MASSACHUSETTS WATER RESOURCES COMMISSION

HYDROLOGIC CONDITIONS IN MASSACHUSETTS

DECEMBER
2023

The Commonwealth of Massachusetts

Maura T. Healey, Governor

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

DECEMBER 2023 HYDROLOGIC CONDITIONS

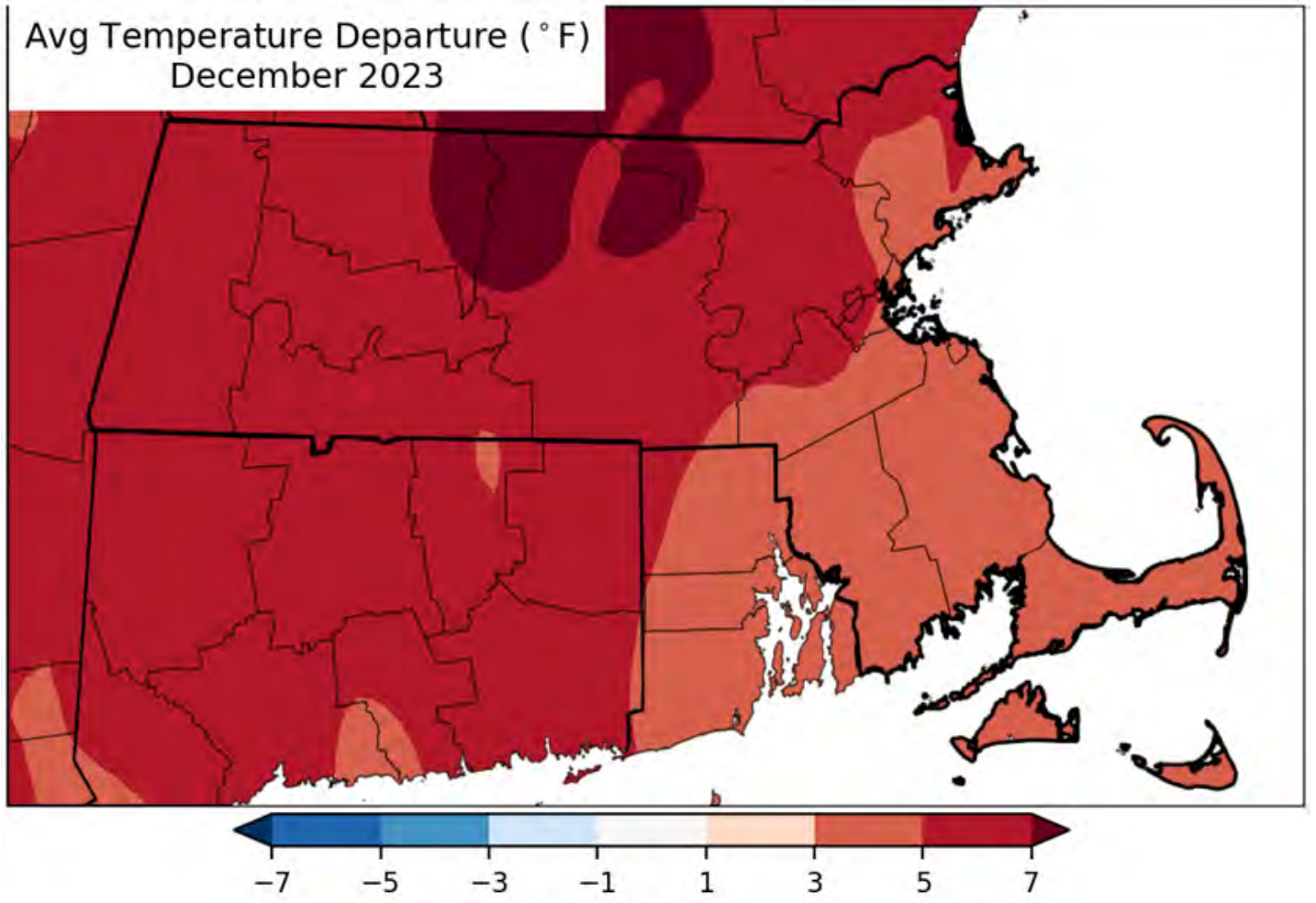
SUMMARY OF CONDITIONS

- Monthly average temperatures were well above normal.
- Precipitation was normal to above normal. The Cape Cod and Islands regions are at an elevated Index Severity Level (ISL) at the 2- and 3-month. There was snow cover remaining at the end of December in western part of the state.
- The Evaporative Demand Drought Index is not reported in December.
- The Keetch-Byram Drought Index is not reported in December.
- Streamflow was above normal except for one gage in the Cape Cod Region. Sixteen rivers crested above flood stage on the 18th through the 19th.
- Groundwater regional medians were above normal except for the Cape Cod Region, which is normal, and the Islands Region, which is elevated at ISL 3.
- Lake and impoundment levels were above their 30th percentile and/or were at or near 100% full.
- NOAA's January outlook shows chances likely for above-normal temperatures and chances leaning for above-normal precipitation.
- NOAA's 3-month outlook shows chances leaning for above-normal temperatures, chances leaning for above-normal precipitation in southeastern parts of the state, and equal chances for above-normal, normal, or below-normal precipitation in the rest of the state.
- 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 01/09/2024. 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

