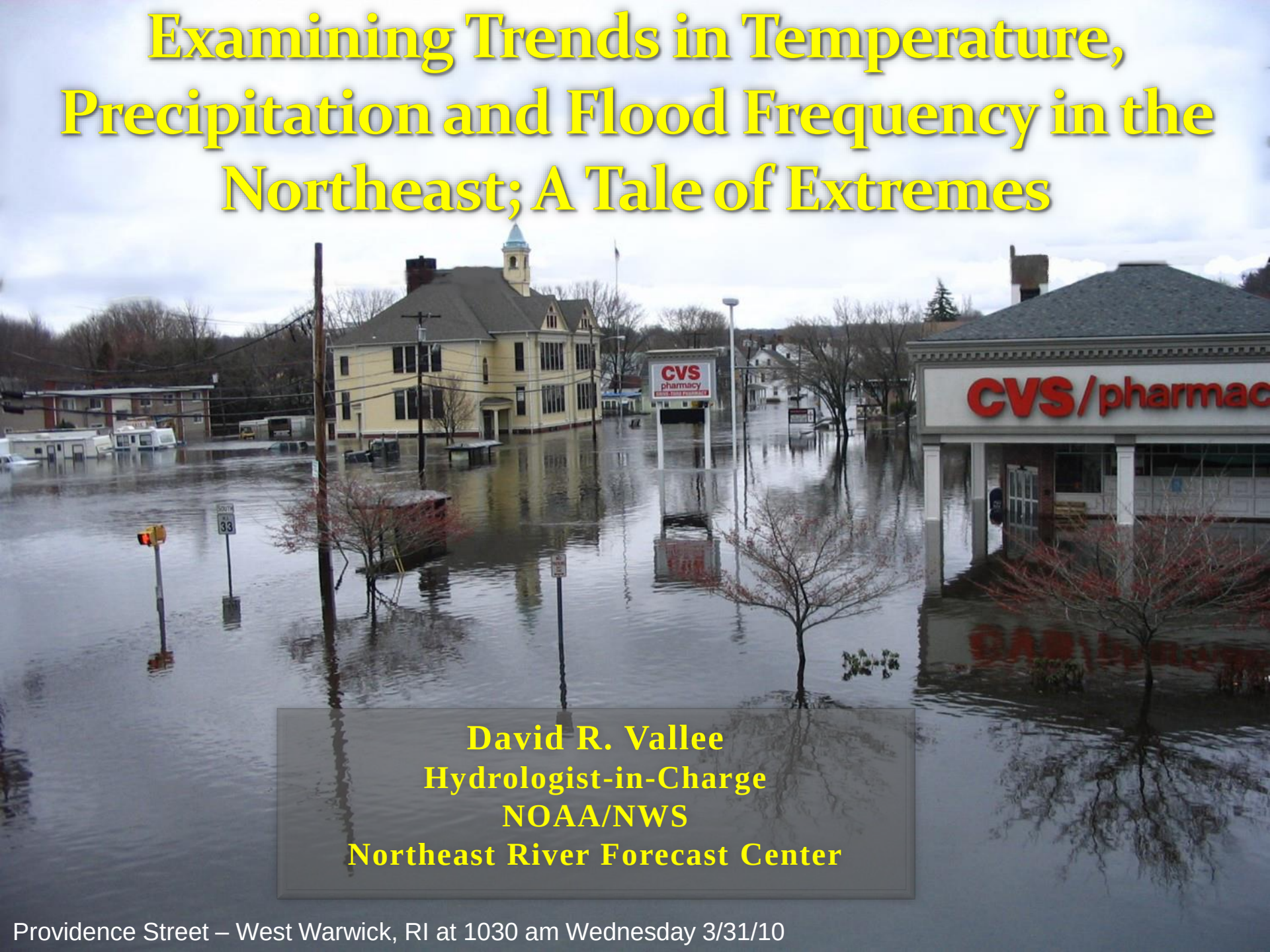
Examining Trends in Temperature, Precipitation and Flood Frequency in the Northeast; A Tale of Extremes



David R. Vallee
Hydrologist-in-Charge
NOAA/NWS
Northeast River Forecast Center

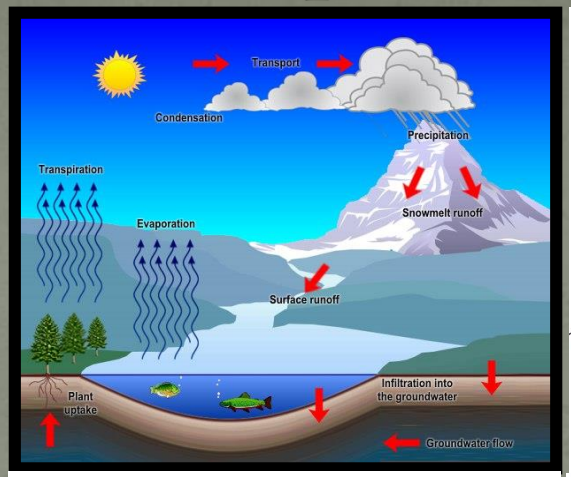
Providence Street – West Warwick, RI at 1030 am Wednesday 3/31/10

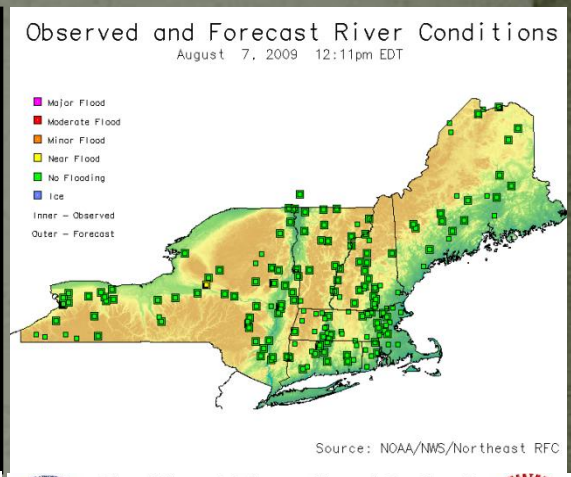
Outline

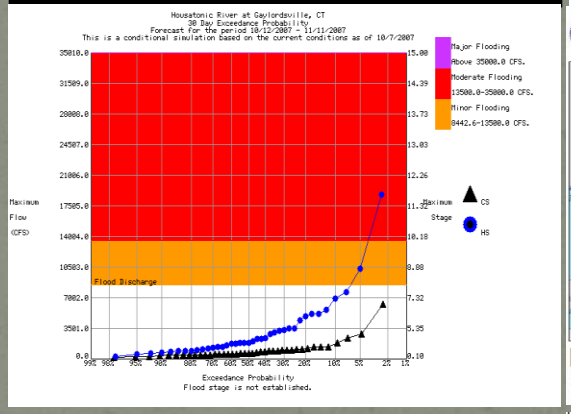
- From a “Practitioner’s Perspective”
- How may a changing climate be impacting storm behavior in the Northeast?
- Substantial warming trend
- Big Rainstorms & Increased River Flooding
- Intense short-term droughts
- What does this all mean?

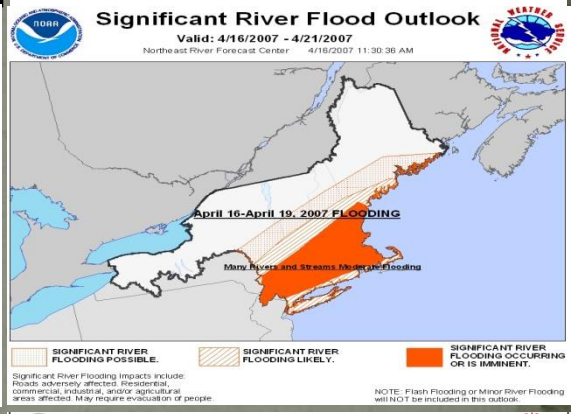
River Forecast Center Responsibilities

- Calibrate and implement a variety of hydrologic and hydraulic models to provide:
  - River flow and stage forecasts at 180 locations
  - Guidance on the rainfall needed to produce Flash Flooding
  - Ensemble streamflow predictions
  - Ice Jam and Dam Break support
  - Water Supply forecasts
  - Partner with NOAA Line Offices to address issues relating to Hazard Resiliency, Water Resource Services, Ecosystem Health and Management, and Climate Change

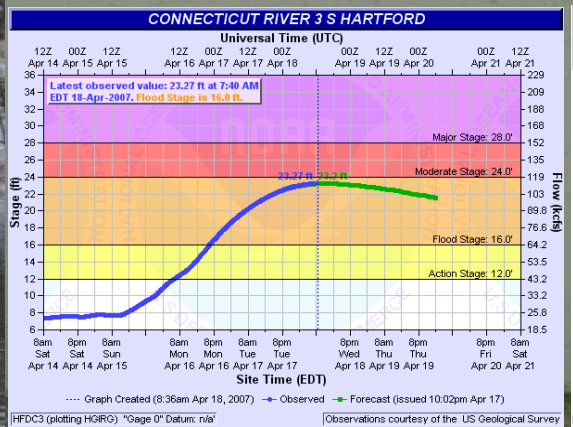


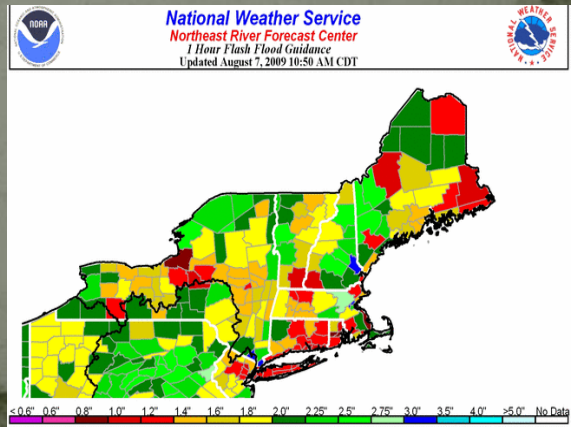






Moderate flooding - Connecticut River at Portland, CT.





My "religious experience":

Takes on a whole new meaning when it hits your hometown…

Providence Street – West Warwick, RI at 1030 am Wednesday 3/31/10

It is happening throughout the Northeast!

Record flooding along the Fish and Saint John Rivers – northeast Maine, 4/30/2008

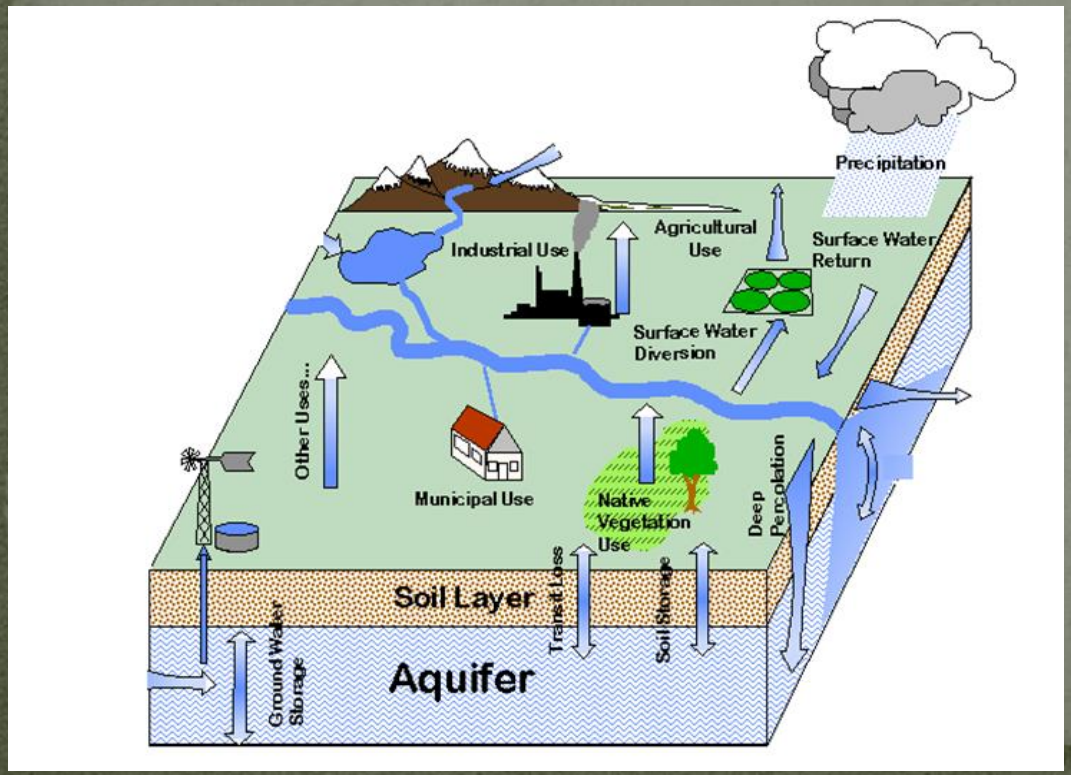
St-Jean-sur-Richelieu, Quebec, Canada, 5/6/11
Photo: AP//Canadian Press, R. Remoirz

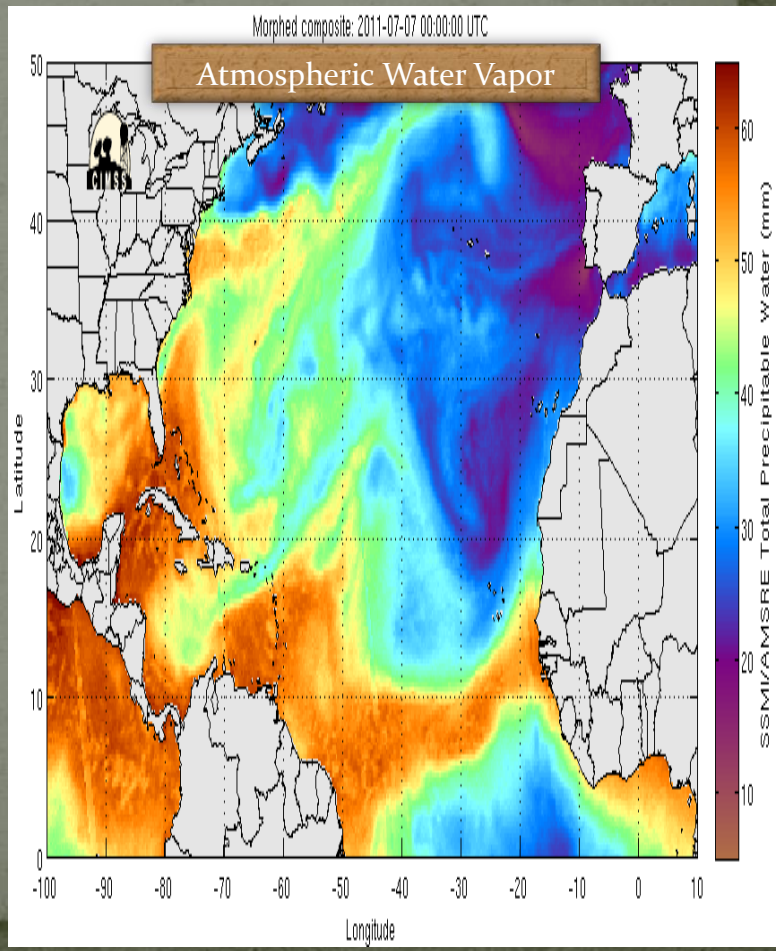
Warwick Mall – Warwick, RI at 2 pm, Wednesday March 31st, 2010

Home washed off its foundation along the Schoharie Creek, Prattsville, NY – Tropical Storm Irene

Is there a common theme to recent ?

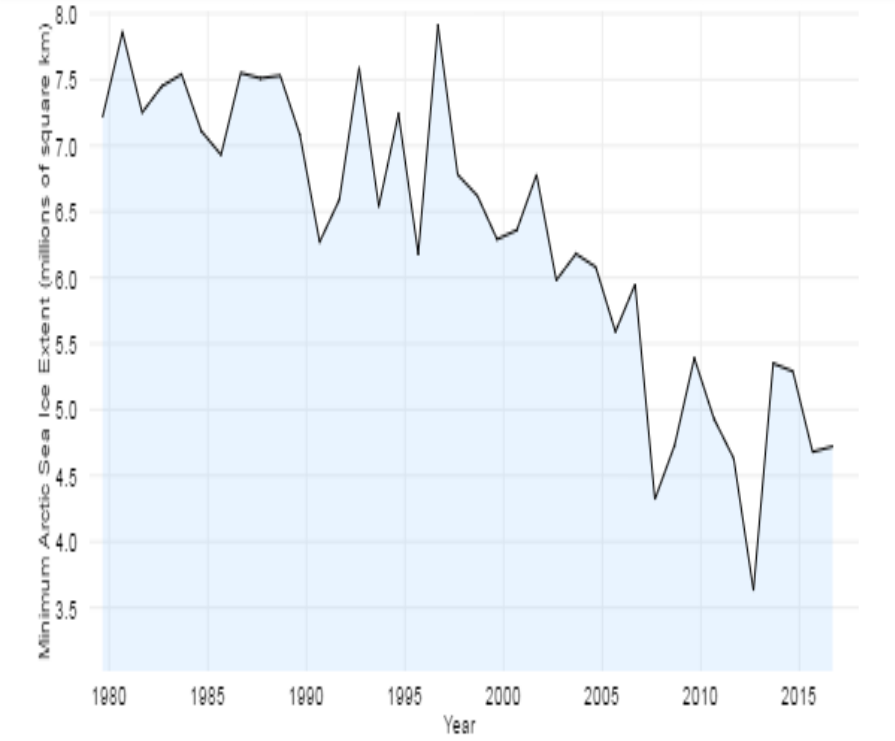
- Several:
  - Slow moving weather systems – a blocked up atmosphere
  - Multiple events in close succession or 1 or 2 slow movers
  - Resulted in saturated antecedent conditions
  - Each fed by a “tropical connection”
    - Plumes of deep moisture





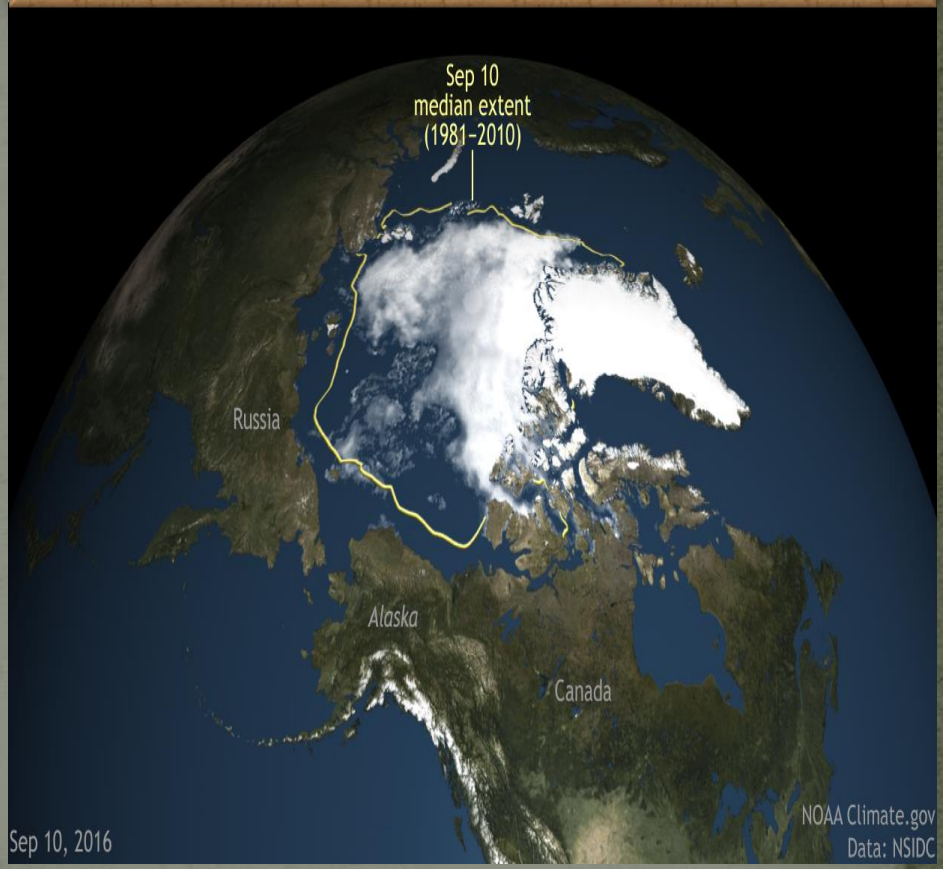
A warming planet and shrinking Arctic Sea ice

September Minimum Sea Ice Cover 1979-2016



This graph shows the average area covered by sea ice during September each year. Minimum sea ice extent has decreased 12% per decade since 1979. Data provided by the National Snow and Ice Data Center.

