

Colorado Basin Overview

Kevin Werner

NWS Colorado Basin River Forecast Center



**NIDIS CoCal Meeting
May 10, 2012**



Outline

Colorado River Primer

CBRFC Forecasts and Operation of Lakes
Powell and Mead



Why the Colorado River Stopped Flowing -All Things Considered, July 14, 2011





Colorado River

- 25 million people in US rely on Colorado River water
- 3.5 million acres of irrigation in US
- 85% of runoff comes from above 9000 feet
- Total mean annual flow is 15 MAF
- Storage capacity is about 60 MAF (4 times mean annual flow)
- River is fully used and little flows to ocean

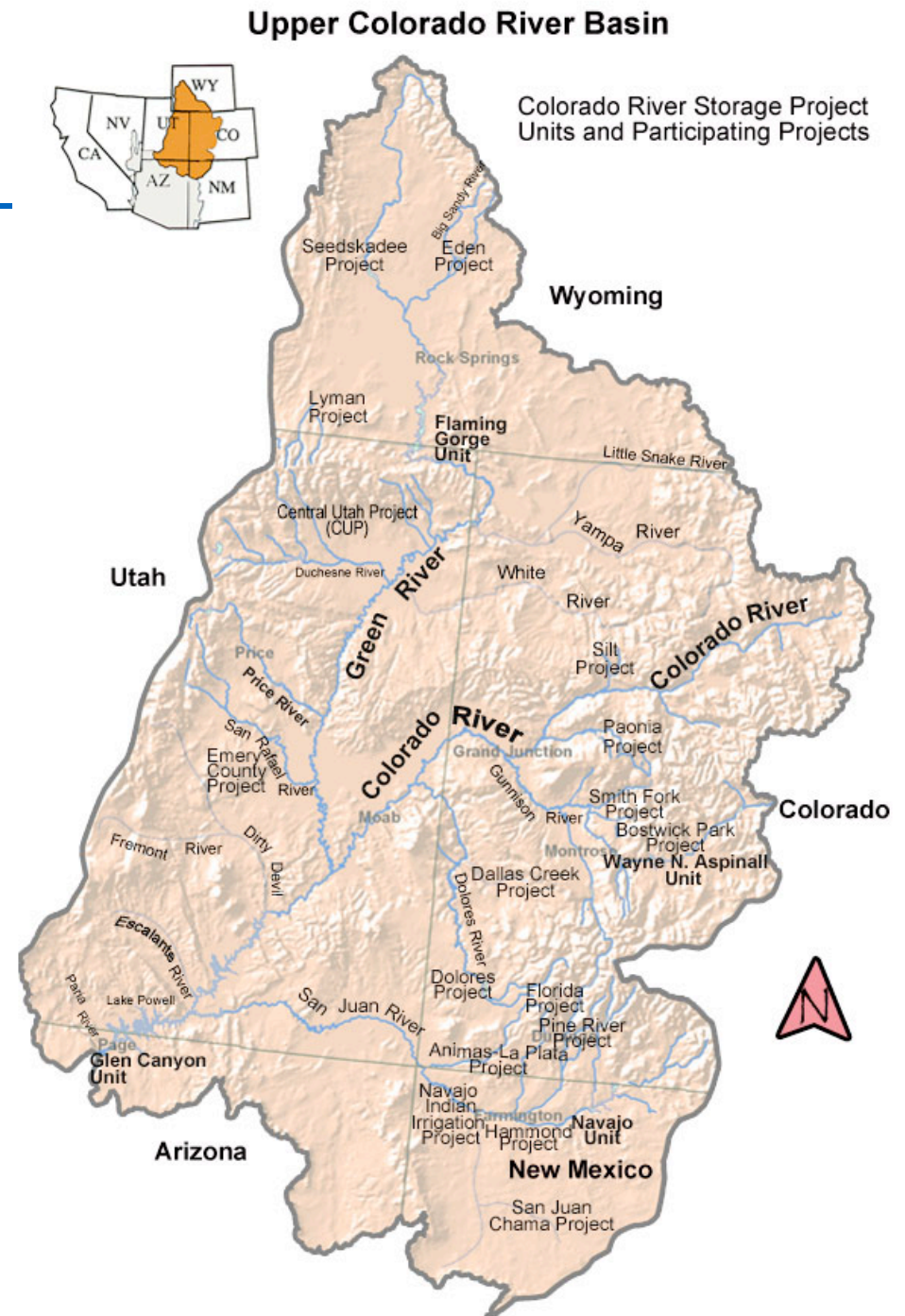


The image cannot be displayed. Your computer may not have enough memory to open the image, or the image may have been corrupted. Restart your computer, and then open the file again. If the red x still appears, you may have to delete the image and then insert it again.



