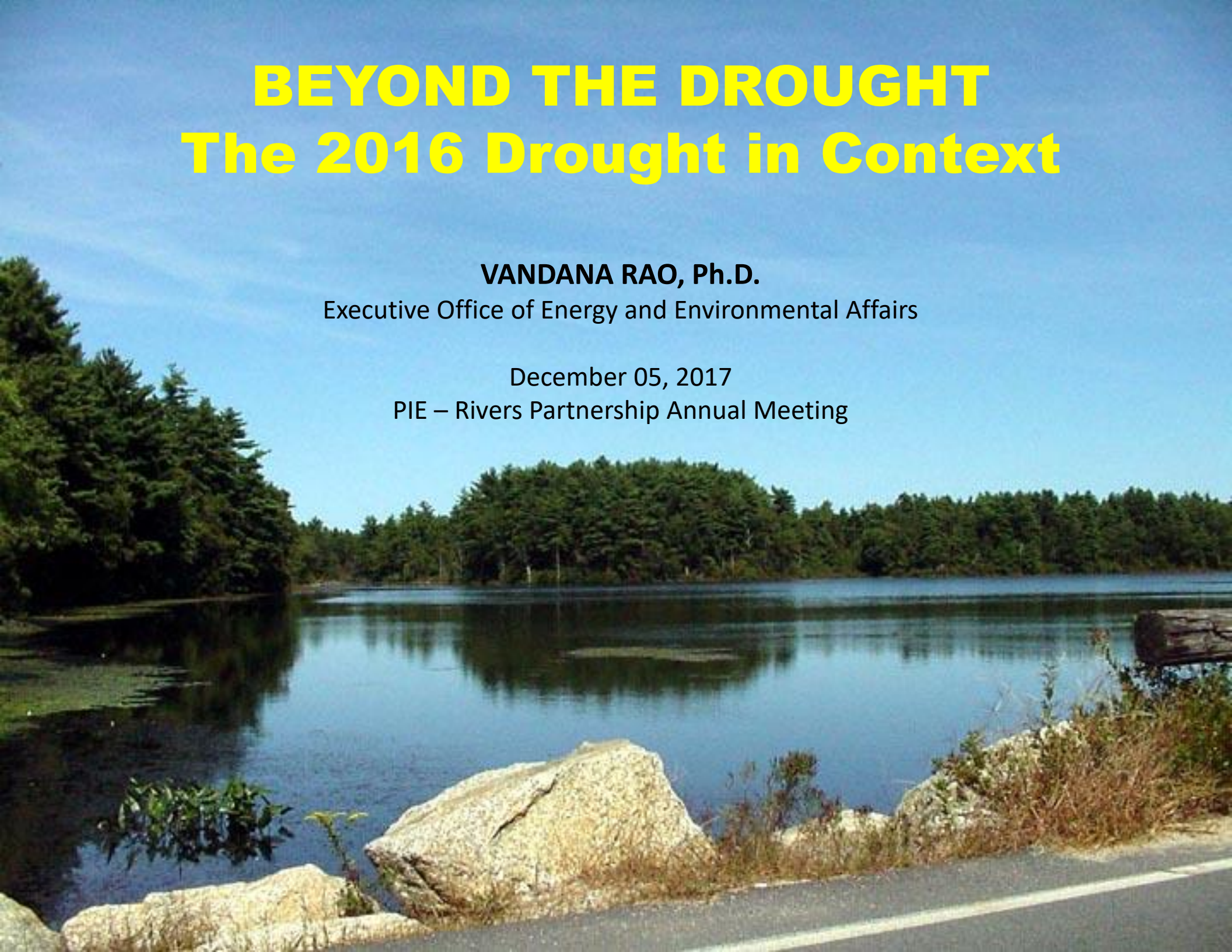
BEYOND THE DROUGHT
The 2016 Drought in Context

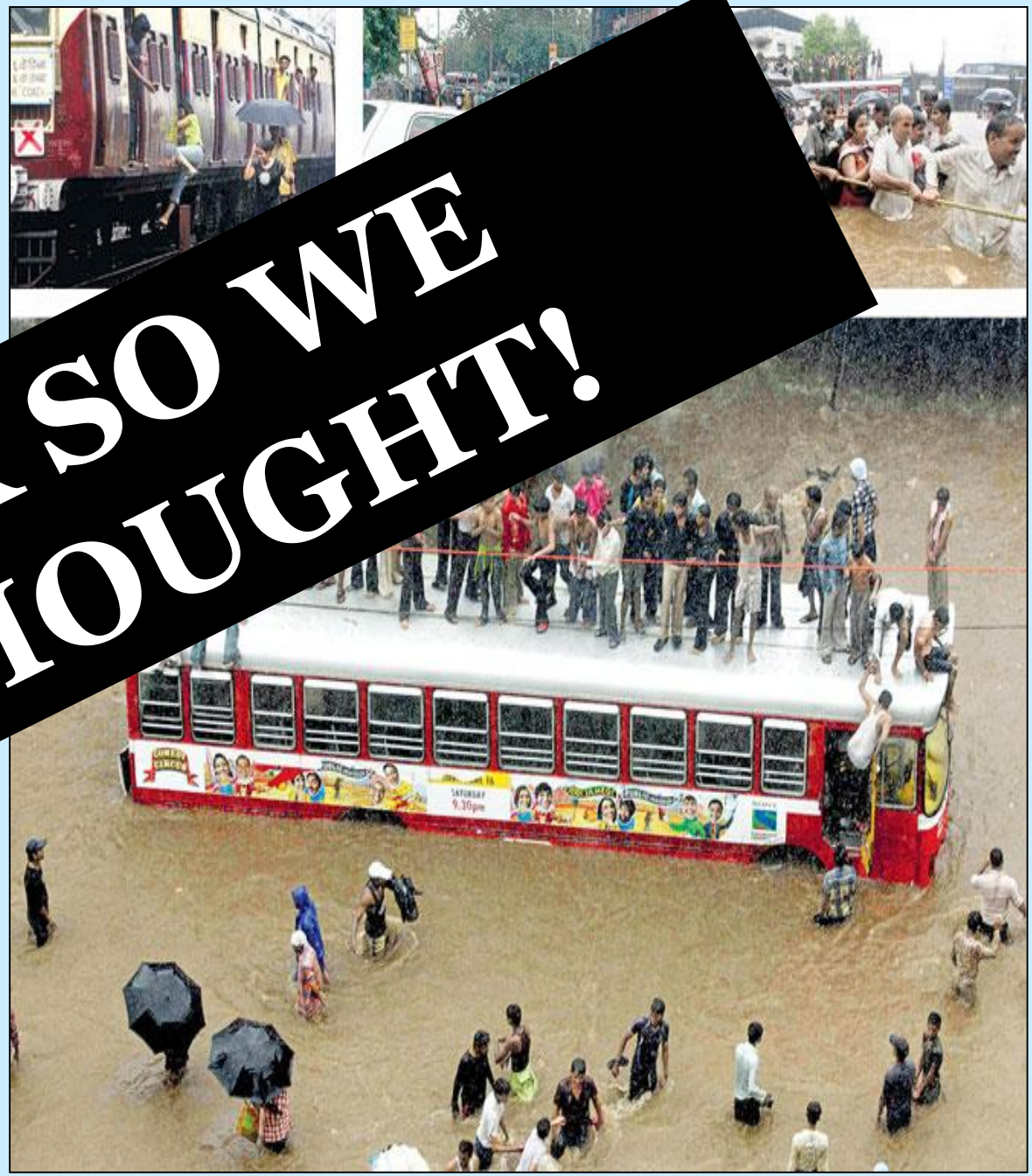
VANDANA RAO, Ph.D.
Executive Office of Energy and Environmental Affairs

December 05, 2017
PIE – Rivers Partnership Annual Meeting



Granted, we don't have this……

Location:
Mumbai
(Bombay),
India



OR SO WE THOUGHT!