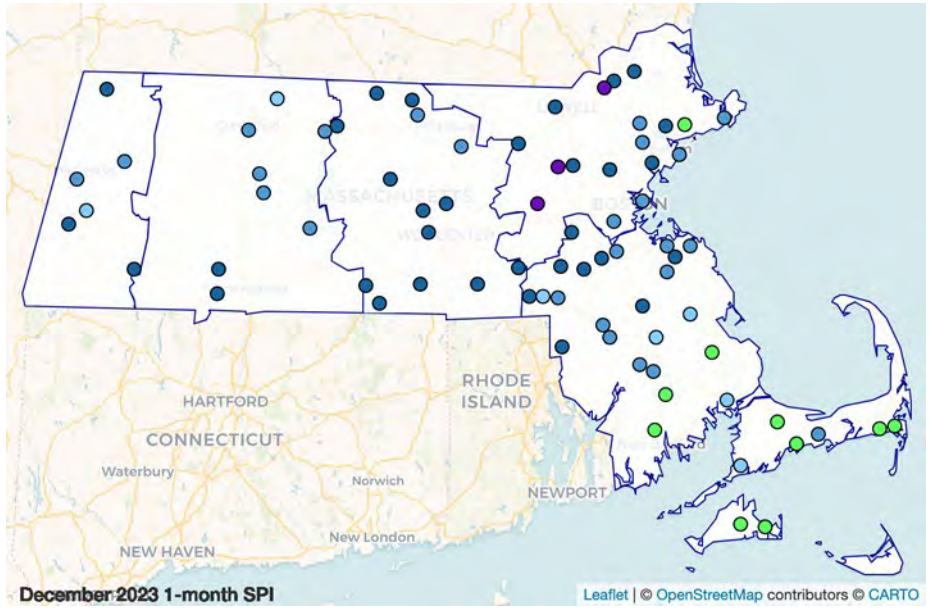
Monthly average temperatures were much above normal. According to the Northeast Regional Climate Center (NRCC), the Boston climate site had its 3rd warmest December on record, and the Worcester site had its 2nd warmest December. Overall, for MA it was the 2nd warmest December on record and 2023 was the warmest year on record.

-http://www.nrcc.cornell.edu/regional/monthly/monthly.html



STANDARDIZED PRECIPITATION INDEX (SPI) AS A PERCENTILE

December precipitation was normal to above normal. Some longer look-back periods are showing deficits in the Cape Cod and Islands Regions. In addition to the table below, Appendix I provides all the look-back periods. According to the NRCC, Massachusetts had its 9th wettest December and 7th wettest year.



≥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	

REGION	NUMBER OF SITES REPORTING	DECEMBER MONTHLY AVERAGE (IN)	DEPARTURE FROM HISTORICAL (IN)	SPI PERCENTILE 1-MONTH	SPI PERCENTILE 3-MONTH	SPI PERCENTILE 6-MONTH
WESTERN	6	5.91	2.37	92	73	92
CTRV	8	6.09	2.27	87	52	95
CENTRAL	14	7.81	3.70	94	60	98
NORTHEAST	18	7.30	3.31	91	53	96
SOUTHEAST	24	7.00	2.58	86	35	89
CAPE COD	6	4.94	0.51	61	12	61
ISLANDS	2	4.05	-0.19	55	7	45

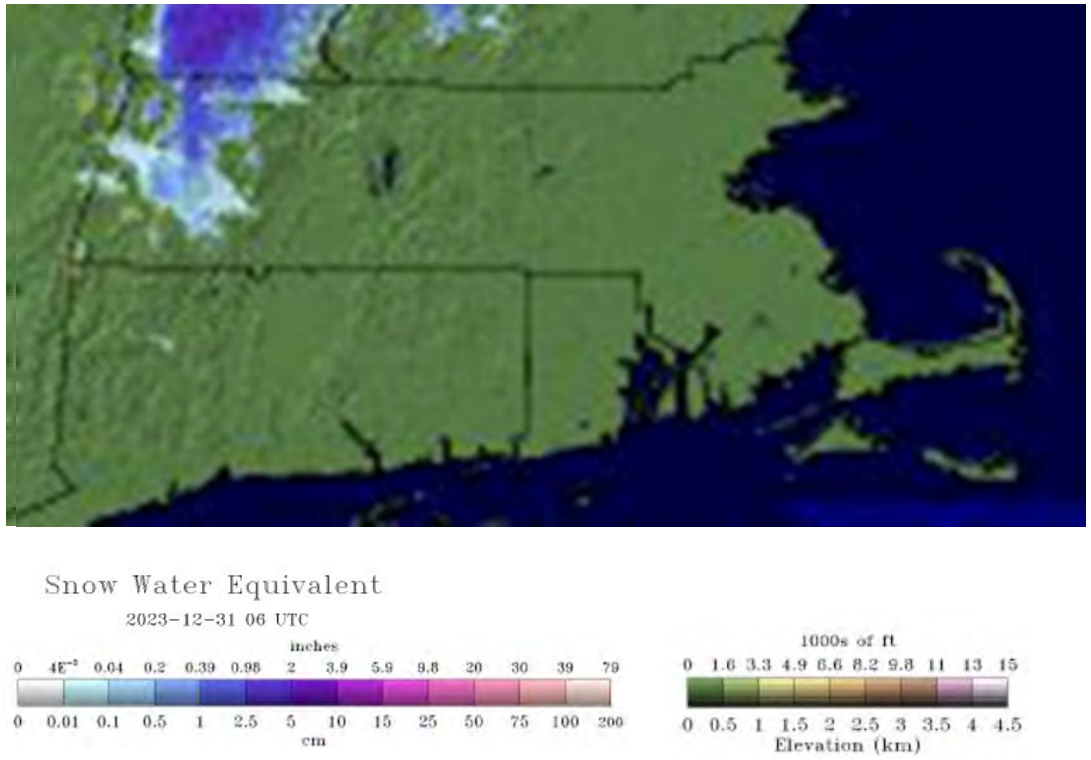
SPI is the Standardized Precipitation Index used in the Drought Management Plan (DMP) expressed here as a percentile and represents the variation from long-term precipitation.

