releases averaged 9,400 cfs for December, 9,600 cfs for January and 8,000 cfs for February. The project releases were increased from 7,600 to 10,000 cfs on December 13, 1999 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 January 13, 2000, and once the ice conditions downstream stabilized, the releases were decreased to 9,000 cfs on January 20, 2000 where they remained until February 2, 2000. On February 3, 2000 the releases were reduced from 9,000 to 8,000 cfs and held until March 3, 2000. Daily releases were below the monthly average during this past winter season. This was required for intrasystem storage balance and downstream flood control. December, January, and February average daily releases were 700, 2,000, and 4,200 cfs below average, respectively.

The Fort Peck Lake level began the winter season at elevation 2236.5 feet msl, 2.5 feet into the annual flood control zone and 1.3 feet below the previous year. The lake fell to the season low of 2233.8 feet msl on February 23, 2000. At the end of February the lake was still at elevation 2233.8 feet msl, 0.2 foot below the base of the annual flood control zone.

Winter River and Ice Conditions Below Fort Peck Dam. Ice formation on the Missouri River below Fort Peck Dam began on December 21, 1999 when the stage rose over 2.6 feet in the Culbertson, Montana area. The formation of a solid ice cover in the Wolf Point area didn't occur until near the middle of January 2000. Stages rose over 6 feet between January 12-18, 2000. On January 18, 2000 the Missouri River stage at Wolf Point peaked near 9.5 feet, just 1.5 feet under

flood stage. No reports of ice-affected flooding on the Missouri River below Fort Peck Dam were recorded during this winter season.

Spring and Summer 2000. Releases from Fort Peck averaged 5,300 cfs in March and 7,000 cfs in April, which is above the 6,000 cfs recommended to support fish spawning below the dam. In May, releases from Fort Peck averaged above normal at 9,900 cfs. Summer releases from Fort Peck were reduced from 10,000 cfs to 9,000 cfs on June 15. June and July's release averages were slightly below normal at 9,700 and 9,000 cfs, respectively.

The elevation of Fort Peck Lake was at 2234.5 feet msl at the beginning of the 2000 navigation season, 0.6 foot lower then the beginning of the 1999 navigation season. The pool peaked on April 6 at 2234.6 feet msl, 3.7 feet lower than the 1999 peak. Fort Peck Lake in 2000 occupied 0.6 foot of the annual flood control storage zone, which extends from 2234 to 2250 feet msl. By the end of July the pool had fallen to 2232.0 feet msl, 2.0 feet below the base of the annual flood control pool.

3. Garrison Operation - August 1999 to July 2000. 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 1999. Daily releases from Garrison varied between 16,600 cfs and 28,700 cfs with monthly average releases of 27,900, 23,400, 18,800, and 17,500 cfs for August through November. The releases were +2,200, +1,400, -2,000, and –3,900 cfs from average during August through November, respectively. Lake Sakakawea began the period at elevation 1847.1 feet msl, 9.6 feet above the base of the flood control pool and 4.1 feet higher than at the same time a year earlier. By the end of November it was at 1842.0 feet msl, 0.2 foot higher than a year earlier.

Winter 1999-2000. Releases from Garrison were below normal for the entire winter season, December through February. The releases, which were 20,000 cfs on December 1, 1999 were reduced to 18,000 cfs on December 3, 1999 to permit dredging of the Mandan, North Dakota water intake and remained at 18,000 cfs through December 17, 1999. Releases were increased to 21,500 cfs on December 18, 1999 and remained at this level for 4 days. On December 22, 1999 releases were reduced to 20,000 cfs and held through December 26, 1999 as a precaution against ice-affected flooding in the Bismarck area as colder weather arrived. Beginning on December 27, 1999, the Garrison releases were increased from 20,000 to 21,500 cfs where they remained until January 3, 2000, when a second wave of cold temperatures necessitated a decrease to 20,000 cfs. Garrison releases remained at 20,000 cfs from January 4 through January 21, 2000

when they were increased to 21,000 cfs. Garrison releases were gradually increased during the last week in January and reached 24,000 cfs at the end of the month where they remained through March 3, 2000. Beginning on March 4, 2000, Garrison releases were decreased about 1,000 cfs a day from the 24,000 cfs to 17,000 cfs by March 9, 2000. Garrison releases were held at 17,000 cfs through April 3, 2000, to meet both power demands and intrasystem storage balance.

Lake Sakakawea began the season near elevation 1842.0 feet msl, 4.5 feet into the annual flood control zone. The lake declined throughout the winter season to an elevation of 1837.7 feet msl by February 29, 2000, which was only 0.2 foot above the top of the carryover multiple use zone.

Winter River and Ice Conditions Below Garrison Dam. During the first half of December, with the warmer temperatures and the lower Garrison winter release of 18,000 cfs, ice formation in the Bismarck area was minimal. However, on December 21, 1999, Garrison releases were reduced from 21,500 to 20,000 cfs to prevent the Missouri River at Bismarck, North Dakota from exceeding the critical 14.0-foot stage during the freeze-in. On December 21, 1999, the stage, which had been near 7.3 feet, increased more than 3 feet in less than 36 hours, then continued its climb to 10.8 feet by December 23, 1999. The Corps Bismarck field office received several reports of lowland flooding downstream from Bismarck during the winter's first ice action. Following a warm period in late December, the established ice cover on the Missouri River in the Bismarck reach thawed.

During a second wave of cold temperatures the ice cover reestablished itself on the Missouri River. The stage crested on January 15, 2000 near 12.9 feet. Flood stage is 16 feet on the Missouri River at Bismarck; however, the critical ice-affected stage is 14 feet. Once the river conditions stabilized and river flows could pass safely under the established ice cover, Garrison releases were gradually increased in late January. The Bismarck stage remained ice affected, fluctuating between 10.0 and 11.5 feet, through late February. The stage dropped below 10 feet on February 23, 2000 and continued to decline slowly, ending the month just under 8.3 feet. The trend continued in March and the Missouri River stage fell to just under 5.7 feet at Bismarck.

Spring and Summer 2000. Releases from Garrison during the spring and summer were below normal. Releases in March and April were 18,200 and 19,500 cfs, respectively. In April, 30,000 acre-feet of water was transferred to Lake Audubon. No additional water was transferred. Releases during May averaged 22,300 cfs, June averaged 24,300, and July averaged 23,500 cfs. Pool elevations for Lake Sakakawea were 1837.3 feet msl on April 1, 1836.0 on May 1, 1835.6 on June 1, 1838.0 on July 1, and 1837.4 at the end of July. Lake Sakakawea peaked at an elevation of 1838.4 on July 15, 2000, down 9.0 feet from last year's peak. Pumping costs associated with the Buford-Trenton project for the period August 1, 1999 through July 31, 2000 were $16,580; the total pumping costs to date are $174,903.

4. <u>Oahe and Big Bend Operation - August 1999 to July 2000</u>. 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 1999. Monthly releases at Oahe and Big Bend ranged from 12 percent below normal in August to 38 percent above normal in October. The Big Bend pool fluctuated between elevations 1419.6 and 1421.5 feet. Lake Oahe began the period at elevation 1616.9 feet msl, 9.4 feet into the annual flood control pool and 4.7 feet higher than at the same time a year earlier. By the end of November it was at 1607.4, 1.9 feet lower than a year earlier.

Winter 1999-2000. Oahe Lake began the winter season at elevation 1607.4 feet msl and declined through the winter to 1604.9 feet msl by February 5, 2000, 1.2 feet lower than the previous winter's minimum pool level. The average release for the winter period was 23,200 cfs, 3,600 cfs lower than the previous winter and 5,100 cfs greater than the release rate from the downstream Fort Randall project. The additional volume released from the Oahe and Big Bend projects was stored in Lake Francis Case. Oahe's daily average releases varied from 3,600 to 44,100 cfs during the winter period December 1999 to February 2000.

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 45,500 cfs. The level of Lake Sharpe varied in a narrow range from elevation 1419.7 to 1421.2 feet msl.

Spring and Summer 2000. Releases from Oahe were above normal from April through July. The daily average release for April was 27,200 cfs, up from the 22,500 cfs normal release. May's releases averaged 26,900 cfs, 3,200 cfs above normal; June was 5,700 cfs above average at 32,000 cfs; and July was slightly above the 31,000 cfs average at 32,100 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, 2000 near elevation 1606.4 feet msl and crested at an elevation of 1608.0 feet msl on March 8, 10.7 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. Fort Randall Operation - August 1999 to July 2000. 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 1999. Releases averaged 37,300, 41,400, 41,600, and 41,000 cfs during the August through November period; 1,700, 5,500, 6,300 and 8,900 cfs greater than normal, respectively. Lake Francis Case was near elevation 1360.3 feet msl, 10.3 feet into the flood control and multipurpose pool zone at the beginning of August and up from the 1355.2 feet msl pool that occurred in August 1998. The annual fall drawdown caused the lake to decline 21.9 feet to 1338.4 feet msl by December 1, 1999. 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 1999-2000. Fort Randall releases were reduced from the autumn floodwater evacuation rate to the winter release rate during the month of December. Fort Randall releases ranged from 38,500 to 16,100 cfs in December. Ice conditions below Fort Randall remained stable through the winter season, and no ice jam or ice affected flooding problems were reported this winter season. Through the winter season, Fort Randall releases ranged between 10,700 and 21,500 cfs as needed to maintain the Lewis and Clark pool elevation near 1207 feet msl.

Fort Randall releases averaged 22,000, 19,100, and 13,000 cfs during December, January, and February, respectively. February was 2,000 cfs below the normal winter release rate of 15,000 cfs and 1,300 cfs below the long term average. The releases varied from 118 percent of normal in December to 120 percent in January and 91 percent of normal in February. Lake Francis Case rose from 1338.4 feet msl on the first of December to 1353.7 feet msl in late February.

Spring and Summer 2000. Releases from Fort Randall generally paralleled those from Gavins Point and averaged 19,600 cfs in March, 25,900 in April, 29,200 cfs in May, 31,000 in June, and 29,800 cfs in July. Daily average releases varied between 12,700 and 35,300 cfs during this period. Lake Francis Case was at an elevation of 1354.8 on April 1, 2000, 1356.7 on May 1, 2000, and peaked at elevation 1357.9 on May 12, 2000, down 5.2 feet from the previous year's peak. The lake level declined to 1355.7 by June 1, 2000 and was at elevation 1354.6 feet msl at the end of July.

