Colorado Basin
River Forecast Center
National Weather Service

Water Year 2024
Early Season Water Supply Outlook

December 13, 2023

2024 Early Season Water Supply Outlook

Water Year 2023 summary

Observed precipitation over the past several months

Hydrologic model soil moisture conditions entering winter

Current snow conditions

Ensemble Streamflow Prediction (ESP) overview

2024 water supply - early season model guidance

Upcoming weather outlook & ENSO status

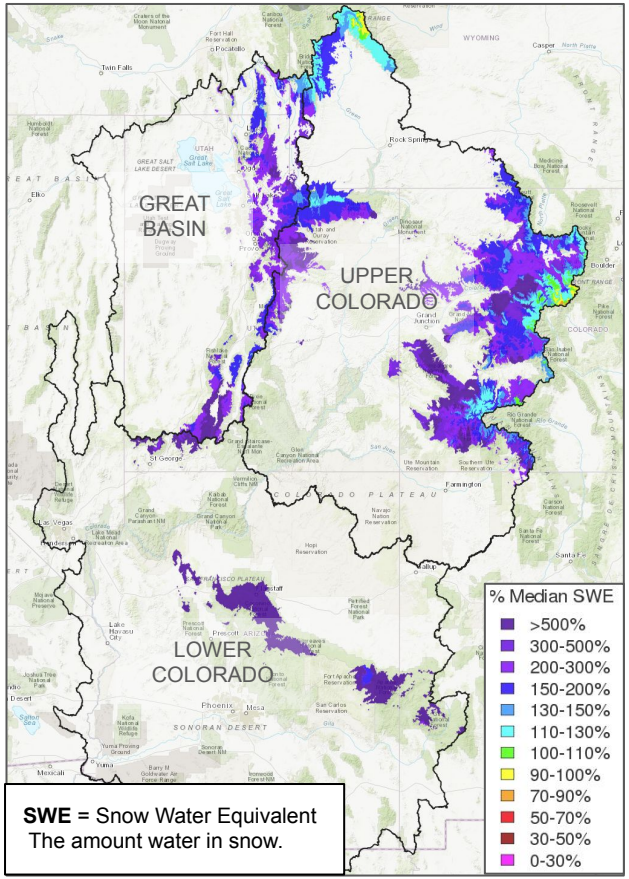
Forecast points of contact

Please mute yourself until the question period.

Webinar recording & slides will be made available on CBRFC webpage.

Water Year 2023 Summary: April 1 SWE and Observed Runoff

April 1, 2023 Model SWE (%Median)
CBRFC Model (Major Contributing Areas)



SWE = Snow Water Equivalent
The amount water in snow.

Many basins had well above normal snowpack conditions and seasonal runoff that ranked in the top 5 dating back to 1991.

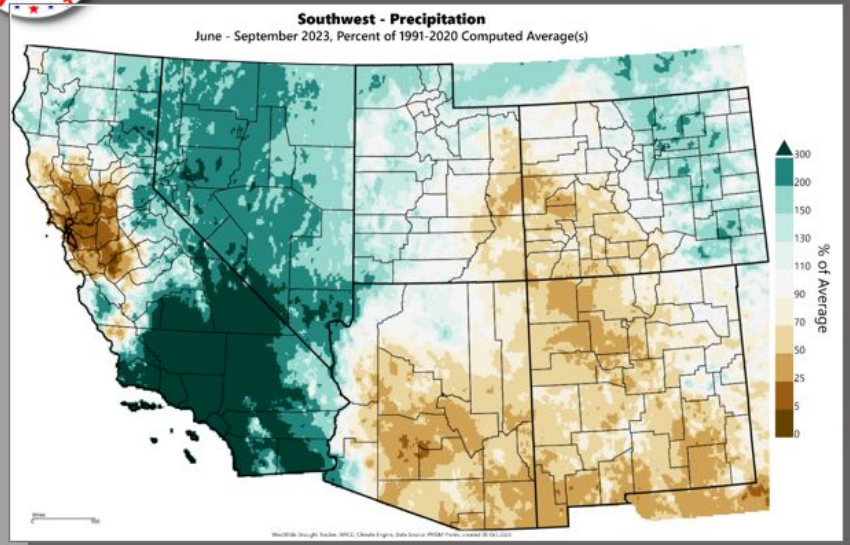
Some basins experienced record snowpack and seasonal runoff.

2023 Seasonal Observed Unregulated Streamflow Volumes

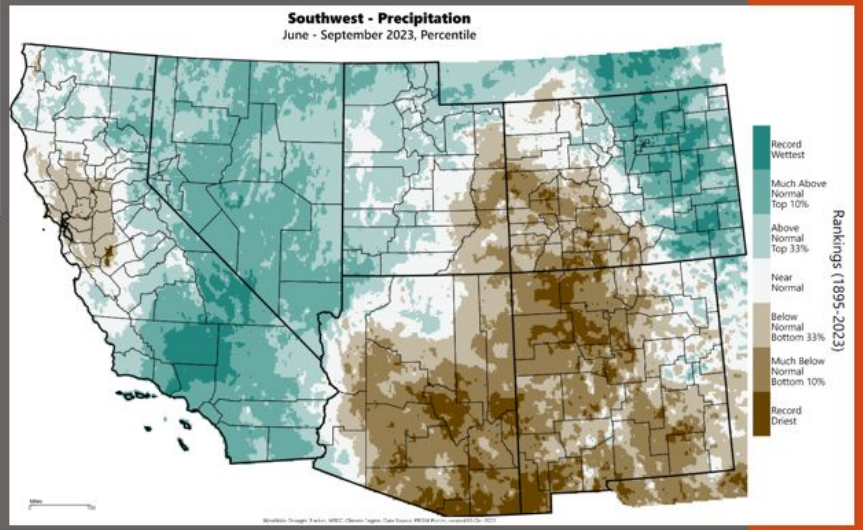
	Observed Volume (KAF)	%Average (1991-2020)	Rank (1=wettest) (1991-2023)	Period
UPPER COLORADO RIVER BASIN				
Lake Powell	10,619	166	4	Apr-Jul
Green River Basin				
Fontenelle Reservoir	950	129	11	Apr-Jul
Flaming Gorge Reservoir	1,458	151	6	Apr-Jul
Yampa-Deerlodge Park	2,014	169	2	Apr-Jul
White-Watson	427	158	5	Apr-Jul
Duchesne-Randlett	692	198	5	Apr-Jul
Colorado River Headwaters				
Colorado-Kremmling	984	113	10	Apr-Jul
Eagle-Gypsum	350	105	12	Apr-Jul
Roaring Fork-Glenwood Springs	791	121	9	Apr-Jul
Colorado-Cameo	2,934	129	8	Apr-Jul
Southwest Colorado				
Blue Mesa Reservoir	834	131	9	Apr-Jul
Gunnison-Grand Junction	2,175	164	5	Apr-Jul
McPhee Reservoir	527	207	1	Apr-Jul
Dolores-Cisco	1,071	212	2	Apr-Jul
Navajo Reservoir	1,028	163	5	Apr-Jul
San Juan-Bluff	1,853	167	5	Apr-Jul
LOWER COLORADO RIVER BASIN				
Virgin-Virgin	150	268	4	Apr-Jul
Little Colorado-Chevelon Creek	83	444	1	Jan-May
Verde-Above Horseshoe Dam	809	291	3	Jan-May
Salt-Above Roosevelt Lake	862	224	3	Jan-May
Upper Gila-San Carlos Reservoir	371	187	6	Jan-May
GREAT BASIN				
Bear-Woodruff Narrows Reservoir	207	192	3	Apr-Jul
Weber-Gateway	611	222	2	Apr-Jul
Big Cottonwood Creek	48	142	5	Apr-Jul
Provo-Utah Lake	505	329	2	Apr-Jul
Sevier-Hatch (*Regulated)	142	276	3	Apr-Jul

