

Development of the 2012 Missouri River Mainstem Reservoir System Runoff Forecast

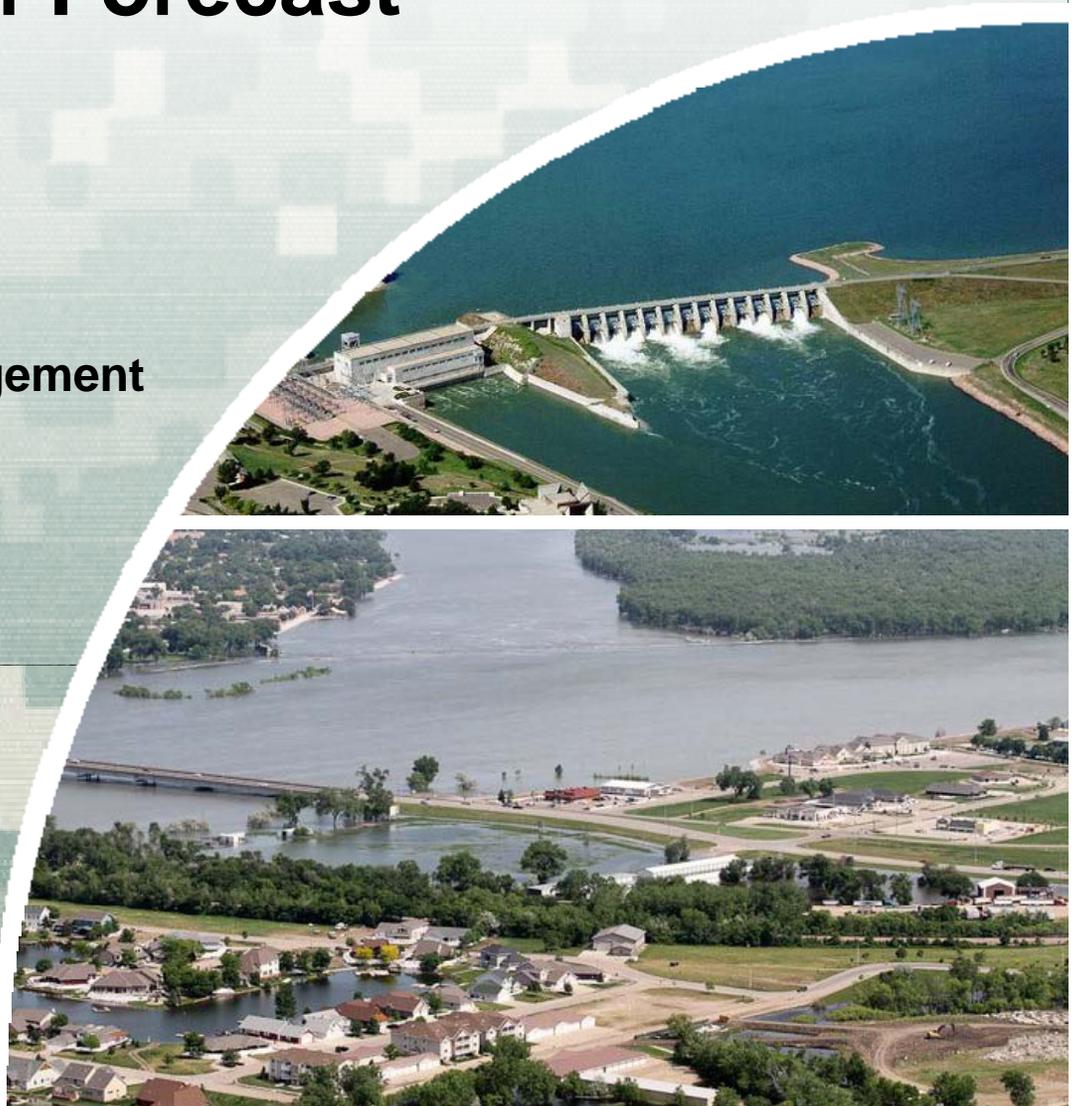
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Missouri River Basin Water Management
Northwestern Division

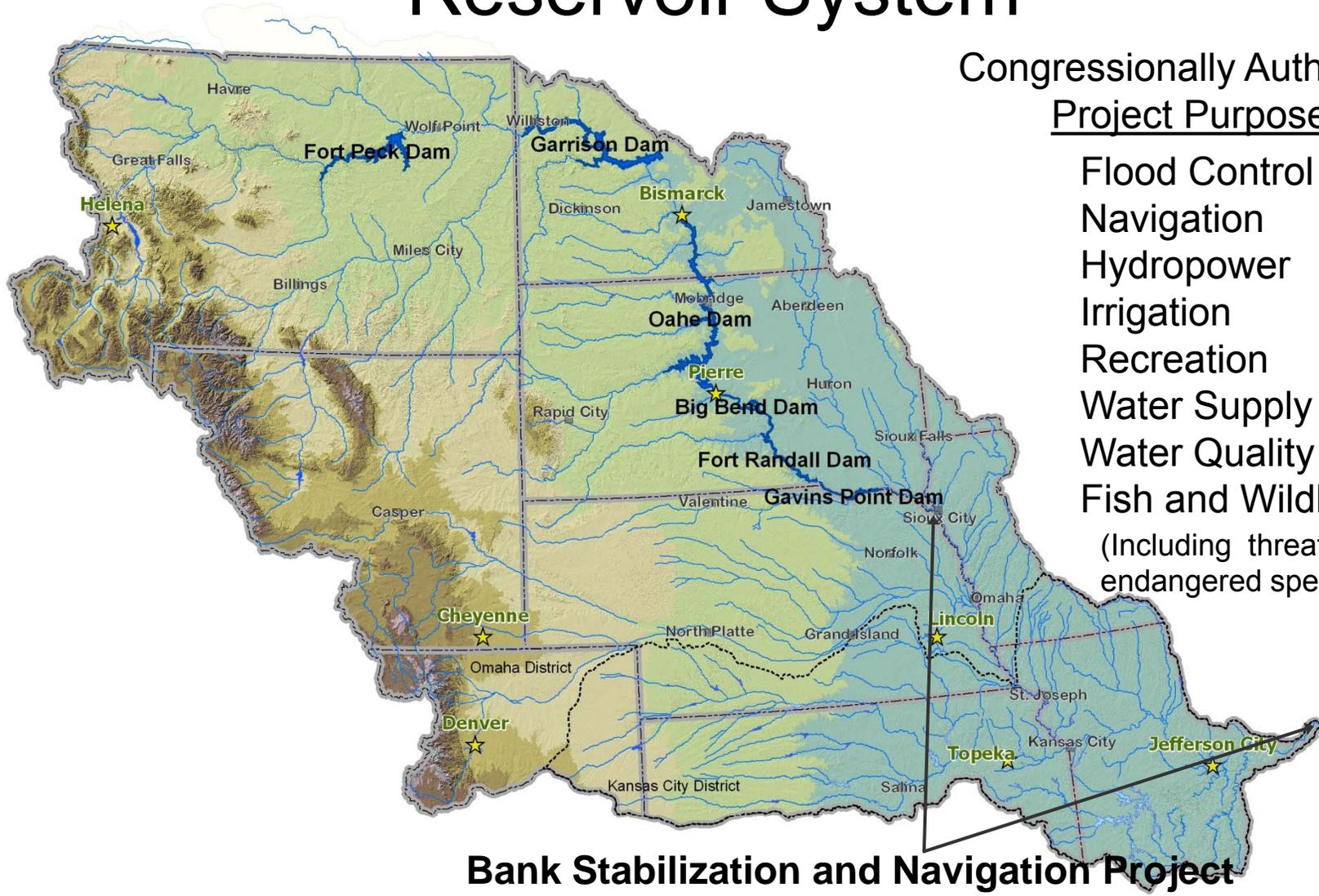
February 10, 2012



US Army Corps of Engineers
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Missouri River Mainstem Reservoir System



Congressionally Authorized Project Purposes

Flood Control
Navigation

Hydropower
Irrigation

Recreation
Water Supply

Water Quality
Fish and Wildlife

(Including threatened & endangered species)