Upper Basin

- Distribution of Average Runoff in Lake Powell:
 - 1/2 Upper Colorado including Gunnison, Dolores
 - 1/3 Green River including Yampa, Duchesne
 - 1/6 San Juan River





Colorado River Allocation

- Colorado Compact (1922) divided water between the upper basin and lower basin – 7.5 MAF each
- Mexican Water Treaty (1944) allocated Mexico 1.5 MAF
- Arizona v. California (1964) allocated water among lower basin states
- Interim Guidelines (2007) specify shortages and surpluses through 2026 that are tied to forecasts
- Key facts:
 - River is over-allocated: original allocation (16.5 MAF) was based on a series of wet years. Actual average flow is ~15 MAF
 - Lower basin states (AZ, CA, NV) use full 7.5 MAF each year
 - Mexico uses its full 1.5 MAF
 - Upper basin states (CO, WY, UT, NM) are still “developing” their 7.5 MAF
 - No shortage has ever been declared on the river
 - Shortages would affect lower basin states first (and AZ first of all)



Long Term Supply / Demand



The image cannot be displayed. Your computer may not have enough memory to open the image, or the image may have been corrupted. Restart your computer, and then open the file again. If the red x still appears, you may have to delete the image and then insert it again.



Interim Operating Guidelines

- Guidelines specify how shortages and surpluses will be distributed among the basin states
- USBR directed to operate reservoirs based, to a large extent, on CBRFC/NRCS official forecasts
- Most years 8.23 MAF released from Lake Powell to Lake Mead
- In wet years when Lake Mead is low (such as 2011), “extra” water can be released. This is called equalization and/or balancing.

Lake Powell		
Elevation (feet)	Operations According to Interim Guidelines	Live Storage (MAF)
3,700	Equalization Tier Equalize, Avoid Spills or Release 8.23 MAF	24.3
3,636 - 3,666 (2008-2026)		15.5 - 19.3 (2008-2026)
	Upper Elevation Balancing Tier¹ Release 8.23 MAF; if Lake Mead < 1,075 feet, balance contents with a min/max release of 7.0 and 9.0 MAF	9.5
3,575	Mid-Elevation Release Tier Release 7.48 MAF; if Lake Mead < 1,025 feet, Release 8.23 MAF;	
3,525	Lower Elevation Balancing Tier Balance contents with a min/max release of 7.0 and 9.5 MAF	5.9
3,490		
3,370		

Lake Mead		
Elevation (feet)	Operations According to Interim Guidelines	Live Storage (MAF)
1,220	Flood Control, 70R or ICS Surplus	25.9
1,200		22.9
	Domestic or ICS Surplus	15.9
1,145		
1,105	Normal Operations or ICS Surplus	11.9
1,075		9.4
1,050	Shortage 333 KAF²	7.5
1,025		5.8
1,000		4.3
895	Shortage 500 KAF² and Consultation³	0

15.5 MAF
3,636
4/1/2012

14.5 MAF
1,129
4/1/2012



Value

Damage from 1/10 AZ storm:	\$11m ^a
Damage from 6/10 UT flooding:	\$6.5m ^a
Damage from 12/10 UT/NV storm:	\$35m ^a
Damage from spring 2011 UT/CO/WY flooding:	<\$200m

Colorado River average runoff: 12.4 MAF

Replacement value of \$330/AF -> \$4b^b


****Economic value of water resources far greater than flooding damages**

Sources:

a: WFO, FEMA (via stormdata); b: MWD (via Hasencamp, private communication)



Colorado Basin River Forecast Center

 The image cannot be displayed. Your computer may not have enough memory to open the image, or the image may have been corrupted. Restart your computer, and then open the file again. If the red x still appears, you may have to delete the image and then insert it again.

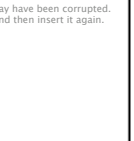


The Colorado Basin River Forecast Center (CBRFC) generates streamflow forecasts across the Colorado Basin and Utah. The latest forecasts, data, and more are available online:

- **Daily streamflow forecasts**
- **Long lead peak flow forecasts**
- **Water supply forecasts**
- **Webinar briefings**
- **Email updates**
- **And More....**