June-September 2023 Precipitation

Sources:
NWS
azwater.gov

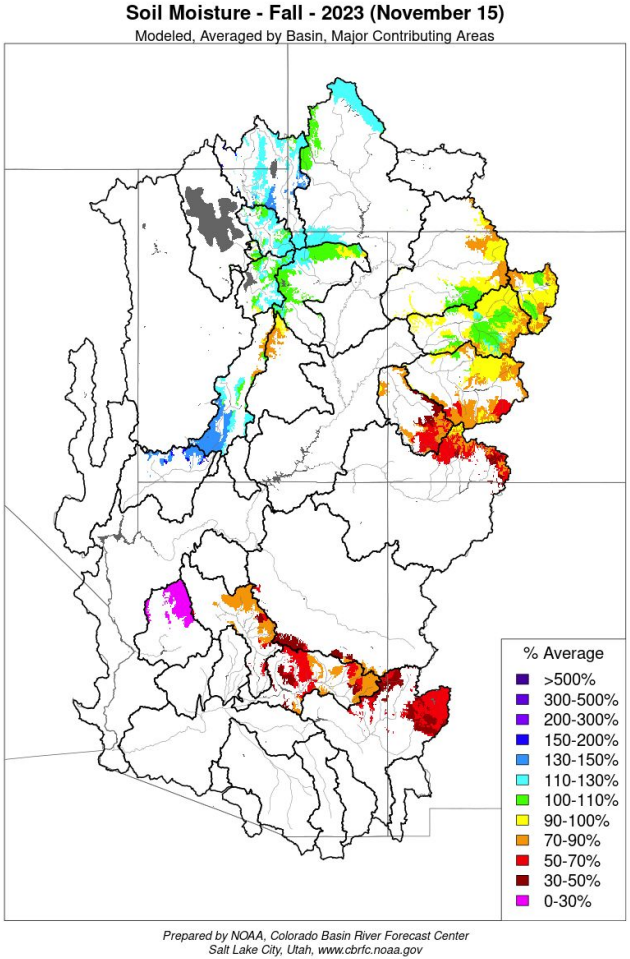


- With the exception of far western and northern Arizona, Monsoon 2023 was much drier than normal
- Much of the southeast half of the state received less than 50% of normal monsoon rainfall



- Summer rainfall was equally spotty and/or absent across the Upper Colorado basin
- Similar to southern Arizona, much of eastern Utah and western Colorado ranked in the lowest 1/3 of historical summer rainfall

Fall 2023 Hydrologic Model Soil Moisture Conditions



The map shows the model soil moisture conditions from the lower soil zone in CBRFC's hydrologic model, and is a result of past hydrologic conditions including but not limited to:

-previous year(s) runoff
-summer/fall precipitation

CBRFC hydrologic model soil moisture is adjusted (if necessary) every fall after irrigation season has ended and before winter.
Data used to make adjustments:

-Early November streamflow observations (baseflow)
-Reservoir inflows
-July-October precipitation
-Past season(s) runoff conditions

<u>Soil Moisture Impacts on Water Supply / Runoff</u>
Above normal soil moisture conditions → positive impact (increased runoff efficiency)
Below normal soil moisture conditions → negative impact (decreased runoff efficiency)

Colorado River Basin: near to below normal; improves from south to north

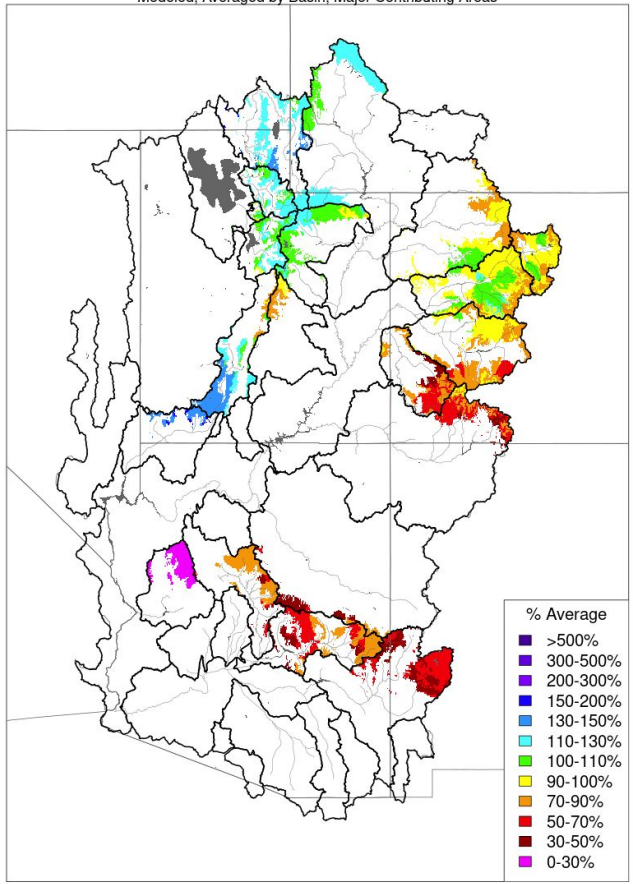
Great Basin / Utah: near to above normal

The timing and magnitude of spring runoff is ultimately a result of snowpack conditions, spring weather, and soil moisture conditions.

Fall Model Soil Moisture Conditions: 2023 vs. 2022

Soil Moisture - Fall - 2023 (November 15)

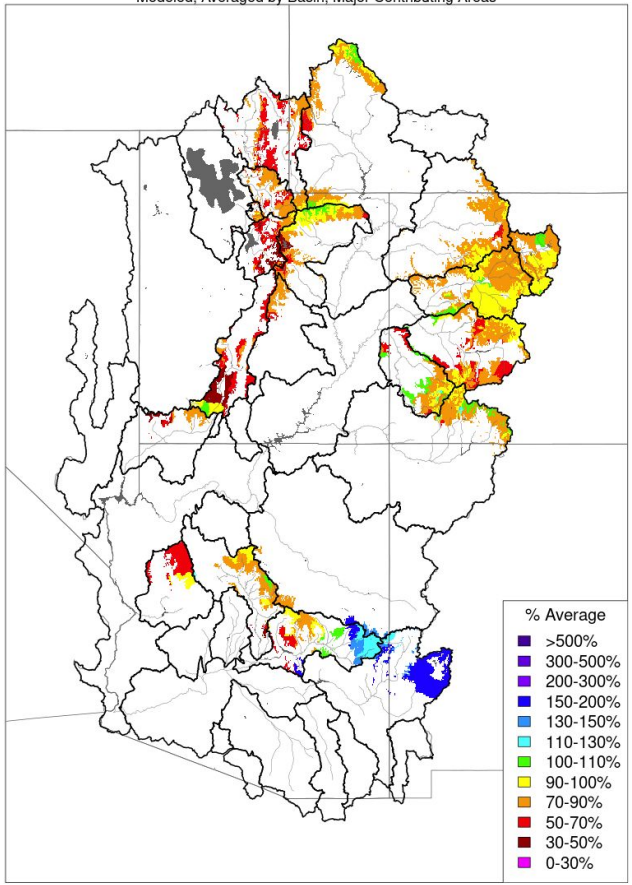
Modeled, Averaged by Basin, Major Contributing Areas



Prepared by NOAA, Colorado Basin River Forecast Center
Salt Lake City, Utah, www.cbrfc.noaa.gov

Soil Moisture - Fall - 2022 (November 02)

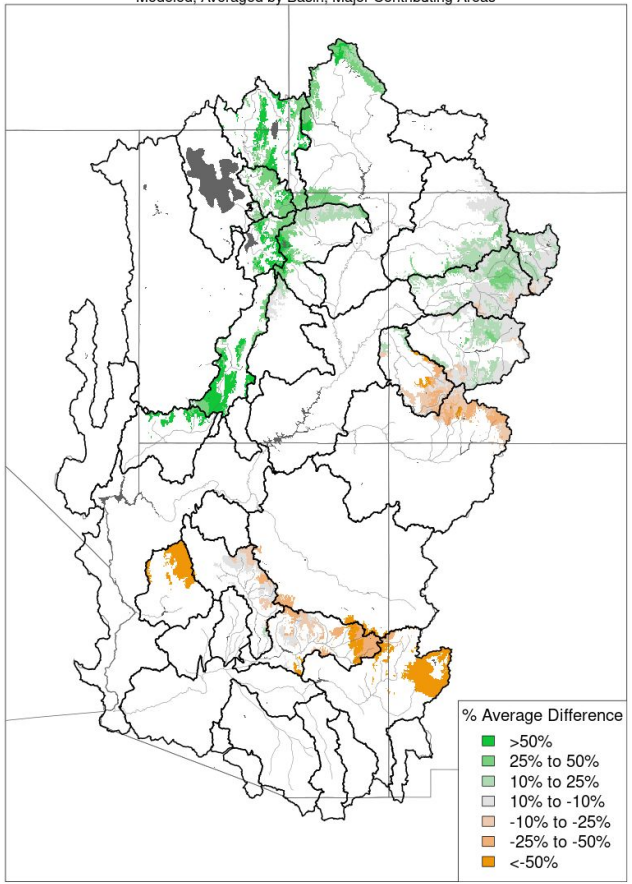
Modeled, Averaged by Basin, Major Contributing Areas



Prepared by NOAA, Colorado Basin River Forecast Center
Salt Lake City, Utah, www.cbrfc.noaa.gov