6. Gavins Point Operation - August 1999 to July 2000. 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 1999. The primary operational objective of Gavins Point during the late summer and fall of 1999 was the evacuation of excess storage from the upper reservoirs. In response to the excess storage, Gavins Point releases were as high as 45,000 cfs. Average monthly releases were 39,400 cfs for August, 2,300 cfs above average; 44,400 cfs for September, 6,600 cfs above average; 44,300 cfs for October, 6,800 cfs above average; and 43,900 cfs for November, 9,300 cfs above average. In early December, releases were stepped down, reaching 22,000 cfs on December 10, 1999 to deal with the threat of much colder weather and in anticipation of ice formation later in the month. The official closing of the 1999 navigation season at the mouth of the Missouri occurred on December 11, 1999.

Lewis and Clark Lake was operated to maintain a pool elevation near 1207 feet msl throughout the period, varying between 1205.2 and 1207.5 feet msl.

Winter 1999-2000. The plan for Gavins Point during the winter 1999-2000 was to evacuate the remaining 1.2 MAF of floodwater stored in the System by March 1. The winter release rate for Gavins Point Dam was set at 22,000 cfs, 2,000 cfs above the normal maximum winter release. The 22,000 cfs release was maintained from December 10, 1999 to January 23, 2000. In late January releases were decreased 1,000 cfs every other day and ended the month at 18,000 cfs.

Releases were reduced to 17,000 in early February and remained at that level through March 16, 2000.

During this period, release adjustments were not required to prevent flooding downstream from Gavins Point during ice building or bridging. Like the previous 3 years, ice bridging on the Missouri River downstream from Gavins Point was not a major problem; however, the above normal winter release required careful monitoring of downstream stages and weather conditions to prevent flooding and ice jams.

The Gavins Point average daily release was above the normal winter release rates for two of three winter months. Monthly averages were 25,800 cfs in December, 21,300 cfs in January, and 17,000 cfs in February. December and January were above their monthly averages by 8,500 and 3,300 cfs, respectively, and February was below by 1,600 cfs.

During the winter period, Lewis and Clark Lake was near 1207 feet msl, the same target as the previous eight 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 1207.8 feet msl on December 9, 1999. The minimum pool level of the season occurred on February 13, 2000 when Lewis and Clark Lake reached 1206.1 feet msl.

Winter River and Ice Conditions Below Gavins Point Dam. The Gavins Point winter release rate of 22,000 cfs was reached on December 10, 1999. This was the second consecutive unusual winter season on the Missouri River below Gavins Point; no ice cover developed and no ice-jam flooding was reported. The moderate winter temperatures and diligent regulation of releases from Gavins Point Dam during the periods of ice formation allowed above average releases for both December and January. The first reports of floating ice on the Missouri River were received on December 22, 1999: 20 to 50 percent floating ice and 2- to 8-foot-size pads. However, by December 27, 1999, the Missouri River was free of floating ice. The next report of floating ice on the Missouri River was made on January 7, 2000 with only 1 to 5 percent floating ice and 1- to 6- foot pads between Sioux City, Iowa and Plattsmouth, Nebraska. Between January 21 and 28, the second largest amount of floating ice for the winter season was reported between Sioux City, Iowa and Jefferson City, Missouri with 10 to 50 percent floating ice and 5- to 10-foot-size pads. The last report of floating ice was made on February 2, 2000 with only 5 percent floating ice in the Sioux City, Iowa area and only 2- to 4-foot-size pads. Like the previous winter season, the 1999-2000 winter season had remarkably low floating ice formation.

Spring and Summer 2000. Following the much below normal winter inflows into the System, Gavins Point releases were increased beginning on March 17, 2000 in preparation for the start of the 2000 navigation season. Releases reached 29,000 cfs on March 21. The March average release rate was 22,200 cfs, 1,000 cfs above normal. The first tow of 2000, the "Omaha," entered the river on March 6. Five tows were operating on the Missouri River on April 1, the first official day of flow support for the 2000 navigation season.

With below normal mountain snowpack and a light plains snowpack, Gavins Point releases were set to meet full service navigation targets from late March through the first half of May.

However, lack of runoff downstream of the System during April and May kept monthly average releases from Gavins Point above normal. April's average of 29,100 cfs was 2,000 cfs above normal, and the May average of 32,200 cfs was 1,700 cfs above normal. In late May, releases were increased to the 34,000 cfs summer release rate for the endangered species nesting season.

There were no reductions in System releases to provide downstream flood control during the spring and summer of 2000. Due to the lack of runoff in the basin, releases were set to maintain navigation targets and endangered species levels through the season. Based on the July 1, 2000 System storage, navigation targets were reduced by 1,500 cfs. As a result, Gavins Point releases were reduced accordingly.

Average daily outflows were 33,800 cfs in June, 2,000 cfs above average, and 32,600 cfs in July, 1,900 cfs below average.

Lewis and Clark Lake was targeted for elevation 1206 feet msl throughout the spring and summer of 2000. The lake elevation ranged from 1205.3 to 1206.9 feet msl.

E. Non-Routine Operations and Other Items Pertaining to Main Stem Regulation. 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. St. Phillips Cemetery. On December 10, 1999, during the annual fall lowering of Lake Francis Case to elevation 1337.5 feet msl, Corps personnel discovered exposed skeletal remains, caskets, and casket parts. The pool was near elevation 1340.3 feet msl. Historical records indicated that the remains are affiliated with the Yankton Sioux Tribe. The remains, which had not been removed and reburied during the 1950 relocation of St. Phillips cemetery, are believed to have been buried in unmarked and unknown graves. After the remains were discovered, the Yankton Sioux Tribe filed a suit to prevent the Corps from raising the water level. On January 11, 2000, US District Judge Lawrence L. Pierson ruled that the lake may be raised after the loose and scattered remains were removed. The lake was held below 1340 feet msl until the exposed remains were removed. The pool was rapidly refilled to elevation 1353 feet msl beginning on January 23 and ending on March 1, 2000.

2. Year 2000 (Y2K) Preparations. Conversion of the Water Management Division's computer programs to be year 2000 compliant began in 1998. A contractor was hired to modify all pertinent programs to accept 4-digit years rather than 2-digit years. All programs were subsequently tested and put into use in the fall of 1998.

Water Management Division personnel also participated in Y2K preparations with Omaha District staff. As part of those preparations, a Hydropower and Water Control Contingency Plan was developed for use during the days before and during the rollover to the year 2000. Prior to the actual rollover two exercises were performed that simulated operations under potential Y2K scenarios. Office personnel participated in those drills in April and September 1999.

Prior to the 3-day holiday weekend that included January 1, 2000, Reservoir Regulation and Power Production Orders were sent with supplemental instructions regarding project releases. During the rollover the Water Management office was staffed from 10 p.m., December 31, 1999 to 2 a.m., January 1, 2000. Normal business resumed the morning of January 1 with only minor data acquisition problems occurring.

3. Fort Peck. Requests were received for a month-long warm water spill from Fort Peck in the spring of 2000 in combination with powerplant releases. This operation was not scheduled in 2000, but a mini-test is planned for 2001, hydrologic conditions permitting.

4. Oahe. 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 floodproofing 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 conditions on the Missouri River. Section 136 has already been utilized to purchase 49 of the lowest properties in the area. Approximately 120 properties will eventually be purchased 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 27 September 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 2000 are presented in ***Table IV***.

TABLE IV
PROJECT POOL LEVELS AND STORAGES

	Pool Elevation feet msl		Water in Storage - 1,000 AF July 31, 2000		
	July 31, 2000	12-Month Change	Total	Above Min. Pool*	12-Month Change
Fort Peck	2232.0	- 5.6	14,580	10,369	- 1,200
Garrison	1837.4	- 9.7	18,087	13,107	- 3,207
Oahe	1604.8	- 12.1	17,990	12,617	- 4,052
Big Bend	1420.3	- 0.3	1,708	26	- 12
Fort Randall	1354.6	- 5.7	3,495	1,978	- 497
Gavins Point	1205.8	+ 0.5	353	32	+ 14
			56,213	38,129	- 8,954

*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, 1999 was 65.2 MAF, 3.2 MAF greater than the 33-year average of 62.0 MAF and 6.0 MAF lower than in the record runoff year of 1997. After peaking at 65.4 MAF on July 22, 1999, System storage was down only 0.2 MAF. Releases during the late summer, fall, and early winter were directed at evacuating flood storage. Releases were scheduled to reduce System storage to the base of the annual flood control zone, 57.1 MAF, by March 1, 2000.

Dry conditions, which began to develop in the fall of 1999, resulted in much below normal mountain snowpack and very limited plains snowpack during the winter of 1999-2000. System storage was reduced to 56.7 MAF on January 27 but rebounded to 57.1 MAF by March 1, 2000. With the limited snowmelt runoff and lack of spring and summer rains, very little gain was made during the primary runoff season, and System storage peaked at 57.7 MAF on March 15, 2000. As releases were increased for navigation support in late March, System storage began to decline and fell to 56.2 MAF by August 1.

The 2000 System storage peak was 7.7 MAF lower than the previous year's peak and 4.9 MAF below the average peak storage for the period 1967-1999. The estimated total flood damage prevented by the main stem reservoirs during Fiscal Year (FY) 2000 is $17.4 million. The $17.4 million total damages prevented in the Missouri River basin includes $3.1 million in the Kansas City District and $14.3 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 $18.0 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 2000 were limited to $95,000 due to the low runoff and lack of significant rainfall events during 2000. The estimated flood damages incurred along the Missouri River in the Kansas City District have not yet been provided for FY 2000. Lower runoff in 2000 also drastically reduced the number of acres that were either not planted, were flooded out, or forced to plant late thereby reducing yield. The total number of acres of farmland affected in the reach between Sioux City, Iowa and St. Joseph, Missouri in 2000 was 357 acres, down from 69,500 acres in 1999.

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 $2.9 million.

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.