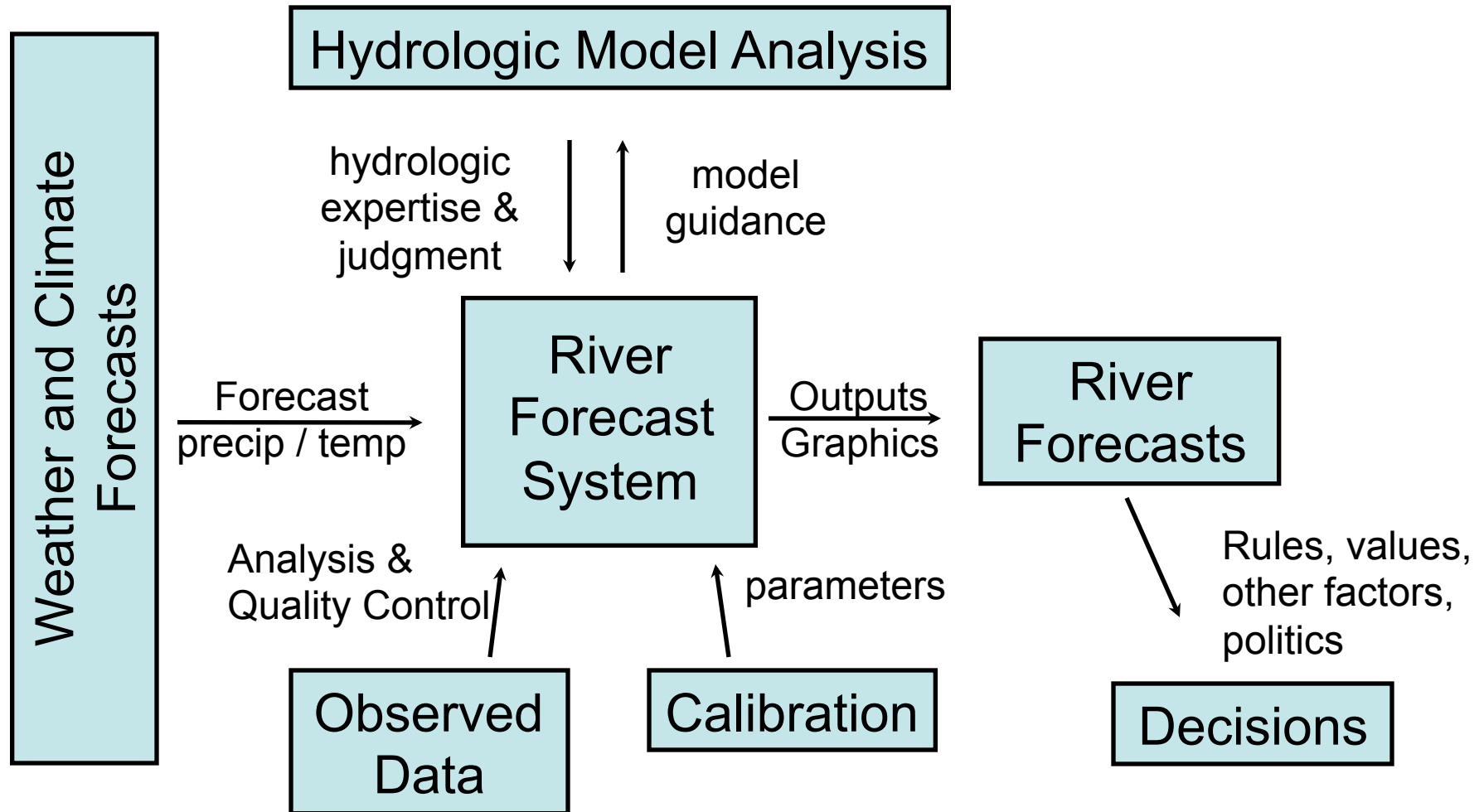
www.cbrfc.noaa.gov

 The image cannot be displayed. Your computer may not have enough memory to open the image, or the image may have been corrupted. Restart your computer, and then open the file again. If the red x still appears, you may have to delete the image and then insert it again.