**Bank Stabilization and Navigation Project
Sioux City, IA – St. Louis, MO**

Missouri River Mainstem System Runoff Forecast

- Volumetric forecast in million/thousand acre feet
- Six reservoir/river reaches
- Monthly value for each reach
- Monthly and annual summations above
 - ▶ Gavins Point
 - ▶ Sioux City
- 72 individual monthly values in the forecast

Missouri River Basin Calendar Year 2012 Runoff Forecast										1-Feb-12
	Incremental Runoff in Reaches						Summation above Gavins Point	Summation above Sioux City	End-of-Month Accumulated Runoff above Sioux City	
	Fort Peck	Garrison	Oahe	Fort Randall	Gavins Point	Sioux City				
	Values in 1000 Acre Feet									
(History)										
JAN 2012	334	233	-46	140	100	219	760	980	980	
NORMAL	312	261	12	25	100	40	710	750	750	
DEPARTURE	22	-28	-58	115	0	179	50	230	230	
% OF NORM	107%	89%	-383%	559%	100%	548%	107%	131%	131%	
(Forecast)										
FEB 2012	350	320	60	100	125	200	955	1,155	2,135	
NORMAL	360	356	90	49	130	92	985	1,077	1,827	
DEPARTURE	-10	-36	-30	51	-5	108	-30	78	308	
% OF NORM	97%	90%	67%	204%	96%	217%	97%	107%	117%	
MAR 2012	570	960	500	200	180	400	2,410	2,810	4,945	
NORMAL	596	1,003	567	209	206	299	2,581	2,880	4,707	
DEPARTURE	-26	-43	-67	-9	-26	101	-171	-70	238	
% OF NORM	96%	96%	88%	96%	87%	134%	93%	98%	105%	
APR 2012	610	1,040	430	140	140	600	2,360	2,960	7,905	
NORMAL	649	1,080	481	144	180	360	2,534	2,894	7,601	
DEPARTURE	-39	-40	-51	-4	-40	240	-174	66	304	
% OF NORM	94%	96%	89%	97%	78%	167%	93%	102%	104%	
MAY 2012	980	1,260	300	140	180	500	2,860	3,360	11,265	
NORMAL	1,081	1,245	312	147	186	292	2,971	3,263	10,864	
DEPARTURE	-101	15	-12	-7	-6	208	-111	97	401	
% OF NORM	91%	101%	101%	96%	97%	171%	96%	103%	104%	
JUN 2012	1,390	2,690	400	140	175	510	4,795	5,305	16,570	
NORMAL	1,612	2,667	423	152	178	286	5,032	5,318	16,182	
DEPARTURE	-222	23	-23	-12	-3	224	-237	-13	388	
% OF NORM	86%	101%	95%	92%	98%	178%	95%	100%	102%	
JUL 2012	790	1,780	175	52	135	400	2,932	3,332	19,902	
NORMAL	819	1,776	179	57	137	218	2,968	3,186	19,368	
DEPARTURE	-29	4	-4	-5	-2	182	-36	146	534	
% OF NORM	96%	100%	98%	91%	99%	183%	99%	105%	103%	
AUG 2012	340	600	65	35	110	220	1,150	1,370	21,271	
NORMAL	353	604	65	39	115	131	1,176	1,307	20,675	
DEPARTURE	-13	-4	-1	-4	-5	89	-27	63	596	
% OF NORM	96%	99%	99%	90%	96%	168%	98%	105%	103%	
SEP 2012	330	445	110	35	110	170	1,030	1,200	22,472	
NORMAL	333	452	111	38	111	99	1,045	1,144	21,819	
DEPARTURE	-3	-7	-1	-3	-1	71	-15	56	653	
% OF NORM	99%	99%	99%	92%	99%	172%	99%	105%	103%	
OCT 2012	380	520	65	4	115	170	1,084	1,254	23,726	
NORMAL	385	523	66	5	120	78	1,099	1,177	22,996	
NOV 2012	380	520	65	4	115	170	1,084	1,254	23,726	
DEPARTURE	-4	-3	-2	-1	-3	64	-13	51	781	
% OF NORM	99%	99%	97%	83%	97%	184%	99%	105%	103%	
DEC 2012	325	245	0	10	95	120	675	795	25,621	
NORMAL	329	247	0	12	100	52	680	740	24,785	
DEPARTURE	-4	-2	0	-2	-5	68	-13	55	836	
% OF NORM	99%	99%	100%	83%	95%	231%	98%	107%	103%	
Calendar Year Totals	6,779	10,488	2,124	1,001	1,580	3,649	21,972	25,621		
NORMAL	7,213	10,612	2,373	883	1,681	2,023	22,762	24,785		
DEPARTURE	-434	-124	-250	118	-101	1,626	-791	836		
% OF NORM	94%	99%	89%	113%	94%	180%	97%	103%		

<http://www.nwd-mr.usace.army.mil/rcc/reports/runoff.pdf>

Forecast Variables

Quantitative

- Mountain snowpack
- Plains snowpack
- Soil moisture content & frost
- Antecedent precipitation & temperature
- Current streamflow & groundwater levels

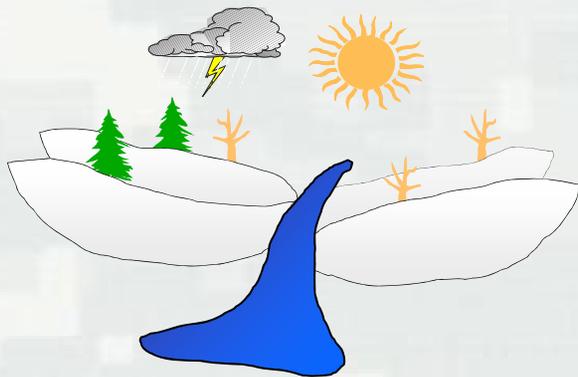
Qualitative

- Long-range temperature & precipitation outlooks
- Climate indicators
 - ▶ ENSO (La Nina/El Nino)
 - ▶ Arctic Oscillation



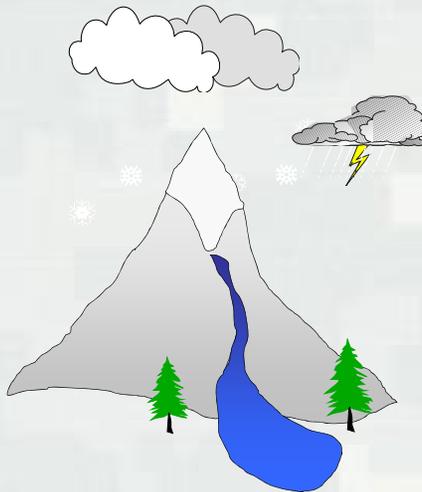
Runoff Components

Plains Snowmelt &
Rainfall



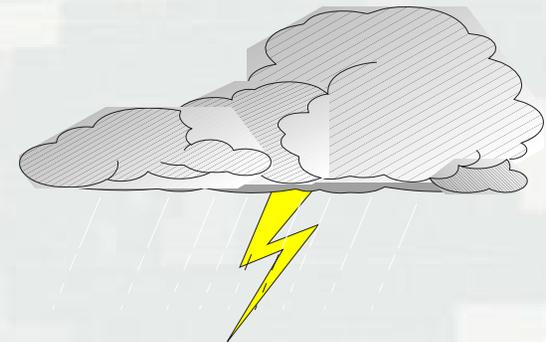
March and April
(25%)

Mountain Snowmelt
& Rainfall



May, June and July
(50%)

Rainfall



March through October
(25%)

Average Runoff above Sioux City, IA = 24.8 MAF

Record Runoff = 61.2 MAF (247% of normal) in 2011

Forecast Technical Studies

- MH-1973 - Missouri River Mainstem Reservoir System Long Range Runoff Forecasts
- D-1979 - Missouri River Mainstem Reservoir System Inflow Forecasting
- D-1996 - Missouri River Mainstem Reservoirs Long Term Runoff Forecasts
- M-2011 - Update to Missouri River Mainstem Reservoirs Long Term Runoff Forecasting