DMP Index Severity Levels			
1	2	3	4

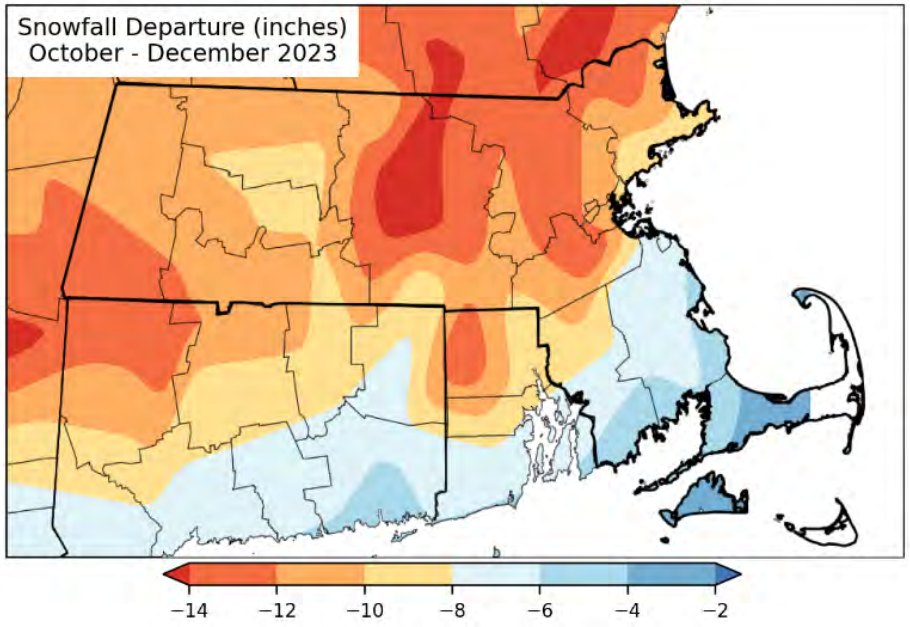
SNOW COVER

At the end of December, there was snow cover in western Massachusetts. According to the NRCC, the Worcester climate site had its least snowy December (14.9” deficit). The Boston climate site had an 8.8” deficit in December.

http://www.nrcc.cornell.edu/regional/monthly/monthly.html

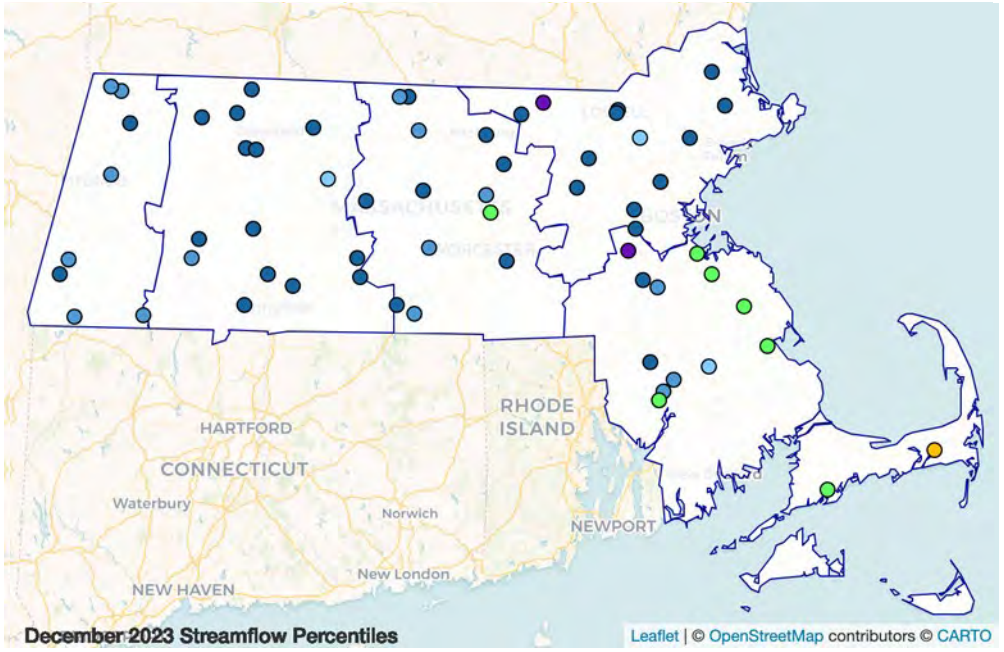


SEASON-TO-DATE SNOWFALL DEPARTURE



During December, streamflow was well above normal across the state except one gage in the Cape Cod Region.

MEDIAN MONTHLY STREAMFLOW PERCENTILES COMPARED TO HISTORICAL VALUES



≥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	

REGION	NUMBER OF GAGES REPORTING	≥0 TO ≤2 PERCENTILE	>2 TO ≤10 PERCENTILE	>10 TO ≤20 PERCENTILE	>20 TO ≤30 PERCENTILE	>90 PERCENTILE	MEDIAN OF INDIVIDUAL GAGE PERCENTILES
WESTERN	8	0	0	0	0	2	89
CTRV	15	0	0	0	0	13	94
CENTRAL	13	0	0	0	0	7	91
NORTHEAST	13	0	0	0	0	12	96
SOUTHEAST	12	0	0	0	0	3	79
CAPE COD	2	0	0	1	0	0	33

