

MASSACHUSETTS WATER RESOURCES COMMISSION



# HYDROLOGIC CONDITIONS IN MASSACHUSETTS

AUGUST  
2023

The Commonwealth of Massachusetts

*Maura T. Healey, Governor*

*Rebecca L. Tepper, Secretary  
Executive Office of Energy and Environmental Affairs*



# AUGUST 2023 HYDROLOGIC CONDITIONS

## SUMMARY OF CONDITIONS



- Monthly average temperatures were normal to below normal.
- Precipitation was above normal except for the CTRV and Islands Regions where it was normal.



- Crop Moisture Index showed abnormally moist and normal conditions across the state at the end of the month. The 1-month and 2-month EDDI maps showed normal to below normal except for the Cape Cod and Islands Regions where there were areas that were above to much above normal.



- The Keetch-Byram Drought Index showed normal soil moisture conditions at the end of the month for much of the state except for the Islands Region, which is at Index Severity Level (ISL) 1.



- Streamflow was much above normal except for the Cape Cod Region where it was normal. Some new, daily record highs were set.



- Groundwater was below normal to above normal. Regional medians were in the much above-normal range except for Cape Cod where it was normal and the Islands where it is at ISL 2.



- Lake and impoundment levels were above their 30th percentile and/or were at or near 100% full.



- NOAA's September outlook shows chances leaning for above-normal temperatures and equal chances for below-normal, normal, or above-normal precipitation.

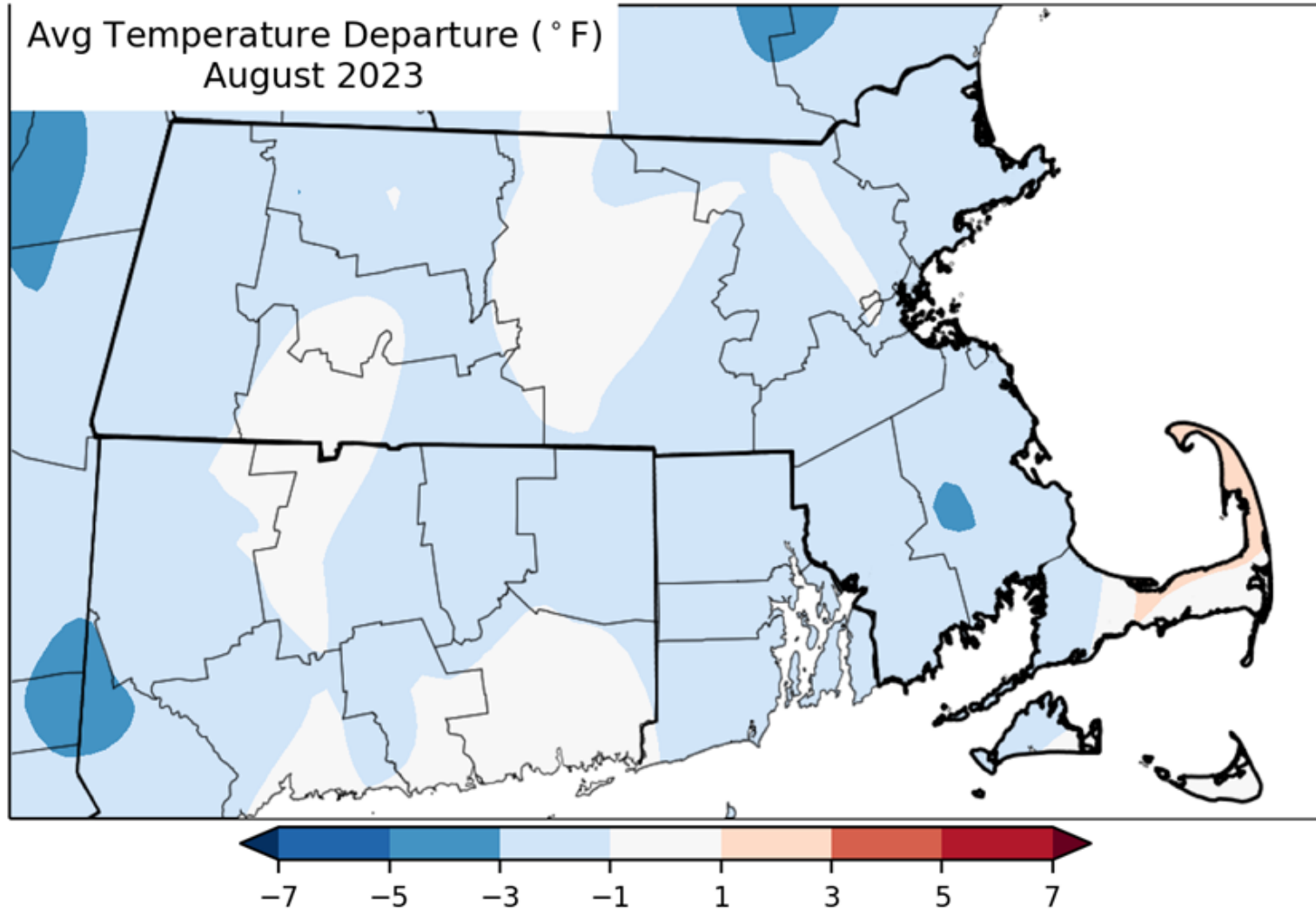


- NOAA's 3-month outlook shows chances likely for above-normal temperatures and equal chances for below-normal, normal, or above-normal precipitation.

- Appendix II provides information on the Massachusetts Drought Management Plan (DMP) including ISL thresholds used in this report.

This report was prepared by the Massachusetts Department of Conservation and Recreation. Data may be preliminary. Analysis reflects automated calculations done 09/12/2023. Additional information, previous reports, and the Massachusetts Drought Dashboard with weekly updates to the drought indices can be found at: <https://www.mass.gov/drought-monitoring>