Forecast Procedure

- March-April (plains snowmelt and rainfall)
 - ▶ Applies to all six reservoir reaches
 - ▶ Plains Snowpack Classification vs Runoff (M-2011)
 - ▶ Weighted with soil moisture, frost, temperature conditions, precipitation/temperature outlooks
- May-June-July (mountain snowmelt and rainfall)
 - ▶ Applies to Fort Peck and Garrison
 - ▶ Runoff Regression Equations (M-2011)
 - ▶ Weighted with soil moisture & frost conditions, and precipitation/temperature outlooks



Forecast Procedure

- February, August – December periods
 - ▶ Baseflow & rainfall
 - ▶ Applies to all reservoir reaches
 - ▶ Persistence / recession of existing runoff volumes
 - ▶ Weighted with soil moisture, frost, temperature conditions, precipitation/temperature outlooks

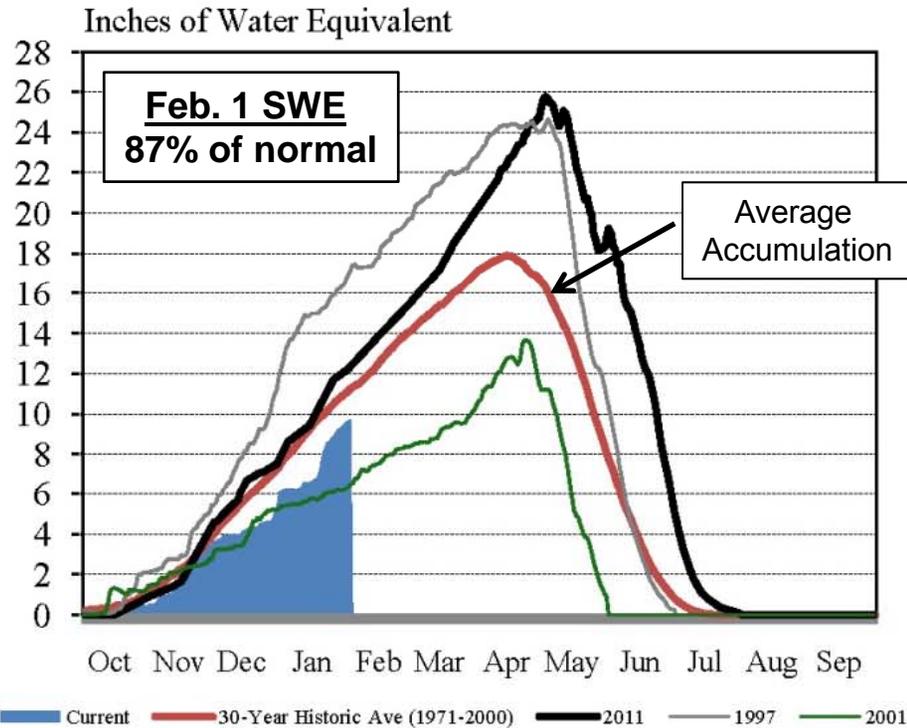


Missouri River Basin

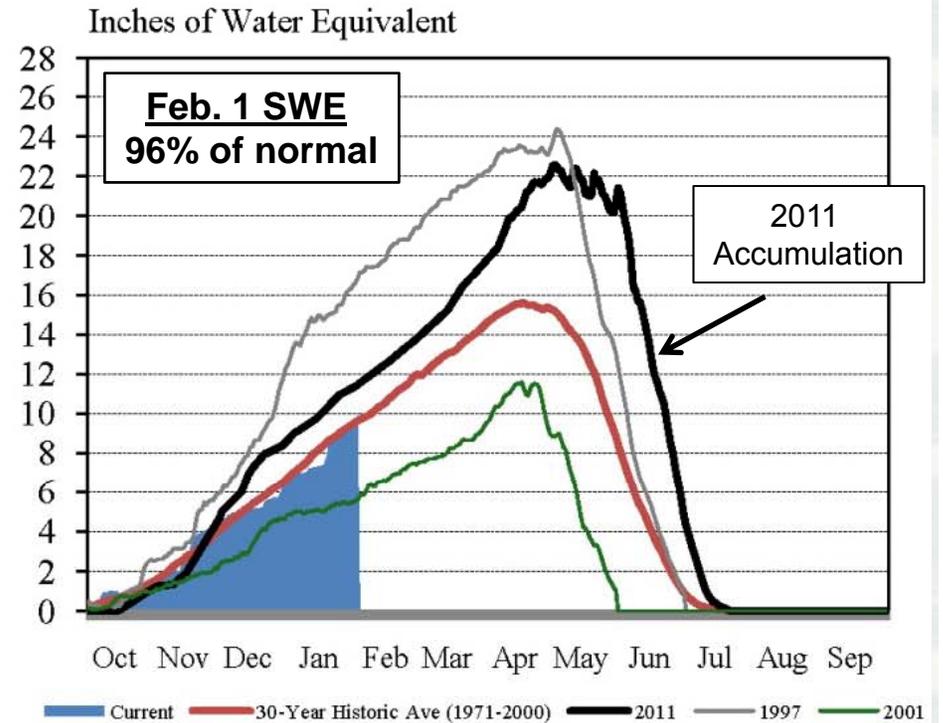
Mountain Snowpack Water Content

2011-2012 with comparison plots from 1997*, 2001* and 2011

Total above Fort Peck



Total Fort Peck to Garrison



Graphics assembled from data provided by USDA NRCS SNOTEL gages.

On average 61% of mountain SWE accumulates by Feb 1.