We <u>ARE</u> seeing more of this….

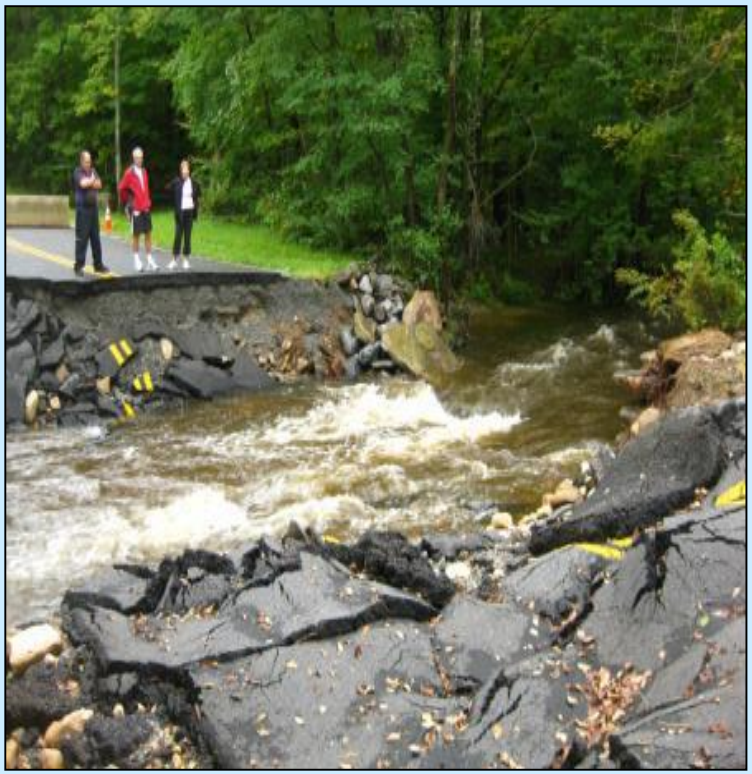
July 10, 2010 Storm – 4 inches in 1 hour

Source: John Bolduc, Environmental Planner, City of Cambridge

March 31, 2010 - West Warwick

Source: Northeast River Forecasting Center

and this.....



And this…….Worcester in October 2016

….while we were in the middle of our worst drought since the 1960s!