Soil Moisture - Fall - 2023 vs 2022

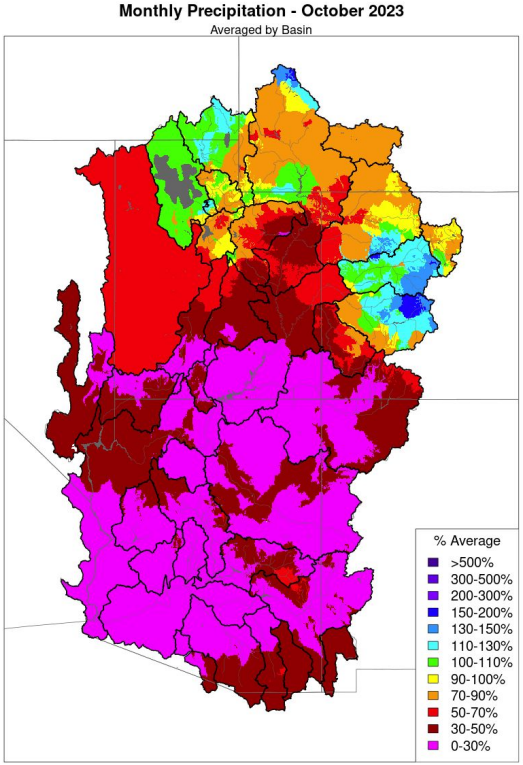
Modeled, Averaged by Basin, Major Contributing Areas

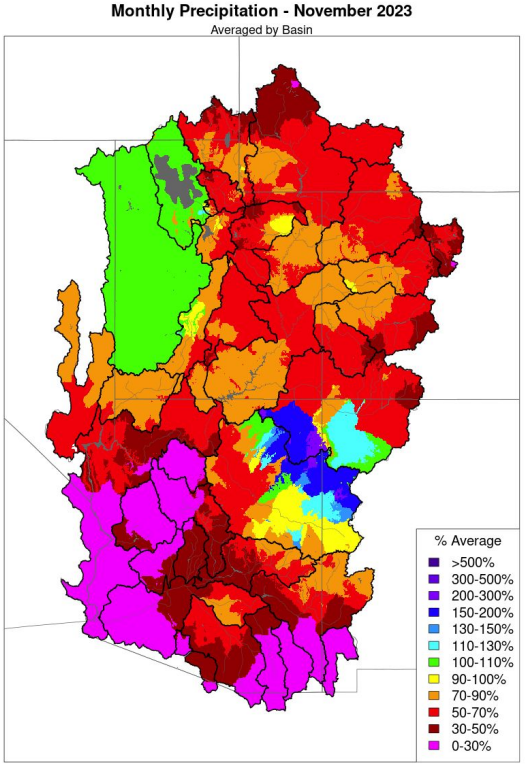


Prepared by NOAA, Colorado Basin River Forecast Center
Salt Lake City, Utah, www.cbrfc.noaa.gov

Water Year 2024: October/November Precipitation

Below average start to Water Year 2024



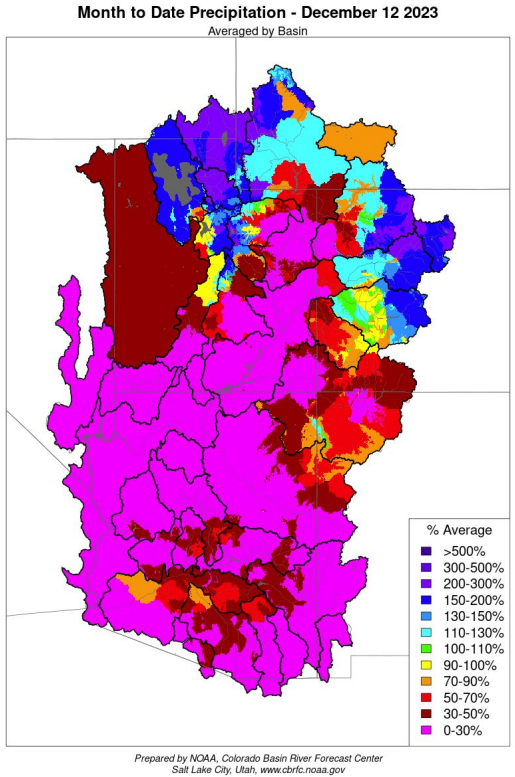


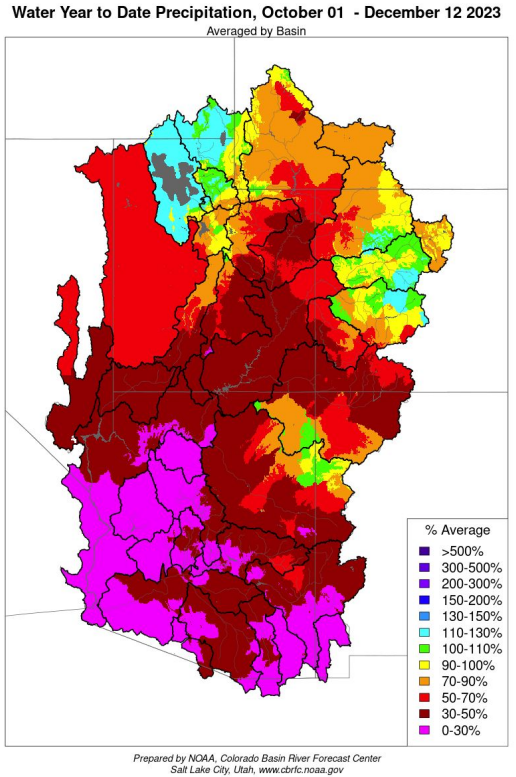
Water Year 2024 CBRFC Precipitation (Major Contributing Areas) Percent of 1991-2020 Average			
UPPER COLORADO RIVER BASIN			
	Oct	Nov	Oct-Nov
Above Lake Powell	92	56	73
Green River Basin			
Above Fontenelle	125	38	77
Above Flaming Gorge	108	46	74
Yampa/White	96	57	73
Duchesne	77	52	65
Price/San Rafael/Dirty Devil	77	60	69
Colorado River Headwaters			
Above Kremmling	93	44	67
Eagle	137	53	89
Roaring Fork	135	66	96
Above Cameo	116	56	83
Southwest Colorado			
Gunnison	113	60	85
Dolores	61	57	59
San Juan	46	56	51
LOWER COLORADO RIVER BASIN			
Virgin	26	79	52
Little Colorado	28	72	50
Verde	26	41	34
Salt	32	65	48
Upper Gila	28	69	46
GREAT BASIN			
Bear	103	54	75
Weber	91	58	73
Six Creeks	97	72	83
Provo/Utah Lake	83	74	78
Sevier	38	82	60

Precipitation-To-Date: December & Water Year

Storm activity increased in December, especially across northern basins.

Water Year 2024 precipitation is generally below average. Exceptions: northern Great Basin, west central Colorado

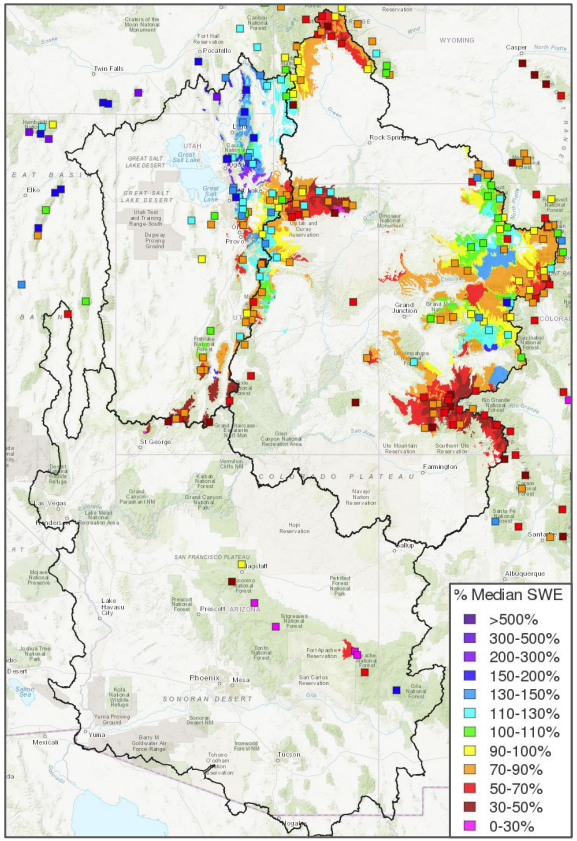




Mid-December Snowpack Conditions

December 12, 2023 SWE Conditions

NRCS SNOTEL Observed (Squares)
CBRFC Model (Major Contributing Areas)



Water Year 2024 CBRFC Model SWE (Major Contributing Areas) Percent of 1991-2020 Median	
UPPER COLORADO RIVER BASIN	
	December 12
Above Lake Powell	77
Green River Basin	
Above Fontenelle	71
Above Flaming Gorge	76
Yampa/White	96
Duchesne	56
Price/San Rafael/Dirty Devil	98
Colorado River Headwaters	
Above Kremmling	79
Eagle	89
Roaring Fork	95
Above Cameo	87
Southwest Colorado	
Gunnison	81
Dolores	58
San Juan	48
LOWER COLORADO RIVER BASIN	
Virgin	27
Little Colorado	2
Verde	0
Salt	32
Upper Gila	3
GREAT BASIN	
Bear	117
Weber	120
Six Creeks	125
Provo/Utah Lake	91
Sevier	67

SWE = Snow Water Equivalent
The amount water in snow.