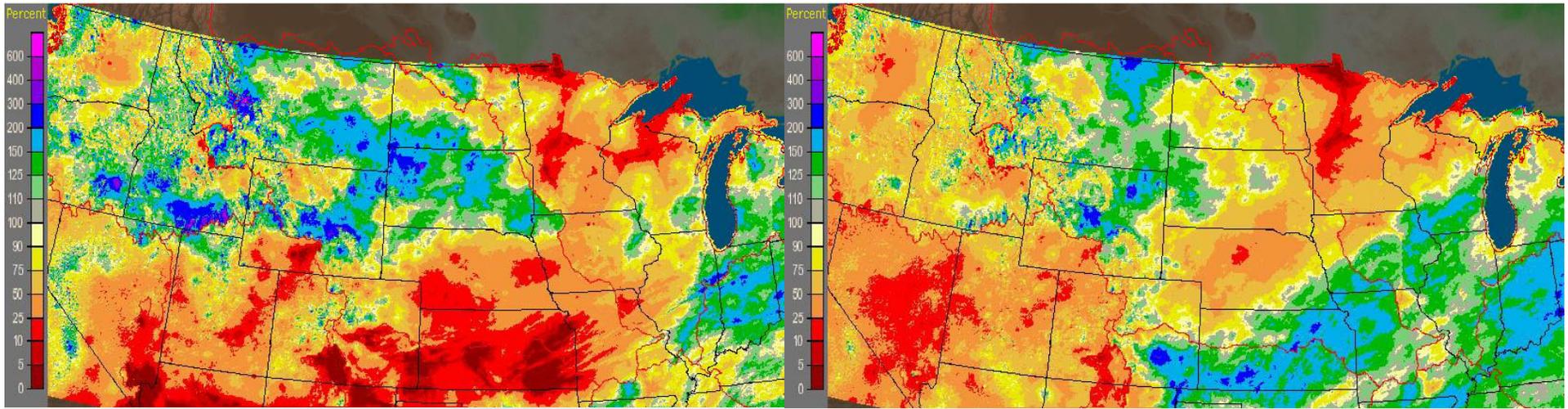
January 2012

Antecedent Rainfall

90-day ending
January 31, 2012

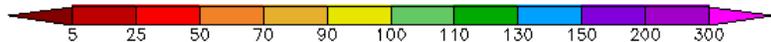
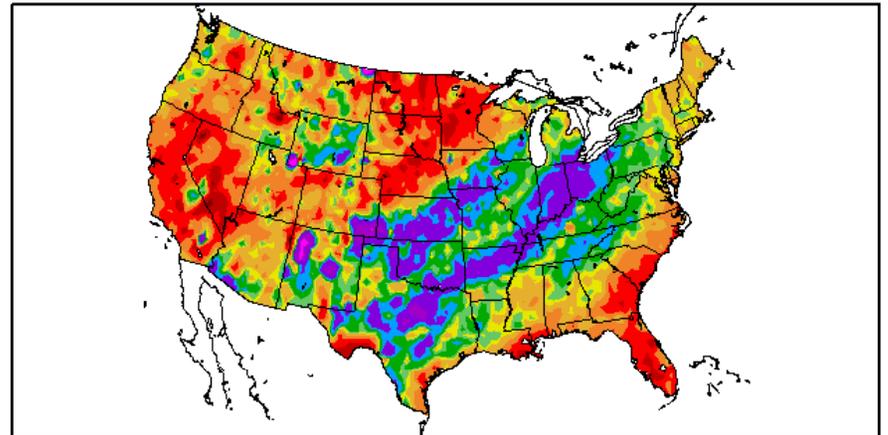
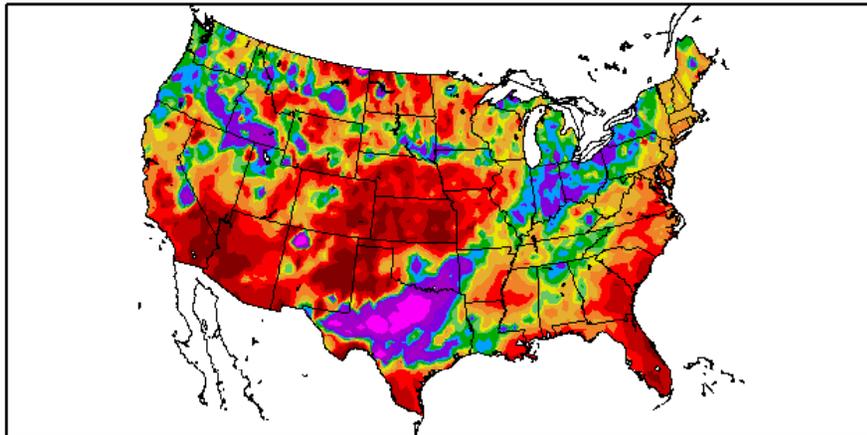
Missouri Basin RFC Pleasant Hill, MO: January, 2012 Monthly Percent of Normal Precipitation
Valid at 2/1/2012 1200 UTC- Created 2/3/12 21:41 UTC

Missouri Basin RFC Pleasant Hill, MO: Current 90-Day Percent of Normal Precipitation
Valid at 1/31/2012 1200 UTC- Created 1/31/12 20:17 UTC



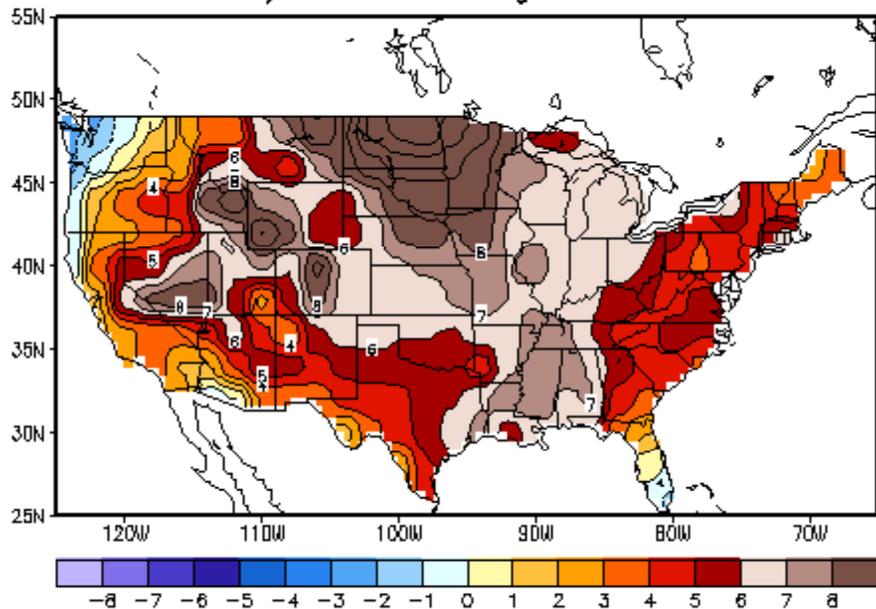
Percent of Normal Precipitation (%)
1/1/2012 - 1/31/2012

Percent of Normal Precipitation (%)
11/1/2011 - 1/31/2012



January 2012

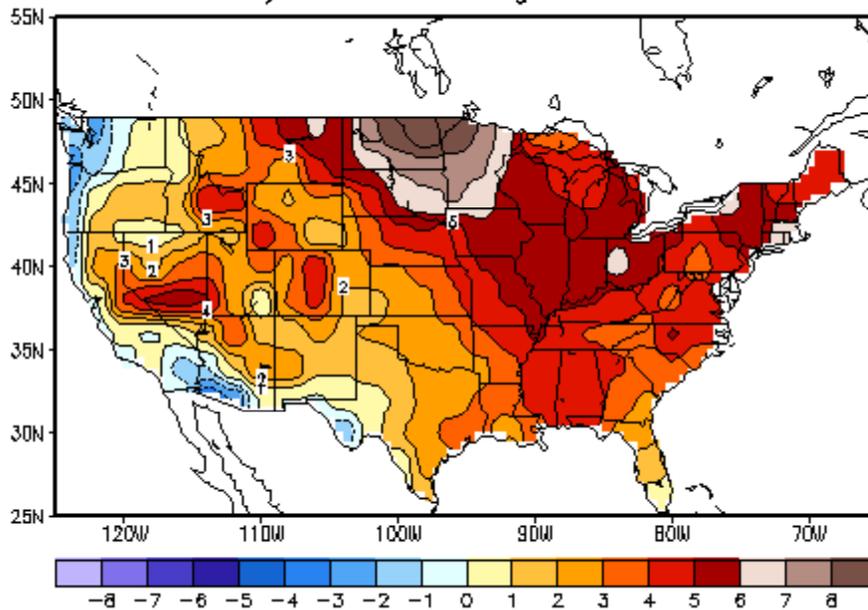
Mean Temp (F) Anomaly
30-day mean ending Feb 01 2012



