2024 Snowpack Status and Streamflow Outlook for the Eastern Sierra & Humboldt Basin

Nevada Division of Water Resources
April 11, 2024

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April 1, 2023
Depth 91in
SWE 37.4in
425% of median

April 2, 2024
Willow Flat Snow Course
Little Walker Basin
Depth 26in
SWE 8.8in
100% of median

Natural Resources Conservation Service

https://www.nrcs.usda.gov/nevada/snow-survey

Snowpack Status

New - Willow Flat SNOTEL

Installed September 13, 2023

Location: Little Walker Basin
Elevation: 8215ft

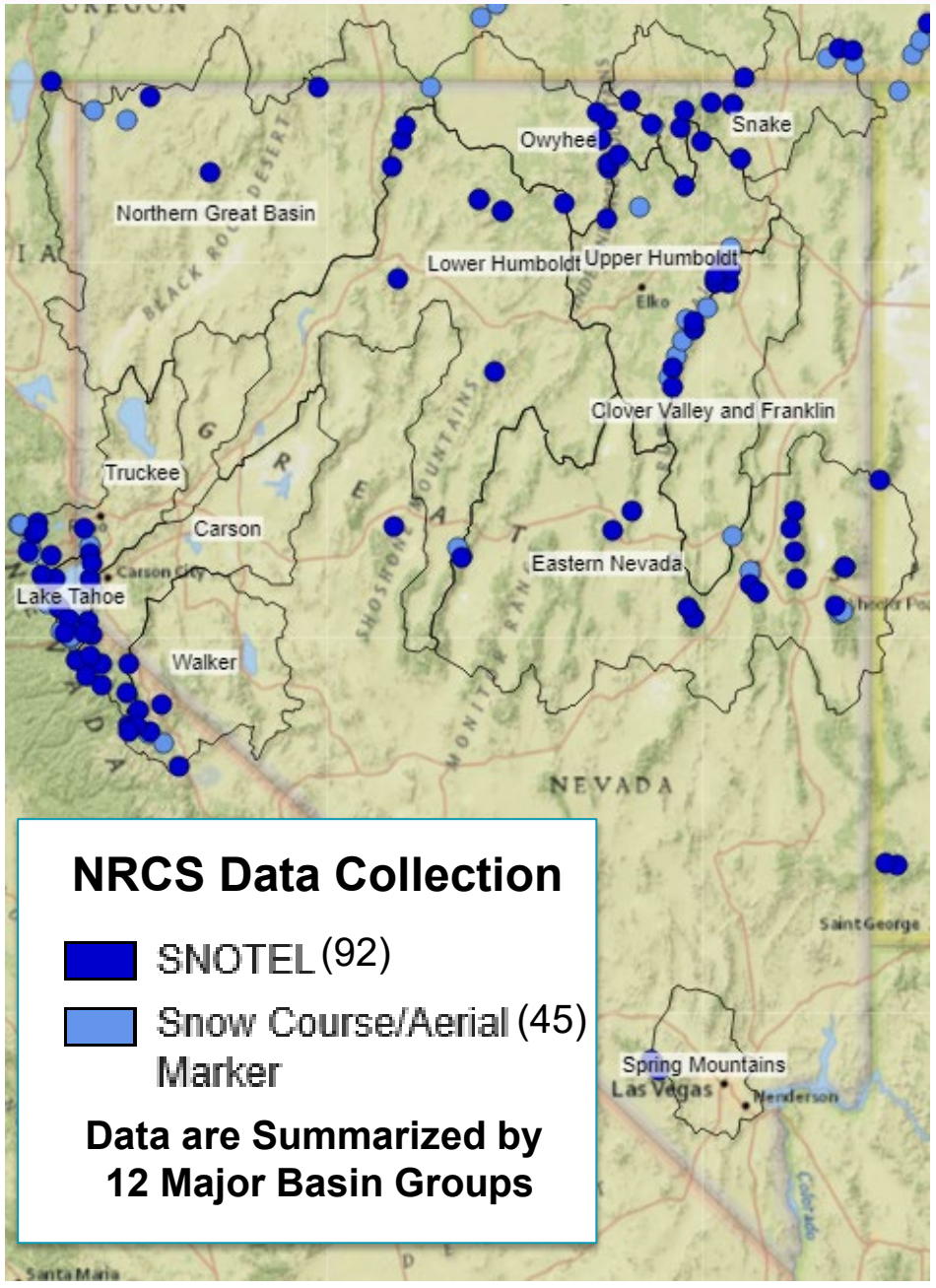
Located outside wilderness
~¾ mile from long-term snow course

SNOTEL Sensors

SWE *(10ft Water Saver Polypropylene Pillow)*
Precipitation *(SNOTEL Rocket Gage)*
Air Temperature *(Apogee ST 300 / RAD06 Shield)*
Snow Depth *(SnowVue10 – Campbell Scientific)*
Soil Moisture / Temperature *(Stevens HydraProbe)*
Telemetry *(GOES – Sutron Geo Anetena and Satlink 3 XMTR transmiiter)*

USDA United States Department of Agriculture

Snow Survey Overview

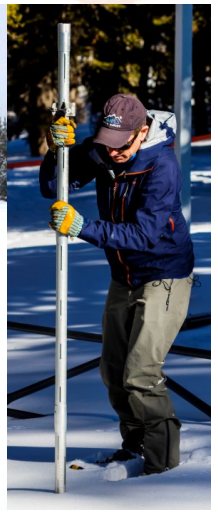


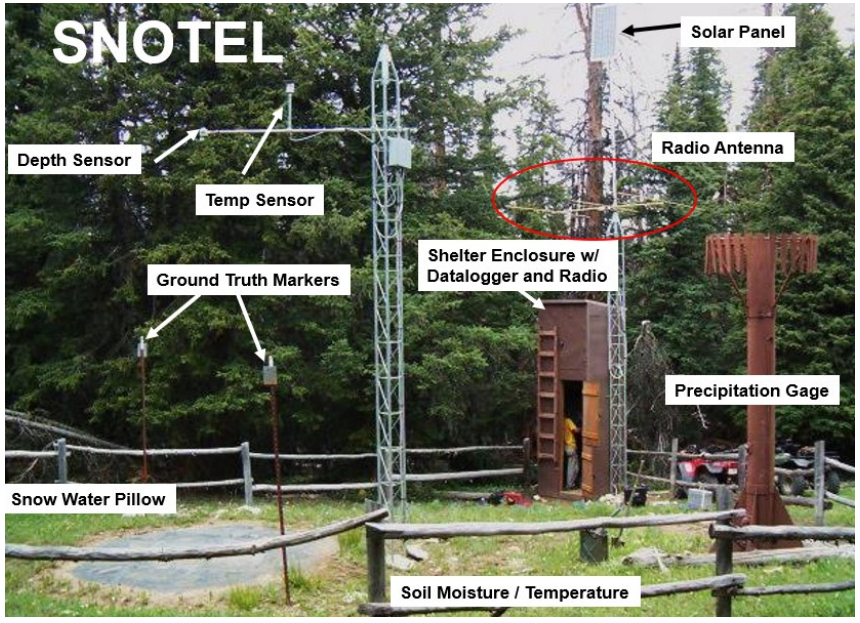
NRCS Data Collection

- SNOTEL (92)
- Snow Course/Aerial (45)
- Marker

Data are Summarized by 12 Major Basin Groups

Key Vocab: Snow Water Equivalent (SWE)





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Flying 14ft precipitation gage into Poison Flat

2023 Summer Field Work Highlights

Poison Flat – Replaced 12ft precip gage with 14ft

Ebbetts Pass – Replaced 16ft precip gage with 18ft,
Replaced bent alter shield from snow cap

Virginia Lakes Ridge - Replaced 14ft precip gage with 16ft,
Replaced bent alter shield from snow cap

Leavitt Lake – Replaced 30ft Rohn Tower damaged by snow creep.
Installed SnowVUE snow depth sensor
Installed RM Young Wind on new tower

Carson Pass – Replaced flat snow pillow,
Installed SnowVUE snow depth sensor over pillow

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Conservation
Service

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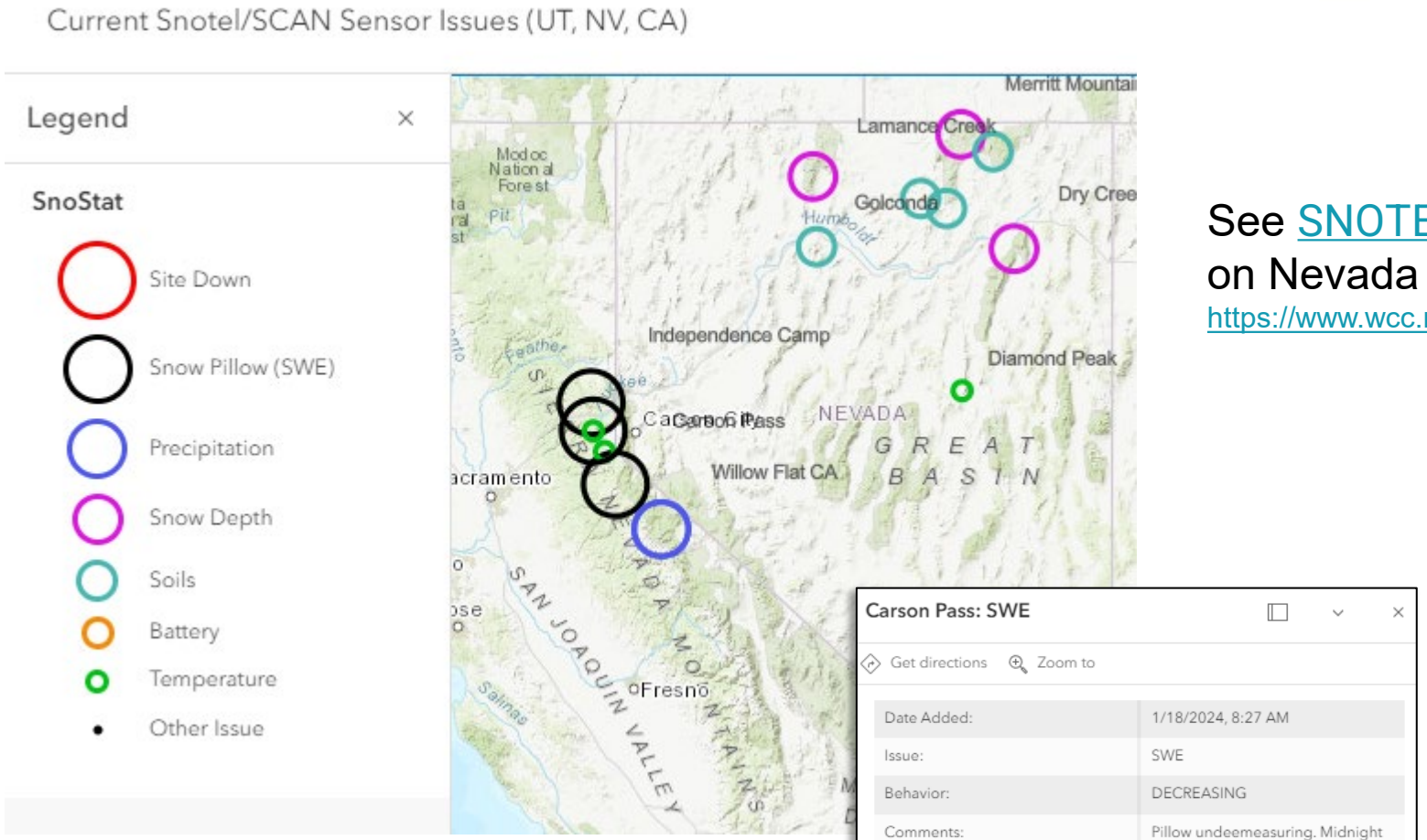
Reminder: SNOTEL Sensor Issue Map



Click site for more info

See SNOTEL Sensor Issues
on Nevada Snow Survey Products page:
https://www.wcc.nrcs.usda.gov/ftpref/support/states/NV/web/index.html

Looking ahead to Summer 2024
Snow Depth Sensor Upgrade

Replacing Judd sensor with Sommer USH9 and Campbell Sci SnowVue

SnowVUE10

Sommer - USH 9

Judd

SiteMetadata xy

USH-9 (left) and SnowVue10 (right).

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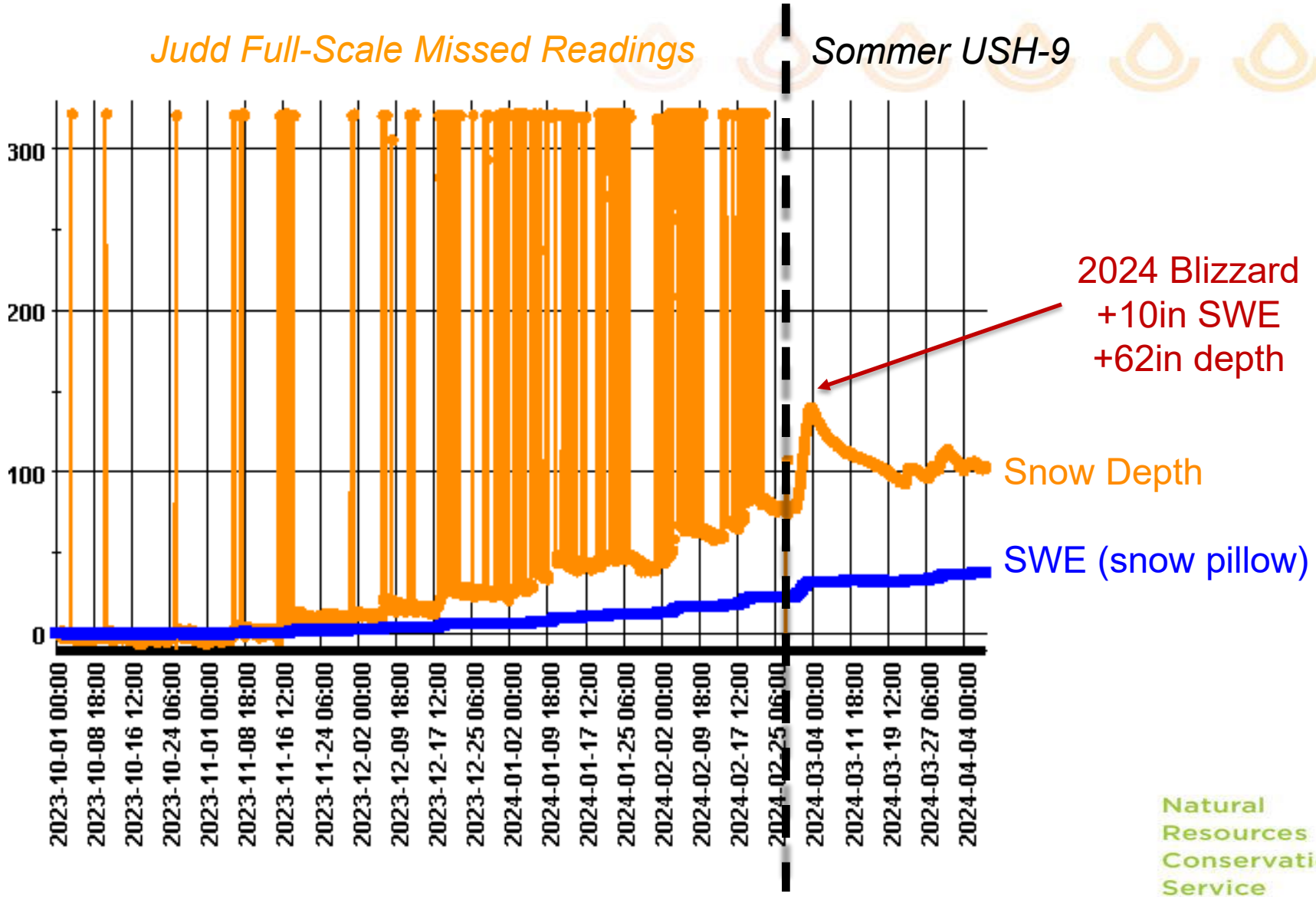

