

# Island Lake Technical Committee

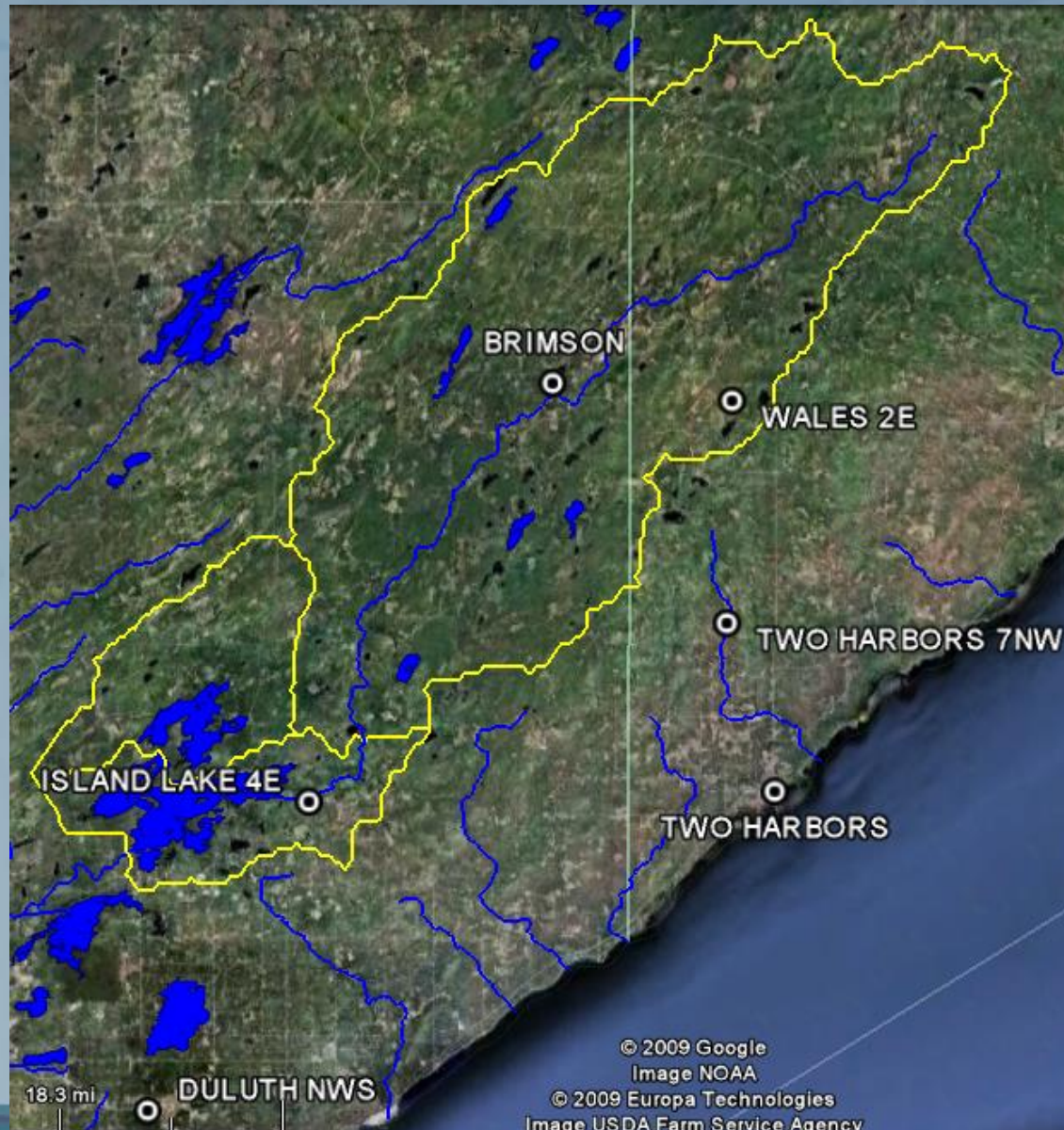
## Spring Refill 2024

*Steve Gohde - Observing Program Leader  
National Weather Service  
WFO Duluth*

*Laura Diamond  
North Central River Forecast Center  
Hydrologic Forecaster*

*April 4<sup>th</sup>, 2024*

# Island Lake Basin



# Bottom Line Up Front

- **Record Low Snow Pack**

- Snow water equivalent (SWE) 1.5 inches which is peak of the season
  - 4.5 inches of SWE at peak season is normal

- **Drought status currently D1 Moderate Drought**

- If trend continues expansion of drought expected

- **Weather Outlooks**

- Below normal precipitation and above normal temperatures

## **River Forecast Model run 3/27/2024**

- **30%** Chance of Refill under normal conditions
- **65%** Chance of Refill under dry condition

# Setting Up Current Conditions

- Heavy rain in September removed severe drought classification
- Two to 3 inches of rain late December melted frost. A large percentage of rainfall runoff moved through the basin
- Late March snow storm brought 1-2 inches of SWE
- **Drought conditions**
  - Moderate drought (D1) classification in the basin
- **Currently observing second lowest snow fall season**
  - 1.5 inches of SWE average across the basin
- **Frost depth as of 4/4/2024 was 15 inches and decreasing**

# 2024 Water Year Precipitation

Starting Oct 2023

- Precipitation near normal
- Historically low snowfall
- Current snow water equivalent is 20-30% of normal
  - Many years of record show zero snow depth by April 1<sup>st</sup>
- Drought could rapidly intensify if we see below normal precipitation

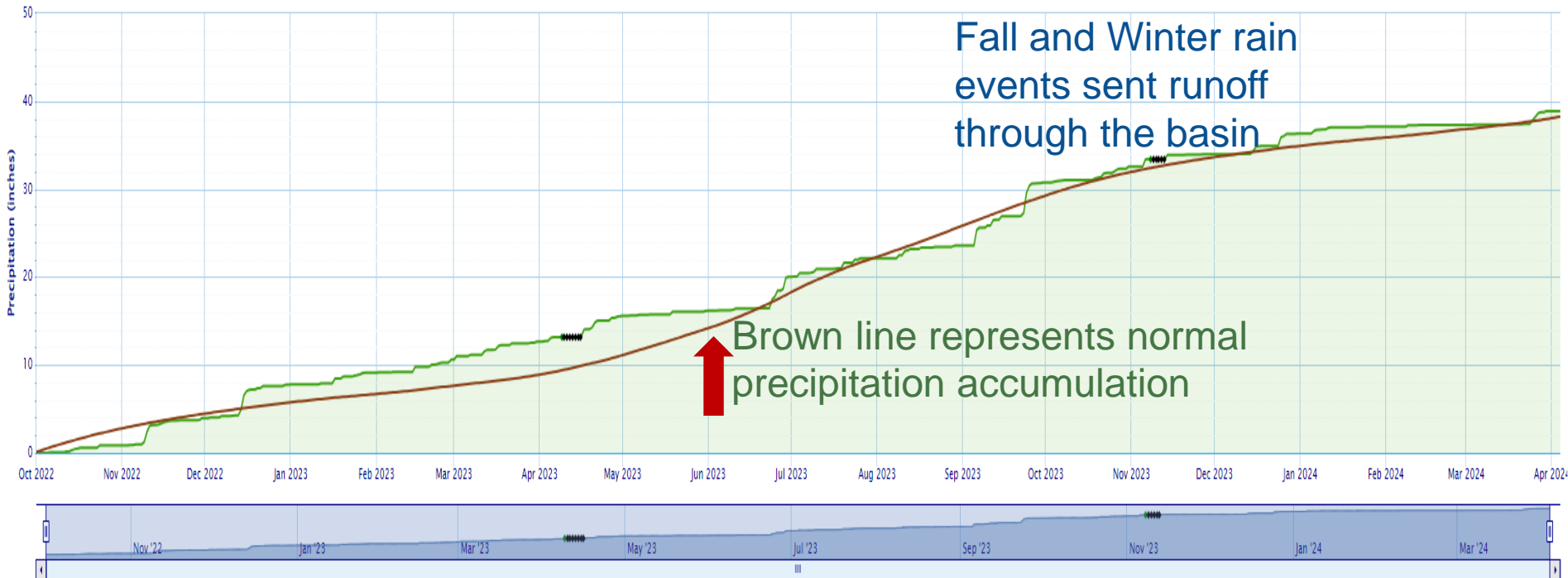
# Two Year Precipitation View Oct 2023-Apr 2024

Accumulated Precipitation - BRIMSON 2S, MN

Use navigation tools above and below chart to change displayed range; green/black diamonds represent subsequent/missing values

Zoom 1m 3m 6m YTD 1y All

From 2022-10-01 To 2024-04-04



Powered by ACIS

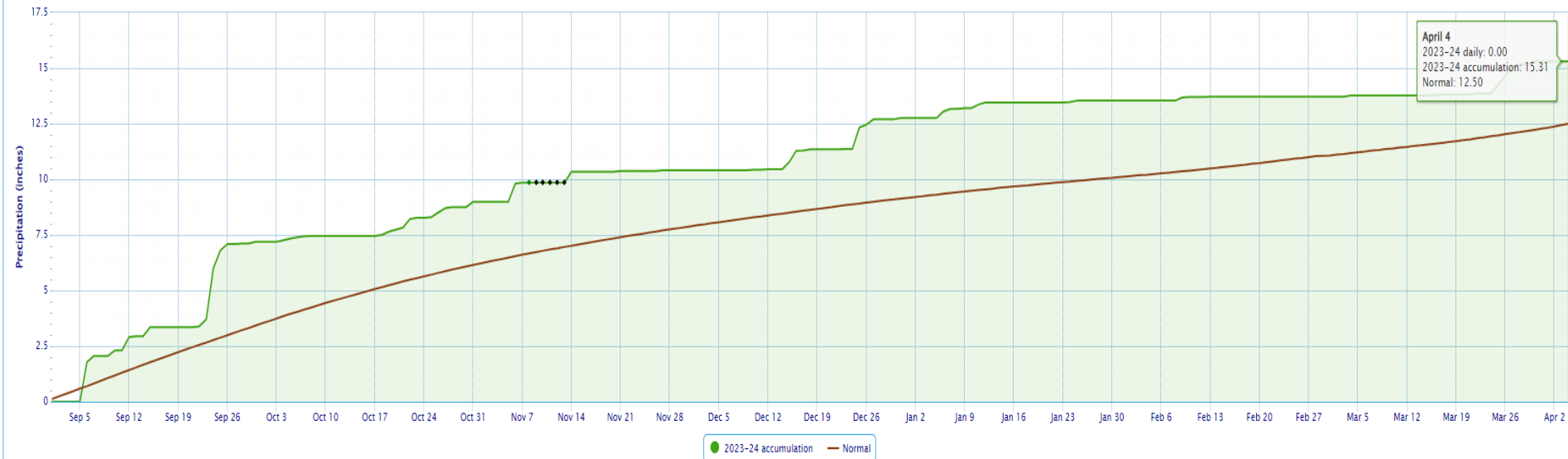
- Normal water year due to strong fall and winter rains

# Brimson Precipitation

Departure 9/1/2023-4/4/2024

Accumulated Precipitation - BRIMSON 2S, MN

Click and drag to zoom to a shorter time interval; green/black diamonds represent subsequent/missing values



Powered by ACIS

Click to Plot/Remove Years of Interest

(number of missing days in parentheses)