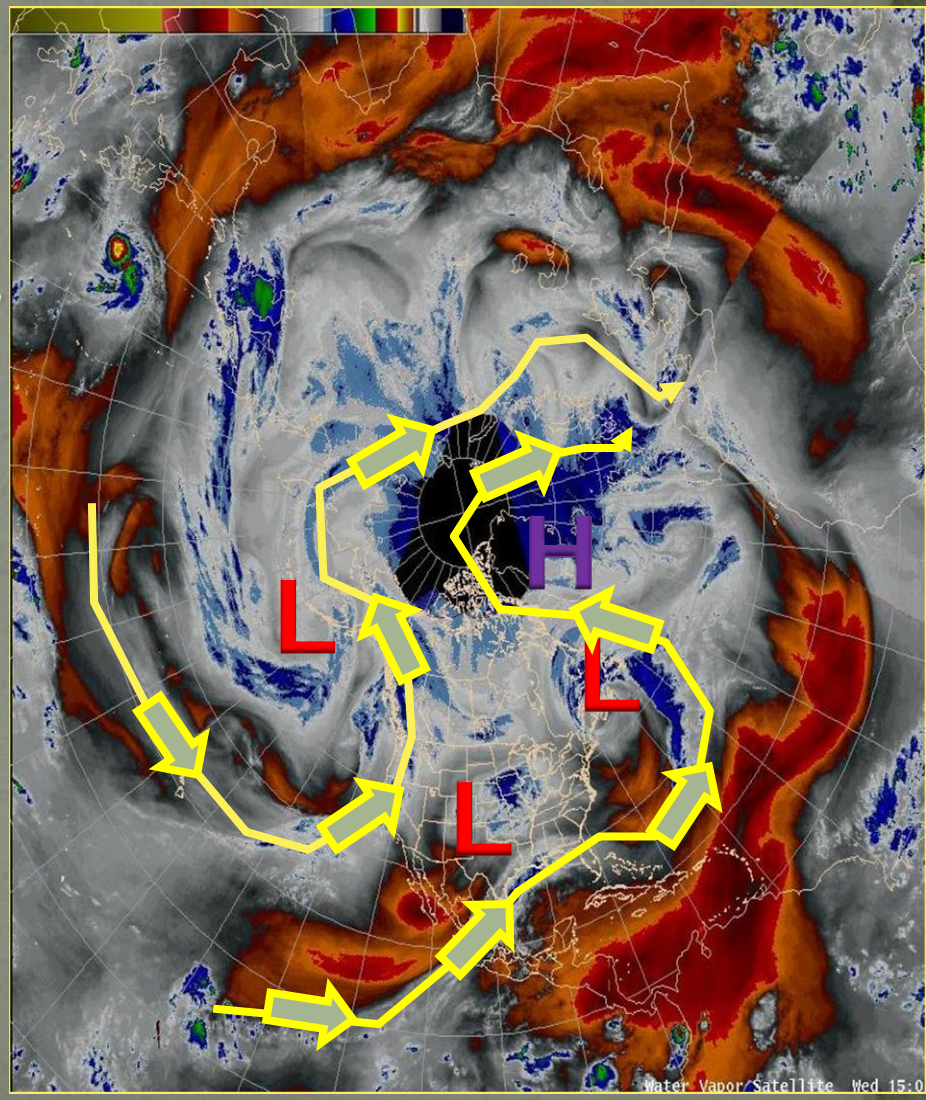
2016 Arctic Sea Ice Summer Minimum



Arctic sea ice concentration on the date of the 2016 minimum extent, September 10, 2016. NOAA Climate.gov image based on NOAA and NASA satellite data from NSIDC.

Is there a plausible "Climate Hypothesis"?

- Modest changes in air & sea temperatures = atmosphere can hold more moisture
  - New England is in close proximity to the Gulf & Atlantic moisture streams
  - Affected by dual storm tracks and blocking high pressure over Greenland
  - These ingredients offer us more “opportunities” to latch onto plumes
- Reduction of sea ice changes upper level wind flow
  - Arctic Amplification
  - Blocked up pattern induces slower moving storms or back-to-back-to back events



The Changing Climate: Increasing extremes

- Common themes across New England :
  - Increasing annual precipitation
  - Increasing frequency of heavy rains
  - Warming annual temperatures
  - Shift in precipitation frequency
- For smaller (<800 sq. mi) basins
  - Trend toward increased flood magnitude and/or frequency
    - Most pronounced where significant land use change and/or urbanization has occurred
- The Dry side
  - Intense periods of dry – lasting months at a time
  - "Flash Drought" behavior

Residents are rescued from their homes by boat along flooded Pawcatuck River , Westerly RI, on March 30, 2010. Photo: www.theday.com

Major flooding along Route 7 from the Housatonic River in New Milford, CT on March 11, 2011. Source: Ctcameraeye.com

Trends in U.S. Temperature: Decadal trends and 1991-2012 relative to 1901-1960

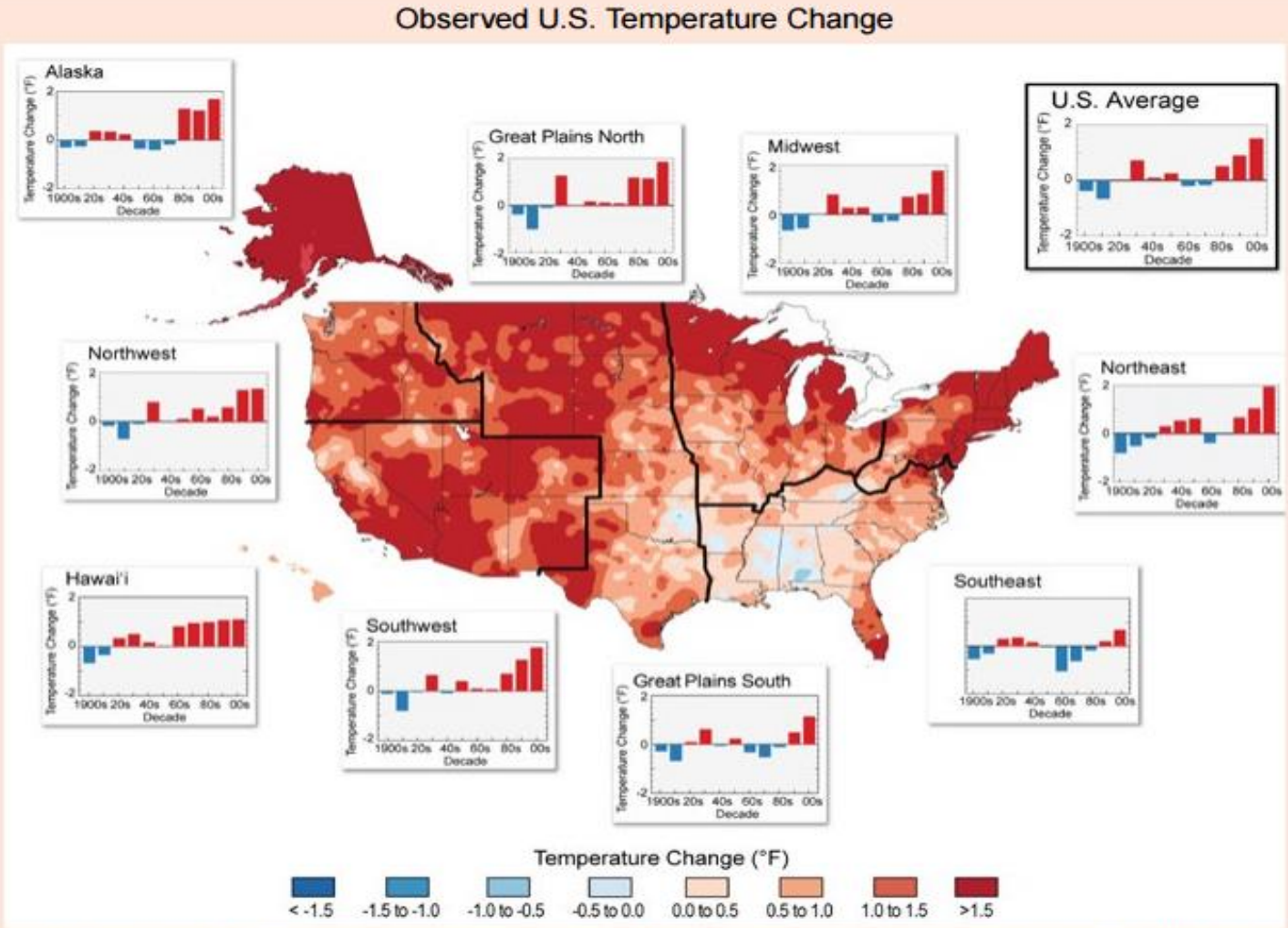
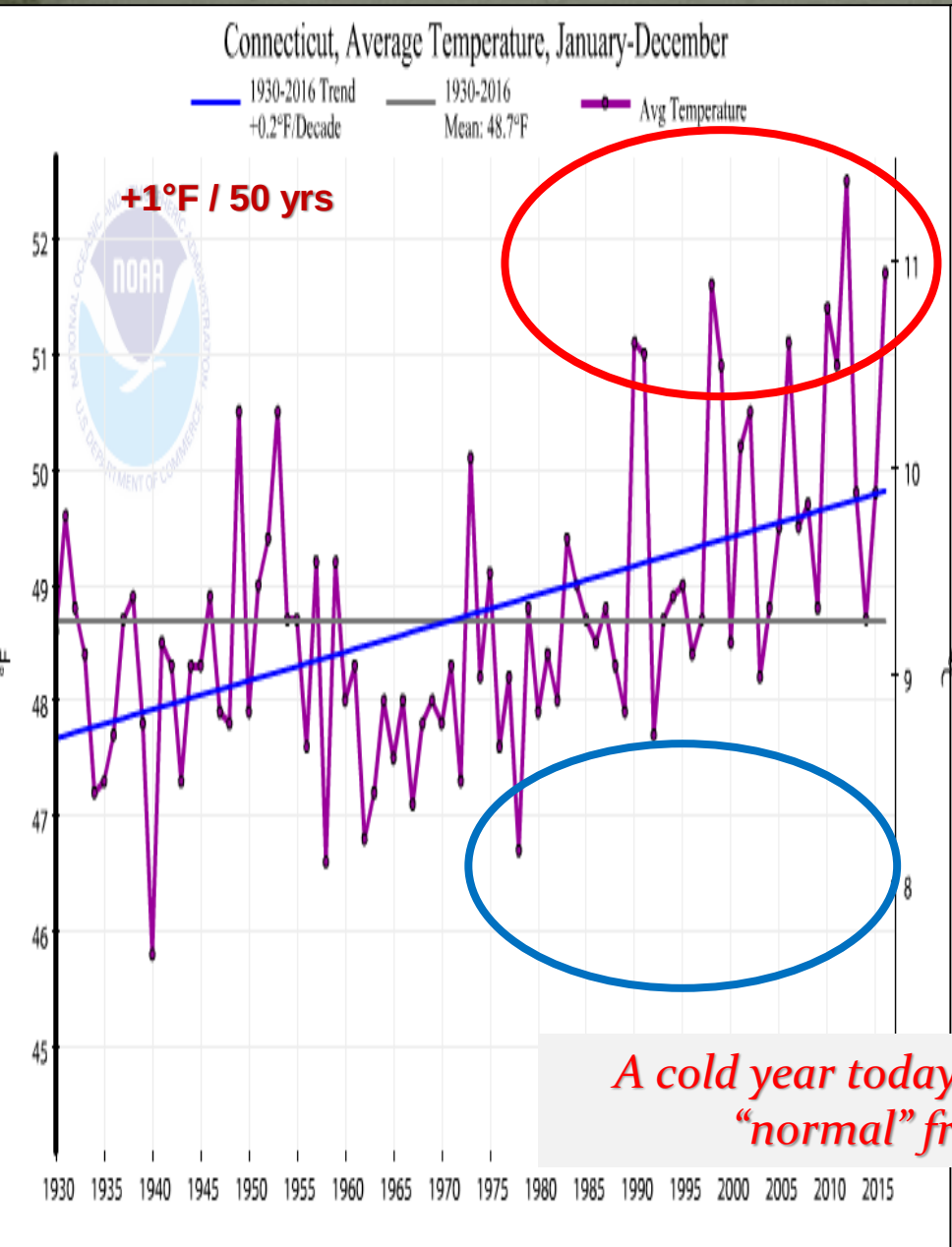
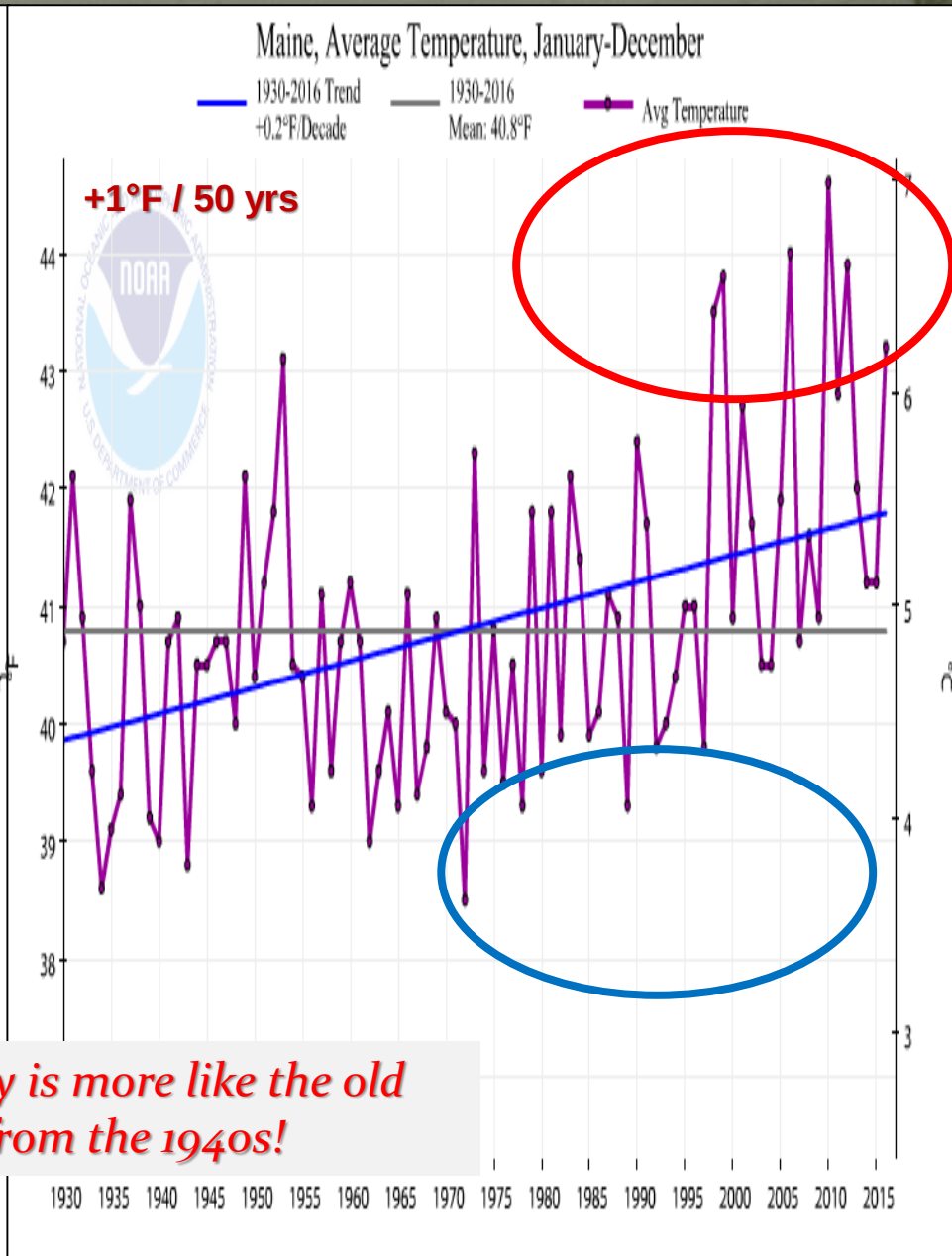


Figure 2.7. The colors on the map show temperature changes over the past 22 years (1991-2012) compared to the 1901-1960 average, and compared to the 1951-1980 average for Alaska and Hawai'i. The bars on the graphs show the average temperature changes by decade for 1901-2012 (relative to the 1901-1960 average) for each region. The far right bar in each graph (2000s decade) includes 2011 and 2012. The period from 2001 to 2012 was warmer than any previous decade in every region. (Figure source: NOAA NCDC / CICS-NC).

A Look at Temperature Trends

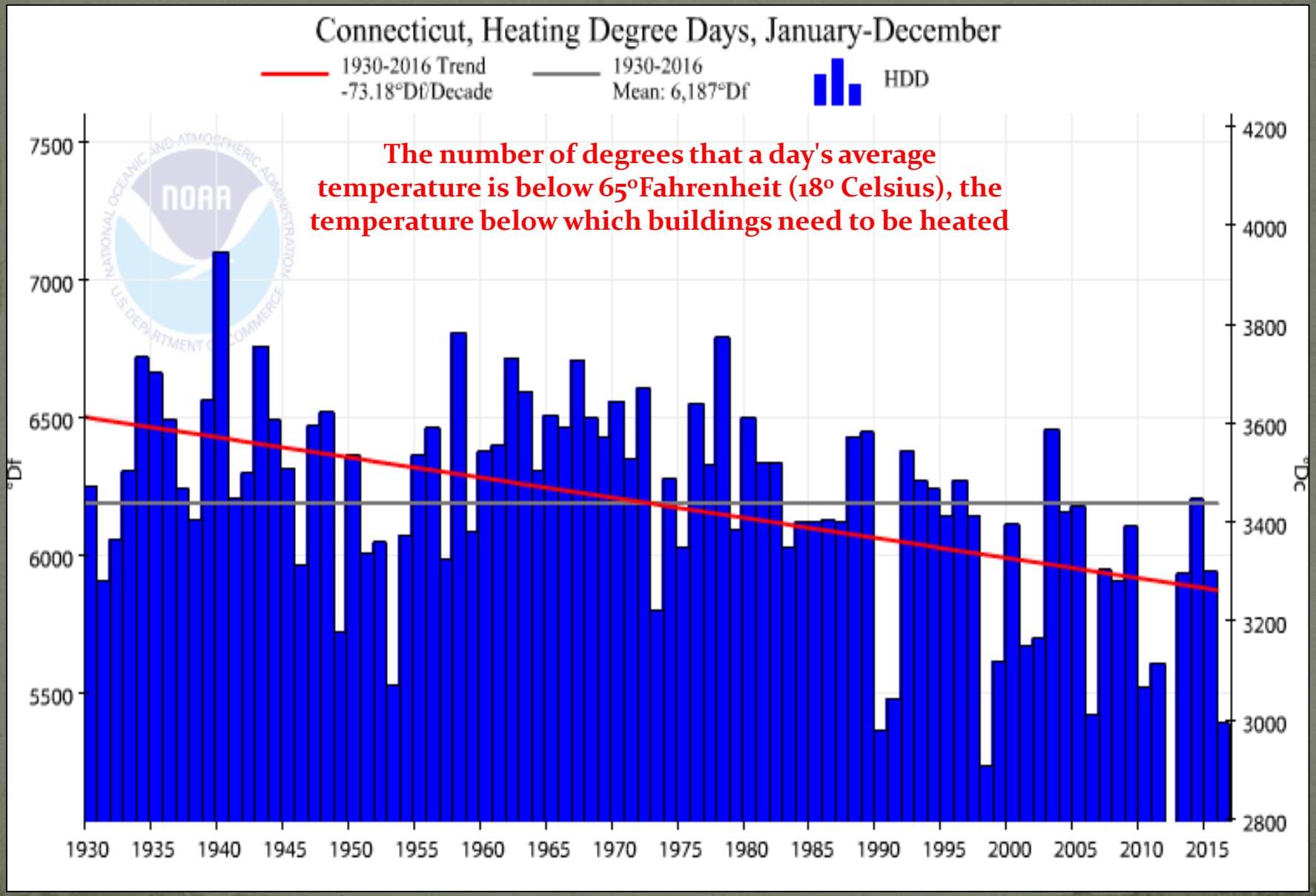
http://www.ncdc.noaa.gov/cag



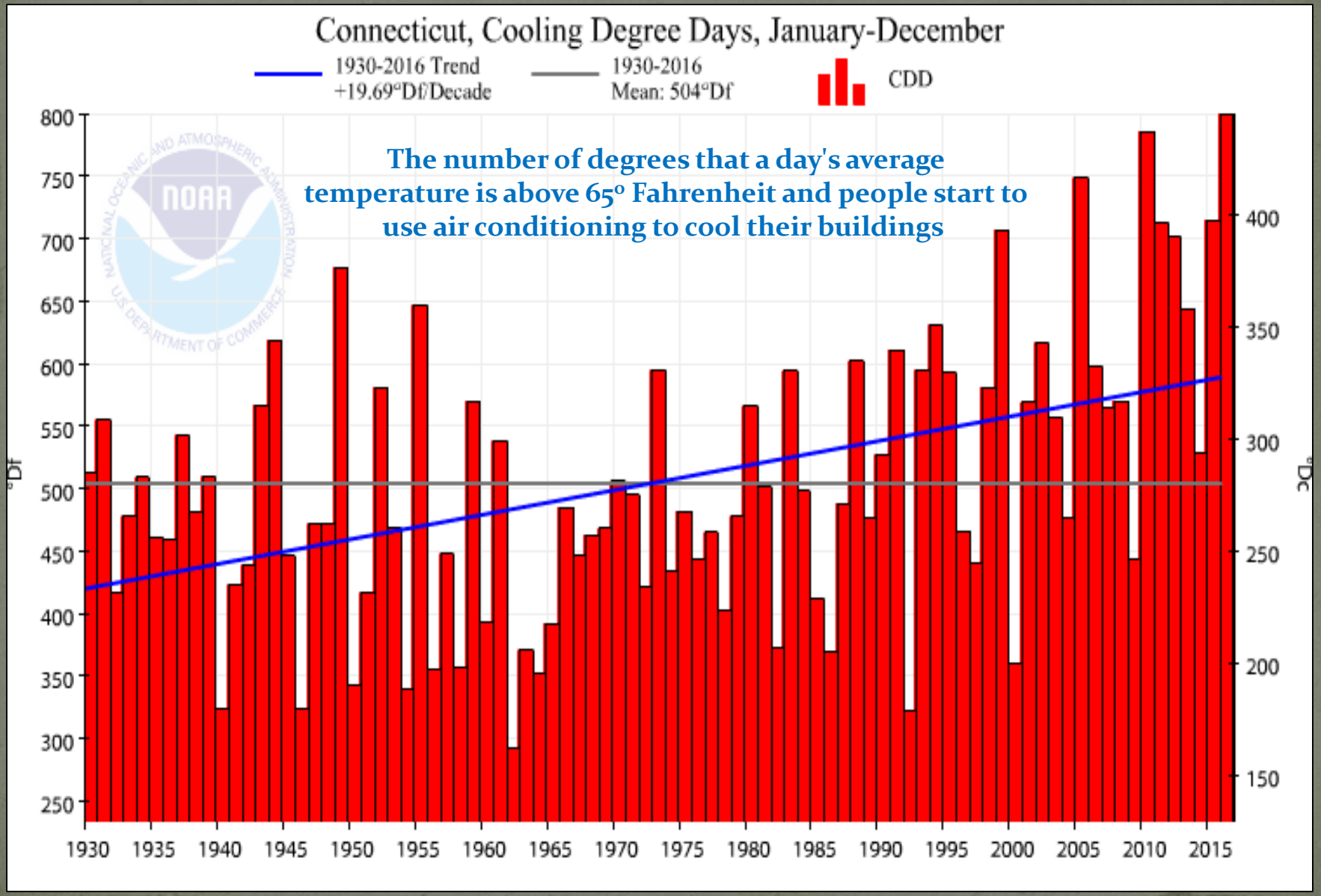


A cold year today is more like the old "normal" from the 1940s!