Level 4
DROUGHT
WARNING

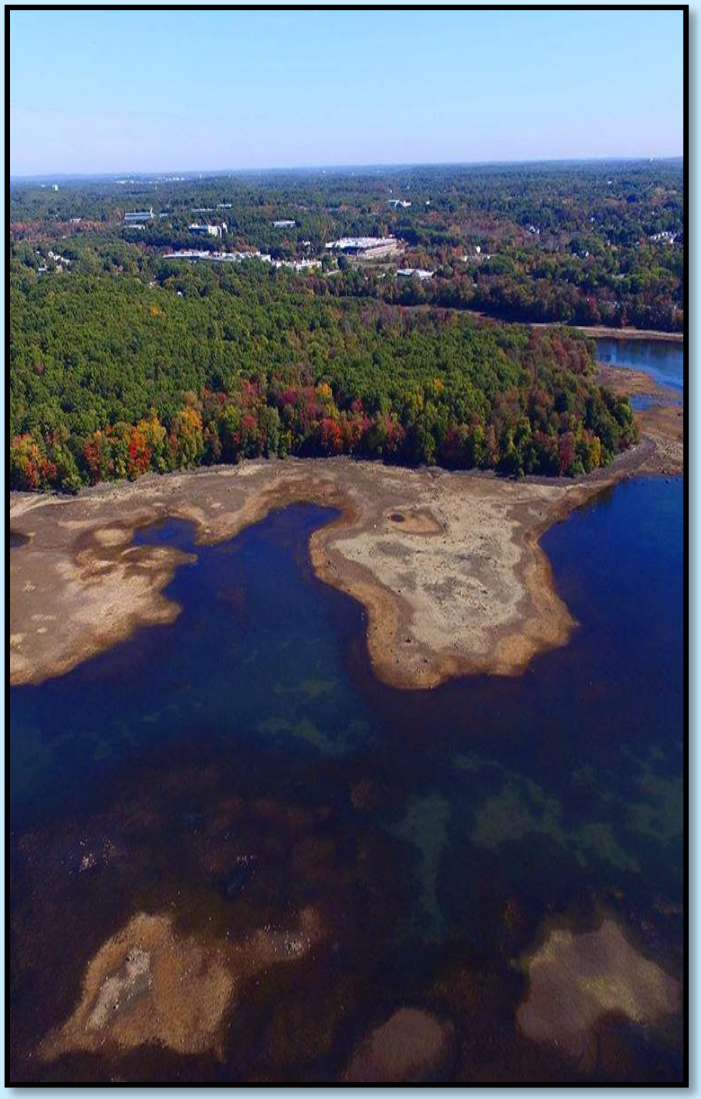
And over the last 20 years

Our most severe drought since the 1960s

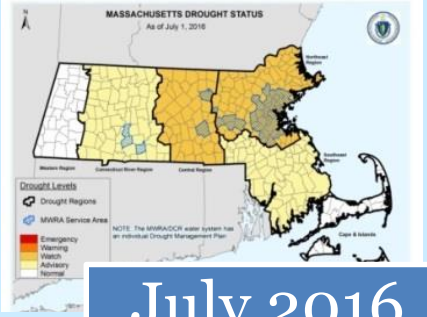
Mattapoisett River
September 2016

Martins Brook
Fall 2016

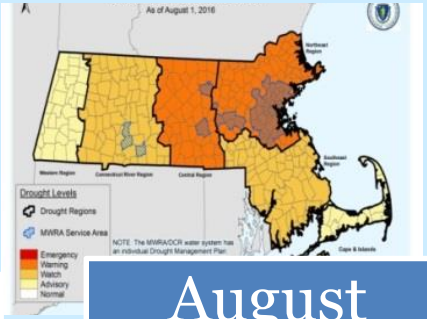
Cambridge Reservoir
Fall 2016



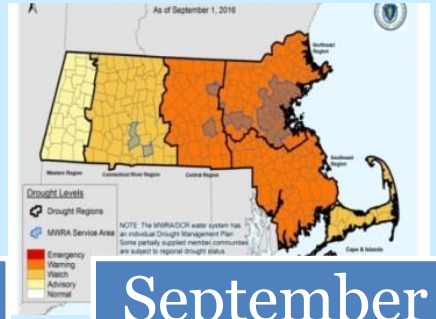
The Drought of 2016 - 2017



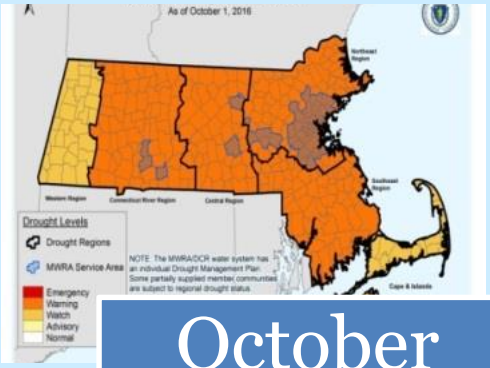
July 2016



August

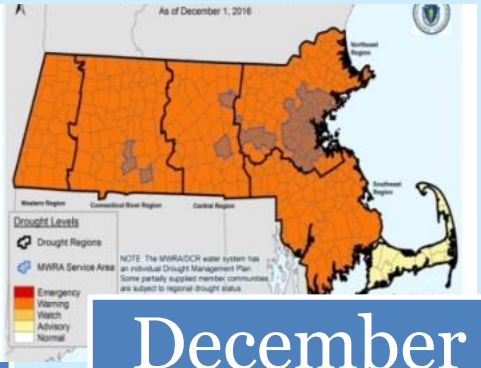


September

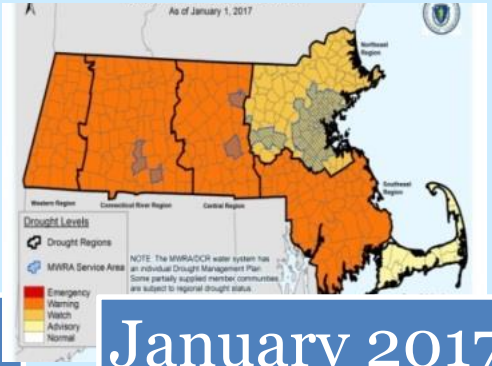


October

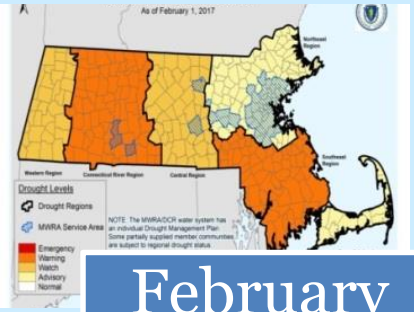
November



December

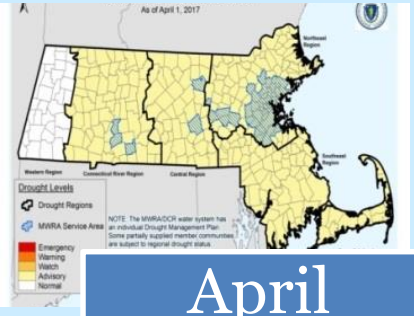


January 2017

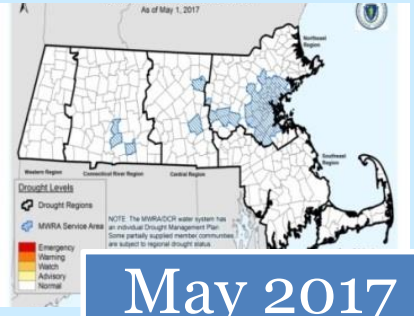


February

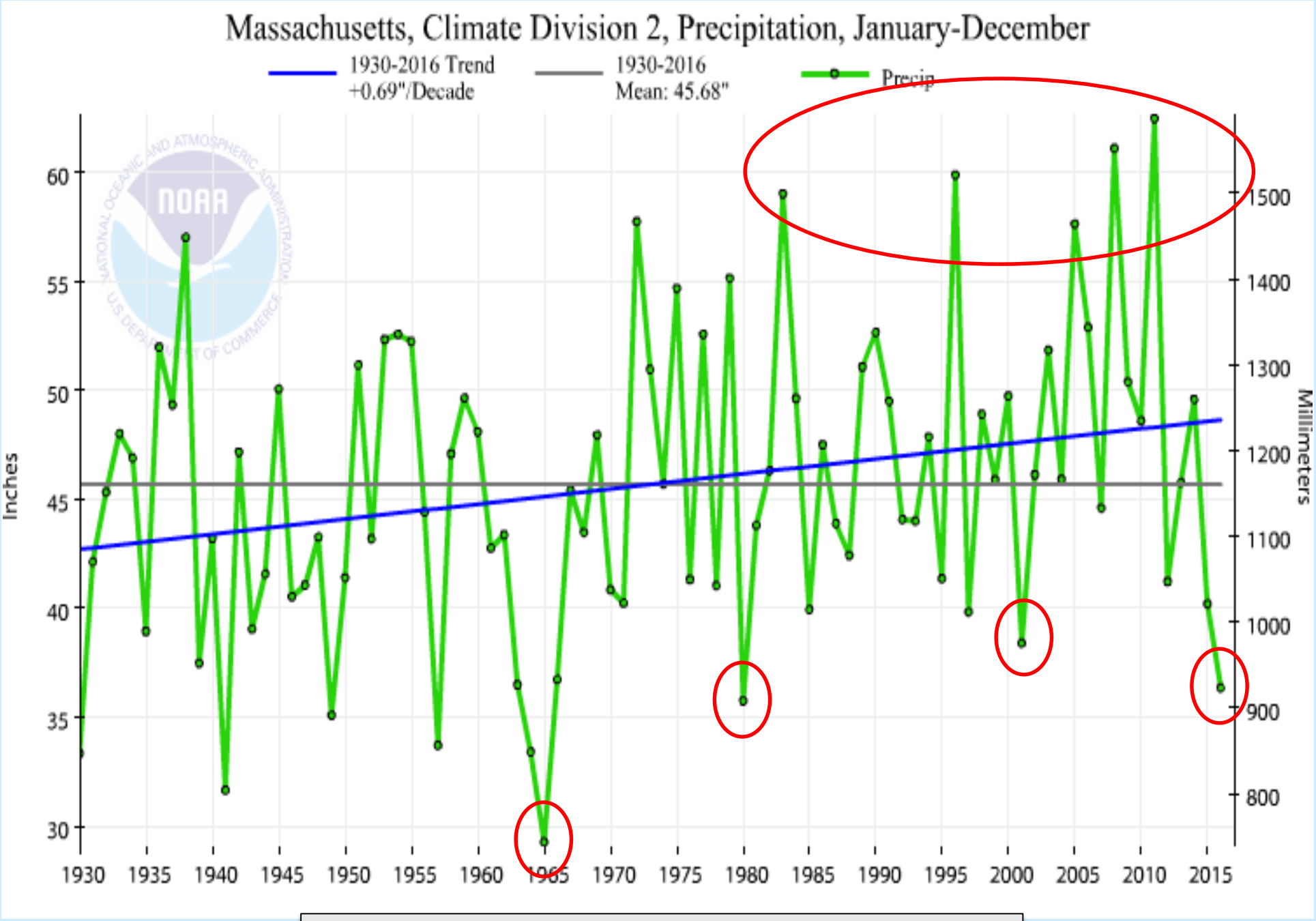
March



April



May 2017



CT Valley to Merrimack Valley

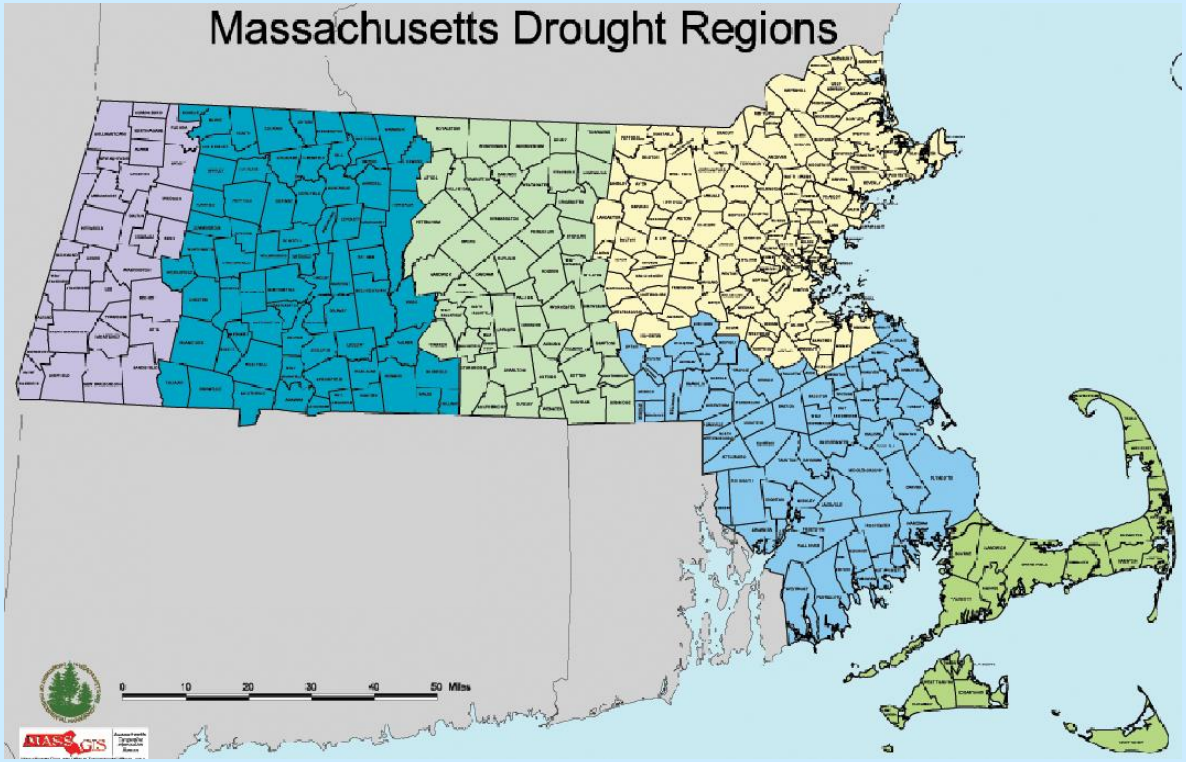
