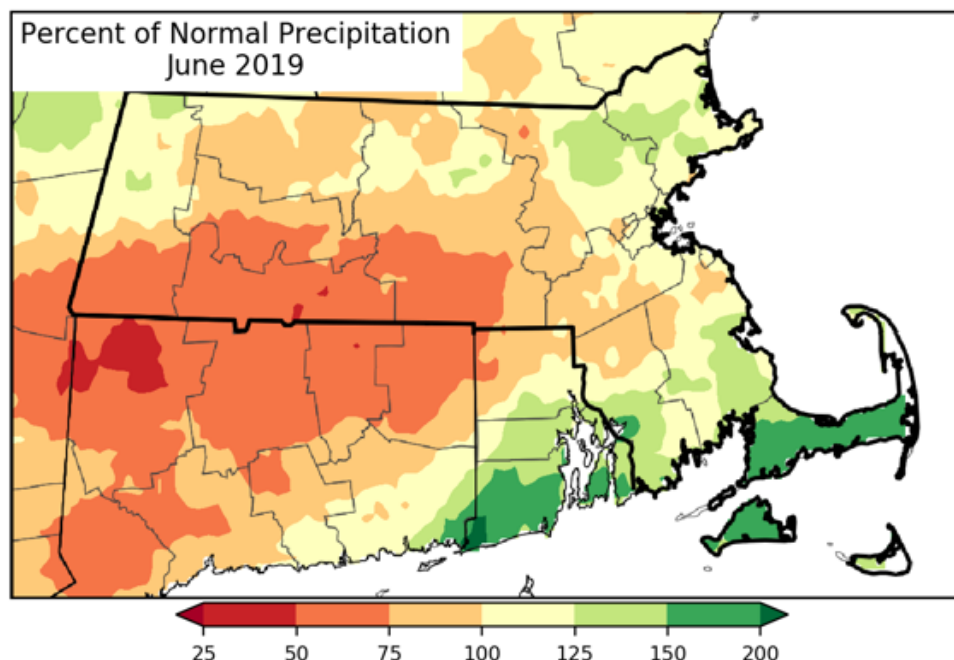


June 2019 Hydrologic Conditions in Massachusetts

SUMMARY OF CONDITIONS

- Monthly average temperatures were near historical average.
- Precipitation ranged from well above average to below average; however, both Precipitation Indices remain Normal for all regions.
- Streamflows were mostly near average for the month and the Streamflow Index is Normal for all regions.
- Groundwater levels were mostly at or above average except in the CT River Region where levels ranged from below the 10th to greater than the 90th percentile; however, the Index is Normal for all regions.
- Reservoir and Crop Moisture Indices are Normal for all regions.
- Keetch-Byram Drought Index is at the Advisory level for all regions except the Western and Cape Cod & Islands regions. The Fire Chief stated that there are no areas of concern for fire danger.
- For July, NOAA projects equal chances for above, at, or below average temperatures and precipitation.
- Appendix I details additional precipitation data. Appendix II presents drought level thresholds for indices.

PRECIPITATION



Precipitation ranged widely from below average in the southwest portion of the state to well above average in the southeast. Despite month-to-month variability in rainfall since February, both drought indices for precipitation remain Normal for all regions.

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

Region	Estimated Precipitation (inches)	Departure from Average June (inches)	MA Drought Plan Levels	
			Standardized Precipitation Index (SPI)	Percent of Normal Index
Western	4.87	0.72	Normal	Normal
CT River Valley	3.54	-0.41	Normal	Normal
Central	4.03	0.26	Normal	Normal
Northeast	4.21	0.78	Normal	Normal
Southeast	4.50	1.13	Normal	Normal
Cape Cod & Islands	6.96	3.59	Normal	Normal