Temperature Anomalies

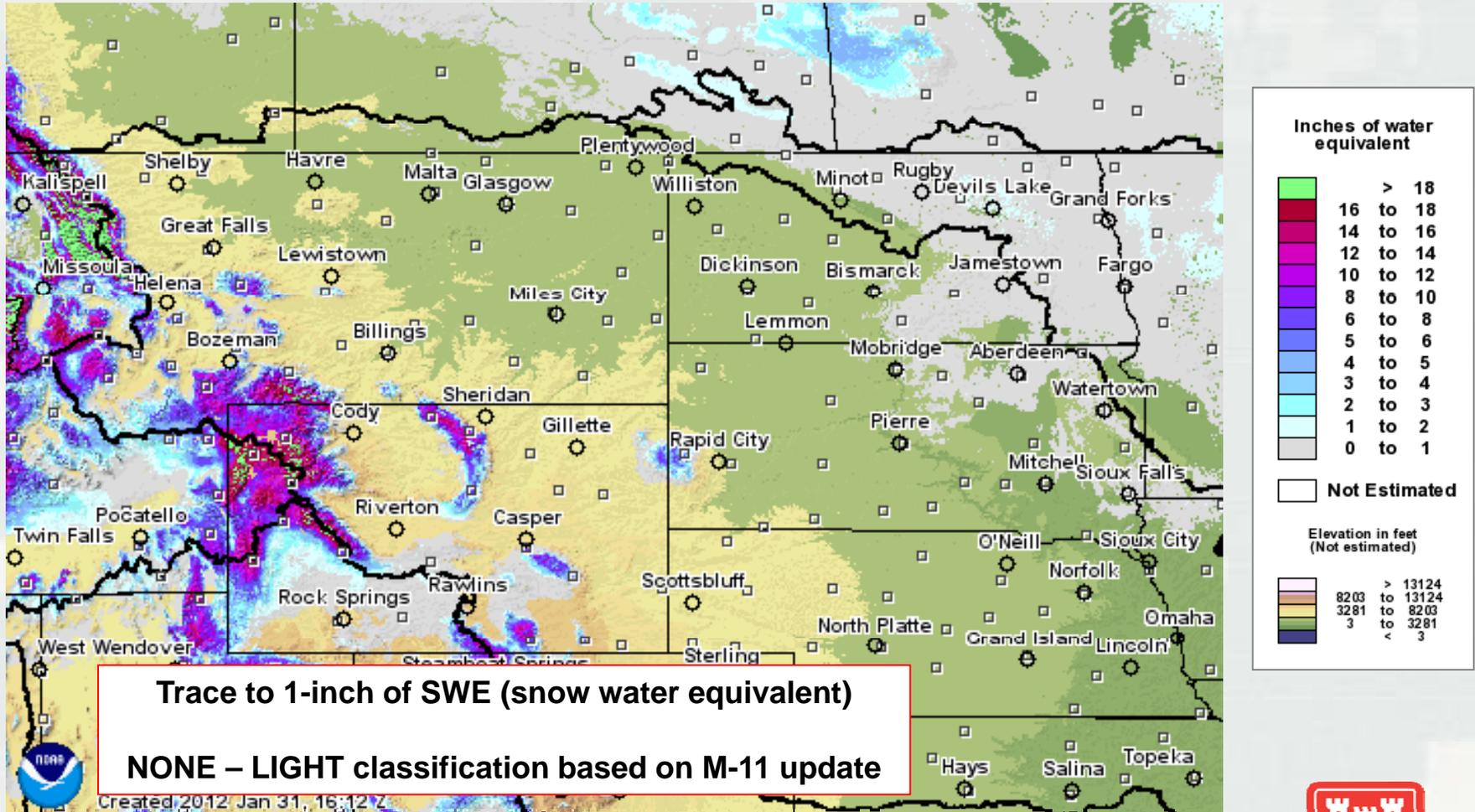
90-day ending
January 31, 2012

Mean Temp (F) Anomaly
90-day mean ending Feb 01 2012



Plains Snowpack

1 February 2012

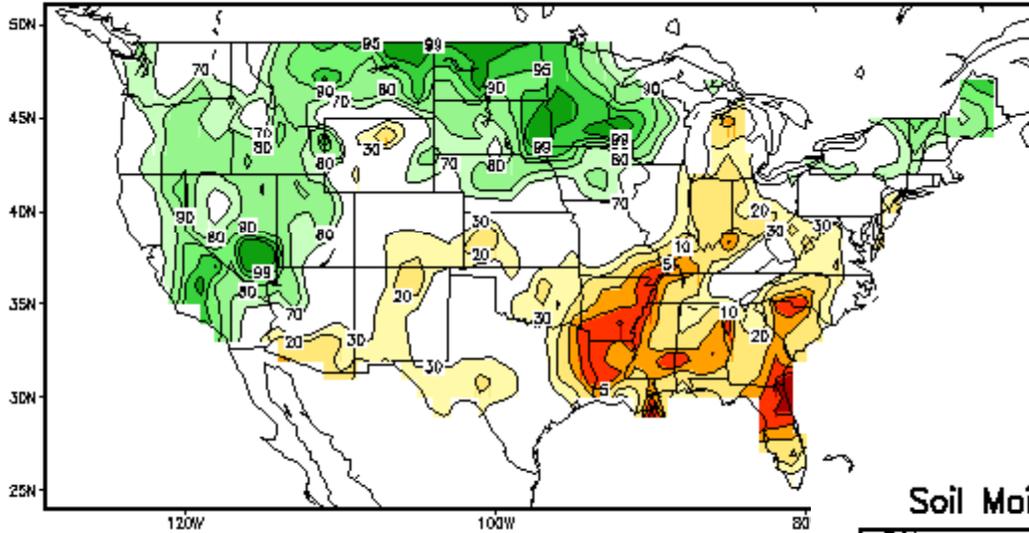


Graphics courtesy of NOAA - National Operational Hydrologic Remote Sensing Center

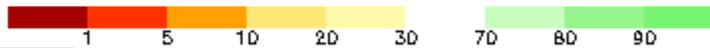
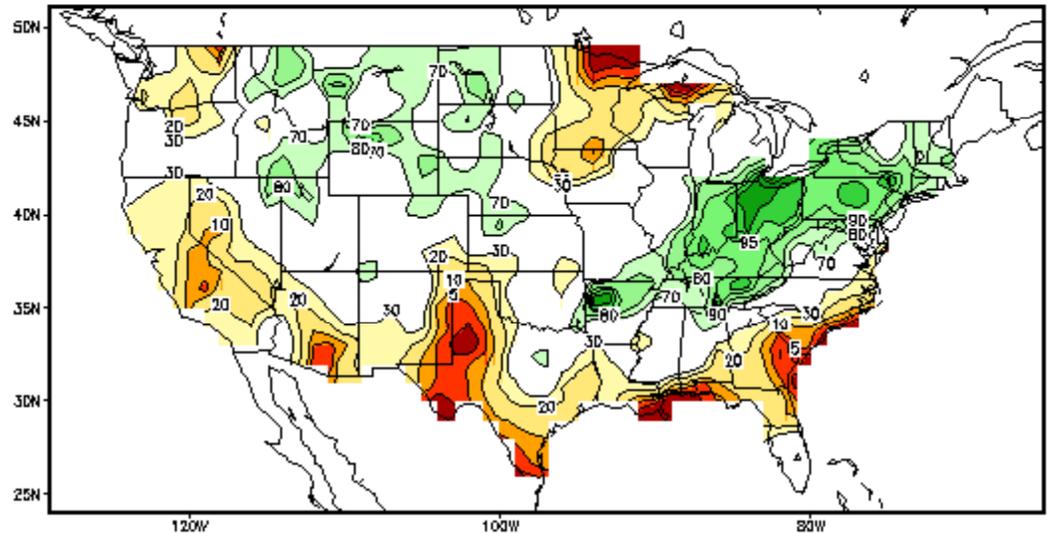


Soil Moisture Ranking

Calculated Soil Moisture Ranking Percentile
JAN, 2011



Soil Moisture Ranking Percentile Last day of JAN, 2012



1 Year ago

**Much Drier Basin-Wide
Year-to-Year
and (especially)
Since Summer 2011
(except far lower basin)**



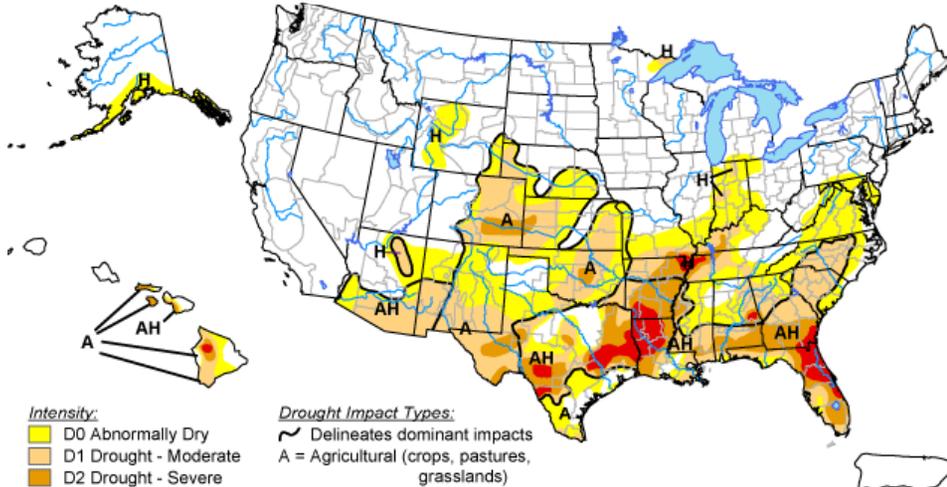
Most recent...