Source: http://www.ncdc.noaa.gov/cag

Massachusetts Drought Management Plan

MA Drought Management Plan (DMP), 2001 (revised 2013)

Drought Indicators
Precipitation
Streamflow
Groundwater
Reservoirs
Crop Moisture
Fire Danger

Drought Levels
Normal
Advisory
Watch
Warning
Emergency



Western
Connecticut River Valley
Central
Northeast
Southeast
Cape and Islands

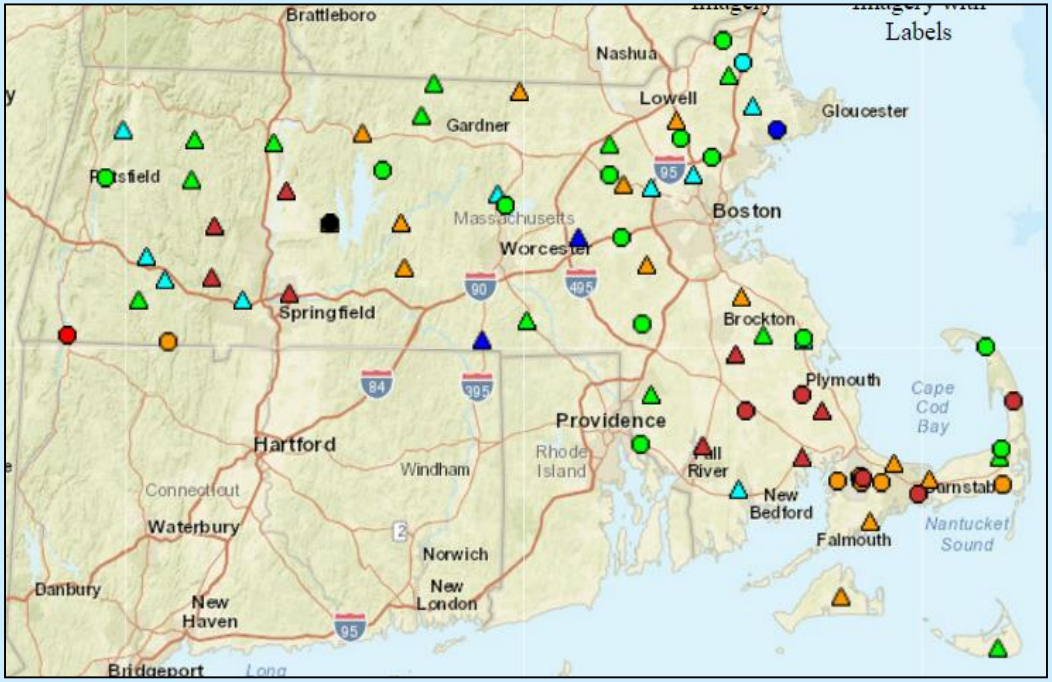
www.mass.gov/eea/wrc-dmtf

Summary of Current Methods

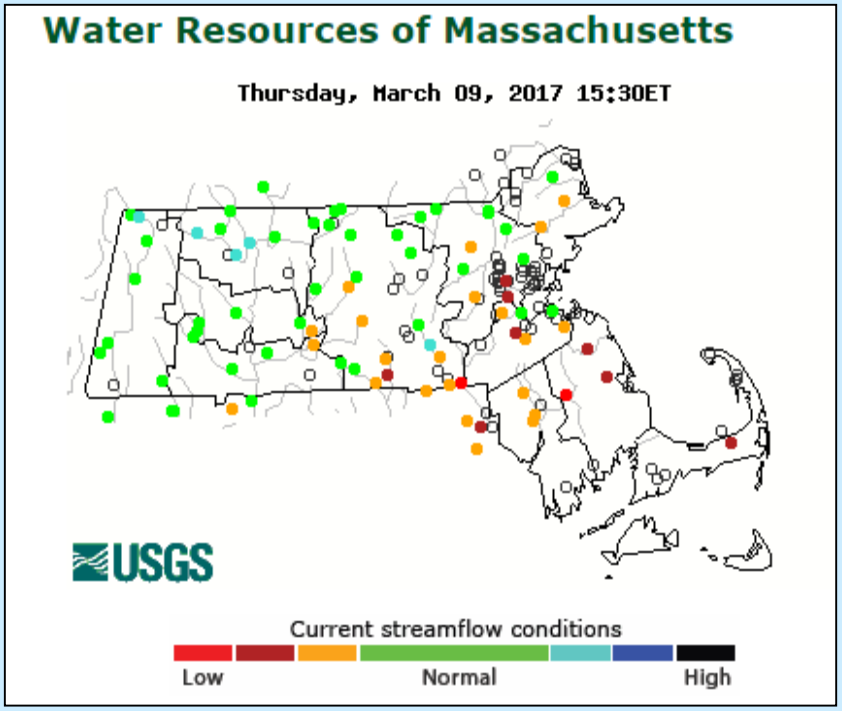
- Precipitation – cumulative months (2,3,6,12) below thresholds
  - SPI – normalized standard deviation
  - Percent of normal –specific percent thresholds
- Streamflow and Groundwater
  - Count of months below 25th percentile of historical values
- Reservoirs – size of reservoir below average
- KBDI (Fire Danger) – 0 to 800 units
- Crop Moisture Index – standard deviations