Impacts on Energy to Heat or Cool



Impacts on Energy to Heat or Cool



Trends in U.S. Precipitation: Decadal trends and 1991-2012 relative to 1901-1960

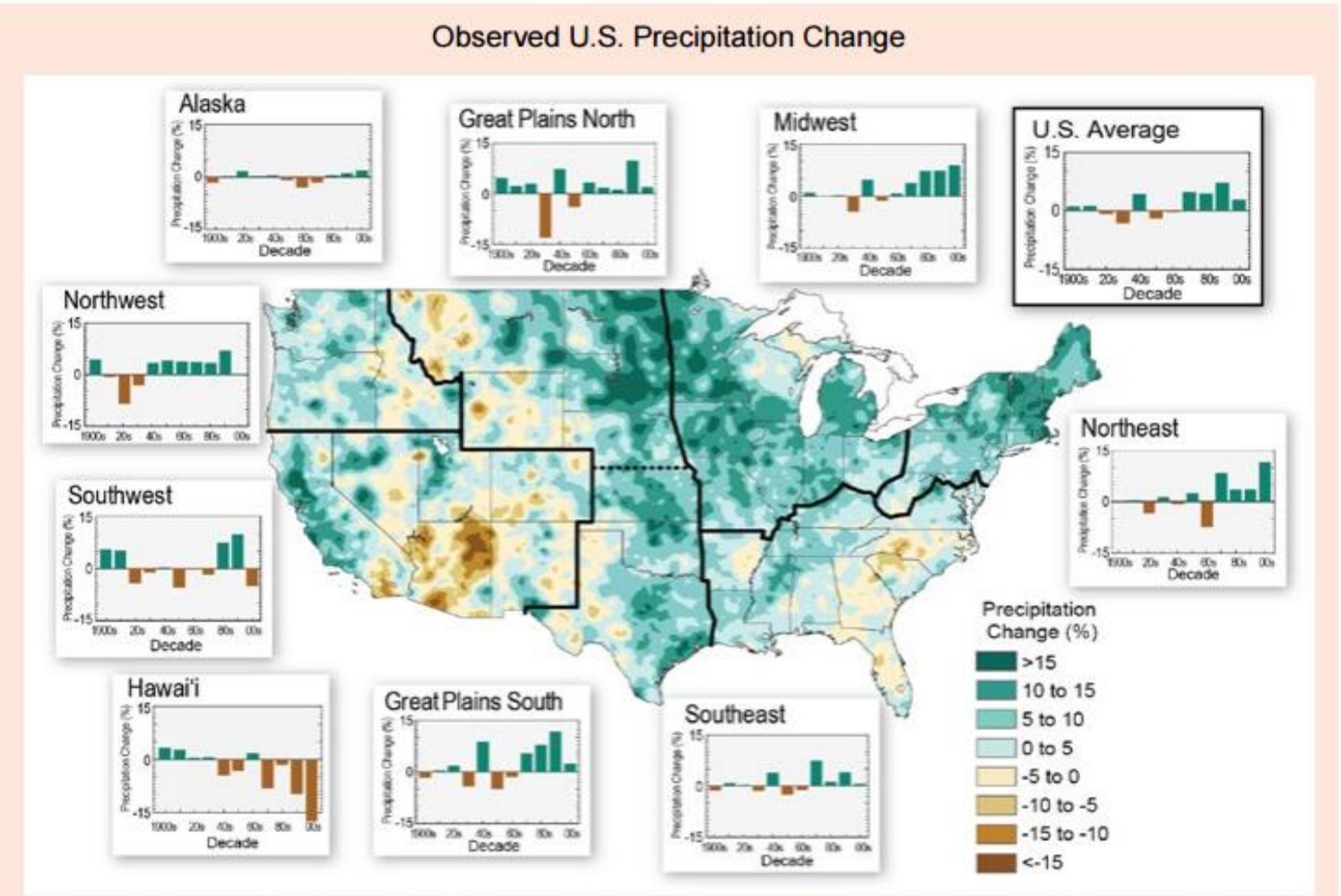
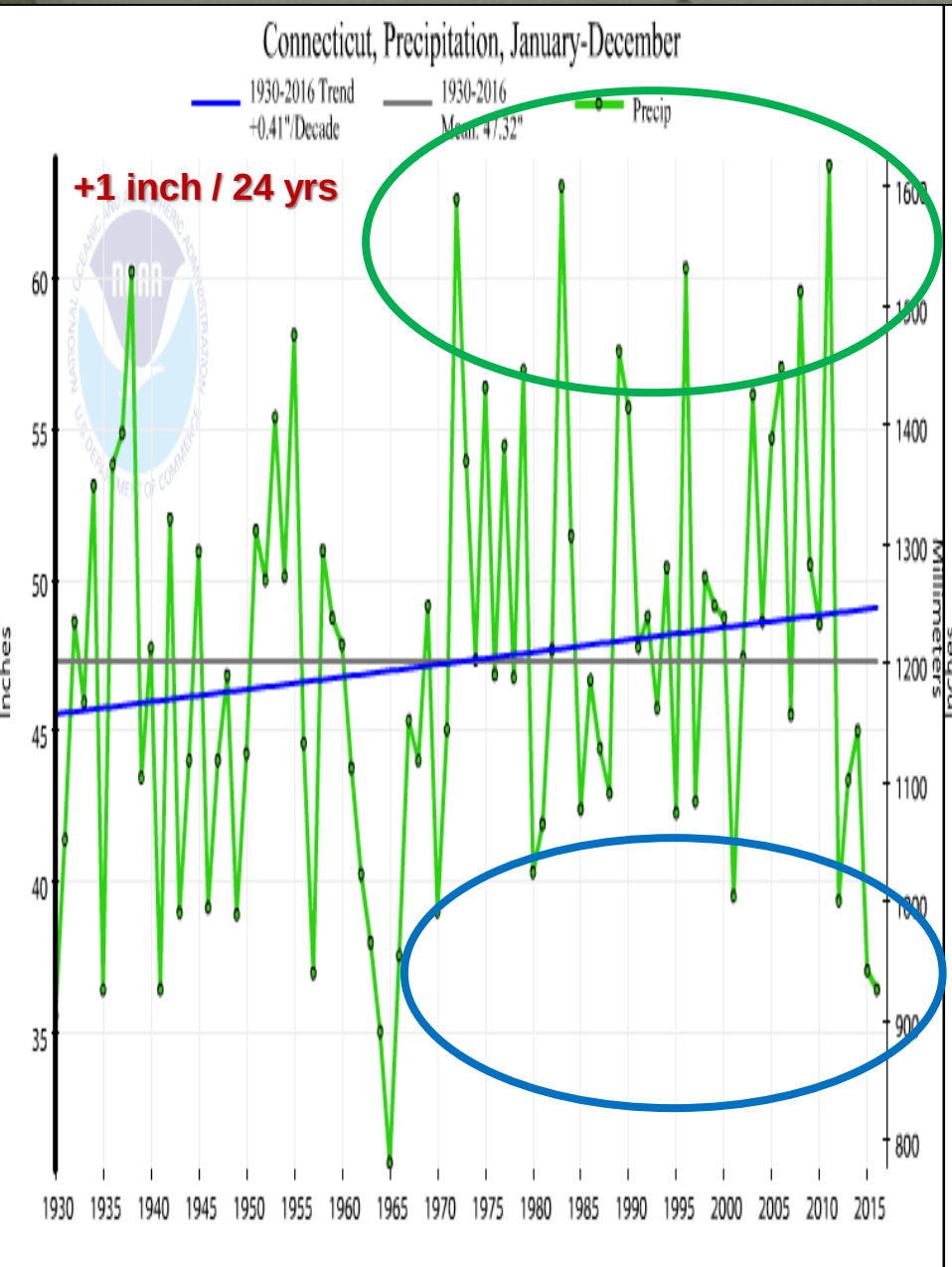
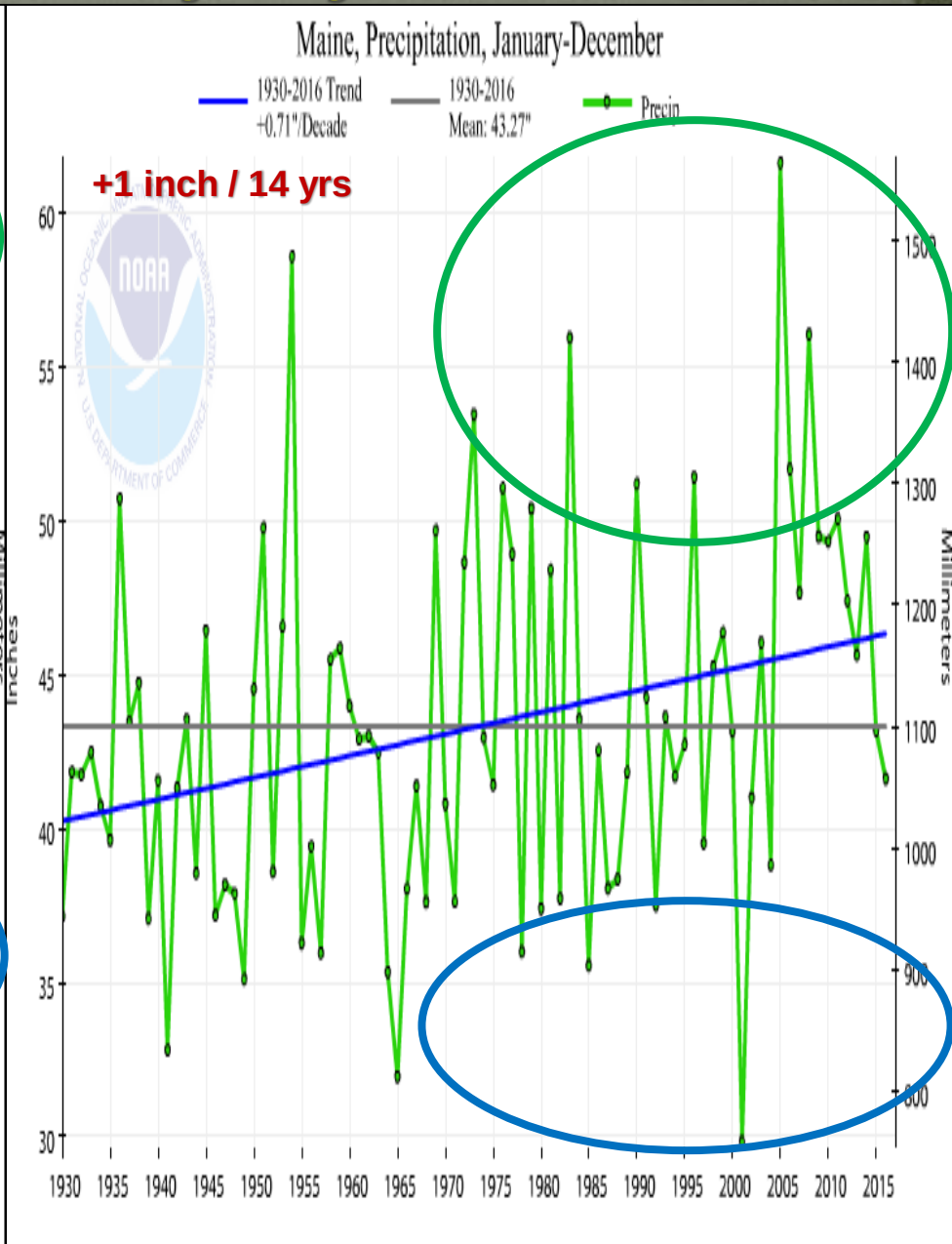


Figure 2.12. The colors on the map show annual total precipitation changes for 1991-2012 compared to the 1901-1960 average, and show wetter conditions in most areas. The bars on the graphs show average precipitation differences by decade for 1901-2012 (relative to the 1901-1960 average) for each region. The far right bar in each graph is for 2001-2012. (Figure source: adapted from Peterson et al. 2013[48]).

A Look at Precipitation Trends

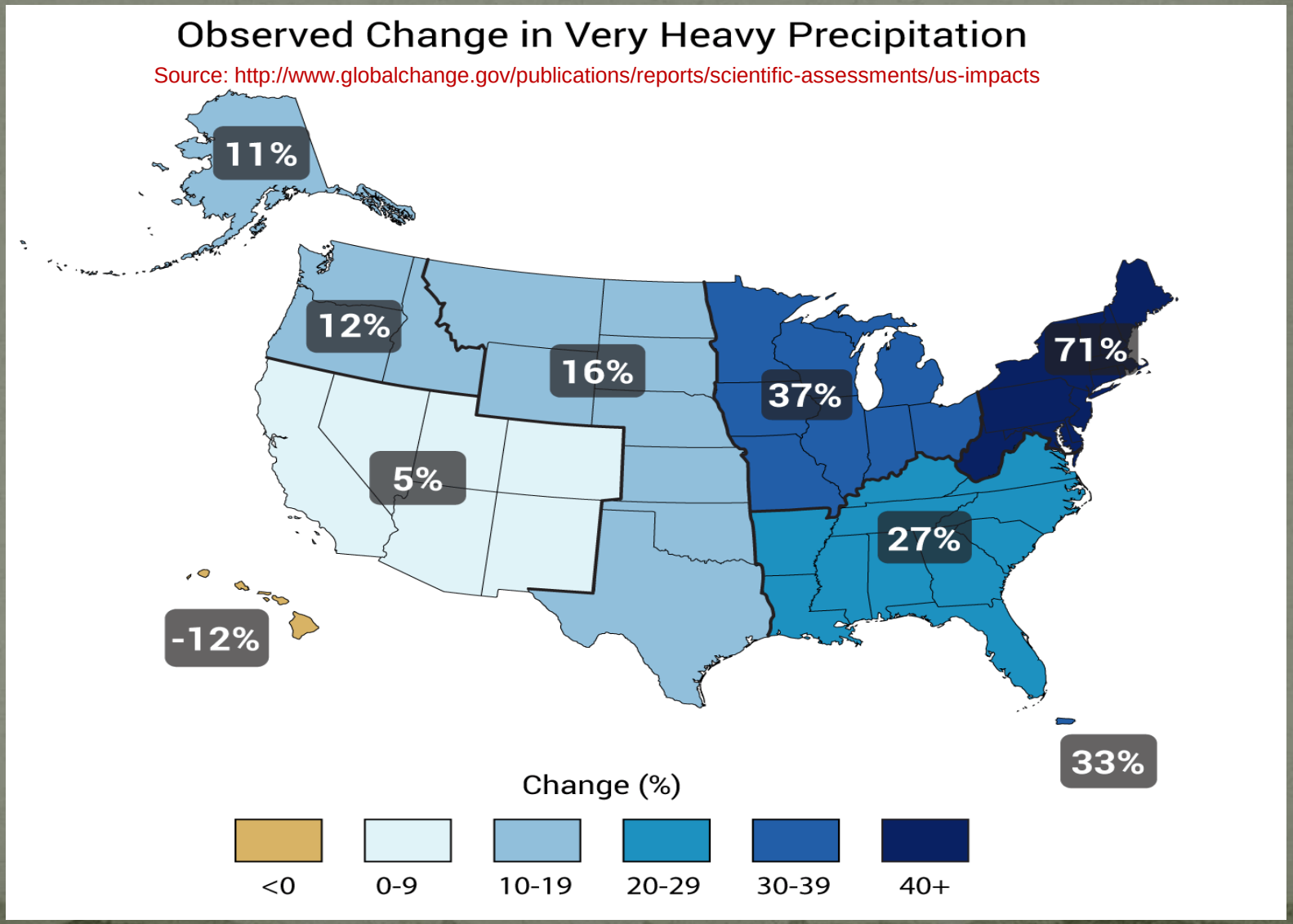
http://www.ncdc.noaa.gov/cag





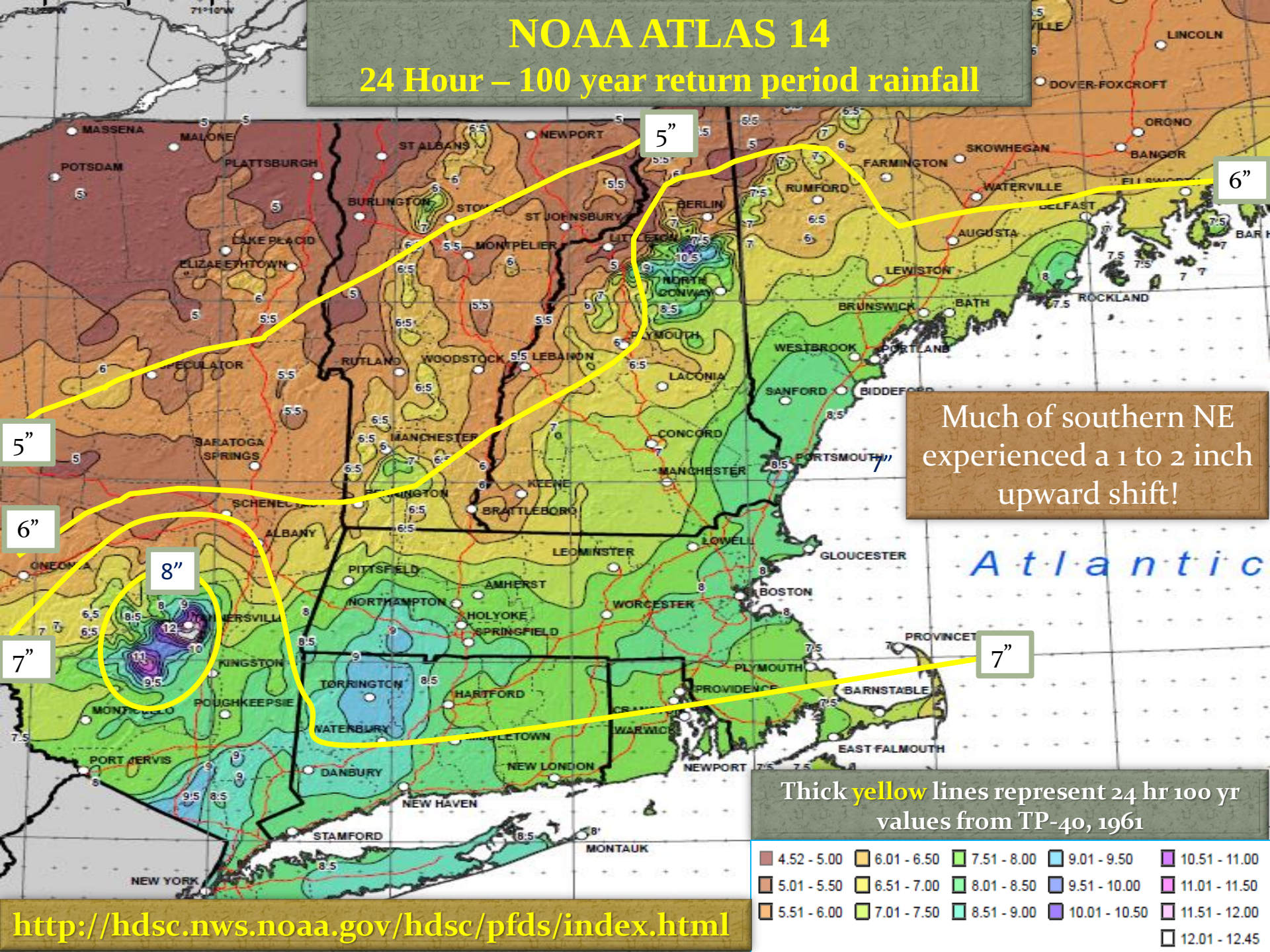
Change in Precipitation Patterns

Intense precipitation events (the heaviest 1%) in the continental U.S. increased by 20% over the past century while total precipitation increased by 7% (1958-2012).



