2022 Snowpack Status and Streamflow Outlook for the Eastern Sierra & Humboldt Basin

Old meteorburst telemetry

New GOES telemetry

Nevada Division of Water Resources
March 16, 2022

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Hydrologist – NRCS Nevada Snow Survey
Jeff.Anderson@usda.gov

Photo: 3/11/22 Marlette Lake SNOTEL Telemetry Upgrade

www.nrcs.usda.gov/wps/portal/nrcs/main/nv/snow/
NRCS Data Collection

- SNOTEL (85)
- Snow Course/Aerial (45) Marker

Data are Summarized by 12 Major Basin Groups

Snow Survey Overview

Key Vocab: Snow Water Equivalent (SWE)
2021 Fires – Dodging the Flames

NRCS SNOTEL Sites Lake Tahoe Area with fire activity 8/29-30/2021

Final Perimeter

Spratt Ck SNOTEL after rebuild

A big thanks to fire personnel who defended other SNOTEL sites from damage and for hazard tree removal at Spratt Creek.
New for 2022

**Snow Survey - You Tube Video**
An overview of the Snow Program in Nevada including information about the SNOTEL network, streamflow forecasting and services available.
Click Here

**1991-2020 Normals Dashboard**
The NRCS updated its 30-year normals period from 1981-2010 to 1991-2020. Normals are used in a variety of products to represent data as a percent of normal. Changing normals impacts percentages and requires users to recalibrate themselves. The dashboard provides tools to assess impacts in Nevada.
Click Here

**Palisade Tahoe Name Change**
The names of the SNOTEL and snow course located at the ski resort formally known as Squaw Valley have been changed. New names are:
Palisades Tahoe SNOTEL
Palisades Tahoe #2 Snow Course

**New Stream Forecasts for 2022**
- Bruneau River at Rowland
  Snake Basin (new)
- Jarbidge River below Jarbidge
  Snake Basin (new)
- SF Humboldt R ab Tenmile Ck
  Upper Humboldt Basin (new)
  Gage is above Southfork Res
- L Humboldt nr Paradise Valley
  Lower Humboldt Basin
  Adjusted for Chimney Ck Res
Record Breaking

October Precipitation

Sierra SNOTELs ~5-20in
Humboldt Basin
Ruby Mtns ~4-6in
Santa Rosa Mtns ~6-9in
Soil Moisture much better than 2021
Record High & Low Snowpack Accumulation

Snowiest December on record +13-30" SWE in Sierra

Boom & Bust In one year

Least Snowy Jan & Feb on Record
Snow is thin to gone on south/west aspects

Genoa Peak – Tahoe / Carson Basins
9000ft east side of Tahoe 3/13/22

Waterhouse Peak - Carson Basin
9400ft on near Lost Lakes 3/8/22

Sonora Pass Rd - Walker Basin
Below 7800ft 3/8/22

Sunny side of Mt Houghton and Mt Rose
Truckee Basin
9000-10500ft
3/12/22

Photos courtesy Sierra and Bridgeport Avalanche Centers
Jolyne Lea’s comment on March 1, 2022 forecasts...

“Forecast decreases since January 1 are the largest declines I have seen in my career.”

Jolyne has been forecasting Nevada streamflow for the NRCS since 1991.
Forecast skill increases as winter passes.

Spread between 10% and 90% exceedances shrink.

What is correct exceedance level?

#1 What’s future weather – wet or dry?

#2 What other factors are special in 2022

- soil moisture / base flows
- lack of snow on sunny aspects
Eastern Sierra Basin Summary
Water Supply Forecasts
March 1, 2022

Forecast Point

Forecast Period

Percent of Median (1991-2020)

<table>
<thead>
<tr>
<th>Forecast Point</th>
<th>Apr-Jul</th>
<th>Apr-Jul</th>
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<tbody>
<tr>
<td>Lake Tahoe Net Inflow</td>
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<td>L Truckee R at Boca Reservoir</td>
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<td>EF Carson R at Gardnerville</td>
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<td>Carson R at FL Churchill</td>
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<td>E Walker R at Bridgeport</td>
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<td>W Walker R at L Walker R at Coleville</td>
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</tbody>
</table>

61-81% '91-20 median

Humboldt River Summary
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March 1, 2022