Forecast Process





Water Supply Forecasts

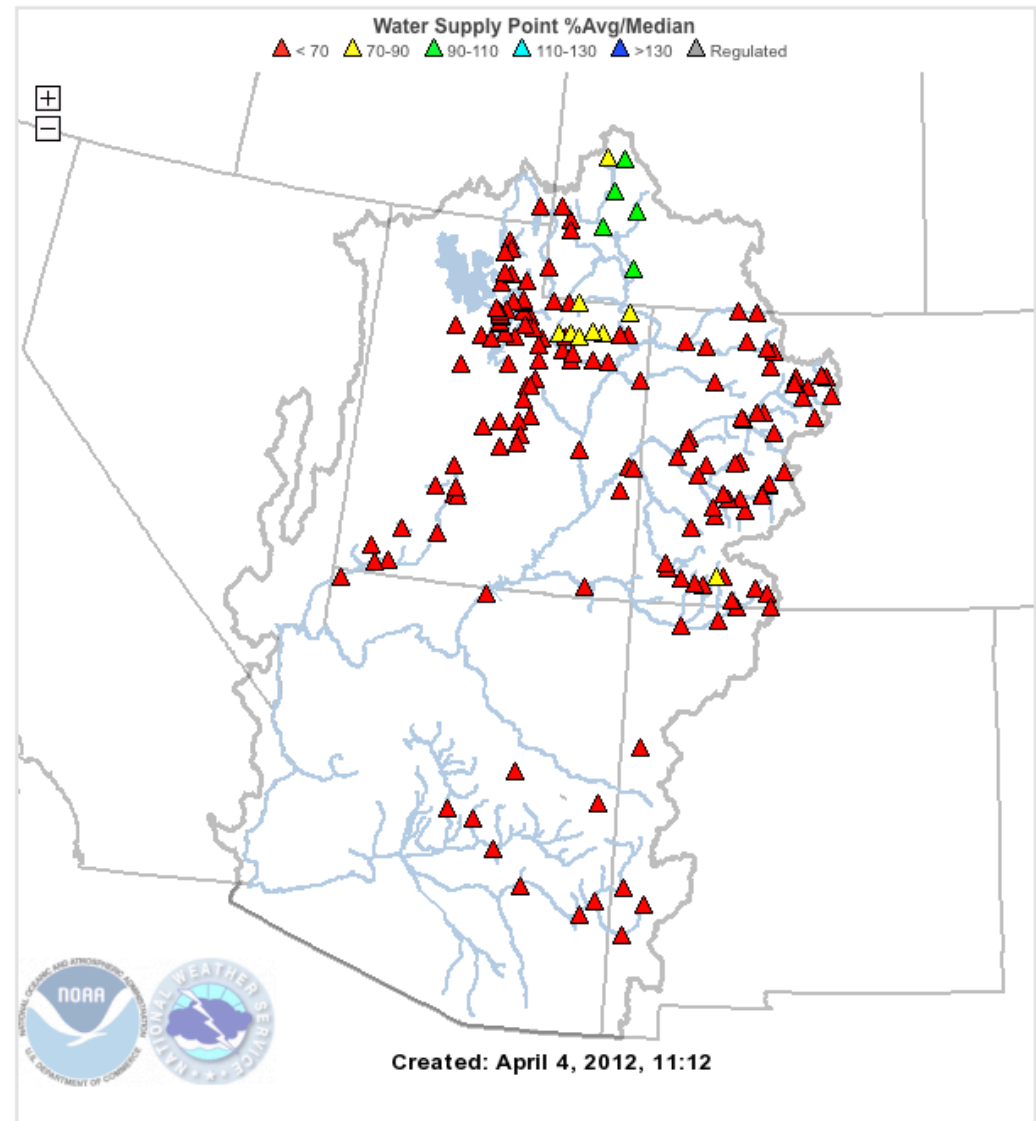
Generated seasonally

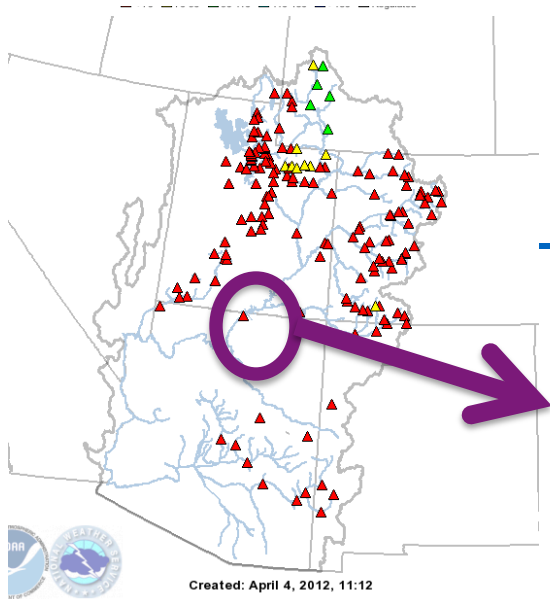
- Typically January through June
- Updated monthly or as needed

Forecast runoff volume
(usually April – July)