NOAA ATLAS 14

24 Hour – 100 year return period rainfall



http://hdsc.nws.noaa.gov/hdsc/pfds/index.html

Trends in Flood Frequency:
Smaller watersheds feeling the effects first

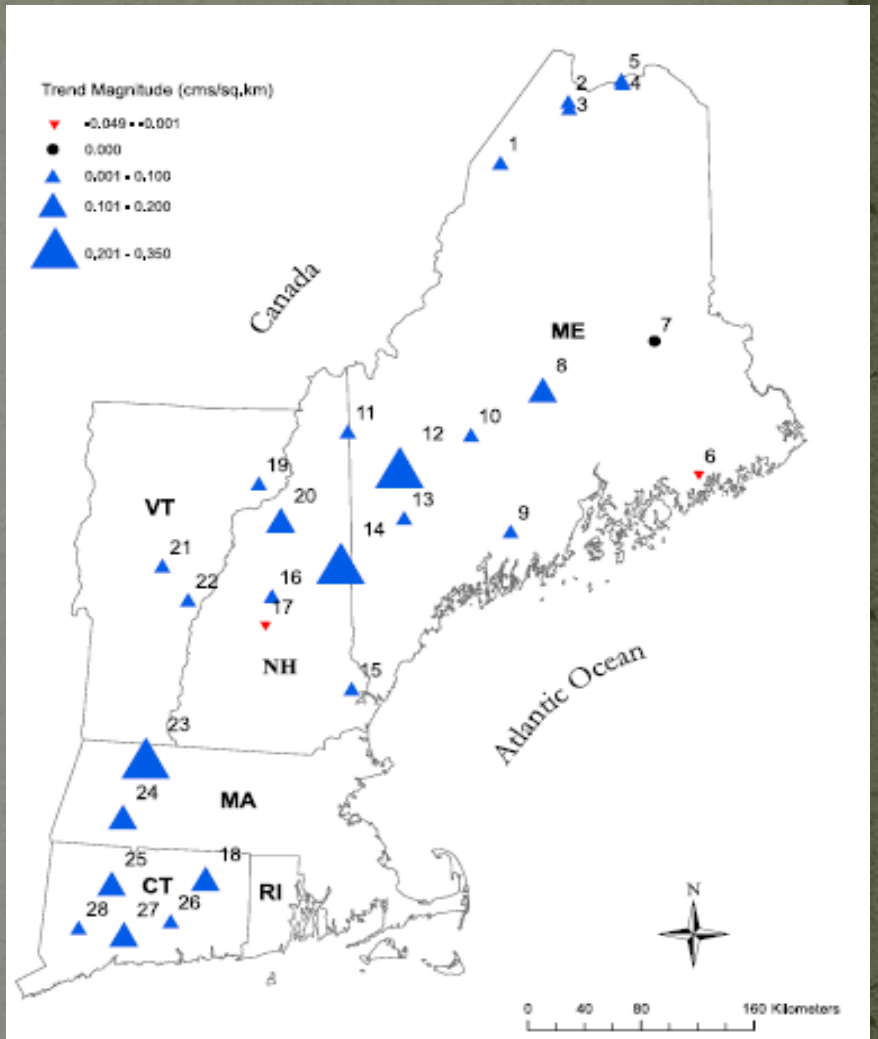
- Changes in frequency/magnitude
- Part land use/urbanization
  - Compounded by encroachment in the floodplain
- Part changing climate
- Larger basins & those with flood control haven't seen as noticeable a shift
  - Greater capacity to handle more rain
  - Greater capacity to control releases
- Northern and western parts of the state are seeing the most dramatic increase in flooding
  - Same area where 100 year rainfall has shifted dramatically

Flooding along the Housatonic River following Lee, Sept 8, 2011. Photo: A. Driscoll, CT Post

Moderate flooding along Connecticut River , April 1st, 2010. Photo: NBC Connecticut

Instantaneous peak flows

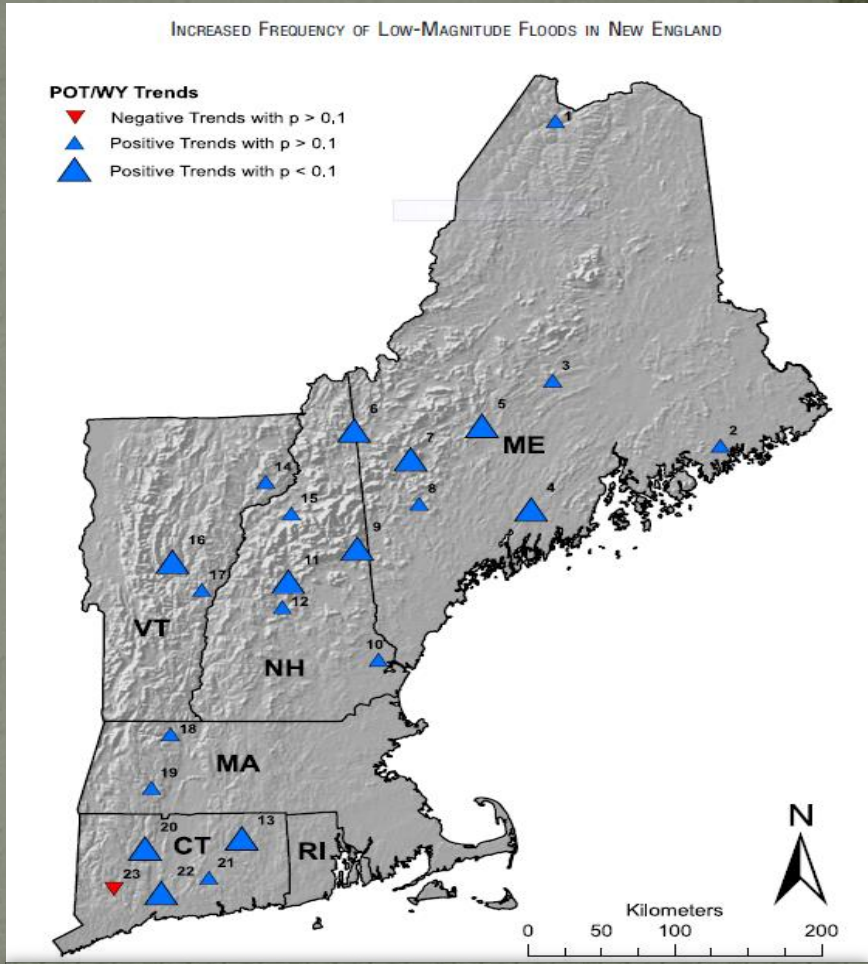
- Mathias Collins – NOAA NFMS – Restoration center
  - 2009 study of 28 watersheds with minimal human influences
  - Results indicate basins throughout much of New England have experienced increased peak annual flows
    - Strongest statistical trends noted by the large blue triangles



Spatial distribution of trend directions & magnitudes for based with minimal human influences.
Reference: *M. Collins, Journal of The American Water Resources Association (JAWRA) April 2009.*

Increased low magnitude floods

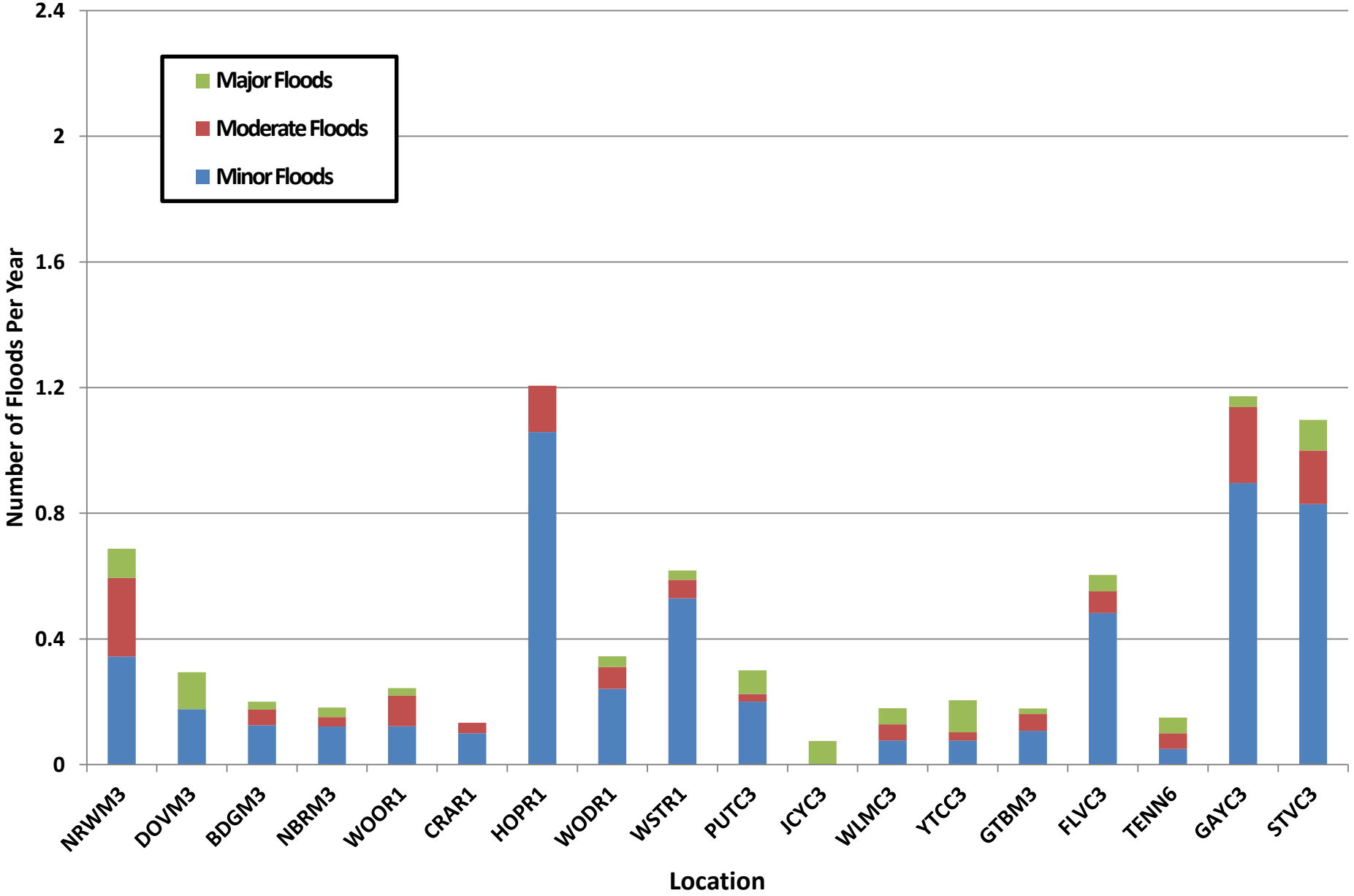
- Mathias Collins – NOAA NFMS – Restoration center
  - 2011 study of 23 watersheds with minimal human influences
  - Examined peaks over defined thresholds per water year (direct measure of flood frequency)
  - More frequent flooding at 22 of 23 locations
  - Increasing flood magnitude at 17 of 23 locations



Spatial Distribution of Flood Frequency – as measured by peaks over threshold per water year.
Reference: W. Armstrong, M. *Collins, and N. Snyder Journal of The American Water Resources Association (JAWRA) April 2011.*

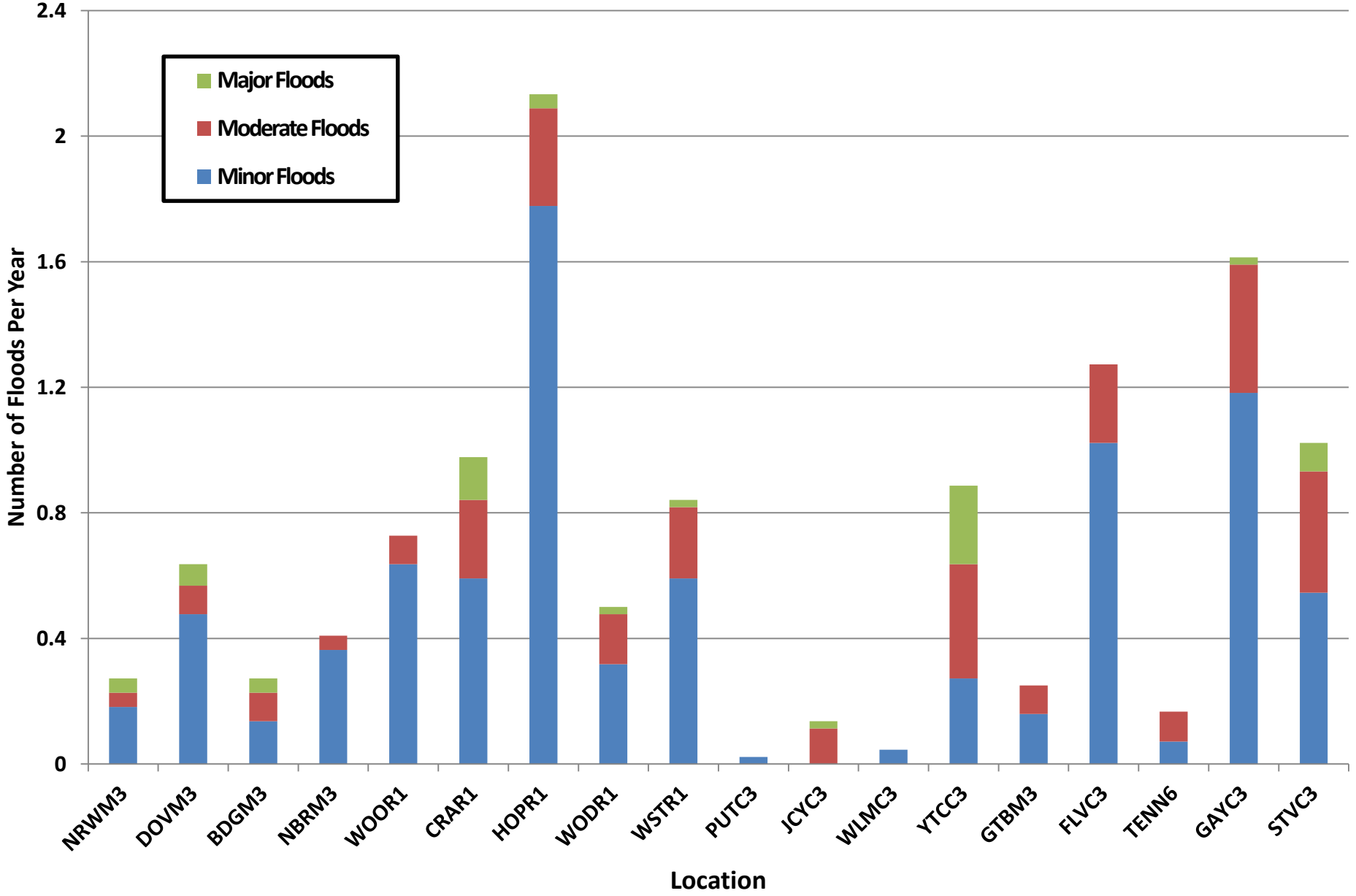
Southern New England River Basin Normalized Number of Minor, Moderate, and Major Floods Prior to 1970

Data provided by USGS science for a changing world



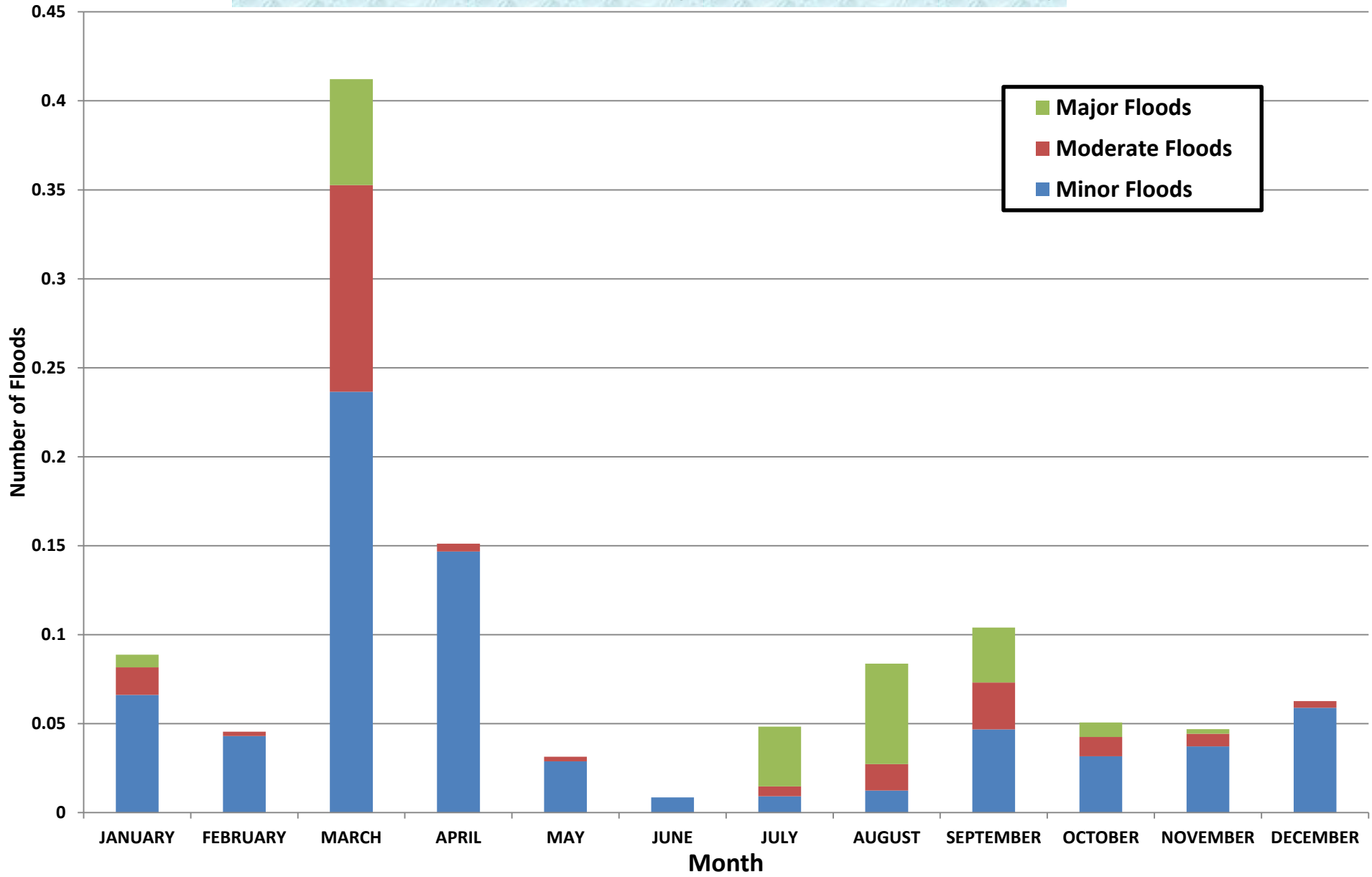
Southern New England River Basin Normalized Number of Minor, Moderate, and Major Floods from 1970-2013