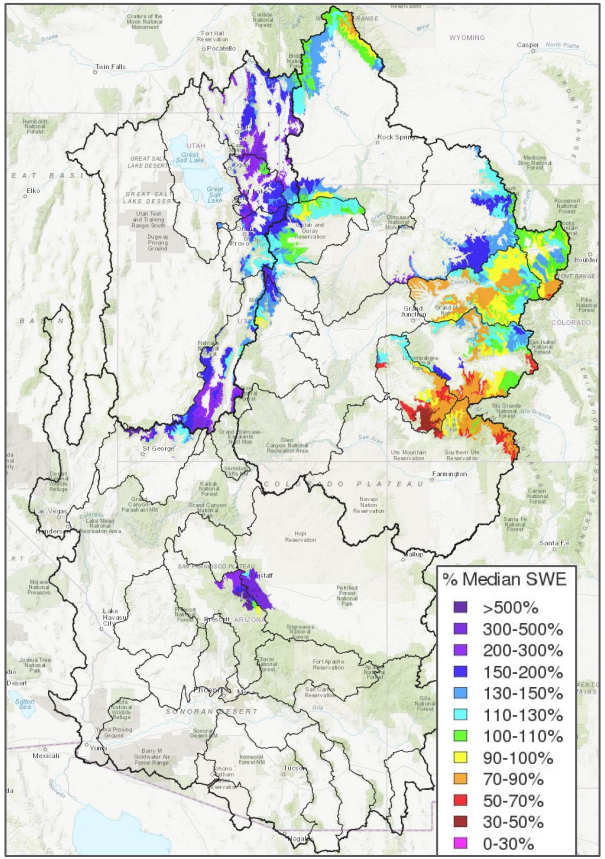
Upper Colorado River Basin
Near to well below normal

Lower Colorado River Basin
Worst snowpack conditions

Great Basin
Best snowpack conditions

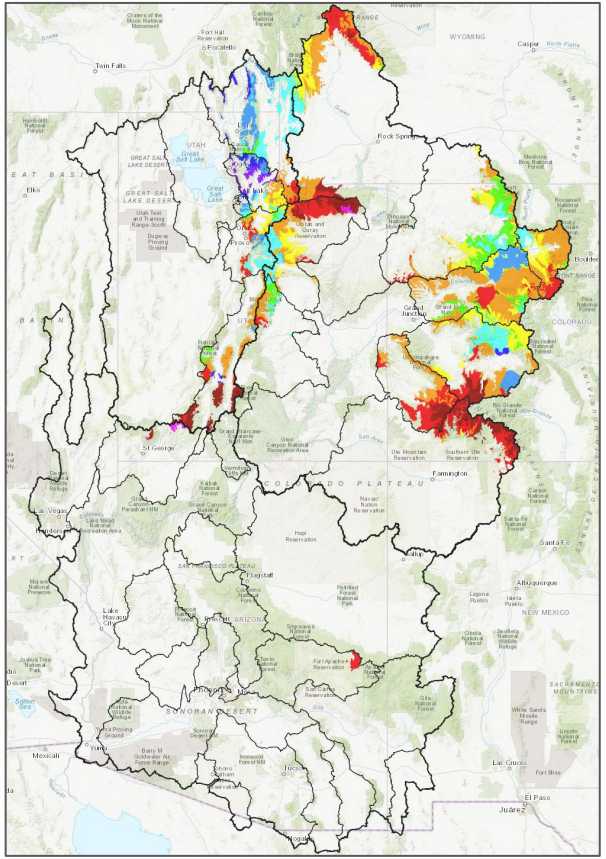
Mid-December CBRFC Model Snow Conditions: 2022 vs. 2023

December 12, 2022



Current snowpack conditions are worse compared to last year.

December 12, 2023



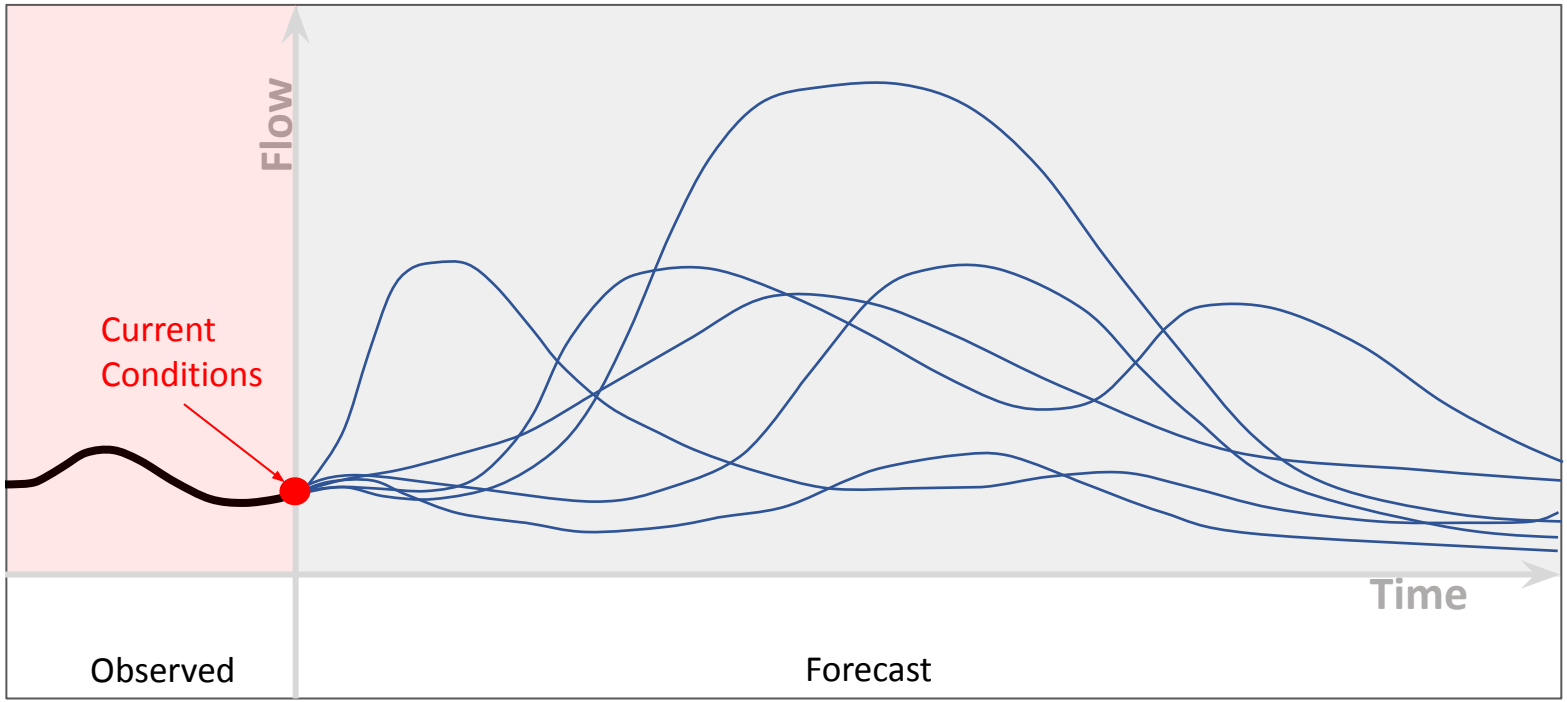
Water Supply - Early Season Model Guidance