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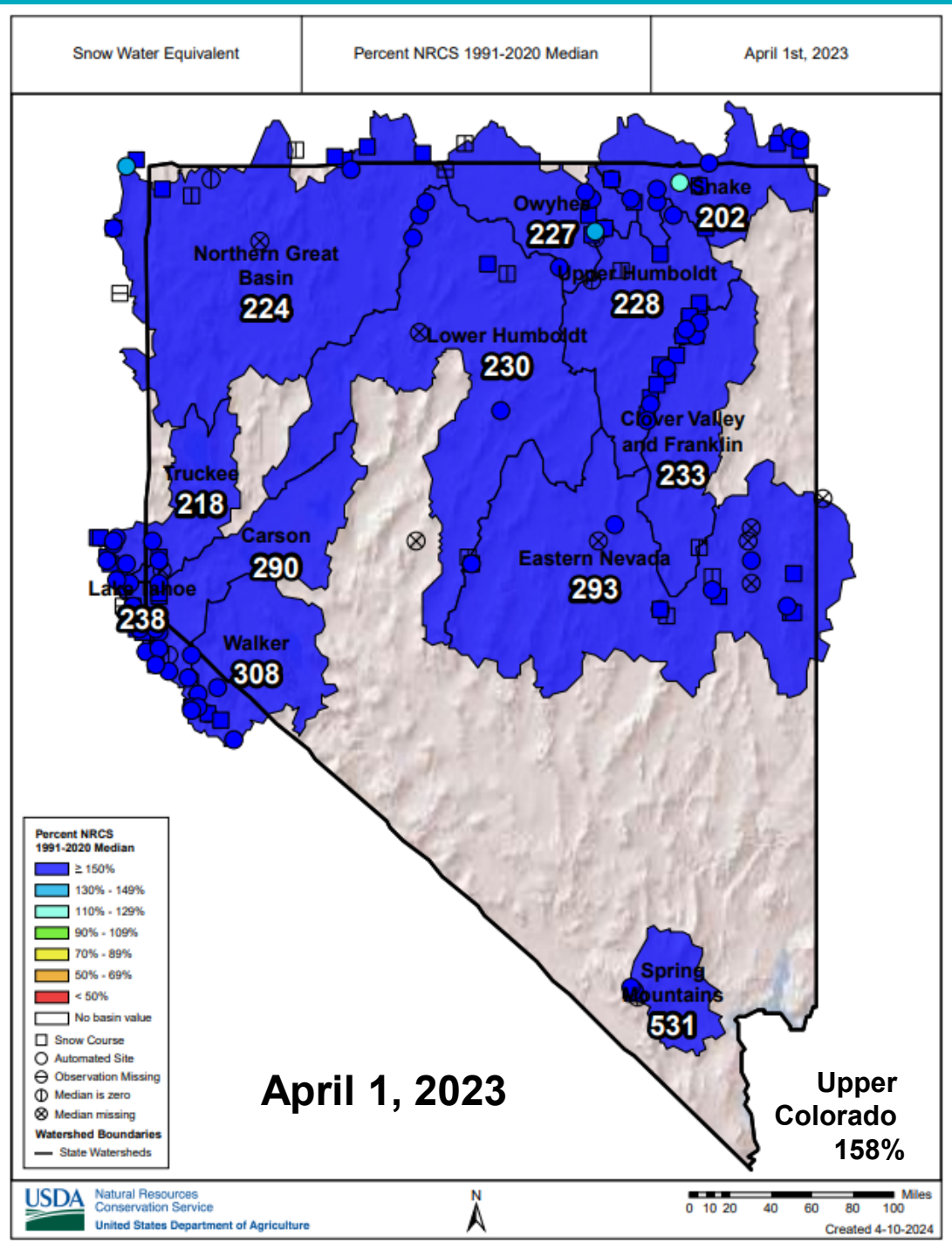
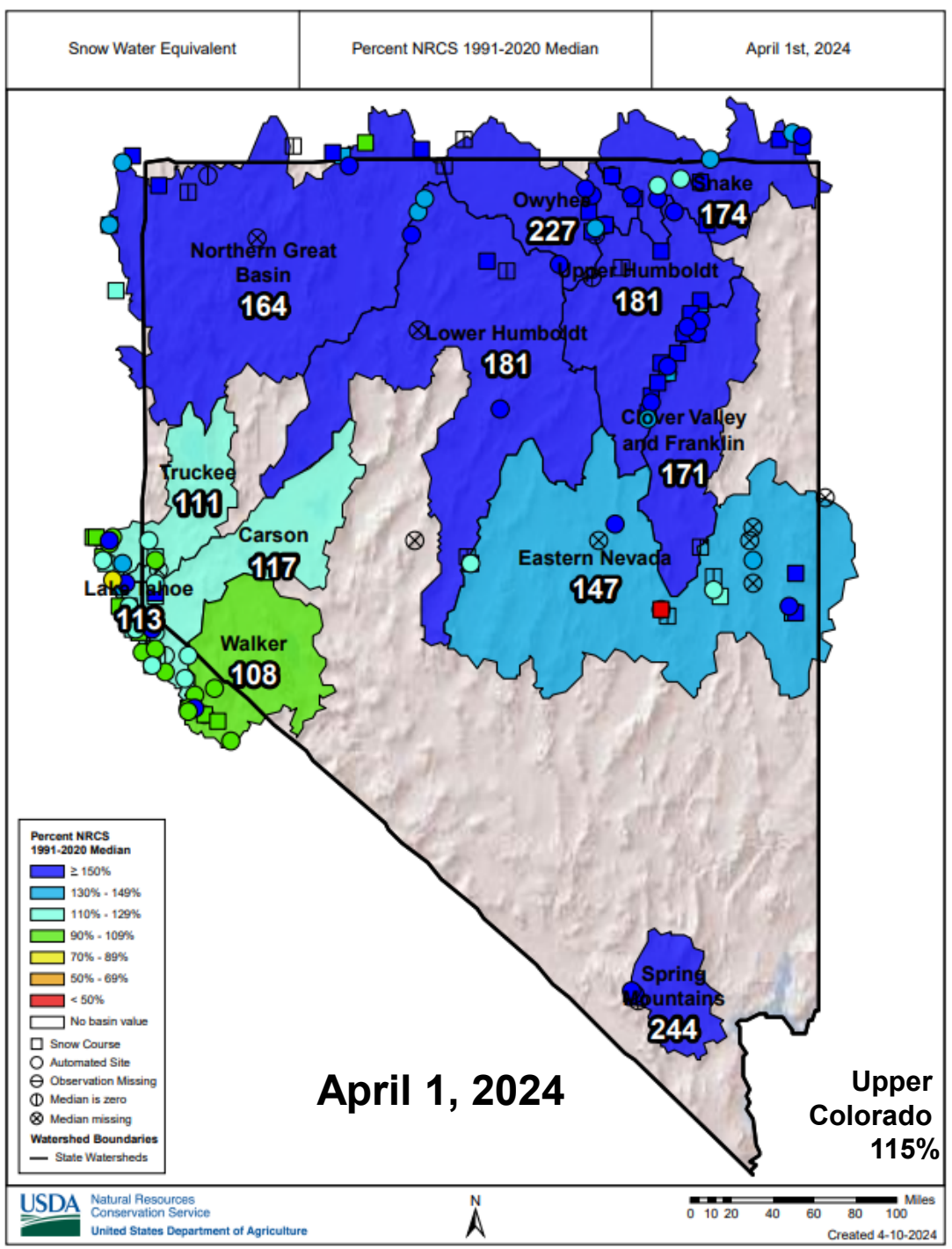


Back-to-Back Above Median Snowpacks!

Statewide and in the Upper Colorado



Basin Site Name	Elev (ft)	Snow Water Equivalent			Water Year-to-Date Precipitation		
		Current (in)	Median (in)	Pct of Median	Current (in)	Median (in)	Pct of Median
WALKER RIVER							
Leavitt Lake	9604	60.9	55.1	111	44.1	42.6	104
Virginia Lakes Ridge	9400	16.7	15.7	106	21.7	19.8	110
Summit Meadow	9313	20.1	17.8(17)	113	21.0	18.6(17)	113
Lobdell Lake	9249	14.2	11.5	123	18.3	17.9	102
Sonora Pass	8770	24.8	21.8	114	27.3	27.0	101
Monitor Pass	8306	16.6	11.8	141	18.6	16.3	114
Willow Flat CA	8215	16.0	N/A	*	17.9	N/A	*
Leavitt Meadows	7198	8.5	1.6	531	24.4	25.2	97
Basin Index (%)				**120**			**105**

SUM | =C9/D9

	A	B	C	D	E	F	G	H	I
1		elev	SWE	SWE median	% median	WY Prec	WY Prec medi	% median	
2	Leavitt Lake	9604	60.9	55.1	111	44.1	42.6	104	
3	Virginia Lakes Ridge	9400	16.7	15.7	106	21.7	19.8	110	
4	Summit Meadow	9313	20.1	17.8	113	21	18.6	113	
5	Lobdell Lake	9249	14.2	11.5	123	18.3	17.9	102	
6	Sonora Pass	8770	24.8	21.8	114	27.3	27	101	
7	Monitor Pass	8306	16.6	11.8	141	18.6	16.3	114	
8	Leavitt Meadows	7198	8.5	1.6	531	24.4	25.2	97	
9	Basin	**Total**	**161.8**	**135.3**		**175.4**	**167.4**		
10		Basin %			=C9/D9			**105%**	
11									
12	Willow Flat CA	8215	16.0	N/A	*	17.9	N/A	*	excluded
13									

How are Basin % Calculated?

Sum of Current SWE (stations with medians)

Divided by

Sum of Median SWE (stations with medians)

In this case Basin is 120%

vs

averaging station percentages 177%

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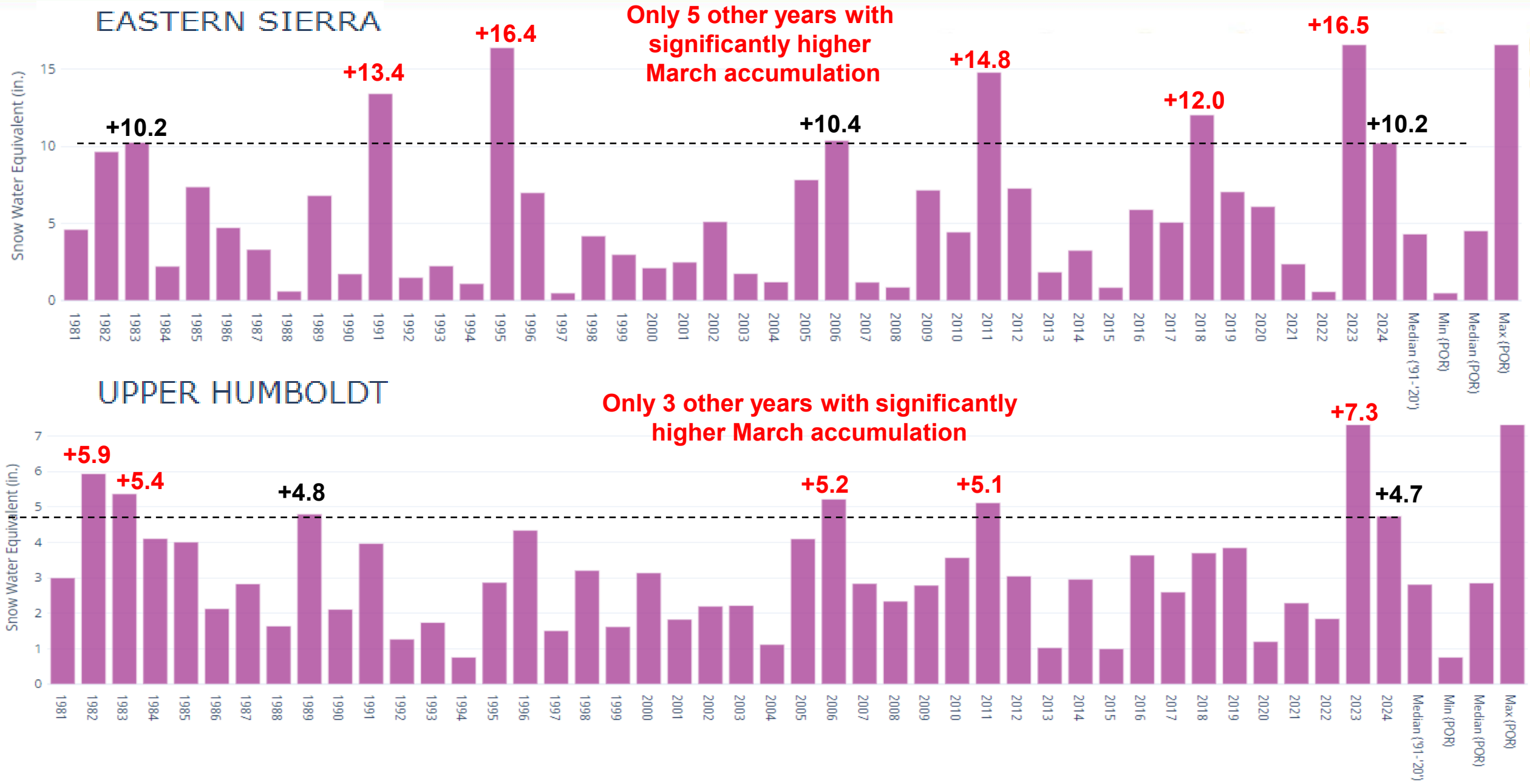
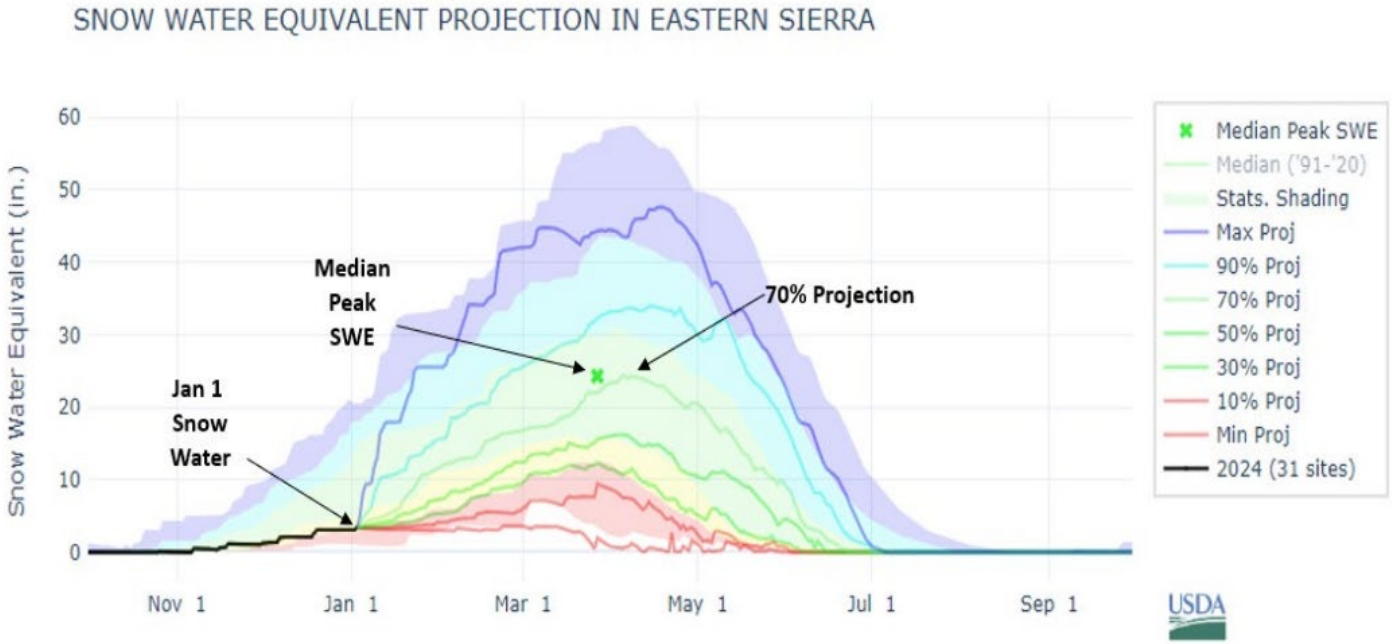
USDA United States Department of Agriculture