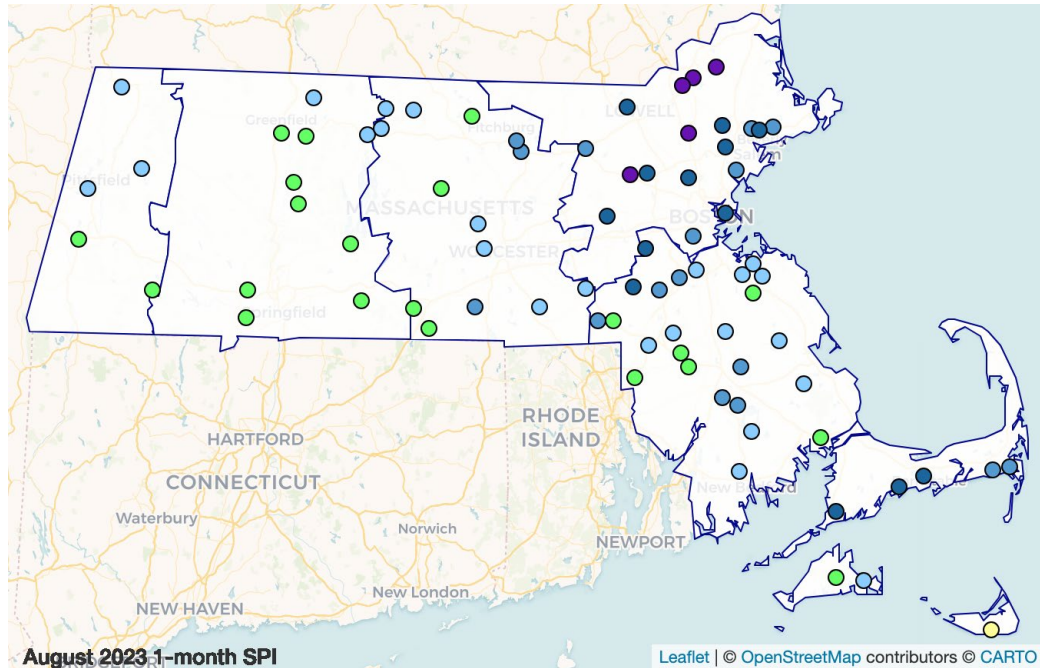
Monthly average temperatures were normal to below normal.  
<http://www.nrcc.cornell.edu/regional/monthly/monthly.html>





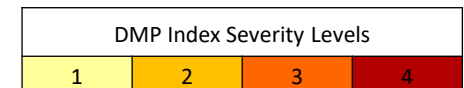
# STANDARDIZED PRECIPITATION INDEX (SPI) AS A PERCENTILE

August precipitation was above normal except for the CTRV and Islands Regions where it was normal. An individual station on Nantucket was again below normal for the month. According to the NRCC, Massachusetts had its second wettest summer on record. In addition to the table below, Appendix I provides all the look-back periods.



REGION	NUMBER OF SITES REPORTING	AUGUST MONTHLY AVERAGE (IN)	DEPARTURE FROM HISTORICAL (IN)	SPI PERCENTILE 1-MONTH	SPI PERCENTILE 3-MONTH	SPI PERCENTILE 6-MONTH
WESTERN	5	4.88	0.62	73	94	92
CTRV	10	4.18	0.20	59	95	94
CENTRAL	14	5.34	1.37	77	98	96
NORTHEAST	18	8.54	5.00	95	99	98
SOUTHEAST	25	5.49	1.54	76	92	87
CAPE COD	5	6.46	2.92	91	85	80
ISLANDS	3	3.42	-0.05	68	59	18

SPI is the Standardized Precipitation Index used in the Drought Management Plan (DMP) expressed here as a percentile and represents the variation from long-term precipitation.



● $\geq 0$ to $\leq 2$	● $> 2$ to $\leq 10$	● $> 10$ to $\leq 20$	● $> 20$ to $\leq 30$	● $> 30$ to $\leq 70$
● $> 70$ to $\leq 80$	● $> 80$ to $\leq 90$	● $> 90$ to $\leq 98$	● $> 98$ to $\leq 100$	



## CROP MOISTURE INDEX (CMI)

Weekly values for the period ending September 2, 2023 from NOAA’s National Weather Service Climate Prediction Center were in the Slightly Dry/Favorably Moist/normal range in the western climate division and in the Abnormally Moist range in the central and coastal climate divisions.

[https://www.cpc.ncep.noaa.gov/products/monitoring\\_and\\_data/drought.shtml](https://www.cpc.ncep.noaa.gov/products/monitoring_and_data/drought.shtml)

CLIMATE DIVISION	CROP MOISTURE INDEX
WESTERN	0.27
CENTRAL	1.25
COASTAL	1.39

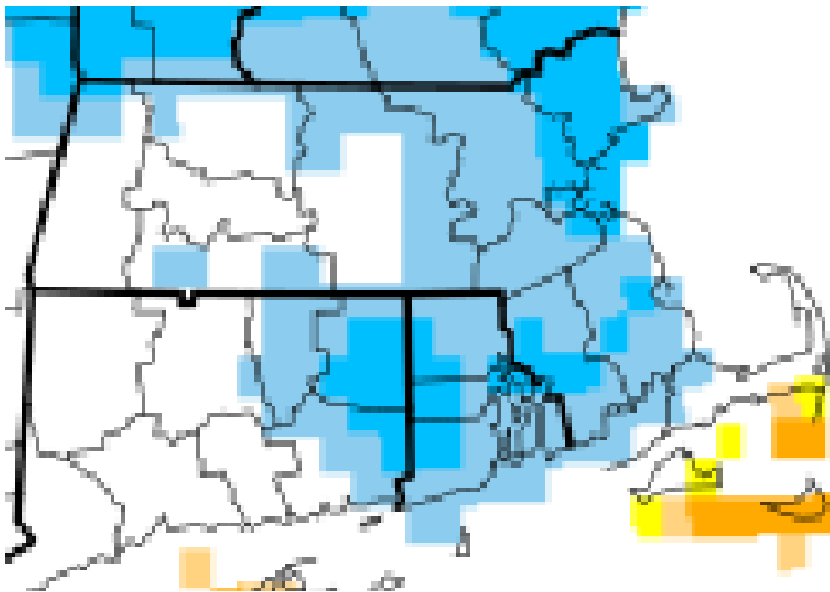




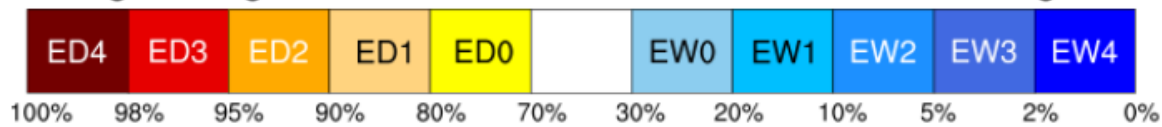
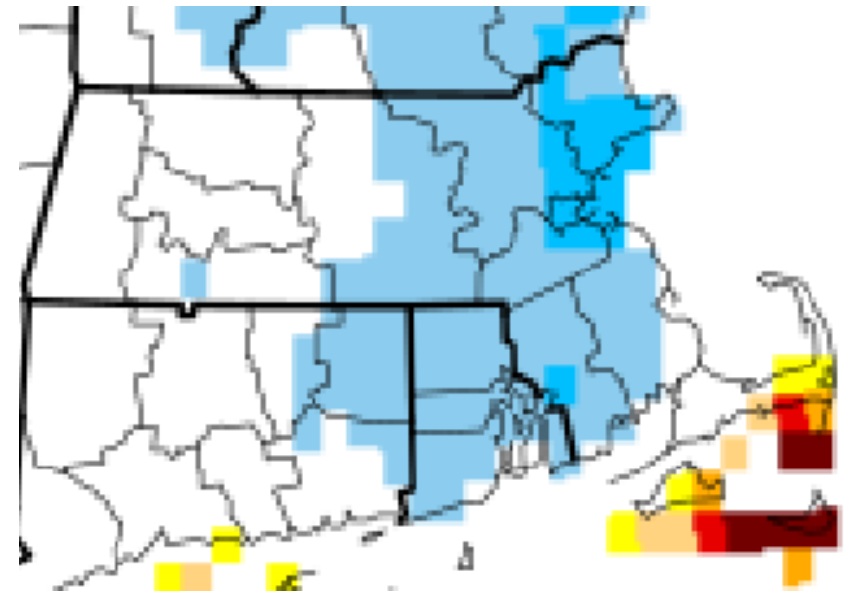
# EVAPORATIVE DEMAND DROUGHT INDEX (EDDI)

The 1-month and 2-month EDDI categories for August 28, 2023 were normal to below normal except for part of the Cape Cod Region and the Islands Region, which were above to much above normal.