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

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		

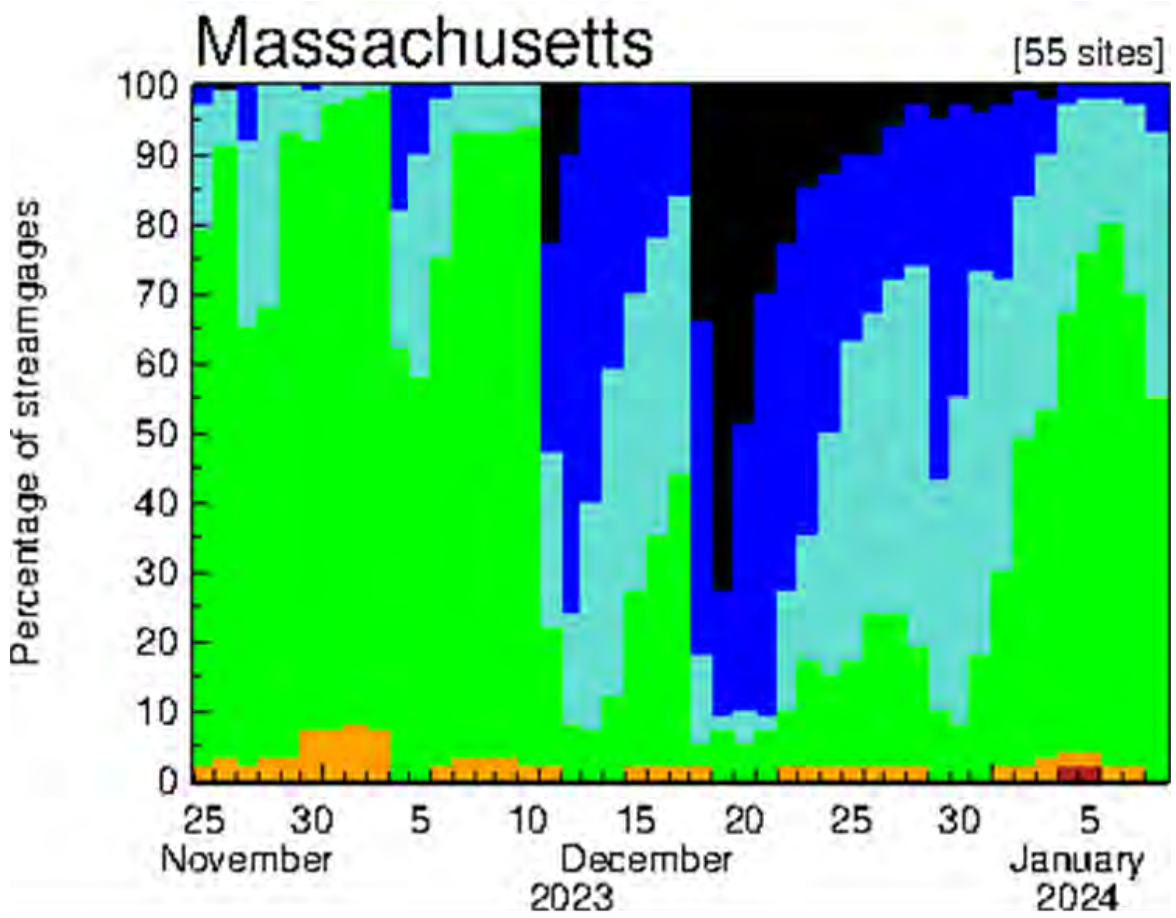


Image: Courtesy of NASA/JPL-Caltech

Norton/Boston NWS E-5 Monthly Report of Hydrologic Conditions indicated river flooding occurred in Massachusetts during December. The Albany NWS E-5 Office did not report river flooding in Massachusetts. With already high streamflows, two storms with heavy precipitation resulted in flood warnings and rivers cresting at flood stage. Searches of the Iowa State University Iowa Environmental Mesonet produced a few storm reports in addition to flood warnings.

December 10-11th: Two rivers forecasted to reach flood stage but did not. There were three areal flood warnings in Worcester and Bristol counties and no flood storm reports.

December 18-19th: 22 rivers forecasted to reach flood stage and 16 did in the Connecticut, Merrimack, Charles, Neponset, and Shawsheen basins. There were three areal flood warnings in Hampshire, Hamden, and Norfolk counties, and one flood storm report in Williamsburg.

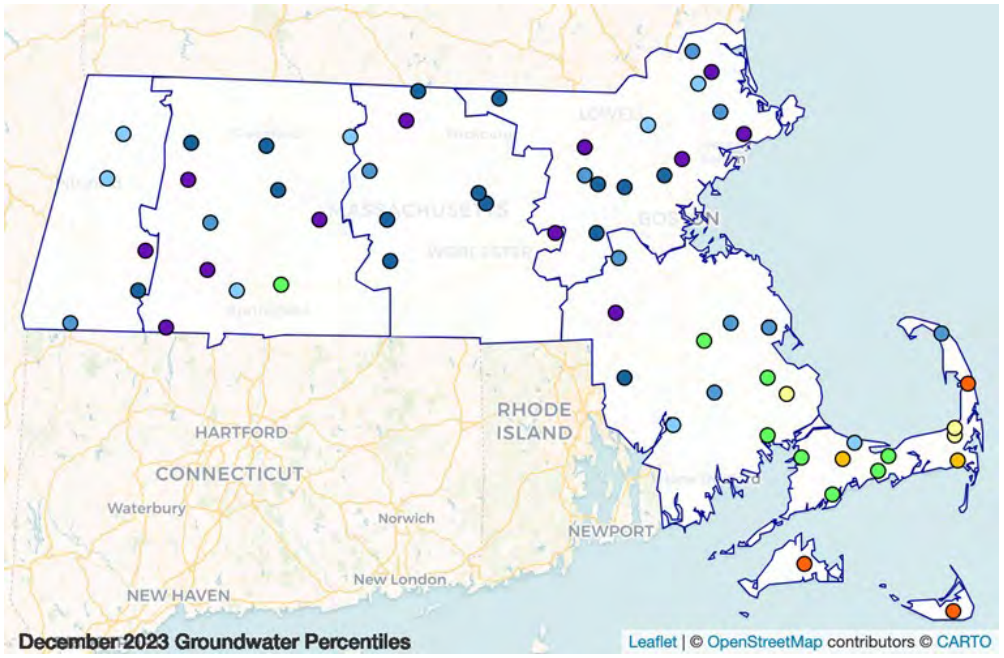
2023 Weather Year in Review Boston NWS including flood events:

https://storymaps.arcgis.com/stories/f1bde8168bcb440b86d47409ef04042a

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

December groundwater levels ranged from below normal to much above normal. Regional medians were above normal except for Cape Cod in the low-end of normal and the Islands Region, which is at ISL 3.