Probabilistic

Increasingly doing year round forecasts to support USBR and others





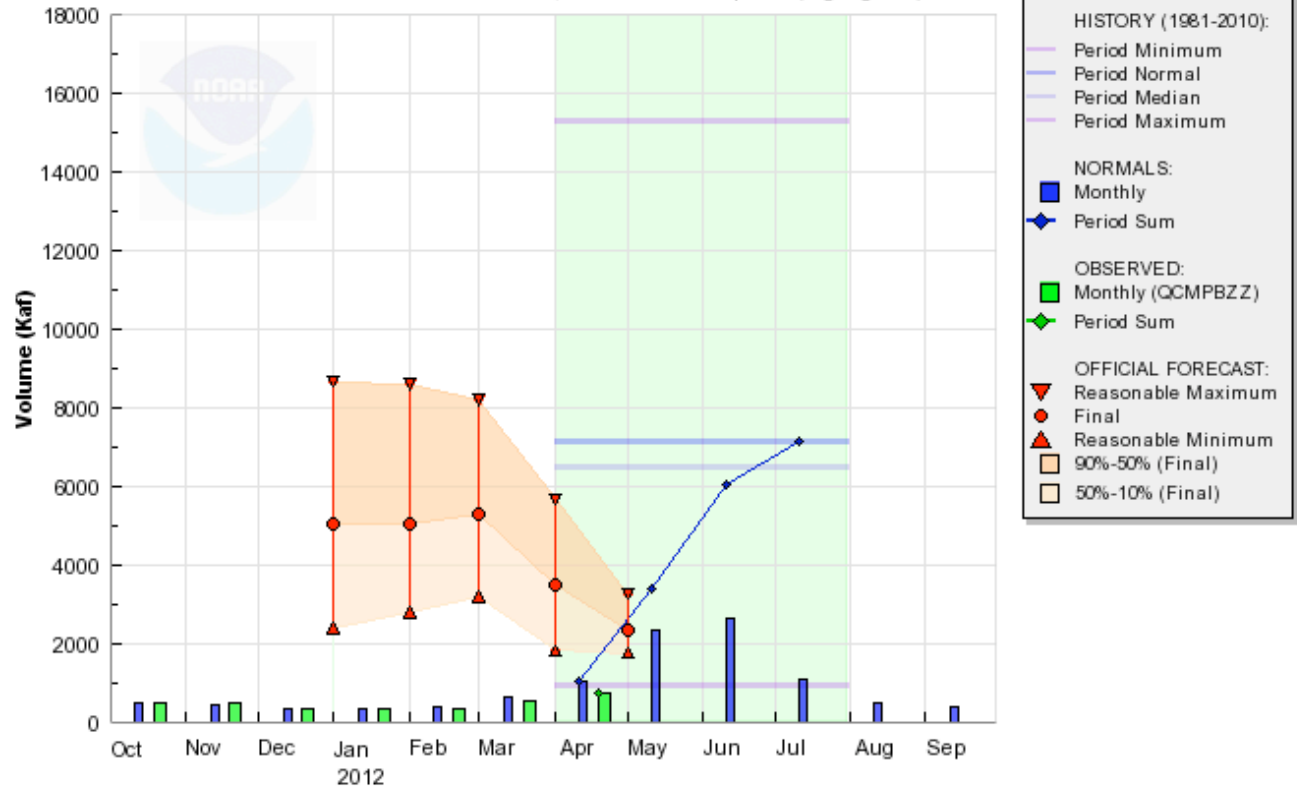
Seasonal Water Supply Forecast

Forecast Period: Apr-Jul

2360 kaf 50% Exceedence (Official Forecast)		36% of Historical Median	33% of Historical Mean
1760 kaf 90% Exceedence	3260 kaf 10% Exceedence	100th of 103 Official Historical Flows	
Forecast Issued: May 1 2012		View Water Supply Forecast Plot	

COLORADO - LAKE POWELL, GLEN CYN DAM, AT (GLDA3)

Water Year 2012, Forecast Period Apr-Jul (highlighted)