1-month EDDI

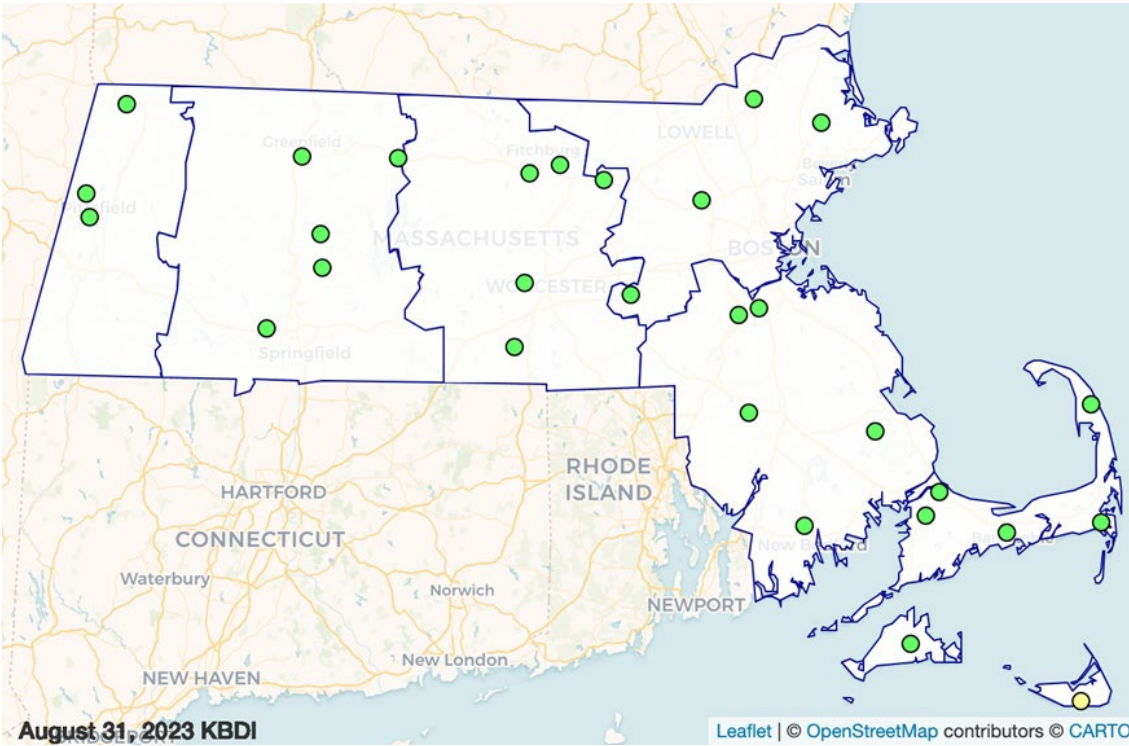


2-month EDDI

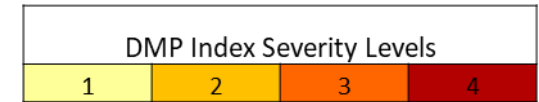


Generated by NOAA/ESRL/Physical Sciences Laboratory

At the end of August, the Keetch Byram Drought Index (KBDI) was elevated in the Islands Region, which is at ISL 1.



REGION	NUMBER OF SITES REPORTING	HIGHEST OF SITE VALUES
WESTERN	3	102
CTRV	5	160
CENTRAL	5	104
NORTHEAST	4	46
SOUTHEAST	5	170
CAPE COD	5	113
ISLANDS	2	284

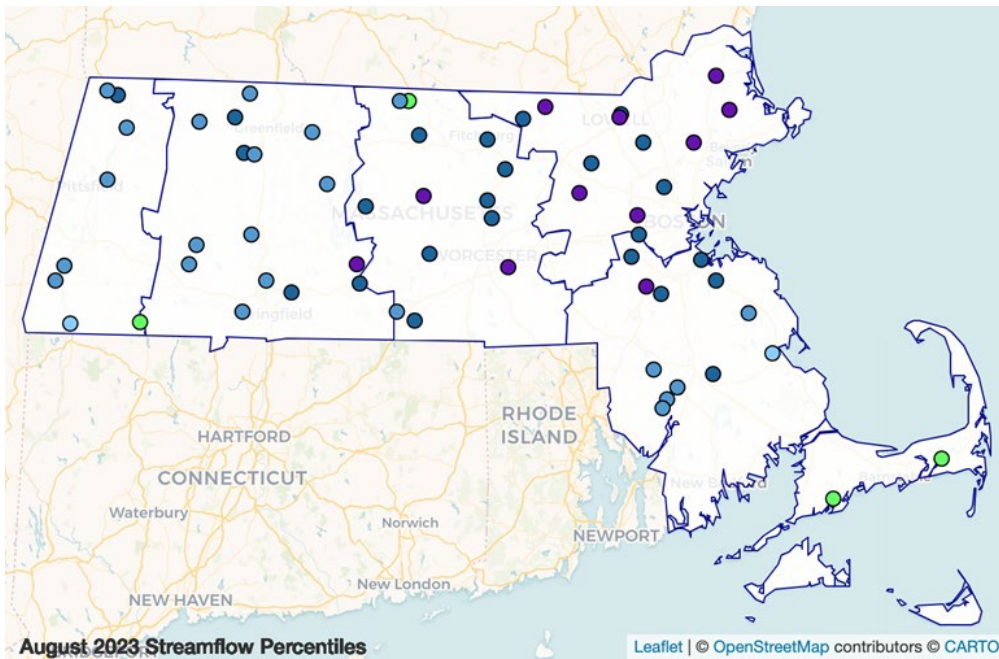


Point Values - KBDI Range				
● ≥700 to ≤800	● ≥600 to <700	● ≥400 to <600	● ≥200 to <400	● ≥0 to <200



During August, streamflow was high across the state except for Cape Cod. Most percentiles of individual streamflow gages were above normal to much above normal. Some gages recorded new, daily record highs (see timeseries graph on the next page).