March Snow Water Accumulation



This "Normal" Sierra Snowpack

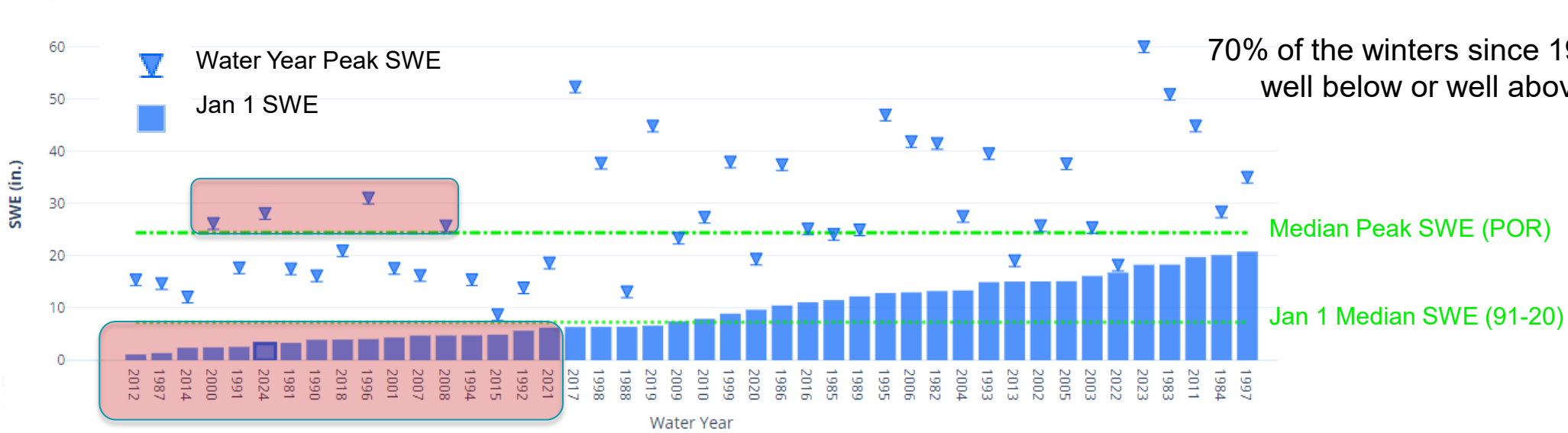


The path to a normal snowpack wasn't linear…
On January 1 snowpack was 44%
Statistically there was
~30% chance of reaching normal peak SWE

Of the 17 lowest January 1 snowpacks only
2024, 2008, 2000 and 1996
recovered to a normal peak.

Is "normal" even normal?
Just 13 of the last 44 years peaked between
80% and 120%.

70% of the winters since 1981 have been
well below or well above "normal"



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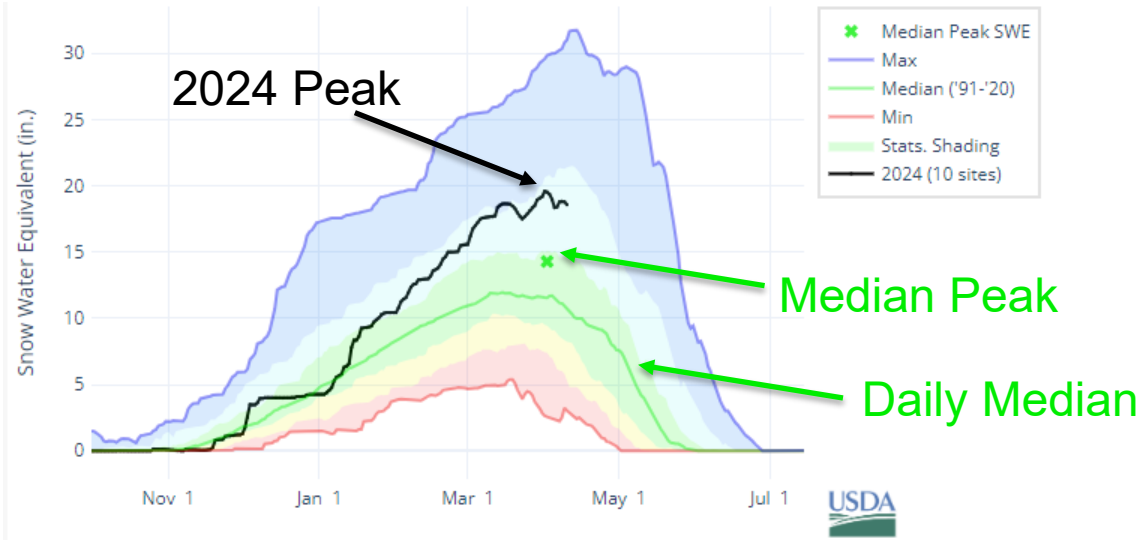
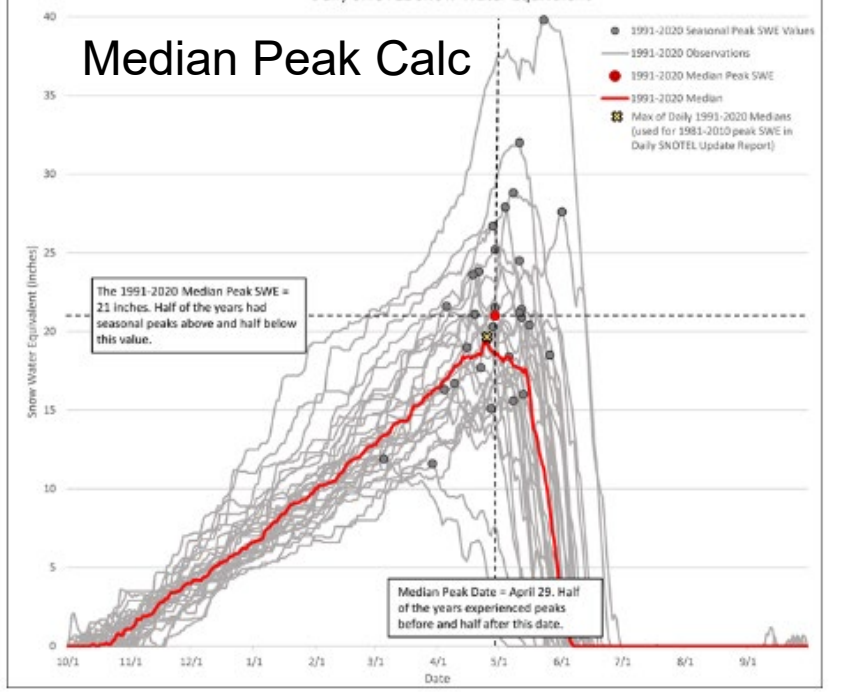
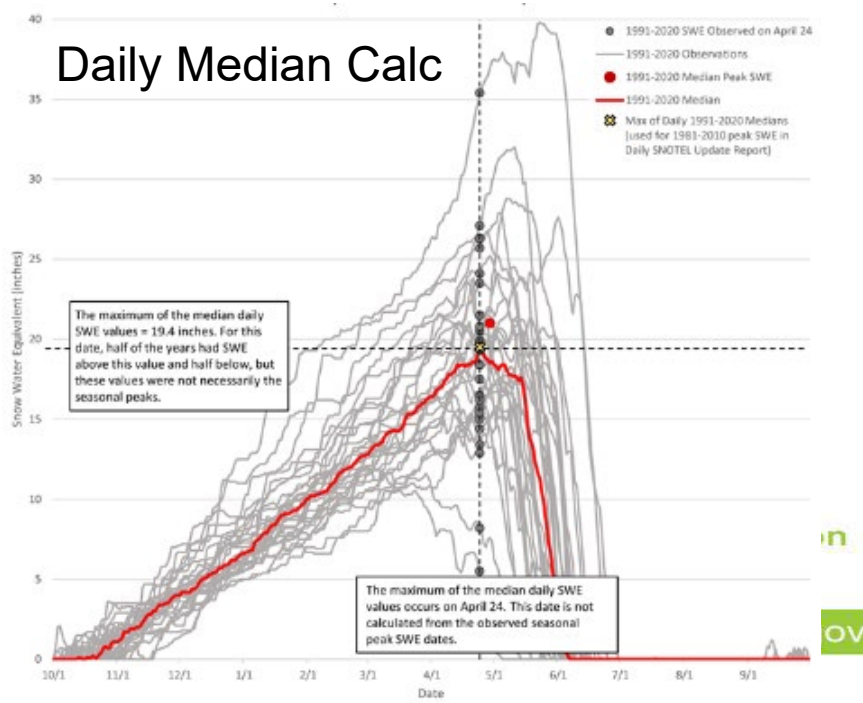
2024 Peak SWE Stats

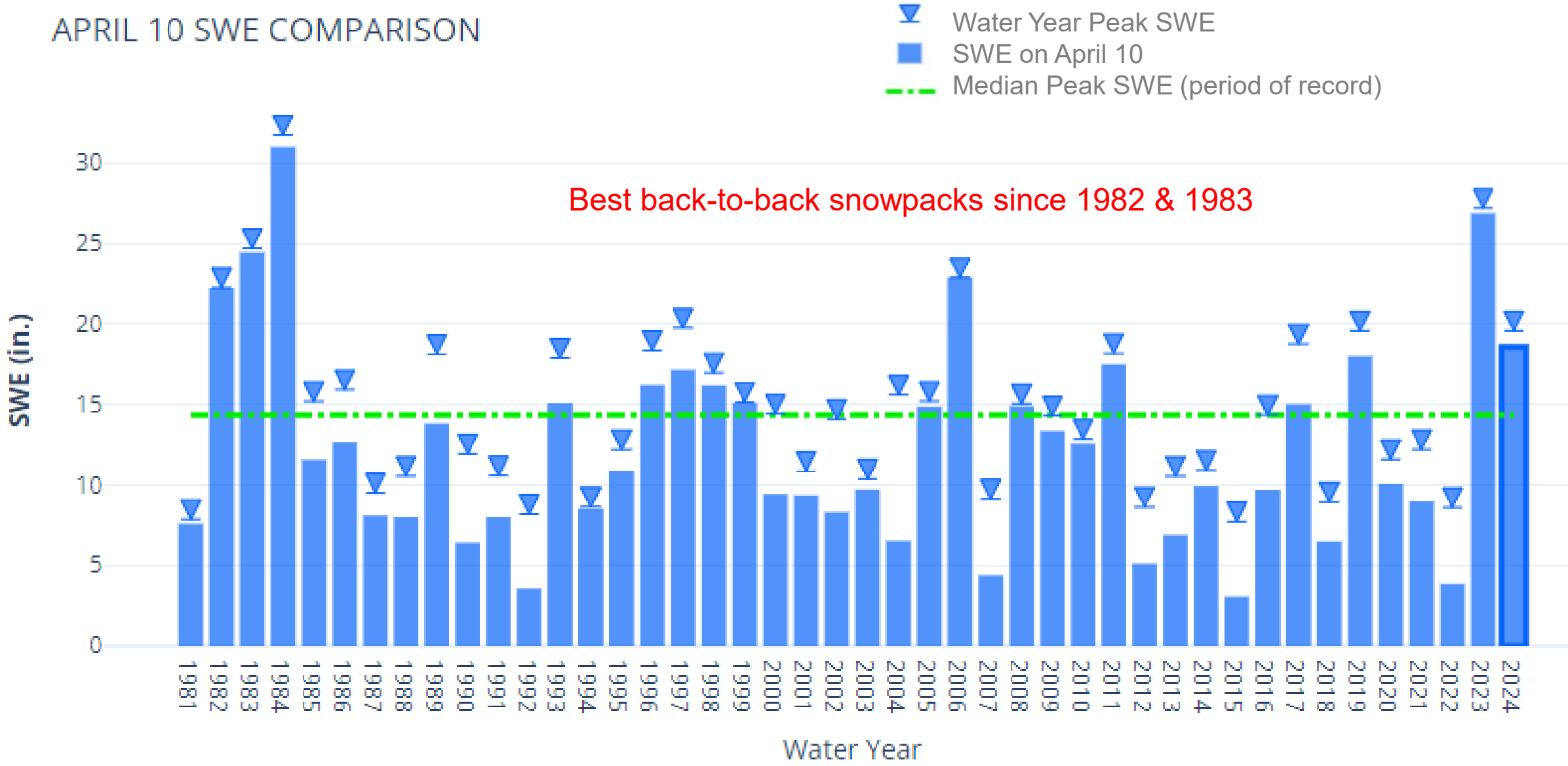


Basin	2024 Peak as Percent of Median Peak	2024 Peak SWE (in)	2024 Peak Date	Median Peak SWE (in)	Median Peak Date
Lake Tahoe	**101%**	27.4	2-Apr	27.0	27-Mar
Truckee	**105%**	28.4	1-Apr	27.1	27-Mar
Carson	**115%**	24.3	7-Apr	21.1	27-Mar
Walker	**115%**	23.5	9-Apr	20.5	27-Mar
Upper Humboldt	**137%**	19.6	1-Apr	14.3	2-Apr
Lower Humboldt	**137%**	20.6	9-Apr	15.0	26-Mar