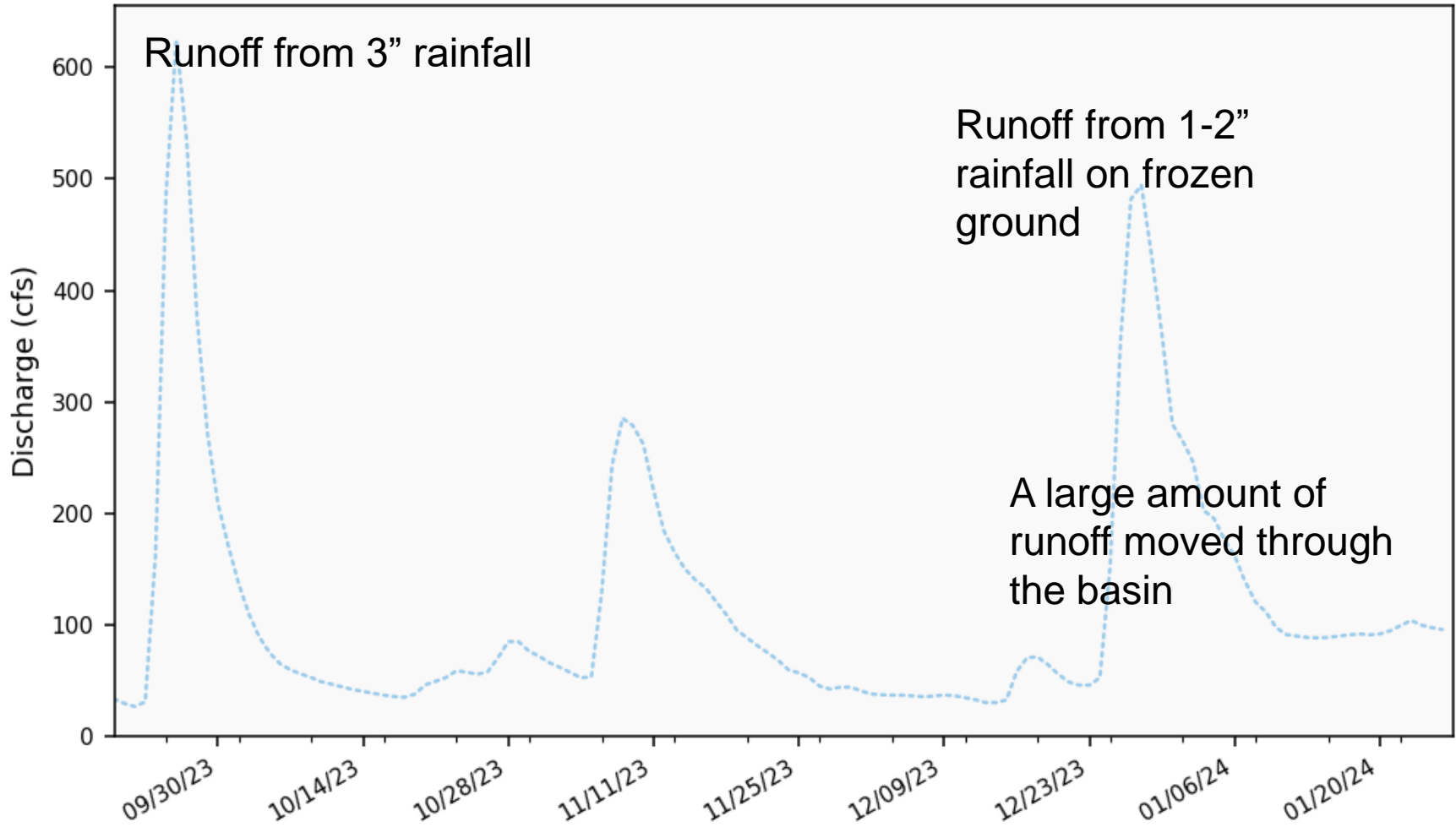
Resort table by year

1947-48: - (217)	1967-68: 7.44	2012-13: 8.72	2009-10: 9.87 (2)	1986-87: 11.68	1997-98: 12.44	1995-96: 13.49	1974-75: 14.93	1996-97: 17.32 (1)
1965-66: - (216)	1948-49: 7.48 (1)	1959-60: 8.81 (1)	1989-90: 9.88	1964-65: 11.72 (15)	2013-14: 12.71	2017-18: 13.55	2016-17: 14.93	2019-20: 17.87
1979-80: - (217)	1980-81: 7.53 (31)	1953-54: 8.86 (4)	1992-93: 9.88	1981-82: 11.87 (3)	2010-11: 12.80	1951-52: 13.89 (3)	2023-24: 15.31	1977-78: 17.90 (6)
1978-79: 3.08 (186)	1950-51: 7.99 (30)	1960-61: 8.89 (2)	2006-07: 9.92	1990-91: 12.00	1972-73: 12.85 (4)	1975-76: 14.04	2022-23: 15.48	2015-16: 20.95
1952-53: 5.55 (1)	2002-03: 8.07	1956-57: 9.25	1961-62: 10.14 (28)	2004-05: 12.01 (30)	1988-89: 12.87 (2)	1999-00: 14.19	2018-19: 15.59	1970-71: 21.65
1976-77: 6.63	2014-15: 8.15	1958-59: 9.43	2020-21: 10.16	2000-01: 12.09	1949-50: 12.90 (1)	2007-08: 14.47	1971-72: 16.21	
2011-12: 6.69	1993-94: 8.19 (1)	2001-02: 9.55	1994-95: 10.23	1955-56: 12.36 (1)	1983-84: 12.92 (1)	1982-83: 14.56	1991-92: 16.26	
1962-63: 6.89 (4)	1957-58: 8.30	1987-88: 9.59 (1)	1973-74: 10.43 (30)	1969-70: 12.39	2005-06: 12.97	2008-09: 14.80	1998-99: 17.06	
1963-64: 7.40	1966-67: 8.50	1954-55: 9.83	2003-04: 11.08	1984-85: 12.41	1985-86: 13.40 (15)	2021-22: 14.80	1968-69: 17.09	

- September and December rains improved soil conditions
- Late March snowfall resulted in 1.5 inches of SWE

# River Responses to Rainfall/Snowmelt

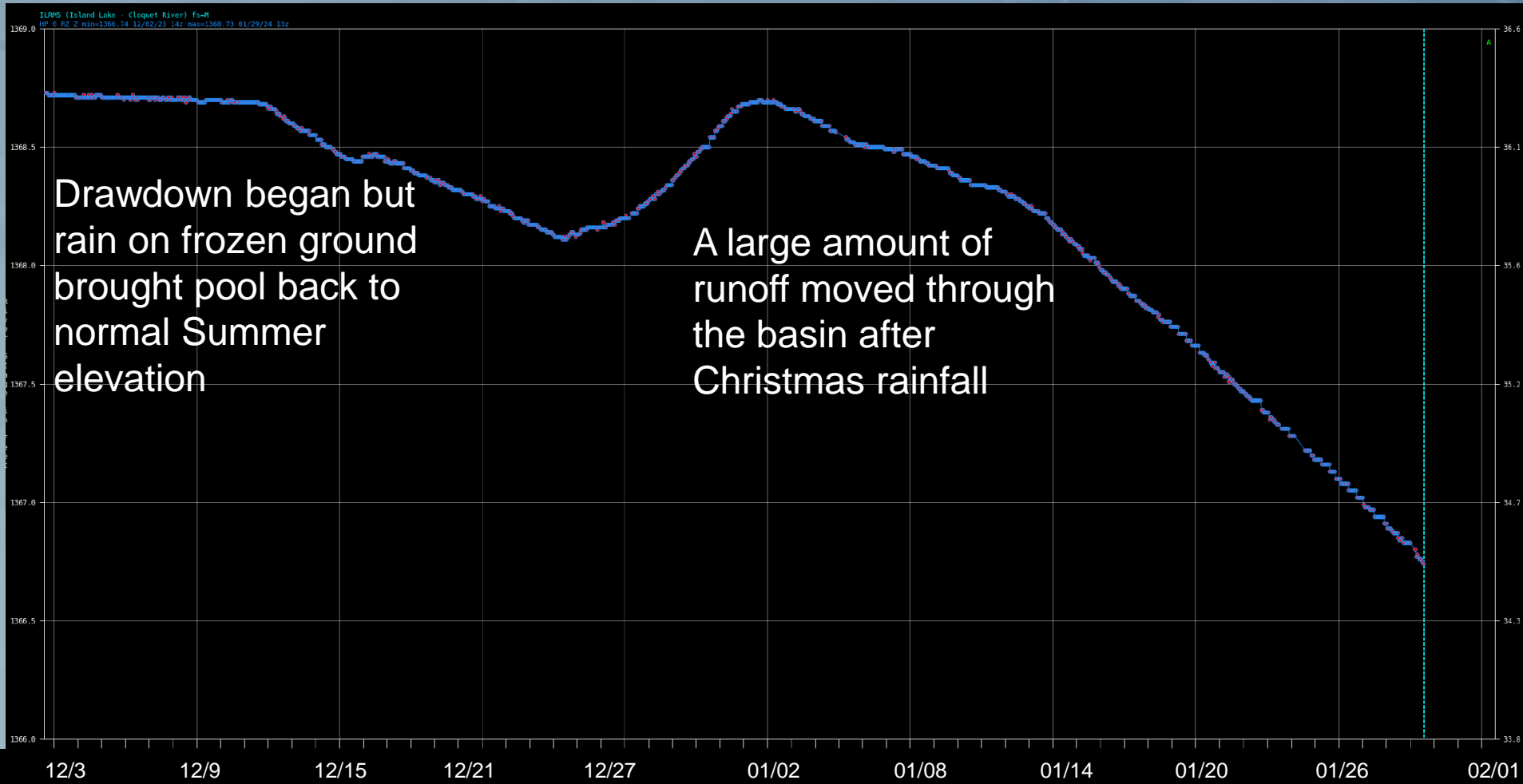
Cloquet River nr Brimson, CSAH44 (04012001)  
2023-9-20 to 2024-1-26



- Rainfall runoff from fall and winter rainfall



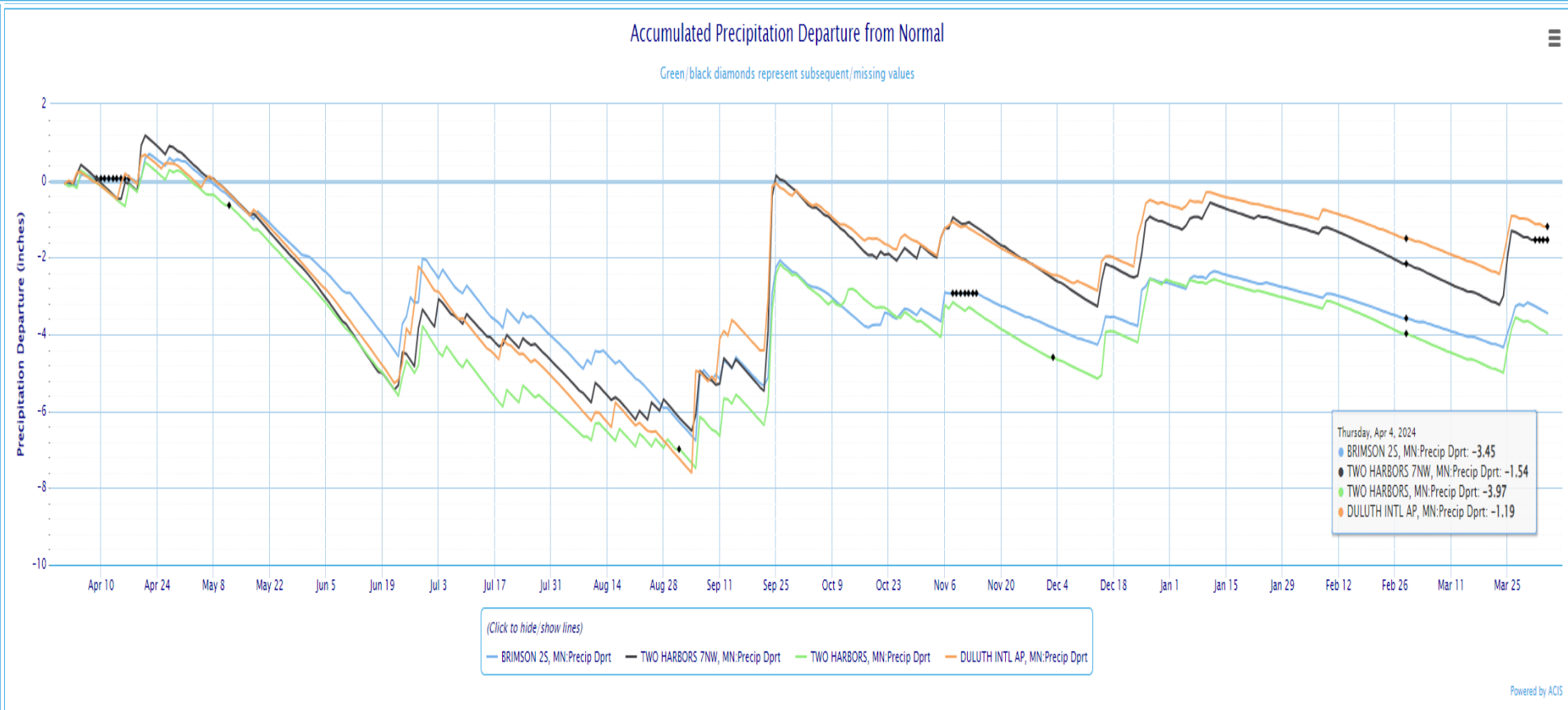
# Reservoir Response to Rainfall/Snowmelt



- This chart shows Island Lake elevation

# Precipitation Departure

4/1/2023 - 4/04/2024

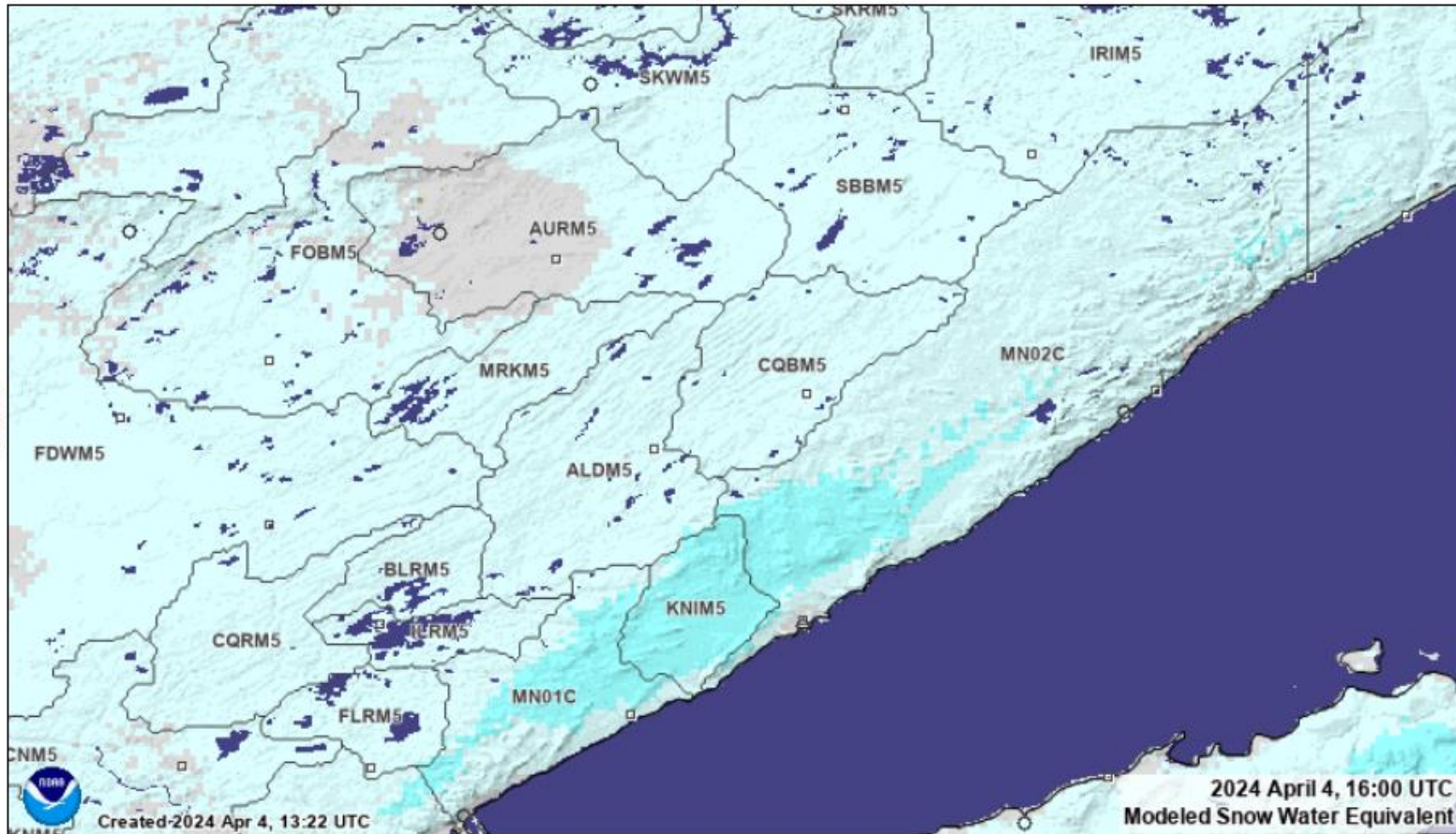


- Precipitation departure since April 1<sup>st</sup> is generally 1.5 to 4.0 inches below normal for several stations near or in the Cloquet River Basin