Data provided by USGS science for a changing world



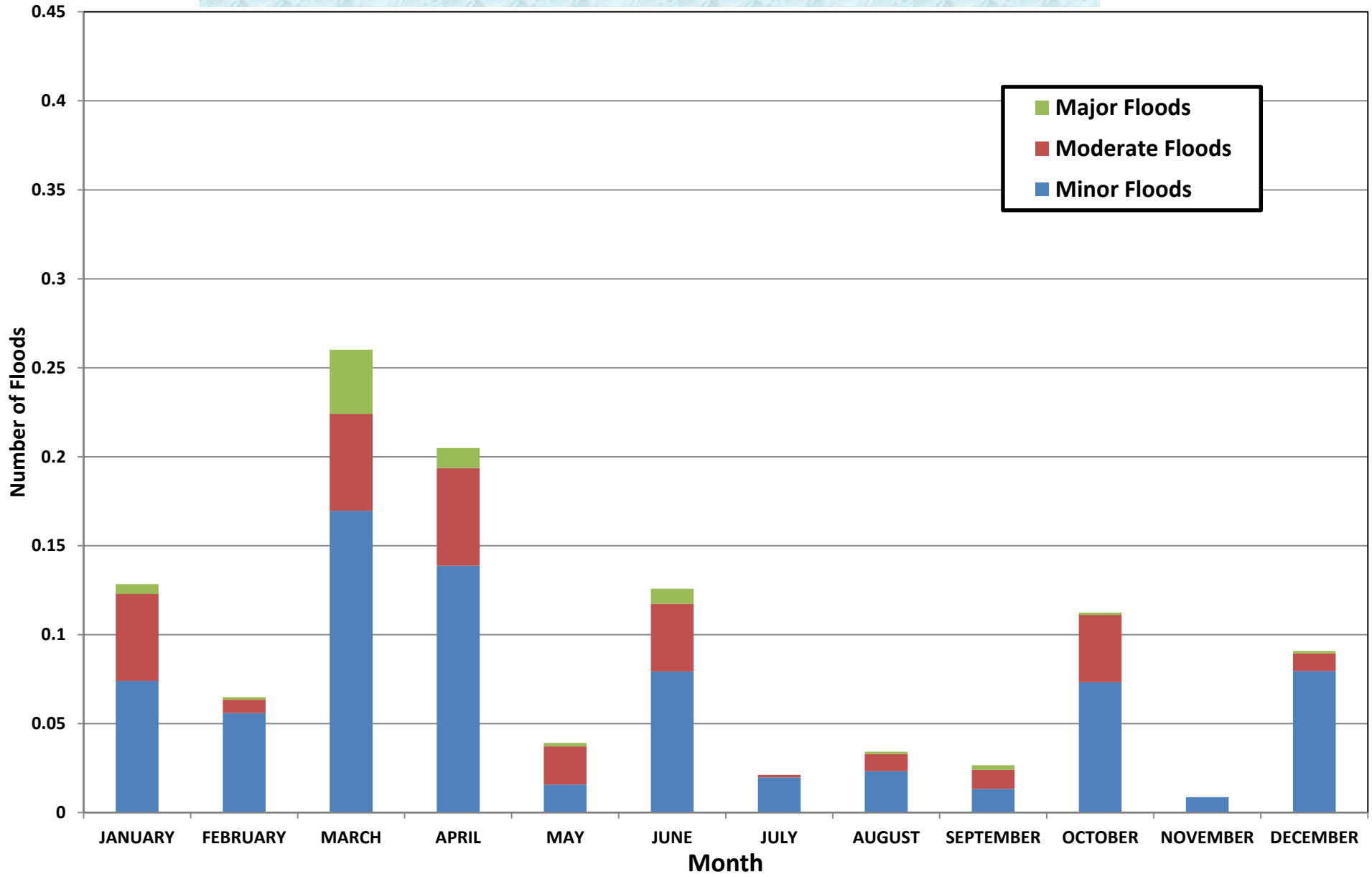
Southern New England River Basin Normalized Number of Minor, Moderate, and Major Floods Per Month Prior to 1970 (18 forecast locations)

Data provided by USGS science for a changing world



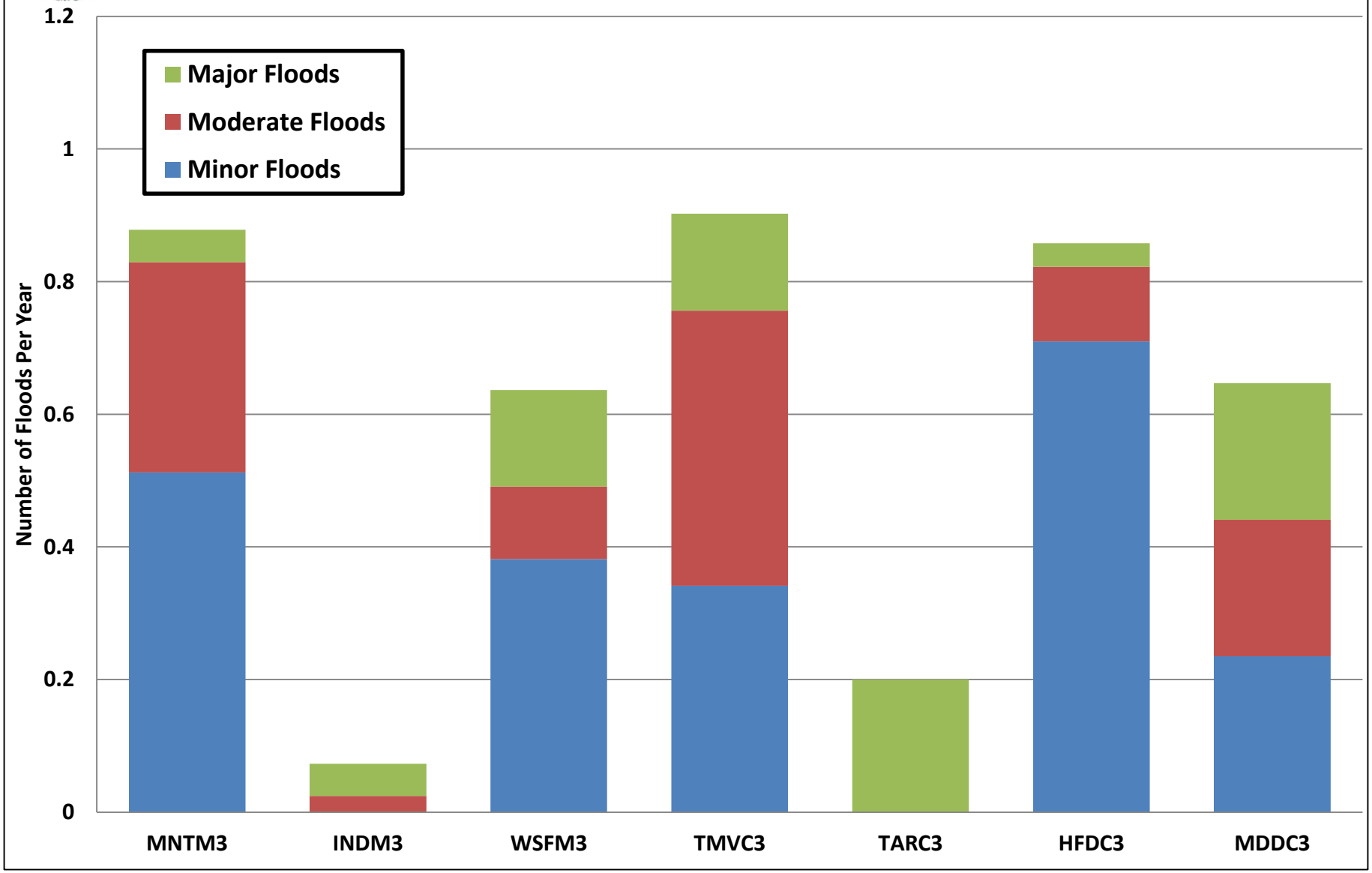
Southern New England River Basin Normalized Number of Minor, Moderate, and Major Floods Per Month from 1970 - 2013 (18 forecast locations)

Data provided by USGS science for a changing world



Lower Connecticut Basin Normalized Number Of Minor, Moderate, & Major Floods Per Year Prior to 1970

Data provided by USGS science for a changing world



Lower Connecticut Basin Normalized Number Of Minor, Moderate, & Major Floods Per Year from 1970 - 2013

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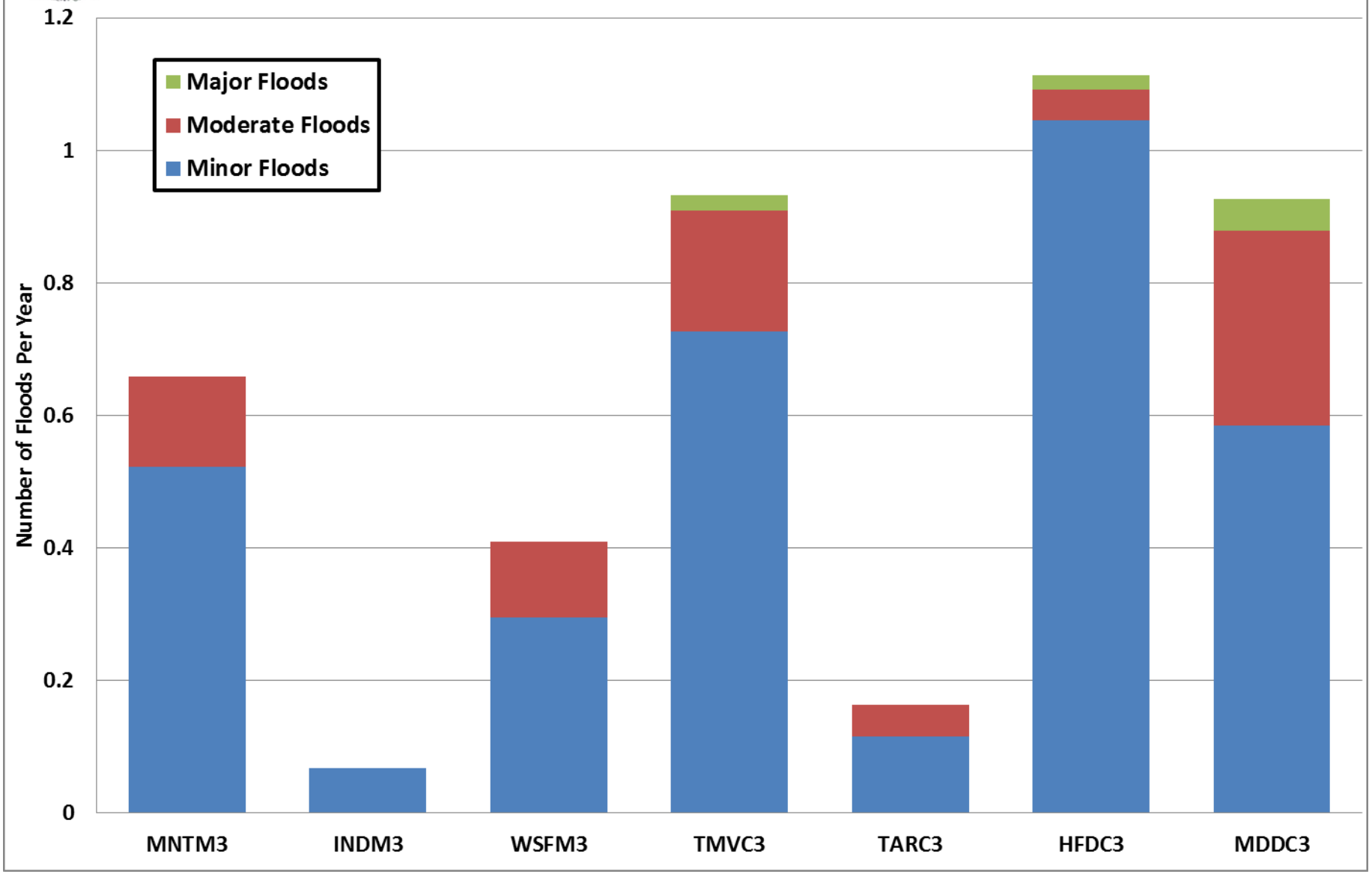
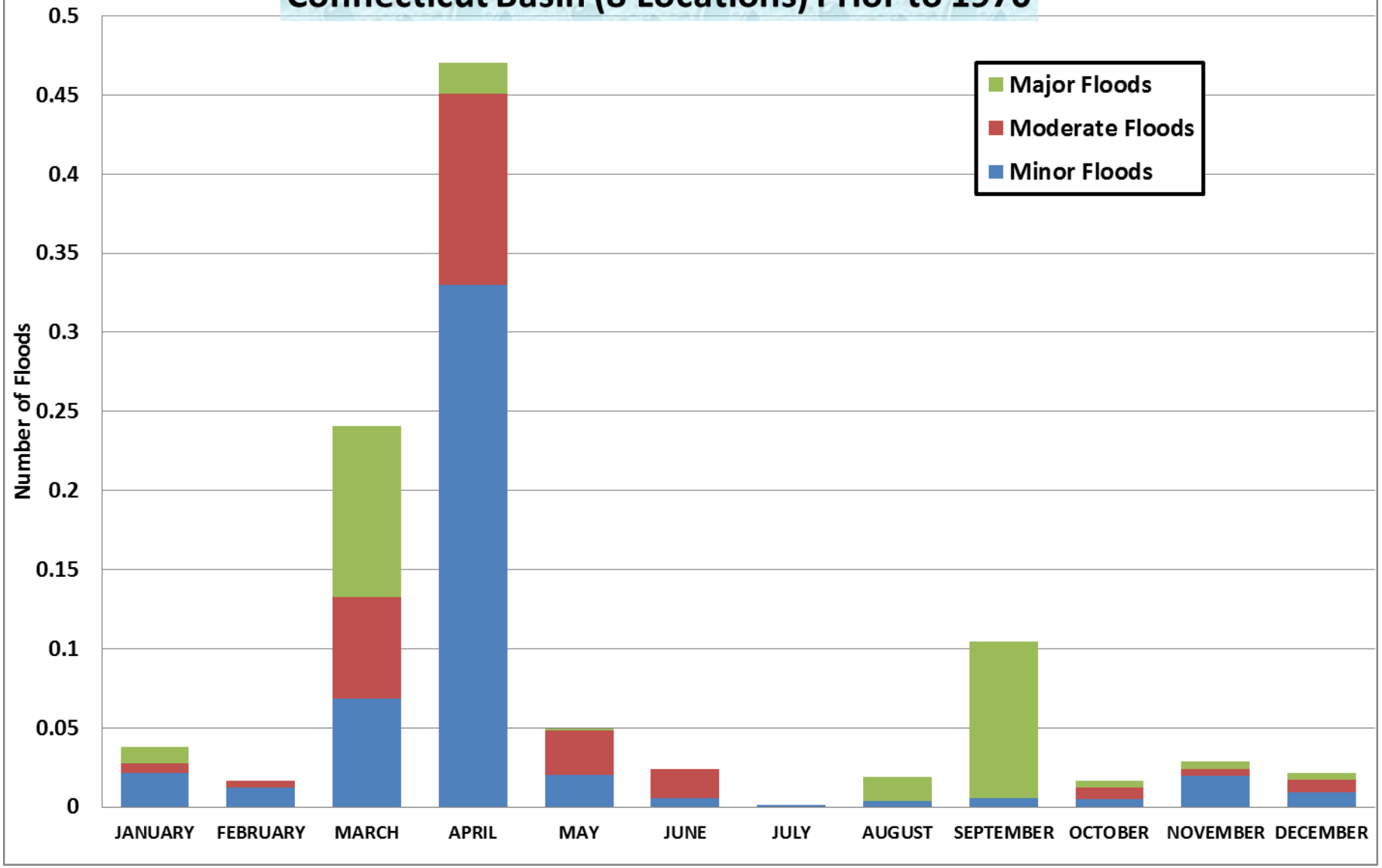


Normalized Number Of Minor, Moderate, & Major Floods Per Month for the Lower Connecticut Basin (8 Locations) Prior to 1970

Data provided by USGS science for a changing world



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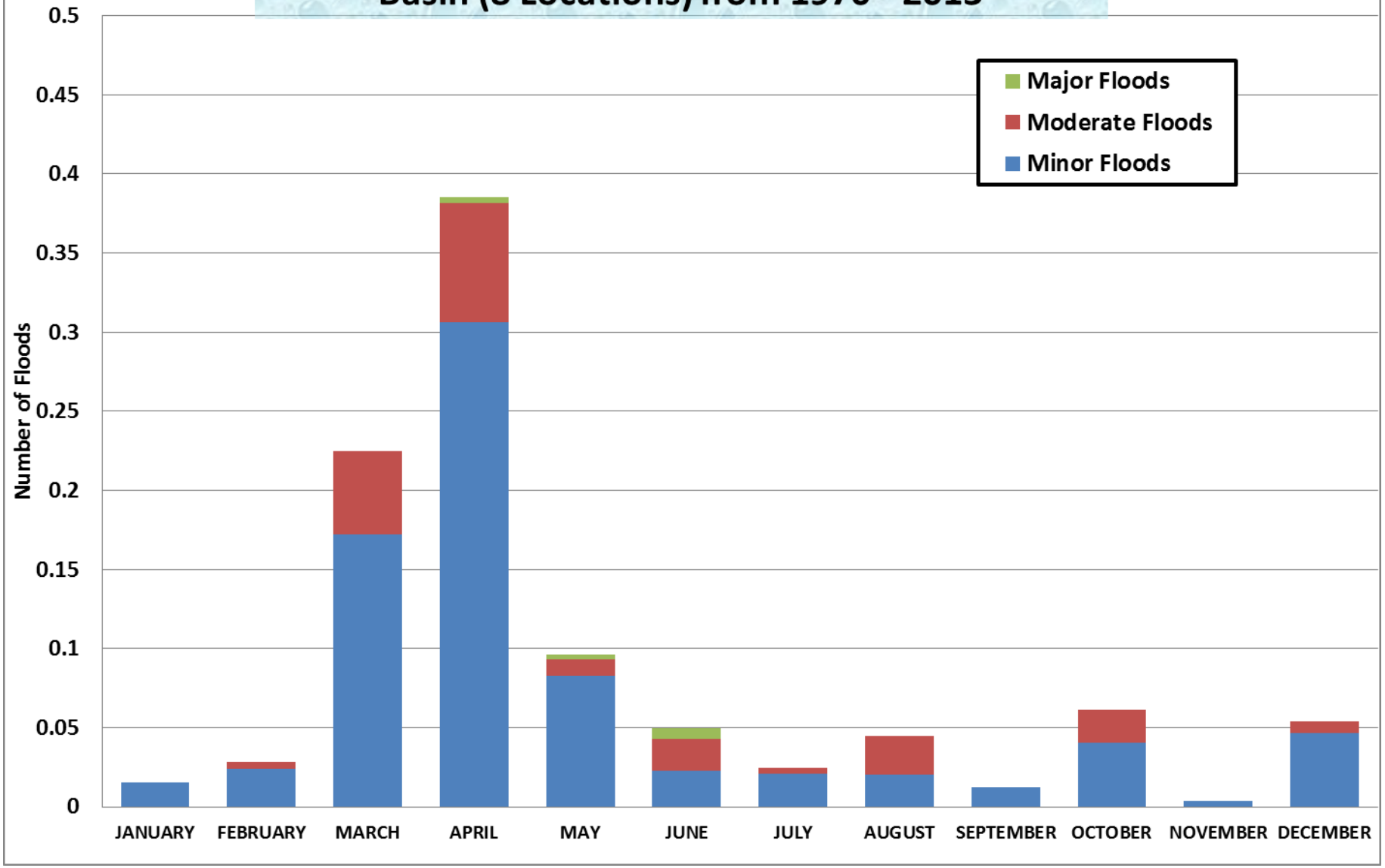
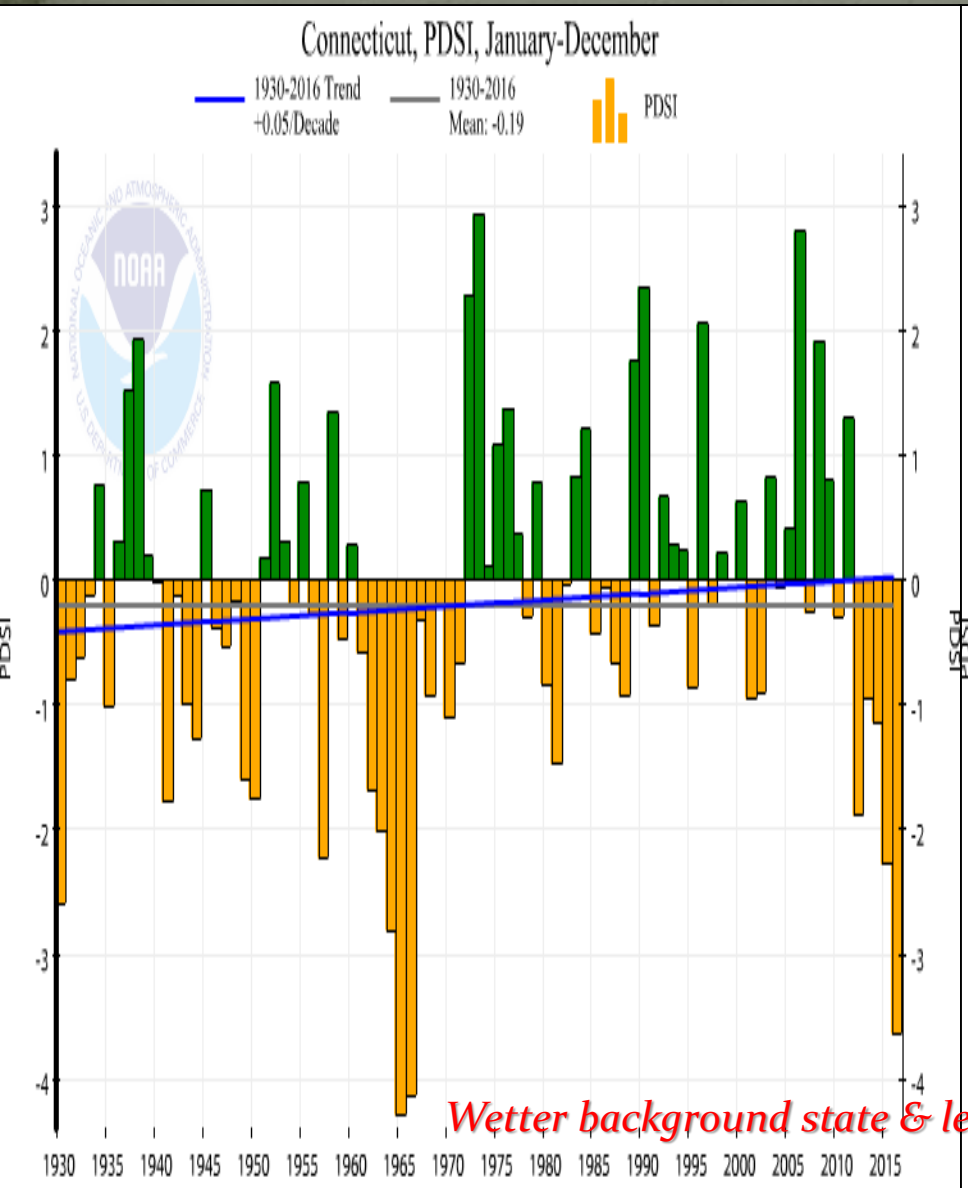
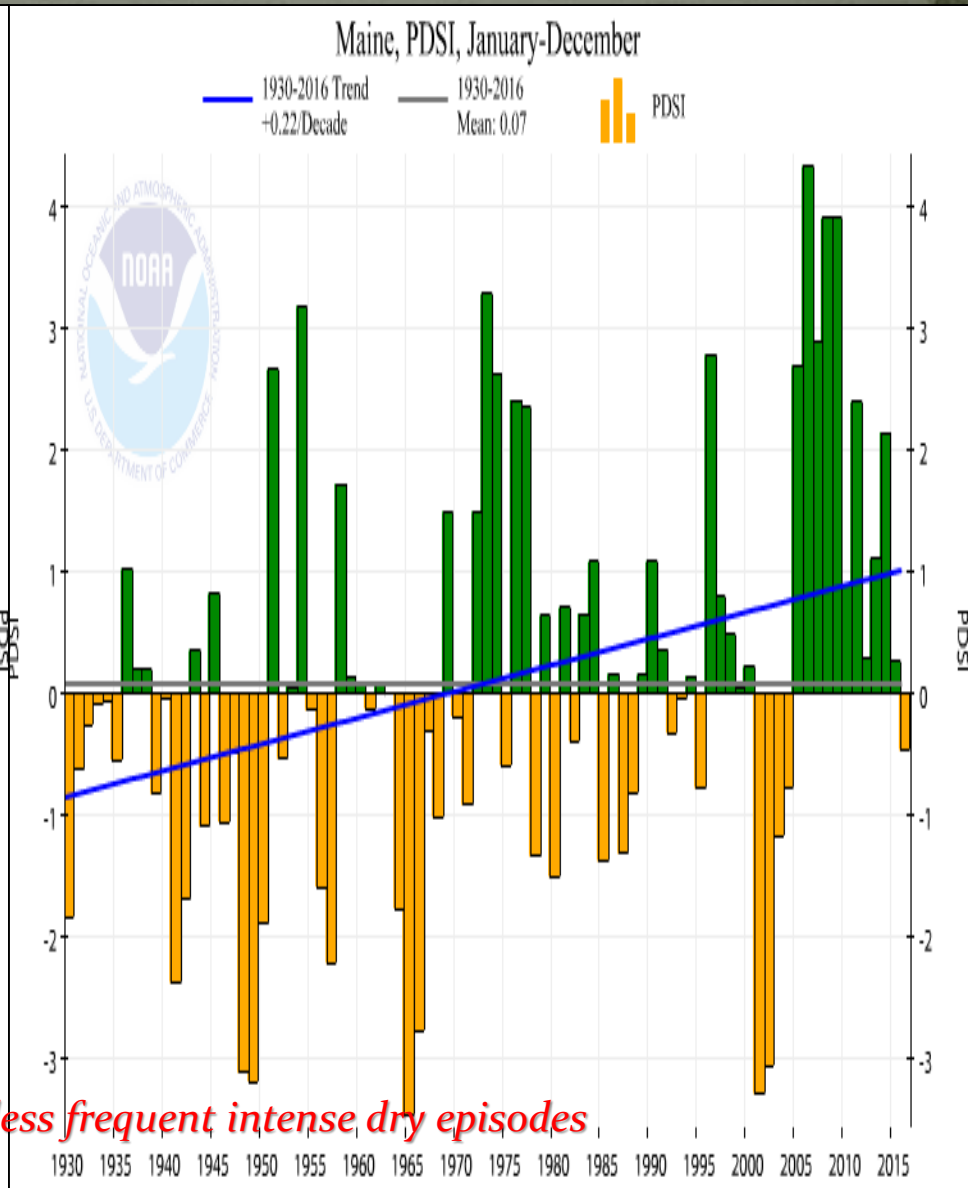