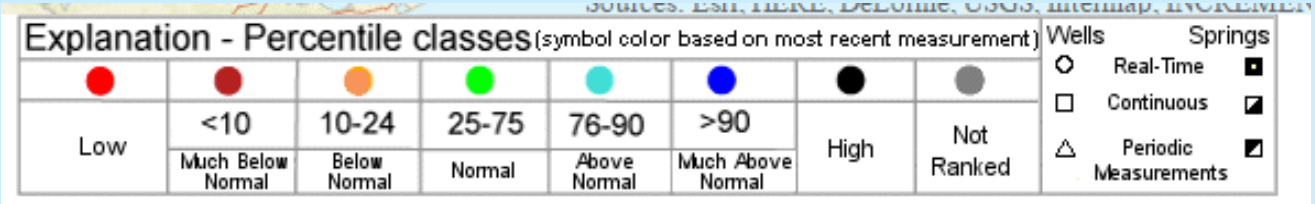
Groundwater & Streamflow Networks

Groundwater



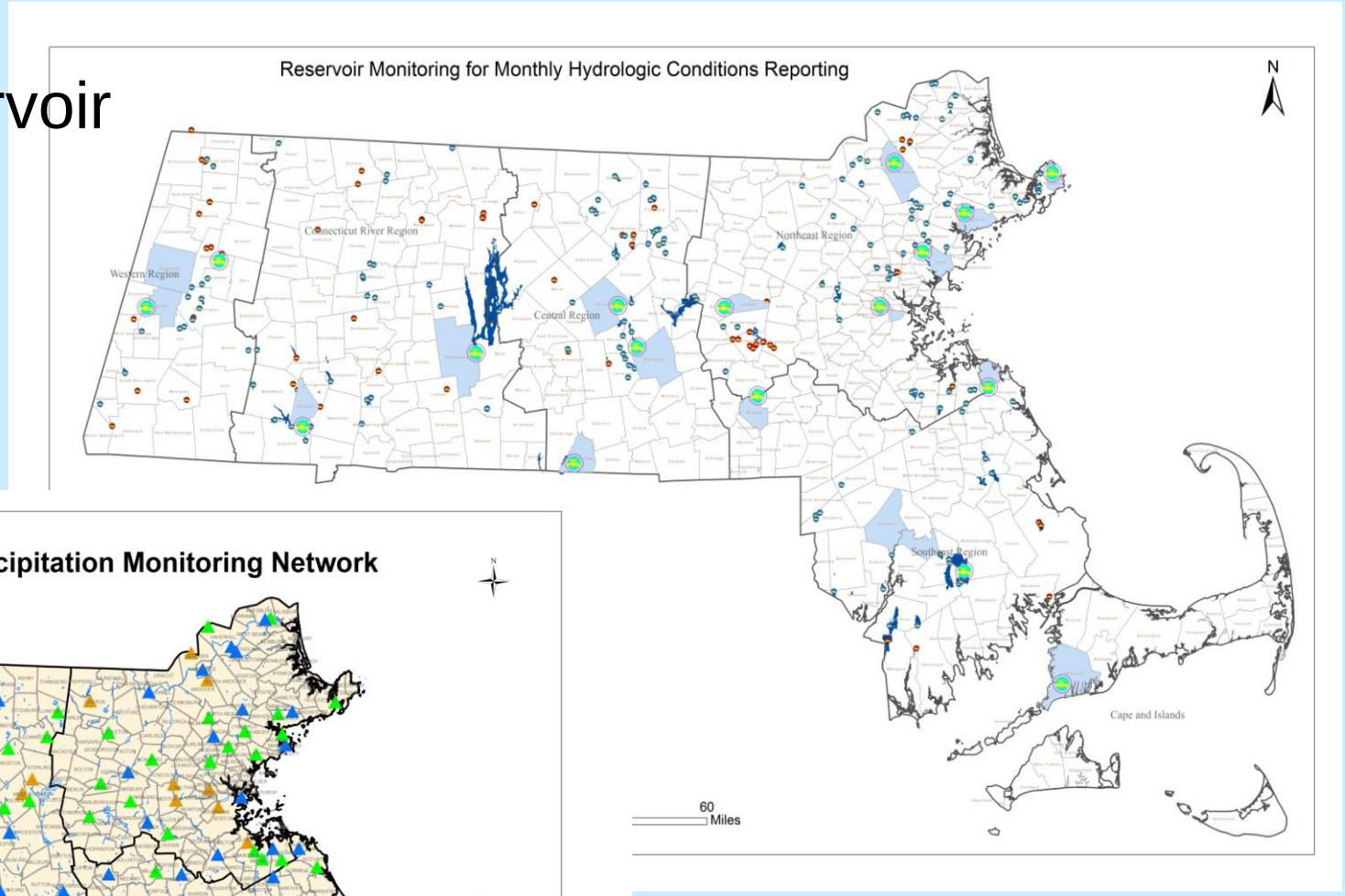
Streamflow



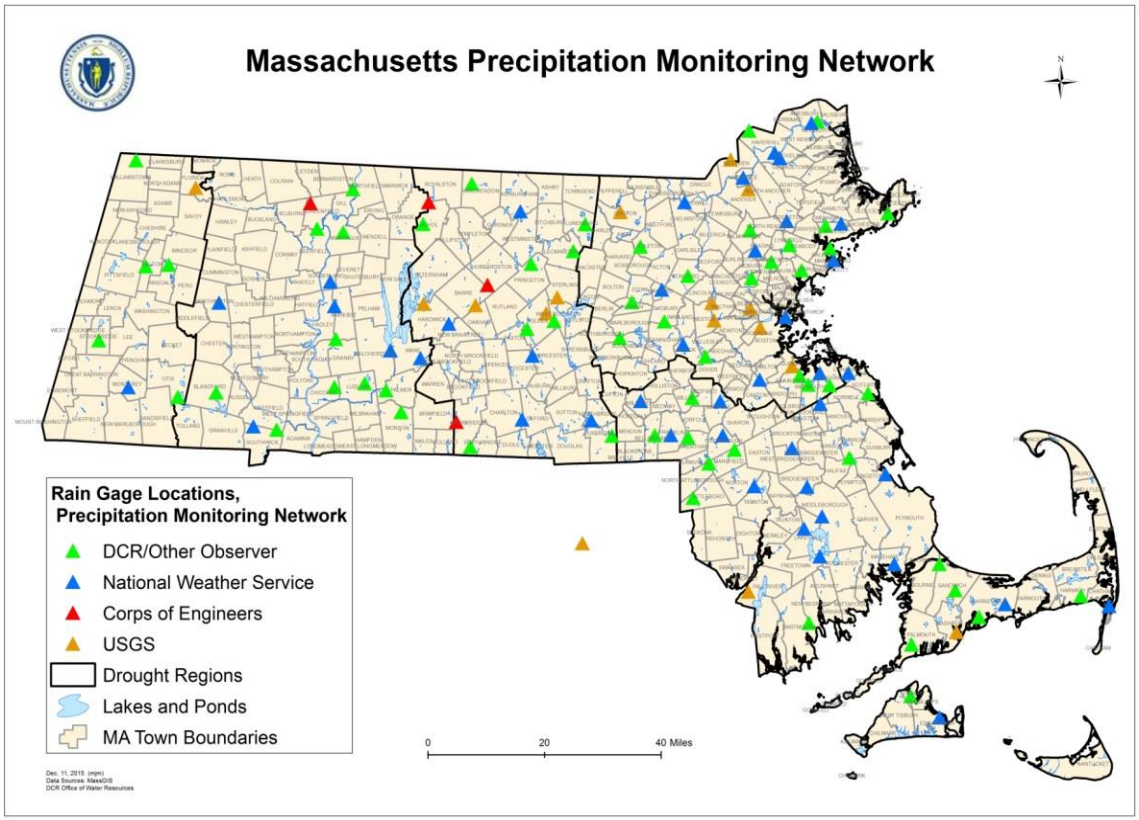


Precipitation and Reservoir Networks

Reservoir



Precipitation



Data Points for Decision Making

Region	West	CT Valley	Central	North-east	South-east	Cape & Islands	Totals
Precipitation	4	6	6	6	6	3	31
Groundwater	5	11	10	17	12	13	68
Streams	6	11	16	19	6	n/a	58
Reservoirs	2	2	4	7	3	1	19
Totals	17	30	36	49	27	17	176

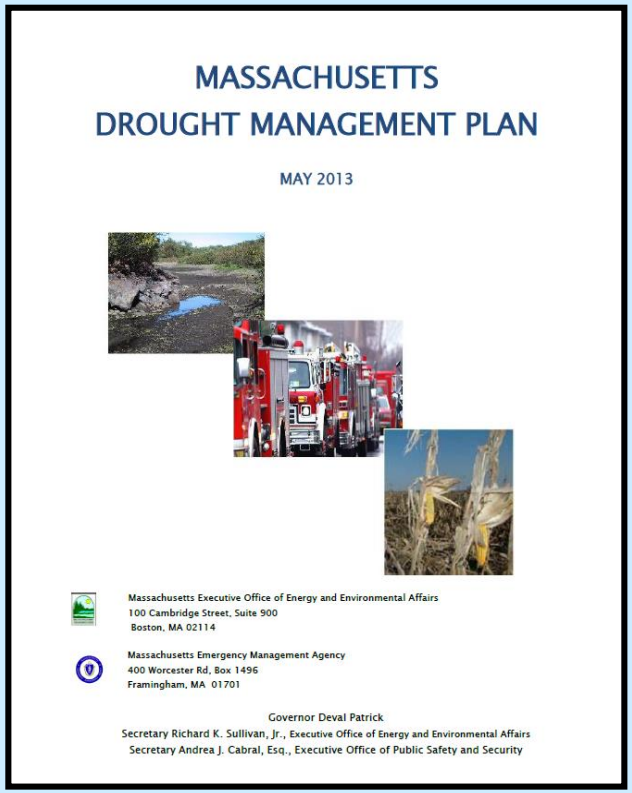
Detail on Drought Years

RECENT DROUGHT HISTORY									
					Drought Level by Regions				
Year	Begin Date	End Date	Comment	Western	CT River	Central	Northeast	Southeast	Cape & Islands
	12/28/2001	1/31/2003							
2001	12/28/2001			Advisory	Advisory	Advisory	Advisory	Advisory	Advisory
2002			February 2002	Advisory	Watch	Watch	Watch	Advisory	Advisory
2002			March 2002	Watch	Watch	Watch	Watch	Watch	Watch
2002			April 2002	Watch	Watch	Watch	Watch	Watch	Watch
2002			May 2002	Watch	Watch	Watch	Watch	Watch	Watch
2002			June 2002	Advisory	Advisory	Advisory	Advisory	Advisory	Advisory
2002			July 2002	Advisory	Advisory	Advisory	Advisory	Advisory	Advisory
2002			August 2002	Advisory	Advisory	Advisory	Advisory	Watch	Watch
2002			September 2002	Advisory	Advisory	Advisory	Advisory	Watch	Watch
2002			October 2002	Advisory	Advisory	Advisory	Advisory	Advisory	Advisory
2002			December 2002	Normal	Normal	Normal	Normal	Normal	Advisory
2003		1/31/2003	As of January 31, 2003	Normal	Normal	Normal	Normal	Normal	Normal
	10/1/2007	3/18/2008							
2007	10/1/2007			Normal	Advisory	Advisory	Advisory	Advisory	Normal
2008		3/18/2008	As of March 18, 2008	Normal	Normal	Normal	Normal	Normal	Normal
	8/1/2010	11/19/2010							
2010	8/1/2010			Normal	Normal	Advisory	Advisory	Normal	Normal
			October 2010	Normal	Advisory	Advisory	Advisory	Normal	Normal
2010		11/19/2010	As of November 19, 2010	Normal	Normal	Normal	Normal	Normal	Normal
	10/1/2014	11/30/2014							
2014	10/1/2014			Normal	Normal	Normal	Normal	Advisory	Advisory
2014		11/30/2014	As of December 1, 2014	Normal	Normal	Normal	Normal	Normal	Normal
	7/1/2016								