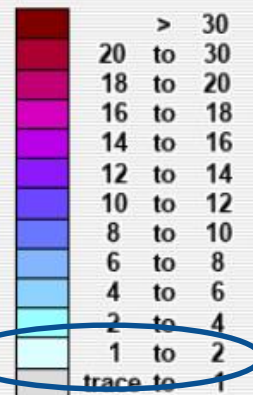
# Modeled Snow Water Equivalent

Modeled Snow Water Equivalent forecasted for 2024 April 4, 16:00 UTC

86.9 mi

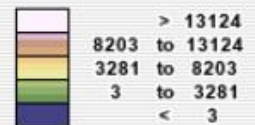


Inches of water equivalent



Not Estimated

Elevation in feet

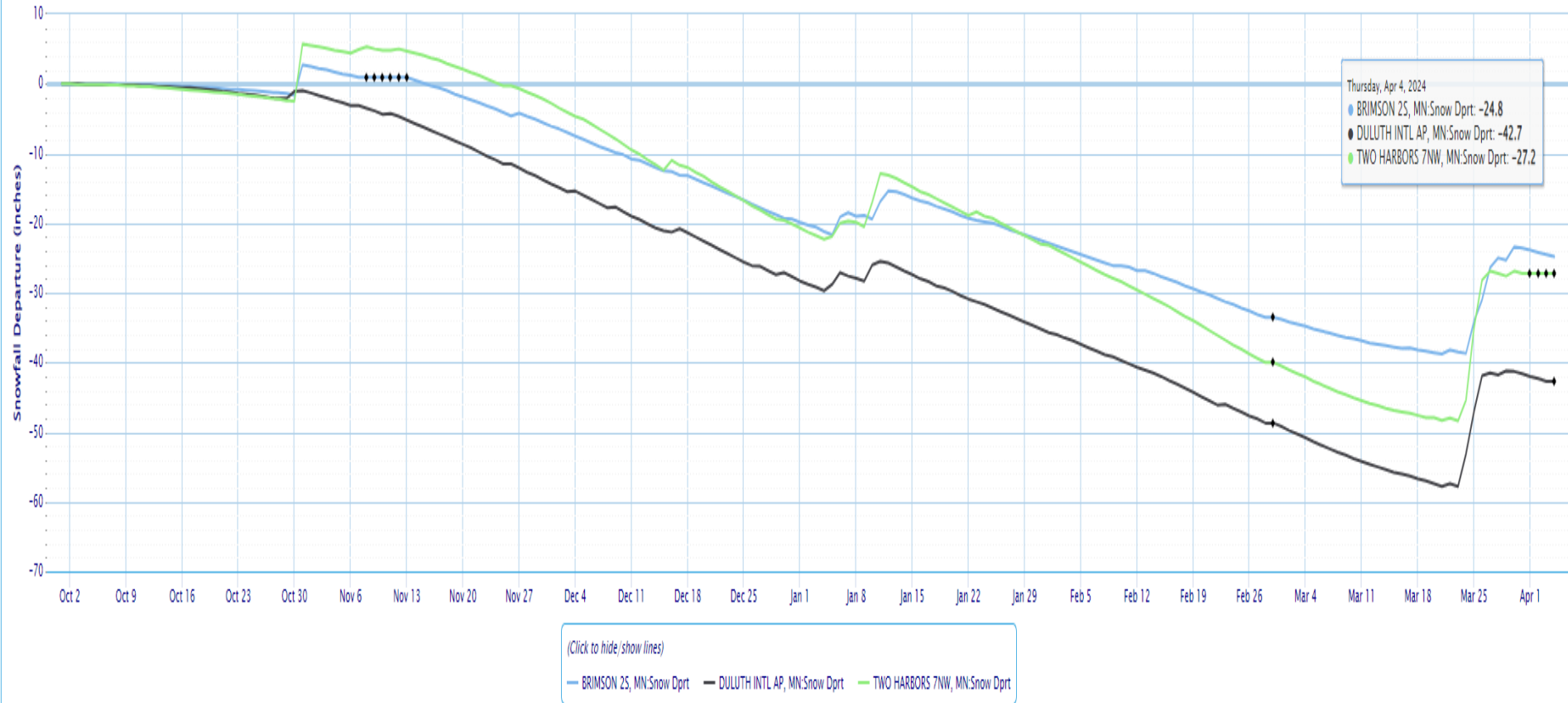


# Snowfall Deficit

10/1/2023 - 4/4/2024

Accumulated Snowfall Departure from Normal

Green/black diamonds represent subsequent/missing values



Powered by ACIS

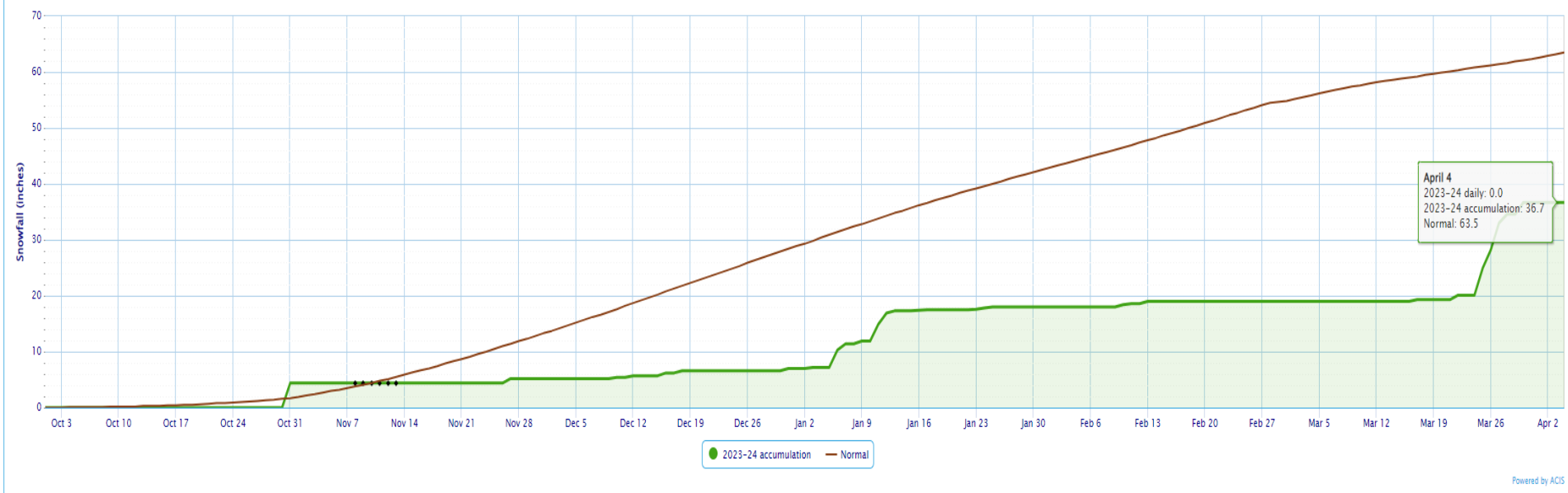
- Stations in and near the Cloquet Basin reporting 25-45” Snowfall deficits this season

# Snowfall Deficit Brimson

10/1/2023 - 4/4/2024

Accumulated Snowfall – BRIMSON 25, MN

Click and drag to zoom to a shorter time interval; green/black diamonds represent subsequent/missing values



Powered by ACIS

Click to Plot/Remove Years of Interest

(number of missing days in parentheses)

Resort table by year

1947-48: - (187)	1958-59: - (186)	1979-80: - (187)	1971-72: 0.0 (141)	1983-84: 0.0 (103)	1989-90: 40.6 (8)	2006-07: 56.8	2008-09: 67.2 (1)	2013-14: 85.1
1950-51: - (186)	1959-60: - (187)	1980-81: - (186)	1972-73: 0.0 (155)	1984-85: 0.0 (153)	1994-95: 42.9 (3)	2012-13: 57.4	2015-16: 67.6 (1)	2021-22: 85.3
1951-52: - (187)	1960-61: - (186)	1948-49: 0.0 (155)	1973-74: 0.0 (155)	1985-86: 0.0 (120)	2002-03: 44.4	2016-17: 57.5	2019-20: 71.3	1996-97: 89.8 (2)
1952-53: - (186)	1961-62: - (186)	1949-50: 0.0 (155)	1974-75: 0.0 (151)	1999-00: 28.7	2007-08: 48.3	2001-02: 58.9 (1)	2004-05: 72.7 (30)	2022-23: 105.5
1953-54: - (186)	1962-63: - (186)	1963-64: 0.0 (156)	1975-76: 0.0 (156)	2014-15: 35.8 (2)	1990-91: 51.0	2017-18: 59.1	2018-19: 81.8	1995-96: 106.3 (3)
1954-55: - (186)	1965-66: - (186)	1964-65: 0.0 (185)	1976-77: 0.0 (182)	2023-24: 36.7 (6)	2011-12: 52.9	2005-06: 59.3	1988-89: 82.6 (21)	
1955-56: - (187)	1966-67: - (186)	1968-69: 0.0 (155)	1977-78: 0.0 (155)	1997-98: 38.8	2020-21: 53.1	2000-01: 64.0	1991-92: 83.6 (1)	
1956-57: - (186)	1967-68: - (187)	1969-70: 0.0 (155)	1981-82: 0.0 (159)	1987-88: 39.0 (3)	2009-10: 53.4	1992-93: 66.4	2003-04: 83.7	
1957-58: - (186)	1978-79: - (186)	1970-71: 0.0 (152)	1982-83: 0.0 (155)	1986-87: 39.5 (1)	1998-99: 54.0 (1)	2010-11: 66.8 (1)	1993-94: 83.8	

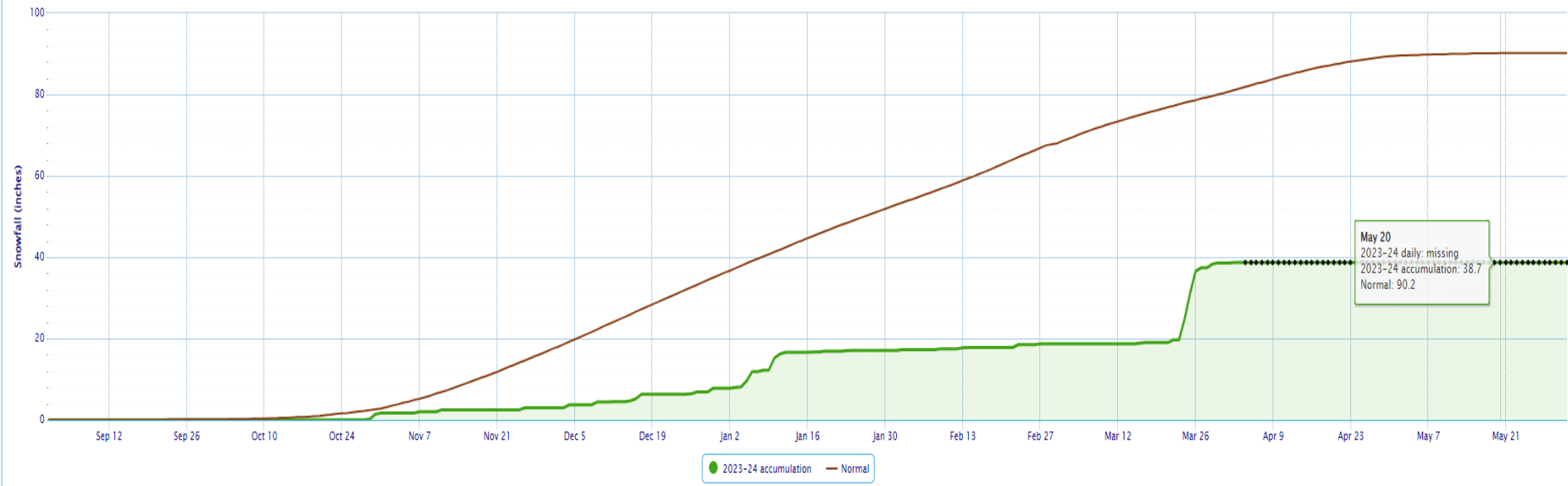
● Third Lowest ranked snowfall at Brimson

# Snowfall Deficit

## 4/4/2024

Accumulated Snowfall - DULUTH INTL AP, MN

Click and drag to zoom to a shorter time interval; green/black diamonds represent subsequent/missing values



Powered by ACIS

Click to Plot/Remove Years of Interest

(number of missing days in parentheses)

Resort table by year

1980-81: 36.5	2011-12: 49.1	1961-62: 63.3	1951-52: 72.0	1956-57: 80.8	1998-99: 90.2	1969-70: 94.9	1983-84: 107.3	2012-13: 129.4
2023-24: 38.7 (59)	2014-15: 49.2	1990-91: 63.8	1973-74: 73.3	2015-16: 81.4	1954-55: 91.0	1981-82: 95.7	1950-51: 109.1	2013-14: 131.0
1967-68: 39.3	1987-88: 53.8	2009-10: 65.8	2008-09: 73.6	1953-54: 83.6	1994-95: 91.2	1982-83: 96.5	2003-04: 109.9	1949-50: 131.8
1976-77: 40.6	1963-64: 54.2 (1)	2016-17: 67.0	2020-21: 76.4	2001-02: 86.0	2004-05: 91.5	2000-01: 99.3	1993-94: 110.4	1995-96: 135.4 (1)
1986-87: 40.6	1979-80: 55.1	1984-85: 68.2	1948-49: 79.5	1978-79: 88.7	2017-18: 91.9	1991-92: 100.0	1964-65: 110.9	2022-23: 140.1
1958-59: 44.5	1999-00: 55.5	1952-53: 68.3	2007-08: 80.0	2005-06: 89.2	2019-20: 92.2	1974-75: 100.4	1970-71: 116.9	
1972-73: 45.8	2002-03: 56.3	1960-61: 68.4	1997-98: 80.1	1985-86: 89.3	2010-11: 93.4	1955-56: 103.5	1988-89: 119.1	
1957-58: 48.4	1989-90: 58.3	1959-60: 69.3	1966-67: 80.3	1975-76: 89.4	2021-22: 93.4	2018-19: 106.8	1968-69: 121.0	
1962-63: 48.6	1947-48: 60.4 (122)	1977-78: 69.7	2006-07: 80.7	1965-66: 90.0	1992-93: 94.2	1971-72: 107.1	1996-97: 128.2 (57)	