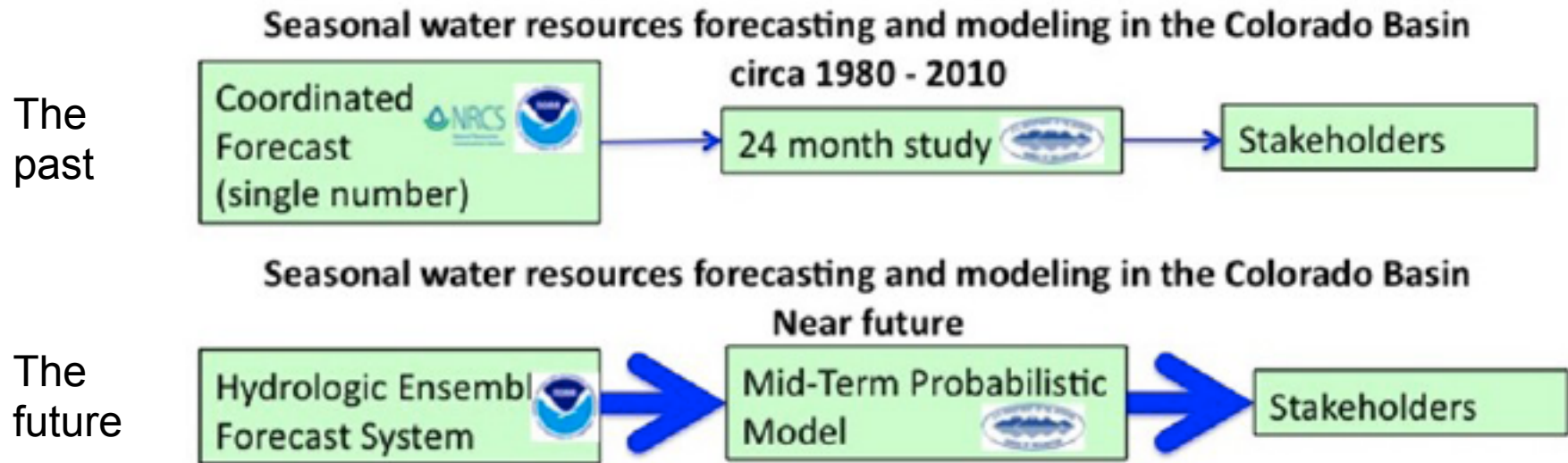


CBRFC/NWS/NOAA 05/04/12 05:03:49 UTC

Web Reference: www.cbrfc.noaa.gov/gmap/gmapm.php?wcon=checked



Water Supply Decision Support



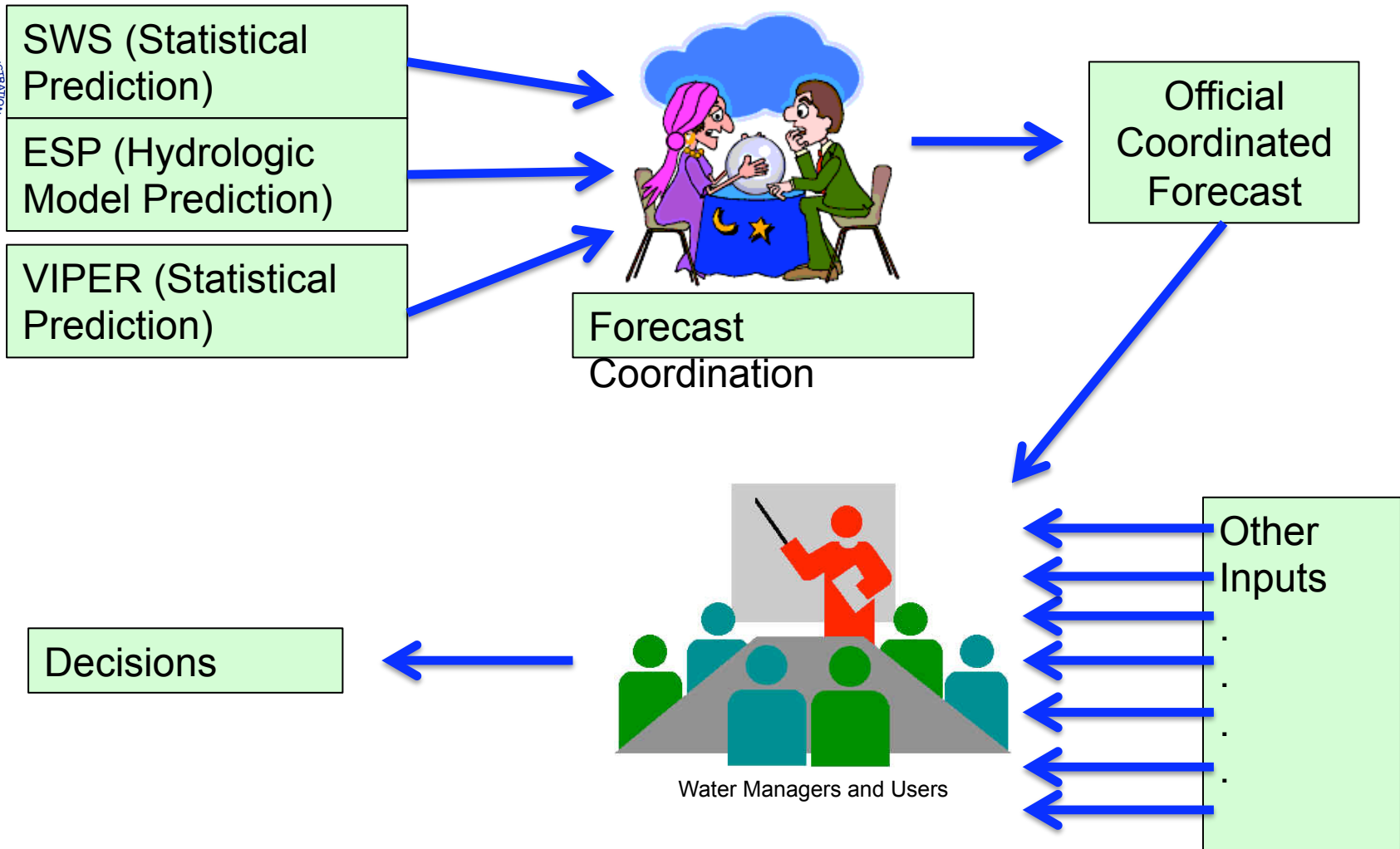
Efforts in parallel --

- CBRFC working to improve probabilistic flow forecasts
- BOR working to implement probabilistic water management model