## MEDIAN MONTHLY STREAMFLOW PERCENTILES COMPARED TO HISTORICAL VALUES



REGION	NUMBER OF GAGES REPORTING	≥0 TO ≤2 PERCENTILE	>2 TO ≤10 PERCENTILE	>10 TO ≤20 PERCENTILE	>20 TO ≤30 PERCENTILE	>30 TO ≤70 PERCENTILE	>70 TO ≤80 PERCENTILE	>80 TO ≤90 PERCENTILE	>90 PERCENTILE	MEDIAN OF INDIVIDUAL GAGE PERCENTILES
WESTERN	8	0	0	0	0	0	0	0	1	87
CTRV	15	0	0	0	0	0	0	0	5	89
CENTRAL	13	0	0	0	0	0	0	0	10	95
NORTHEAST	13	0	0	0	0	0	0	0	13	99
SOUTHEAST	12	0	0	0	0	0	0	0	6	90
CAPE COD	2	0	0	0	0	0	0	0	0	53

**Note:** Not all gages report in all months due to ice, beaver dams or other conditions. Streamflow index is not applicable to the Islands.

DMP Index Severity Levels			
1	2	3	4

● ≥0 to ≤2	● >2 to ≤10	● >10 to ≤20	● >20 to ≤30	● >30 to ≤70
● >70 to ≤80	● >80 to ≤90	● >90 to ≤98	● >98 to ≤100	

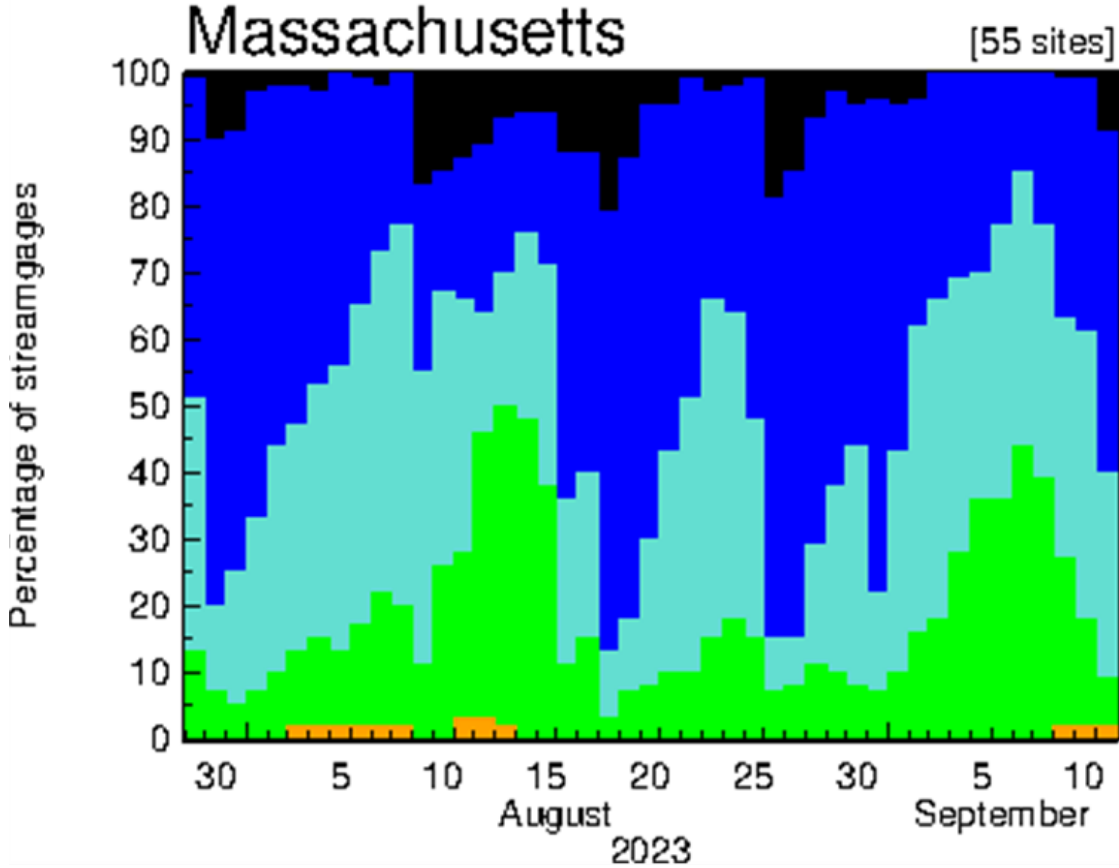




# USGS TIME SERIES OF THE PERCENT OF GAGES AT THEIR RESPECTIVE PERCENTILE FLOWS FOR AVERAGE DAILY STREAMFLOWS COMPARED TO HISTORICAL VALUES

<https://waterdata.usgs.gov/nwis/sw>

Explanation - Percentile classes							
Low	<10	10-24	25-75	76-90	>90	High	No Data
	Much below normal	Below normal	Normal	Above normal	Much above normal		



A search of the Local Storm Report App database on the Iowa State University Iowa Environmental Mesonet website produced 79 storm reports for Massachusetts of which 42 were flooding reports occurring on August 8<sup>th</sup> and 18<sup>th</sup>. Over those two days there were numerous warnings issued for severe thunderstorms, flooding, and flash flooding by NWS.

On August 8<sup>th</sup> urban/drainage flooding occurred in Bristol, Essex, Middlesex, Norfolk, and Worcester counties. Of note were the towns of Haverhill and North Andover. In Haverhill a brick sewer collapsed causing a sink hole and evacuations. In North Andover there was heavy flooding on Main, High, and Middlesex Streets leading to evacuations.

On August 18<sup>th</sup> urban/drainage flooding occurred in Bristol, Essex, Middlesex, Norfolk, Plymouth, Suffolk, and Worcester counties.

For a summary of the summer flooding see WBUR's article "It's Been a Summer of Rain and Flooding Misery in Mass." by Beth Healy.