Missouri River Main Stem

Cumulative Flood Damages Prevented

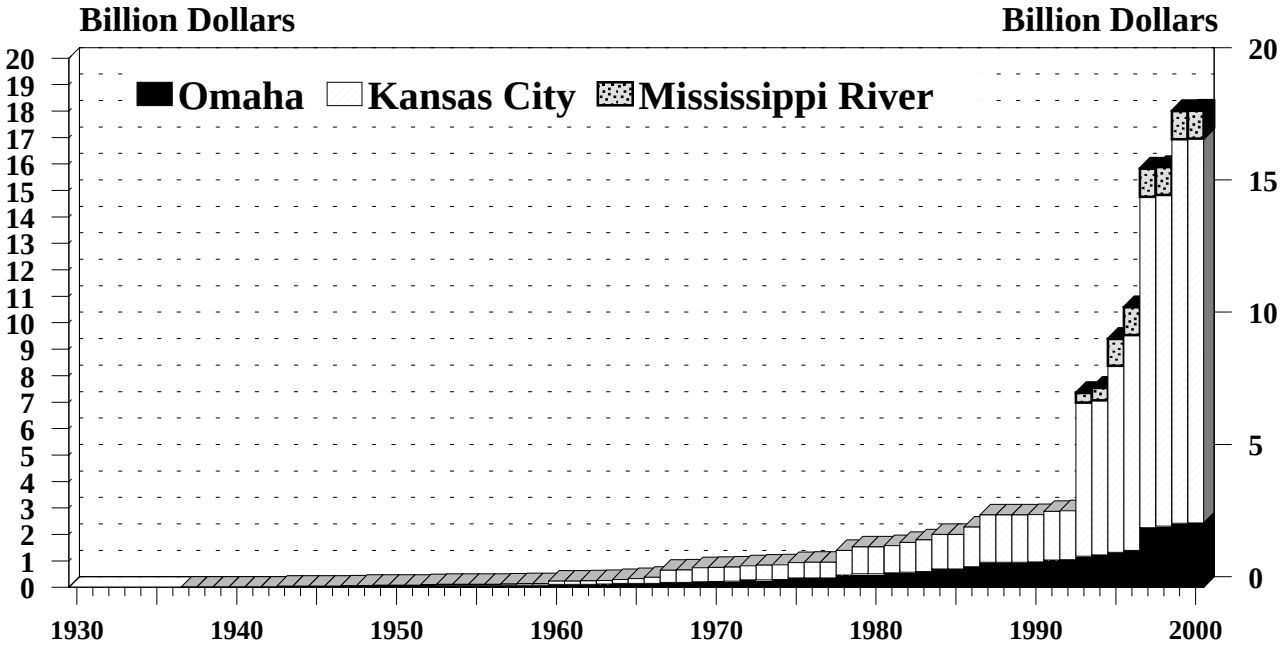


Figure 6A

Annual Flood Damages Prevented

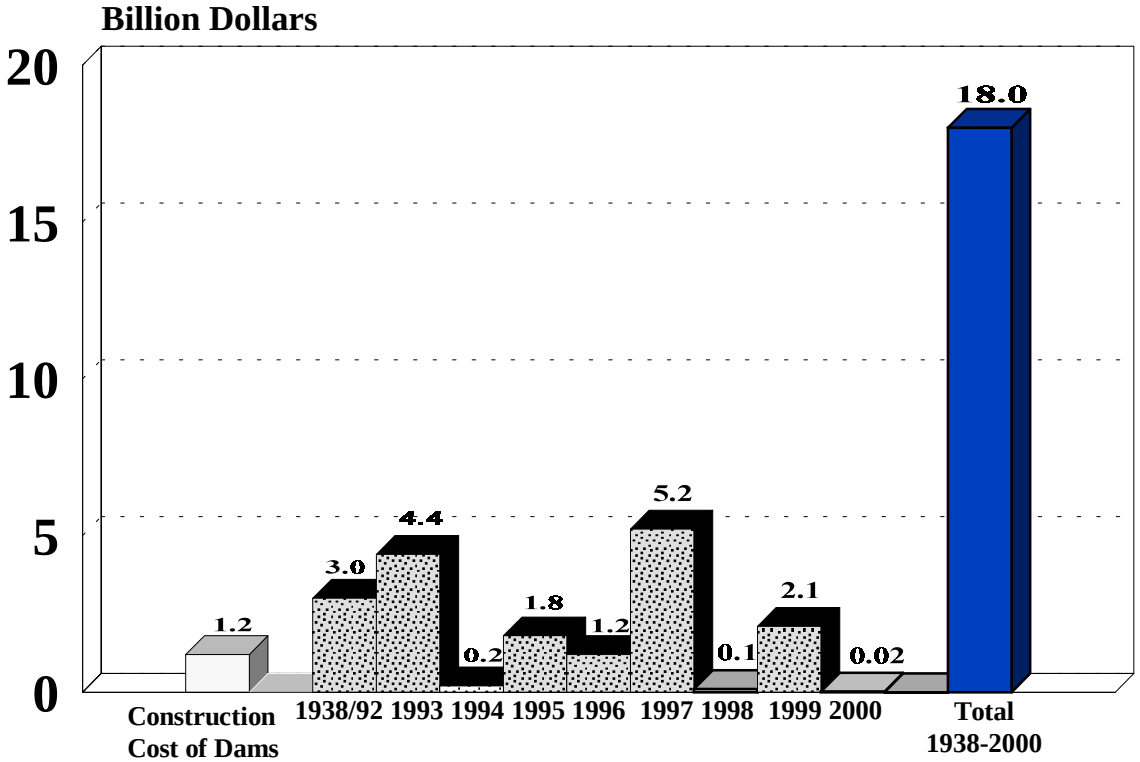
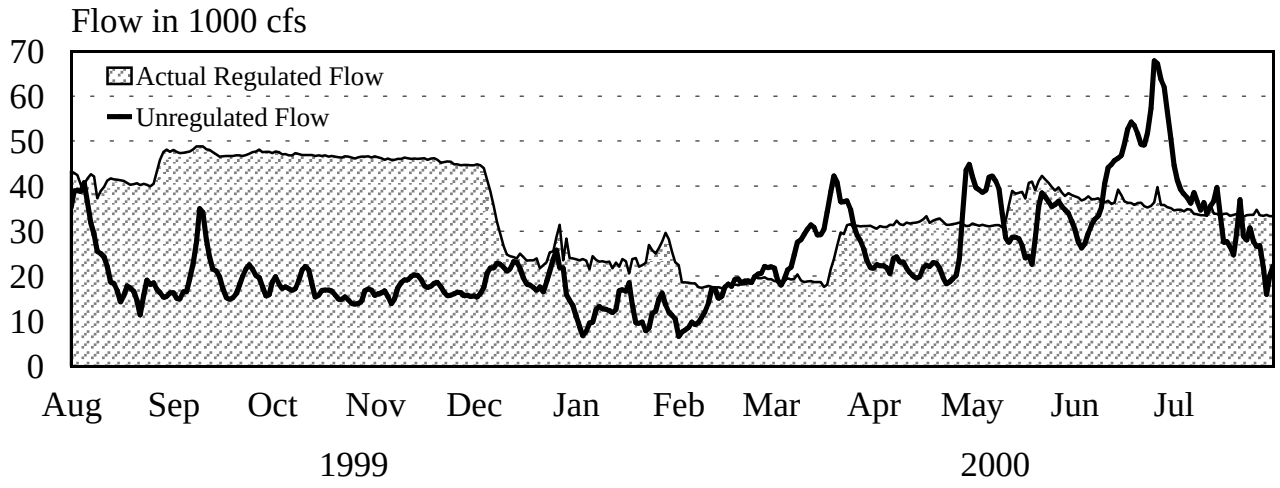
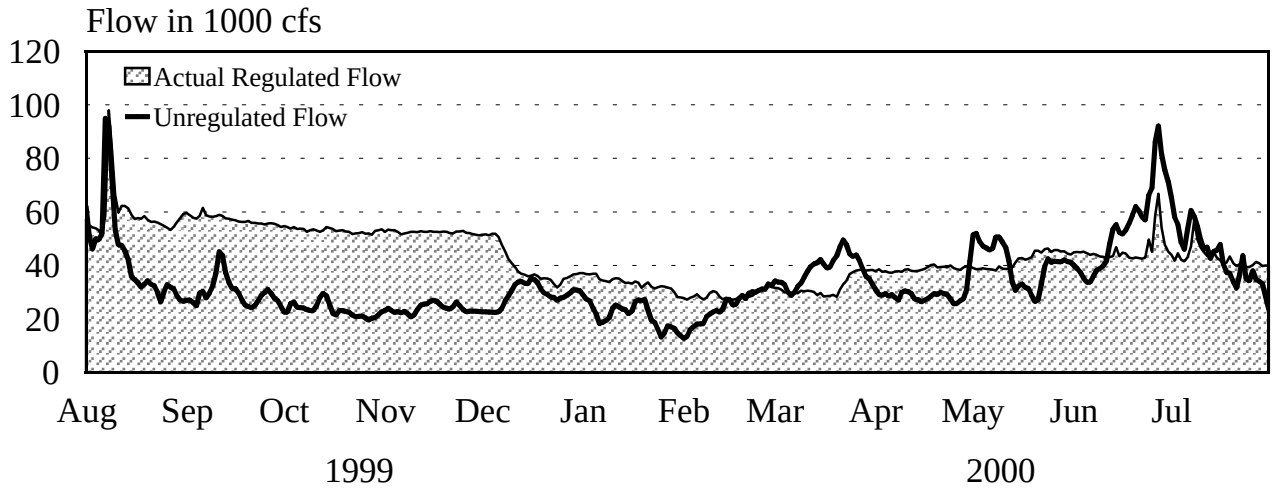


Figure 6B

Sioux City
Regulated and Unregulated Flows



Nebraska City
Regulated and Unregulated Flows



St. Joseph
Regulated and Unregulated Flows

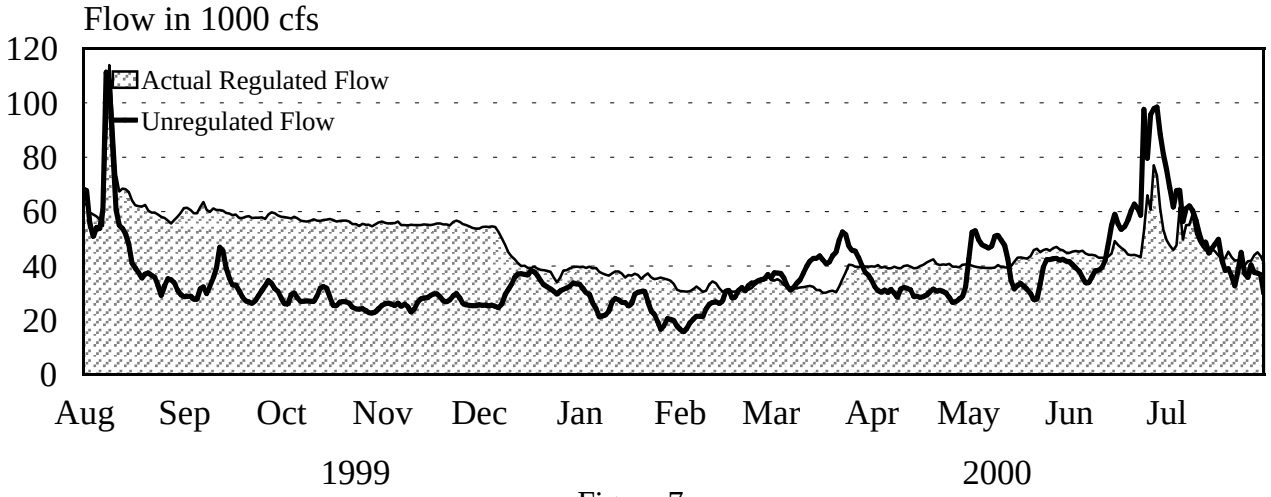


Figure 7

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 1999 and 2000 generally met the needs of irrigators.

