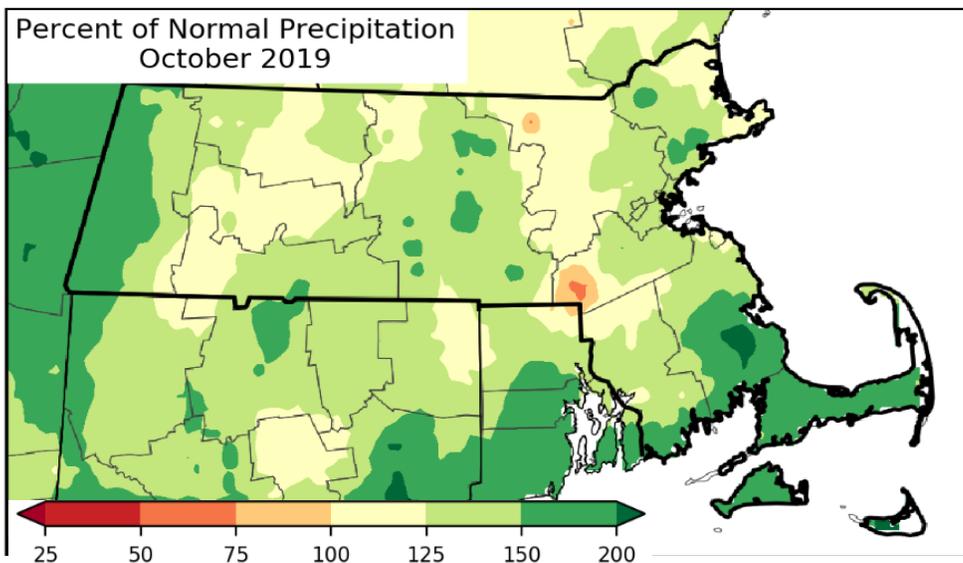


October 2019 Hydrologic Conditions in Massachusetts

SUMMARY OF CONDITIONS

- Temperatures were average to slightly above average for October.
- Significant rain events the second half of the month resulted in index severity levels of 0 for all regions.
- Streamflows and groundwater levels recovered sufficiently to result in index levels of 0 for all regions.
- Lakes & Impoundments by drought region are at index severity level 0.
- At the end of the month, Crop Moisture and Keetch-Byram Drought Indices were level 0 for all regions.
- For November, NOAA projects 50% -60% chance for below-normal temperatures and equal chances for above-normal, normal, or below-normal precipitation.
- Appendix I and II provide additional information on precipitation data and the Massachusetts Drought Management Plan (DMP) , respectively.

PRECIPITATION



Precipitation was below normal for the first half of the month. However, two significant rain events in the second half of the month provided sufficient rain to total well above historical average for the month for the entire state. All look-back periods for the SPI are at Severity Level 0.

Map from the Northeast Regional Climate Center. <http://www.nrcc.cornell.edu/regional/monthly/monthly.html>

Region	Number of Sites	Average Precipitation (inches)	Departure from Average Oct. (inches)	MA Drought Plan Standardized Precipitation Index 1-month	MA Drought Plan Standardized Precipitation Index 2-month	MA Drought Plan Standardized Precipitation Index 3-month
Western	5	6.71	2.14	1.11	0.05	-0.14
CT River Valley	11	6.24	1.97	0.80	0.01	-0.19
Central	12	6.59	2.41	1.17	0.30	0.41
Northeast	13	5.90	2.17	1.00	0.09	0.18
Southeast	15	6.01	1.62	0.73	0.06	-0.26
Cape Cod	4	6.63	2.40	1.06	0.93	0.38
Islands	3	6.90	2.70	1.24	1.00	0.42