Key to Drought Plan Levels

Normal

Advisory

Watch

Warning

Emergency

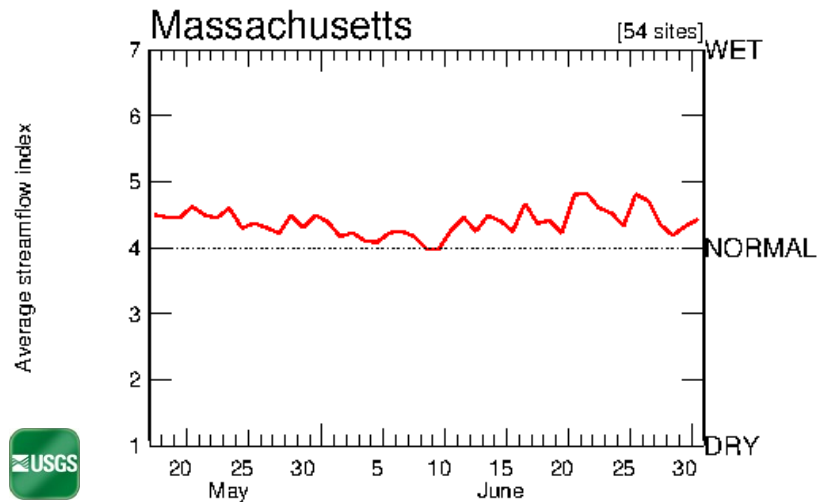
STREAMFLOW

The state-wide averages of daily streamflows were near average historical values. Monthly average streamflows at individual gages ranged from average to above average with one gage still registering at greater than its respective 90th percentile value for the month.

Average Daily Streamflow Compared to Historical for the Day of the Year

KEY:

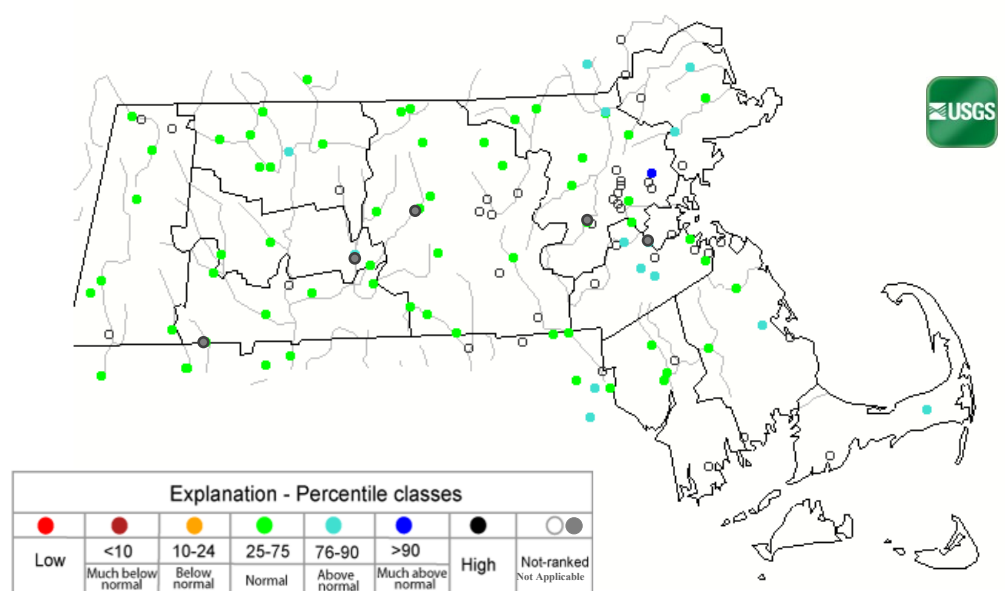
- 1 = New record low for day
- 2 = < 10th percentile
- 3 = 10th – 24th percentile
- 4 = 25th – 74th percentile
- 5 = 75th – 89th percentile
- 6 = > 90th percentile
- 7 = New record high for day



Average June Streamflow Compared to Historical for the Month of the Year

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

<http://waterwatch.usgs.gov/index.php?r=ma&id=mv01d>



Region	Number of Gages				>90th percentile flow	MA Drought Plan Index/# of consecutive months majority below 25th percentile
	Total Reporting for June	<25th to 10th percentile	<10th percentile to above record low	Record low		
Western	6	0	0	0	0	Normal/0
CT River Valley	14	0	0	0	0	Normal/0
Central	11	0	0	0	0	Normal/0
Northeast	17	0	0	0	1	Normal/0
Southeast	6	0	0	0	0	Normal/0