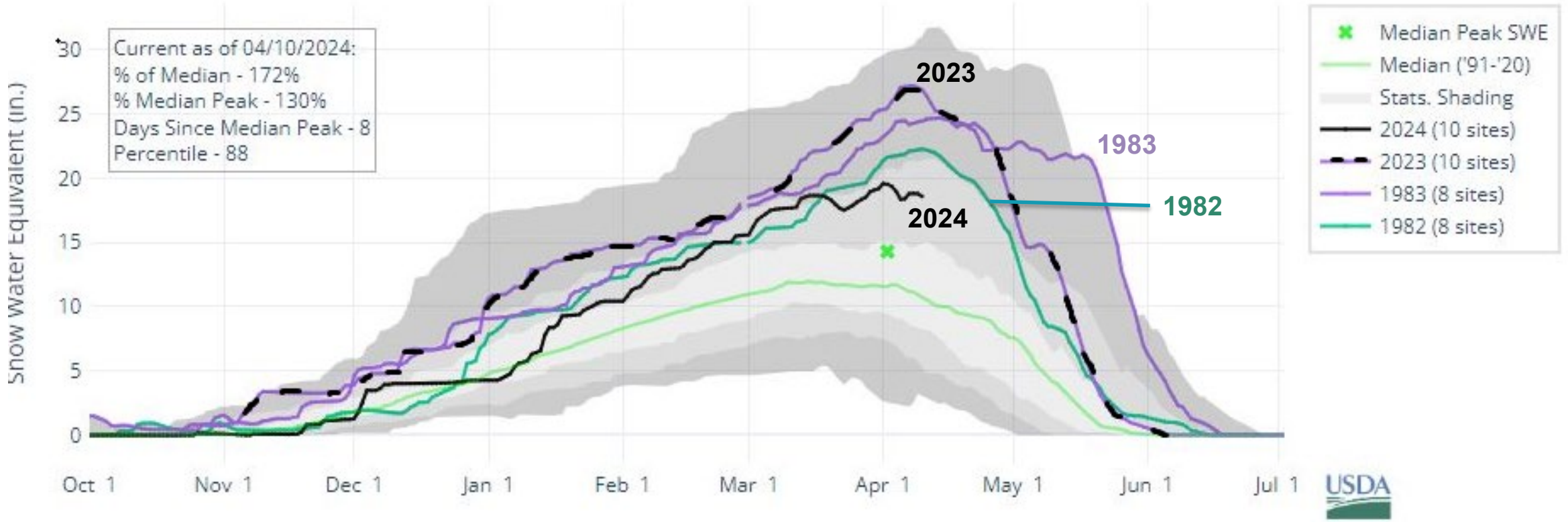




UPPER HUMBOLDT
APRIL 10 SWE COMPARISON



SNOW WATER EQUIVALENT IN UPPER HUMBOLDT



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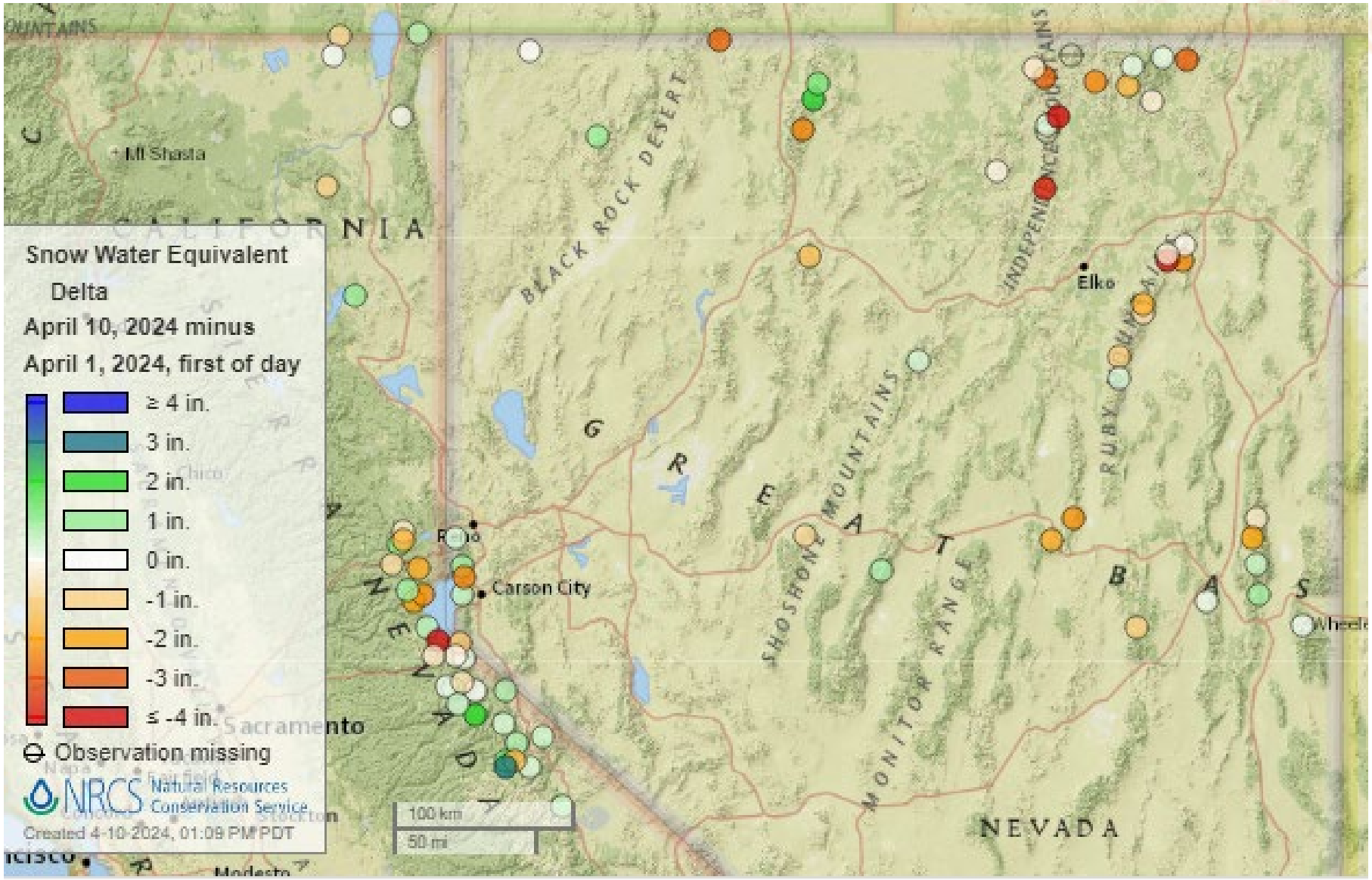

Since April 1

Lower elevations
Melt underway
up to 4 inches of SWE
5 sites snow free / 6 normal

Higher elevations
+2 to +3 inches SWE
or holding steady

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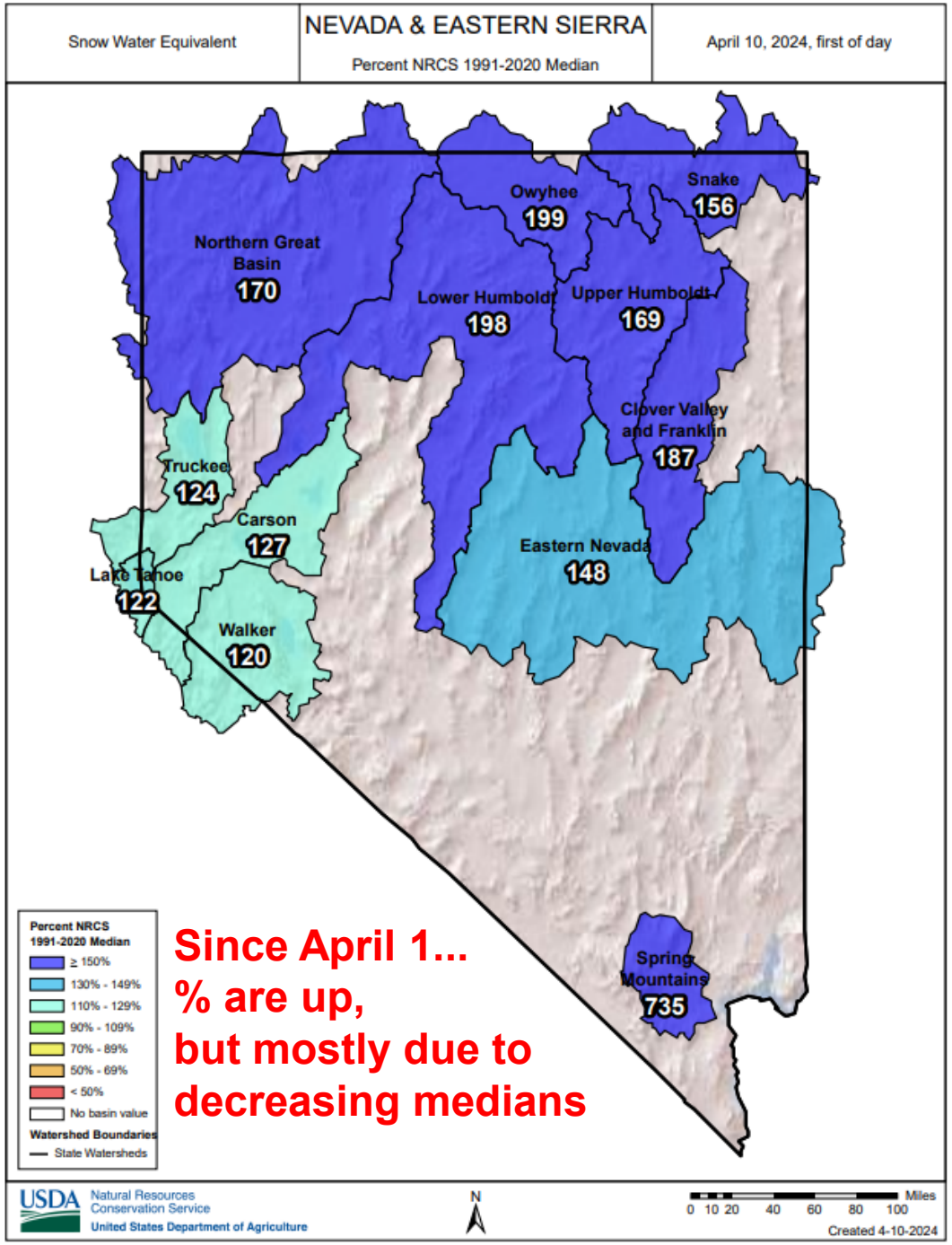
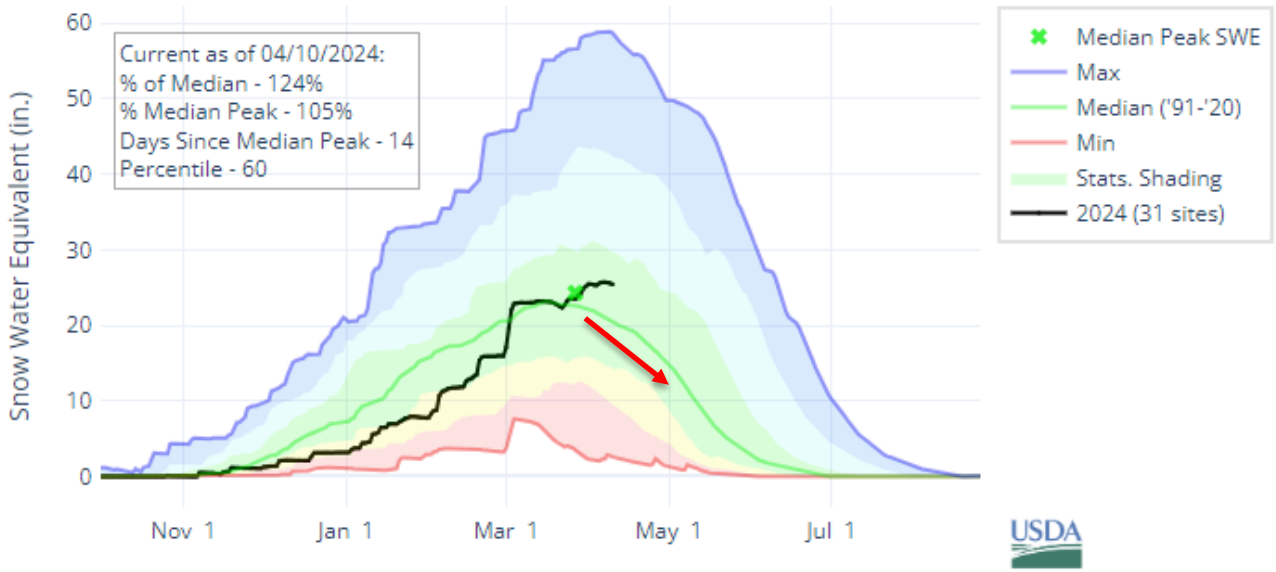
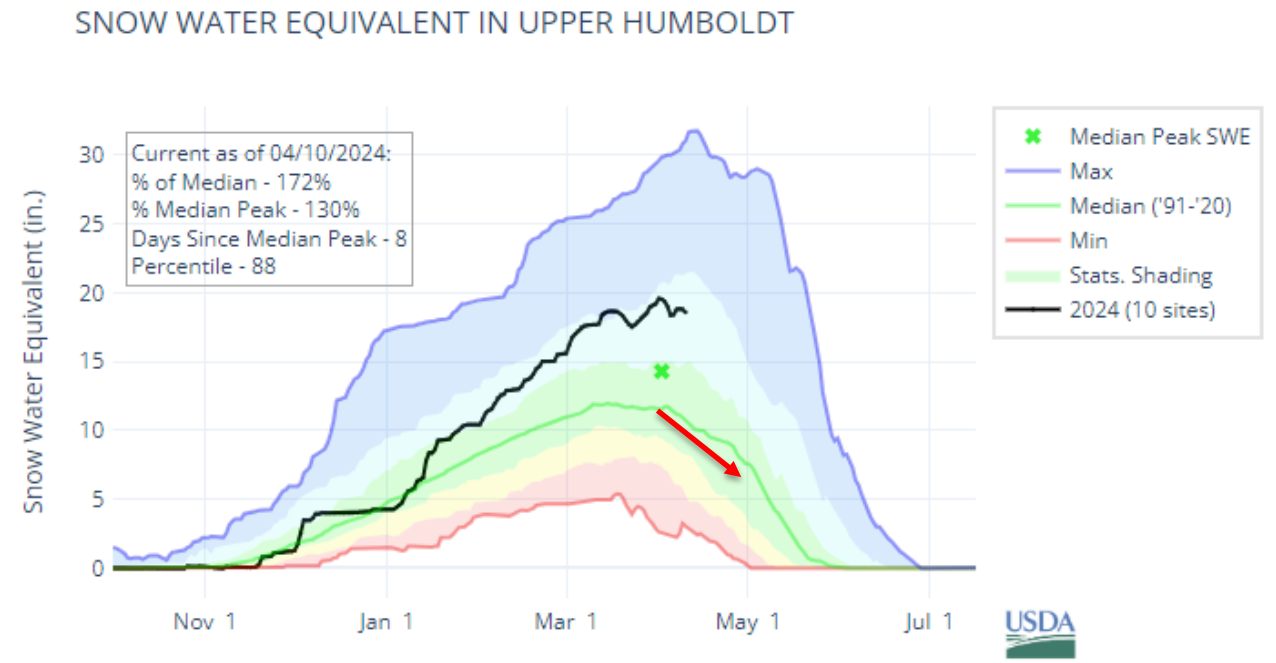
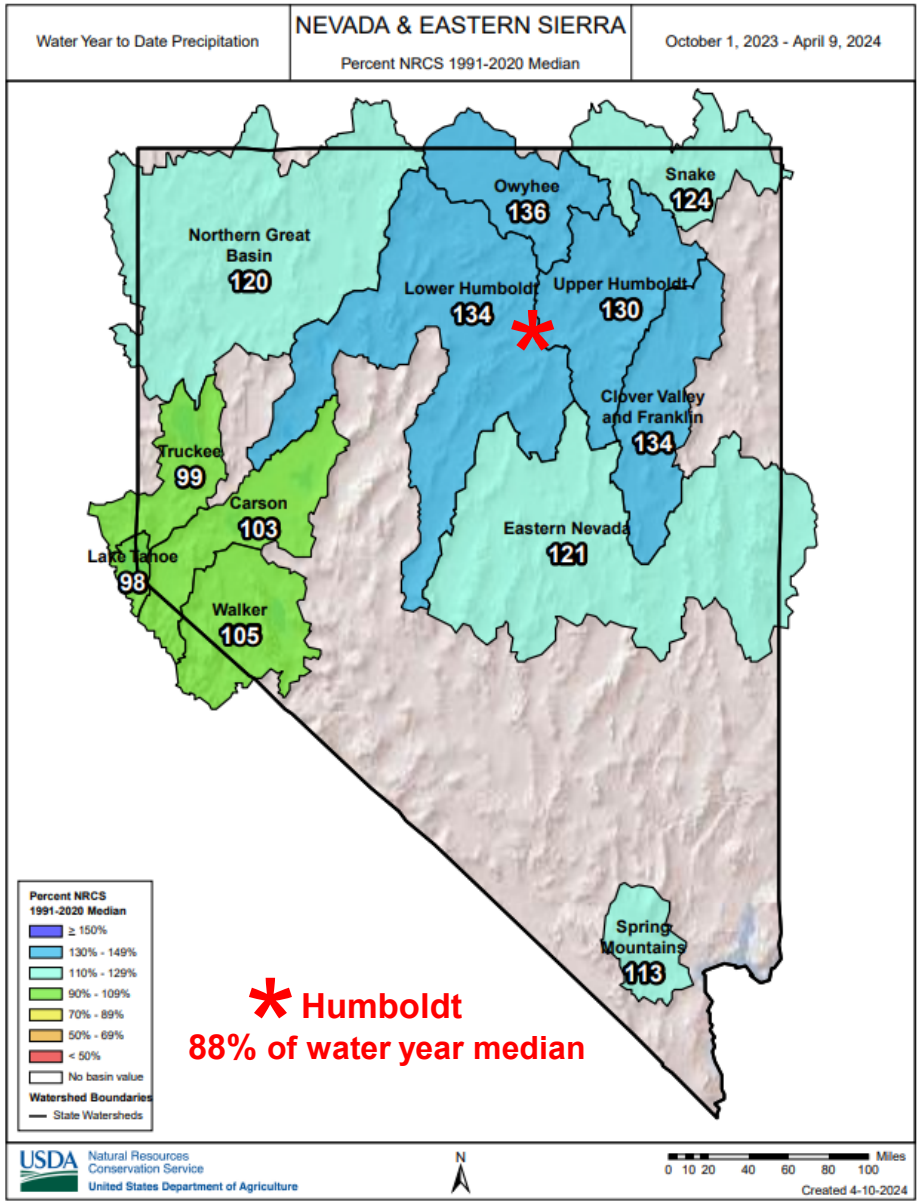