At this point in time…

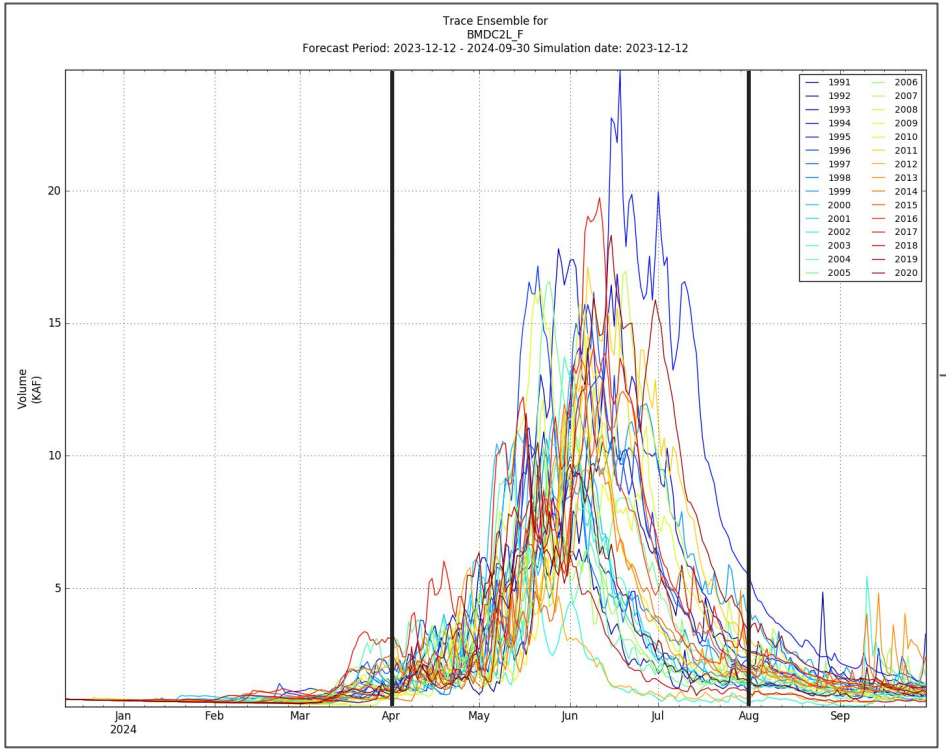
- Ideally, model soil moisture & snow states are accurate and representative of current conditions.
- Soil moisture (also represented by baseflow) has a larger influence on water supply guidance compared to later in the season.
- As we progress into the winter, snowpack conditions will have a larger impact on forecasts in the Upper Colorado and Great Basins.
- Winter rain events generally have the largest impacts on Lower Colorado River Basin forecasts.
- Early season forecast errors are generally 20-40% and typically improve through the spring.
  - The primary source of forecast uncertainty is future weather (next 5-7 months).
- Mid-December snowpack conditions
  - Typically around 30-35% of the seasonal snow has occurred by mid-December.
  - Historical median (normal) snowpack values are still small compared to later in the season.
  - ESP more sensitive to SWE earlier in the season
    - A 2” SWE surplus is more impactful now compared to a 2” SWE surplus in April.

Water Supply Forecast Method: Ensemble Streamflow Prediction (ESP)

- Start with current model conditions of snowpack, soil moisture and simulated flow
- Apply precipitation and temperature from each historical year from 1991-2020
  - A forecast hydrograph, or trace, is generated for each of the 30 years
- Results are used to produce probabilistic forecasts



ESP Example: Blue Mesa Reservoir (Gunnison Basin)



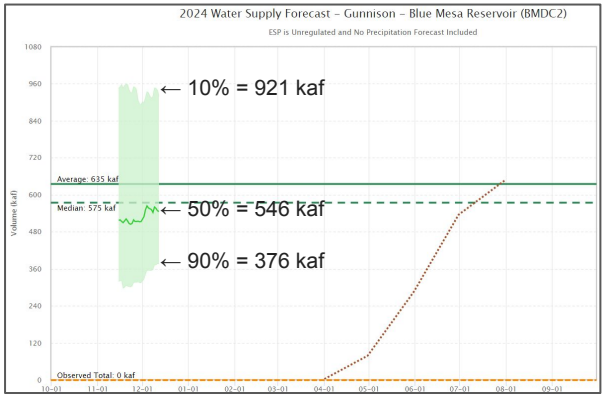
Empirical Sample Points:
2024-04-01 - 2024-07-31

	UnRegNoQPF
1991	545.39
1992	418.30
1993	910.20
1994	472.84
1995	1117.61
1996	810.62
1997	726.47
1998	418.73
1999	710.51
2000	616.44
2001	546.01
2002	228.39
2003	461.27
2004	464.94
2005	629.91
2006	452.89
2007	409.49
2008	748.55
2009	785.30
2010	486.80
2011	818.55
2012	313.06
2013	507.93
2014	538.53
2015	604.71
2016	599.10
2017	921.69
2018	372.19
2019	952.87
2020	478.98

Chances of Exceeding Volume KAF for
BMDC2L_F
Forecast Period: 2024-04-01 - 2024-07-31
Simulation date: 2023-12-12

Period: 2024-04-01 - 2024-07-31

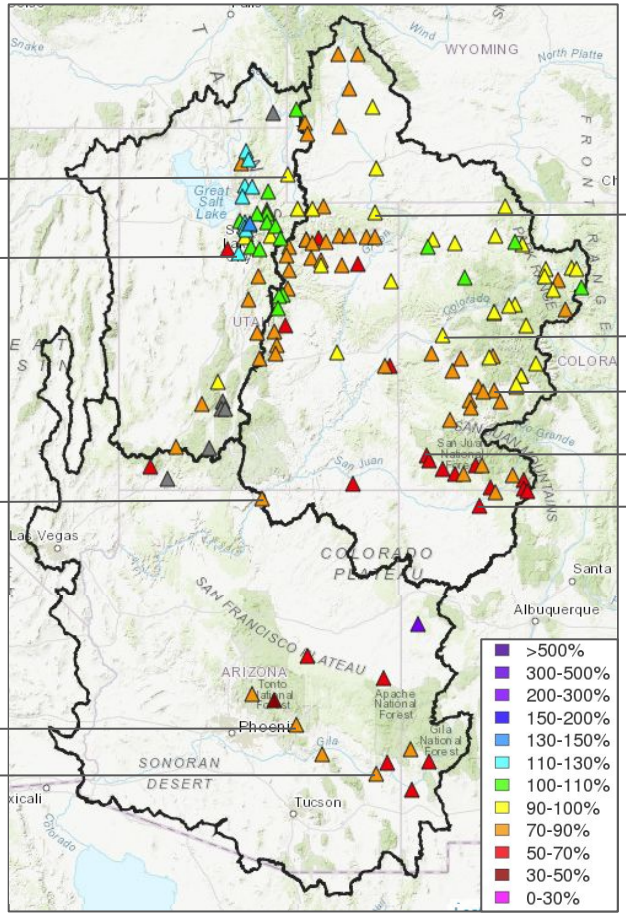
	UnRegNoQPF
90%	375.92
80%	425.56
70%	467.31
60%	495.26
50%	545.70
40%	611.75
30%	721.68
20%	805.56
10%	920.54



1. The flows are summed into volumes for the period of interest (typically April 1 – July 31)
2. Exceedance values are calculated
3. These are the basis for the official probabilistic forecasts

CBRFC ESP Model Run: December 12, 2023

Percent of 1991-2020 Normal Seasonal Volume



Bear-Woodruff Narrows
107 kaf
99% avg

Utah Lake
256 kaf
119% avg

Lake Powell
5,060 kaf
79% avg

Salt-Roosevelt
191 kaf
76% med

San Carlos Res.
64 kaf
88% med

Flaming Gorge Reservoir
872 kaf
90% avg

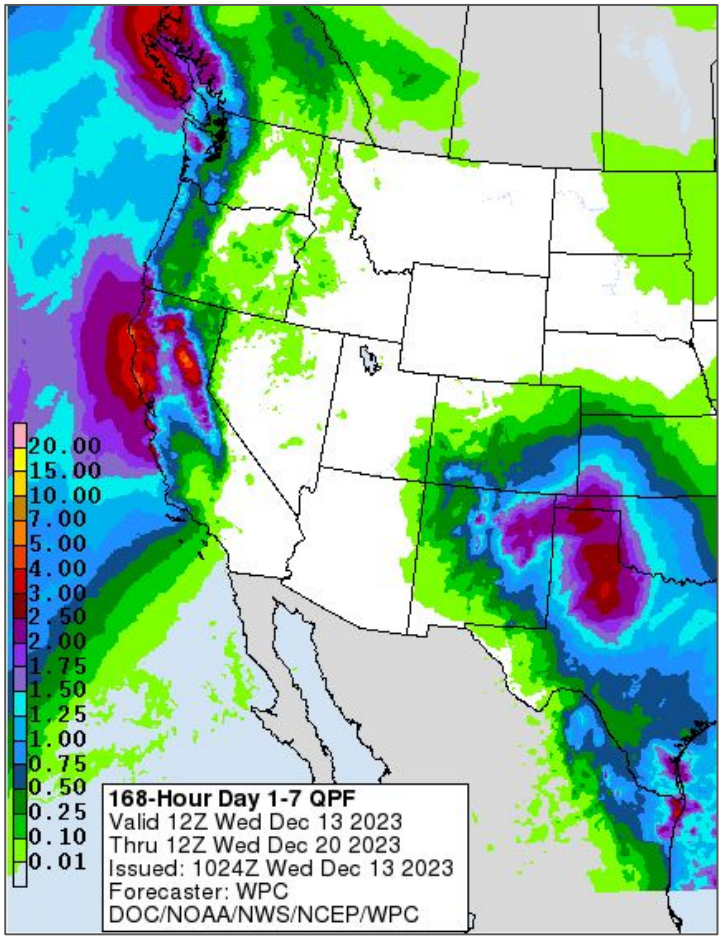
Colorado-Cameo
2,090 kaf
92% avg

Blue Mesa Reservoir
546 kaf
86% avg

McPhee Reservoir
171 kaf
67% avg

Navajo Reservoir
400 kaf
63% avg

Upcoming Weather: 7-Day Precipitation Outlook (December 13-20)