- Second lowest ranked snowfall at Duluth

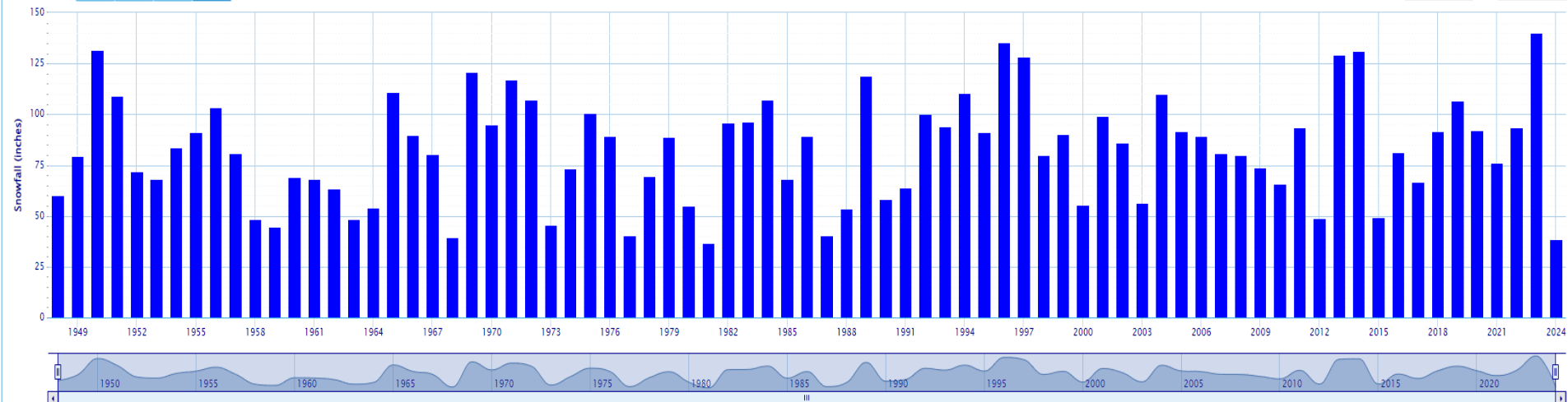
# Snowfall Ranking at Duluth

Total Snowfall Jul 1 to Jun 30 - DULUTH INTL AP, MN

Use navigation tools above and below chart to change displayed range

Zoom 1 yr 10 yrs 30 yrs All

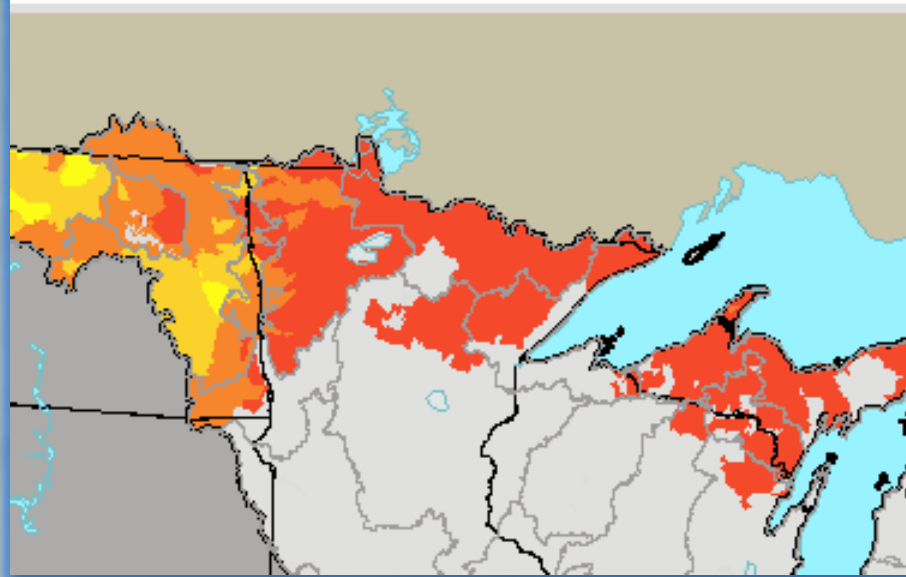
From 1948 To 2024



Rank	Ending Date	Total Snowfall Jul 1 to Jun 30
1	1981-06-30	36.5
2	2024-06-30	38.7
3	1968-06-30	39.3
4	1987-06-30	40.6
-	1977-06-30	40.6
6	1959-06-30	44.5
7	1973-06-30	45.8
8	1958-06-30	48.4
9	1963-06-30	48.6
10	2012-06-30	49.1

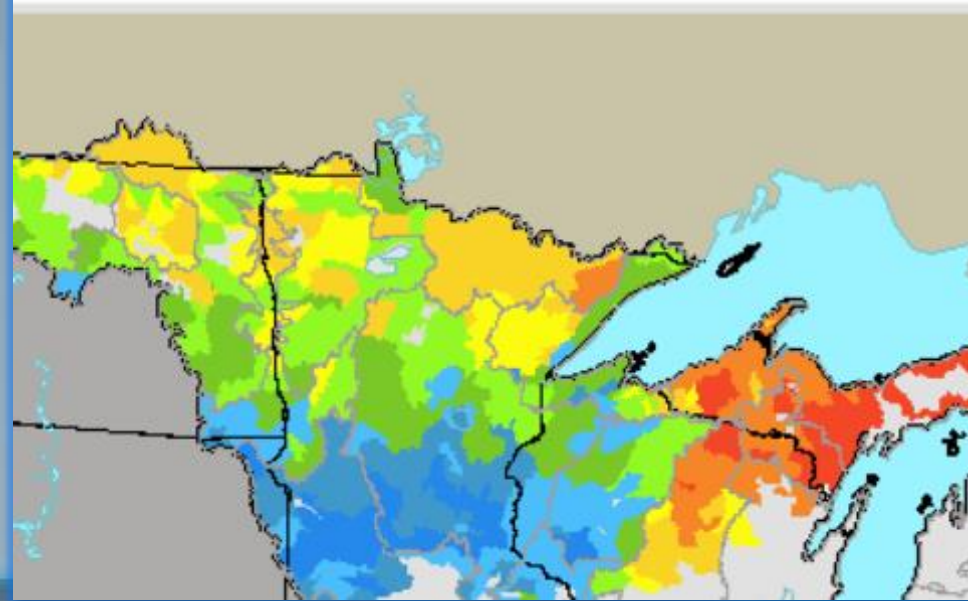
- Snowfall total compared to seasonal total

North Central River Forecast Center  
Ranked Simulated Snow Water Equivalent  
Valid for 03/04/2024 12 GMT



- Record low snow pack for most of the season.  
Late March snow storm increased SWE rank to 30-40% for April 1<sup>st</sup>.

North Central River Forecast Center  
Ranked Simulated Snow Water Equivalent  
Valid for 04/01/2024 12 GMT





# Most Recent Drought Monitor

## U.S. Drought Monitor Duluth, MN WFO

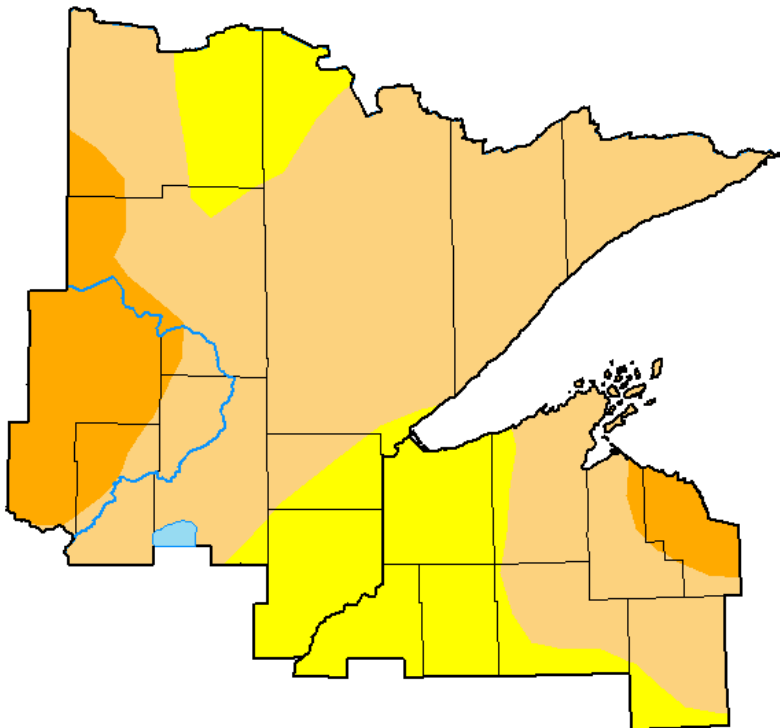
**April 2, 2024**

*(Released Thursday, Apr. 4, 2024)*

Valid 8 a.m. EDT

*Drought Conditions (Percent Area)*

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
<b>Current</b>	0.00	100.00	75.24	13.54	0.00	0.00
<b>Last Week</b> <i>03-26-2024</i>	0.00	100.00	75.24	13.54	0.00	0.00
<b>3 Months Ago</b> <i>01-02-2024</i>	0.00	100.00	49.28	18.52	0.00	0.00
<b>Start of Calendar Year</b> <i>01-02-2024</i>	0.00	100.00	49.28	18.52	0.00	0.00
<b>Start of Water Year</b> <i>09-26-2023</i>	0.00	100.00	78.51	46.15	4.13	0.00
<b>One Year Ago</b> <i>04-04-2023</i>	95.46	4.54	0.00	0.00	0.00	0.00



*Intensity:*



*The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. For more information on the Drought Monitor, go to <https://droughtmonitor.unl.edu/About.aspx>*

*Author:*

Brad Pugh  
CPC/NOAA



[droughtmonitor.unl.edu](https://droughtmonitor.unl.edu)

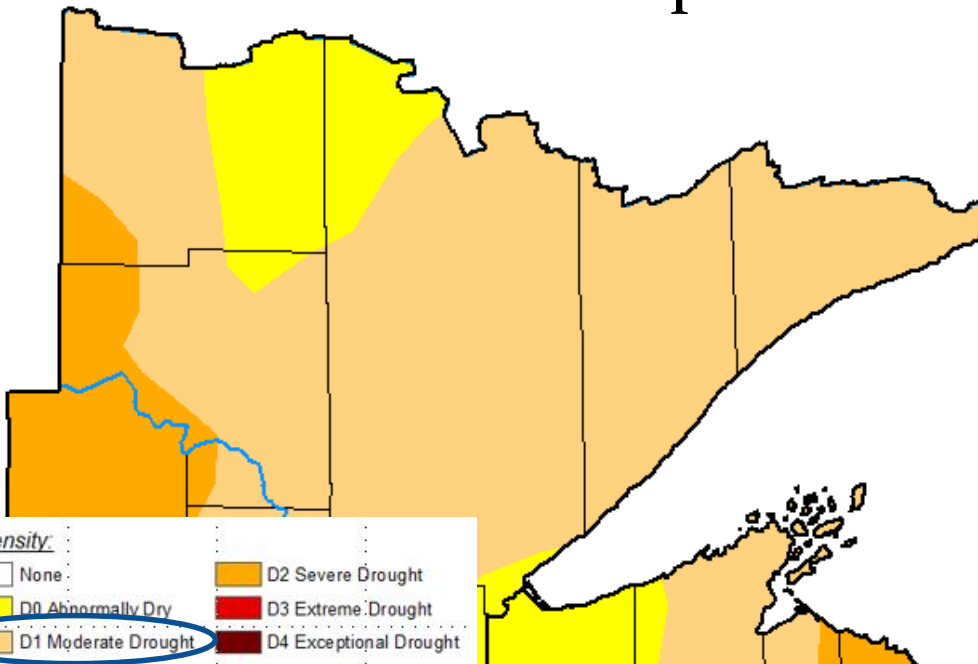
- D1 Moderate Drought in Cloquet River Basin

- [Click for Link to NWS Duluth Drought Discussion](#)

# Drought Conditions Expanding

## U.S. Drought Monitor Duluth, MN WFO

- D1 Moderate drought conditions present




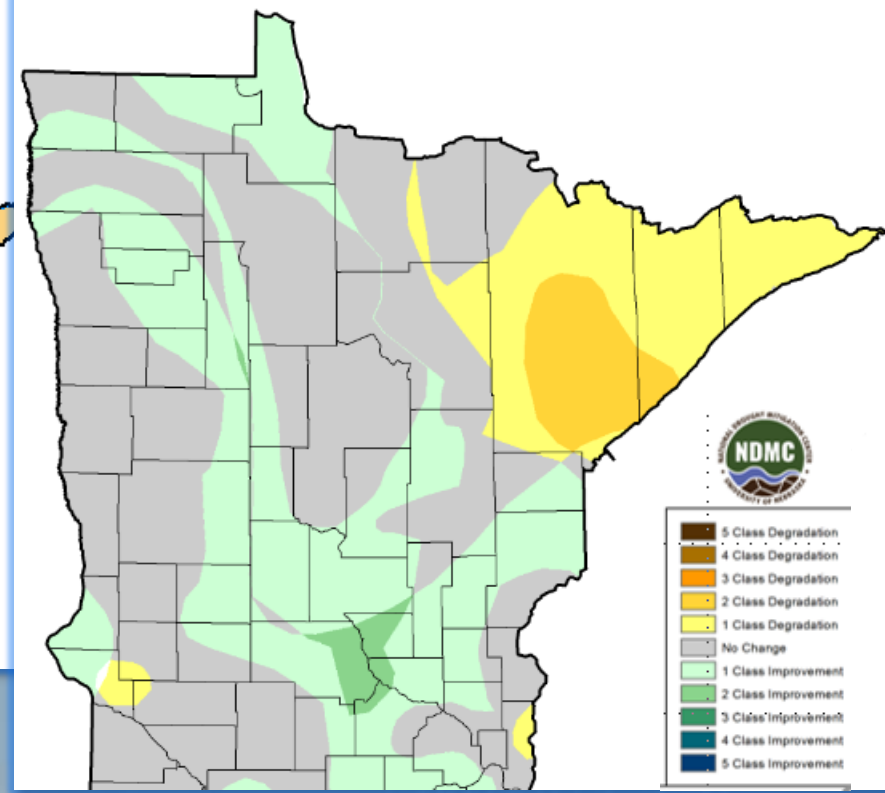
**Intensity:**

None	D2 Severe Drought
D0 Abnormally Dry	D3 Extreme Drought
<b>D1 Moderate Drought</b>	D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. For more information on the Drought Monitor, go to <https://droughtmonitor.unl.edu/About.aspx>