The Dry side: Palmer Drought Severity Index

Floods kill people – Droughts kill civilizations

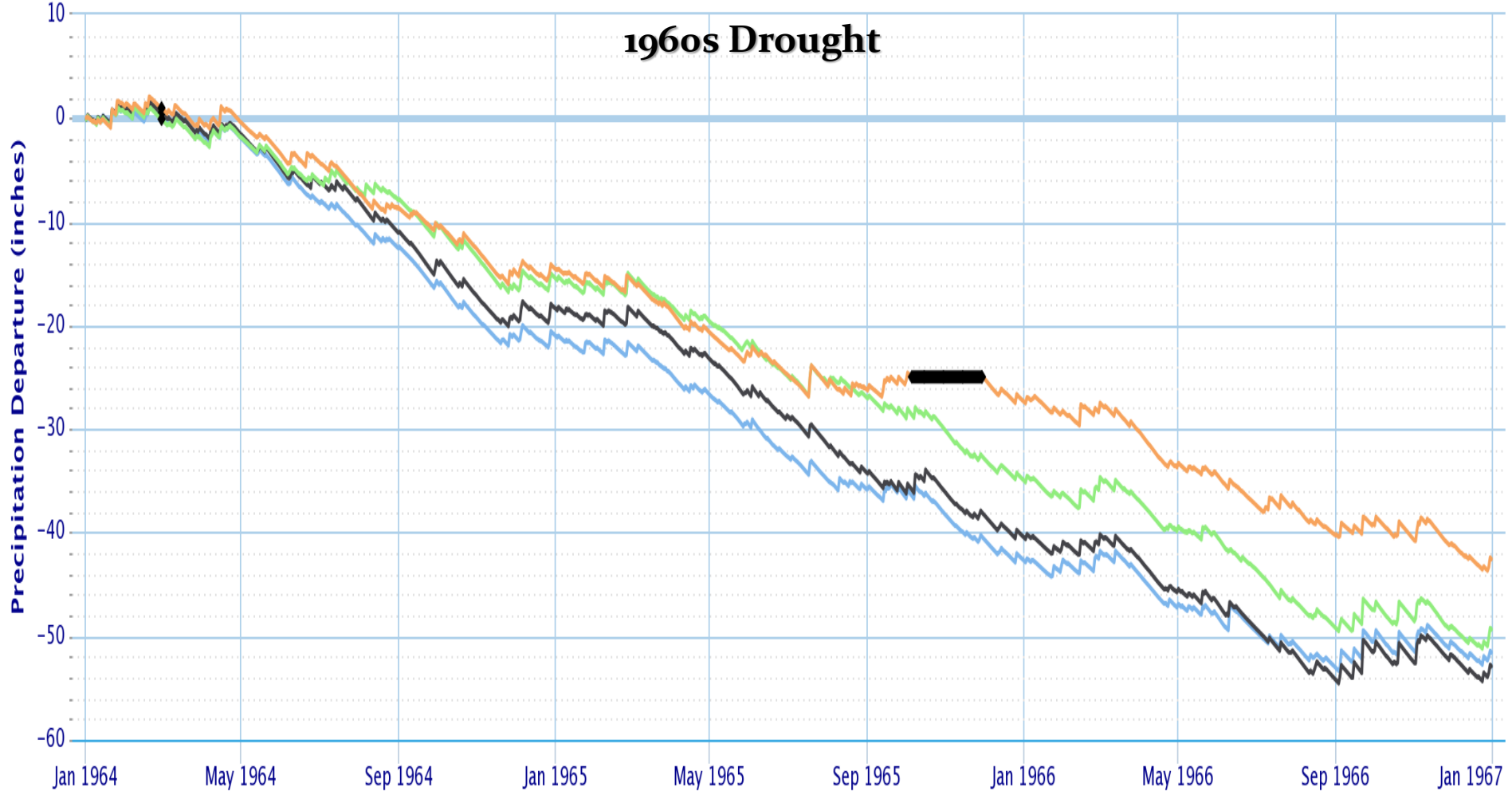




Wetter background state & less frequent intense dry episodes

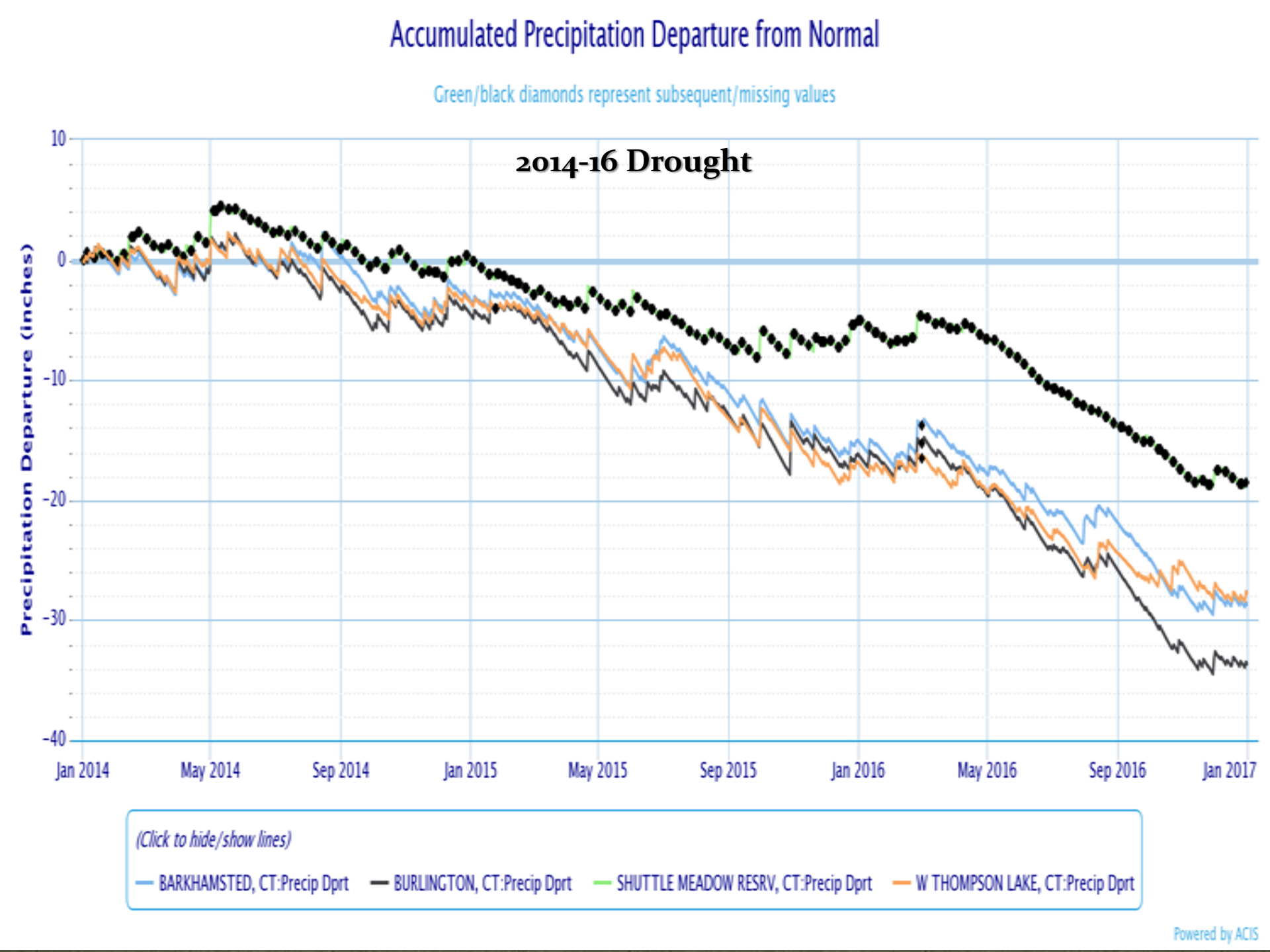
Accumulated Precipitation Departure from Normal

Green/black diamonds represent subsequent/missing values

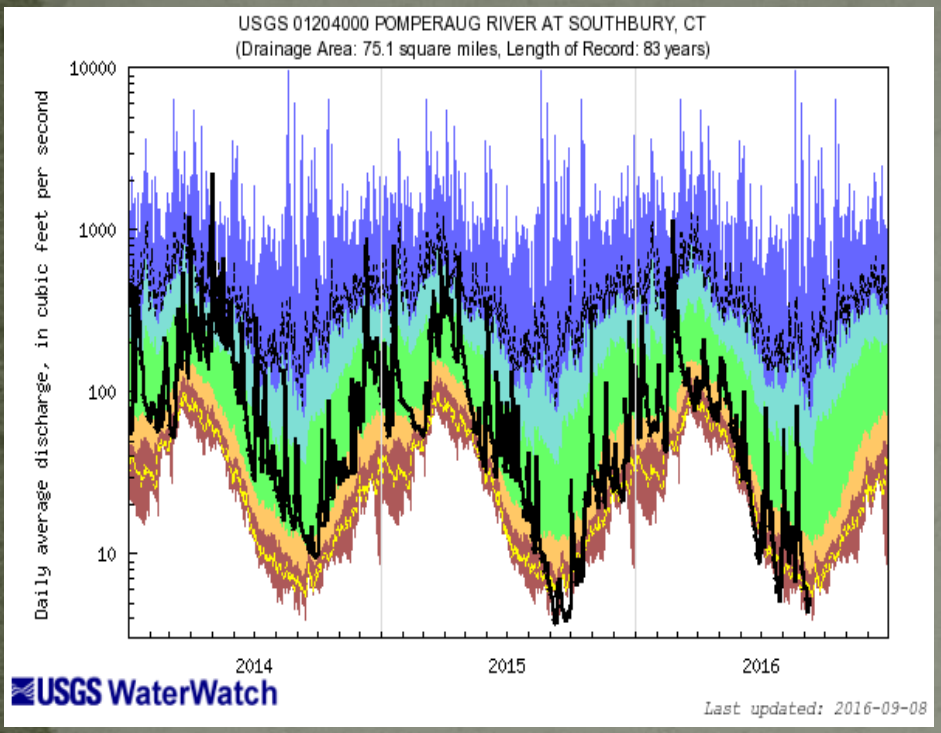


(Click to hide/show lines)

BARKHAMSTED, CT:Precip Dprt — BURLINGTON, CT:Precip Dprt — SHUTTLE MEADOW RESRV, CT:Precip Dprt — W THOMPSON LAKE, CT:Precip Dprt

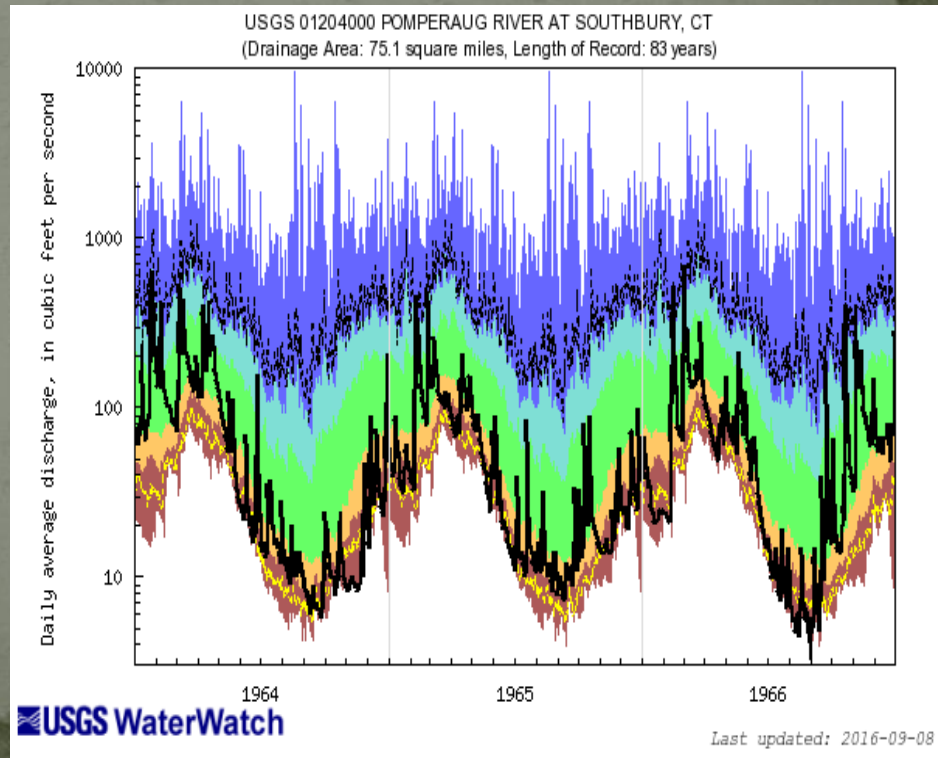

Accumulated Precipitation Departure from Normal
Green/black diamonds represent subsequent/missing values
2014-16 Drought
Precipitation Departure (inches)
10
0
-10
-20
-30
-40
Jan 2014
May 2014
Sep 2014
Jan 2015
May 2015
Sep 2015
Jan 2016
May 2016
Sep 2016
Jan 2017
(Click to hide/show lines)
BARKHAMSTED, CT:Precip Dprt
BURLINGTON, CT:Precip Dprt
SHUTTLE MEADOW RESRV, CT:Precip Dprt
W THOMPSON LAKE, CT:Precip Dprt
Powered by ACIS

Closer look at drought characteristics



- Short/intense drought episodes:
  - 2014 and 2015
- Record daily flows
  - Exceeding minimums during the 1960s drought!
  - But…shorter duration with long periods of significant recharge if not flood volumes

- Droughts of yesteryear:
  - 1964-66
- Prolonged record lows
  - Not as "record" as today's low minimum flows
  - But far longer in duration with little significant recharge

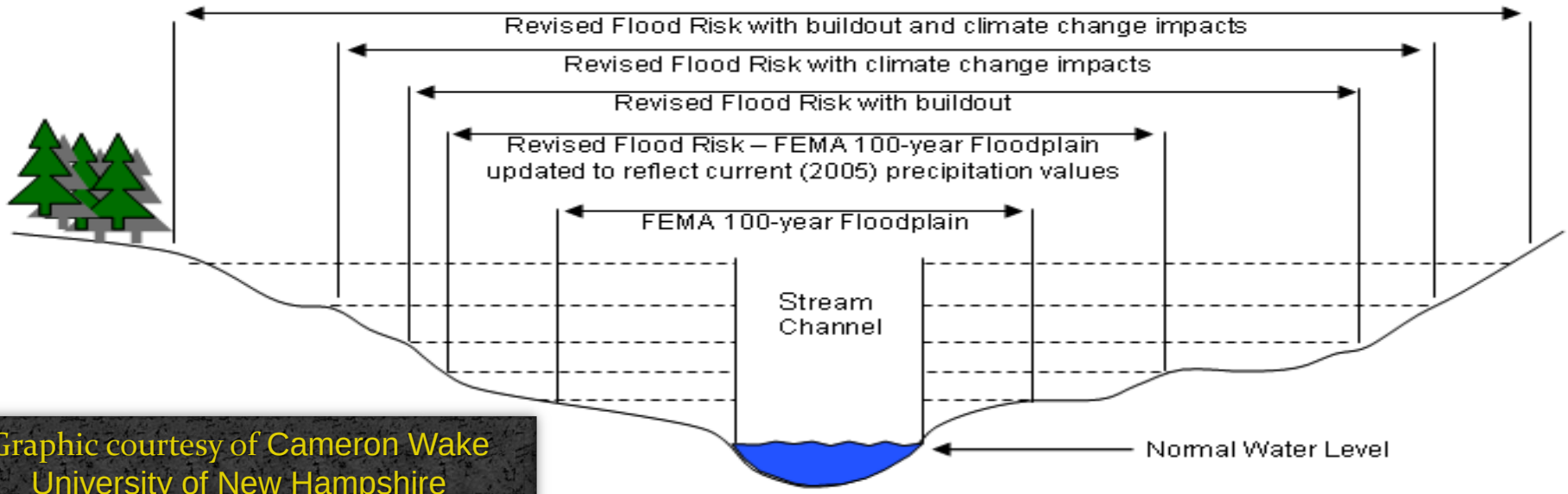


Summary

- The Northeast U.S. has become a “hot spot” for record floods & heavy rainfall in the past 10 years
- Noticeable trends include increased yearly rainfall and increased annual temperatures
  - Most pronounced shift in the 1% / 100 yr. 24 hour rain event ~ Litchfield Hills/northwest part of the state
- Smaller watersheds & those with significant urbanization and/or land use change are most vulnerable to increased river & stream flooding
- Droughts of long duration have become less frequent
  - But noticing intense short term droughts increasing

Far reaching implications:
Protect, Adapt or Retreat???