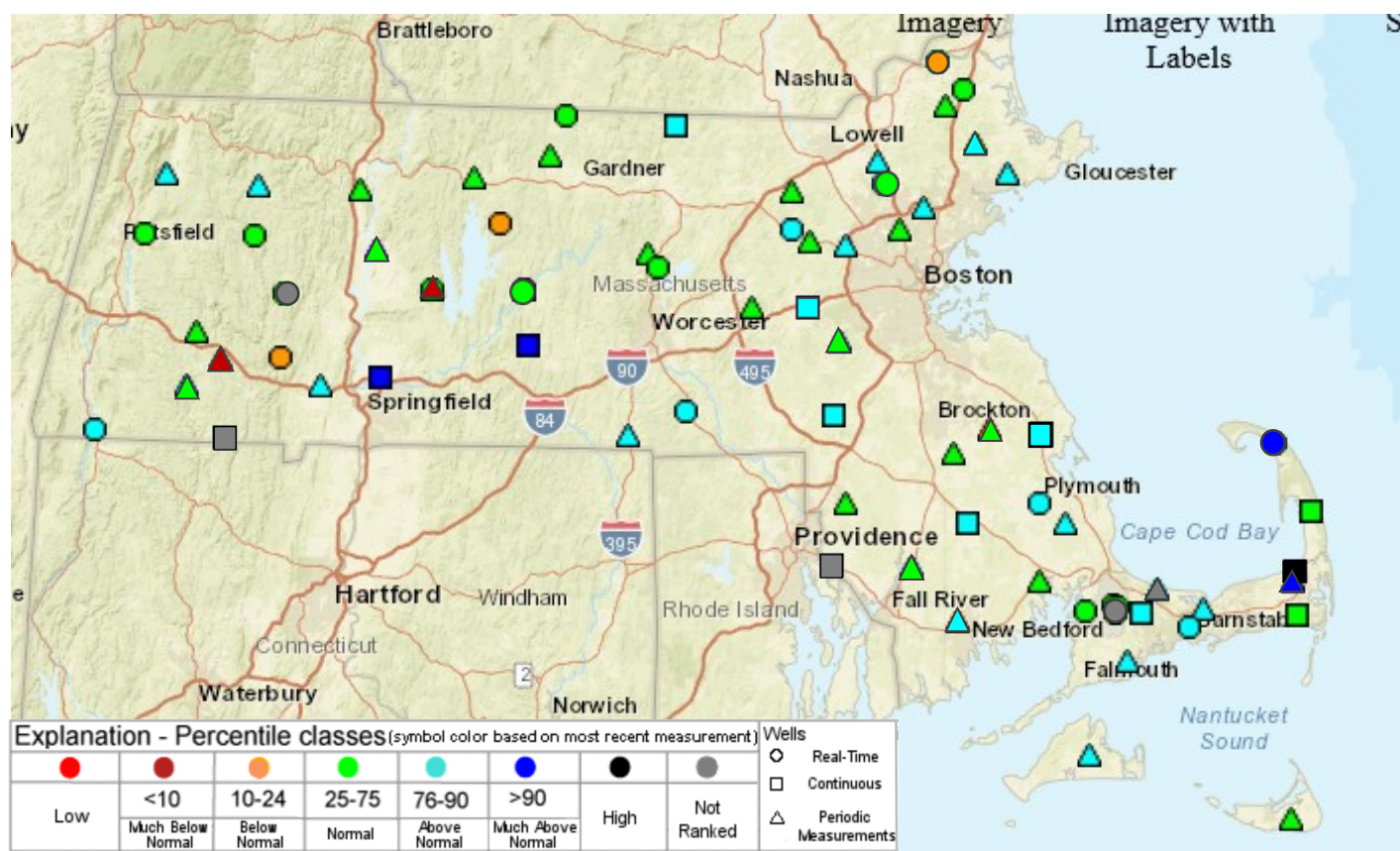
Notes: Gage counts are non-cumulative except for "total reporting". Not all gages report in all months due to ice, beaver dams or other conditions. Streamflow index is not applicable to Cape Cod and the Islands.

GROUNDWATER

In general, groundwater levels were at or above average historical levels. The CT River Valley Region levels, however, had a wide range of values from below the 10th percentile to greater than 90th percentile. The Cape Cod and Islands Region had one record high.

Groundwater Conditions in the Climate Response Network at the End of June

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



Region	Number of wells					MA Drought Plan Index /# consecutive months majority below 25 th percentile
	Total Reporting for June	<25th to 10th percentile	<10th percentile to above record low	Record low	> 90th percentile	
Western	5	0	0	0	0	Normal/0
CT River Valley	9	1	2	0	1	Normal/0
Central	10	1	0	0	1	Normal/0
Northeast	16	1	0	0	0	Normal/0
Southeast	10	0	0	0	0	Normal/0
Cape and Islands	11	0	0	0	3	Normal/0

Notes: Well counts are non-cumulative except for "total reporting". Not all data are available in time for reporting.

RESERVOIRS

At the end of June, many reporting reservoirs were above average levels. For example, Lenox reported both reservoirs full even though they are usually declining this time of the year.

