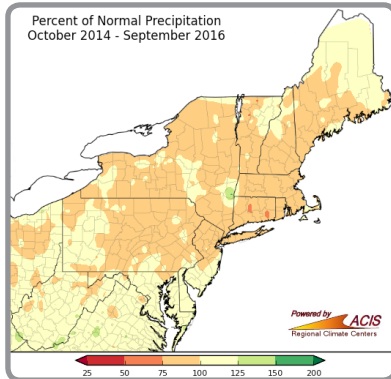
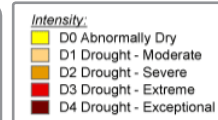
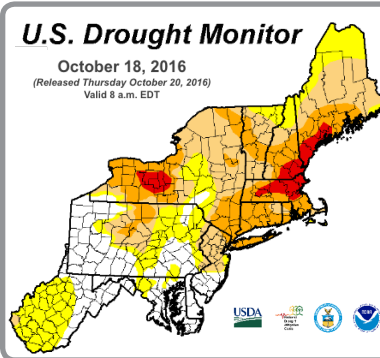


On October 11, a Northeast Drought and Climate Outlook Forum was held at UMass Boston. The purpose of the forum was to discuss the current drought conditions in the region, impacts of the drought, response and preparedness resources, and climate outlooks for the coming seasons. The forum was developed through a partnership with the National Oceanic and Atmospheric Administration (NOAA), the National Integrated Drought Information System (NIDIS), the Northeast Regional Climate Center (NRCC), U.S. Representative Seth Moulton's (D-Salem, MA) office, and the American Association of State Climatologists (AASC). A [recording of the forum](#) and [speaker presentations](#) are available online.

## Weather Patterns & Drought Monitor



Portions of Northeast have experienced drier-than-normal conditions over the past two years. During the cold season, the jet stream pattern did not favor large East Coast storms and contributed to storms moving quickly through the region. Frigid temperatures and coastal ice limited moisture available to storms in early 2015. During the warm season, sinking air associated with an elongated area of



Drought conditions intensified during summer 2016, with extreme drought (D3) introduced in parts of New York and New England in August. It was the first time several of these areas had experienced D3 conditions since Drought Monitor data began in 1999.

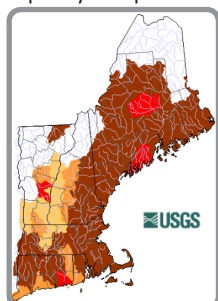
relatively high pressure inhibited precipitation. Increased solar radiation due to clear skies, as well as above-normal temperatures, contributed to greater evaporation since late spring 2016. In both the cold and warm seasons, moisture from the Atlantic Ocean and the Gulf of Mexico was cut off or not directed at the Northeast.

Extreme drought conditions would be expected to occur on average once per 20–50 years. Portions of New York and New England have been in an extreme drought for 6–10 weeks. The [U.S. Drought Monitor](#) released on October 20 showed extreme drought continuing and severe and moderate drought expanding in these areas.

## Impacts

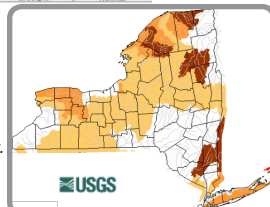
### Water Resources

Large areas of New England and New York have experienced a moderate, severe, or extreme hydrologic drought over the past few months. [Streamflow](#) has been much below normal, with many waterways setting record low flows. For instance, the Saco River at Cornish, ME, which has 99 years of data, had its lowest ever 7-day average streamflow in late September. [Groundwater](#) levels have also been much below normal, with some sites, such as Marlborough, CT, setting record lows. Hundreds of shallow, private wells have gone dry in New Hampshire. The Massachusetts Water Resources Authority (MWRA) oversees the [Quabbin and Wachusett reservoirs](#). These reservoirs can store water for multiple years, so they have been less affected by the drought. Some communities, including Worcester, are buying water from the MWRA. [Worcester](#) declared a stage 1 drought alert in mid-June, with conditions deteriorating to a stage 3 drought emergency in early September when the city's reservoirs were at 55% of capacity compared to average of 82%.



Explanation - Percentile classes			
Low	≤5	6-9	10-24
Extreme hydrologic drought	Severe hydrologic drought	Moderate hydrologic drought	Below normal

Below normal September 2016 average streamflow compared to historical September streamflow.