2016	7/1/2016		June 2016	Normal	Advisory	Watch	Watch	Advisory	Normal
			July 2016	Advisory	Watch	Warning	Warning	Watch	Advisory
			August 2016	Advisory	Watch	Warning	Warning	Warning	Watch
			September 2016	Watch	Warning	Warning	Warning	Warning	Watch
			October 2016	Warning	Warning	Warning	Warning	Warning	Advisory
			November 2016	Warning	Warning	Warning	Warning	Warning	Advisory
			December 2016	Warning	Warning	Warning	Watch	Warning	Advisory
			January 2017	Watch	Warning	Watch	Advisory	Warning	Advisory

Revisions to Drought Plan

The Need for Revision

- 2016/17 Drought 1st time MA hit Warning - we learned a lot
- Plan not “operationalized”, per MEMA
- Plan short on actions
- Some indicators didn’t track severity
- Indicators did not catch early drought onset
- Need better communication
- Drought level names unclear



MASSACHUSETTS
DROUGHT MANAGEMENT PLAN

MAY 2013

Massachusetts Executive Office of Energy and Environmental Affairs
100 Cambridge Street, Suite 900
Boston, MA 02114

Massachusetts Emergency Management Agency
400 Worcester Rd, Box 1496
Framingham, MA 01701

Governor Deval Patrick
Secretary Richard K. Sullivan, Jr., Executive Office of Energy and Environmental Affairs
Secretary Andrea J. Cabral, Esq., Executive Office of Public Safety and Security

Revision Process

- Intent to revise announced in fall of 2016 with request for comment letters from DMTF and stakeholders
- Listening sessions held with key stakeholders:
  - Water Suppliers (Jan 2017)
  - Mass Rivers Alliance Members (Feb 2017)
  - Agricultural Community members (April 2017)
  - DMTF Meetings
  - 8 comment letters received
- Drought Indicators Technical Workgroup
  - EEA staff + NWS + USGS; 8 meetings to date
- Drought Actions workgroup
  - EEA staff, 4 meetings to date

Stakeholder Comments on Indices

- Naming of drought levels
- Drought regions
- Timing of drought declarations especially at onset
- Meet human and environmental needs for water
- Longer look back periods
- Indices should reflect severity not just duration
- Consider effect of inaccurate data or outliers

Indicators Review

Goal: To accurately and comprehensively provide information on onset, severity and end of droughts.