Coordinated NRCS/CBRFC Water Supply Forecast

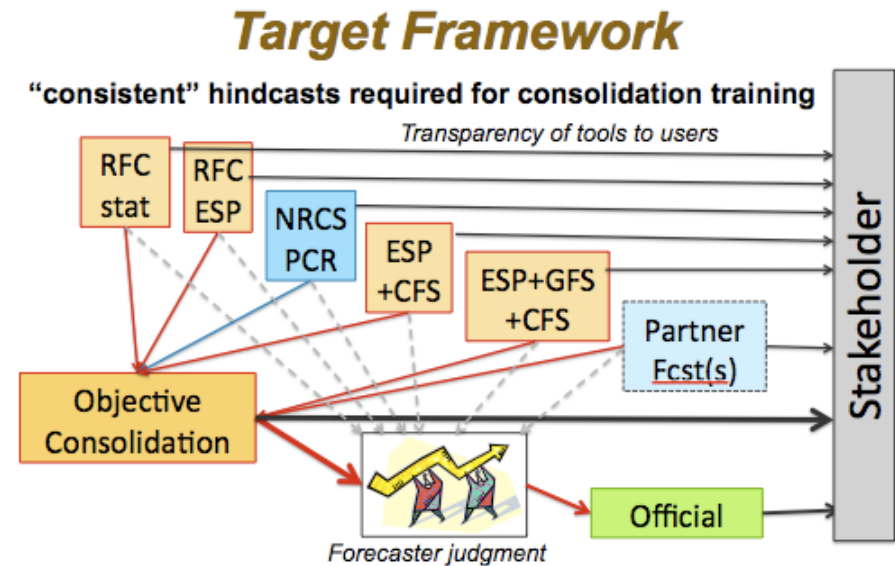




Future CBRFC Water Supply Forecast Method



- Objective, repeatable ensemble forecasts
- Integrate skill from weather and climate predications
- Tailor to stakeholder thresholds and concerns
- Forecaster role:
 - Monitor forecast process and system
 - Apply judgement (less frequently?)
 - Decision support
 - Work to improve forecast system and processes based on objective standards
 - Follow best practices identified by CPC





USBR 24 month study



- Upper and Lower Colorado Regions operate reservoirs based on the 24 month study
- 24 month study:
 - Updated monthly
 - Extends out 24 months
 - Specifies reservoir releases and target levels
 - Single value output (except Aug, Jan, Apr when it has reasonable min and reasonable max)
 - Labor intensive and subjective

OPERATION PLAN FOR COLORADO RIVER SYSTEM RESERVOIRS
RECLAMATION *Managing Water in the West* **March 2011 24-Month Study**
 Most Probable Inflow*
Lake Powell

Date	Unreg Inflow (1000 Ac-Ft)	Regulated Inflow (1000 Ac-Ft)	Evap Losses (1000 Ac-Ft)	PowerPlant (1000 Ac-Ft)	Bypass Release (1000 Ac-Ft)	Total Release (1000 Ac-Ft)	Reservoir Elev End of Month (Ft)	Bank Storage (1000 Ac-Ft)	EDM Storage (1000 Ac-Ft)	Leas Ferry (1000 Ac-Ft)
* Mar 2010	479	475	17	602	0	602	3619.41	17809	13701	612
H Apr 2010	844	717	26	602	0	602	3620.50	17782	13816	614
I May 2010	1399	1224	32	601	0	601	3625.86	17764	14405	612
S Jun 2010	2776	2321	53	601	0	601	3638.82	17953	15684	612
T Jul 2010	674	706	65	802	0	802	3636.52	18099	15596	824
O Aug 2010	504	608	64	802	0	802	3634.55	18069	15369	826
R Sep 2010	277	461	58	480	0	480	3633.66	18093	15267	490
WY 2010	8634	8674	444	8234	0	8235				8419
I Oct 2010	362	512	41	495	0	495	3634.08	18022	15315	502
C Nov 2010	438	474	39	810	0	810	3630.31	18074	14886	826
A Dec 2010	416	446	30	847	0	847	3626.54	18062	14469	865
L Jan 2011	381	429	9	997	0	997	3620.55	18132	13822	1015
* Feb 2011	318	378	10	964	0	964	3614.95	18123	13235	984
Mar 2011	500	522	16	1034	0	1034	3610.16	18083	12746	1034
Apr 2011	1100	946	25	966	0	966	3609.75	18080	12705	966
May 2011	2900	2417	30	1103	0	1103	3621.23	18175	13884	1103
Jun 2011	3750	3185	51	1179	0	1179	3637.45	18320	15104	1179
Jul 2011	1450	1424	65	1300	0	1300	3637.92	18324	15759	1300
Aug 2011	595	748	64	1224	0	1224	3633.60	18284	15260	1224
Sep 2011	471	636	58	714	0	714	3632.49	18274	15134	714
WY 2011	12682	12118	437	11633	0	11633				11712
Oct 2011	514	615	40	738	0	738	3631.15	18262	14982	738
Nov 2011	523	602	38	800	0	800	3629.20	18245	14764	800
Dec 2011	414	569	30	875	0	875	3626.39	18220	14452	875
Jan 2012	384	533	9	875	0	875	3623.40	18194	14127	875
Feb 2012	398	495	10	800	0	800	3620.68	18171	13836	800
Mar 2012	628	614	17	700	0	700	3619.79	18163	13741	700
Apr 2012	950	824	26	600	0	600	3621.50	18178	13923	600
May 2012	2161	1955	33	700	0	700	3631.80	18268	15055	700
Jun 2012	2811	2442	54	850	0	850	3643.88	18382	16479	850
Jul 2012	1346	1237	68	1000	0	1000	3645.28	18395	16635	1000
Aug 2012	566	678	68	975	0	975	3642.48	18368	16298	975
Sep 2012	460	589	51	714	0	714	3641.11	18356	16134	714
WY 2012	11154	11162	455	9627	0	9627				9627
Oct 2012	514	595	42	738	0	738	3639.66	18341	15963	738
Nov 2012	523	583	40	800	0	800	3637.63	18322	15725	800
Dec 2012	414	551	32	900	0	900	3634.58	18293	15372	900
Jan 2013	384	514	10	900	0	900	3631.36	18264	15006	900
Feb 2013	398	478	10	800	0	800	3628.61	18240	14688	800