<https://www.wbur.org/news/2023/09/12/summer-flooding-rain-massachusetts>



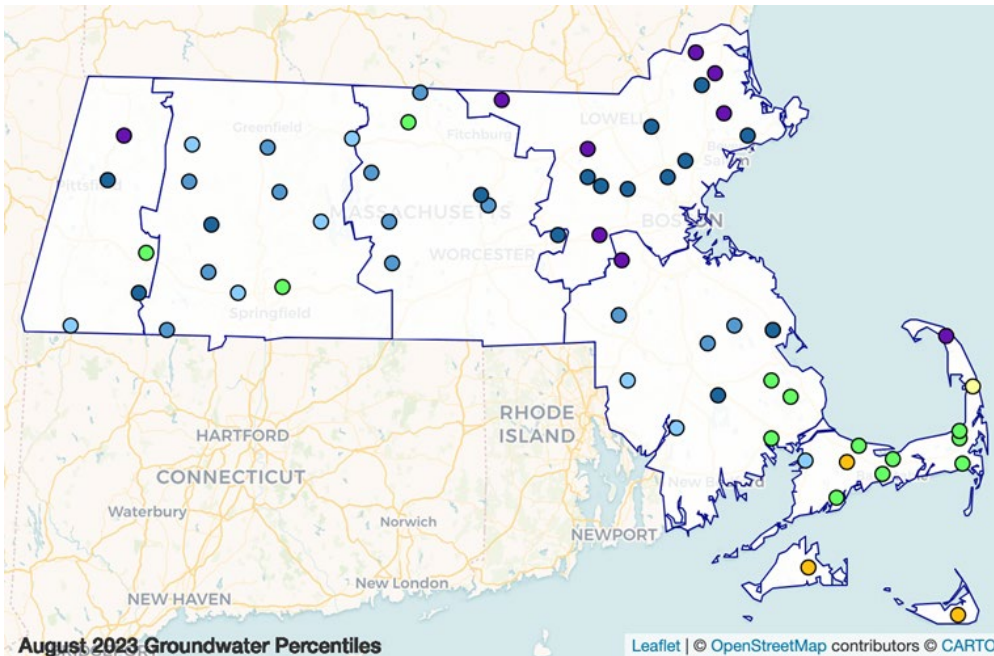
Image: Courtesy of NASA/JPL-Caltech

<https://mesonet.agron.iastate.edu/vtec/search.php#eventsbypoint/-93.6530/41.5300>



August groundwater levels ranged from below normal to much above normal. Regional medians were in the much above-normal range except for the Cape Cod Region, which was in the low-end of normal range, and the Islands Region, which is at ISL 2.

## END OF MONTH GROUNDWATER COMPARED TO HISTORICAL IN THE CLIMATE RESPONSE NETWORK WELLS



REGION	NUMBER OF WELLS REPORTING	≥0 TO ≤2 PERCENTILE	>2 TO ≤10 PERCENTILE	>10 TO ≤20 PERCENTILE	>20 TO ≤30 PERCENTILE	>30 TO ≤70 PERCENTILE	>70 TO ≤80 PERCENTILE	>80 TO ≤90 PERCENTILE	>90 TO ≤98 PERCENTILE	>98 TO ≤100 PERCENTILE	MEDIAN OF INDIVIDUAL WELL PERCENTILES
WESTERN	5	0	0	0	0	0	0	0	3	0	92
CTRV	11	0	0	0	0	0	0	0	1	0	82
CENTRAL	8	0	0	0	0	0	0	0	2	0	88
NORTHEAST	14	0	0	0	0	0	0	0	14	0	98
SOUTHEAST	12	0	0	0	0	0	0	0	3	0	83
CAPE COD	11	0	0	1	1	0	0	0	1	0	33
ISLANDS	2	0	0	0	2	0	0	0	0	0	12

DMP Index Severity Levels			
1	2	3	4

●	≥0 to ≤2	●	>2 to ≤10	●	>10 to ≤20	●	>20 to ≤30	●	>30 to ≤70
●	>70 to ≤80	●	>80 to ≤90	●	>90 to ≤98	●	>98 to ≤100		



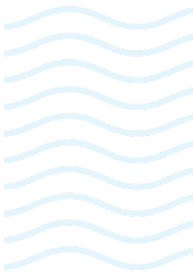
At the end of August, reporting lake and impoundment levels were above their 30th percentile and/or were at or near 100% full.

REGION	NUMBER OF SITES REPORTING	MEDIAN OF INDIVIDUAL PERCENTILES OR PERCENT FULL
WESTERN	1	94th
CTRV	2	72nd
CENTRAL	4	90th
NORTHEAST	5	95th
SOUTHEAST	2	88th
CAPE COD	1	52nd

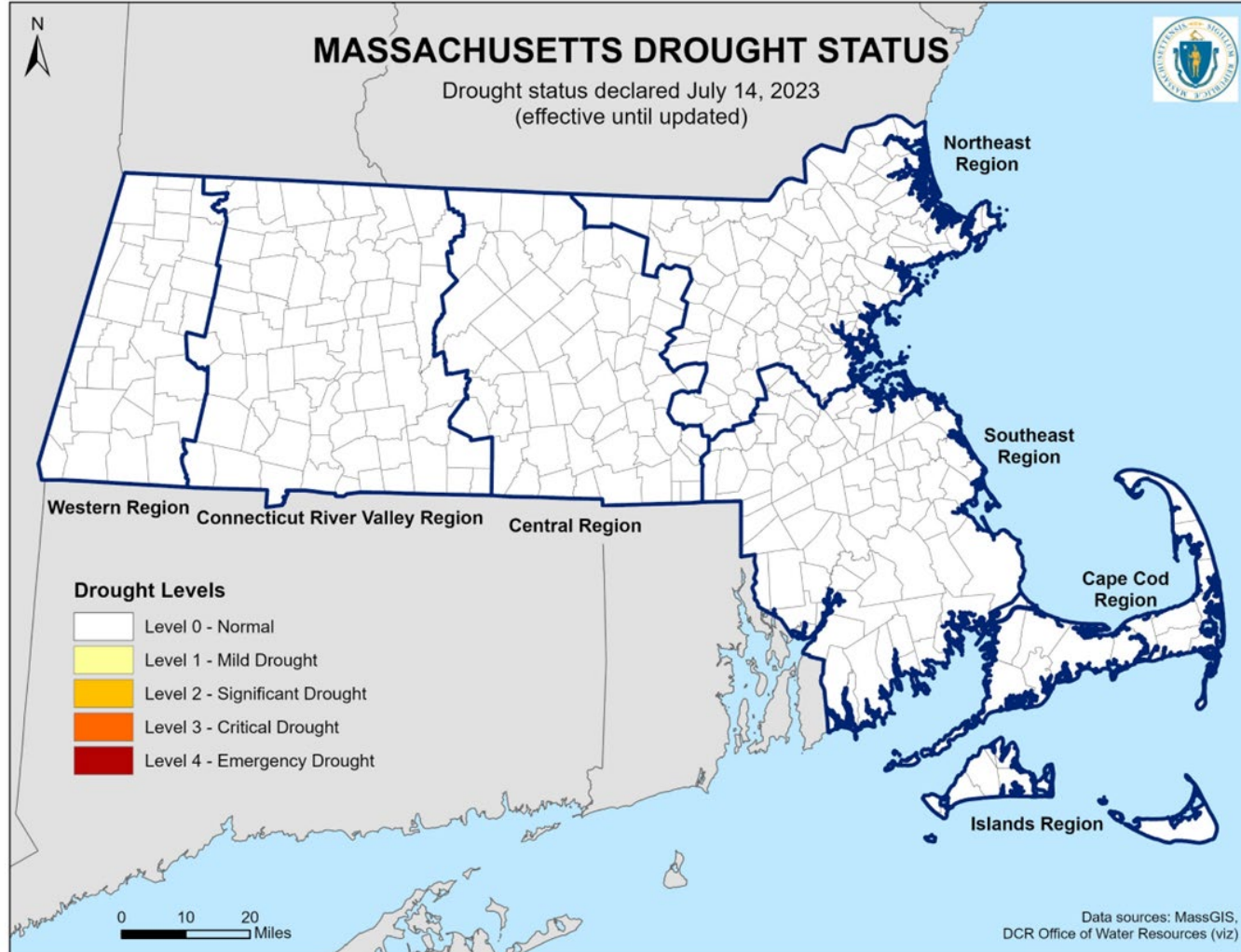
DMP Index Severity Levels			
1	2	3	4

DMP Index Severity Levels do not necessarily reflect water supply status.