1. Indicator review
   - Do we have the right indicators?
   - Are the data networks sufficient for our indicators?
2. Method review
   - Consider US Drought Monitor (USDM) methods which indicates severity better, standardizes data,
   - Compare to previous droughts and historic data
3. What to call the drought levels for clarity
   - Current nomenclature doesn't convey condition or order of severity
4. How to "roll up" each indicator within a region
   - Majority/median/mean per region? Weighted for worst condition?
5. How to make overall drought determination by region
6. Review of drought region boundaries

Indicators Review

- Keep only one precipitation index to eliminate double weighting
  - SPI for drought determination, add 9, 24 month lookbacks
- Replace Crop Moisture Index with an index that better reflects effect of temperature & ET on precipitation
- All other indices remain (KBDI, streamflow, reservoirs, groundwater)

Proposed MA Drought Levels

US DROUGHT MONITOR

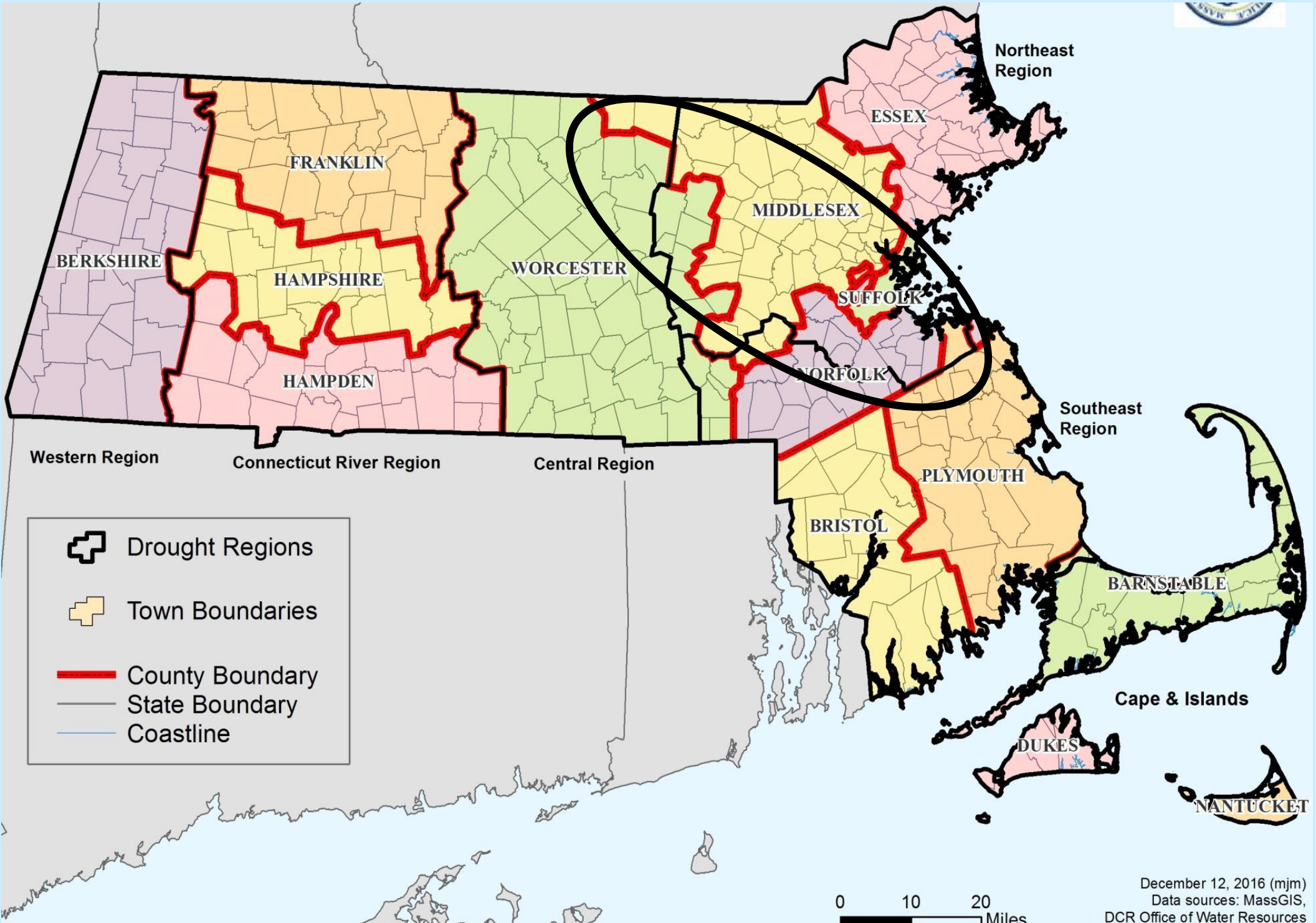
Names	Recurrence	Percentile Range
D0: Abnormally Dry	once per 3 to 5 years	21 to 30
D1: Moderate	once per 5 to 10 years	11 to 20
D2: Severe Drought	once per 10 to 20 years	6 to 10
D3: Extreme Drought	once per 20 to 50 years	3 to 5
D4: Exceptional Drought	once per 50 to 100 years	0 to 2