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



≥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	

REGION	NUMBER OF WELLS REPORTING	≥0 TO ≤2 PERCENTILE	>2 TO ≤10 PERCENTILE	>10 TO ≤20 PERCENTILE	>20 TO ≤30 PERCENTILE	>90 PERCENTILE	MEDIAN OF INDIVIDUAL WELL PERCENTILES
WESTERN	5	0	0	0	0	2	81
CTRV	11	0	0	0	0	7	97
CENTRAL	8	0	0	0	0	7	94
NORTHEAST	14	0	0	0	0	9	94
SOUTHEAST	12	0	0	0	1	2	78
CAPE COD	11	0	1	2	2	0	34
ISLANDS	2	0	2	0	0	0	6

DMP Index Severity Levels			
1	2	3	4

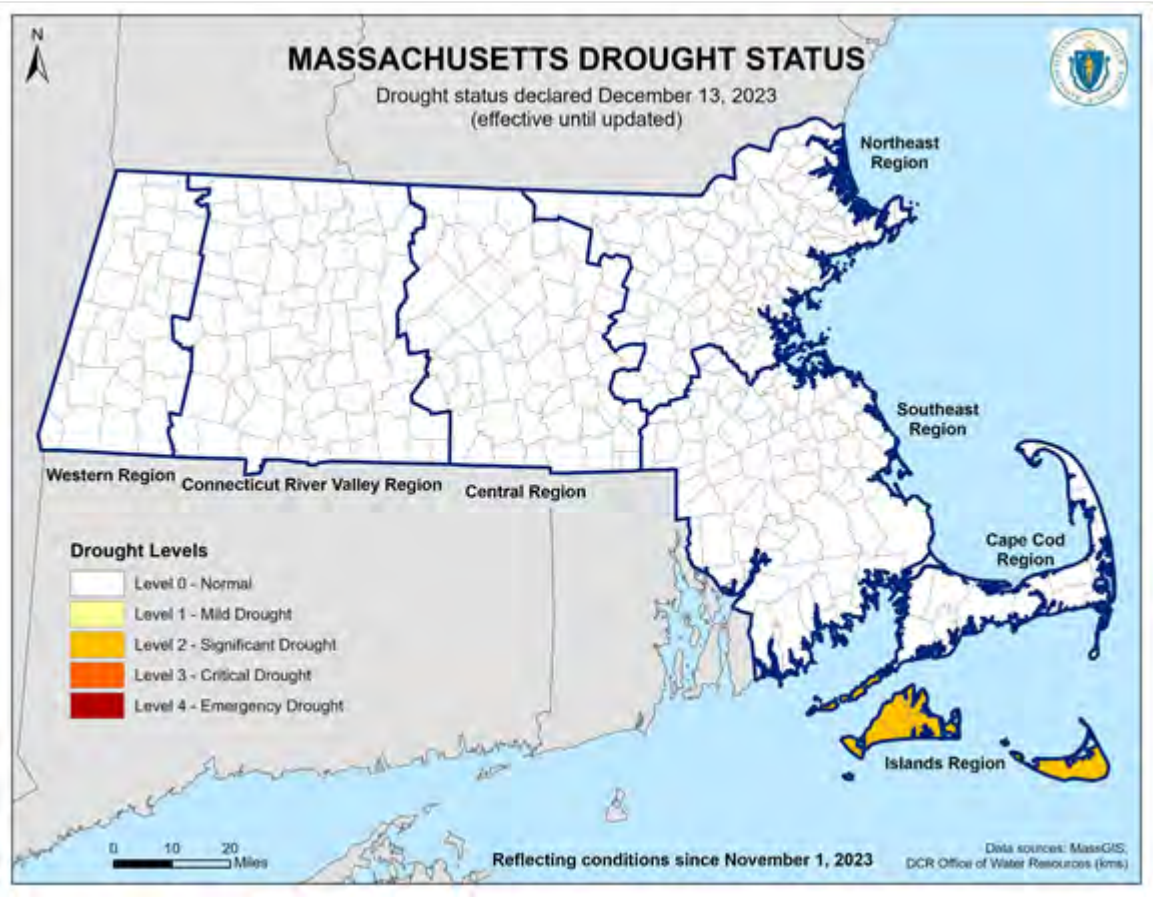
At the end of December, reporting lake and impoundment levels were above their 30th percentile and/or were at or near 100% full.

REGION	NUMBER OF SITES REPORTING	MEDIAN OF INDIVIDUAL PERCENTILES OR PERCENT FULL
WESTERN	2	64th
CTRV	2	89th
CENTRAL	3	85th
NORTHEAST	2	86th
SOUTHEAST	2	91st
CAPE COD	1	37th