# MASSACHUSETTS DROUGHT STATUS

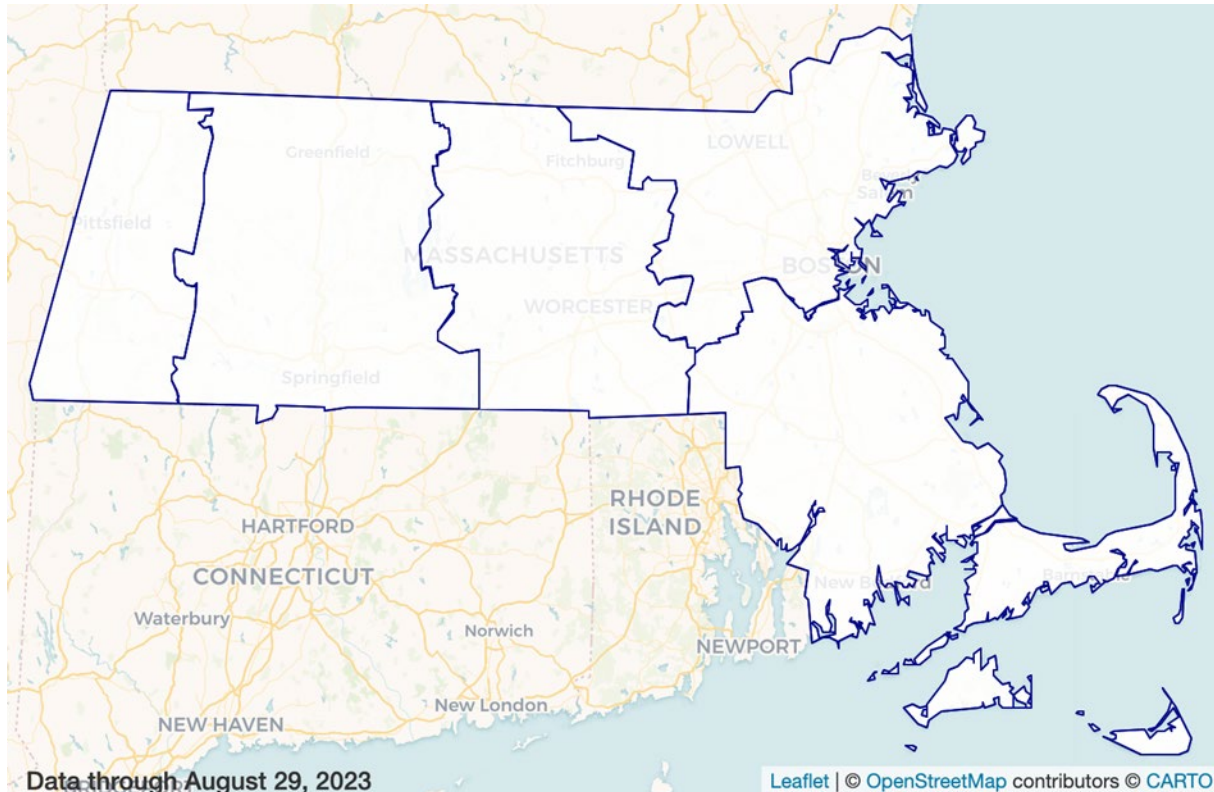




# U.S. DROUGHT MONITOR (USDM)

At the end of August, the USDM showed no areas of drought.

USDM maps are produced by the National Drought Mitigation Center (NDMC). For methods, weekly updates, and past maps see: <https://droughtmonitor.unl.edu>

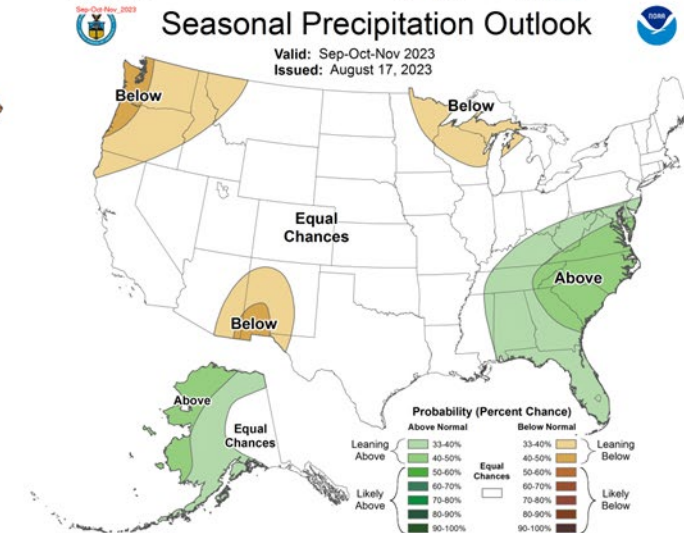
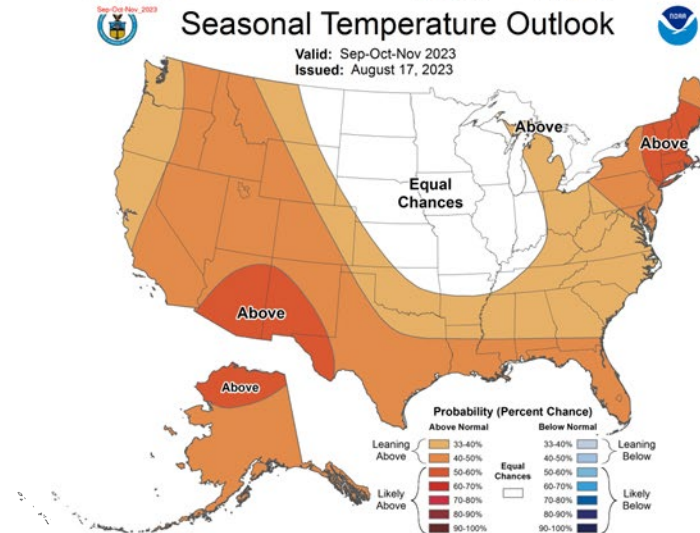
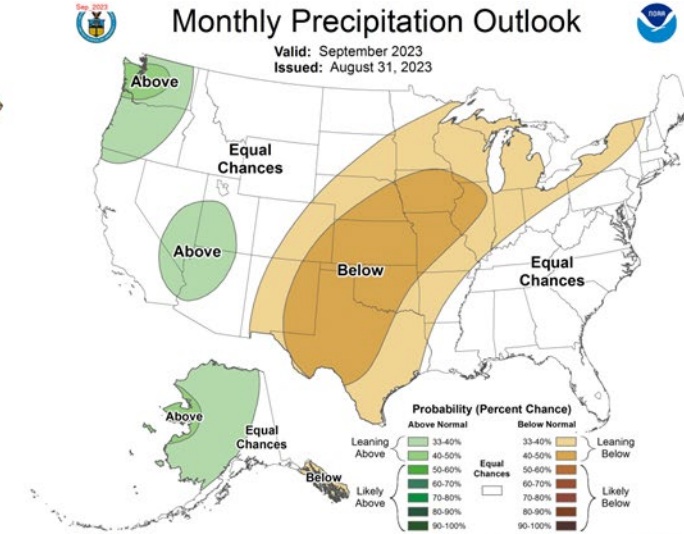
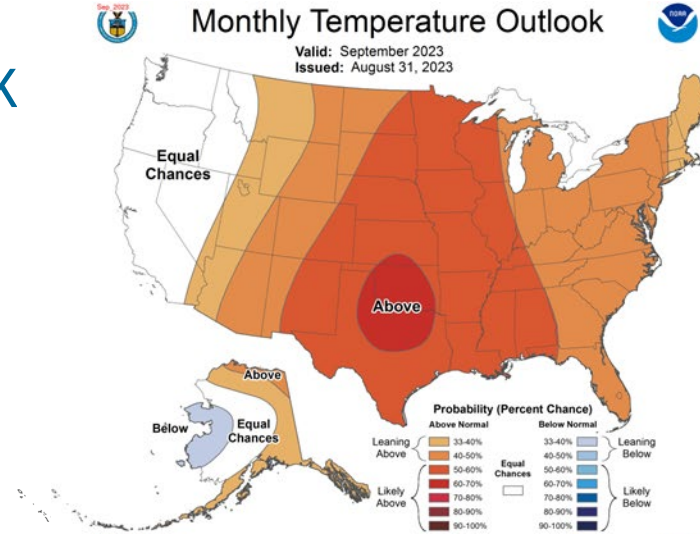