Snow Water Equivalent
NEVADA & EASTERN SIERRA
Percent NRCS 1991-2020 Median
April 10, 2024, first of day
Northern Great Basin 170
Owyhee 199
Snake 156
Lower Humboldt 198
Upper Humboldt 169
Clover Valley and Franklin 187
Truckee 124
Carson 127
Eastern Nevada 148
Lake Tahoe 122
Walker 120
Spring Mountains 735
Percent NRCS 1991-2020 Median
≥ 150%
130% - 149%
110% - 129%
90% - 109%
70% - 89%
50% - 69%
< 50%
No basin value
Watershed Boundaries
State Watersheds
Since April 1...
% are up,
but mostly due to
decreasing medians
USDA Natural Resources Conservation Service
United States Department of Agriculture
N
0 10 20 40 60 80 100 Miles
Created 4-10-2024

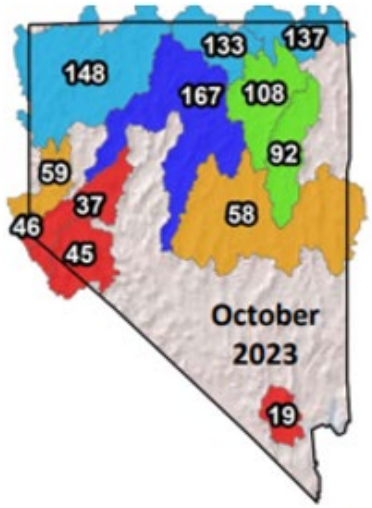

SNOW WATER EQUIVALENT IN EASTERN SIERRA
Snow Water Equivalent (in.)
Current as of 04/10/2024:
% of Median - 124%
% Median Peak - 105%
Days Since Median Peak - 14
Percentile - 60
Median Peak SWE
Max
Median ('91-'20)
Min
Stats. Shading
2024 (31 sites)
Nov 1
Jan 1
Mar 1
May 1
Jul 1
USDA

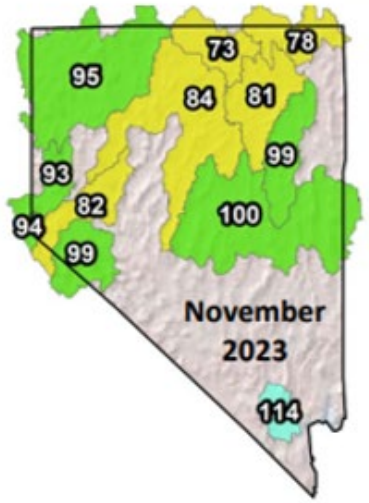

SNOW WATER EQUIVALENT IN UPPER HUMBOLDT
Snow Water Equivalent (in.)
Current as of 04/10/2024:
% of Median - 172%
% Median Peak - 130%
Days Since Median Peak - 8
Percentile - 88
Median Peak SWE
Max
Median ('91-'20)
Min
Stats. Shading
2024 (10 sites)
Nov 1
Jan 1
Mar 1
May 1
Jul 1
USDA

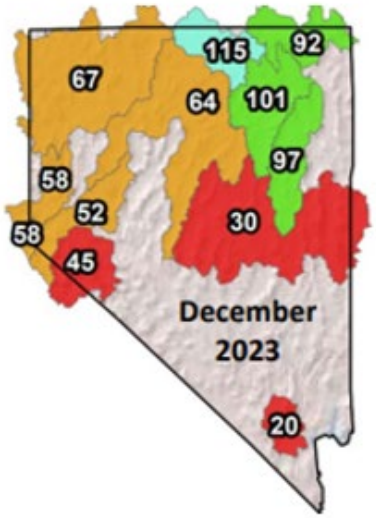
Water Year Precipitation

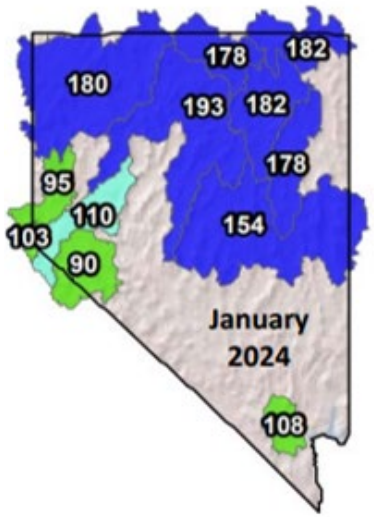


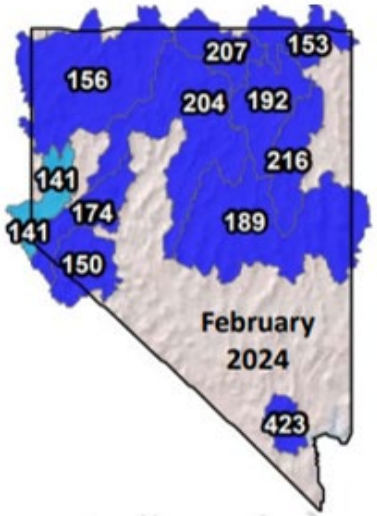
Monthly Precipitation

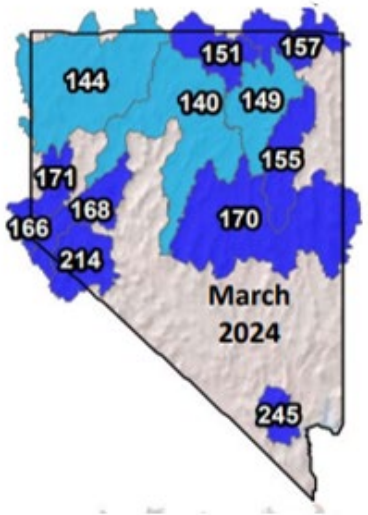


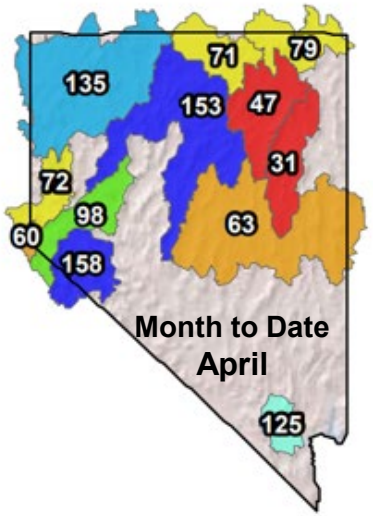












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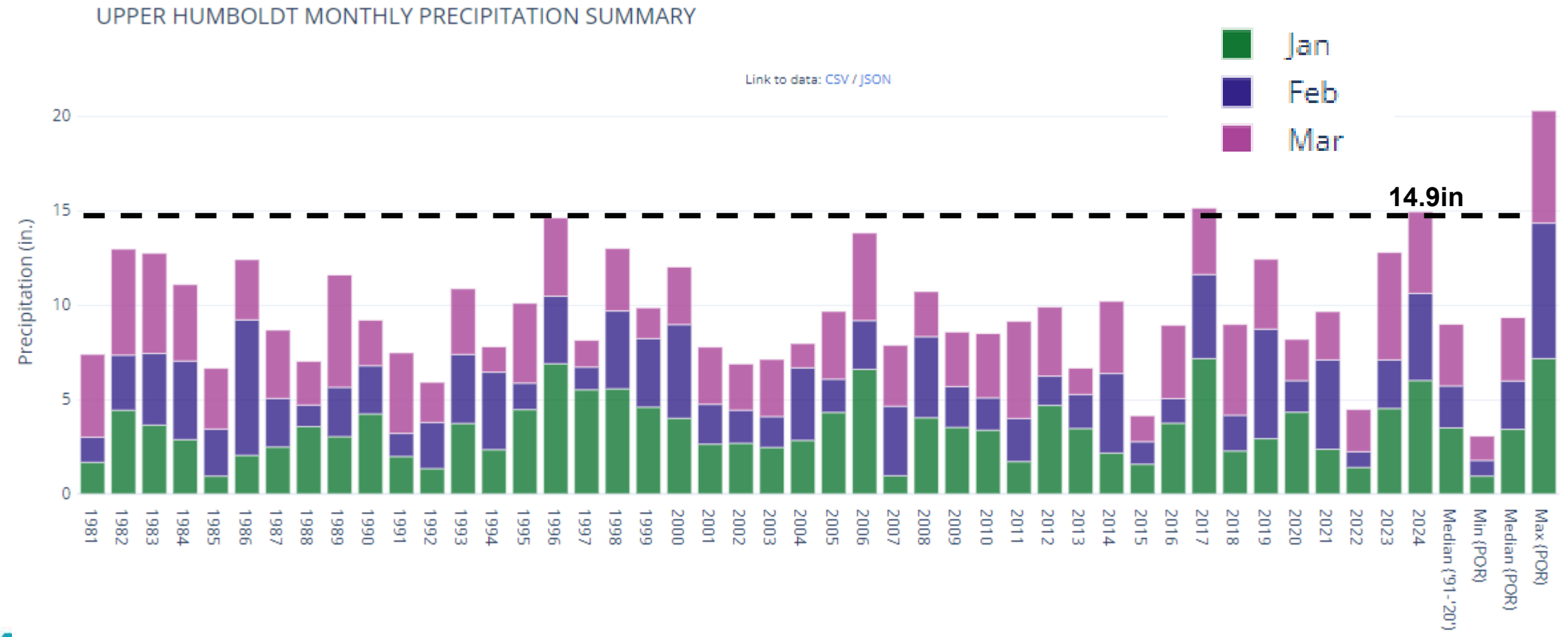
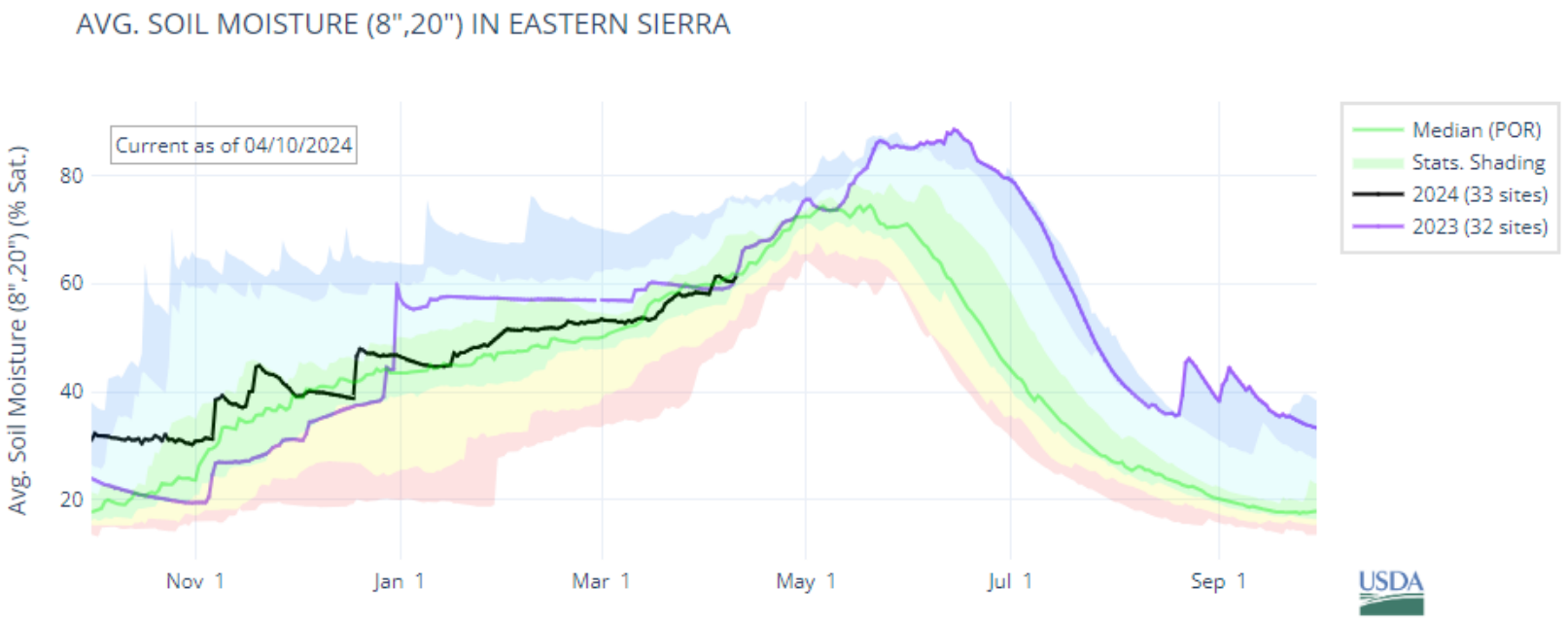
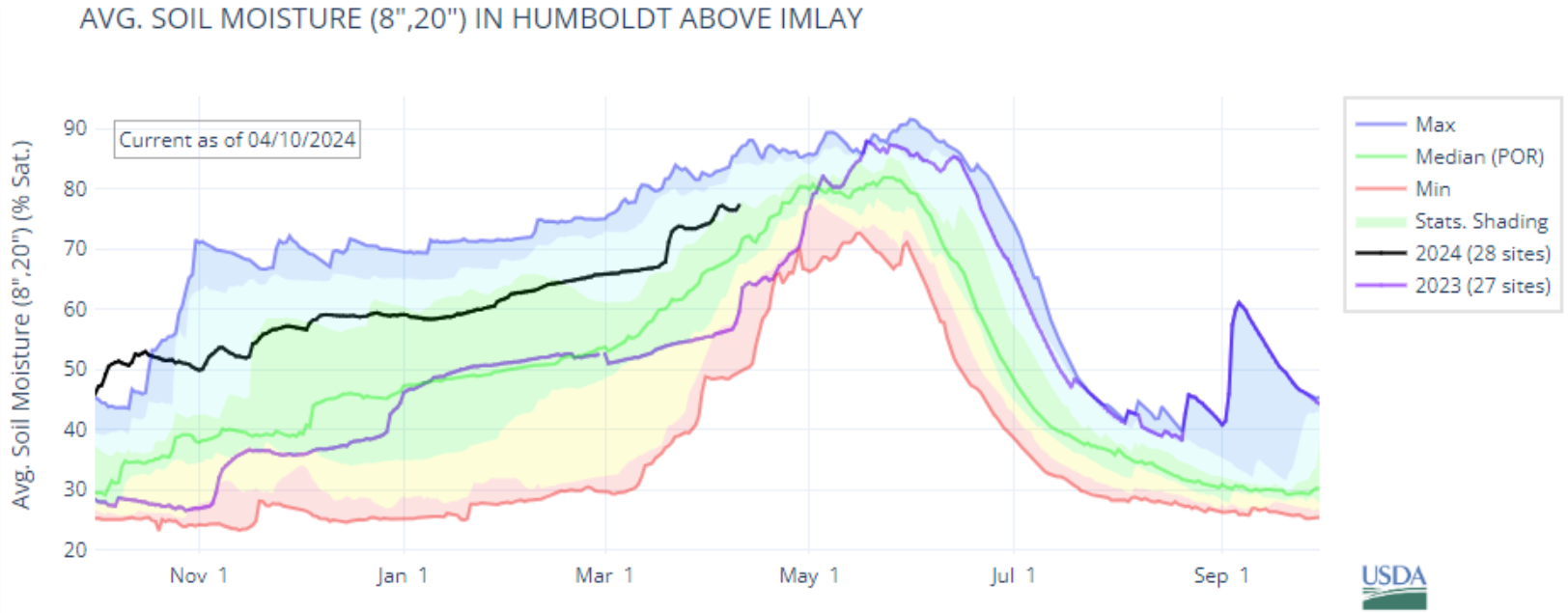
Upper Humboldt near record January – March precipitation in 2024
Similar to 2017 and 2 inches more than 2023