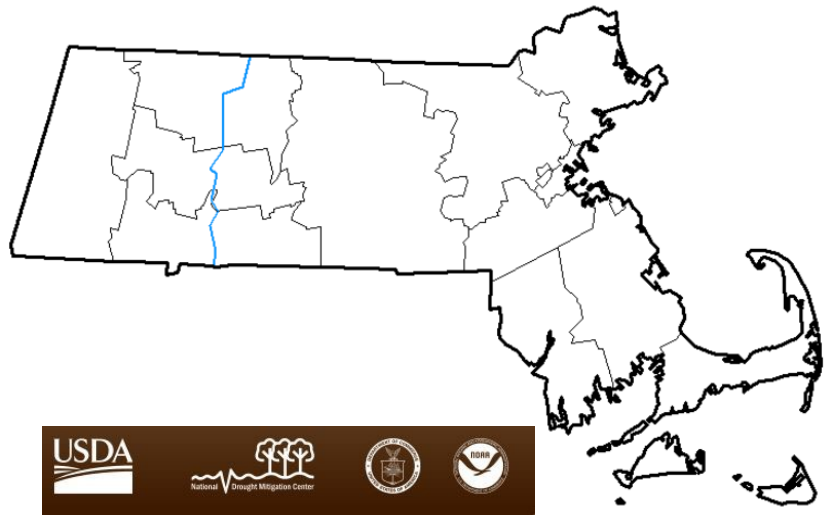
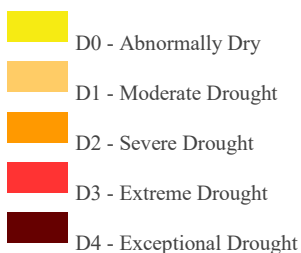
Region	Total Reporting for June	Reservoir Levels	MA Drought Management Plan Reservoir Index
Western	2	Normal	Normal
CT River Valley	2	Normal	Normal
Central	2	Normal	Normal
Northeast	6	Normal	Normal
Southeast	4	Normal	Normal
Cape Cod & Islands	1	Normal	Normal

DROUGHT CONDITIONS AND FORECASTS BY NOAA AND PARTNERS

U.S. Drought Monitor: Drought Conditions as of June 25, 2019

Summary: The USDM map shows all regions as normal.

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

July: The outlook projects equal chances for above normal, normal, or below normal for both temperature and precipitation.

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

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

NOAA Climate Prediction Center: Monthly and Seasonal Drought Outlook

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

Appendix I: Additional Information

Keetch-Byram Drought Index (KBDI)

The DCR Fire Chief reported that there are no areas of concern in the state for fire danger although four regions have reached the Advisory level for the Drought Index.

Region	June KBDI value	Drought Index
Western	129	Normal
CT River Valley	162, 206, 211	Advisory
Central	289, 230,	Advisory
Northeast	128, 59, 321	Advisory
Southeast	272, 98	Advisory
Cape Cod & Islands	Estimated at <200 by DCR Fire Chief	Normal

Crop Moisture Index (CMI)

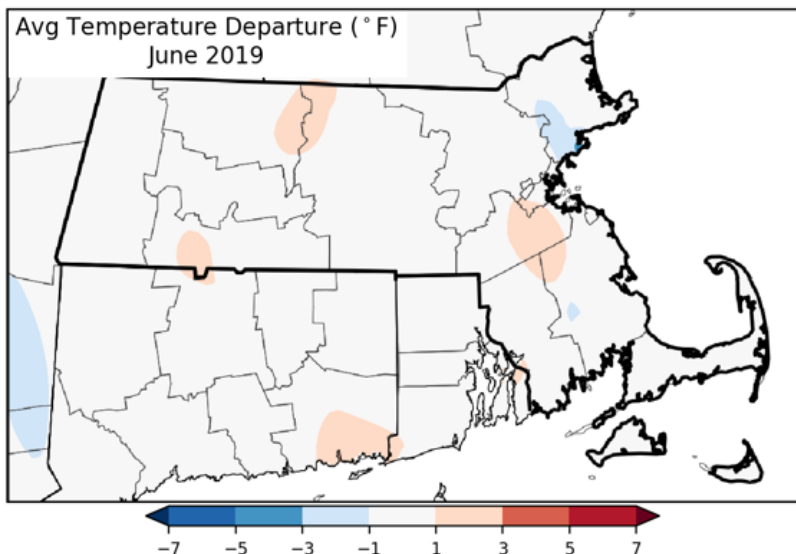
The CMI map for the week ending June 29, 2019 shows slightly dry to favorably moist conditions across the state, resulting in the Index being Normal for all regions.

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

Season-to-date Snowfall Departure and Snow Cover

Information provided seasonally.