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

DMP Index Severity Levels			
1	2	3	4

MASSACHUSETTS DROUGHT STATUS

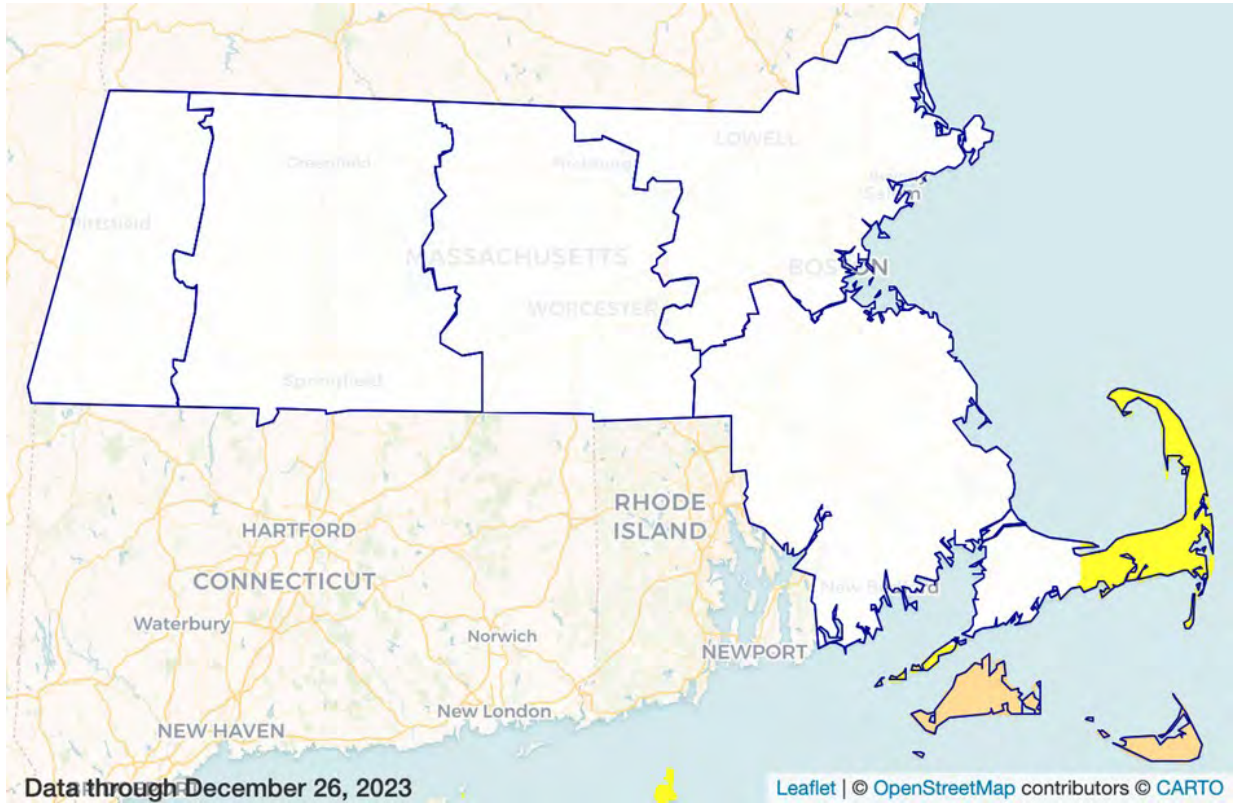


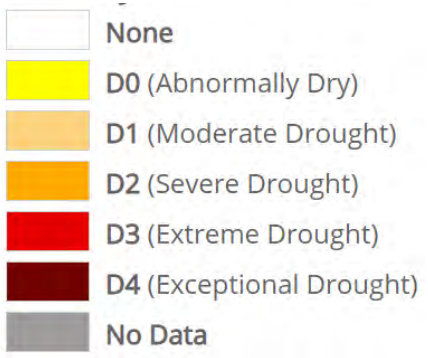
On December 13, 2023, Massachusetts Energy and Environmental Affairs (EEA) Secretary Rebecca L. Tepper declared that starting from November 1, 2023, the Islands Region is at Level 2 Significant Drought. This status remains in effect until further updated.

U.S. DROUGHT MONITOR (USDM)

At the end of December, the USDM showed areas of D1 on the Islands and D0 in the mid-Mid to the Outer Cape.