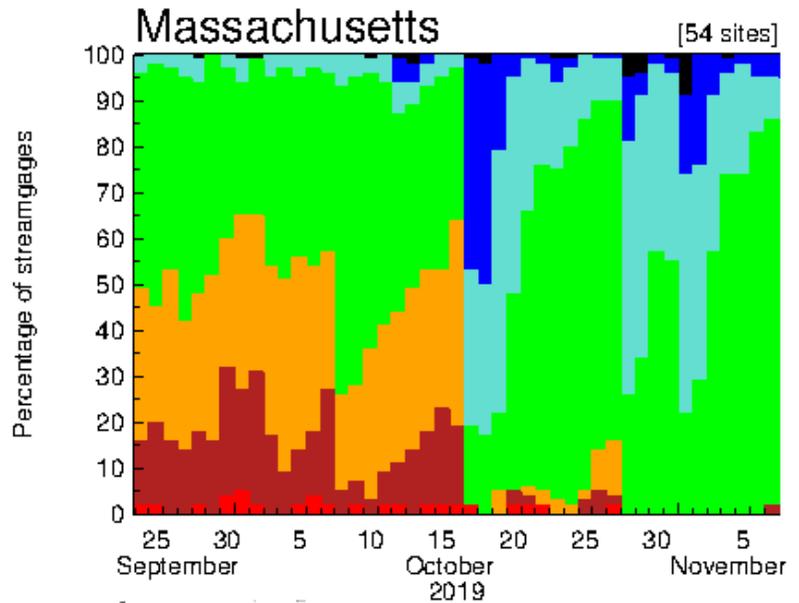
STREAMFLOW

Streamflows were significantly below historical values the first half of the month. Significant rain events mid month and second half of the month raised streamflow levels to historical averages. Overall, the median monthly flow remains below the 30th percentile at several gages but all drought regions are back at Index Severity 0.

Time Series of Daily Streamflows Compared to Historical Values

https://waterwatch.usgs.gov/index.php?id=real&sid=w_plot_sum&r=ma

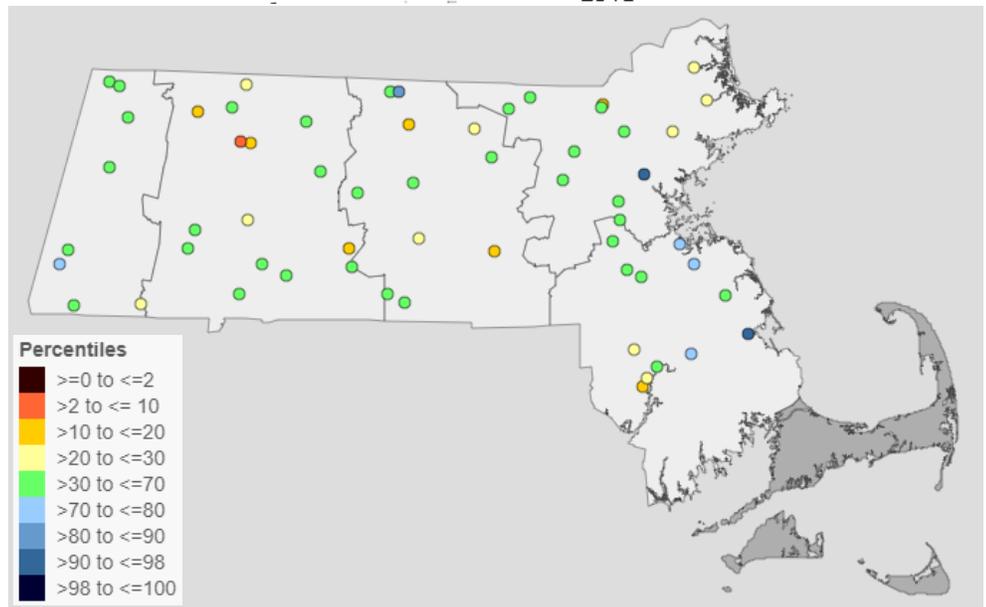
Explanation - Percentile classes							
Low	<10	10-24	25-75	76-90	>90	High	No Data
	Much below normal	Below normal	Normal	Above normal	Much above normal		



Median Monthly Streamflows Compared to Historical Median Values

Streamflow is monitored by the Commonwealth of Massachusetts and United States Geological Survey (USGS) cooperative stream gaging program.