# TEMPERATURE AND PRECIPITATION OUTLOOK

**September:** The outlook issued 8/31 shows a 40-50% chance of above-normal temperature for the western part of MA, a 33-40% chance of above-normal temperatures for the rest of the state, and equal chances for above-normal, normal, or below-normal precipitation for the entire state.

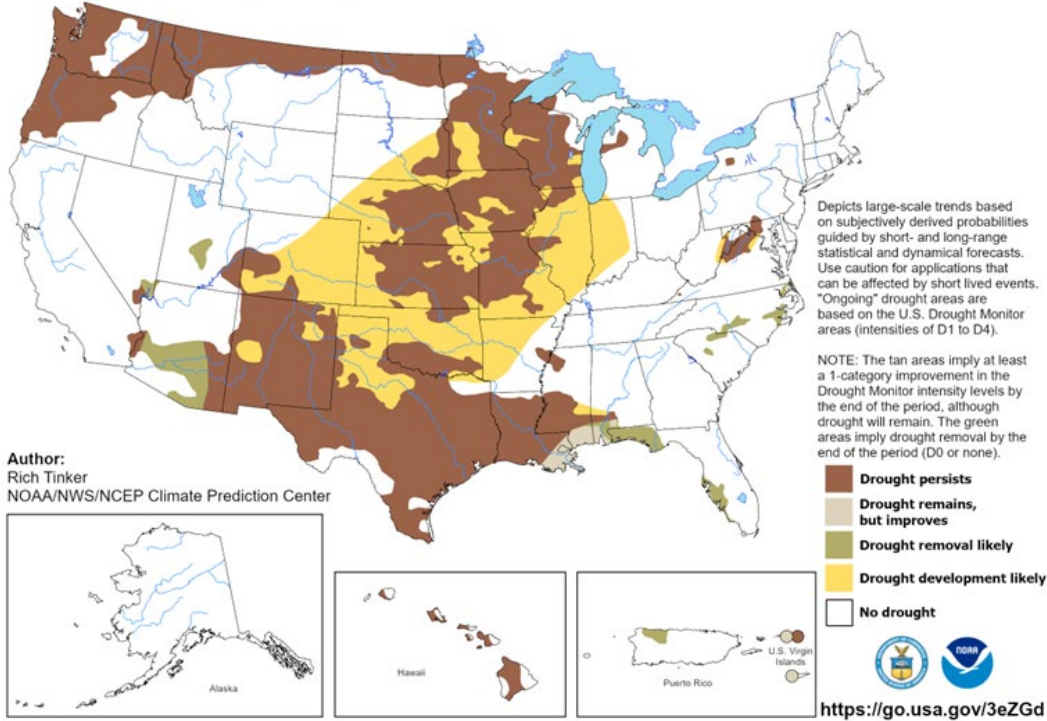
**September through November:** The seasonal outlook issued 8/17 shows a 50-60% chance of above-normal temperatures and equal chances for above-normal, normal, or below-normal precipitation.

<https://www.cpc.ncep.noaa.gov/>



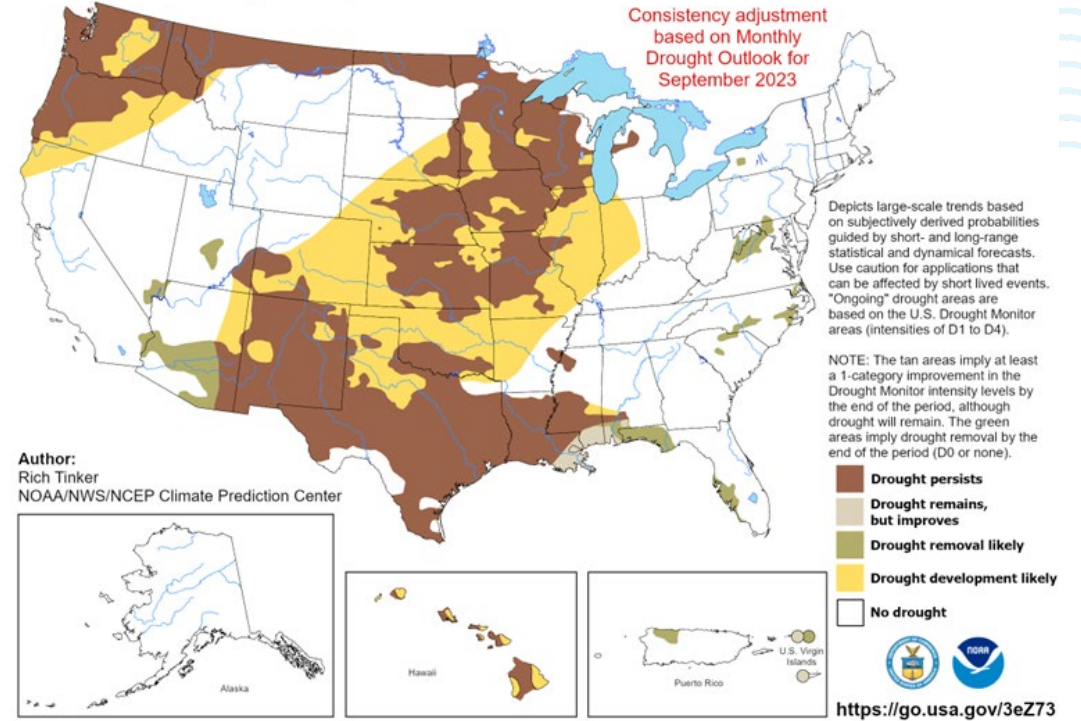
### U.S. Monthly Drought Outlook Drought Tendency During the Valid Period