- Floodplain, land use, infrastructure, dam spillway requirements, drainage requirements, non-point source runoff, bridge clearances, "hardening" of critical facilities in the floodplain, property values etc…
- Water supply: significant varying conditions season to season and year to year; large swings in conditions



Graphic courtesy of Cameron Wake
University of New Hampshire

Examining Trends in Temperature, Precipitation and Flood Frequency in the Northeast; A Tale of Extremes

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Flooding along the Housatonic River following Lee, Sept 8, 2011.

Connecticut's MS4 Permit: *What's New?*

David Dickson, Chet Arnold, Mike Dietz, & Amanda Ryan
NEMO Program
Center for Land Use Education & Research
University of Connecticut

1. Brief Intro to CLEAR
2. New Provisions
3. NEMO's MS4 Support

CLEAR

- Approved by UConn Board of Trustees in 2002
- Dept. of Extension / Dept. of NRE / CT Sea Grant
- 8 – 9 core faculty/staff
- largely grant funded
- Mission:

  …to provide information and assistance to land use decision makers and other audiences in support of better land use decisions, healthier natural resources, and more resilient communities.

CLEAR Program Areas

Water

Land Use &
Climate Resiliency

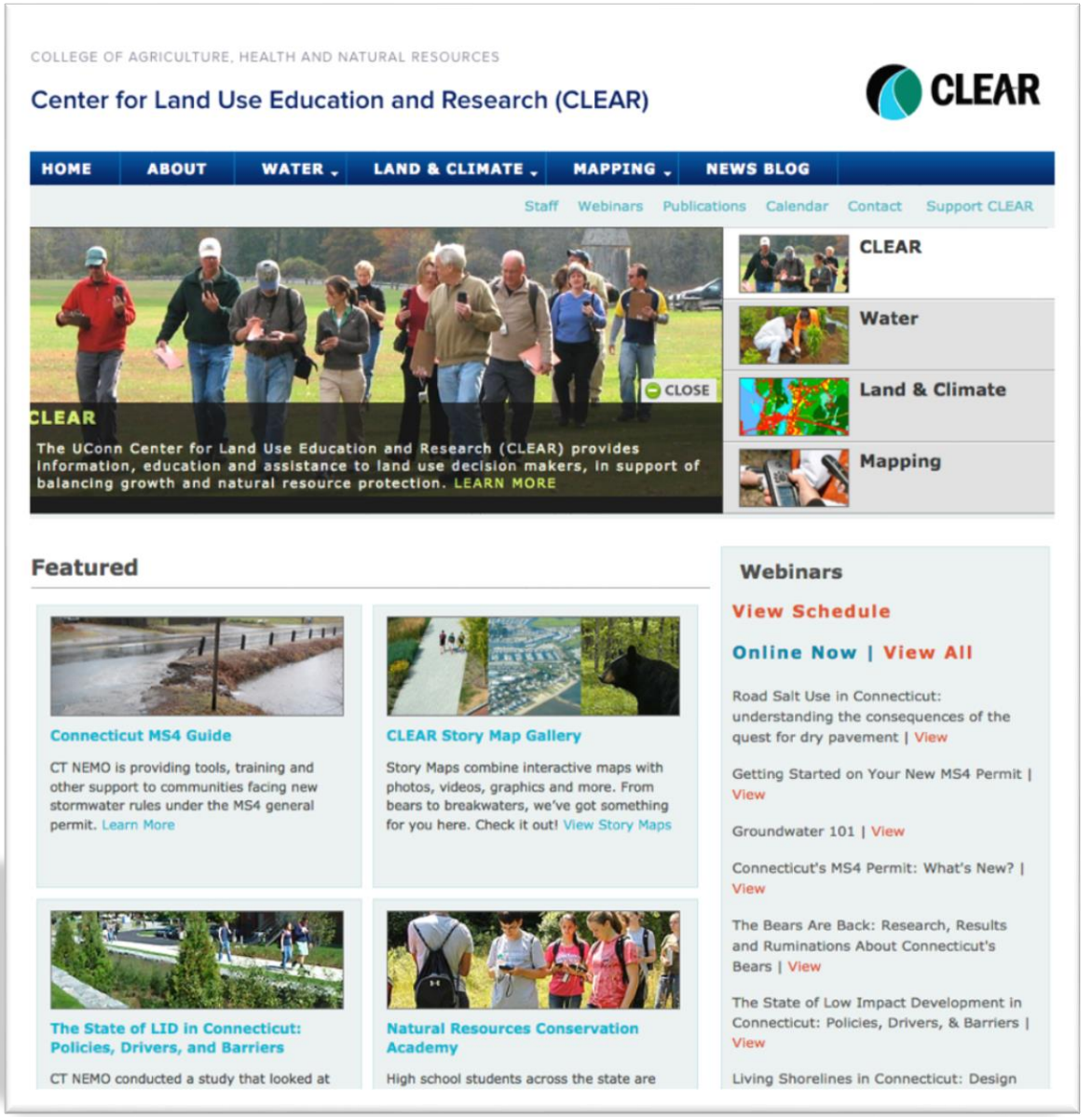
Geospatial Tools &
Training

Secondary School
STEM

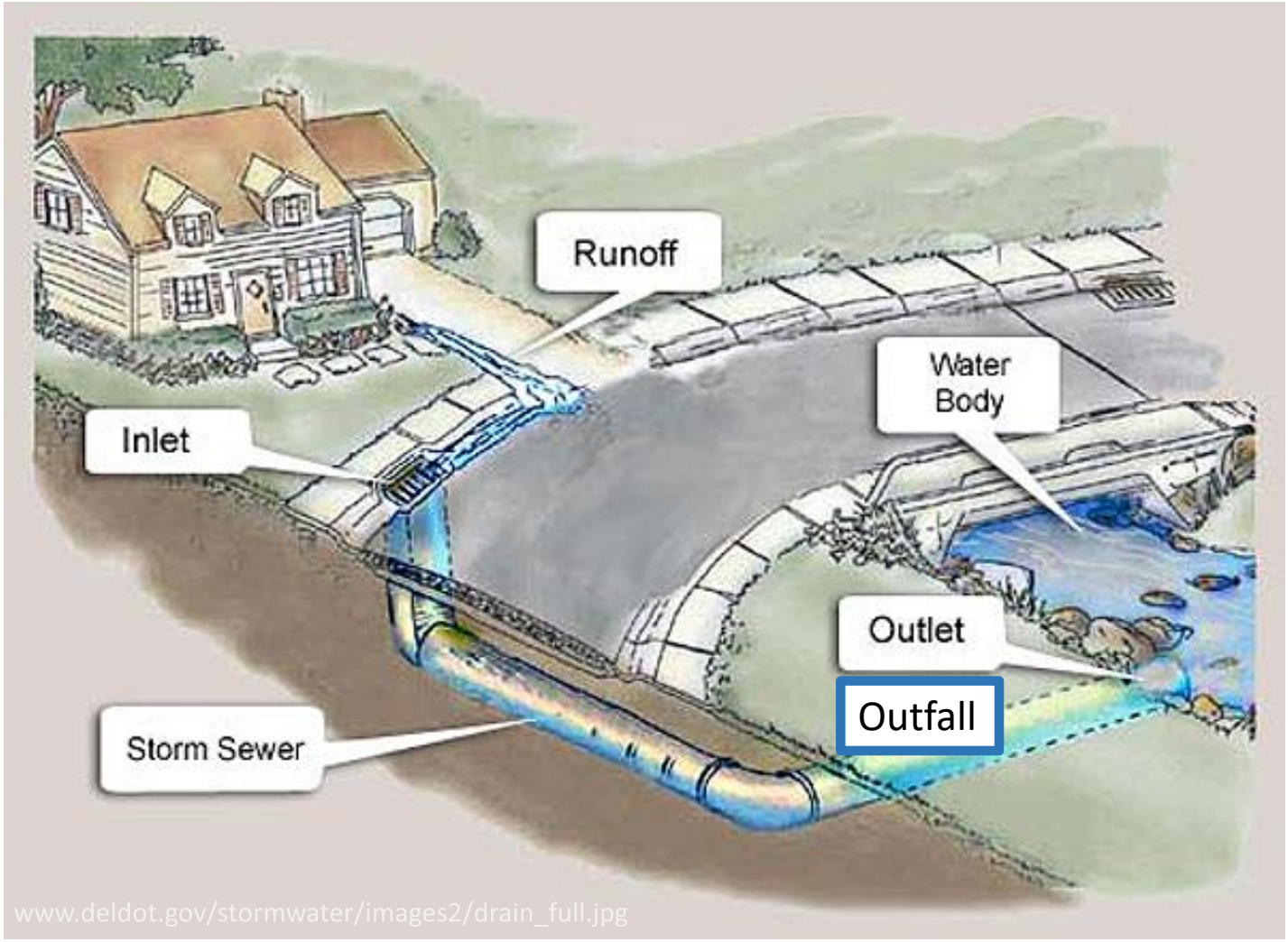
- Applied research
- Geospatial technology
- Extension outreach

CLEAR

http://clear.uconn.edu

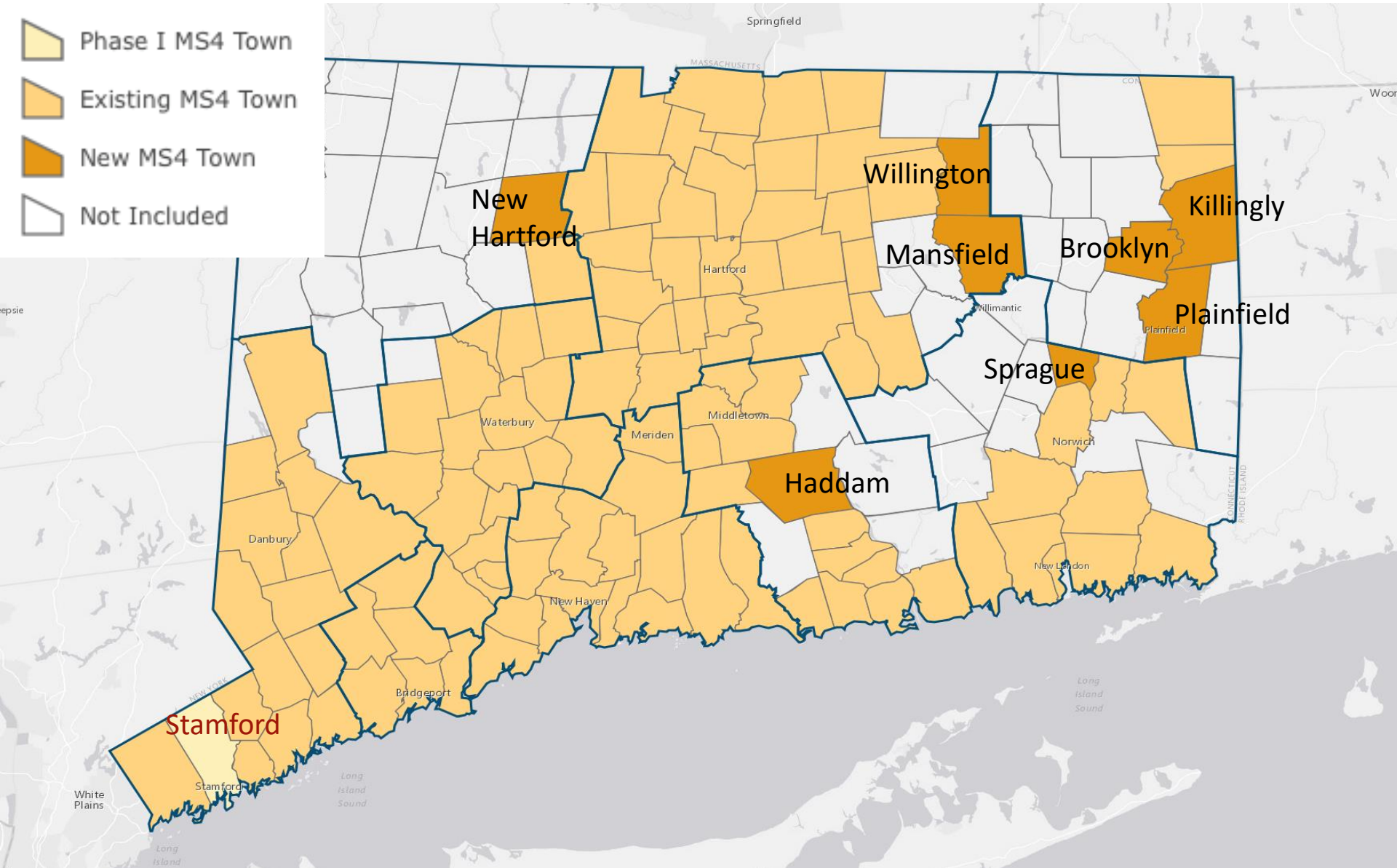


First, what is an MS4?



www.deldot.gov/stormwater/images2/drain_full.jpg

Who's Included?



What's Required?

- Register with CT DEEP
- Stormwater Management Plan
  - 6 minimum control measures
- Implementation
  - Annual reports
- Water quality monitoring

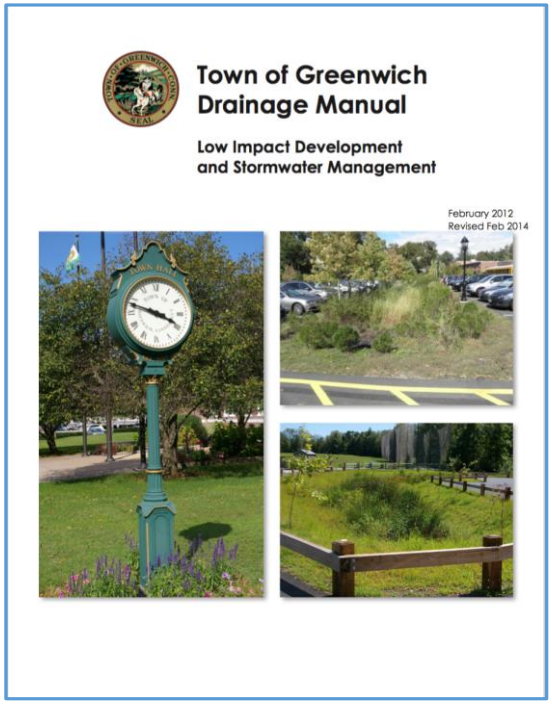
Illicit Discharge Detection & Elimination

- **More detailed & focused**
  - Map ALL outfalls
  - Expand local legal authority (including penalties)
  - Citizen reporting program

https://www.wsdot.wa.gov/Environment/WaterQuality/

Low Impact Development

- **LID in Land Use Regulations**
  - Require consideration of low impact development 1st
  - Review municipal regulations for obstacles to LID



Impervious Cover (IC)

- **Determine amount of DCIA**
- **Disconnect 1% IC per year**
- **Require stormwater retention**
  - Site with DCIA > 40% - retain first ½”
  - Site with DCIA < 40% - retain first 1”
  - If can’t → pay fee or for mitigation project elsewhere

Municipal Operations

- Fertilizer use
- Storage of sand / salt
- Leaf pickup
- Storm drain cleaning
- Street sweeping

Water Quality Monitoring

- Inventory **all** outfalls to **impaired waters** (rather than 6 across municipality)
- Screen for pollutants of concern

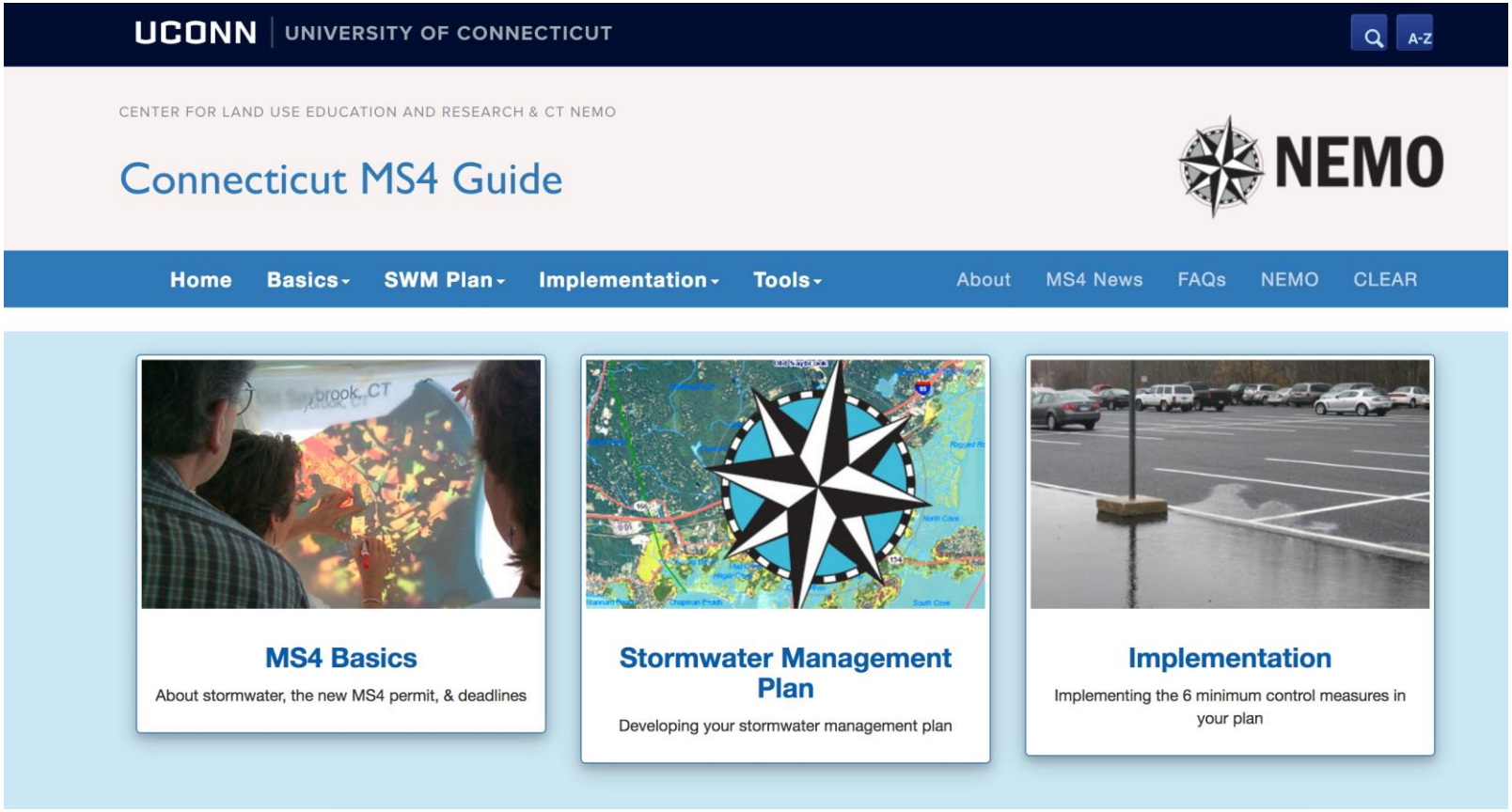
CLEAR/DEEP Partnership

CLEAR
Center for Land Use Education & Research

CONNECTICUT ENERGY ENVIRONMENT

- 5 year MOA
- Provide multi-faceted support to MS4 towns
- Started last summer

MS4 Website



www.nemo.uconn.edu/MS4

Thank you!