Graphics courtesy of NOAA Climate Prediction Center

U.S. Drought Monitor

U.S. Drought Monitor

January 18, 2011
Valid 7 a.m. EST



- Intensity:**
- D0 Abnormally Dry
 - D1 Drought - Moderate
 - D2 Drought - Severe
 - D3 Drought - Extreme
 - D4 Drought - Exceptional

- Drought Impact Types:**
- Delineates dominant impacts
 - A = Agricultural (crops, pastures, grasslands)
 - H = Hydrological (water)



Released Thursday, January 20, 2011

Author: Brian Fuchs, National Drought Mitigation Center

<http://drought.unl.edu/dm>

1 Year ago

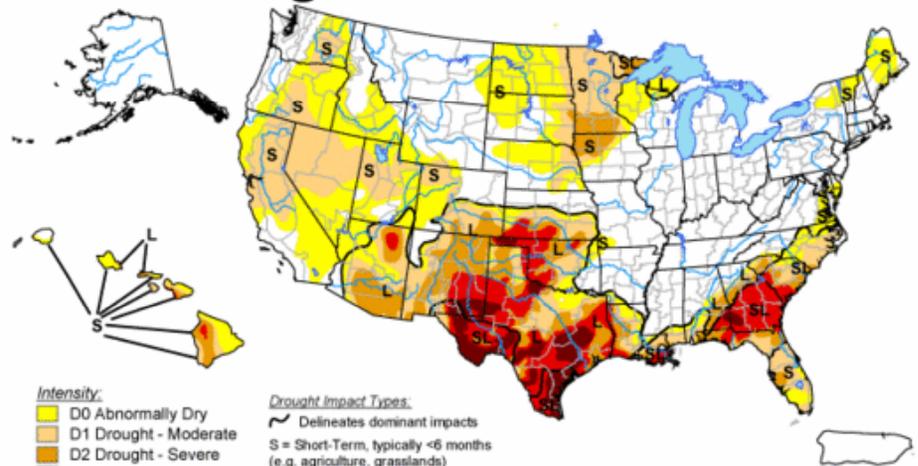
Graphics courtesy of National Drought Mitigation Center

15

Drought Conditions have developed across parts of eastern Nebraska and northwestern Iowa since Summer 2011

U.S. Drought Monitor

January 24, 2012
Valid 7 a.m. EST



- Intensity:**
- D0 Abnormally Dry
 - D1 Drought - Moderate
 - D2 Drought - Severe
 - D3 Drought - Extreme
 - D4 Drought - Exceptional

- Drought Impact Types:**
- Delineates dominant impacts
 - S = Short-Term, typically <6 months (e.g. agriculture, grasslands)
 - L = Long-Term, typically >6 months (e.g. hydrology, ecology)



Released Thursday, January 26, 2012

Author: Eric Luebbehusen, U.S. Department of Agriculture

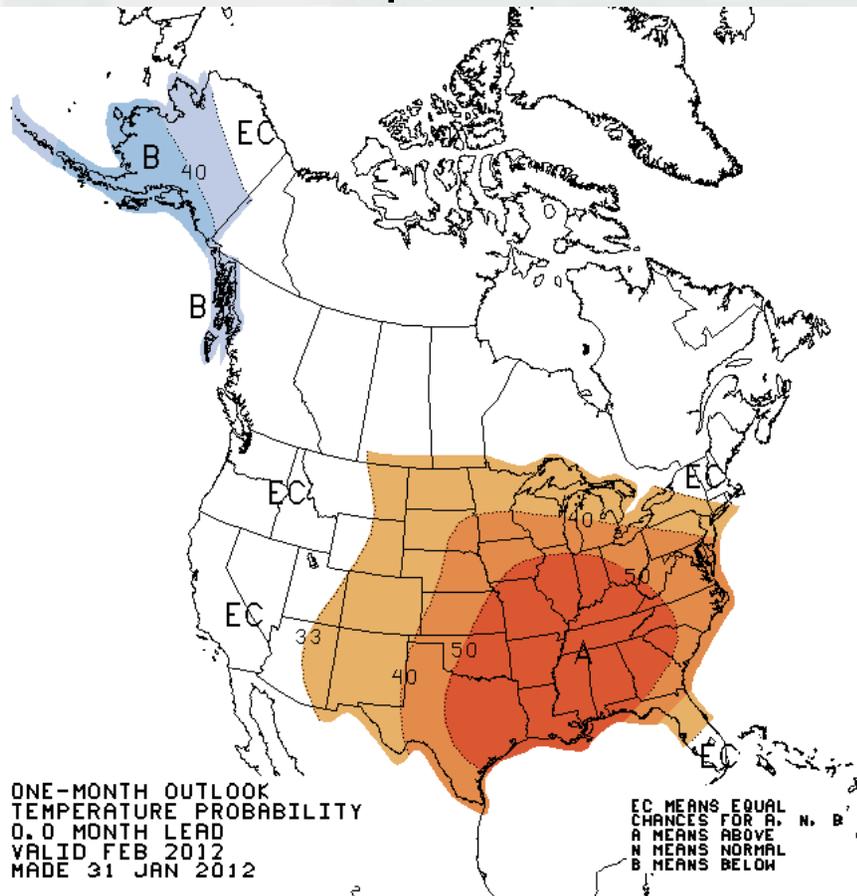
<http://droughtmonitor.unl.edu/>

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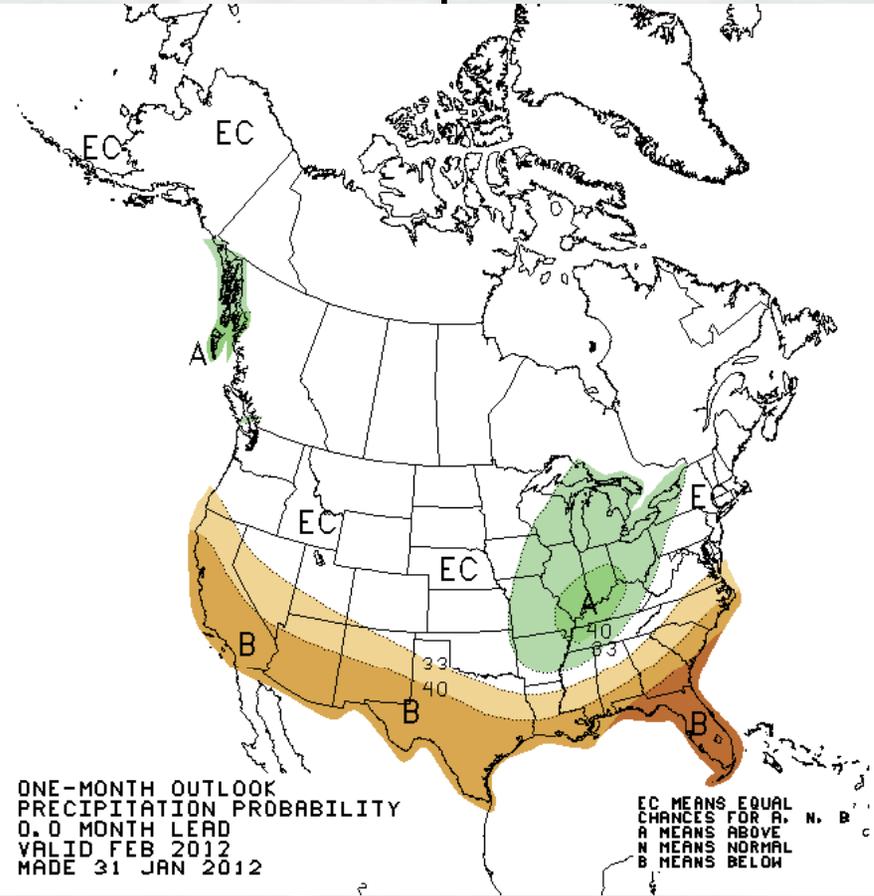
Most recent...