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 1999-2000 period. With higher than average release rates in December and January and slightly below normal releases in February, there were very few water supply problems. Intake owners today are also better prepared to handle periods of low water due to adjustments made to intakes or operating procedures as a result of the drought. 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 1999 and 2000. 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 2000 pool elevations were significantly lower than last year at the upper three reservoirs. On July 31, 2000, Fort Peck (2232.0 feet msl) was 2.0 feet below the top of the carryover multiple use zone and 5.6 feet lower than the 1999 end-of-July level. Garrison (1837.4 feet msl) was essentially at the top of the carryover multiple use zone but 9.7 feet lower than 1999. Oahe (1604.8 feet msl) was 2.7 feet below the top of the carryover multiple use zone and 12.0 feet lower than in 1999. 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 1999 are listed in ***Table V.***

Analysis of the data and the listing of parameters exceeding state water quality standards were not available in 1999. Data were collected but were not entered into the EPA STORET data storage and retrieval system. The STORET system has undergone a complete renovation, and although the new system is available to Federal Agencies, it is not user friendly. Transferring the Omaha District data to the system has been attempted but without success. A front-end program called “DASLER” has been purchased by the Corps to assist in data transfer. The system was installed in August 2000, and the backlog of data is currently being entered into the database. It is anticipated that retrieval of state standard exceedances will be made available in early 2001.

TABLE V
WATER QUALITY ISSUES AND PROBLEMS
IN MAIN STEM LAKES - 1999

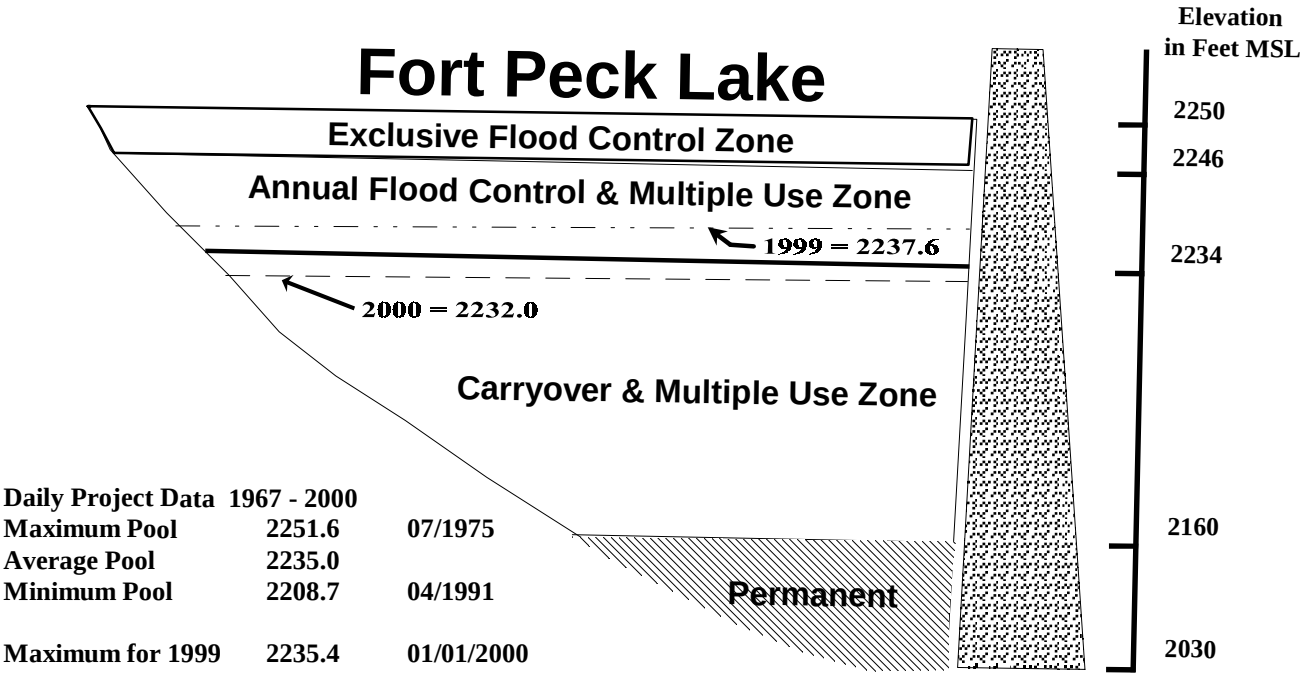
Project	Algal Blooms	Fish Kills	Potential Problem Areas
Fort Peck Lake	No	No	Coal & oil development, algal blooms
Lake Sakakawea	Yes	No	Oil drilling, strip mining, algal blooms, low dissolved oxygen
Lake Oahe	No	No	Agricultural runoff, bioaccumulation of mercury
Lake Sharpe	No	No	Agricultural runoff
Lake Francis Case	No	No	Intrusion of the White River delta
Lewis and Clark Lake	No	No	Emergent aquatic vegetation

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.

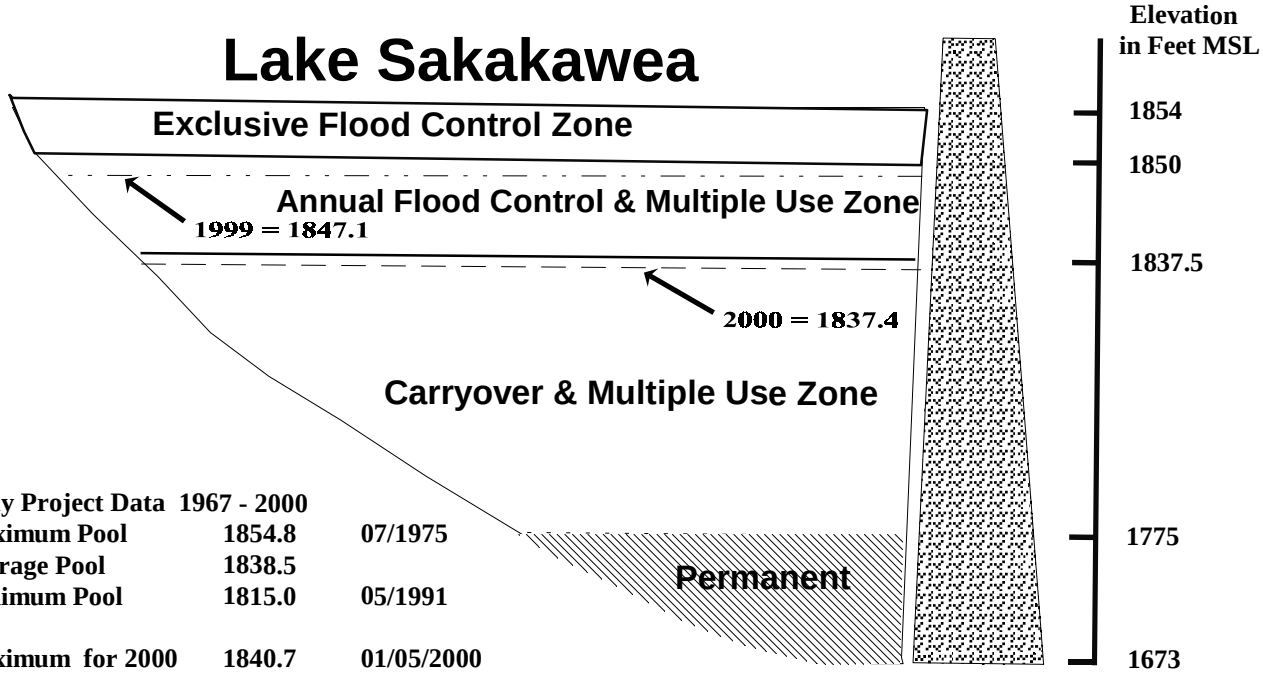
The North Dakota Department of Health and Consolidated Laboratories (NDDHCL) in Bismarck has annually issued since 1993 an advisory on consumption of fish caught in some streams and lakes in North Dakota. Lake Sakakawea was included in this advisory. The advisory was not intended to discourage anglers 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 remains in effect.

4. Navigation. A discussion of the first half of the 1999 navigation season is included in last year's AOP. The latter half of the 1999 navigation season began with flows about

Missouri River Main
End-of-July Lake Elevations and



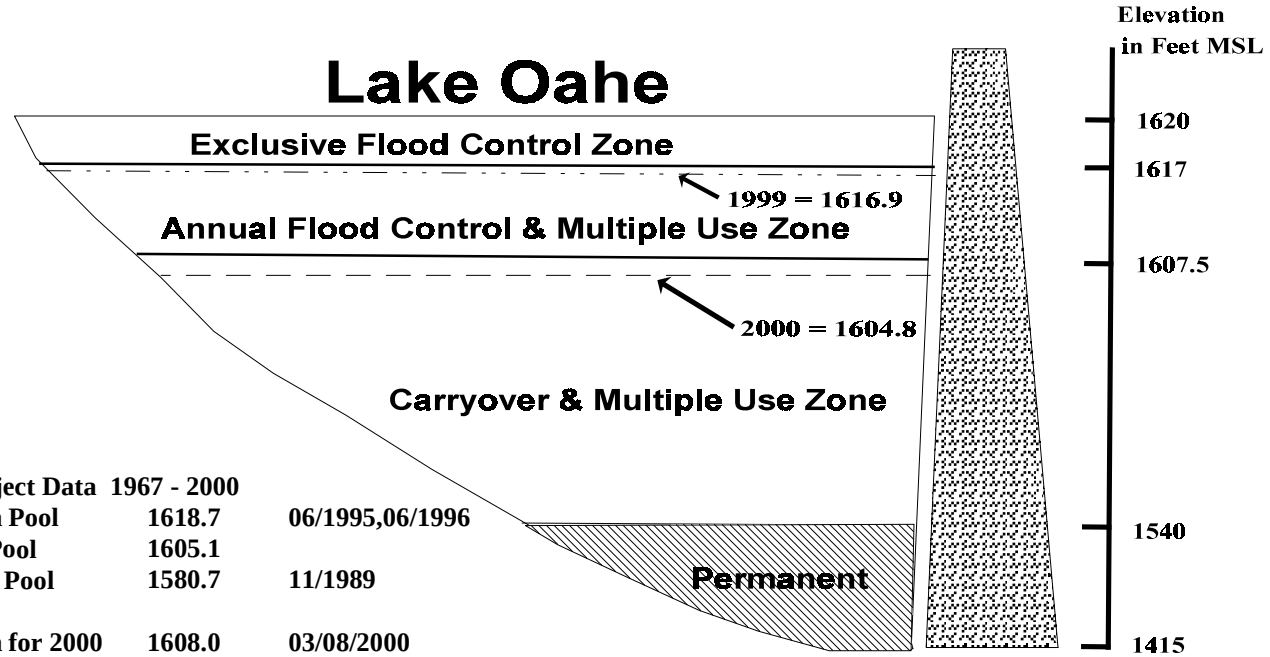
Daily Project Data 1967 - 2000		
Maximum Pool	2251.6	07/1975
Average Pool	2235.0	
Minimum Pool	2208.7	04/1991
Maximum for 1999	2235.4	01/01/2000