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



Region	Number of Gages						Median of Individual Gage Percentiles	MA Drought Plan Index Severity
	Total Reporting for Oct.	≥0 to <=2 Percentile	>2-≤10 Percentile	>10-≤20 Percentile	>20-≤30 Percentile	>90th percentile		
Western	8	0	0	0	1	0	59	0
CT River Valley	15	0	1	3	2	0	35	0
Central	11	0	0	2	2	0	41	0
Northeast	13	0	0	1	3	1	35	0
Southeast	12	0	0	1	2	1	56	0

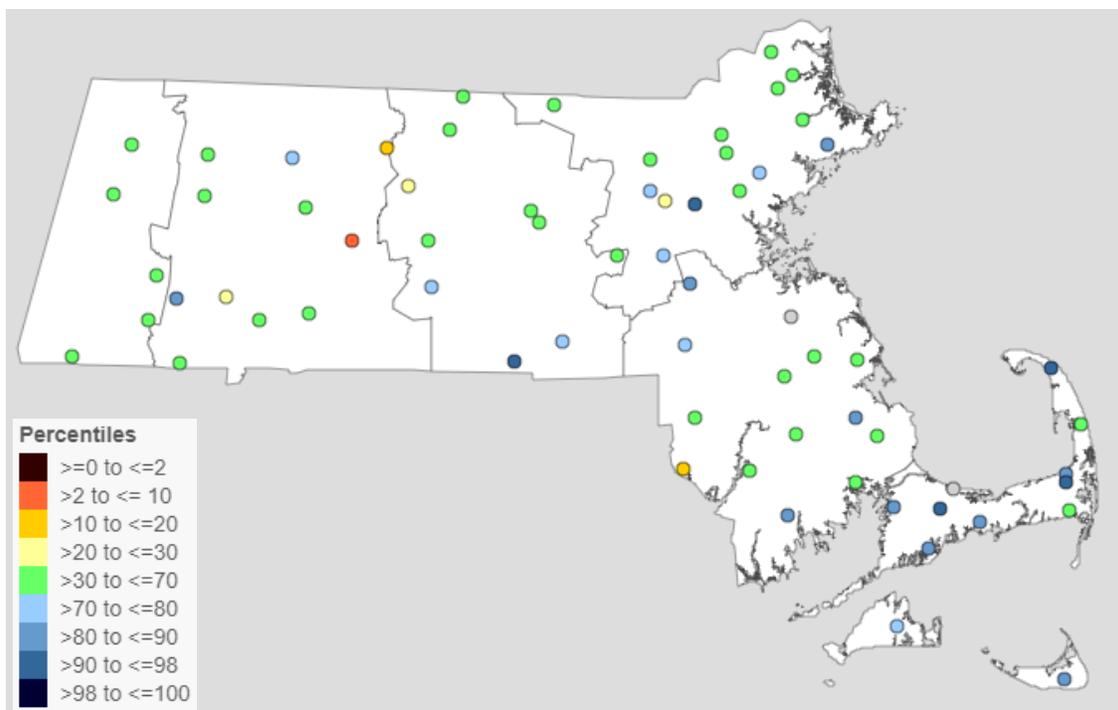
Notes: Not all gages report in all months due to ice, beaver dams or other conditions. Streamflow index is not applicable to Cape Cod and the Islands.

GROUNDWATER

Except for 6 wells, well across the state have recovered from previous precipitation deficits. The remaining wells have greater depth-to-water. It will take additional time for the precipitation from the second half of October to percolate to those aquifers.