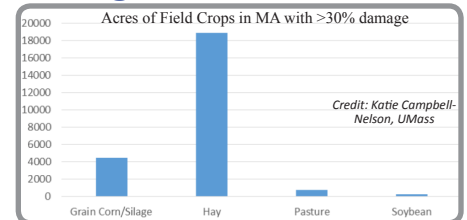
### Fisheries



Low flow on the Paskamansett River near the dam in Dartmouth, MA in mid-September. Credit: Sara Turner, [MA DMF](#)

Some fish, such as river herring, spend most of their life at sea, but return to fresh water to spawn. The juveniles journey to the sea between summer and fall. Other fish, such as the American eel, live in fresh water, but spawn at sea. These fish have become stuck along portions of some rivers in Massachusetts due to low water levels and must wait for flows to increase so they can go to sea. Waterways with dams and without fish ladders are particularly problematic. In low flow situations, fish can become trapped below the dam in low oxygen conditions and can suffocate. There has been a higher rate of these fish kills in Massachusetts as of early October. Some states, including Connecticut, have closed portions of rivers to fishing to protect fish.

### Agriculture & Fire



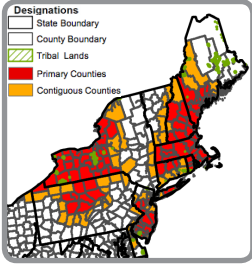
The past few years, Northeast farmers typically experienced crop losses due to [excess moisture or frost/freeze events](#), but in 2016, farmers were severely impacted by drought. Topsoil was the driest it has been in the past 20 years, with southern New England having the greatest percent of topsoil rated short to very short in the country in mid-August. Pasture conditions were also the worst they've been in 20 years. All crops in Massachusetts showed some loss, with significant losses of hay, cranberries, and potatoes. With poor pastures and hay shortages, farmers had to buy feed or move animals to market early. Some surface wells and other water sources for livestock and irrigation dried up. However, the dry conditions led to less disease in crops and sweeter, more intense flavors in fruits.

Fires tend to occur mostly in spring prior to leaf out, with a second season in October when leaves fall. However, there were several large fires in Maine this summer. Soil and large fuels were very dry, making wildfires more difficult to control.



# Resources

## Agriculture



Drought disaster designations as of October 19. Credit: FSA

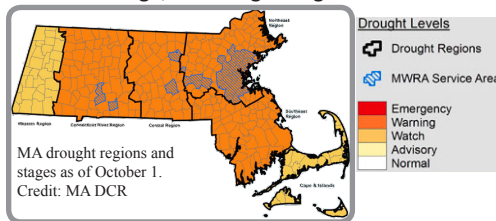
Much of New York and New England and parts of Pennsylvania have been given a Fast Track Secretarial disaster designation, making farmers eligible for emergency loans and other [Farm Service Agency \(FSA\)](#) programs.

The process is triggered based on the Drought Monitor (areas in severe drought for 8 weeks or extreme or exceptional drought for any length). For counties where drought conditions do not trigger a Fast Track designation, a disaster designation can be made with a 30% production loss of at least one crop or a determination that other lending institutions will not be able to provide emergency financing. FSA programs have different eligibility requirements: some are dependent on crop losses and disaster designations, others are determined by a county's location and Drought Monitor rating, and some are tied to weather-related deaths of livestock or trees.

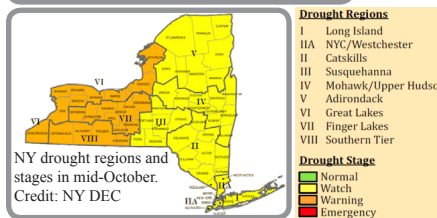
The [National Resources Conservation Service \(NRCS\)](#) has programs available to farmers, regardless of drought conditions. The FSA determines eligibility, then the NRCS works directly with the farmers. The NRCS programs provide technical and financial resources to help farmers plan and implement conservation practices that address natural resource concerns. Examples of these practices include irrigation and cover crops. The NRCS also promotes soil health, including the use of organic matter to retain moisture, and maintains an online database of soil maps and data.

## Hazard Mitigation Plans

FEMA has been working with communities to put together [hazard mitigation plans](#), with the goal of reducing long term risks from natural hazards. Residents and stakeholders are encouraged to participate in the planning process. A risk assessment is created based on all natural hazards that can impact the community, previous occurrences of those hazards and probability of them occurring in the future, and the community's vulnerability to the hazards. Drought is often included in the assessments, but its risk may not be accurately assessed if farmers are not part of the discussion. Drought is also often tied in with wildfire risk. Mitigation strategies are developed, based on the degree of vulnerability to the hazard, then prioritized in order to reduce the long term risk. For instance, drought mitigation strategies may include promoting drought-tolerant landscaping and site design and rain barrels. States also have hazard mitigation plans that are updated every five years. These plans also take into account potential impacts from climate change, including drought.