**Author:**  
Curtis Riganti  
National Drought Mitigation Center

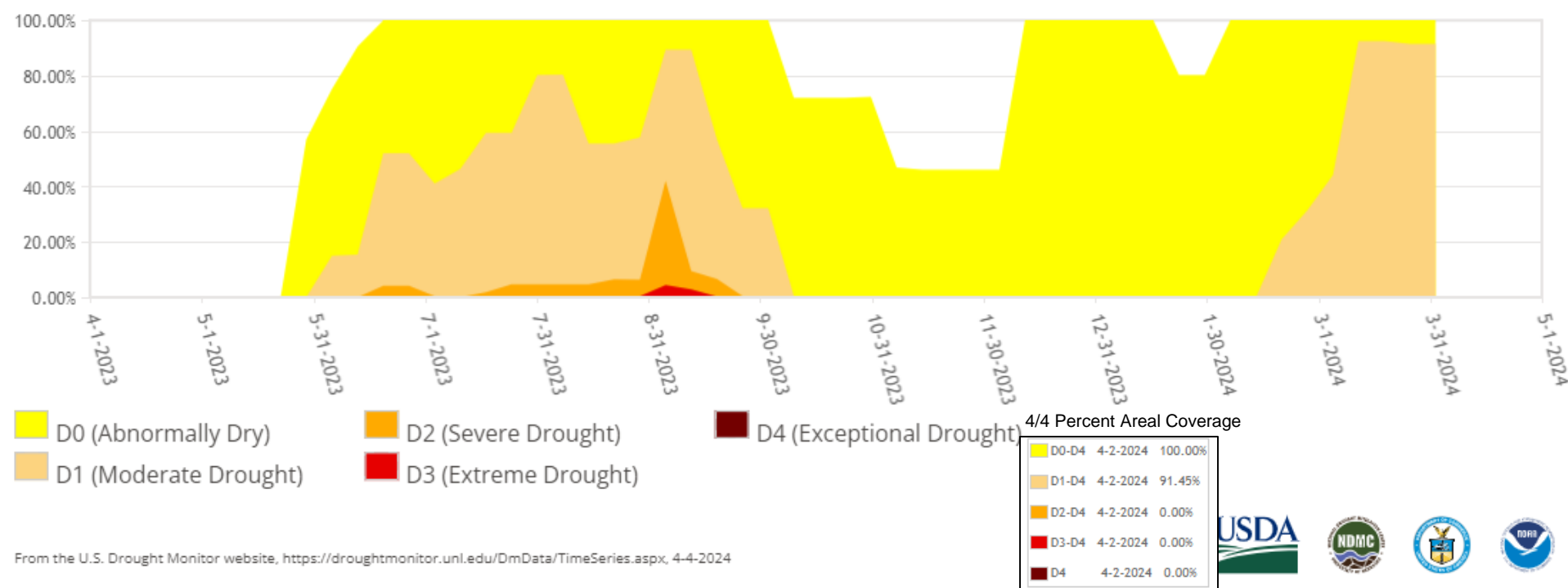
## U.S. Drought Monitor Class Change - Minnesota 24 Week



5 Class Degradation
4 Class Degradation
3 Class Degradation
2 Class Degradation
1 Class Degradation
No Change
1 Class Improvement
2 Class Improvement
3 Class Improvement
4 Class Improvement
5 Class Improvement

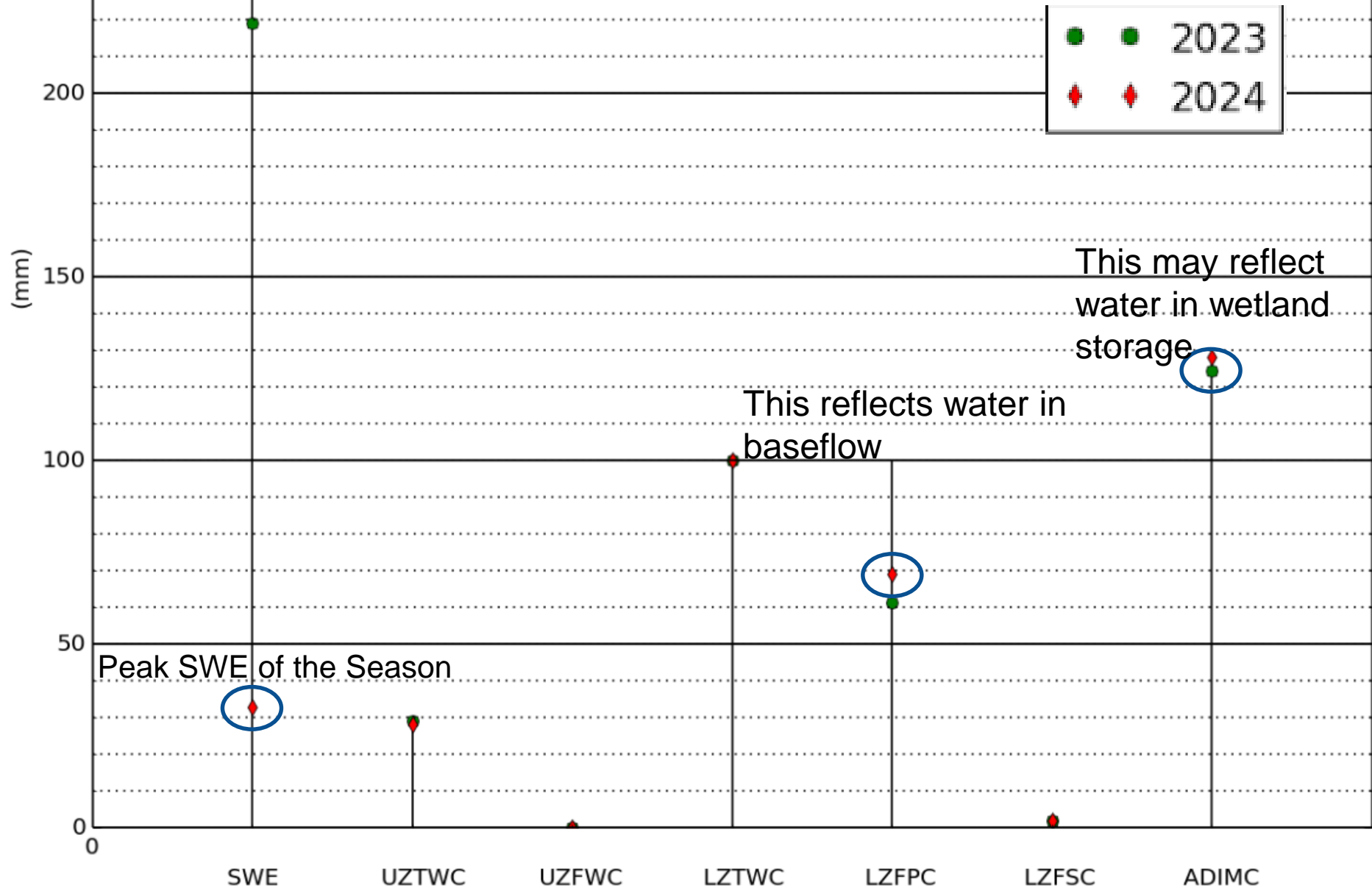
# Drought Historical Context

Northeast, MN (2103) Climate Division Percent Area in U.S. Drought Monitor Categories



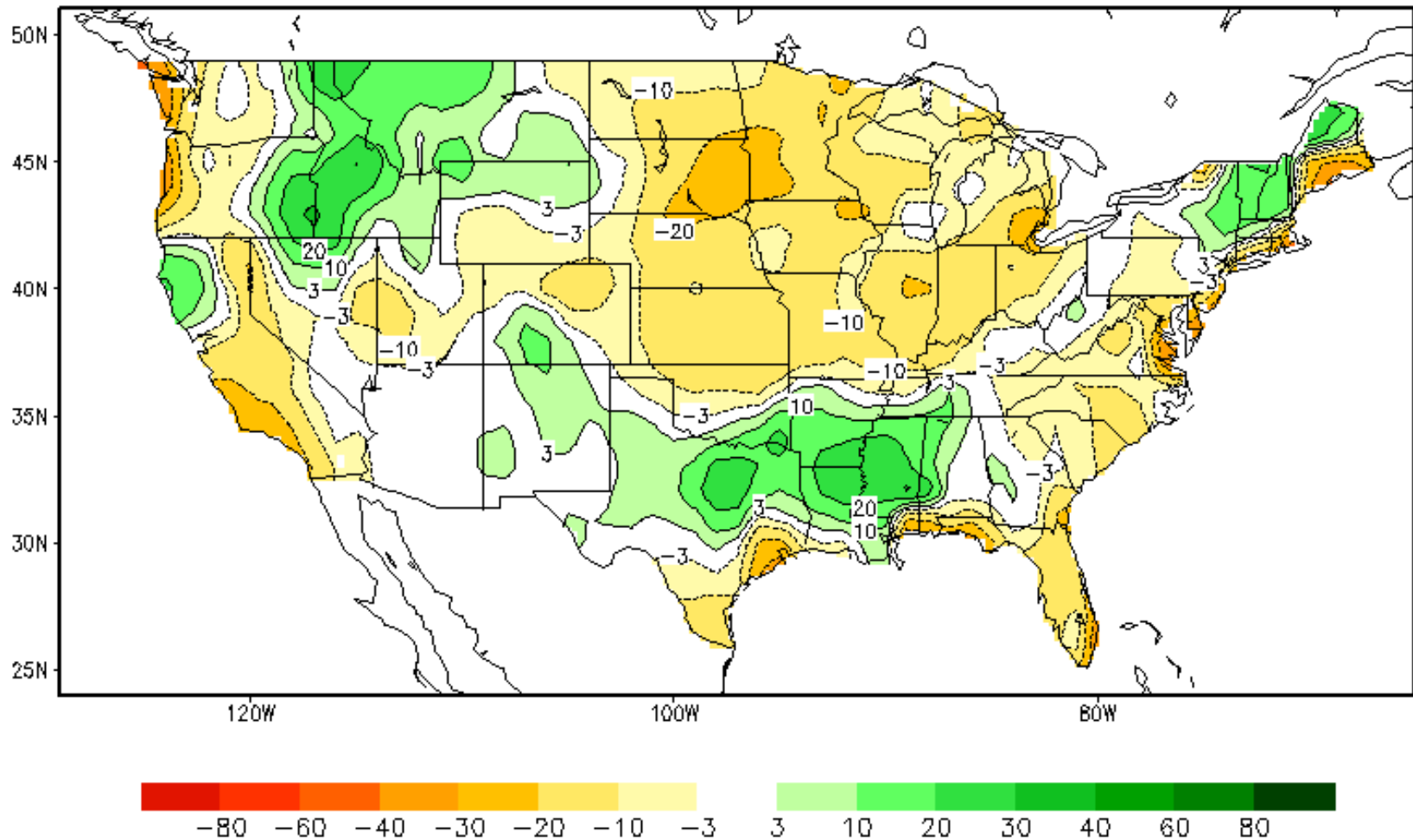
- Increasing drought condition
- Drought condition expanding in NE Minnesota

# Soil Moisture - Modeled



# Soil Moisture Predicted Change

Predicted Soil Moisture Anomaly Change (mm)  
(04Apr2024–18Apr2024)



# Weather Outlook

- Near-term

- Mixed precipitation 4/7 thru 4/9

- Expecting less than  $\frac{1}{2}$  inch

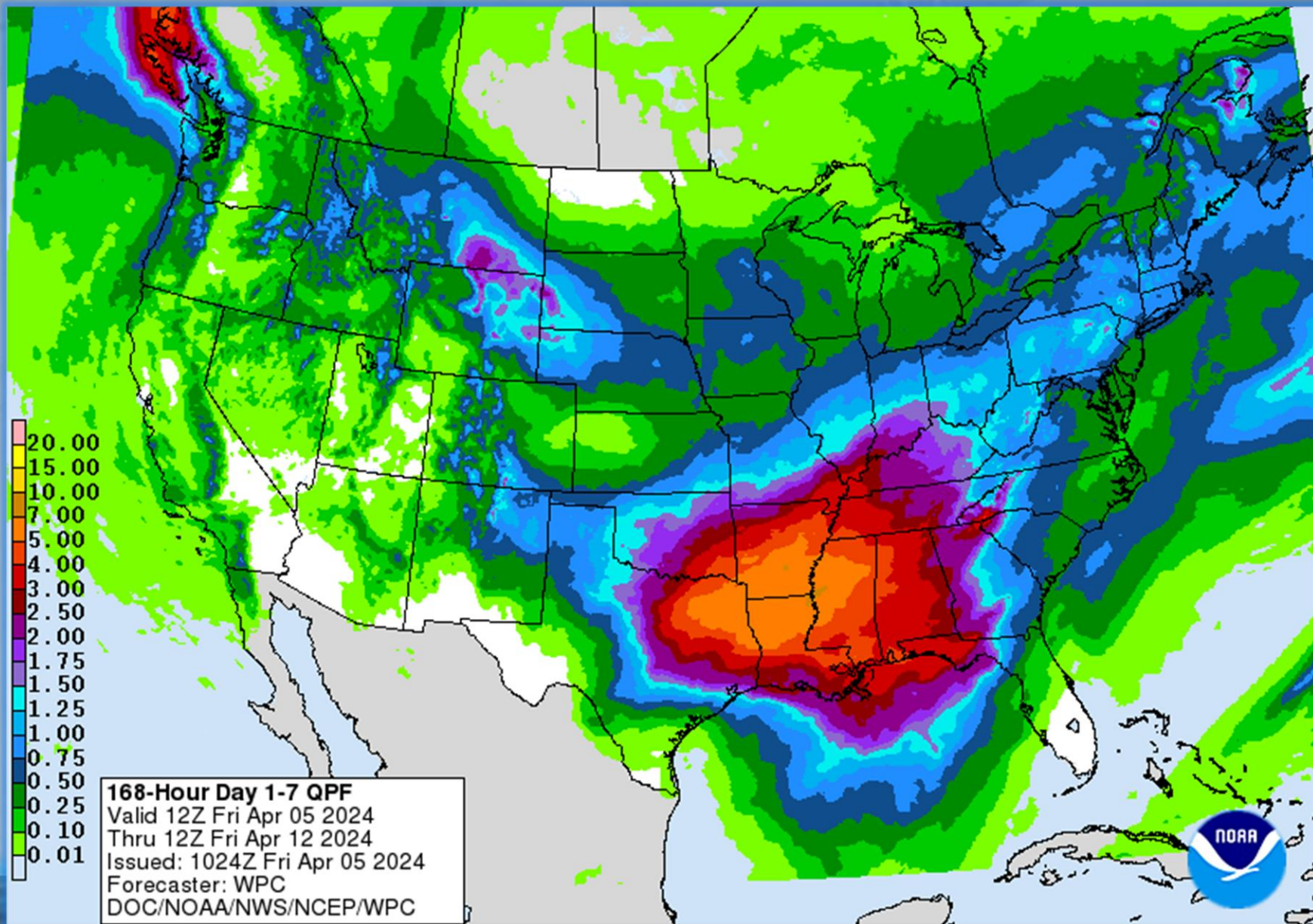
- Above normal temperatures expected through most of April