USDA
United States Department of Agriculture





Soil Moisture
Looking good for an efficient runoff

Eastern Sierra
Near Median
Similar to April 2023

Humboldt
Well above median
Much better than April 2023

Natural Resources Conservation Service
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NRCS Streamflow Forecasts for 2024 and beyond

NRCS has transitioned to M^4 Forecasting System (Multi-Method Machine Learning Metasystem)

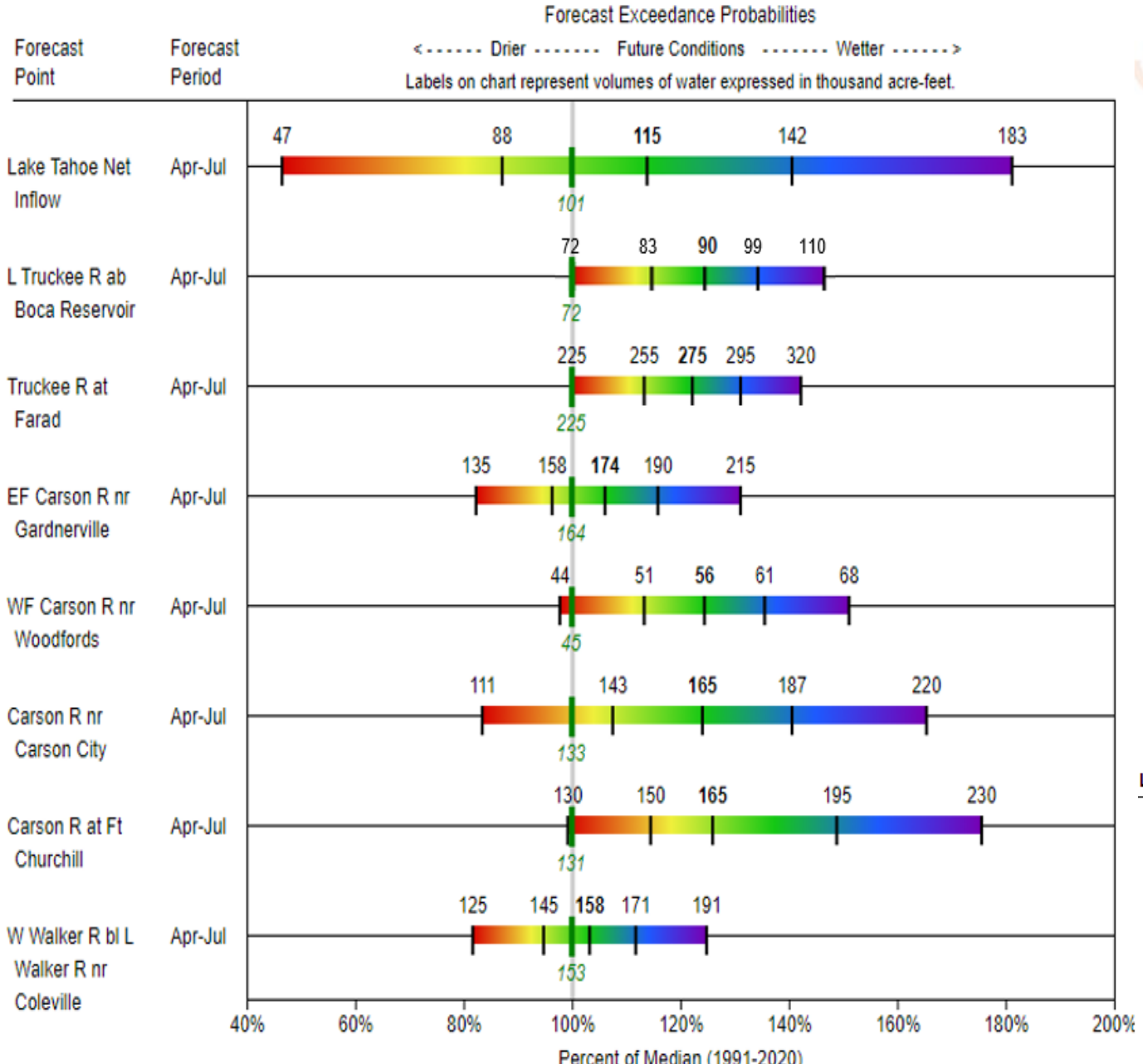
- M^4 uses machine learning to pick predictors for six different statistical models.
- The system combines results to produce an ensemble mean.
- The skill of the ensemble mean generally equals or exceeds the skill of the individual models.
- Multi-model approach insulates against individual model vulnerabilities on a particular year.
- The NRCS continues to publish a single forecast distribution and the way the distribution is interpreted remains unchanged.

Primary NV-CA Forecaster: Gus Goodbody angus.goodbody@usda.gov

For more information:

Fleming S.W., Garen D.C., Goodbody A.G., McCarthy C.S., Landers L.C. (2021). Assessing the new Natural Resources Conservation Service water supply forecast model for the American West: A challenging test of explainable, automated, ensemble artificial intelligence. Journal of Hydrology (602) 126782. https://www.nrcs.usda.gov/sites/default/files/2022-11/Assessing%20the%20new%20Natural%20Resources%20Conservation%20Service%20water%20supply.pdf

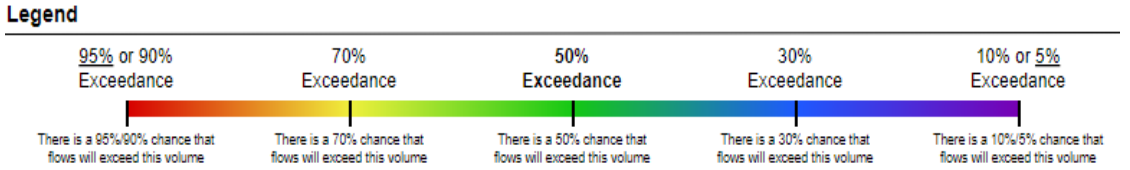
Fleming S.W., Goodbody A.G. (2019). A machine learning metasystem for robust probabilistic nonlinear regression-based forecasting of seasonal water availability in the US West. IEEE Access, 7, 119943-119964, doi:10.1109/ACCESS.2019.2936989. https://www.nrcs.usda.gov/sites/default/files/2022-11/A%20Machine%20Learning%20Metasystem%20for%20Robust.pdf



Eastern Sierra Forecast Summary
April 1, 2024

50% exceedance forecasts range from
103-125% of median
92-104% of average

Most forecasts are between
the ~50th and 60th percentile



Conservation Service

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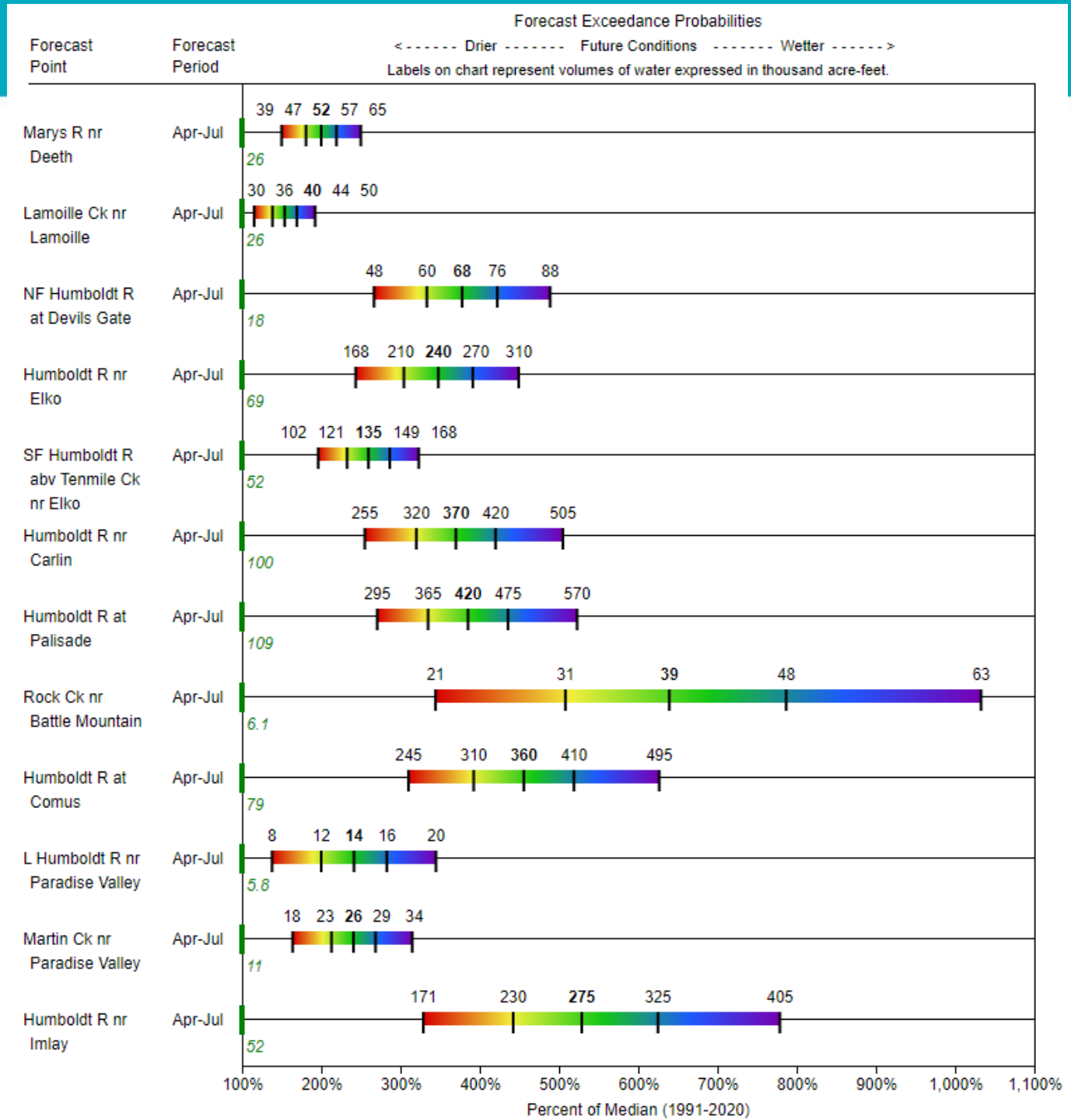

Humboldt Basin Forecast Summary
April 1, 2024

All April-July forecast exceedances are above 100% median

50% exceedance forecasts range from
154-639% of median
138-267% of average

Most forecasts are above the 85th percentile

Legend

95% or 90% Exceedance	70% Exceedance	50% Exceedance	30% Exceedance	10% or 5% Exceedance
There is a 95%/90% chance that flows will exceed this volume	There is a 70% chance that flows will exceed this volume	There is a 50% chance that flows will exceed this volume	There is a 30% chance that flows will exceed this volume	There is a 10%/5% chance that flows will exceed this volume