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<td>Marys R nr Death</td>
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<td>Lamolite Cr nr Lamolite</td>
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<td>NF Humboldt R at Devil's Gate</td>
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<td>Humboldt R at Eiko</td>
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<td>SF Humboldt R at Circle Cr</td>
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<td>Humboldt R at Carlin</td>
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<td>Humboldt R at Paradise</td>
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<td>Rock Cr nr Battle Mountain</td>
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<td>Humboldt R at Comus</td>
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<td>L Humboldt R nr Paradise Valley</td>
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<tr>
<td>Martin Cr nr Paradise Valley</td>
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38-82% '91-20 median
Lessons from 2020 Runoff
Observed vs Exceedances

Eastern Sierra SWE

2022 2020

Late snow
Observed runoff in normal and wetter exceedances

Humboldt SWE

2020

Little spring snow
observed runoff in drier exceedances

Observed < 50%
Forecast

Observed mostly near 50% exceedance or above

Snow Water Equivalent (in.)

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Snow Water Equivalent (in.)
Reservoir Storage

1991-2020 Normals Summary

New 1991-2020 medians & averages for:
• Snow Course – Monthly Snow-water
• Reservoir Storage – monthly volumes
• Streamflow Volumes – monthly & seasonal (April-July)
• SNOTEL – Daily Snow Water & Precipitation
  -- Annual Stats: snow onset, peak & melt-out

Key Points:
• Sites with ≥10 years of data get official normals
• Streamflow forecasts are re-calibrated with '91-20 data
• Update doesn’t change: SNOTEL data or forecasting methods
• Median is the new default for all NRCS products

Change in Years

<table>
<thead>
<tr>
<th>SNOTEL</th>
<th>Years</th>
<th>Basin</th>
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</thead>
<tbody>
<tr>
<td>Rainbow Cyn</td>
<td>12</td>
<td>Spring Mtns</td>
</tr>
<tr>
<td>Bristlecone Trail</td>
<td>12</td>
<td>Spring Mtns</td>
</tr>
<tr>
<td>Lee Canyon</td>
<td>12</td>
<td>Spring Mtns</td>
</tr>
<tr>
<td>Toe Jam</td>
<td>11</td>
<td>Lower Humboldt</td>
</tr>
<tr>
<td>Wheeler Peak</td>
<td>10</td>
<td>Eastern NV</td>
</tr>
</tbody>
</table>

Newer sites with enough years

Change in Stats

<table>
<thead>
<tr>
<th></th>
<th>1981-2010</th>
<th>1991-2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snow Water</td>
<td>median</td>
<td>median</td>
</tr>
<tr>
<td>Precipitation</td>
<td>average</td>
<td>median</td>
</tr>
<tr>
<td>Streamflow</td>
<td>average</td>
<td>median</td>
</tr>
<tr>
<td>Reservoir</td>
<td>average</td>
<td>median</td>
</tr>
</tbody>
</table>
Why Median?

Hydro-climatic datasets (snow, precip, streamflow) are often non-symmetrical.

For non-symmetric data the median better represents the central tendency since half the values are above and half are below.

The median is less skewed than the average by extremes.

April 1 average is skewed 2.1 inches higher by big years like 2017 and 2019.
1991-2020 Normals - What’s happened since 2010?
Dropping ‘83 and ‘84 has big impact on averages

But not on medians
How has changing years changed medians?

In general, new medians < old medians
less water = more red than black

**Snowpack:** April 1 ‘91-20 medians < ‘81-’10

**Water Year Precip:** Mixed results
New Medians ↑ 1/3 sites ↓ 2/3 sites
Increases more common in Humboldt Basin
Decreases more common in Sierra Basins

**Seasonal Streamflow (April-July):**
Most new / old medians +/−10% of each other
17 gages >10% decrease in median
Humboldt River has significant decrease
What is the impact of a lower normals?

Changing the normal, changes the percent

A smaller normal results in a higher percentage

Using 1981-2010 Apr 1 Median = 37"
\[
\frac{23}{37} = 63\%
\]

1991-2020 Apr 1 Median = 35"
\[
\frac{23}{35} = 67\%
\]
Change in snow percentages old median vs new median?

Snowpack on March 15, 2022

<table>
<thead>
<tr>
<th>Basin</th>
<th>% of 1981-2010 Median</th>
<th>% 1991-2020 Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern NV</td>
<td>62-77%</td>
<td>68-87%</td>
</tr>
<tr>
<td>Upper Humboldt</td>
<td>+5%</td>
<td></td>
</tr>
<tr>
<td>Lower Humboldt</td>
<td>+14%*</td>
<td></td>
</tr>
<tr>
<td>Carson</td>
<td>-2%*</td>
<td></td>
</tr>
<tr>
<td>Walker</td>
<td>+1%</td>
<td></td>
</tr>
<tr>
<td>Tahoe</td>
<td>+1%</td>
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</tr>
</tbody>
</table>

* Differences due to short record for newer sites
  - **Carson**: ‘81-10 included 4 sites with 7-8 years of data
  - **L Humboldt**: ‘91-20 includes Toe Jam with 11 years of data
What is impact of changing from average to median for precipitation?