Temperature / Precipitation February Outlooks

Temperature



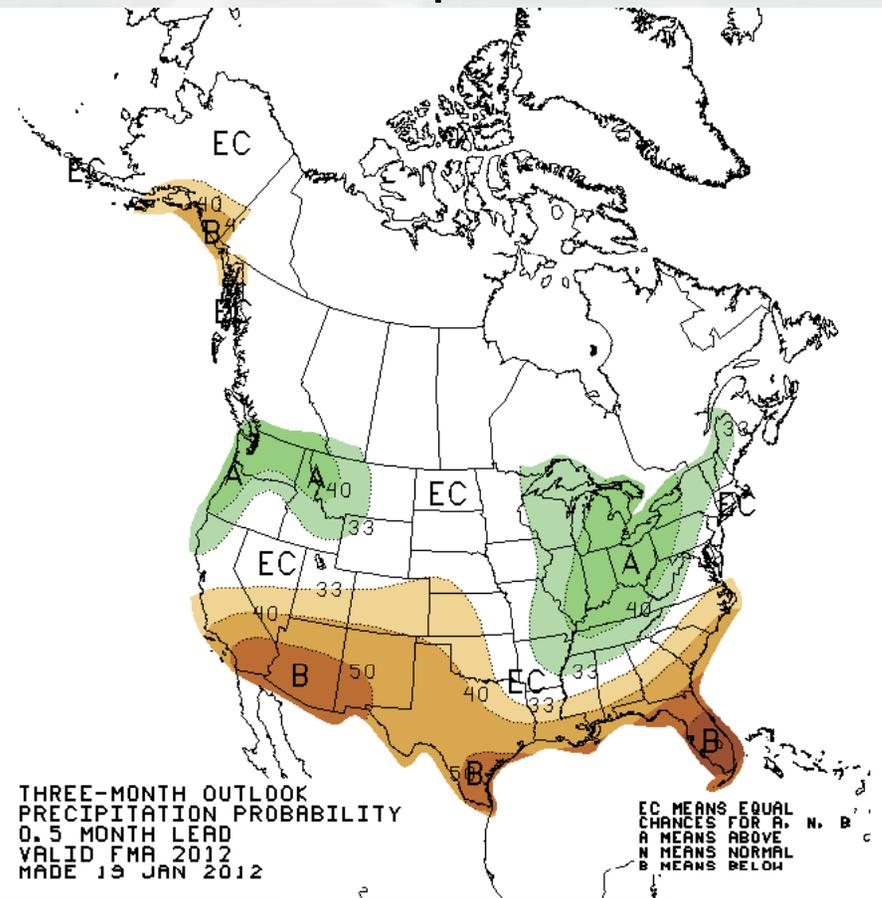
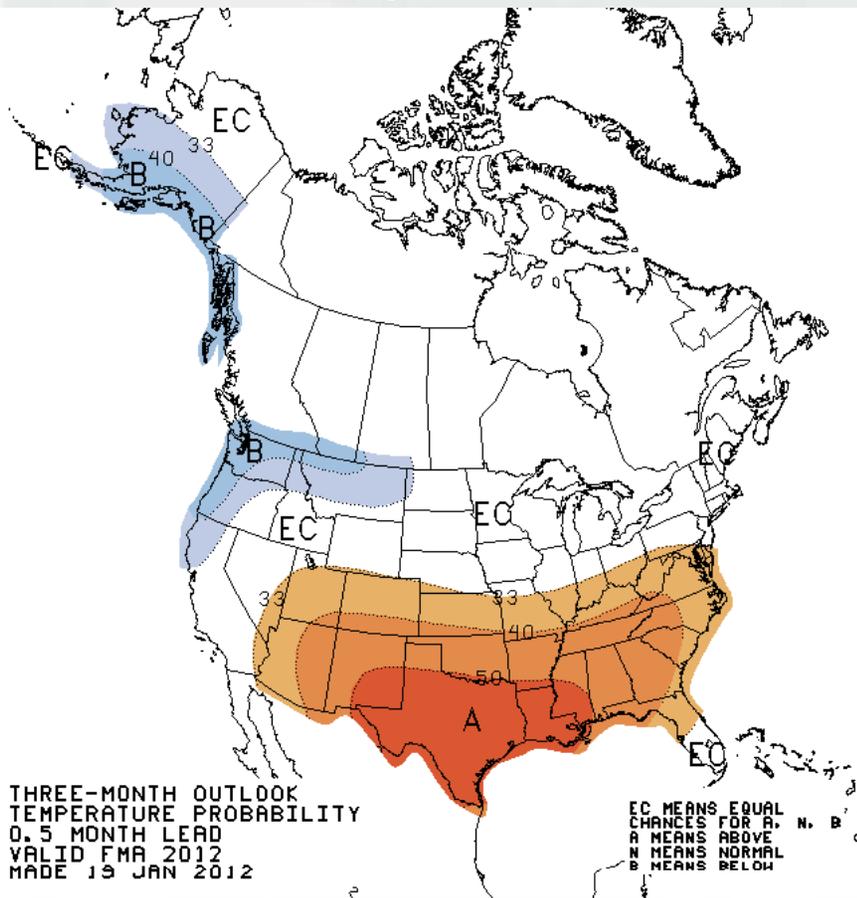
Precipitation



Temperature / Precipitation Feb-Mar-Apr Outlook

Temperature

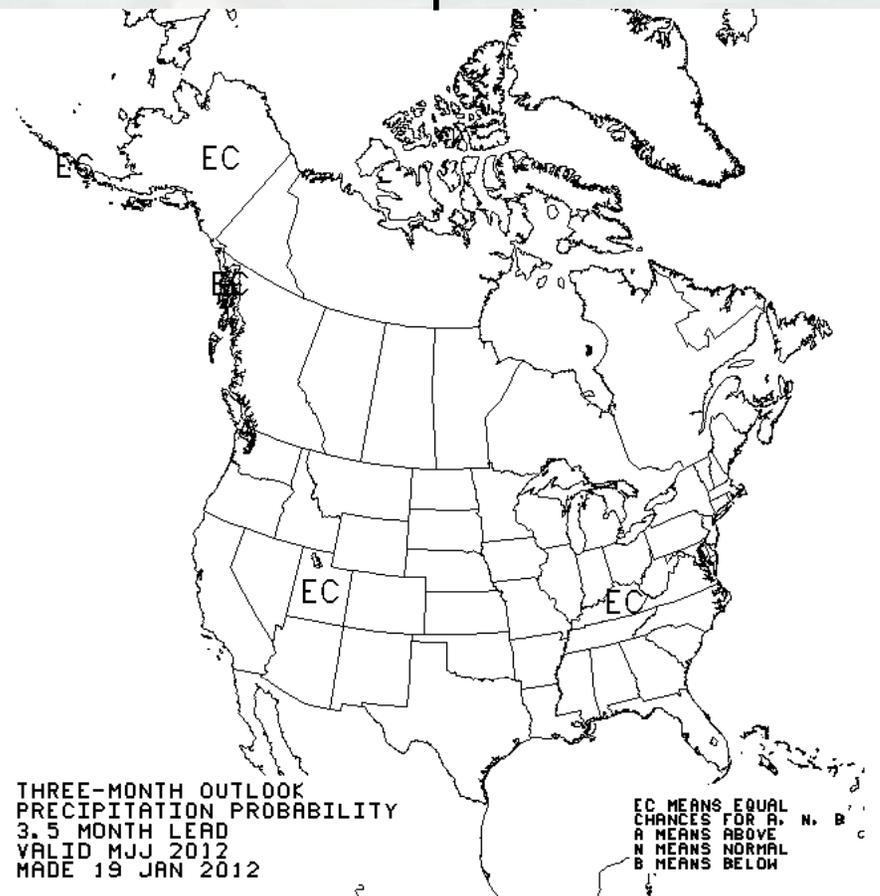
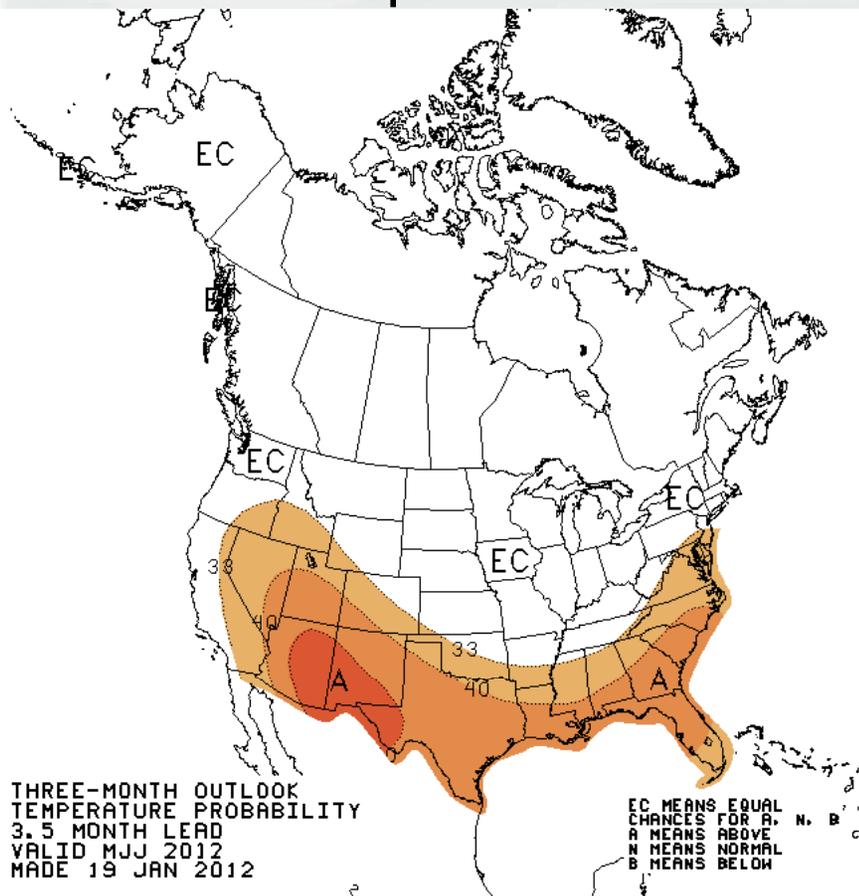
Precipitation