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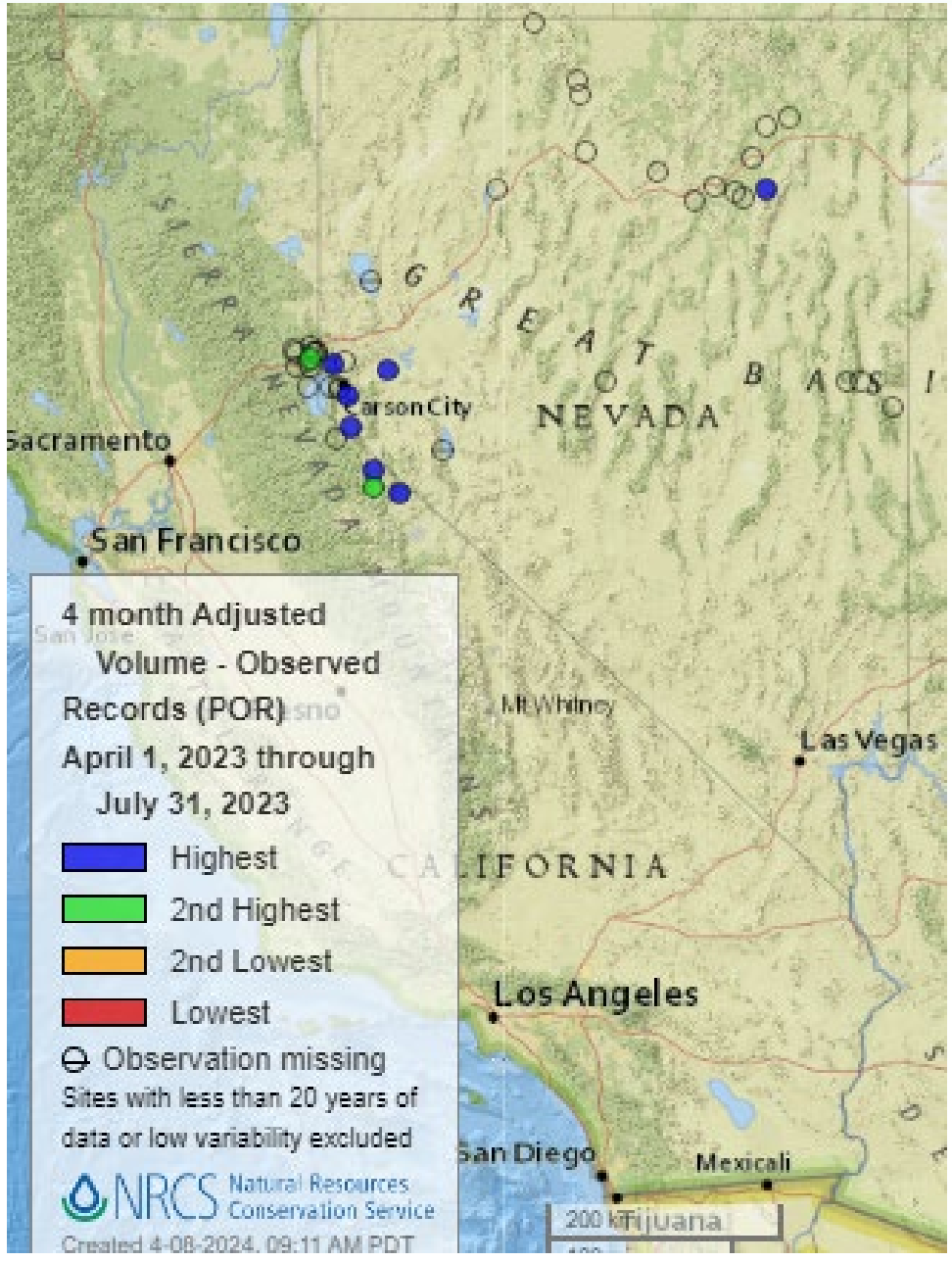


Where we are coming from…

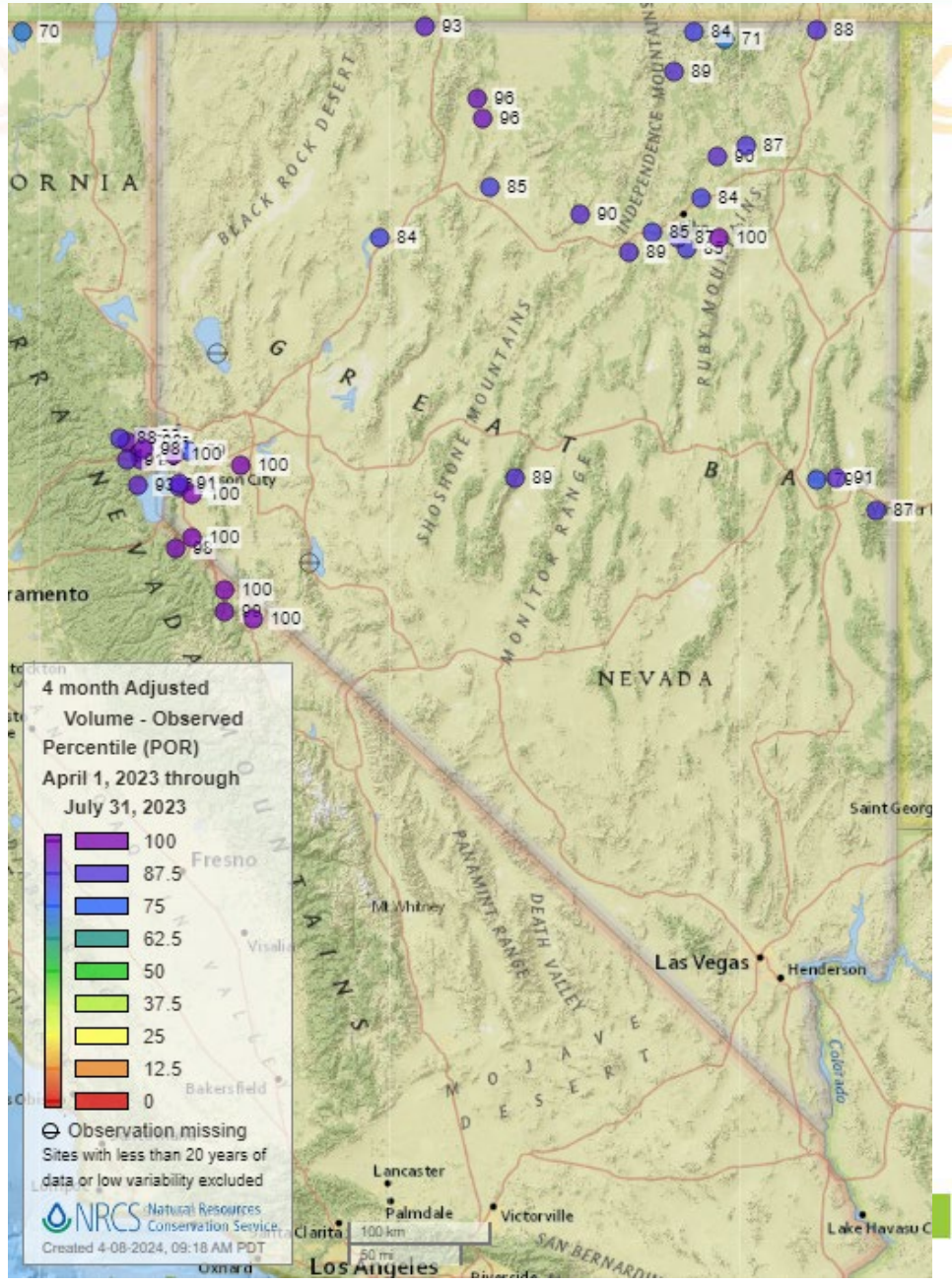
2023 April-July Streamflow

Percentile

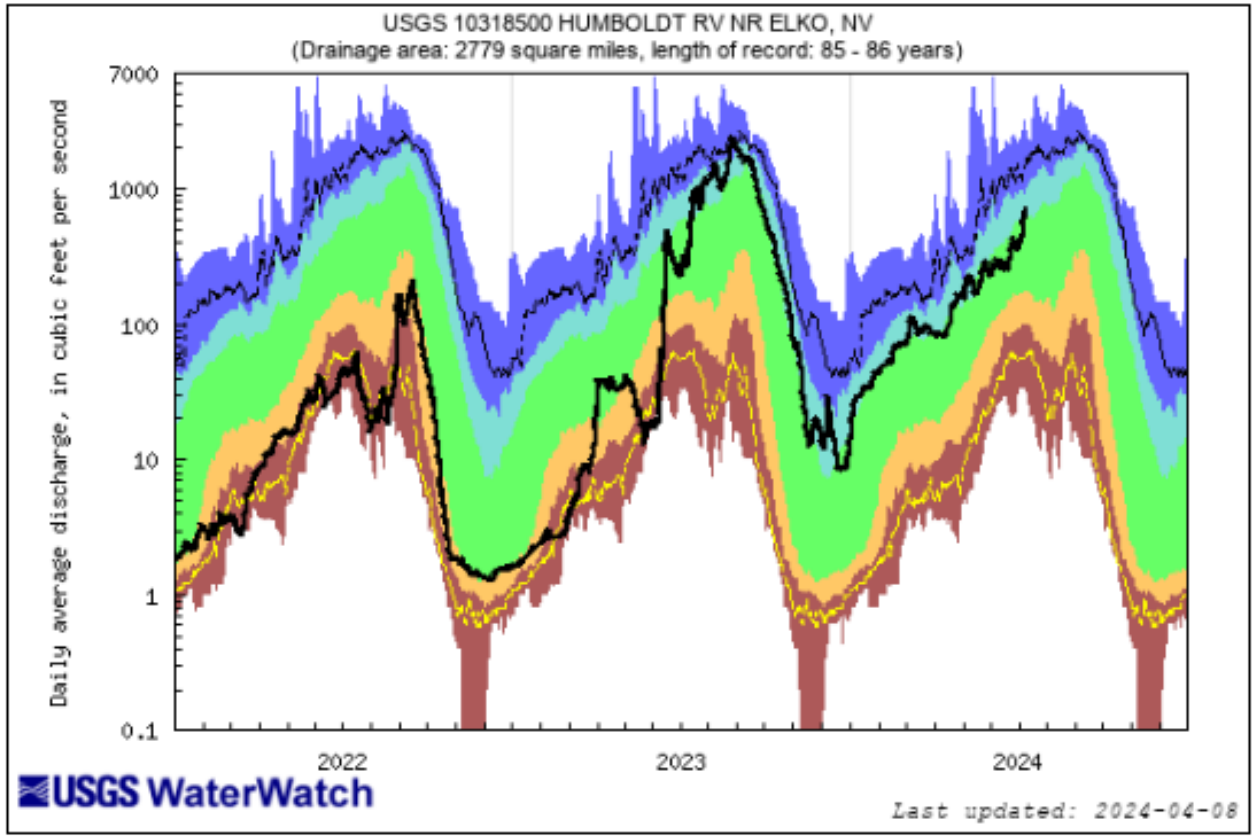
Nearly all points
>80th percentile
Average 91st percentile

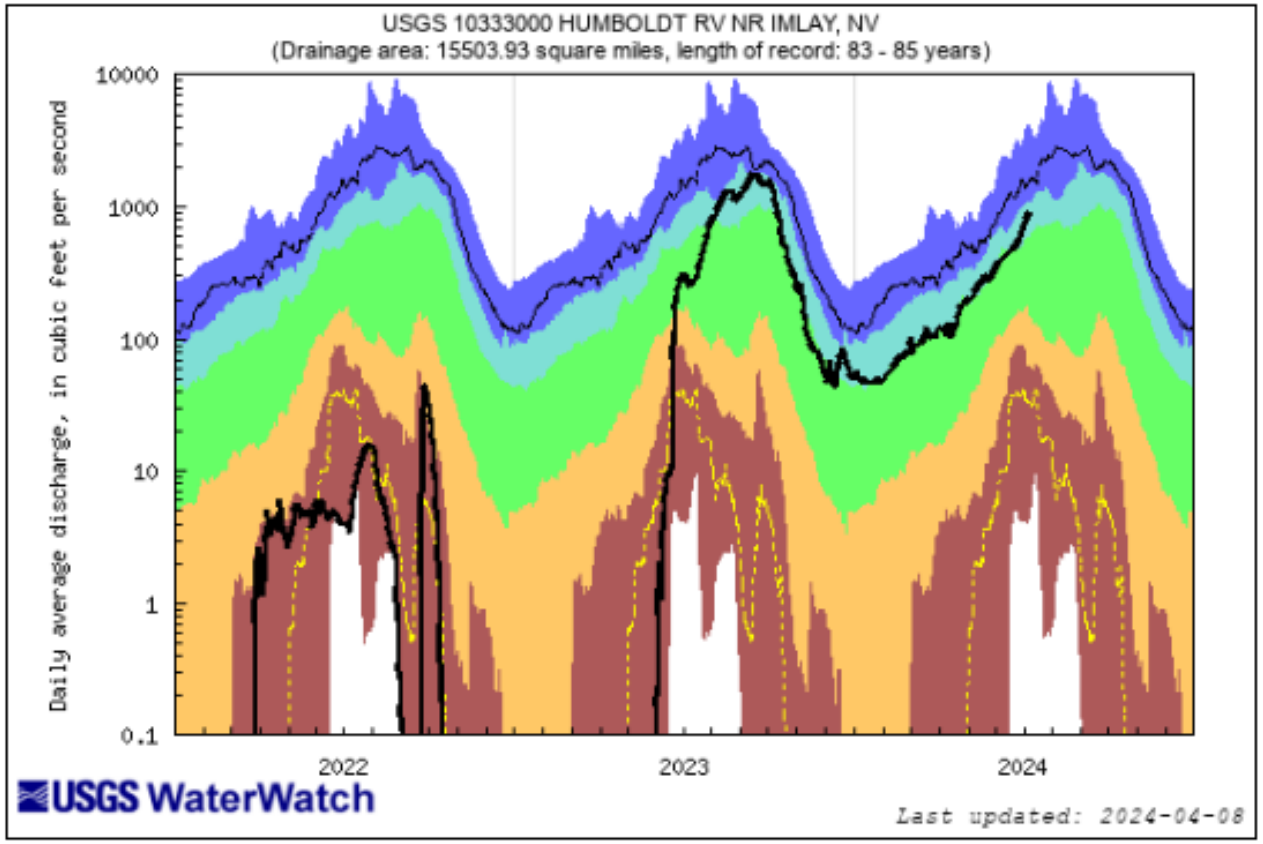
Records

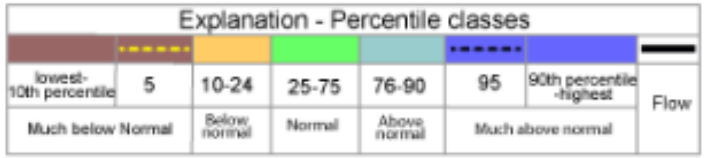
Lamoille Ck
E Walker
W Walker nr Coleville
EF Carson
Carson nr Carson
Carson at Ft Churchill
Galena Creek*
**2017 missing*

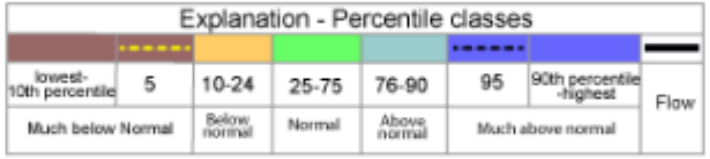


Humboldt transitioned from 2022 (one of the worst years) followed by two strong snowpacks
Streamflow levels well ahead of last year at this time