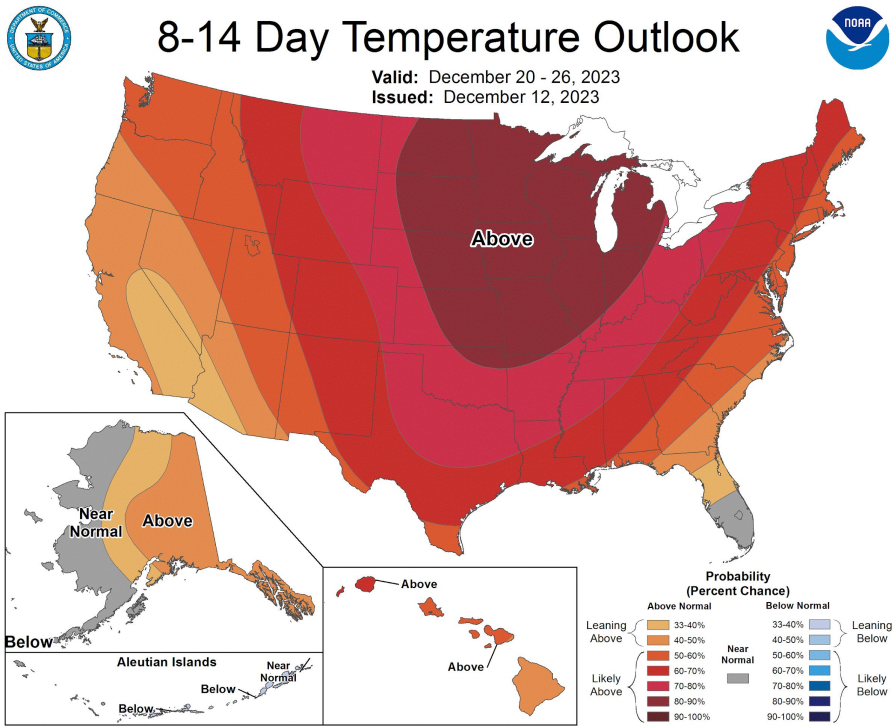


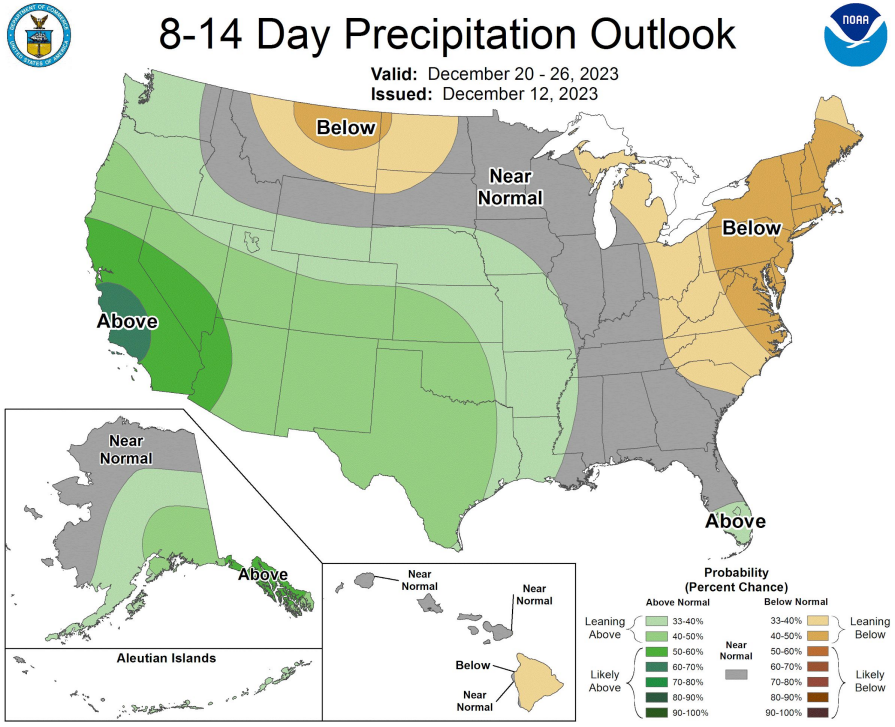
- A storm system will bring precipitation to the eastern part of the area today/tomorrow.
    - San Juan Mountains expecting 6-12” of snow
- High pressure will bring a warming and drying trend to the area into early next week.
- Temperatures will be 10 to 15 degrees above normal across the area by this weekend.

Upcoming Weather: 8-14 Day Outlook (December 20-26)

Warmer than normal temperatures expected.

A storm system is expected to bring precipitation to the western U.S. next week.





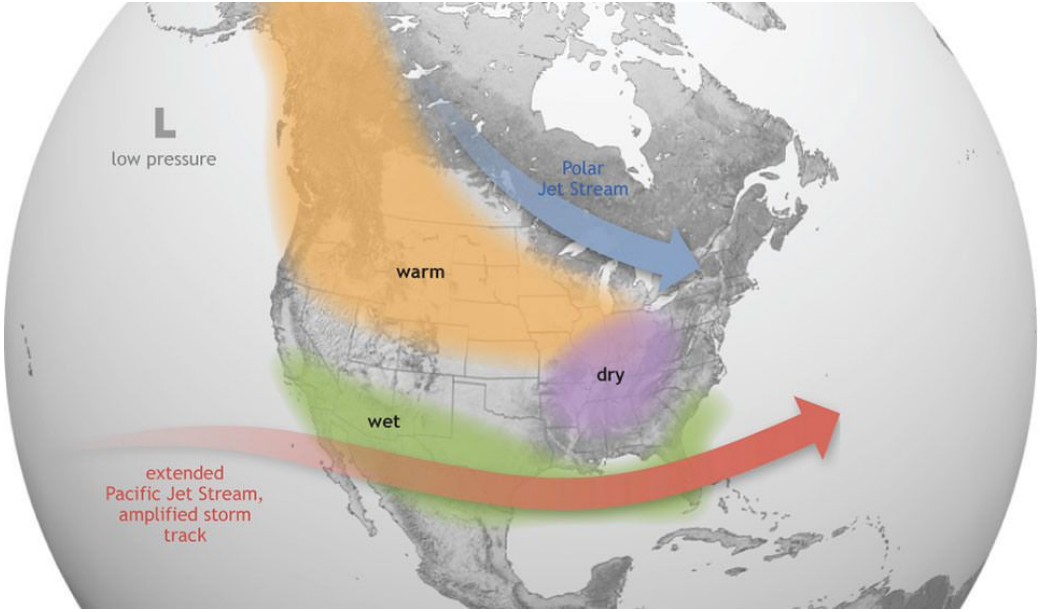
El Niño Southern Oscillation (ENSO) Status

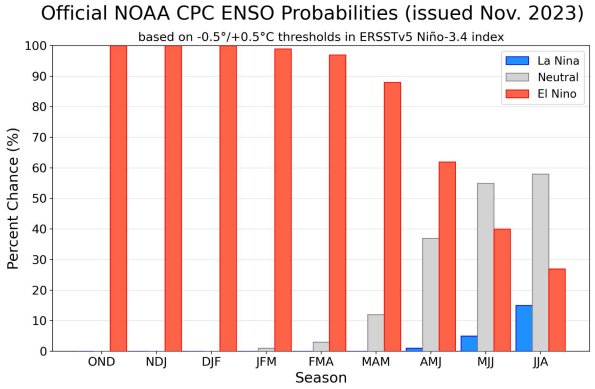
EL NIÑO/SOUTHERN OSCILLATION (ENSO) DIAGNOSTIC DISCUSSION
issued by
CLIMATE PREDICTION CENTER/NCEP/NWS
9 November 2023