End of October Groundwater Values Compared to Historical in the Climate Response Networks

<https://groundwaterwatch.usgs.gov/NetMapT1L2.asp?ncd=crn&sc=25>



Region	Number of Wells						Median of Individual Gage Percentiles	MA Drought Plan Index Severity
	Total Reporting for Oct.	≥0 to ≤2 Percentile	>2-≤10 Percentile	>10-≤20 Percentile	>20-≤30 Percentile	>90th Percentile		
Western	5	0	0	0	0	0	42	0
CT River Valley	11	0	1	1	1	0	53	0
Central	10	0	0	0	1	1	48	0
Northeast	15	0	0	0	1	1	59	0
Southeast	13	0	0	1	0	0	65	0
Cape Cod	9	0	0	0	0	3	87	0
Islands	2	0	0	0	0	0	79	0

LAKES and IMPOUNDMENTS

At the end October, all drought regions were above the 30th percentile (Index Severity 0) .

Region	Total Reporting for Oct.	Median of Lakes and Impoundments Percentiles	MA Drought Management Plan Lakes and Impoundments Index
Western	2	51	0
CT River Valley	2	32	0
Central	2	55	0
Northeast	7	65	0
Southeast	2	55	0
Cape Cod	1	87	0
Islands	N/A	N/A	N/A

KEETCH BYRAM INDEX (KBDI)

The DCR Fire Chief reported that all KBDI values are under 150 due to a combination of the precipitation in the second half of October and colder temperatures.

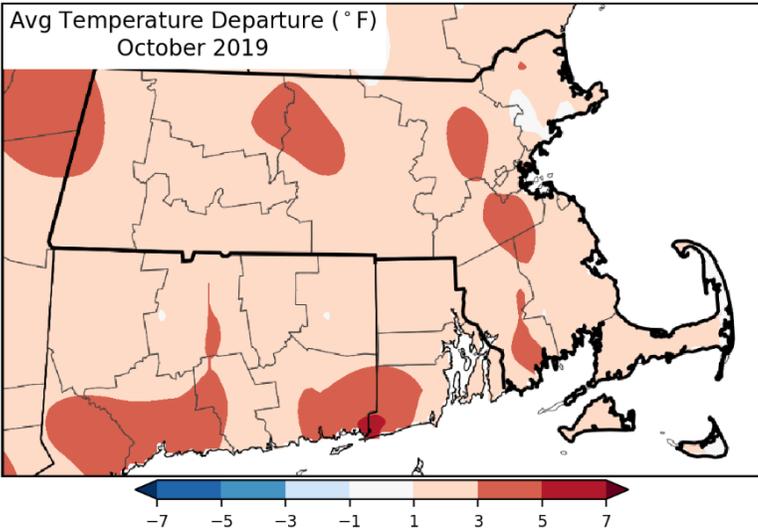
Region	KBDI values for the end of October	Drought Index Severity
Western	<150	0
CT River Valley	<150	0
Central	<150	0
Northeast	<150	0
Southeast	<150	0
Cape Cod	<150	0
Islands	<150	0

CROP MOISTURE INDEX (CMI)

The CMI map for the week ending November 2, 2019 shows Excessive Wet conditions for the Western Region and Wet conditions for the rest of the state, resulting in the Drought Index Severity Level of 0 for all regions.

The CMI shows the short-term need versus available water in a shallow soil profile and responds quickly to changing conditions. The drought level for this indicator is determined based on the repeated or extended occurrence at a given level. This indicator is most relevant during growing season. https://www.cpc.ncep.noaa.gov/products/analysis_monitoring/regional_monitoring/cmi.gif

TEMPERATURE & SNOWFALL



Temperature

Monthly average temperatures ranged from slightly above average to above average for this time of the year. <http://www.nrcc.comell.edu/regional/monthly/monthly.html>

Boston daily temperatures ranged from 42° F to 81° F. Deviation from historical daily average temperatures were -8.2 to +16.2 ° F, respectively. <https://w2.weather.gov/climate/index.php?wfo=box>