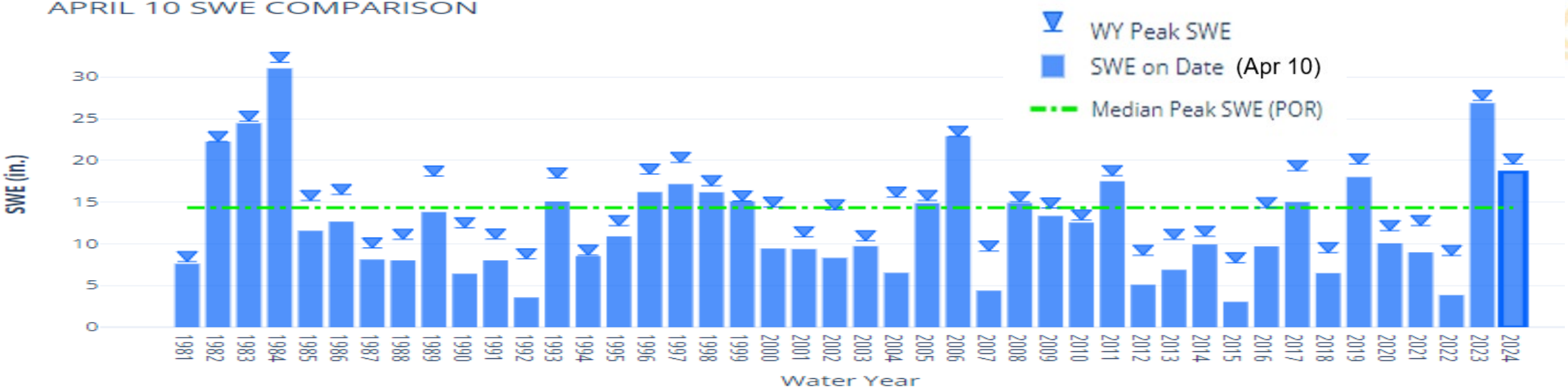






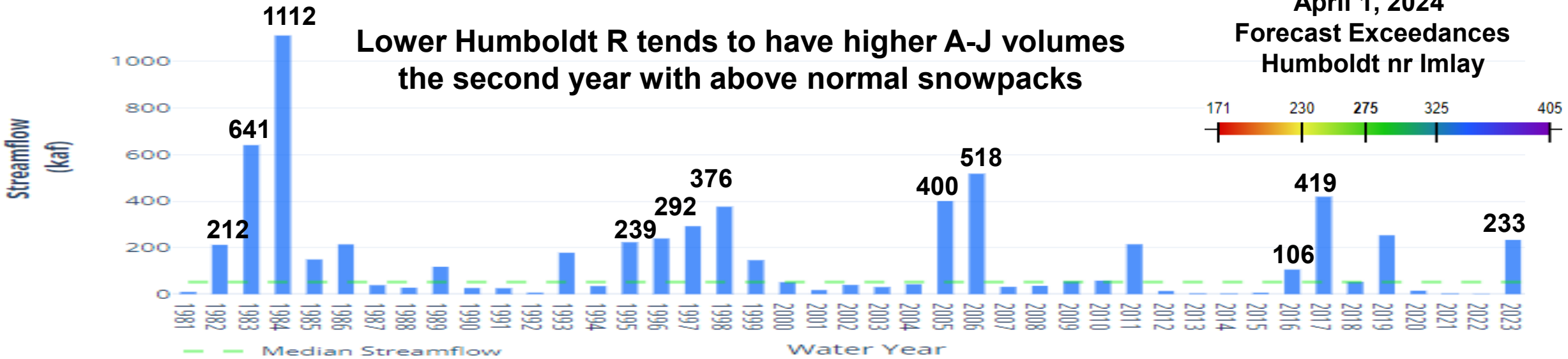


UPPER HUMBOLDT
APRIL 10 SWE COMPARISON

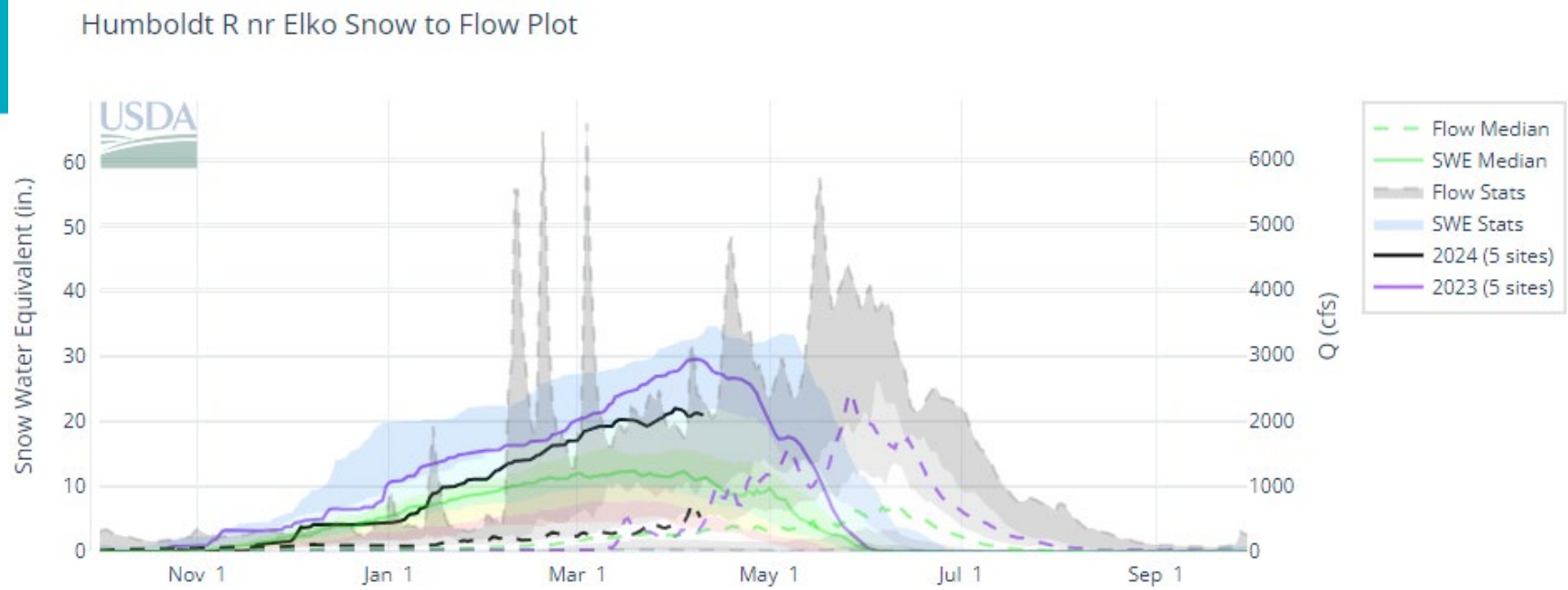


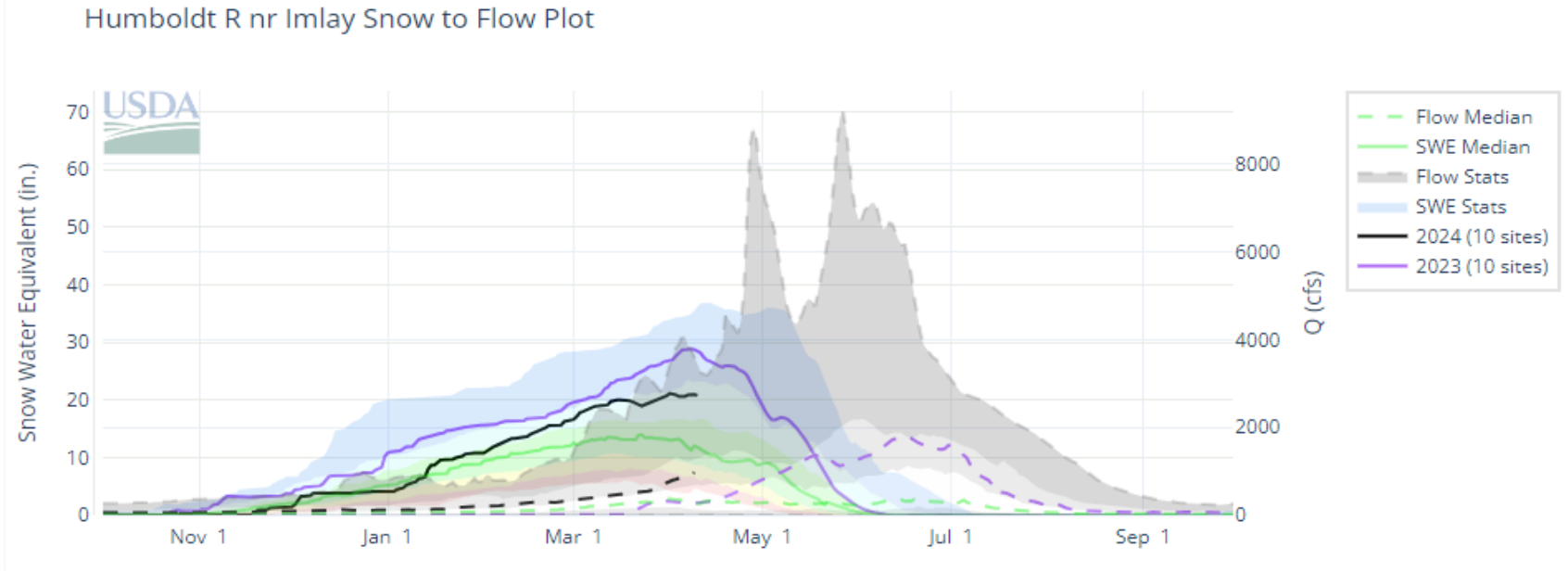
HUMBOLDT R NR IMLAY
APR-JUL SEASONAL STREAMFLOW

Lower Humboldt R tends to have higher A-J volumes the second year with above normal snowpacks



April 1, 2024
Forecast Exceedances
Humboldt nr Imlay





Snow-to-Flow Charts

Humboldt near Elko
4/9/2024 519 cfs
4/9/2023 304 cfs

Humboldt near Imlay
4/9/2024 967cfs
Reached that flow on 5/7 in 2023

https://www.wcc.nrcs.usda.gov/ftpref/support/states/NV/web/streamflow.html

Natural Resources Conservation Service
nrcs.usda.gov/

Summary:

Another strong water year

Back-to-back above normal snowpacks statewide

Slow Start but Strong January – March precipitation

Excellent baseflows coming off last year's amazing snowpack

Current soil moisture will help produce an efficient runoff

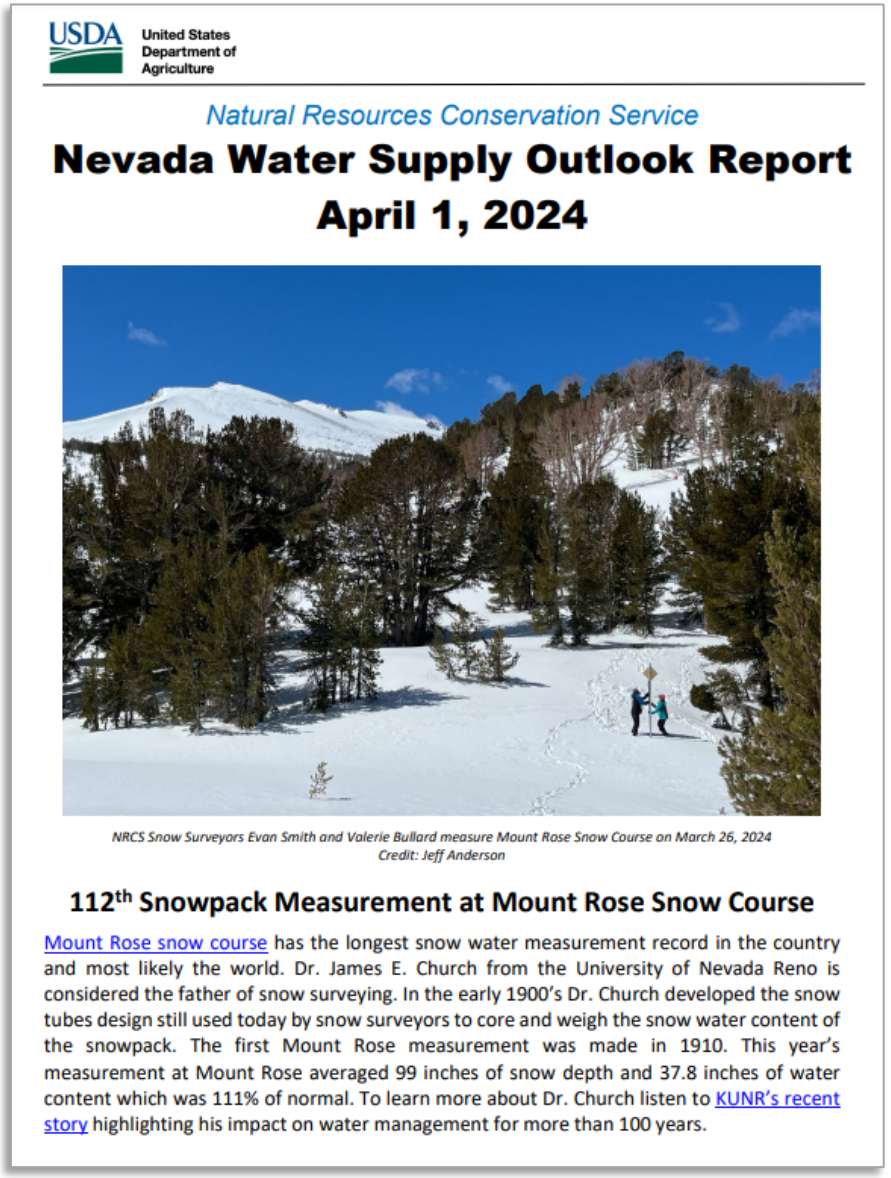
April – July Seasonal Streamflow Forecasts

Eastern Sierra near normal

(ranking in the 50th to 60th Percentile)

*Humboldt Basin well above median **and** average*

(ranking >85th Percentile)



USDA United States Department of Agriculture

Natural Resources Conservation Service

Nevada Water Supply Outlook Report
April 1, 2024

NRCS Snow Surveyors Evan Smith and Valerie Bullard measure Mount Rose Snow Course on March 26, 2024
Credit: Jeff Anderson

112th Snowpack Measurement at Mount Rose Snow Course

Mount Rose snow course has the longest snow water measurement record in the country and most likely the world. Dr. James E. Church from the University of Nevada Reno is considered the father of snow surveying. In the early 1900's Dr. Church developed the snow tubes design still used today by snow surveyors to core and weigh the snow water content of the snowpack. The first Mount Rose measurement was made in 1910. This year's measurement at Mount Rose averaged 99 inches of snow depth and 37.8 inches of water content which was 111% of normal. To learn more about Dr. Church listen to KUNR's recent story highlighting his impact on water management for more than 100 years.

Subscribe to the monthly snow and water outlook report

Website:
https://www.nrcs.usda.gov/nevada/snow-survey

Products Home Page:
https://www.wcc.nrcs.usda.gov/ftpref/support/states/NV/web/index.html

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