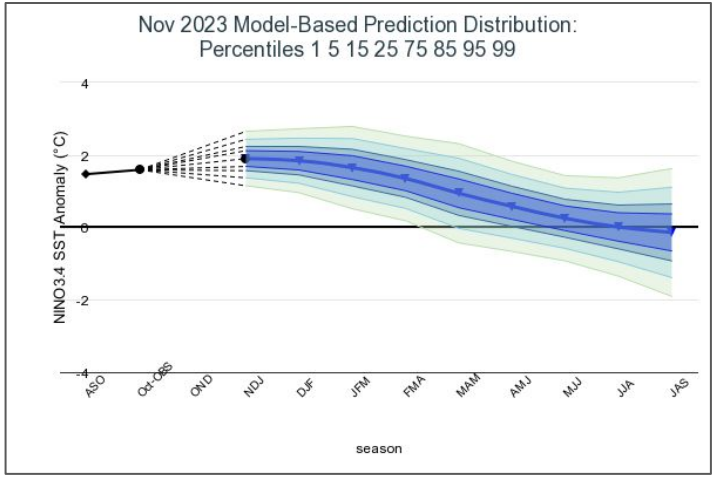
ENSO Alert System Status: El Niño Advisory

- **El Niño** is expected to continue through the spring
  - Increased chances of wetter winter weather in Arizona/LCRB
  - Much weaker correlation/winter weather signal elsewhere in basin

Typical El Niño Winters



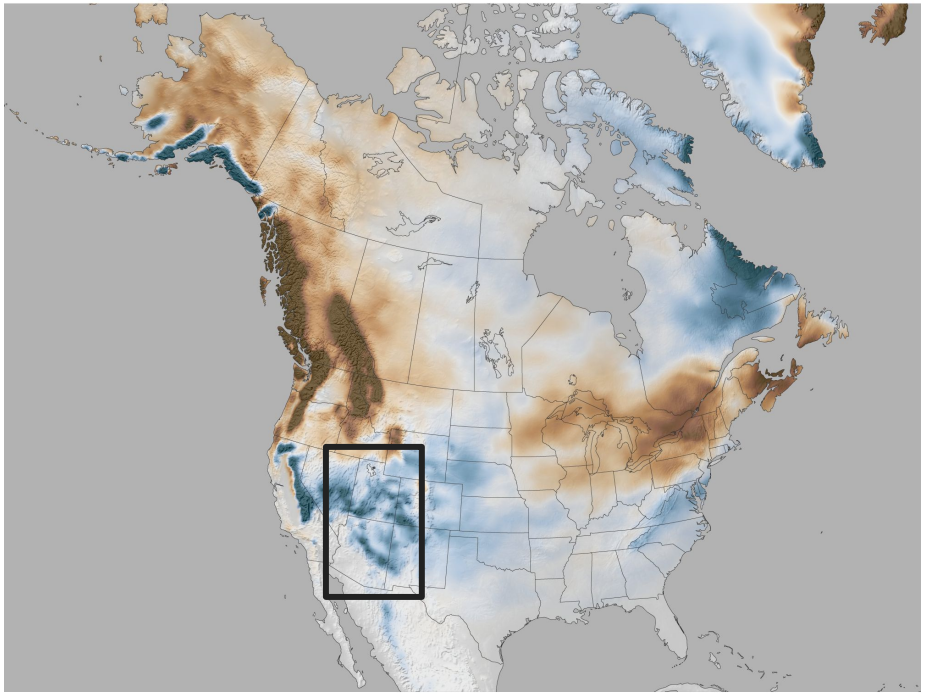




Sources: NOAA, IRI

El Niño Snow Analysis: NOAA Climate.gov

Snowfall during all El Niño winters (Jan–Mar)



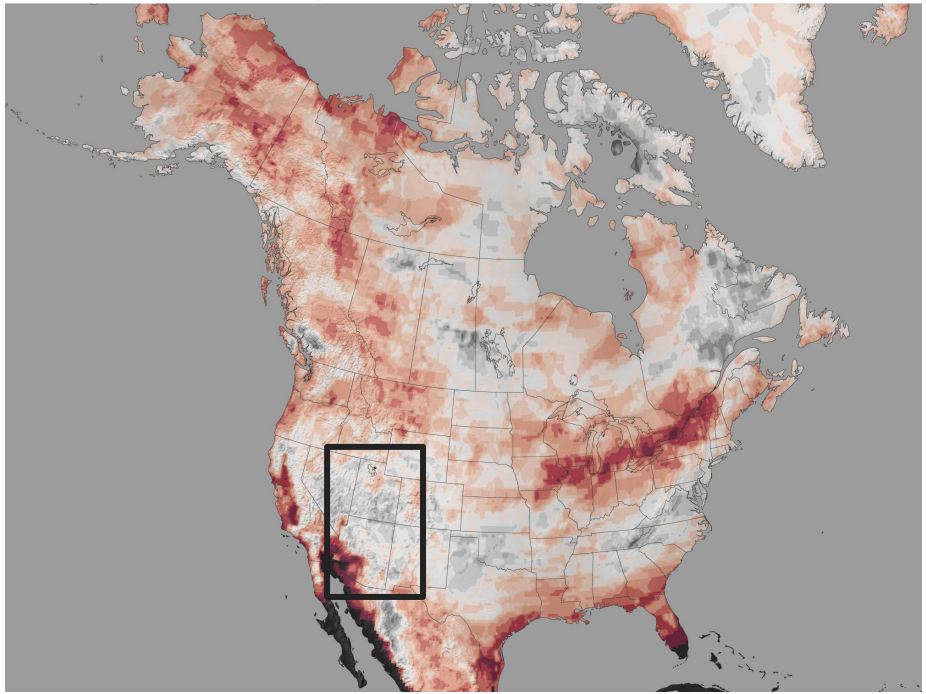
El Niño winters (1959–2023) vs. 1991–2020 average (detrended)

difference from average snowfall (inches)

−10 −8 −6 −4 −2 0 2 4 6 8 10

NOAA Climate.gov
Data: ERA5

How many moderate-to-strong El Niño winters (Jan–Mar) had below-average snowfall?



1959–2023

number of years (out of 13)