Valid for September 2023  
Released August 31, 2023



### U.S. Seasonal Drought Outlook Drought Tendency During the Valid Period

Valid for September 1 - November 30, 2023  
Released August 31, 2023



## MONTHLY AND SEASONAL DROUGHT OUTLOOK

The monthly outlook for September released on 8/31 shows no drought development in Massachusetts.

The seasonal outlook for September through November issued on 8/31 shows no drought development in Massachusetts.

<http://www.cpc.ncep.noaa.gov/products/Drought>

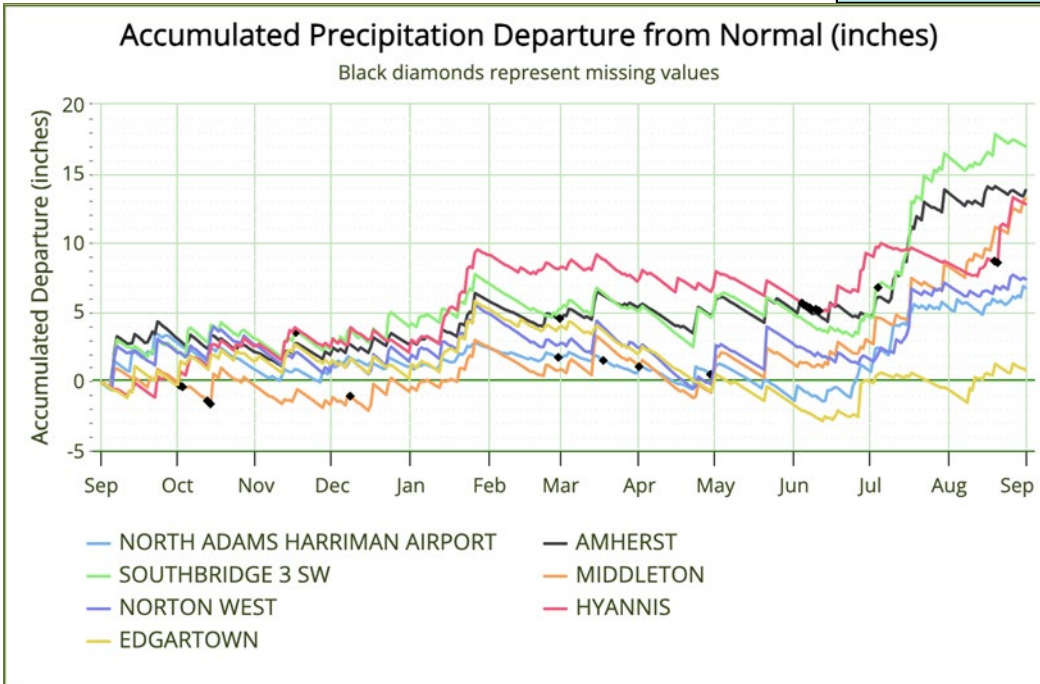




# ADDITIONAL PRECIPITATION DATA

## Standardized Precipitation Index— August 2023 as percentiles

REGION	NUMBER OF SITES	1-mo	2-mo	3-mo	6-mo	9-mo	12-mo	24-mo	36-mo
WESTERN	5	73	94	94	92	90	92	82	87
CTRV	10	59	98	95	94	95	93	71	83
CENTRAL	14	77	99	98	96	97	96	89	92
NORTHEAST	18	95	99	99	98	98	95	77	87
SOUTHEAST	25	76	97	92	87	90	87	72	81
CAPE COD	5	91	85	85	80	93	91	91	77
ISLANDS	3	68	62	59	18	34	56	27	31



DMP Index Severity Levels			
1	2	3	4

## Accumulated Precipitation Departure from 30-Year Normals in Inches

Graph does not consider starting condition's wetness/dryness; does not show summer heat waves with high evapotranspiration; and shows only one station per Drought Region. <https://xmacis.rcc-acis.org/>



# ADDITIONAL PRECIPITATION DATA (CONT.)

## Percent of Average Historical Precipitation—August 2023

REGION	NUMBER OF SITES REPORTING	HISTORICAL AVERAGE	AUGUST AVERAGE (IN)	DEPARTURE FROM HISTORICAL AVERAGE (IN)	PERCENT OF NORMAL
WESTERN	5	4.26	4.88	0.62	115%
CTRV	10	3.98	4.18	0.20	105%
CENTRAL	14	3.97	5.34	1.37	135%
NORTHEAST	18	3.54	8.54	5.00	241%
SOUTHEAST	25	3.95	5.49	1.54	139%
CAPE COD	5	3.54	6.46	2.92	182%
ISLANDS	3	3.47	3.42	-0.05	99%



# DROUGHT MANAGEMENT PLAN INFORMATION

The Massachusetts Drought Management Plan (DMP) can be found at <https://www.mass.gov/doc/massachusetts-drought-management-plan/download>. The document provides details on the Drought Indices, how Drought Levels are determined, and actions associated with each drought level.

## Index Severity Levels (Section 3.4 of the DMP)

## Drought Levels (Section 3.1 of the DMP)

SEVERITY LEVEL	STANDARDIZED PRECIPITATION INDEX (SPI)	STREAMFLOW	LAKES AND IMPOUNDMENTS	GROUNDWATER	KEETCH-BRYAM DROUGHT INDEX (KBDI)	CROP MOISTURE INDEX
0	> 30th percentile				< 200	> -1.0
1	≤ 30 and > 20				200-400	≤ -1.0 and > -2.0
2	≤ 20 and > 10				400-600	≤ -2.0 and > -3.0
3	≤ 10 and > 2				600-700	≤ -3.0 and > -4.0
4	≤ 2				700-800	≤ -4.0

- Level 0** Normal
- Level 1** Mild Drought
- Level 2** Significant Drought
- Level 3** Critical Drought
- Level 4** Emergency Drought



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**Massachusetts Water Resources Commission**

**Executive Office of Energy and Environmental Affairs**

[www.mass.gov/conservemawater](http://www.mass.gov/conservemawater)

[www.mass.gov/drought-management](http://www.mass.gov/drought-management)