Temperature



Monthly average temperatures were near historical average across most of the state for this time of the year. <http://www.nrcc.comell.edu/regional/monthly/monthly.html>

Boston daily temperatures ranged from 53 to 87 degrees Fahrenheit. Deviation from historical daily average temperatures were -9.6 to +8.1 degrees Fahrenheit, respectively. <https://w2.weather.gov/climate/index.php?wfo=box>

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 Information, continued

Percent of Average Historical Precipitation

June-19	Nor- mal	Actu- al	Per- cent Nor- mal	Excess/ Deficit	-----Excess or Deficit Since Last-----								
					10/1/2018	2 Months	% Norm	3 Months	% Norm	6 Months	% Norm	12 Months	% Norm
State	3.66	4.44	121	0.78	10.95	0.74	110	3.68	133	3.90	118	18.27	141
Western	4.15	4.87	117	0.72	10.03	1.67	121	3.98	134	4.46	121	20.60	147
Connecticut River	3.95	3.54	90	-0.41	9.42	-1.16	85	2.28	120	2.48	111	21.90	148
Central	3.77	4.03	107	0.26	9.44	0.17	102	3.89	135	3.15	114	19.81	143
Northeast	3.43	4.21	123	0.78	9.61	0.64	109	3.36	132	3.05	114	15.19	135
Southeast	3.37	4.50	134	1.13	13.83	1.63	124	4.28	140	5.00	122	18.26	140
Cape Cod and Is- lands	3.37	6.96	207	3.59	14.79	3.61	152	5.02	146	7.10	131	11.71	126

Note: Precipitation values are total rainfall and melted snow in inches.

Values are estimated pending receipt of additional data and final calculations.

Standardized Precipitation Index for June 2019

REGION	3-Month SPI	6-Month SPI	12-Month SPI
Western Region	1.23	1.11	2.71
Connecticut River Region	0.70	0.57	2.79
Central Region	1.27	0.79	2.50
Northeast Region	1.05	0.74	1.97
Southeast Region	1.30	1.09	2.22
Cape & Islands	1.51	1.58	1.67

DCR Precipitation Monitoring Composite Reports
and SPI are available at:

<https://www.mass.gov/service-details/precipitation-composite-estimates-1>

<https://www.mass.gov/service-details/standardized-precipitation-index-spi-0>

Appendix II: Description of Drought Indices

(from Table 3 of Massachusetts Drought Management Plan).

Drought Level	Standardized Precipitation Index	Crop Moisture Index*	Keetch-Byram Drought Index*	Precipitation	Groundwater	Streamflow	Reservoir***
Normal	3-month > -1.5 <u>or</u> 6-month > -1.0 <u>or</u> 12-month > -1.0	0.0 to -1.0 slightly dry	< 200	1 month below normal	2 consecutive months below normal**	1 month below normal**	Reservoir levels at or near normal for the time of year
Advisory	3-month = -1.5 to -2.0 <u>or</u> 6-month = -1.0 to -1.5 <u>or</u> 12-month = -1.0 to -1.5	-1.0 to -1.9 abnormally dry	200-400	2 month cumulative below 65% of normal	3 consecutive months below normal**	At least 2 out of 3 consecutive months below normal**	Small index Reservoirs below normal
Watch	3-month < -2.0 <u>or</u> 6-month = -1.5 to -3.0 <u>or</u> 12-month = -1.5 to -2.0	-2.0 to -2.9 excessively dry	400-600	1 of the following criteria met: 3 month cum. < 65% <u>or</u> 6 month cum. < 70% <u>or</u> 12 month cum. < 70%	4-5 consecutive months below normal**	At least 4 out of 5 consecutive months below normal**	Medium index Reservoirs below normal
Warning	6-month < -3.0 <u>or</u> 12-month = -2.0 to -2.5	< -2.9 severely dry	600-800	1 of the following criteria met: 3 month cum. < 65% and 6 month cum. < 65%, <u>or</u> 6 month cum. < 65% and 12 month cum. < 65%, <u>or</u> 3 month cum. < 65% and 12 month cum. < 65%	6-7 consecutive months below normal**	At least 6 out of 7 consecutive months below normal**	Large index reservoirs below normal
Emergency	12-month < -2.5	< -2.9 severely dry	600-800	Same criteria as Warning and previous month was Warning or Emergency	> 8 months below normal**	> 7 months below normal**	Continuation of previous month's conditions

* The Crop Moisture Index is subject to frequent change. The drought level for this indicator is determined based on the repeated or extended occurrence at a given level.

** Below normal for groundwater and streamflow are defined as being within the lowest 25th percentile of the period of record.

*** Water suppliers should be consulted to determine if below normal reservoir conditions are due to operational issues.

Source: Massachusetts Drought Management Plan. May 2013 (<http://www.mass.gov/eea/docs/eea/docs/wrc/droughtplan.pdf>).