MA drought regions and stages as of October 1. Credit: MA DCR



NY drought regions and stages in mid-October. Credit: NY DEC

## State Declarations

Each state has a drought plan and looks at a set of indices and/or the U.S. Drought Monitor to determine if a drought declaration is needed. Several of the state drought committees have been meeting monthly to access conditions.

**Connecticut:** The state is under a drought advisory, the lowest of four drought stages ("advisory" to "emergency"). Residents are asked to reduce water use by 10%, mainly by limiting all outdoor water use.

**Rhode Island:** The state has seven drought regions and four drought stages ("advisory" to "emergency"). The entire state is under a drought advisory. The state's major water suppliers must submit a water supply plan including a drought component and update it every five years.

**New Hampshire:** The state has five drought regions. As of October 13, 162 water systems and 15 municipalities have enacted water restrictions or bans. Although half the state relies on private wells, those also fall under the restrictions or bans.

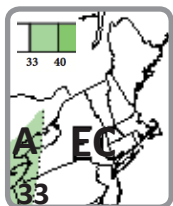
**Maine:** The state is encouraging residents to conserve water and call 211 to report dried up wells. The Maine State Housing Authority may also be able to assist residents with dried up wells.

**Massachusetts:** The state has six drought regions and four drought stages ("advisory" to "emergency"). Four regions are in warning and two are in a watch. The state has focused on water conservation, with 181 water suppliers implementing restrictions (as of September 28), and informing residents using road signs, press releases, and media interviews.

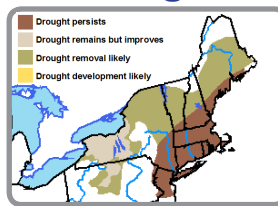
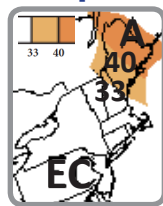
**New York:** The state has nine drought regions and four drought stages ("watch" to "disaster"). Three regions are in a warning and the rest are in a watch.

## Outlooks

### Precipitation, Temperature, and Drought



A: Above-normal  
#: Probability of above-normal



NOAA's [Climate Prediction Center \(CPC\)](#) is calling for an increased chance of above-normal precipitation in western New York during winter 2016–17, with equal chances of below-, near-, or above-normal precipitation elsewhere (above left map). The temperature outlook for winter indicates an increased chance of above-normal temperatures in Maine and northern New Hampshire, with equal chances for the rest of the region (above center map). While a weak La Niña is favored to develop during fall and could persist through winter, there is uncertainty about how much it, or other climate drivers, will impact the region. La Niña should help the region see a colder winter than last year, when the Northeast experienced its second warmest winter on record behind 2001–02. The Northeast could also see a stormier (but not necessarily wetter) winter than last year. Warm ocean temperatures in the western and northern Atlantic could influence storms, but snow amounts are highly dependent on the track of individual storms.

CPC's Drought Outlook for October 20, 2016–January 31, 2017 calls for drought conditions to improve across much of New York and interior northern New England due to the increased likelihood of frequent storms. However, climate models favor drought persistence in southeastern New York, southern New England, southern New Hampshire, and coastal Maine.

## Regional Partners

- National Oceanic and Atmospheric Administration [www.noaa.gov](http://www.noaa.gov)
- National Centers for Environmental Information [www.ncei.noaa.gov](http://www.ncei.noaa.gov)
- National Weather Service [www.weather.gov](http://www.weather.gov)
- NOAA Research [www.research.noaa.gov](http://www.research.noaa.gov)
- NOAA Fisheries [www.nmfs.noaa.gov](http://www.nmfs.noaa.gov)
- Northeast Regional Climate Center [www.nrcc.cornell.edu](http://www.nrcc.cornell.edu)
- National Integrated Drought Information System [www.drought.gov](http://www.drought.gov)
- U.S. Representative Seth Moulton [www.moulton.house.gov](http://www.moulton.house.gov)
- Northeast Region State Climatologists [www.stateclimate.org](http://www.stateclimate.org)
- USDA NRCS, FSA, and Northeast Climate Hub [www.usda.gov/wps/portal/usda/usdahome](http://www.usda.gov/wps/portal/usda/usdahome)
- USGS and USGS New England Water Science Center [www.usgs.gov](http://www.usgs.gov)
- FEMA Region 1, Mitigation Division [www.fema.gov/region-i-mitigation-risk-analysis](http://www.fema.gov/region-i-mitigation-risk-analysis)
- Massachusetts Water Resources Authority [www.mwra.com](http://www.mwra.com)
- City of Worcester, Public Works and Parks [www.worcesterma.gov/dpw](http://www.worcesterma.gov/dpw)
- University of Massachusetts Boston [www.umb.edu](http://www.umb.edu)
- State Departments from New York and New England