Temperature / Precipitation May-Jun-Jul Outlook

Temperature

Precipitation



February 1, 2012 Conditions

- January runoff 131% of normal
- Soil Conditions
 - ▶ Soil moisture: 20th – 80th percentile ranking (CPC & USDA)
 - ▶ Variable frost depth
 - ▶ Shallow groundwater in MT, ND and SD
- No plains snowpack (NOHRSC)
- Mountain snowpack (NRCS):
 - ▶ 87% above Fort Peck
 - ▶ 96% b/n Fort Peck & Garrison

2012 Climate Outlook

- Weak/weakening La Nina (CPC)
- Precipitation Outlook (CPC)
 - ▶ Equal chances for precipitation in February
 - ▶ Increased chance for precipitation in March-April in N. Rockies
 - ▶ Equal chances for May-Jun-Jul
- Temperature Outlook (CPC)
 - ▶ Increased chance for above normal temperatures in upper basin in February
 - ▶ Increased chance for below normal temperatures in MT in Mar-Apr
 - ▶ Equal chances throughout remainder for Mar-Apr
 - ▶ Equal chances for May-Jun-Jul

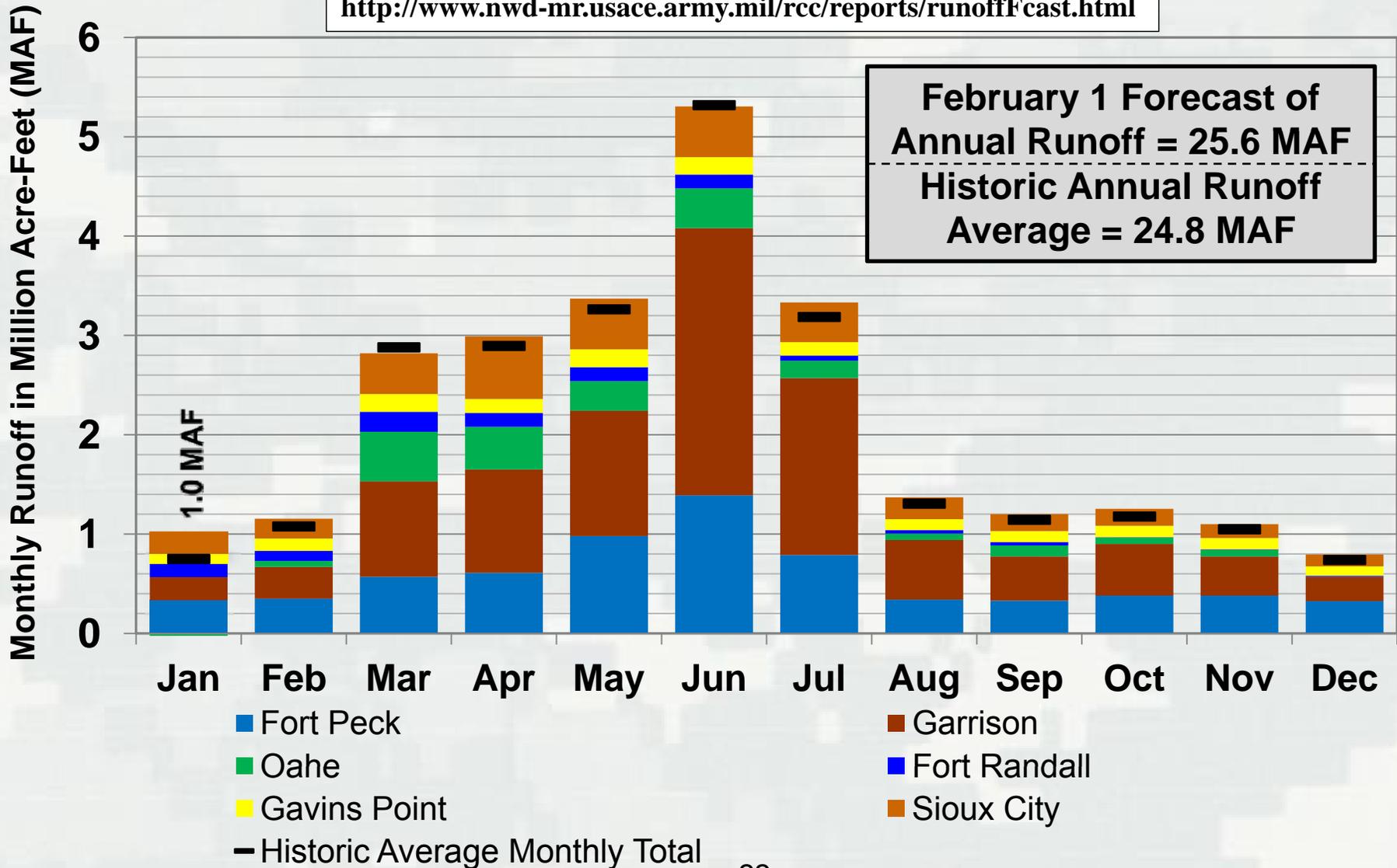
2012 Runoff Forecast (Feb 1)

- 25.6 MAF (103% of normal) ab Sioux City
- 22.0 MAF (97% of normal) ab Gavins Point
- March-April Forecast
 - ▶ 100% of normal ab Sioux City
 - ▶ 93% of normal ab Gavins Point
- May-Jun-Jul Forecast
 - ▶ 90% of normal ab Fort Peck
 - ▶ 101% of normal into Garrison
- Reaches above Gavins Point will have normal to below normal runoff through the end of 2012
- Gavins Point to Sioux City forecast to have 180% of normal runoff



Missouri River Basin 2012 Runoff Forecast above Sioux City*

<http://www.nwd-mr.usace.army.mil/rcc/reports/runoffFcast.html>



Thank you.

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