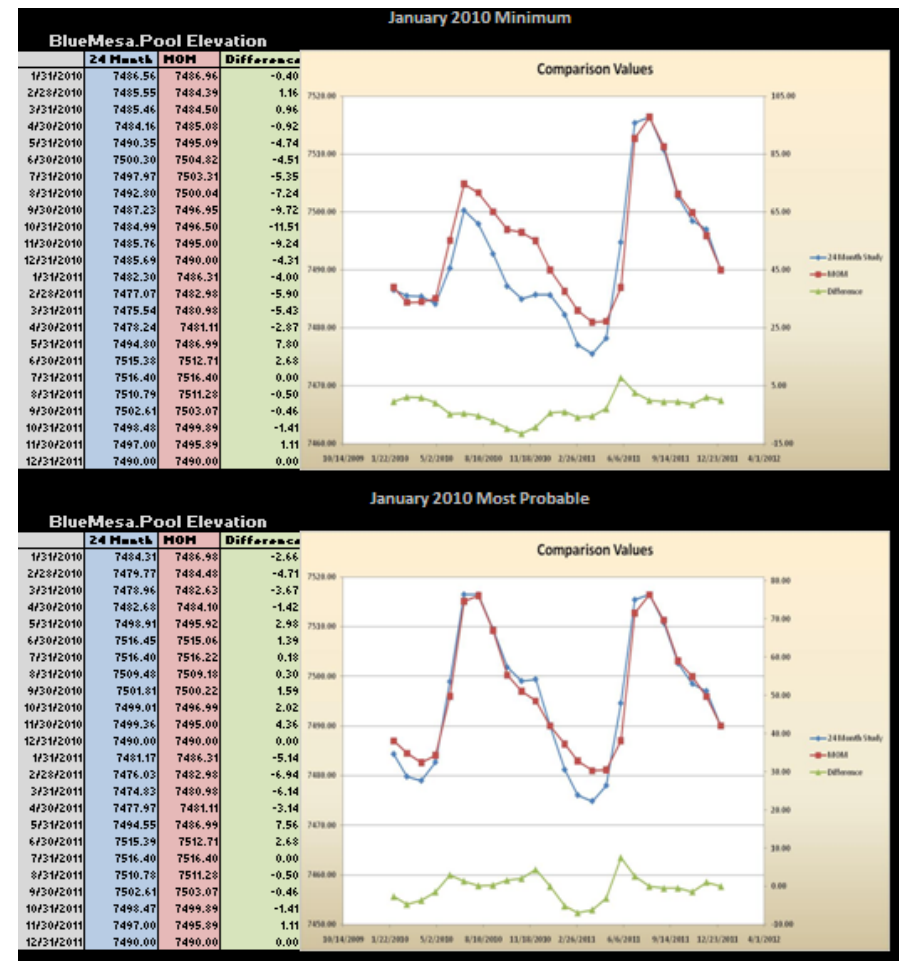
* Based on the Colorado River Basin Forecast Center's Most Probable Water Supply Forecast Model Run ID: 2093 Processed On: 3/8/2011 3:56:56PM



USBR MTOM

Mid-Term Probabilistic Model:

- Uses CBRFC ensemble forecasts for first two years
- Uses “rules” (prioritized logic) to determine releases
- Output will be ensemble forecast for reservoir operations
- Currently undergoing testing
- Expected deployment by WY2013





Summary

Colorado River Primer

CBRFC Forecasts and Operation of Lakes
Powell and Mead



Questions?



Kevin Werner

CBRFC Service Coordination Hydrologist

Phone: 801.524.5130

Email: kevin.werner@noaa.gov