- Minimum temperatures above freezing the week of 4/7 will melt remaining snow

- 3-Month Forecasts April thru June

- Leaning towards above normal temperatures
- Equal chance of above or below normal precipitation

# Near-term Outlook 7 Day Precip.



# Near-term Outlook - Temperature

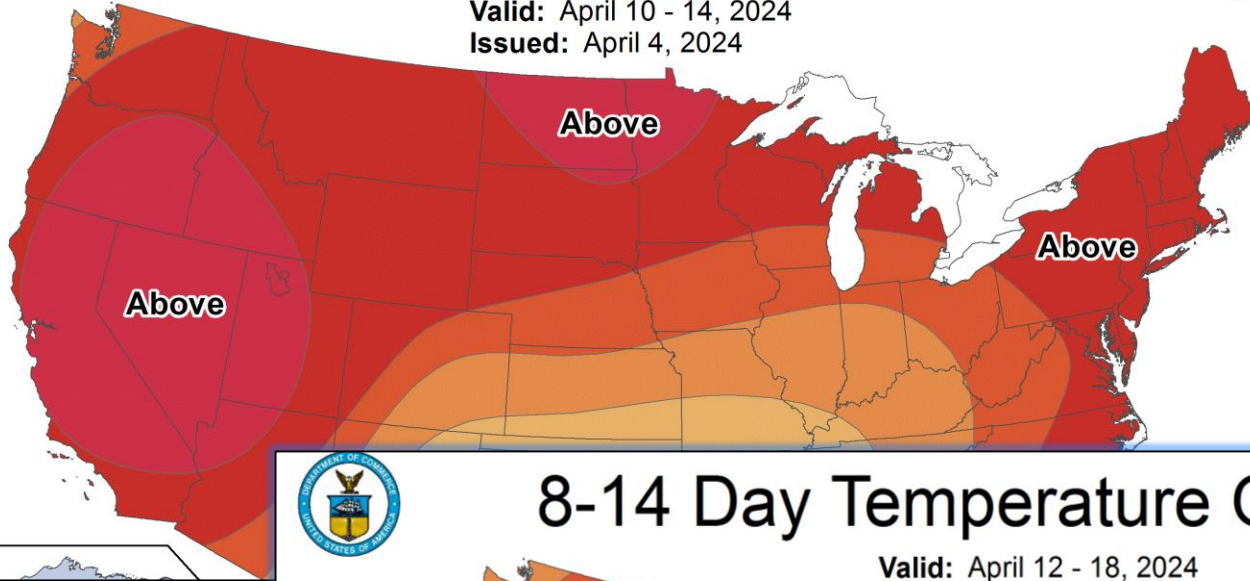


## 6-10 Day Temperature Outlook



Valid: April 10 - 14, 2024

Issued: April 4, 2024

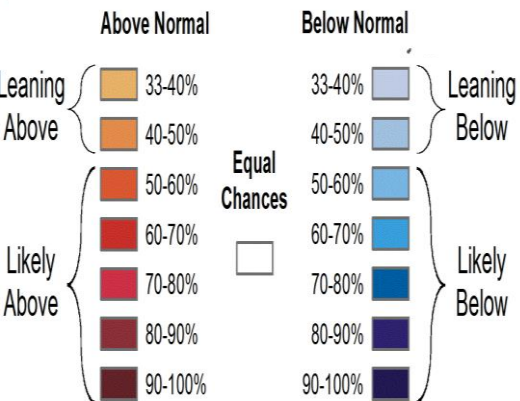
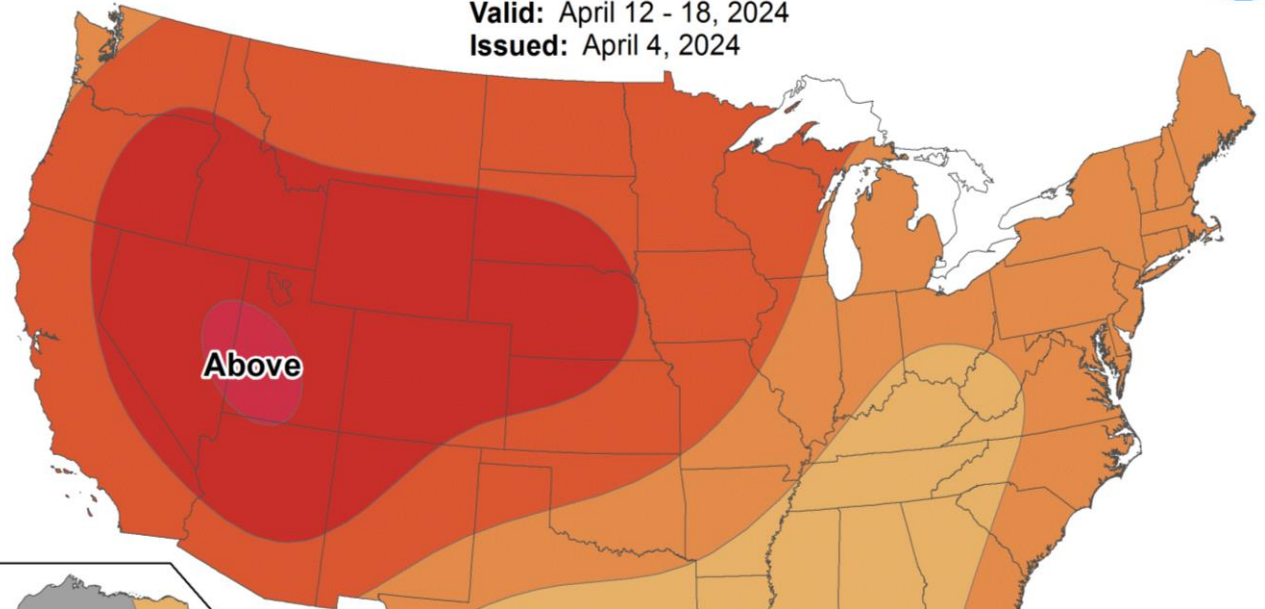


## 8-14 Day Temperature Outlook



Valid: April 12 - 18, 2024

Issued: April 4, 2024





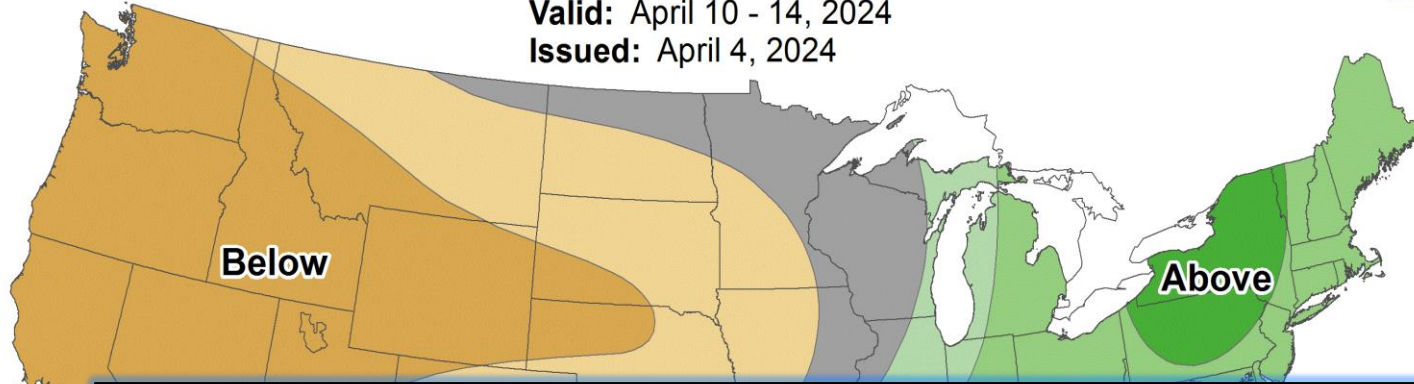
# Near-term Outlook - Precipitation



## 6-10 Day Precipitation Outlook



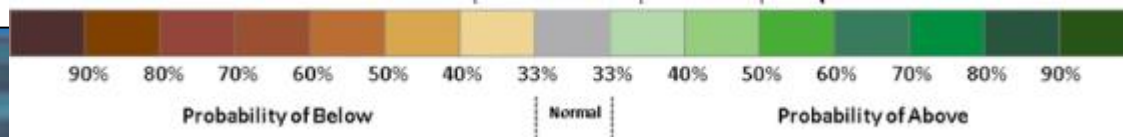
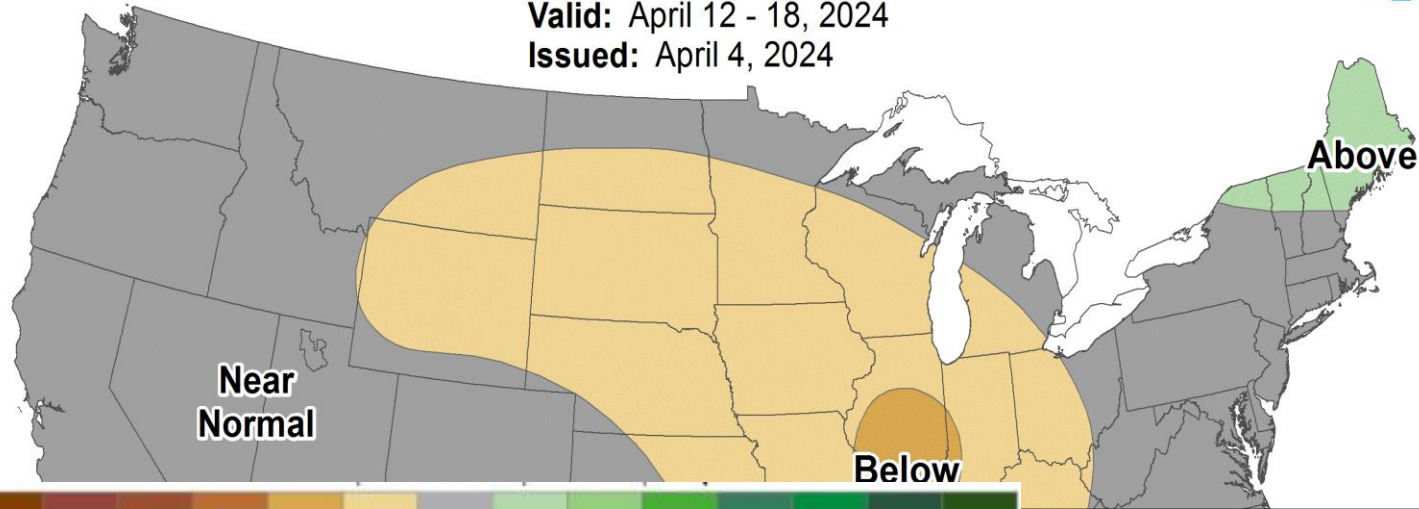
Valid: April 10 - 14, 2024  
Issued: April 4, 2024



## 8-14 Day Precipitation Outlook



Valid: April 12 - 18, 2024  
Issued: April 4, 2024



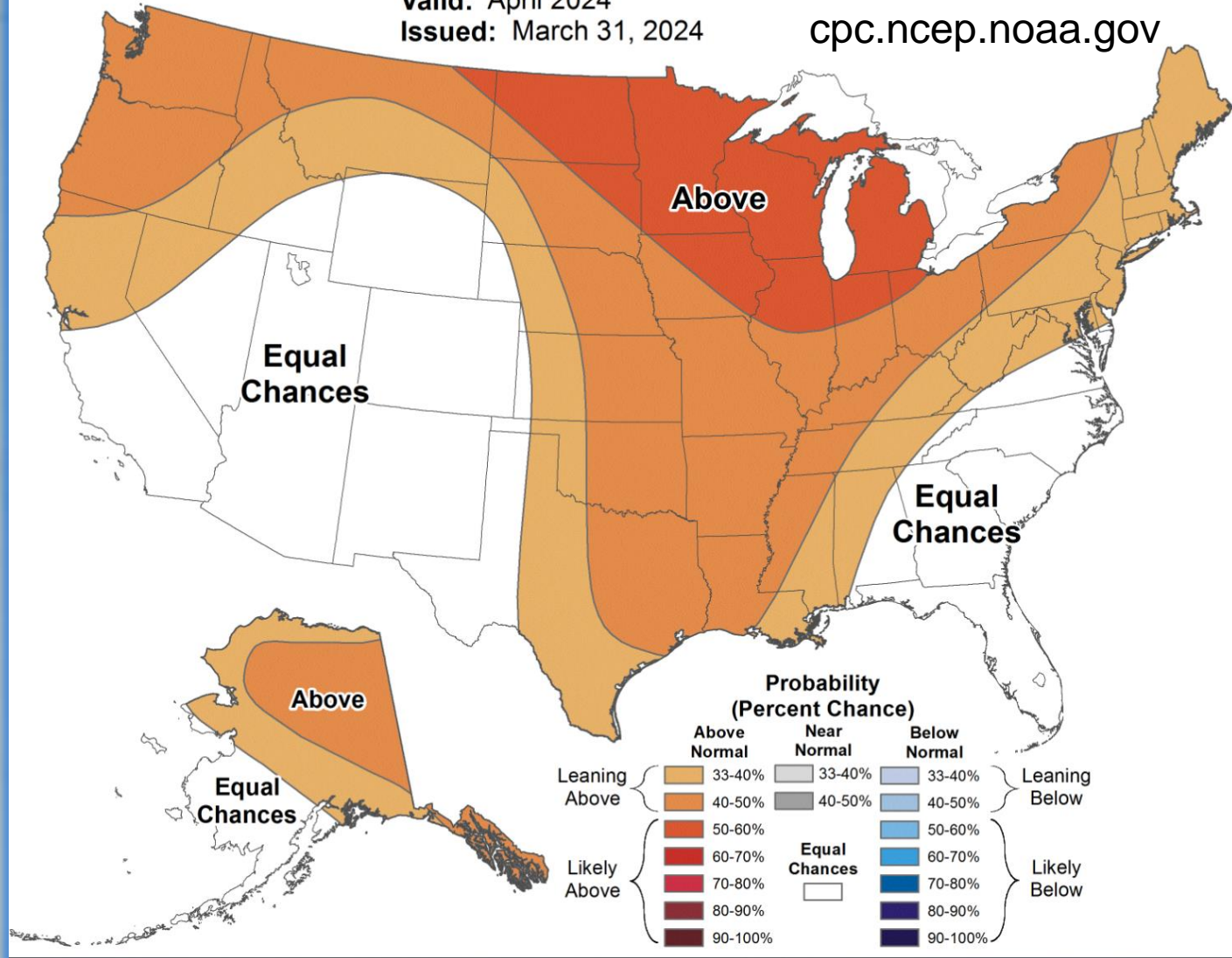


# Monthly Temperature Outlook



Valid: April 2024  
Issued: March 31, 2024

[cpc.ncep.noaa.gov](http://cpc.ncep.noaa.gov)