Season-to-date Snowfall Departure and Snow Cover

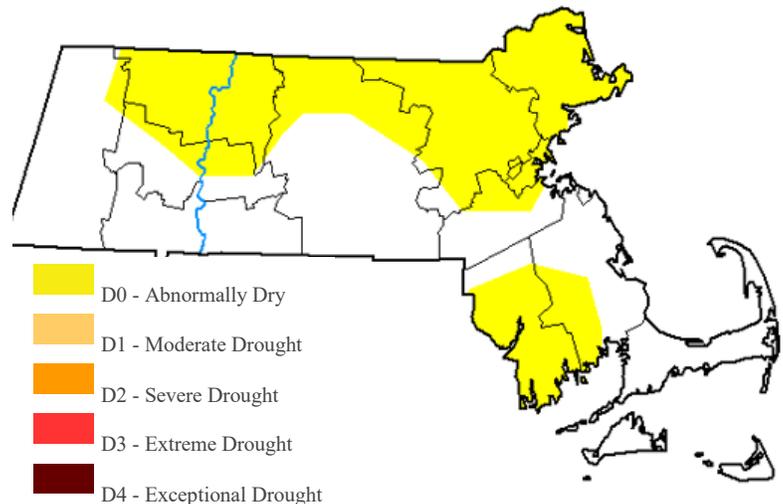
Information provided seasonally.

DROUGHT CONDITIONS AND FORECASTS BY NOAA AND PARTNERS

U.S. Drought Monitor as of October 29, 2019

Summary: The USDM map still showed Abnormally Dry conditions at the end of October.

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



NOAA Climate Prediction Center: Temperature and Precipitation Outlook

November: The outlook projects 50% -60% chance for below-normal temperatures and equal chances for above-normal, normal, or below-normal precipitation.

November through January: The outlook projects 40-50% chance of above-normal temperatures and equal chances for below-normal, normal, or above-normal precipitation.

Monthly and Seasonal Drought Outlook

The monthly outlook for November and seasonal outlook valid through January do not project drought conditions. <http://www.cpc.ncep.noaa.gov/products/Drought/>

This report was prepared by the Massachusetts Department of Conservation and Recreation. Data may be preliminary. Additional information, previous reports, and drought management information can be found at <https://www.mass.gov/water-data-tracking>.

Appendix I— Additional Precipitation Data

Standardized Precipitation Index for October 2019

Drought Region	Number of Sites	SPI1	SPI2	SPI3	SPI6	SPI9	SPI12	SPI24	SPI36
Western	5	1.11	0.05	-0.14	-0.19	-0.13	0.90	0.96	0.84
Connecticut River	11	0.80	0.01	-0.19	-0.28	-0.05	0.75	1.20	1.12
Central	12	1.17	0.30	0.41	0.35	0.68	1.45	1.50	1.58
Northeast	13	1.00	0.09	0.18	0.46	0.65	1.03	1.09	1.02
Southeast	15	0.73	0.06	-0.26	0.39	0.64	1.14	1.42	1.07
Cape Cod	4	1.06	0.93	0.38	0.62	0.75	1.22	1.34	1.16
Islands	3	1.24	1.00	0.42	0.90	0.97	1.46	0.89	1.05

Key to Drought Plan SPI Severity Levels	
0	>-0.52
1	≤ -0.52 and > -0.84
2	≤ -0.84 and > -1.28
3	≤ -1.28 and > -2.05
4	≤ -2.05

Percent of Average Historical Precipitation

Major Basin	Number of Sites	Historical (inches)	Actual (inches)	Departure from Historical (inches)	Percent of Historical
Western	5	4.48	6.71	2.14	147
Connecticut River	11	4.20	6.24	1.97	145
Central	12	4.27	6.59	2.41	155
Northeast	13	3.83	5.90	2.17	159
Southeast	15	4.52	6.01	1.62	137
Cape Cod	4	4.22	6.63	2.40	158
Islands	3	4.05	6.90	2.70	169

DCR Precipitation Reports are available at: <https://www.mass.gov/service-details/precipitation-composite-estimates-1> and <https://www.mass.gov/service-details/standardized-precipitation-index-spi-0>

Appendix II— 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.

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

Index Severity Levels (Section 3.4 of the DMP)

Severity Level	Standardized Precipitation	Stream-flow	Lakes and Impoundments	Ground-water	Keetch-Byram Drought	Crop Moisture
0	>30 th 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