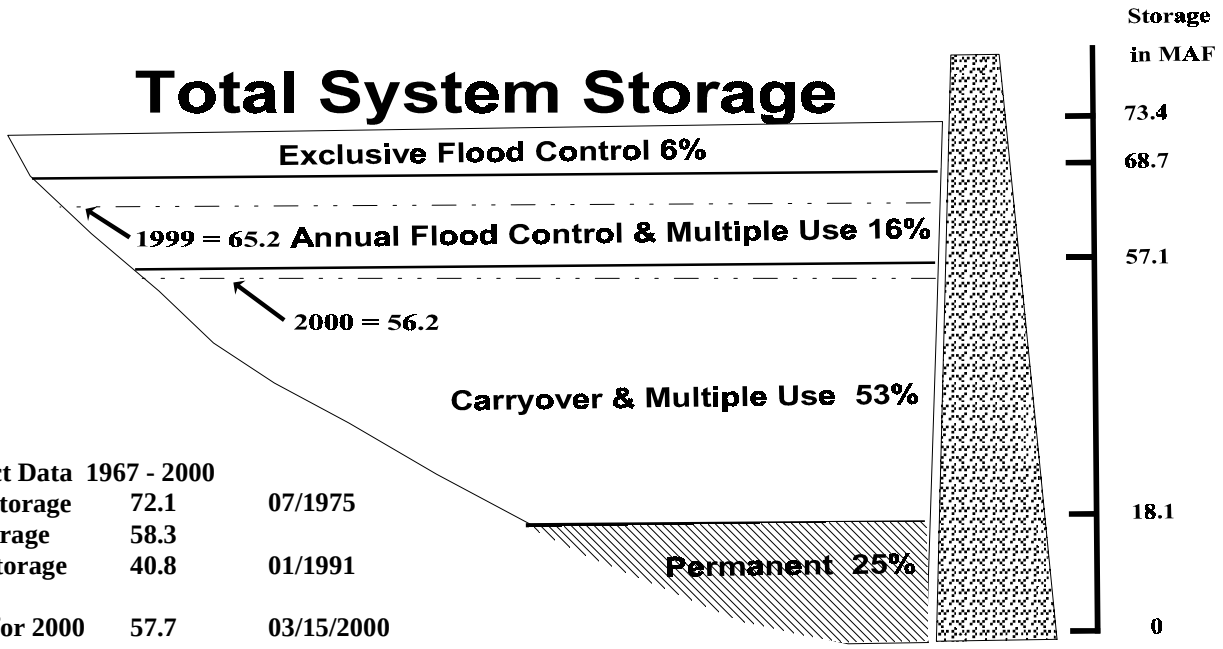
Daily Project Data 1967 - 2000		
Maximum Pool	1854.8	07/1975
Average Pool	1838.5	
Minimum Pool	1815.0	05/1991
Maximum for 2000	1840.7	01/05/2000

Figure 8 A

Stem Reservoirs
Total System Storage



Daily Project Data 1967 - 2000		
Maximum Pool	1618.7	06/1995,06/1996
Average Pool	1605.1	
Minimum Pool	1580.7	11/1989
Maximum for 2000	1608.0	03/08/2000



Daily Project Data 1967 - 2000		
Maximum Storage	72.1	07/1975
Average Storage	58.3	
Minimum Storage	40.8	01/1991
Maximum for 2000	57.7	03/15/2000

Figure 8 B

10,000 cfs above the full service level to evacuate flood control storage. After the last birds had fledged in late August, System releases were increased and a 10-day extension to the navigation season was provided for the fifth consecutive year. Flow support was not needed in 1999 from the Corps' Kansas River tributary reservoirs to help meet Missouri River navigation flows at or below Kansas City.

After a short period of reduced releases for downstream flood control in early August, Gavins Point releases were increased from 39,000 cfs to 45,000 cfs in late August after the birds had fledged. In mid-September releases were reduced slightly, to 44,000 cfs, where they remained until early December. Beginning December 3, releases were stepped down to mark the end of the 1999 navigation season. The winter release rate of 22,000 cfs was reached on December 9. Support flows for the 1999 extended navigation season ended on December 11 at the mouth of the Missouri. The last tow to leave the river was the "Elly Lane," Canal Barge, on December 9, 1999.

Late during the navigation season on November 1, 1999 the “Lauren D,” Blaske Marine Services, hit a right bank standout at river mile 91.8. No damage was done and the tow did not break apart. This area was challenging all season as an upstream chute that remains open modifies the river flow patterns. A river maintenance contractor was at the site nearing completion of two chevron structures at the entrance to the chute to control flows through the chute. The main channel at the grounding location had moved towards the left bank. The Coast Guard rebuoyed the reach and there were no other grounding incidents through the end of the 1999 navigation season.

Preliminary navigation commodity tonnage for 1999 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 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 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 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 1998 and 1999 are shown in ***Table VI***.

TABLE VI
TONNAGE BY COMMODITIES
MISSOURI RIVER

COMMODITY CLASSIFICATION GROUP	TOTAL (Thousand Tons)	
	1998	1999
Grain (Wheat, Corn, Sorghum)	362	356
Other Food and Farm Products (incl soybeans)	342	373
Fertilizers and Other Chemicals	472	343
Petroleum Products	239	278
Primary Manufactured Goods	272	156
Other	48	69
Subtotals	1,735	1,576
Sand and Gravel	6,478	7,532
Waterway Material	167	145
Totals	**8,379**	**9,252**

A summary of tonnage by major commodities for 1960 through 1999 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.

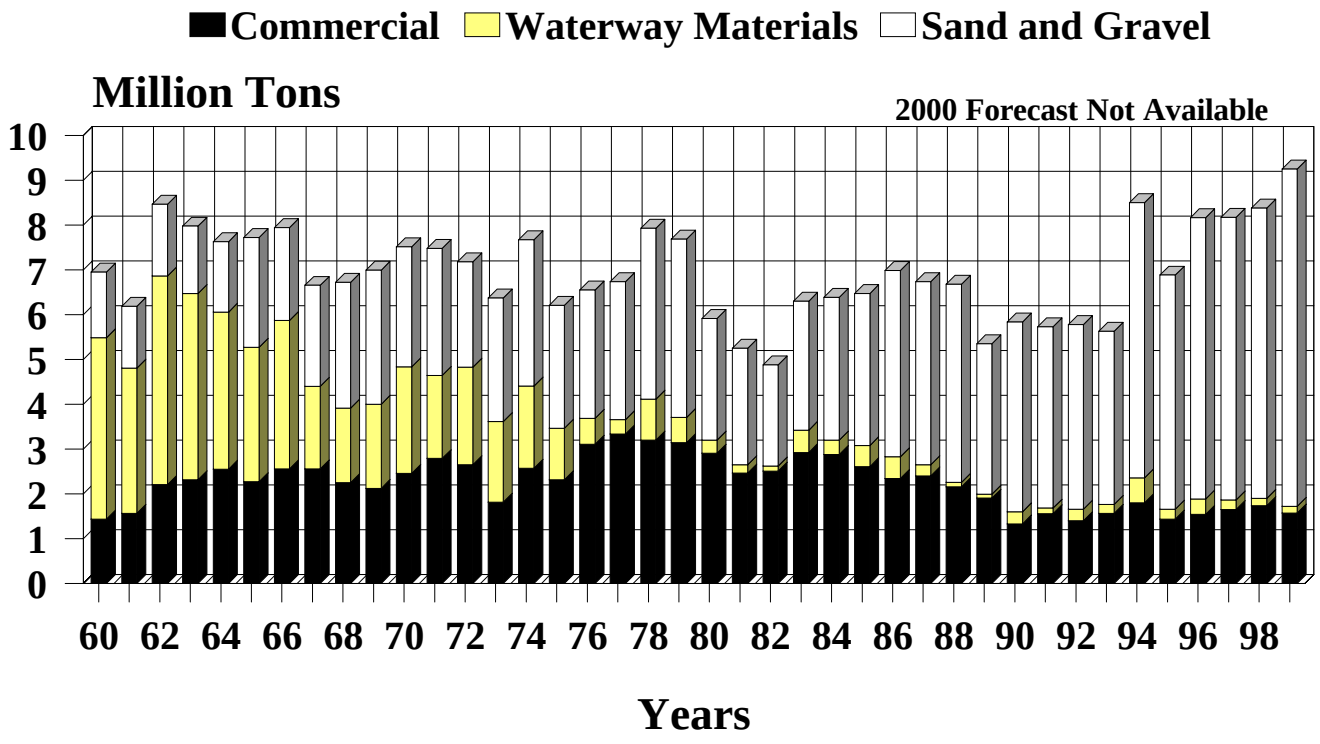
The official 2000 flow support for navigation began on the normal scheduled opening dates of March 23 at Sioux City, March 25 at Omaha, March 28 at Kansas City, and April 1 at the mouth near St. Louis. Releases from Gavins Point Dam were increased from 17,000 on March 16 to 29,000 cfs on March 21, 2000 to meet a Sioux City navigation target.

The first towboat on the Missouri River in 2000 was the "Omaha," Blaske Marine Services, which entered on March 6, 2000. On April 1, the first official day of flow support for the 1999 navigation season at St. Louis, five tows were operating on the river. The first tow to arrive in Sioux City was the “Lauren D,” Blaske Marine Services, in mid-April.