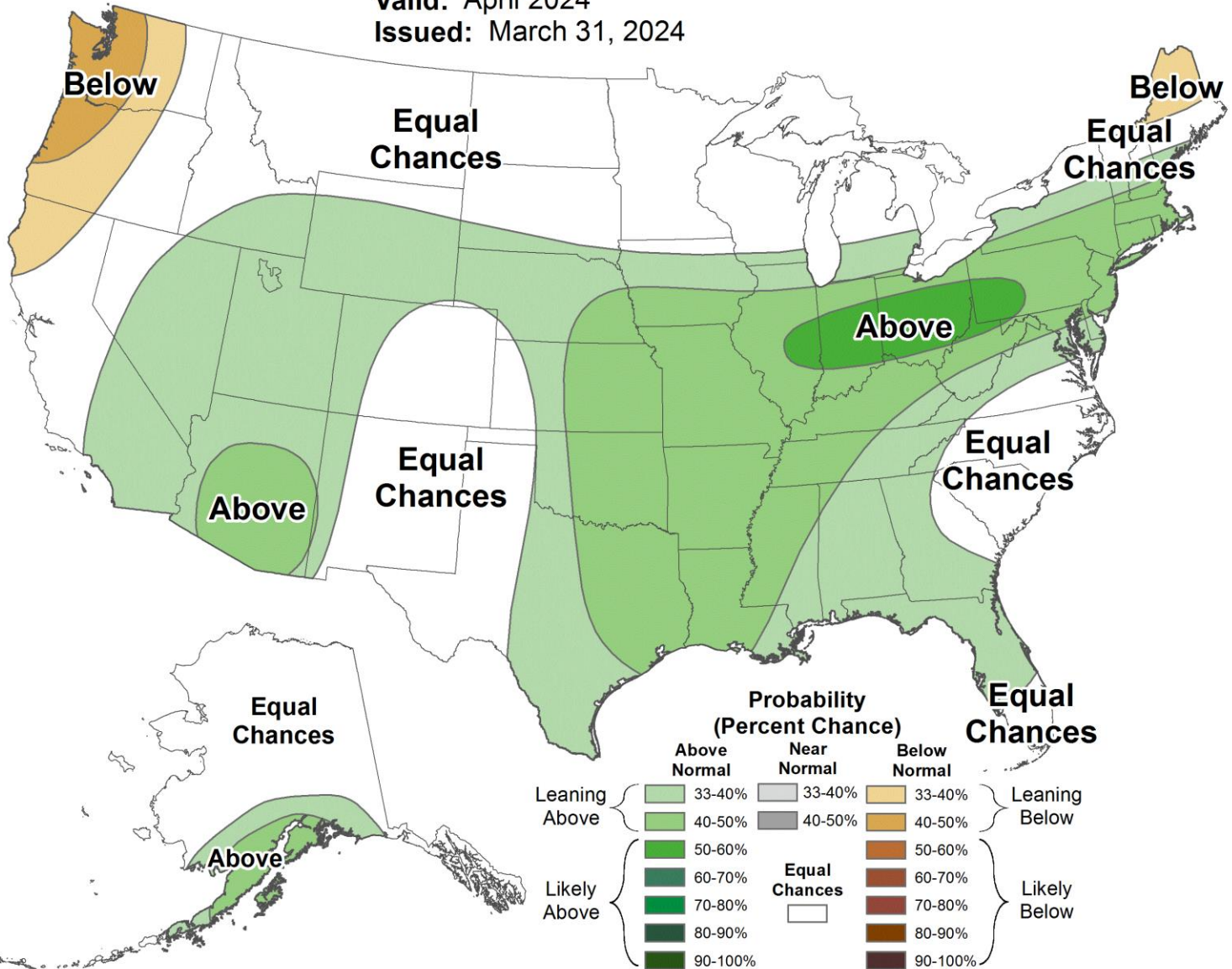
Confidence in above normal temperatures



# Monthly Precipitation Outlook



Valid: April 2024  
Issued: March 31, 2024



No strong signal of above or below normal precipitation

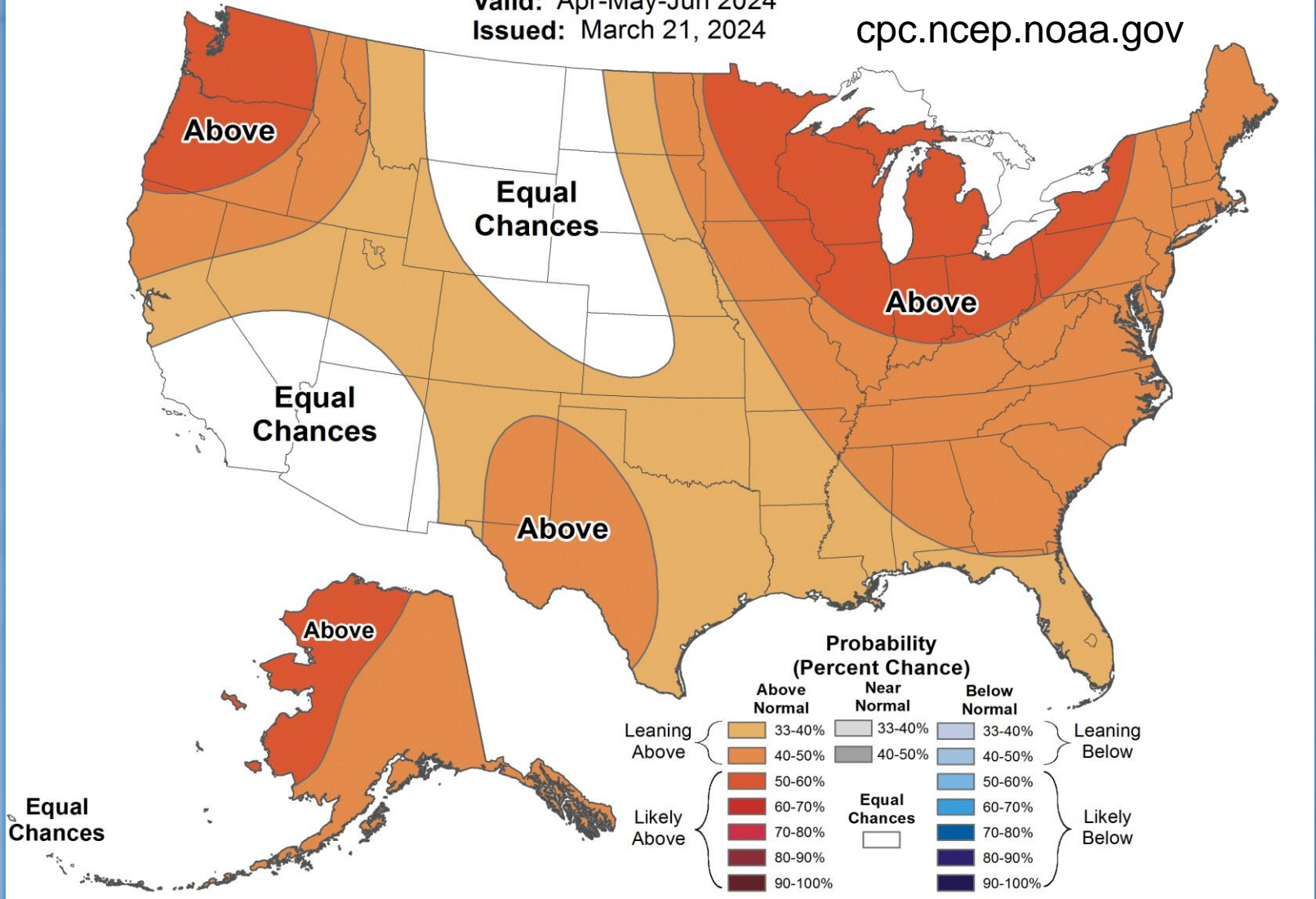


# Seasonal Temperature Outlook



Valid: Apr-May-Jun 2024  
Issued: March 21, 2024

[cpc.ncep.noaa.gov](http://cpc.ncep.noaa.gov)



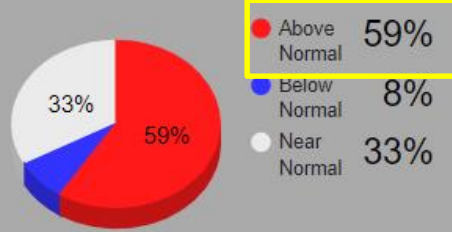
Continued high confidence in above normal temperatures



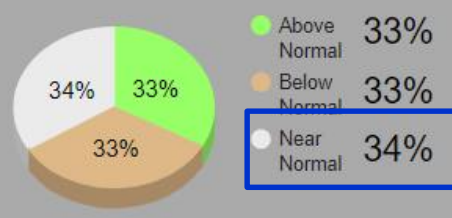
Find address or place

[7 Day Forecast for Brimson, MN](#)

Three Category Temperature Outlook  
Normal Maximum Temperature: **62**  
Normal Minimum Temperature: **37**



Three Category Precipitation Outlook  
Normal Precipitation: **8.73**



Select Lead ▾

# Seasonal Outlook

April 2024-June 2024 (Lead 1)

Temperature

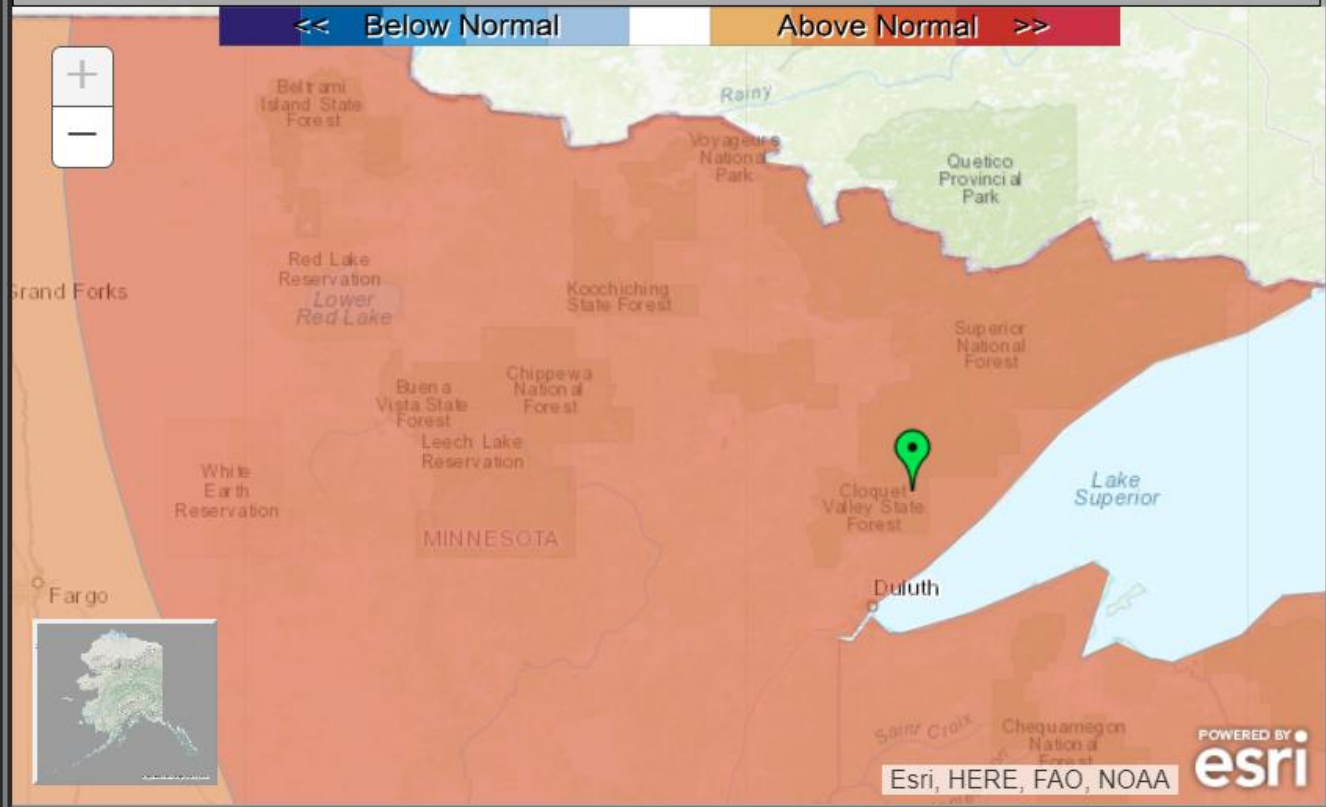
Opacity: 60%

Precipitation

Outlook

Outlook

<< Below Normal Above Normal >>



Esri, HERE, FAO, NOAA **esri** POWERED BY

## Apr-May-June Seasonal Outlook

Temperature 59% leaning towards above normal

Precipitation forecast equal chance of above/below normal

[https://www.cpc.ncep.noaa.gov/products/predictions/long\\_range/interactive/index.php](https://www.cpc.ncep.noaa.gov/products/predictions/long_range/interactive/index.php)