PROPOSED STATE DROUGHT LEVELS

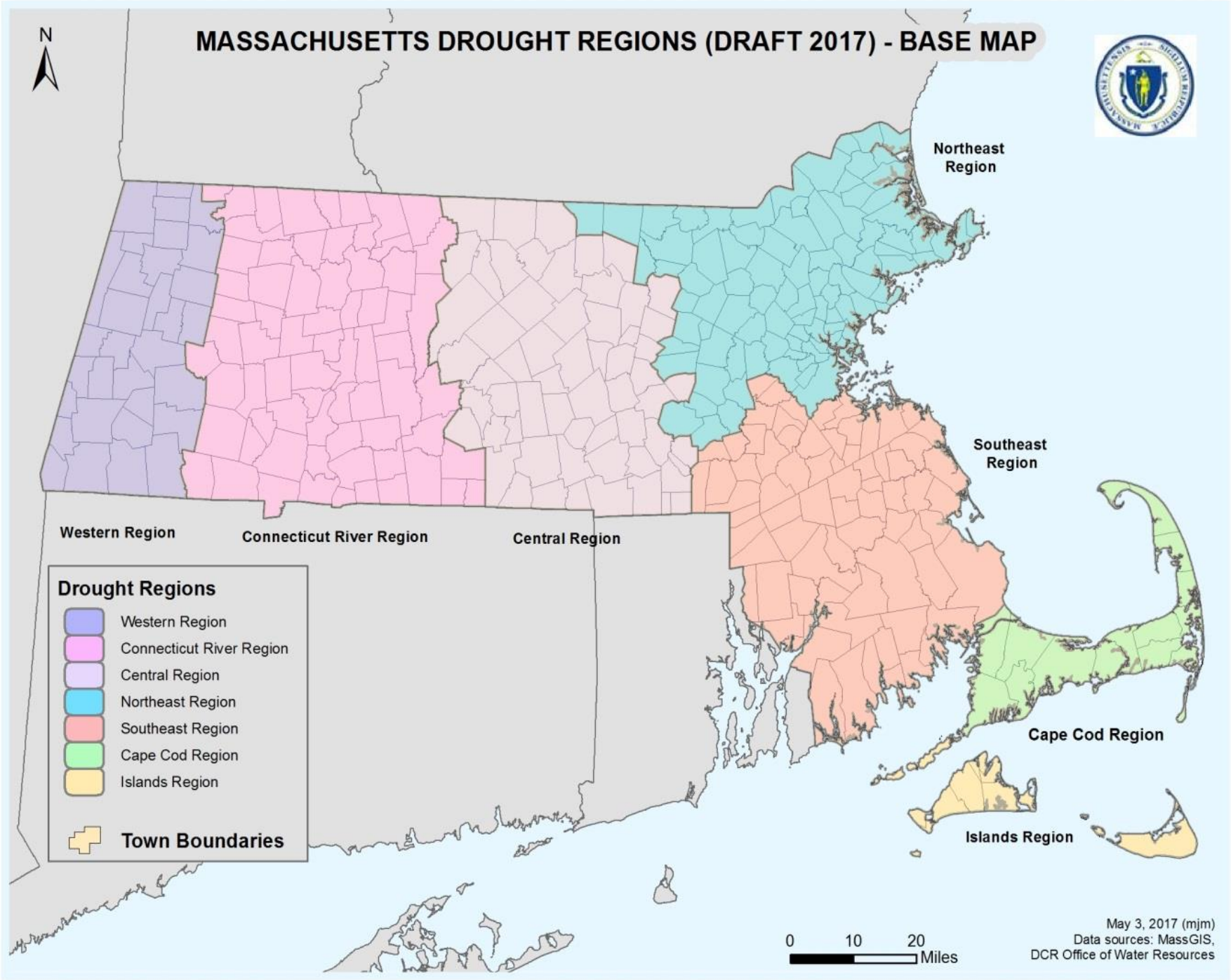
Drought Level	Percentile Range	US Drought Monitor Equivalence	New Nomenclature
1	>20 and ≤30%	D0	**Dry**
2	>10 and ≤20%	D1	**Very Dry**
3	>2 and ≤10%	D2 and D3 combined	**Critically Dry**
4	≤2%	D4	**Emergency**

Current State Drought Levels
Advisory
Watch
Warning
Emergency

Drought Regions – Align with Counties



7 Drought Regions



Next steps on Indices

- Complete assessment of new soil moisture/ET index
- Calculate all indices using new methods for all available historical data
- Assess implications on drought levels - number and severity of droughts

ACTIONS Overview

Feedback we received:

- Current plan lacks specific actions, especially local
- Plan is not "operationalized"
- Plan should include preparedness, not just response
- Some actions should be mandatory, plan needs authority
- Public outreach (more from State, enable local)
- Technical & financial assistance

Process included review of:

- Drought plans across the nation
- Materials from national associations
- Massachusetts policies and guidelines

Proposed Changes:

1. Add Local and State Preparedness to plan
2. Expand Local and State Response Actions during drought
3. User friendly format with menu of options and resources

Menu of Local Preparedness Actions

Major Themes:

1. Local Drought Management Plan (DMP) as part of Emergency Response Plan (including supply side actions)
2. Land Use Planning to Minimize Water Use & Increase Recharge
3. Water Conservation Program (WCP)
4. Water Rates
5. Nonessential Outdoor Water Use Restrictions

Example Local Drought Response Matrix

	State Drought Level and Description	Level 1: Dry	Level 2: Very Dry	Level 3: Critically Dry	Level 4: Emergency
	Reservoir Trigger(s)	Fill in if establishing local reservoir triggers for staged drought response			
	Groundwater Trigger(s)	Fill in if establishing local groundwater triggers for staged drought response			
Demand Management Actions	Nonessential Outdoor Watering	1 day per week watering, before 9 am and after 5 pm.	Hand-held watering only, before 9 am and after 5 pm.	No nonessential outdoor water use	No nonessential outdoor water use
	New sod, seeding, and landscaping	Follow best management practices for efficient watering.	Installation of new sod, seeding, and landscaping is discouraged	Installation of new sod, seeding, and landscaping is strongly discouraged.	Installation of new sod, seeding, and landscaping is prohibited.
	Water Savings Goal	55 gallons per person per day, or reduce use by __%	50 gallons per person per day, or reduce use by __%	45 gallons per person per day, or reduce use by __%	40 gallons per person per day, or reduce use by __%
Water Supply Actions	Interconnection/Backup and Emergency Supplies	n/a	Prepare activation of interconnections/ backup supplies	Activate interconnections/backup supplies	Activate interconnections/backup supplies
Communication Actions	Website/Press/Social Media	Update website/social media with latest information on drought status and restrictions/tips	Weekly Tweets on Water Conservation	Press Events and Weekly Social Media Updates	Daily Communication using all tools
Coordination Actions	Drought Management Team	Convene Drought Team, Monthly Meetings	Weekly Drought Team Meetings	Weekly or Daily Drought Team Meetings	Daily Drought Team Meetings

Statewide Guidance: Avoid Watering During a Drought

Limits on outdoor water use are critical to help ensure that enough water is available for essential needs, including drinking water and fire protection, crop irrigation, and our natural resources.

State Drought Level	Nonessential Outdoor Water Use Restrictions
Level 1 (Dry)	1 day per week watering, after 5 p.m. or before 9 a.m. (to avoid evaporative losses)
Level 2 (Very Dry)	Outdoor watering should be limited to hand held hoses or watering cans, to be used only after 5 p.m. or before 9 a.m.
Level 3 (Critically Dry)	Ban on all nonessential outdoor water use
Level 4 (Emergency)	Ban on all nonessential outdoor water use

State Actions- Key Functions

- Data gathering and analysis
  - Automate analysis, increase real-time data & reporting frequency
- Communication and Public Outreach
  - Develop Communications Strategy, Drought Portal, impact reporting
- Demand Management
  - Improve water-use efficiencies at state facilities
- Supply Management
  - Review Emergency Plans in light of drought
- Technical Assistance
  - Support local development of DMPs, WCPs
- Policy
  - Review/update WCS and DMP every 5 years, consider new policies

Communication

- Include enhanced set of communication strategies
  - Ongoing actions during normal conditions
  - Enhanced actions during a drought
- Target communication strategies to four sectors:
  - The General Public
  - Cities & Towns
  - Media
  - Businesses, including Agriculture

Next Steps

- Winter 2017-2018: Draft Report release for comment anticipated
- Spring 2018: Final Report
- Summer 2018: begin implementing preparedness

Other related Efforts

- NIDIS (National Integrated Drought Information System): Drought Early Warning System for the Northeast
- Massachusetts Water Conservation Standards update
- Nuts and bolts of a local drought plan

Thank you!

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