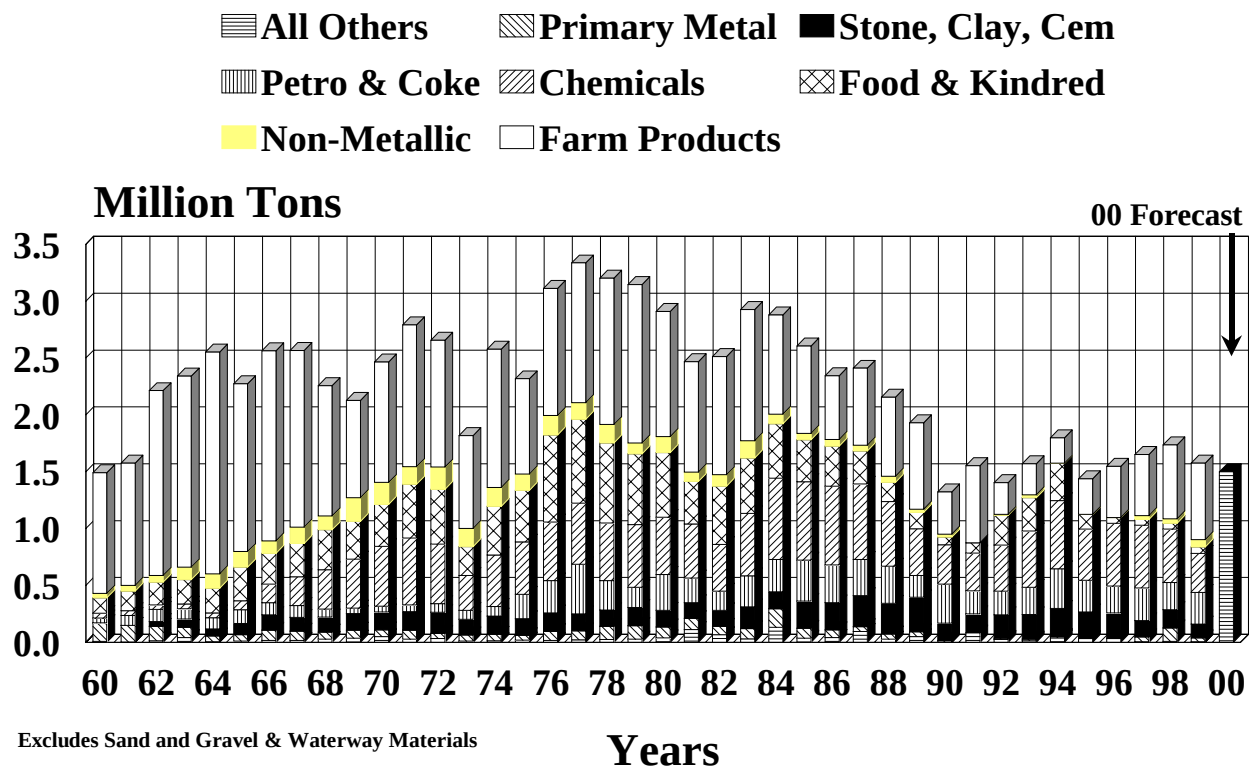
Drought conditions existed in the lower basin during the spring and summer of 2000 such that the tributary inflows below Kansas City did not meet navigation needs to maintain the authorized channel at several locations. The most troublesome was at river mile 91.0. On April 18, 2000 the Coast Guard issued a safety advisory for all tows transiting between river mile 91 to 90 to limit tow sizes to two barges wide, not to exceed eight barges total. On May 21, 2000 the “Renee G,” Phoenix Towing, with one empty and seven loaded barges, grounded while

Missouri River

Total Navigation Tonnage



Commercial Navigation Tonnage



Excludes Sand and Gravel & Waterway Materials

Figure 9

headed downstream at river mile 90.0. The "Evelyn Rushing," also of Phoenix Towing, while assisting, ripped the hull of a grounded barge while pulling it off. The Coast Guard then recommended transiting the area with no more than three barges, one wide. The Kansas City District responded by repairing dike 97.25 at river mile 90.8, completing the work about June 23, 2000. Low river conditions prevailed and on August 15, 2000 the "Lauren D," Blaske Marine Services, grounded at river mile 90. Then on August 16, the "Jennie Dehmer," Magnolia Marine, grounded at river mile 90.1. On August 17, 2000, Northwestern Division Commander, Brigadier General Strock, authorized Kansas City District to construct a 300-foot emergency dike at river mile 90.3. The structure was 95 percent completed by August 31, 2000 providing a reliable 125-foot by 9-foot channel.

Navigation season target flows for past years are given in ***Table VII***. System storage peaked at 57.7 MAF on March 15, 2000, 7.7 MAF lower than the previous year's peak and 4.9 MAF below the average peak storage for the period 1967-1999. Full service flows were provided at all target locations until the July 1 System storage check. With System storage at 57.0 MAF on July 1, support to navigation was reduced 1,500 cfs the remainder of the 2000 navigation season. This marked the first time since the drought of the late 80's and early 90's that less than full service flows have been provided.

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 2000, but for the first time since 1994, a 10-day extension to the navigation season is not planned. The commercial tonnage figure for 2000 is a preliminary estimate and will likely change once final WCSC tabulations are available. Missouri River commercial tonnage in 2000 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 1999 through July 2000 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 1999 navigation season were above the full service level at all locations due to above normal System releases evacuating the accumulated flood control storage. With the exception of one rainfall event in early August, the flows were relatively stable and correlated with System releases. During the first half of the 2000 navigation season, releases were initially geared to meet the Sioux City navigation target and then were increased in early May for the start of the endangered species nesting season. Flows at Nebraska City and Kansas City were influenced by rain in the lower basin in late June and early July.

5. <u>Power - Eastern Division, Pick-Sloan Missouri Basin Program (P-S MBP)</u>. The CY 1999 generated energy was transmitted over a Federal transmission system traversing 7,745 circuit miles. This past year, service was provided to 343 customers in a six-state area. Those receiving direct service include 187 municipalities, 4 Federal agencies, 35 state agencies, 29 U.S. Bureau of Reclamation projects, 3 irrigation districts, 36 rural electric cooperatives, 8 public utility districts, and 39 private utilities. Additional benefits were provided by the interconnections

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

(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)	9,252,000 (9)	
2000	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

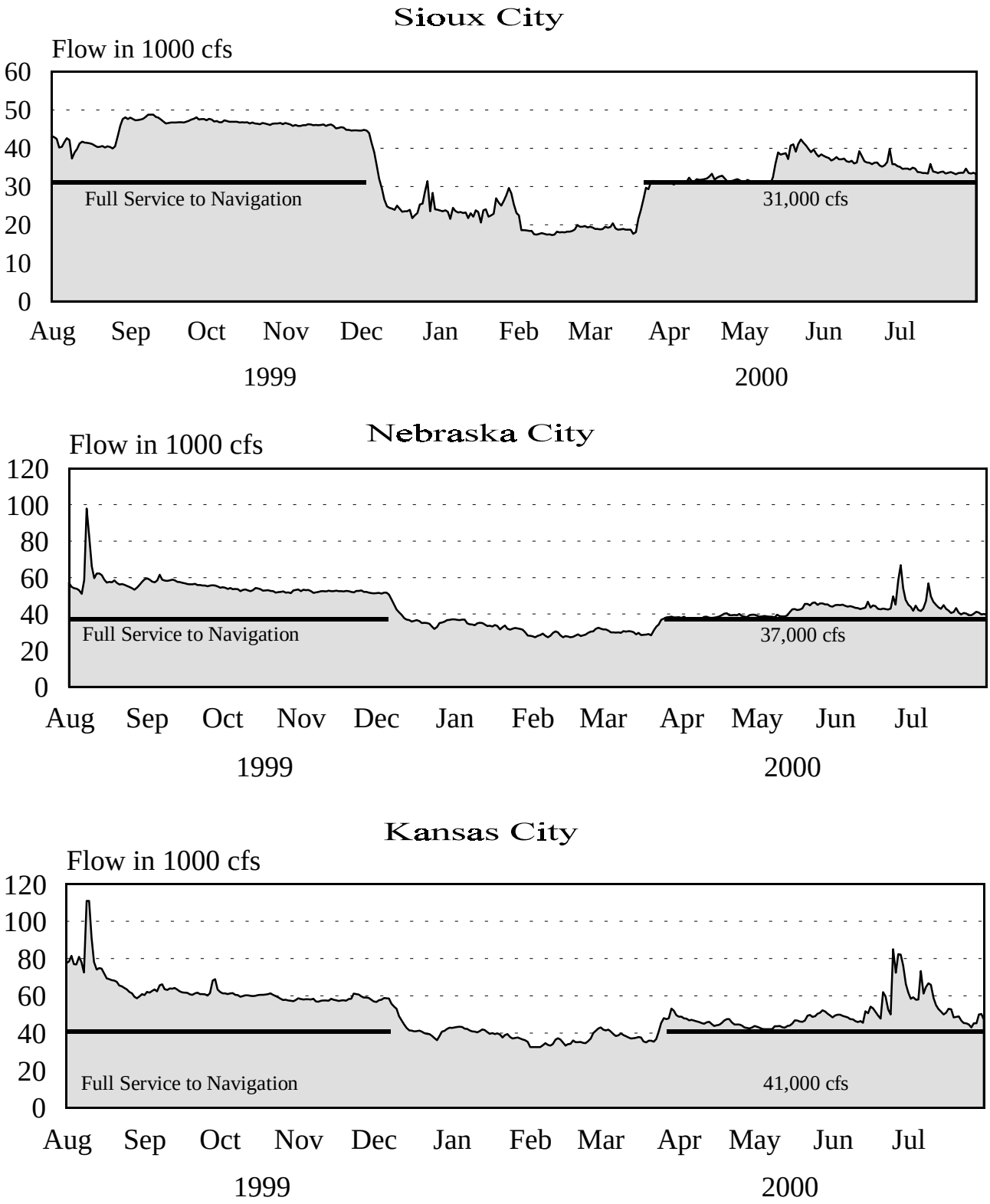


Figure 10

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 1999 by the Federal power system could have supplied all of the yearly needs of one million residential OPPD customers for a retail value of over $927 million.

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 1999 generation was 110 percent of the average since the System first filled in 1967. Above normal average annual releases at all powerplants except Fort Peck resulted in the above normal generation. CY main stem generation with individual project distribution since 1954 is shown on ***Figure 11***.

Generation was 2.2 billion kWh for the December-through-February (1999-2000) winter energy period, 100 percent of the past 33-year average. Western purchased about 1.0 billion kWh between December 1, 1999 and February 29, 2000 at a cost of $18.6 million to supplement main stem hydropower production.

Energy production was above normal August through November 1999 as excess flood control storage was evacuated from the system. April through June 2000 generation was above normal due to above normal system releases. Western sold 4.9 billion kWh over and above firm energy for the August 1999 - July 2000 period valued at $119.2 million.