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

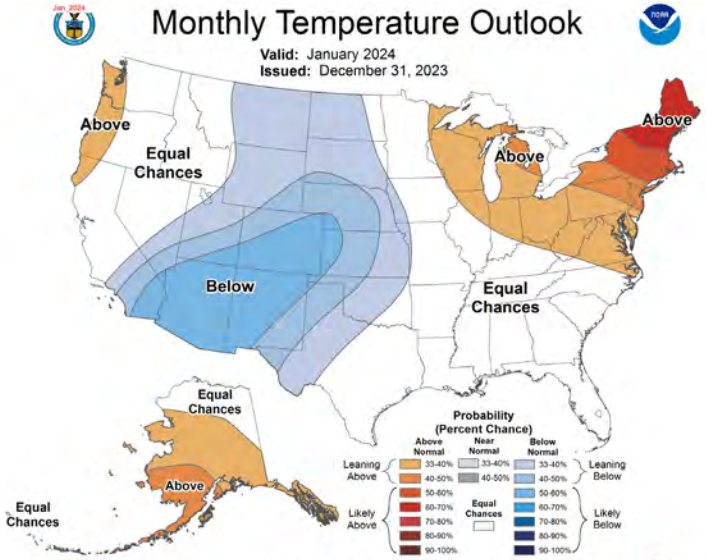


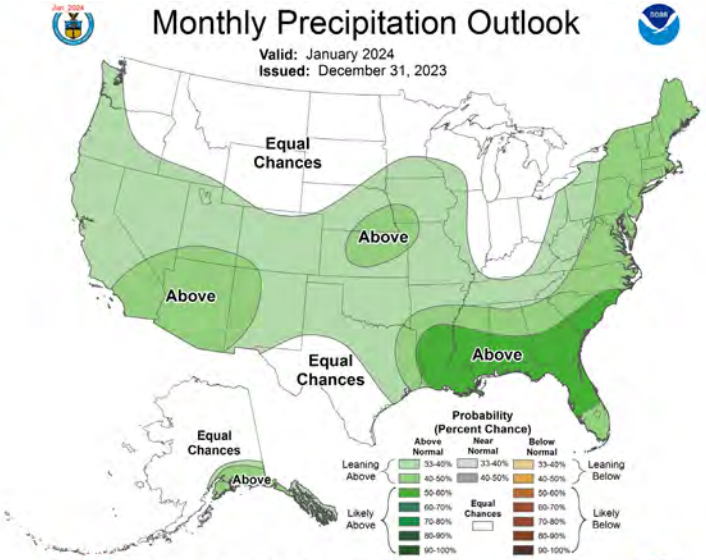


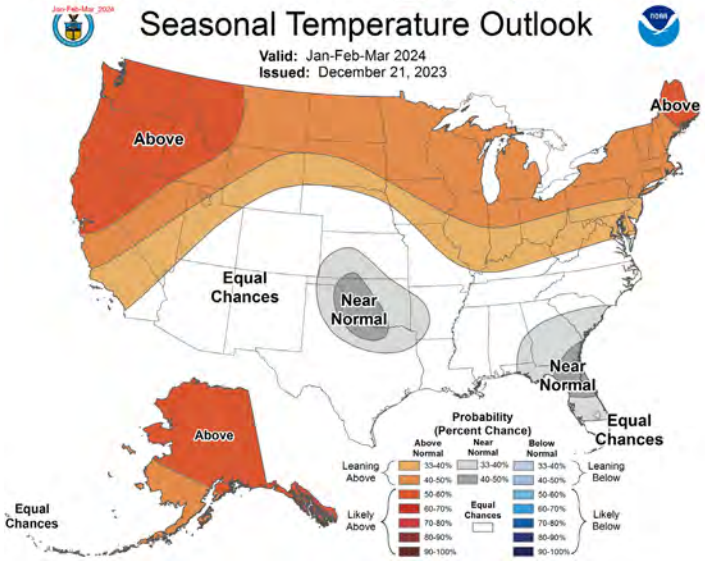
TEMPERATURE AND PRECIPITATION OUTLOOK

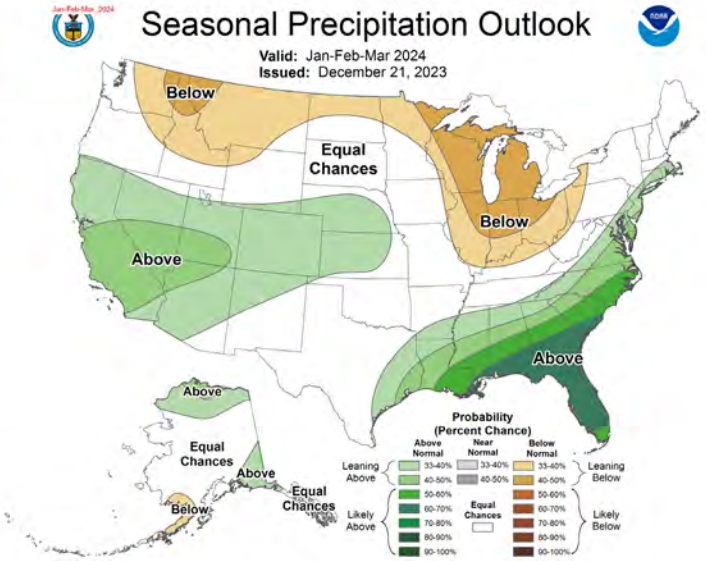
January: The outlook issued 12/31 shows a 50-60% chance of above-normal temperatures and a 40-50% chance of above-normal precipitation.

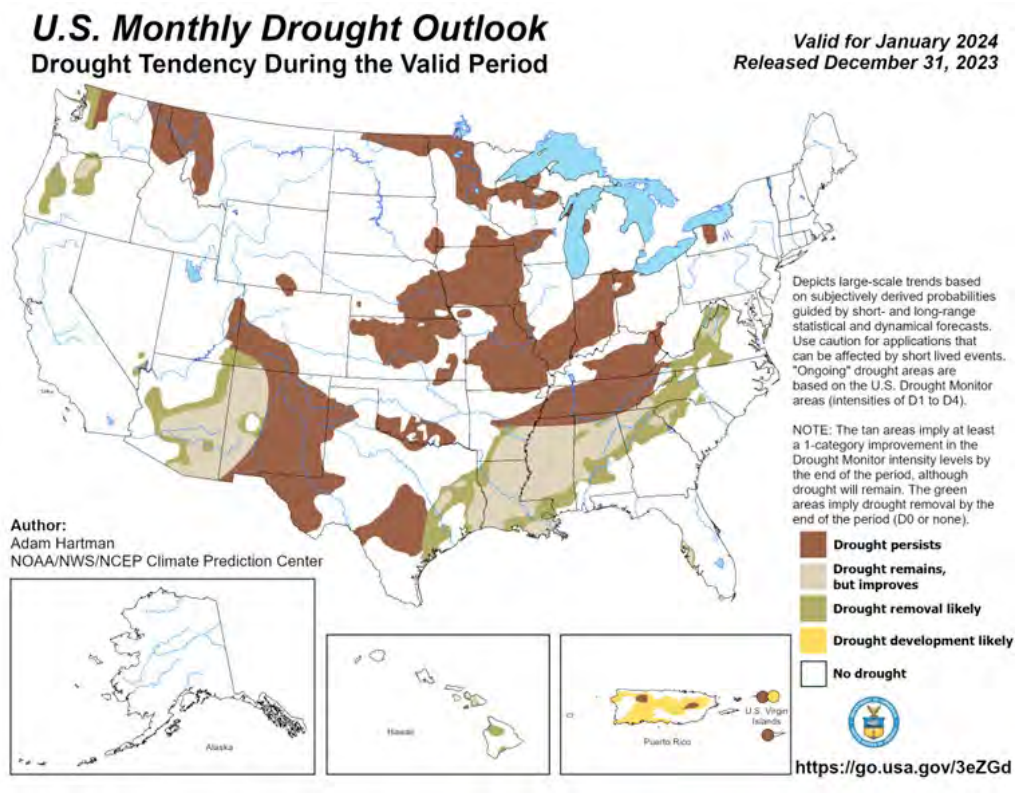
January through March: The seasonal outlook issued 12/21 shows a 40-50% chance of above-normal temperatures, a 33-40% chance of above-normal precipitation in southeastern parts of the state, and equal chances for above-normal, normal, or below-normal precipitation in the rest of the state.
https://www.cpc.ncep.noaa.gov/