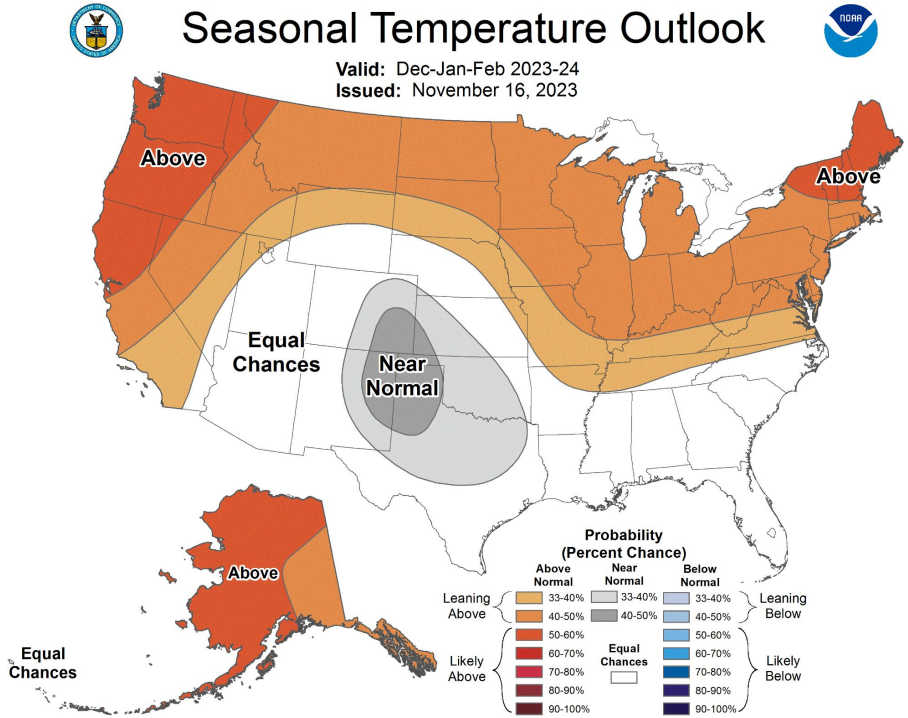
0 1 2 3 4 5 6 7 8 9 10 11 12 13

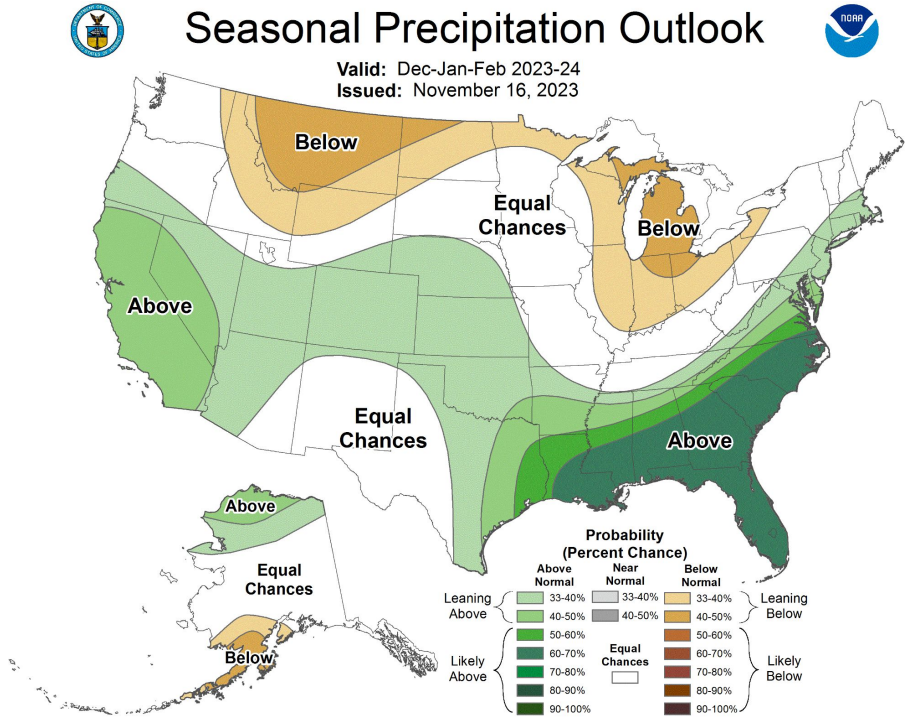
NOAA Climate.gov
Data: ERA5

Link/Source

Climate Prediction Center Seasonal Outlook (Dec-Jan-Feb)

Somewhat representative of a typical El Niño pattern.

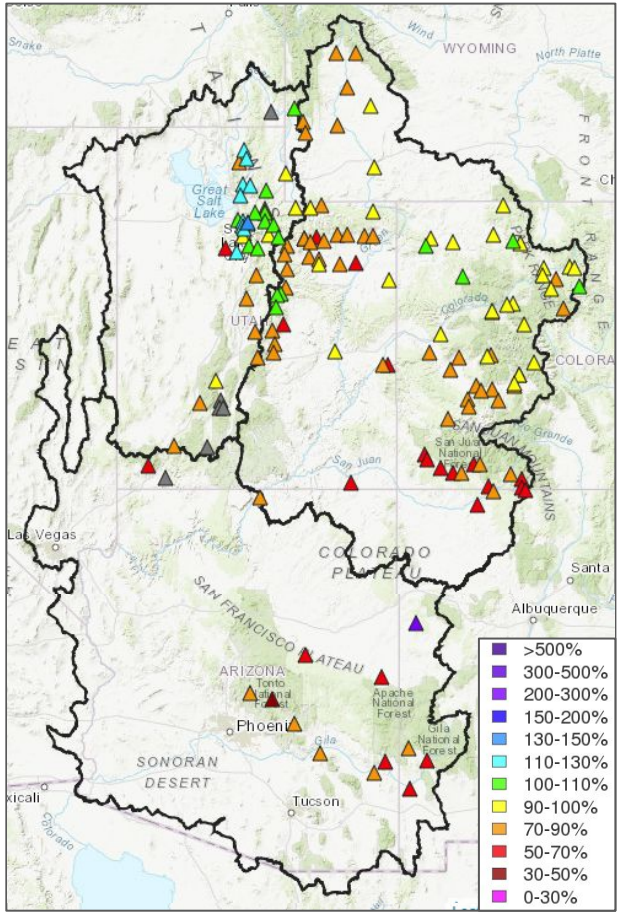




Summary

- **Upper Colorado**
  - Soil moisture: generally near to below normal
  - Snowpack: near to well below normal (50-100%)
- **Lower Colorado**
  - Soil moisture: below normal
  - Snowpack: well below normal (0-30%)
- **Great Basin**
  - Soil moisture: near to above normal
  - Snowpack: near to above normal (90-125%)
    - exception Sevier (65%)
- **Weather forecast**
  - San Juan Mountains: 6-12” snow today/tomorrow
  - Warming/drying trend across the area into early next week
  - Increased chances of precipitation next week
- **El Niño conditions**
  - Increased chances of wetter winter weather in Arizona/LCRB

Current Water Supply Outlook
Percent of 1991-2020 Normal Seasonal Volume



CBRFC Hydrologic Products Timeline

- Water Supply (ESP) model guidance will be available on our website by the end of this week.

- Water supply forecasts are issued starting early January.
  - CBRFC water supply briefings: ~5th working day of the month

- Water supply discussions/reports issued twice monthly starting early January.
  - ~Beginning of month
  - ~Middle of month

- Peak flow forecasts available beginning in early March.

2024 Water Supply Webinar Schedule

**All Times Mountain Time (MT)*

Colorado River Basin

Monday	Jan 8th	10 am
Wednesday	Feb 7th	10 am
Thursday	Mar 7th	10 am
Friday	Apr 5th	10 am
Tuesday	May 7th	10 am

Utah/Great Basin

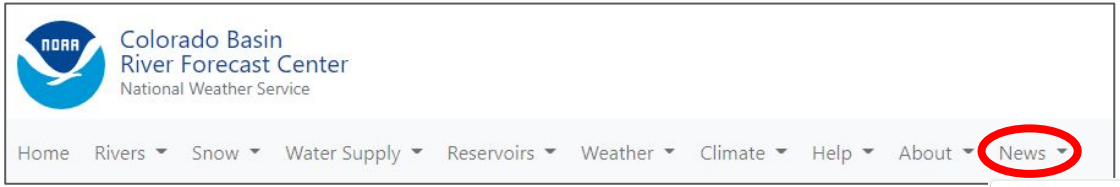
Monday	Jan 8th	11:30 am
Wednesday	Feb 7th	11:30 am
Thursday	Mar 7th	11:30 am
Friday	Apr 5th	11:30 am
Tuesday	May 7th	11:30 am

Peak flow forecast webinar Wednesday, March 20th, 10 am MT

Additional briefings scheduled as needed

Webinar schedule & registration information has been posted to the CBRFC web page

CBRFC Webinar Registration & Email List



cbrfc.noaa.gov

CBRFC Water Supply Forecast Webinar Schedule & Registration - Water Year 2024

The Colorado Basin River Forecast Center (CBRFC) produces water supply forecasts for the Colorado River Basin and the eastern Great Basin. CBRFC conducts December through May webinars explaining the forecasts and current conditions.

Follow the links below to register for a webinar.

Early Season Water Supply Outlook Webinar
- Wednesday December 13 @ 10:00 am MT

Colorado River Basin Water Supply Webinars
- Monday January 8 @ 10:00 am MT
- Wednesday February 7 @ 10:00 am MT
- Thursday March 7 @ 10:00 am MT
- Friday April 5 @ 10:00 am MT
- Tuesday May 7 @ 10:00 am MT

Utah Water Supply Webinars
- Monday January 8 @ 11:30 am MT
- Wednesday February 7 @ 11:30 am MT
- Thursday March 7 @ 11:30 am MT
- Friday April 5 @ 11:30 am MT
- Tuesday May 7 @ 11:30 am MT

Peak Flow Webinar
- Wednesday March 20 @ 10:00 am MT

A notification email will be sent if a date or time change occurs. Additional webinars are scheduled as needed.
The webinar slides will be available on the CBRFC presentations page soon after each briefing.

Email Updates

Available Email Lists
- General Stakeholders
- Water Supply: Green River Basin Forecasts
- Water Supply: Upper Colorado Mainstem Forecasts
- Water Supply: San Juan, Gunnison and Dolores River Basins Forecasts
- Water Supply: Eastern Great Basin Forecasts
- Special forecasts for the Dolores River Basin
- Special forecasts for the San Juan River Basin
- Special forecasts for CUWCD
- Upper Basin Reclamation Reservoirs
- Utah Reservoir Forecasts

Addition Requests
- Request to be on one of our lists by emailing cbrfc.webmasters@noaa.gov

CBRFC Contacts & Water Year 2024 Basin Focal Points

Basin Focal Points (Forecasters)

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CBRFC Webpage
https://www.cbrfc.noaa.gov/

CBRFC Water Supply Presentations
https://www.cbrfc.noaa.gov/present/present.html

3 Job Openings Available Soon

Questions?

Animation showing transition from La Niña to El Niño during 2023.