Total generation for the period August 1999 - July 2000 was 10.7 billion kWh, 105 percent of the 33-year average dating back to 1967. The gross generation from the Federal system (peak capacity and energy sales) for the August 1999 through July 2000 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 - 2000

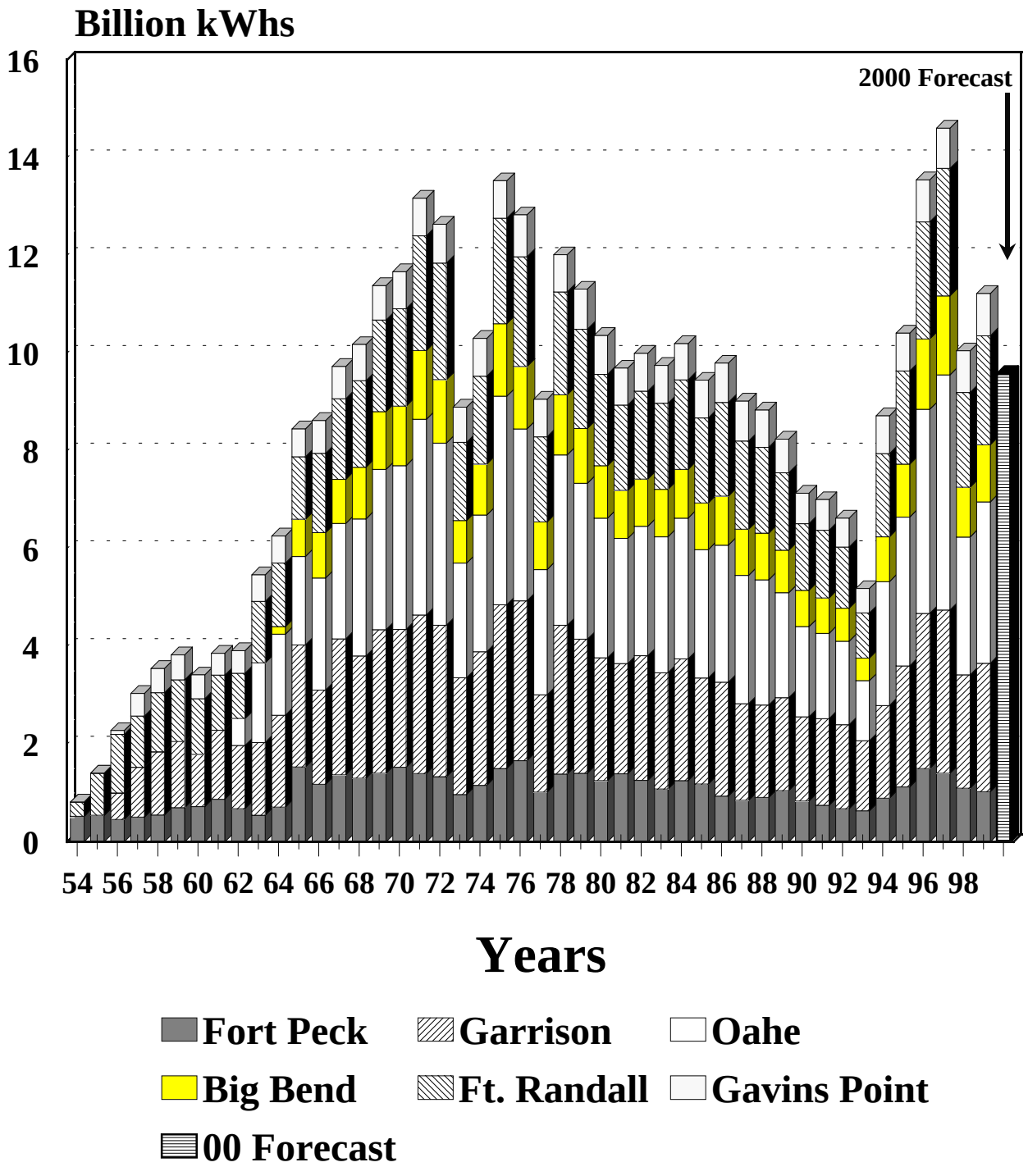


Figure 11

TABLE IX
GROSS POWER SYSTEM GENERATION
(August 1999 through July 2000)

	Energy Generation 1,000 kWh	Peak Hour kW	Generation Date
Corps Powerplants - Main Stem			
Fort Peck	924,898	200,000	8/30 & 9/1/99
Garrison	2,310,248	485,000	8/26/99
Oahe	3,271,073	766,000	10/16/99
Big Bend	1,195,181	480,000	11/10/99
Fort Randall	2,161,990	358,000	8/24/99
Gavins Point	854,629	117,000	12/5/99
Subtotal	10,718,019	2,193,000	8/25/99
USBR Powerplants			
Canyon Ferry	327,338	57,000	9/99
Yellowtail*	404,937	119,000	9/99
USBR Subtotal	732,275		
FEDERAL SYSTEM TOTAL	11,450,294		

*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.

Annual energy production for 2000 will be about 94 percent of normal due to lower than normal fall releases from Fort Peck and Garrison and lower than normal December system releases from Gavins Point.

6. Fish Management. Walleye harvest on Lake Sakakawea was the highest on record. Monthly harvest rates were as high as 0.5 fish per hour. 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, 1999 through July 31, 2000

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**
1999									
August	2,193		36		2,229		700		2,929
September	2,165		36		2,201		469		2,670
October	1,960		54		2,014		437		2,451
November	2,093		37		2,130		695		2,825
December	2,100		36		2,136		711		2,847
2000									
January	1,914		46		1,960		876		2,836
February	1,944		48		1,992		739		2,731
March	1,709		37		1,746		443		2,189
April	1,807		45		1,852		527		2,379
May	1,961		34		1,995		710		2,705
June	2,077		35		2,112		913		3,025
July	2,104		36		2,140		1153		3,293

* 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, 1999 through July 31, 2000

Period	Corps of Engineers Generation (Gross)	(plus)	USBR Generation (Gross)	(equals)	Federal Generation (Gross)	(plus)	Scheduled Interchange and Purchases Received	(equals)	Total System Load
1999									
August	1,105,517		79,000		1,184,517		178,000		1,362,517
September	1,069,060		69,000		1,138,060		65,000		1,203,060
October	1,024,584		75,000		1,099,584		155,000		1,254,584
November	937,554		61,000		998,554		121,000		1,119,554
December	748,428		58,000		806,428		214,000		1,020,428
2000									
January	799,315		63,000		862,315		250,000		1,112,315
February	665,897		58,000		723,897		237,000		960,897
March	673,862		59,000		732,862		262,000		994,862
April	819,747		53,000		872,747		217,000		1,089,747
May	919,255		54,000		973,255		136,000		1,109,255
June	973,206		49,000		1,022,206		98,000		1,120,206
July	981,594		52,000		1,033,594		179,000		1,212,594

*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. Modifications to reservoir releases were made at Garrison Dam during the smelt spawn to try to stem any drop in Lake Sakakawea lake levels. The resulting rainbow smelt run was one of the best ever. Subsequent larval sampling by North Dakota Game and Fish fishery personnel documented the highest catches on record.

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. Rainbow smelt recruitment in the spring of 2000 was hampered by the falling lake level during the smelt spawn. The declining lake level was due to poor plains snowpack coupled with little precipitation during early to mid-April. The lake level began to rise in mid-April but was too late to be of any benefit for the smelt spawn.

7. <u>Endangered and Threatened Species</u>. This is the 15th 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 provided vital information during the 2000 nesting season and proved to be a valuable tool in aiding release decisions benefiting endangered and threatened birds.

The river was flown during the past nesting season and digital ortho photography was accomplished in the four river reaches for use in the Geographic Information System.

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 above average fledge ratios in 1999 and 2000 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 2000, the majority of piping plovers was found on Lake Sakakawea and Lake Oahe. Excellent shoreline habitat existed due to the lower reservoir levels caused by the reduced runoff. A record number of piping plover adults, 797, were found on the Missouri River System this year. The majority of least terns were found on the Missouri River reaches below Garrison, Fort Randall, and Gavins Point Dams.

Table XII shows the population distribution and productivity for terns and plovers for 1989 through 2000. Productivity estimates for these birds on the Missouri River in 2000 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 2000, public use at these lakes was 60,895,700 visitor hours, a 1.4 percent decrease from 1999. Visitor attendance at the lake projects for 1998, 1999, and 2000 is shown in ***Table XIII.*** ***Figure 12*** displays recreation-related visitor hours at each of the six projects for the years 1954 through 2000. 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
	1998	1999	2000	
Fort Peck	5,342,700	5,250,300	5,946,100	+ 13.3
Garrison	14,314,300	16,312,100	16,555,900	+ 1.5
Oahe	16,324,300	15,372,500	14,623,200	- 4.9
Big Bend	5,107,500	5,215,300	5,261,800	+ 0.9
Fort Randall	11,593,600	10,811,200	9,752,300	- 9.8
Gavins Point	9,036,100	8,826,800	8,756,400	- 0.8
SYSTEM TOTAL	61,718,500	61,788,200	60,895,700	-1.4

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											
	1988	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Fort Peck Lake																										
Adults	3	4	6	10	0	7	9	2	0	0	4	0	0	20	12	22	25	26	30	4	5	0	0	4	2	0
Fledglings/Pair	0	3.00	0	0.40	0	0	0.44	0	0	0	0	0	0	1.70	1.50	3.18	1.20	1.00	0.60	1.50	1.20	0	0	0	2.00	0
Fort Peck to Lake Sakakawea																										
Adults	18	48	92	66	110	31	58	95	128	162	25	40	13	5	11	17	13	0	4	9	20	24	23	4	5	4
Fledglings/Pair	0.33	0	0.17	0.55	0.25	0.45	1.41	0.99	0.33	0.53	.1.52	1.70	0.15	0	0.18	0	0	0	0	0	3.50	1.00	0.87	1.00	0	0
Lake Sakakawea																										
Adults	7	15	6	8	29	17	35	7	27	2	23	9	10	143	57	132	150	108	8	45	24	70	3	119	83	277
Fledglings/Pair	0	0	0	0	0.83	0.12	0	0	0.15	0	1.04	0.67	0.20	0	0	0	0	1.50	8.50	1.24	0	0.57	0.67	1.24	1.25	1.61
Garrison to Lake Oahe																										
Adults	142	121	174	195	198	145	217	284	105	41	141	105	105	113	84	71	124	77	127	119	261	45	6	74	139	99
Fledglings/Pair	0.93	0.43	0.44	0.58	0.48	0.28	0.54	0.91	0.08	0.39	1.52	1.50	1.03	0.97	0.26	1.04	1.13	1.06	0.54	0.87	0.87	0.09	0	1.84	0.88	1.41
Lake Oahe																										
Adults	82	97	100	143	124	125	160	84	74	101	110	57	85	55	140	88	87	143	66	85	30	21	31	98	46	141
Fledglings/Pair	0	0	0	0	0.42	0	0.06	0	0.24	0.16	1.29	0.88	1.01	0	0	0	0	0.97	0.33	0.09	0.93	0.29	1.29	1.06	0.30	1.45
Ft. Randall to Niobrara																										
Adults	0	4	26	32	13	38	43	10	2	0	64	124	72	0	0	12	25	8	12	17	0	3	0	33	51	62
Fledglings/Pair	0	0	0.31	0.63	0.46	0	0	0	0	0	0.94	1.03	1.26	0	0	0.67	0.48	0.75	0	0	0	0	0	1.27	1.02	0.87
Lake Lewis and Clark																										
Adults	45	29	63	55	29	76	44	16	28	60	120	76	44	31	18	30	33	6	32	12	4	6	32	84	67	28
Fledglings/Pair	0.13	0.62	0.35	0	1.59	0.97	0	0	0	1.57	2.33	0.21	0.38	0.06	0.56	0.67	0	0	0.06	0.33	0	0	1.25	2.45	0.30	0.5
Gavins Point to Ponca																										
Adults	252	210	167	193	187	272	211	93	82	115	148	161	149	212	122	148	166	112	109	62	63	22	22	49	141	186
Fledglings/Pair	0.49	0.55	0.46	0.26	0.21	0.83	0.48	0.49	0.27	0.90	2.27	2.41	1.72	0.62	0.21	0.39	0.35	0.34	1.06	0.61	0.16	0	0	2.20	1.60	2.17
Total Adults	549	528	634	702	690	711	777	591	446	481	635	572	551	579	444	521	623	480	388	353	407	191	117	465	534	797
Fledglings/Pair	0.59	0.54	0.38	0.41	0.42	0.50	0.41	0.67	0.21	0.66	1.73	1.42	1.22	0.73	0.32	0.76	0.62	0.94	0.76	0.61	0.84	0.39	0.87	1.61	1.01	1.58