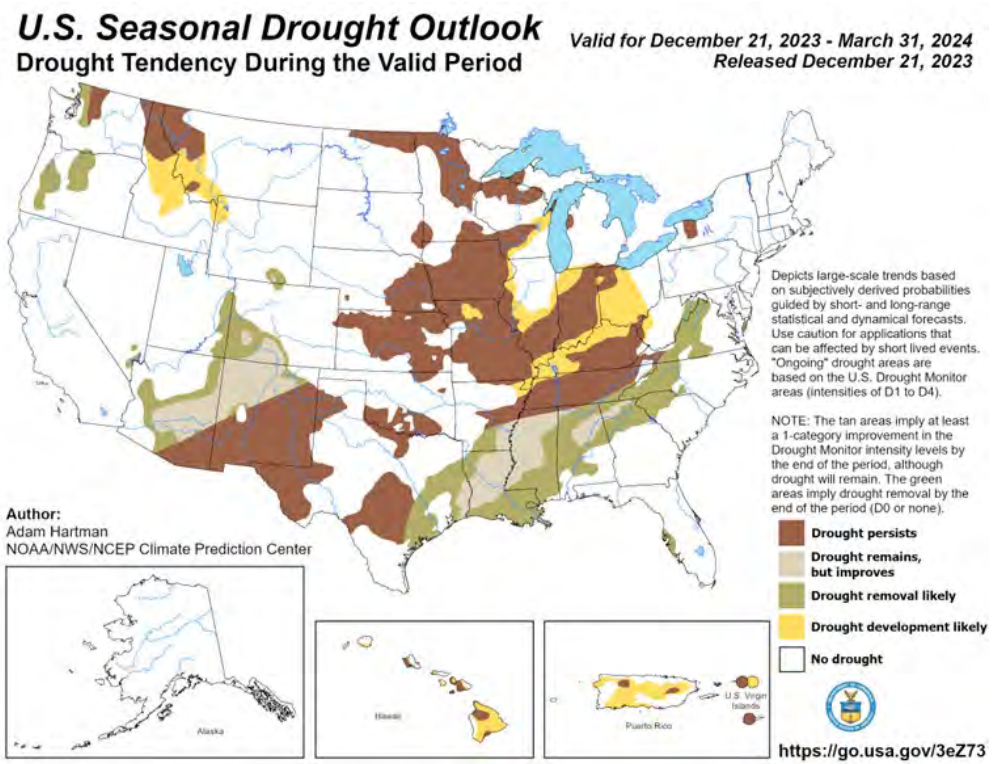












MONTHLY AND SEASONAL DROUGHT OUTLOOK

The monthly outlook for January released on 12/31 shows no drought development in Massachusetts.

The seasonal outlook for January through March issued on 12/21 shows no drought development in Massachusetts.

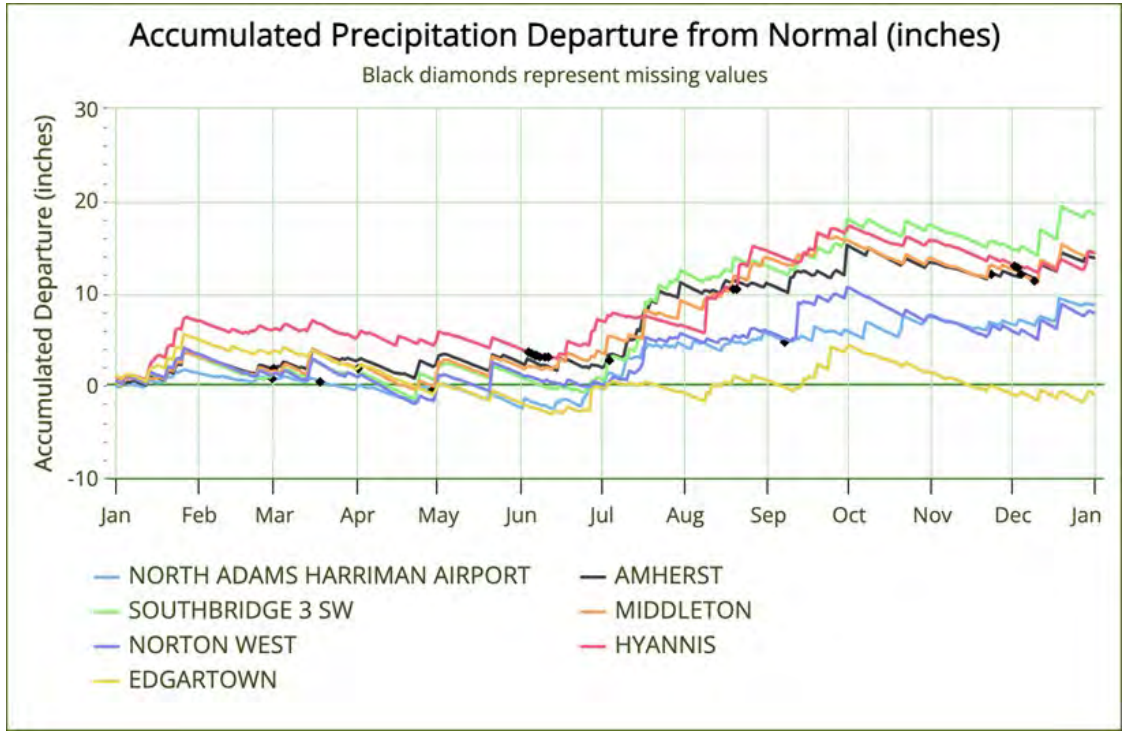
http://www.cpc.ncep.noaa.gov/products/Drought

APPENDIX I

ADDITIONAL PRECIPITATION DATA

Standardized Precipitation Index—December 2023 as percentiles

REGION	NUMBER OF SITES	1-mo	2-mo	3-mo	6-mo	9-mo	12-mo	24-mo	36-mo
WESTERN	6	92	65	73	92	90	88	76	91
CTRV	8	87	59	52	95	92	94	80	88
CENTRAL	14	94	68	60	98	97	97	90	95
NORTHEAST	18	91	73	53	96	95	96	70	87
SOUTHEAST	24	86	59	35	89	85	85	70	79
CAPE COD	6	61	25	12	61	60	76	73	84
ISLANDS	2	55	21	7	45	26	36	18	25



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—December 2023

REGION	NUMBER OF SITES REPORTING	HISTORICAL AVERAGE	DECEMBER AVERAGE (IN)	DEPARTURE FROM HISTORICAL AVERAGE (IN)	PERCENT OF NORMAL
WESTERN	6	3.54	5.91	2.37	167%
CTRV	8	3.82	6.09	2.27	159%
CENTRAL	14	4.11	7.81	3.70	190%
NORTHEAST	18	3.99	7.30	3.31	183%
SOUTHEAST	24	4.42	7.00	2.58	158%
CAPE COD	6	4.43	4.94	0.51	112%
ISLANDS	2	4.24	4.05	-0.19	96%

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)

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

Drought Levels (Section 3.1 of the DMP)

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

Massachusetts Water Resources Commission

Executive Office of Energy and Environmental Affairs

www.mass.gov/conservemawater

www.mass.gov/drought-management