**Water Year Precipitation**
- Medians << Averages
- due to non-symmetric data

**Graph:**
- Mt Rose Ski Area (652) Nevada SNOTEL Site - 8801 ft
- Differences increases thru WY

**Graph Details:**
- Precipitation (inches)
- Average (1981-2010)
- Average (1991-2020)
- Median (1981-2010)
- Median (1991-2020)
Change in precipitation percentages old average vs new median?

Water Year Precipitation on March 15, 2022

% of 1981-2010 Average  % 1991-2020 Median

Basin % Change

Tahoe +7%
Truckee +8%
Carson +2%
Walker +3%
Upper Humboldt +5%
Lower Humboldt +10%
What is impact of changing from average to median on April-July streamflow?

- Most gages in Western US have new medians within 10% of old average. These datasets may have a more normal distribution in data.

- Great Basin streamflow data are highly non-symmetrical. Extreme years skews averages much higher than medians.

- Humboldt River. '91-20 medians are less than half of '81-10 averages.

- Expect a big impact on percentages.
How much do forecast percentages change from old normal to new normal?

Streamflow Forecasts March 1, 2022 (50% Exceedance)

Percent of Average (1981-2010)

<table>
<thead>
<tr>
<th>Location</th>
<th>Percent</th>
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</thead>
<tbody>
<tr>
<td>Lake Tahoe Net Inflow</td>
<td>60%</td>
</tr>
<tr>
<td>Truckee R at Farad</td>
<td>70%</td>
</tr>
<tr>
<td>EF Carson R nr Gardnerville</td>
<td>67%</td>
</tr>
<tr>
<td>WF Carson R nr Woodbords</td>
<td>65%</td>
</tr>
<tr>
<td>Carson R at Ft. Churchill</td>
<td>47%</td>
</tr>
<tr>
<td>E Walker R nr Bridgeport</td>
<td>50%</td>
</tr>
<tr>
<td>W Walker R nr L Walker R nr Coleville</td>
<td>74%</td>
</tr>
<tr>
<td>Humboldt R nr Elko</td>
<td>26%</td>
</tr>
<tr>
<td>Humboldt R nr Inlay</td>
<td>11%</td>
</tr>
<tr>
<td>Kingston Cr nr Austin</td>
<td>36%</td>
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<tr>
<td>Steptoe Cr nr Ely</td>
<td>45%</td>
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</tbody>
</table>

Percent of Median (1991-2020)

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<td>Lake Tahoe Net Inflow</td>
<td>79%</td>
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<tr>
<td>Truckee R at Farad</td>
<td>80%</td>
</tr>
<tr>
<td>EF Carson R nr Gardnerville</td>
<td>76%</td>
</tr>
<tr>
<td>WF Carson R nr Woodbords</td>
<td>78%</td>
</tr>
<tr>
<td>Carson R at Ft. Churchill</td>
<td>61%</td>
</tr>
<tr>
<td>E Walker R nr Bridgeport</td>
<td>77%</td>
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<tr>
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<td>78%</td>
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<tr>
<td>Humboldt R nr Elko</td>
<td>51%</td>
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<tr>
<td>Humboldt R nr Inlay</td>
<td>38%</td>
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<tr>
<td>Kingston Cr nr Austin</td>
<td>73%</td>
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<tr>
<td>Steptoe Cr nr Ely</td>
<td>81%</td>
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</table>

Difference

<table>
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<tr>
<th>Location</th>
<th>Change</th>
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</thead>
<tbody>
<tr>
<td>Lake Tahoe Net Inflow</td>
<td>+19%</td>
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<tr>
<td>Truckee R at Farad</td>
<td>+10%</td>
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<tr>
<td>EF Carson R nr Gardnerville</td>
<td>+9%</td>
</tr>
<tr>
<td>WF Carson R nr Woodbords</td>
<td>+13%</td>
</tr>
<tr>
<td>Carson R at Ft. Churchill</td>
<td>+14%</td>
</tr>
<tr>
<td>E Walker R nr Bridgeport</td>
<td>+27%</td>
</tr>
<tr>
<td>W Walker R nr L Walker R nr Coleville</td>
<td>+4%</td>
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<tr>
<td>Humboldt R nr Elko</td>
<td>+25%</td>
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<tr>
<td>Humboldt R nr Inlay</td>
<td>+27%</td>
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<td>+37%</td>
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<td>+36%</td>
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In Sierra: most forecast percentages +10% to +20%