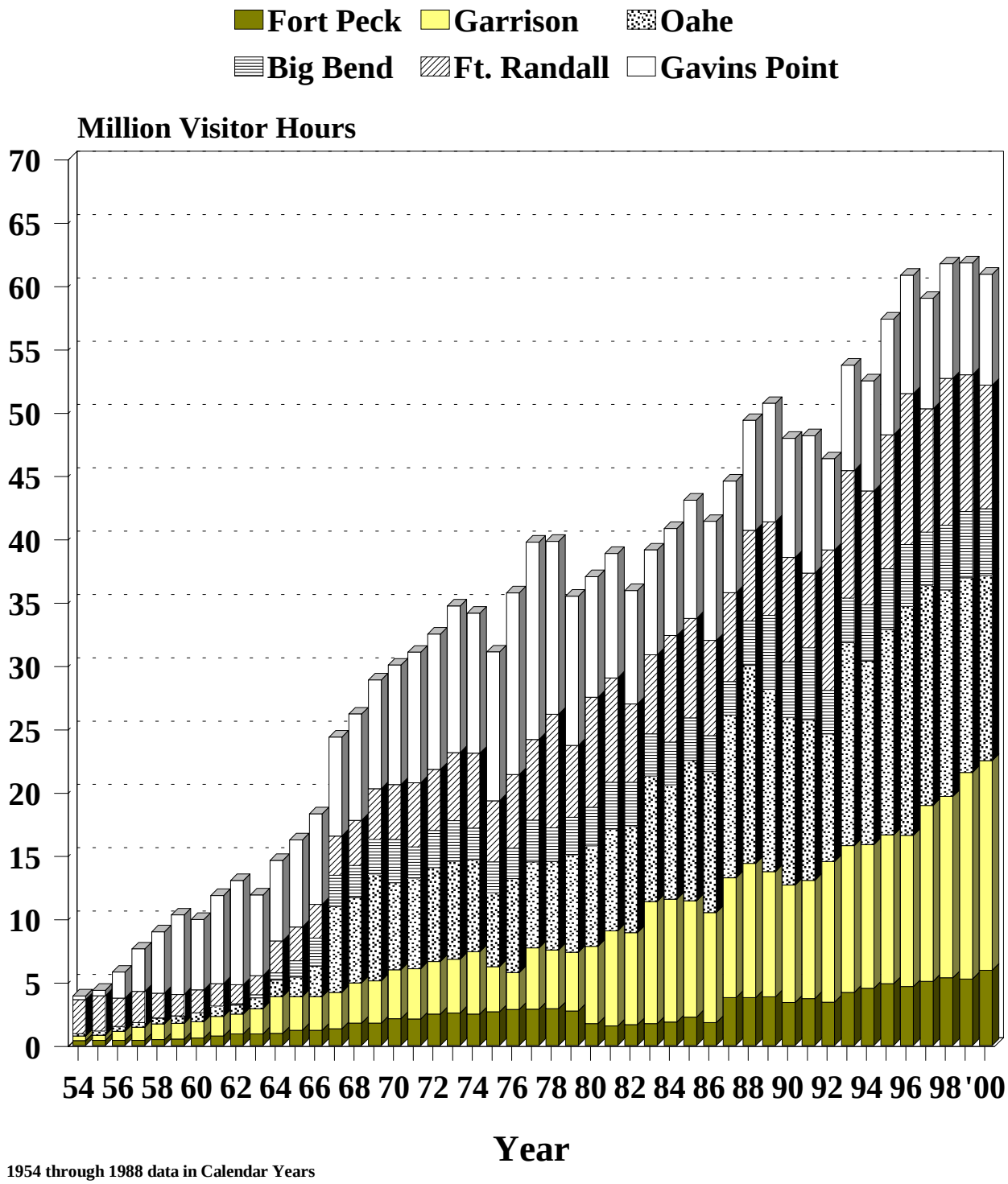
Ten Year Interior Least Tern Fledge Ratio Goal = 0.70

Fifteen Year Piping Plover Fledge Ratio Goal = 1.44

- Data not collected
* Partial Survey Results
{} No Birds Found
\+ Subsamplng 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 2000



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 on the National Bicentennial Council to ensure that adequate facilities and information are available to accommodate the increased visitation, to protect environmental and historical resources, and to plan and coordinate commemorative activities.

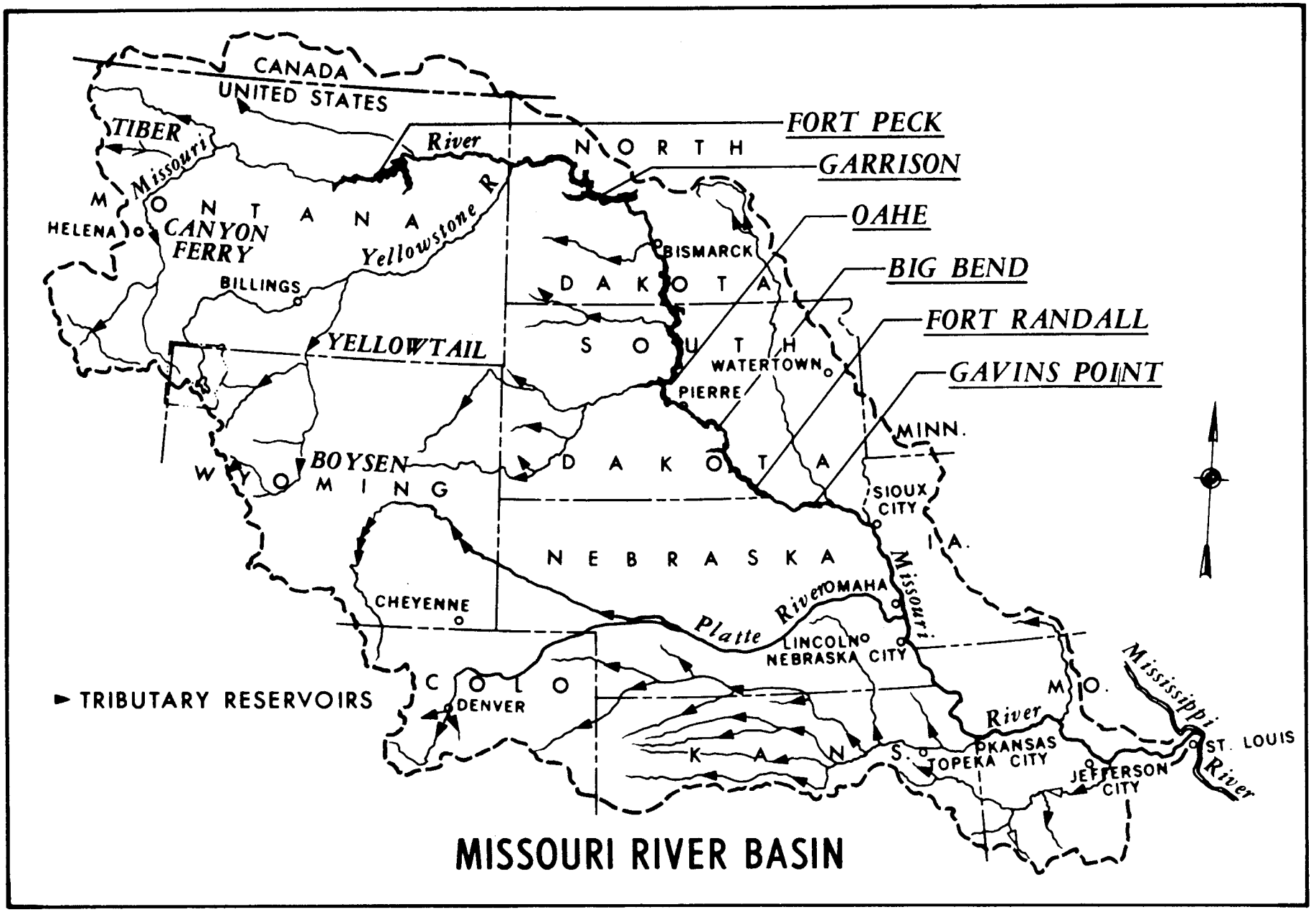

CANADA
UNITED STATES
TIBER
Missouri
River
FORT PECK
NORTH
GARRISON
OAHE
MONTANA
HELENA
CANYON FERRY
Yellowstone R.
BISMARCK
BIG BEND
BILLINGS
DAKOTA
FORT RANDALL
YELLOWTAIL
SOUTH
WATERTOWN
GAVINS POINT
PIERRE
MINN.
BOYSEN
WYOMING
DAKOTA
SIOUX CITY
IA.
NEBRASKA
Missouri
CHEYENNE
Platte River
OMAHA
LINCOLN
NEBRASKA CITY
COLO
DENVER
MO.
Mississippi
River
KANSAS
TOPEKA
CITY
ST. LOUIS
JEFFERSON CITY
TRIBUTARY RESERVOIRS
MISSOURI RIVER BASIN

PLATE 1

Summary of Engineering Data -- Missouri River Main Stem Reservoirs

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)	1,163	2,472	2,908
55	Initial generation, first and last unit	July 1943 - June 1961	January 1956 - October 1960	April 1962 - June 1963
56	Estimated cost September 1996 completed project (13)	$158,428,000	$299,938,000	$346,521,000

Summary of Engineering Data -- Missouri River Main Stem Reservoirs

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	
80, ending near Pierre, SD	107, ending at Big Bend Dam	25, ending near Niobrara, NE	755 miles	4	(2) Includes 1,350 square miles of non-contributing areas.
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) 1967-1999 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 1996.
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	
1351-1355(10) 25,000-100,000 cfs	32,000 cfs - 128,000 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
1,055	1,861	756	10,215 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	$1,161,068,000		May 2000