# Hydrologic Outlook - Refill

- 30% Chance of Refill Under Normal Condition refill rules. \*\*\*Reservoir is currently around 3 feet higher than normal draw down elevation.
- 65% Chance of Refill under Dry Condition refill rules

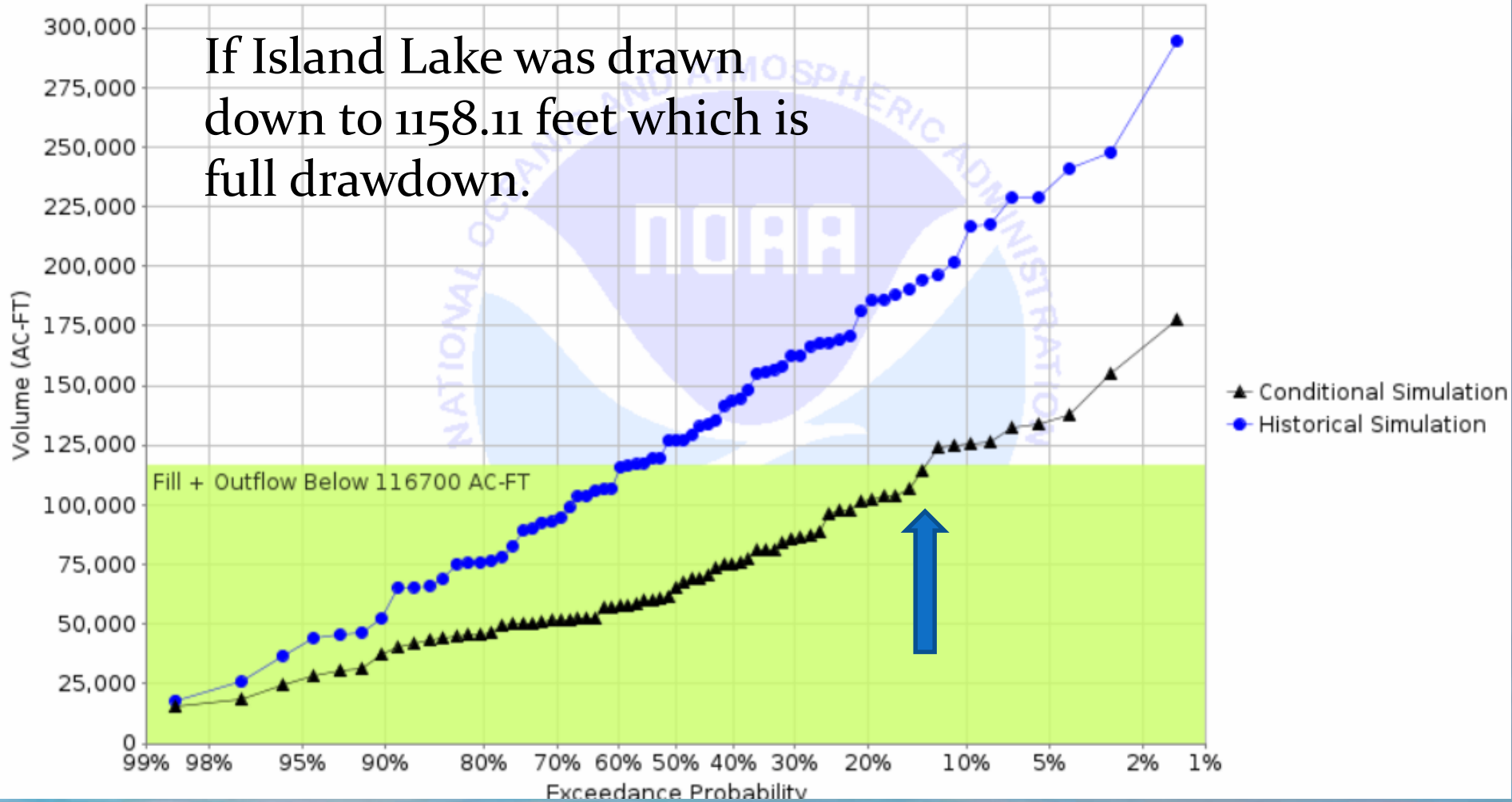
# Was 15 Percent Chance Refill - Normal

Chances of Exceeding River Volume at Cloquet River at Fredenberg 1NNW-Island Lake (ILRM5)

Forecast for the period 03/31/2024 - 05/31/2024

This is a conditional simulation based on the conditions as of 03/04/2024

If Island Lake was drawn down to 1158.11 feet which is full drawdown.





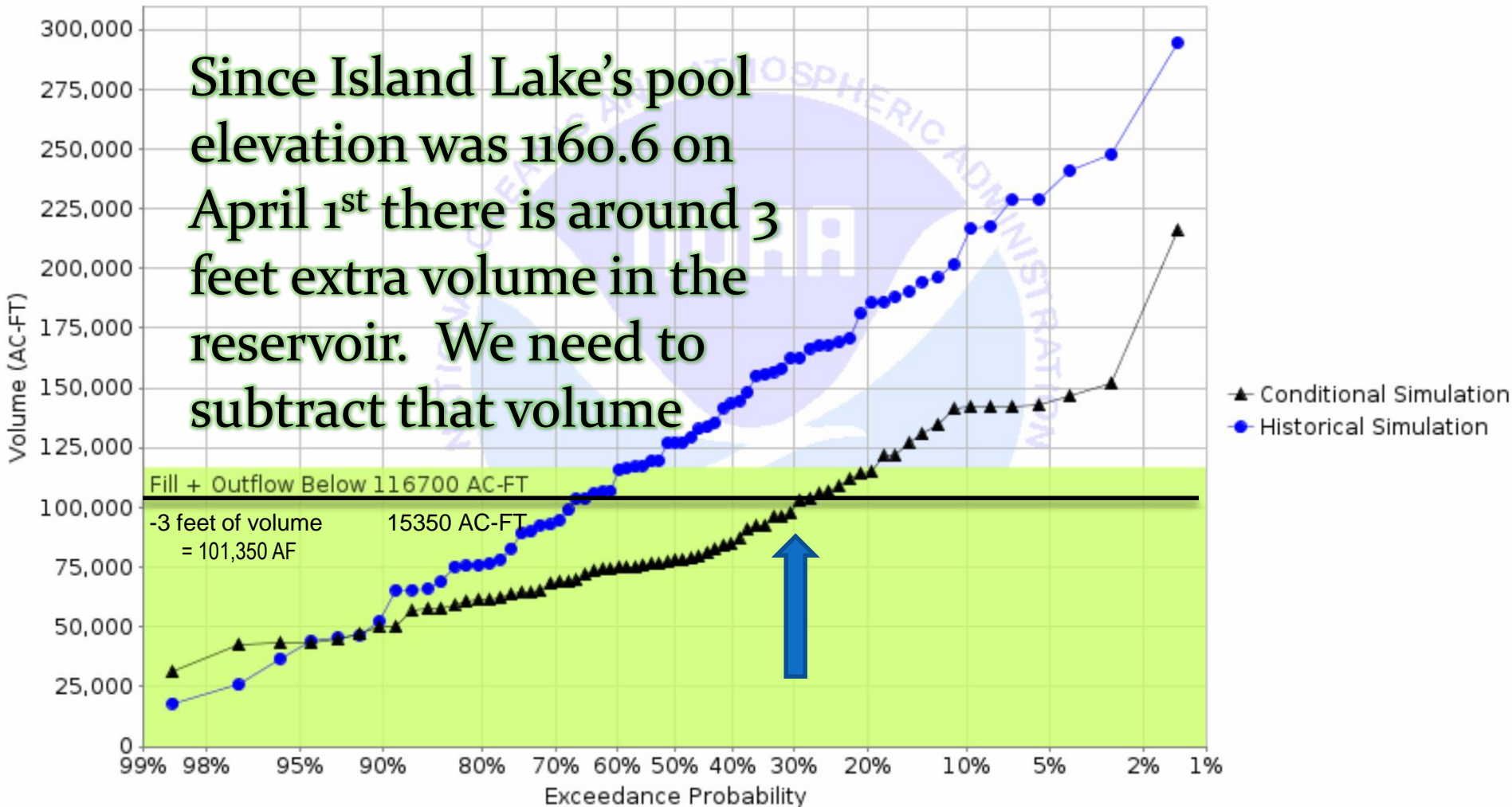
# Now 30 Percent Chance Refill - Normal

Chances of Exceeding River Volume at Cloquet River at Fredenberg 1NNW-Island Lake (ILRM5)

Forecast for the period 04/01/2024 - 06/01/2024

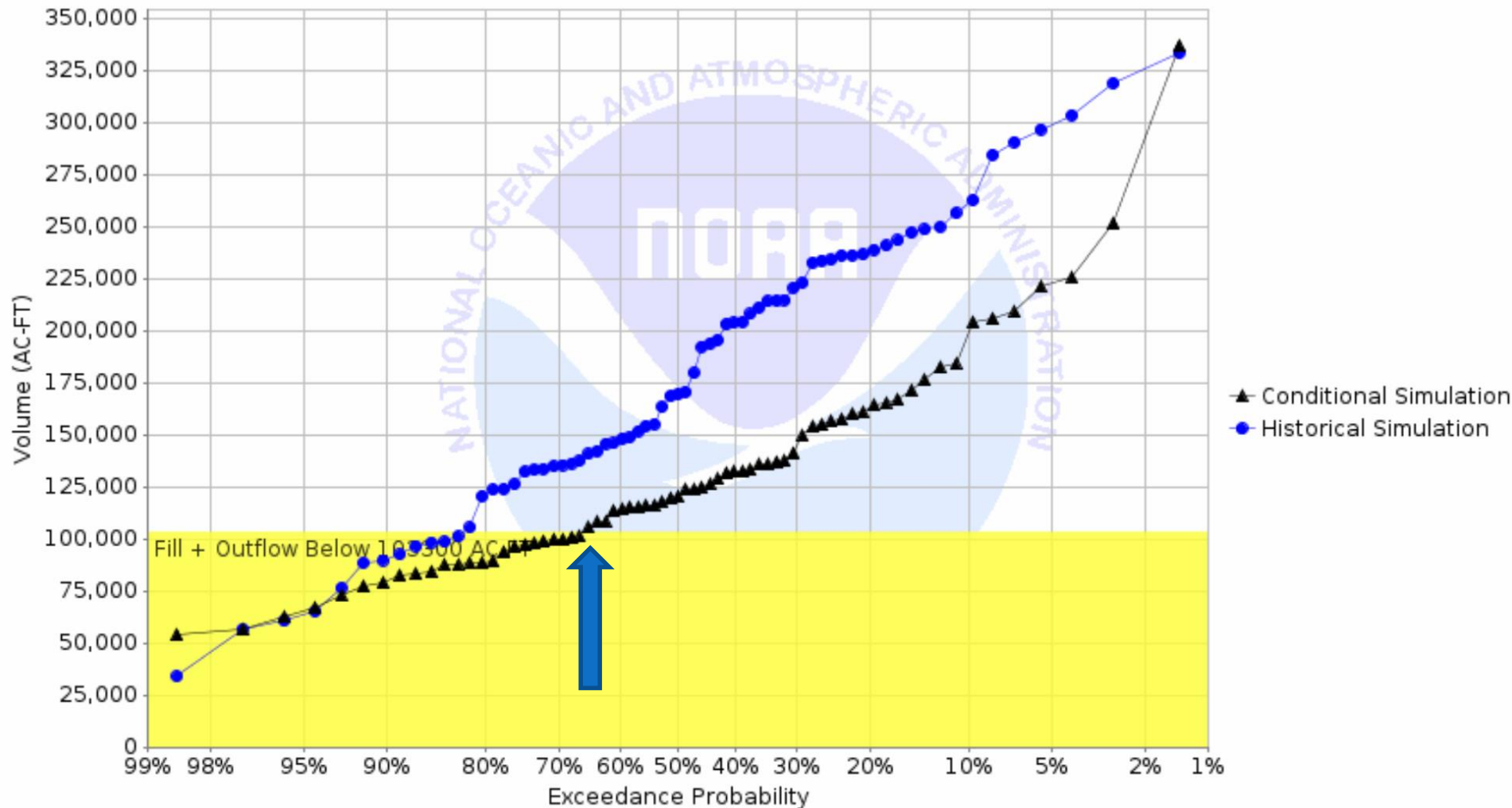
This is a conditional simulation based on the conditions as of 03/27/2024

Since Island Lake's pool elevation was 1160.6 on April 1<sup>st</sup> there is around 3 feet extra volume in the reservoir. We need to subtract that volume



# 65 Percent Chance Refill - Dry

Chances of Exceeding River Volume at Cloquet River at Fredenberg 1NNW-Island Lake (ILRM5)  
Forecast for the period 04/01/2024 - 07/15/2024  
This is a conditional simulation based on the conditions as of 03/27/2024



# 2023-24 Weather/Hydro Outlook -

## Summary

- Emerging Drought - D1(Moderate Drought) present in the basin
- Record low snowpack is driving the refill forecast
- Normal SWE at peak of the season is 4.5“ the peak this season was 1.5 inches after late March snow storm
- Fall and winter rain has helped soil moisture however most rainfall runoff has moved through the basin
- After 2-3 inches of rain in late December we briefly lost frost. There was runoff from that rain on frost event that has moved through the basin.
- 15 inches of frost as of 4/4/24 is decreasing rapidly

# Resources

- <https://www.weather.gov/media/dlh/DssPacket.pdf>
- <https://cpc.ncep.noaa.gov>
- <https://www.wpc.ncep.noaa.gov/qpf/day1-7.shtml>
- <https://prism.oregonstate.edu/comparisons/drought.php>
- <https://www.nohrsc.noaa.gov/interactive/html/map.html>
- [https://www.weather.gov/dlh/drought\\_page](https://www.weather.gov/dlh/drought_page)
- [weather.gov/forecastpoints](https://www.weather.gov/forecastpoints)
- <https://www.weather.gov/mpx/islandlake>