In Humboldt & E NV: >25%
Humboldt R nr Imlay - Historical Data Chart

Difference 91-20 median and average less than Between 81-10 median and average

81-10 Average
91-20 Average
81-10 Median
91-20 Median
When volumes are large, % median values >> % average
Example Jan 1, 2022 50% exceedance forecasts

Some forecasts >400% of median vs Same volumes <200% average
The view from Lamolle Canyon #5 snow course on February 23, 2022

This snow course is in the Ruby Mountains near the top of the Lamolle Canyon road. Snow surveys measured 41 inches of snow depth with 14.0 inches of water content which is 60% of median. Averaging together data from all 25 SNOTEL and snow course locations in the Upper Humboldt Basin the March 1 snowpack is 65% of median. Based on SNOTEL data this is the lowest March 1 snowpack since 2012. Overall, it’s the sixth lowest snowpack since 1983 when SNOTEL data began. Snowpack percentages across Nevada have steadily decreased as the state has seen too many blue bird days and not enough storm days since the start of January. Hopefully late season storms will arrive to improve conditions before the snow starts melting.

Photo Credit: Kent Subcliffe


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Snow Program Manager
Jim Komar
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Bonus Slides
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Forecast Exceedance Probabilities

Labels on chart represent volumes of water expressed as percent of average (1991-2020 period).

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<td>Apr-Jul</td>
<td>05%</td>
</tr>
<tr>
<td>Truckee R at Farad</td>
<td>Apr-Jul</td>
<td>68%</td>
</tr>
<tr>
<td>EF Carson R nr Gardnerville</td>
<td>Apr-Jul</td>
<td>67%</td>
</tr>
<tr>
<td>WF Carson R nr Woodfords</td>
<td>Apr-Jul</td>
<td>66%</td>
</tr>
<tr>
<td>Carson R nr Carson City</td>
<td>Apr-Jul</td>
<td>56%</td>
</tr>
<tr>
<td>Carson R at Fl Churchill</td>
<td>Apr-Jul</td>
<td>47%</td>
</tr>
<tr>
<td>E Walker R nr Bridgeport</td>
<td>Apr-Aug</td>
<td>52%</td>
</tr>
<tr>
<td>W Walker R at L Walker R nr Coleville</td>
<td>Apr-Jul</td>
<td>73%</td>
</tr>
</tbody>
</table>

47-73% '91-20 average

<table>
<thead>
<tr>
<th>Forecast Point</th>
<th>Forecast Period</th>
<th>Percent of Median (1991-2020)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake Tahoe Net Inflow</td>
<td>Apr-Jul</td>
<td>79%</td>
</tr>
<tr>
<td>L Truckee R at Boca Reservoir</td>
<td>Apr-Jul</td>
<td>81%</td>
</tr>
<tr>
<td>Truckee R at Farad</td>
<td>Apr-Jul</td>
<td>80%</td>
</tr>
<tr>
<td>EF Carson R nr Gardnerville</td>
<td>Apr-Jul</td>
<td>76%</td>
</tr>
<tr>
<td>WF Carson R nr Woodfords</td>
<td>Apr-Jul</td>
<td>78%</td>
</tr>
<tr>
<td>Carson R nr Carson City</td>
<td>Apr-Jul</td>
<td>75%</td>
</tr>
<tr>
<td>Carson R at Fl Churchill</td>
<td>Apr-Jul</td>
<td>61%</td>
</tr>
<tr>
<td>E Walker R nr Bridgeport</td>
<td>Apr-Aug</td>
<td>77%</td>
</tr>
<tr>
<td>W Walker R at L Walker R nr Coleville</td>
<td>Apr-Jul</td>
<td>78%</td>
</tr>
</tbody>
</table>

61-81% '91-20 median
Humboldt River Summary
Water Supply Forecasts
March 1, 2022

Forecast Exceedance Probabilities

Percent of Average (1991-2020)

Percent of Median (1991-2020)

15-66%
'91-20 average

38-82%
'91-20 median