Amanda Ryan
Municipal Stormwater Educator
UConn CLEAR
Amanda.ryan@uconn.edu

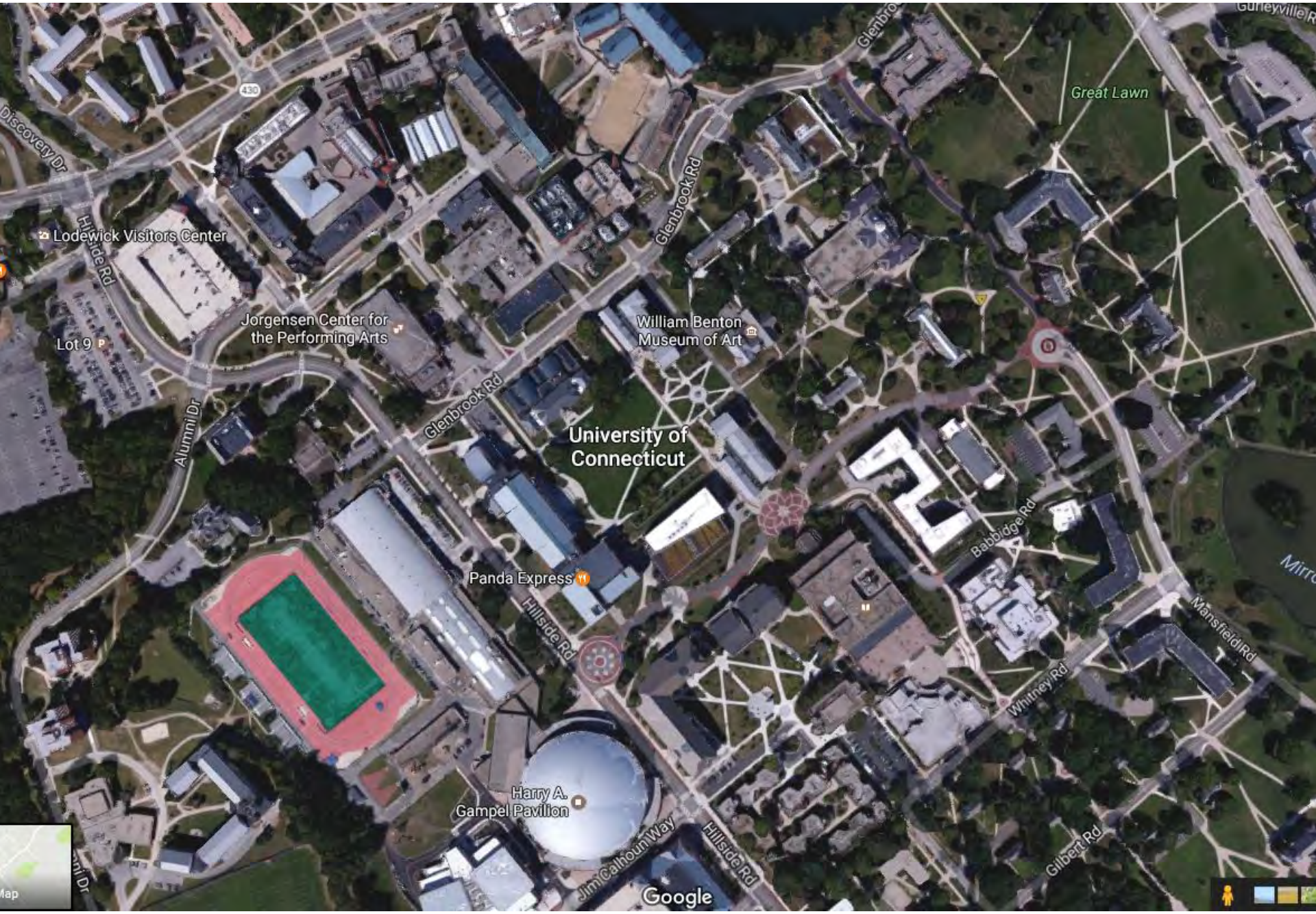
Low Impact Development Practices: Overview for MS4

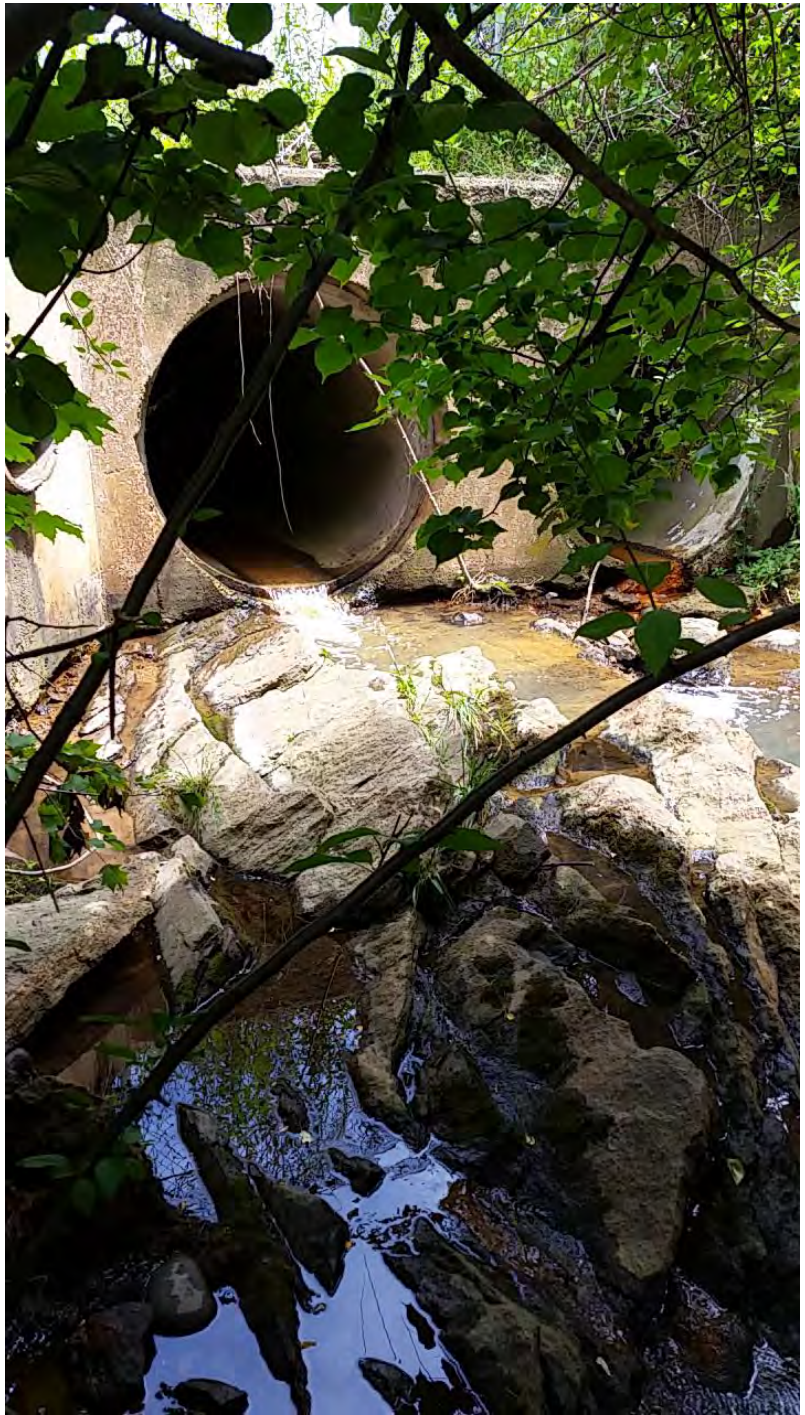
UCONN
COLLEGE OF AGRICULTURE, HEALTH AND NATURAL RESOURCES
EXTENSION

Michael Dietz, Ph.D.
UConn NEMO Program

Water: Too Much or Not Enough?
Rockfall Foundation Symposium
3/31/17

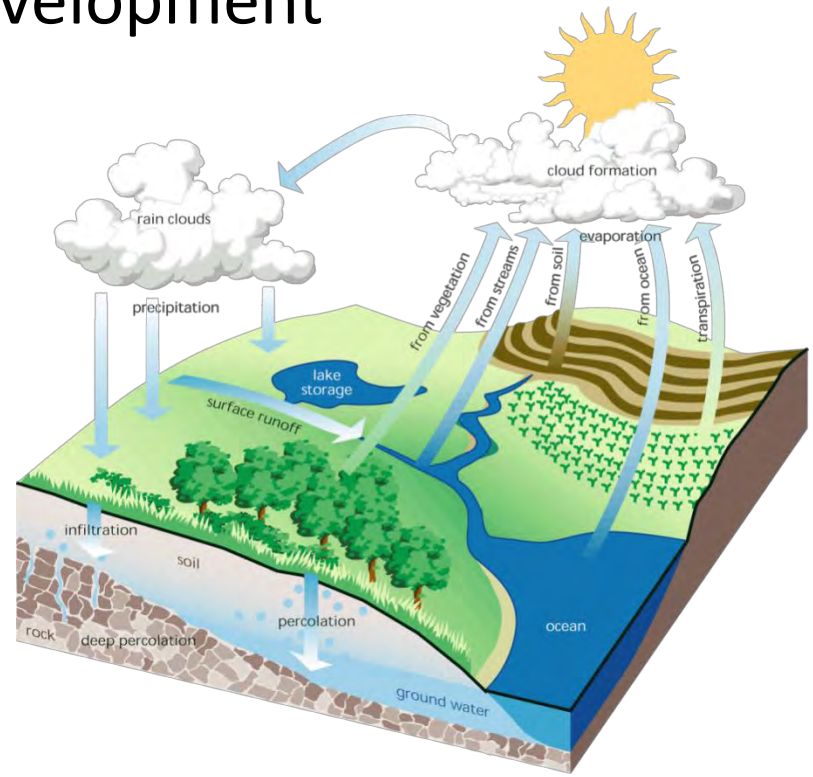
CLEAR


Great Lawn
Discovery Dr
Hillside Rd
Lodewick Visitors Center
Glenbrook Rd
Jorgensen Center for the Performing Arts
William Benton Museum of Art
Lot 9
Alumni Dr
Glenbrook Rd
University of Connecticut
Babbidge Rd
Panda Express
Hillside Rd
Mansfield Rd
Whitney Rd
Harry A. Gampel Pavilion
Jim Calhoun Way
Hillside Rd
Gilbert Rd
Google



Low Impact Development (LID) Site Planning and Design Concepts

- Originated in Maryland in 1990s
- The goal: To preserve pre-development hydrology
  - Runoff volume and rate
  - Groundwater recharge
  - Stream baseflow
  - Runoff water quality



Residential rain gardens

Photo courtesy of Steve Trinkaus

First bioretention at UConn (2004)


2011
Laurel Hall
Bioretention

2013

Rain Gardens & pervious asphalt parking stalls near Whetten Center.

Tree Filters

Pervious asphalt at CT State Capitol

Pervious concrete at CT State Capitol

2009

UConn Pervious Asphalt Lot

UConn Pervious Concrete (2009)

2009

Gant Plaza Green Roof

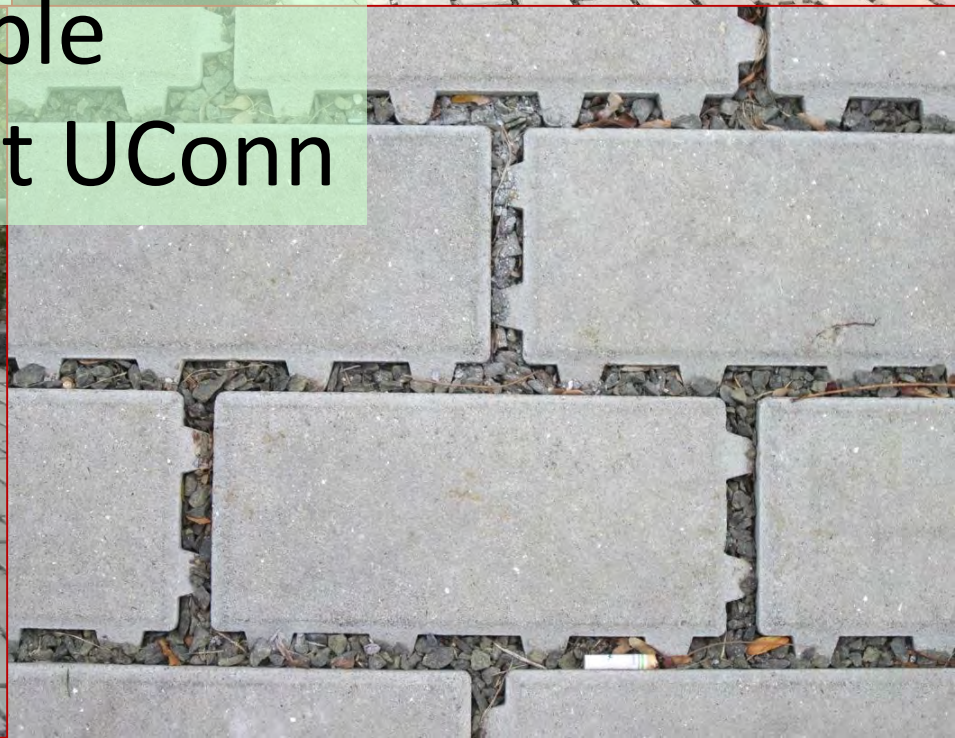
Retained 51% of precipitation!

Gregoire, B., and J. Clausen. 2011. Effect of a modular extensive green roof on stormwater runoff and water quality. *Ecological Engineering*. Vol. 37, pp. 963-969.


2011
Laurel Hall Green Roof

2011

Permeable Pavers at UConn



PICPs in action

2013

Hillside Rd Snow Shelf PICPs

Storrs Hall Green Roof 2013

Can LID help with a changing precipitation regime?

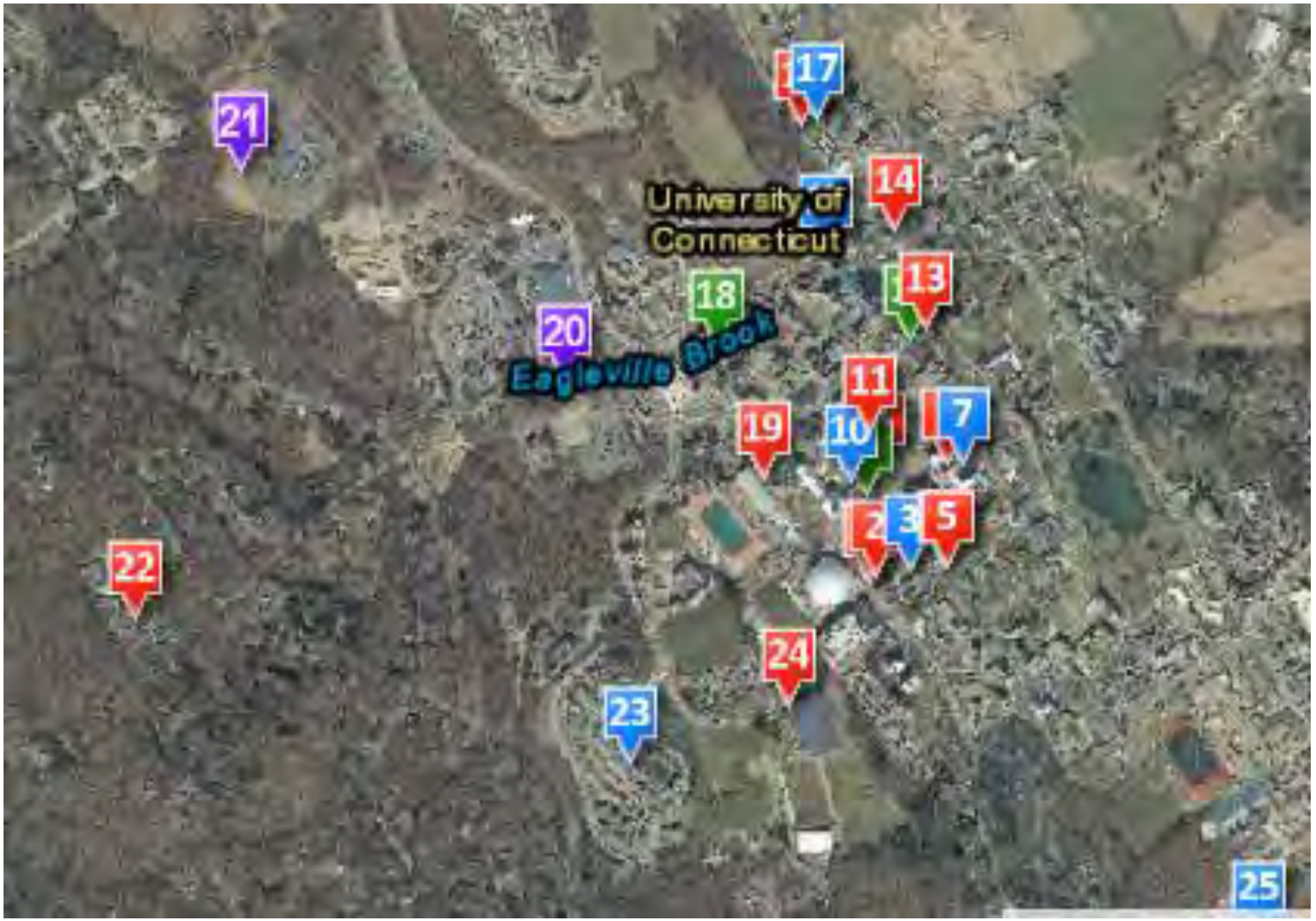
- LID systems are typically designed to treat the "Water Quality Volume", or the runoff from a 1" event

- Not typically designed to reduce flooding

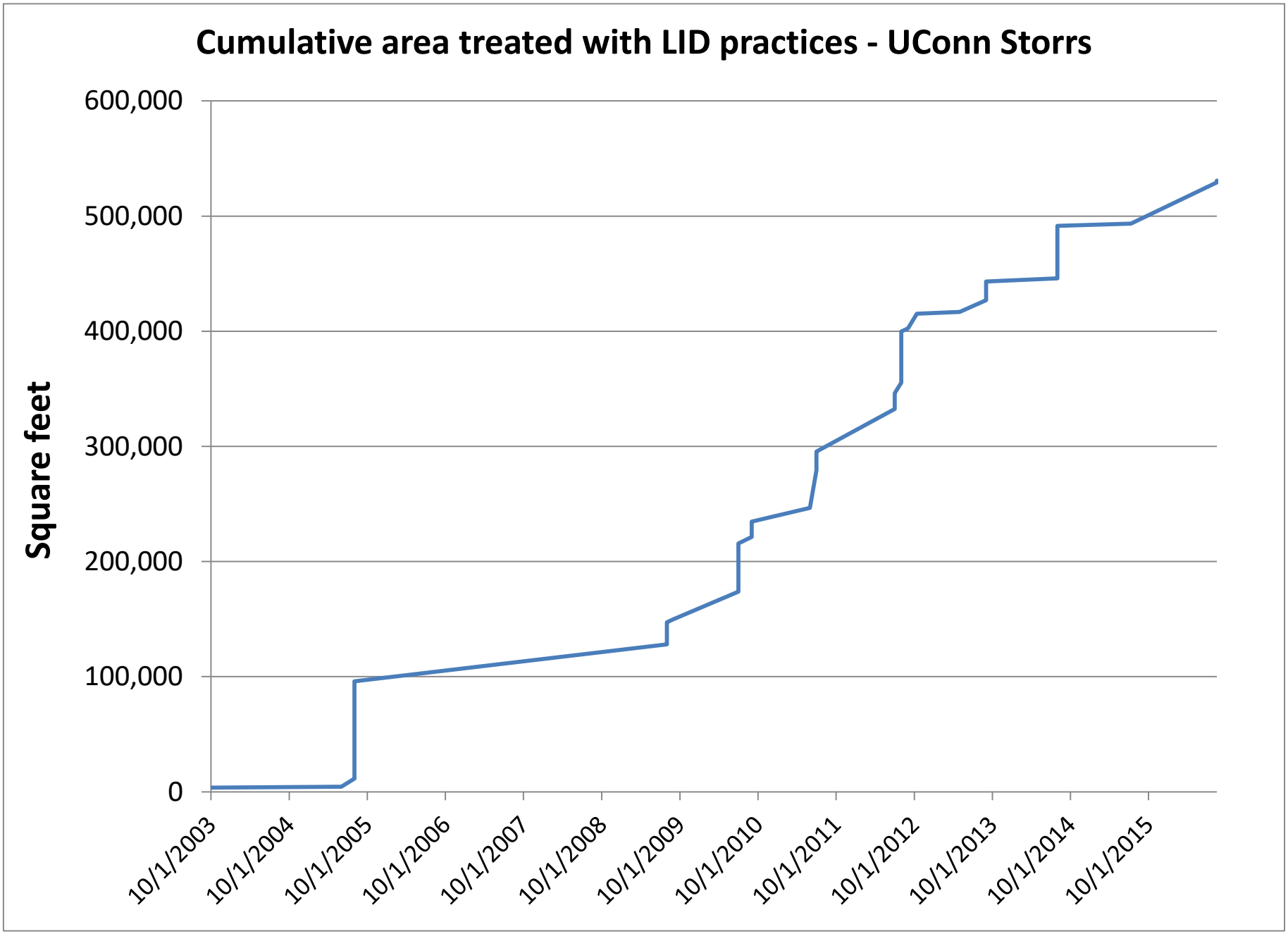
- Recent modeling work for Flood Management Certification at UConn indicated a benefit from the multiple LID practices installed

One small rain garden may not save the world…

But…



http://s.uconn.edu/virtualgsitour


Cumulative area treated with LID practices - UConn Storrs
Square feet
600,000
500,000
400,000
300,000
200,000
100,000
0
10/1/2003
10/1/2004
10/1/2005
10/1/2006
10/1/2007
10/1/2008
10/1/2009
10/1/2010
10/1/2011
10/1/2012
10/1/2013
10/1/2014
10/1/2015

Green Stormwater Infrastructure
- Monitoring
- GSI Tour Request
- GSI Design Resources
- Tools
- Programs
- Internships

Source Water Protection

Traditional Infrastructure

Waterways Restoration

Community Partnerships

Waterways Assessment

Research and Planning

Policy and Regulations

Documents and Data

Green Stormwater Infrastructure

Green stormwater infrastructure includes a range of soil-water-plant systems that intercept stormwater, infiltrate a portion of it into the ground, evaporate a portion of it into the air, and in some cases release a portion of it slowly back into the sewer system.

In Conclusion

- Low Impact Development/Green Stormwater Infrastructure practices work!
- Proper installation and maintenance is critical
- These practices can help deal with changing precipitation regime

Project Partners

- Center for Watershed Protection
- Horsley & Witten Group
- UConn Architectural & Engineering Services
- UConn Office of Environmental Policy
- CT DEEP TMDL & Nonpoint Source Programs
- Town of Mansfield

Funded in part by the Connecticut Department of Energy and Environmental Protection through a United States Environmental Protection Agency Clean Water Act Section 319 Nonpoint Source Grant

Questions?

michael.dietz@uconn.edu

http://s.uconn.edu/virtualgsitour
http://nemo.uconn.edu/raingardens

Impacts to Private Wells

Ryan Tetreault, Supervising Environmental Analyst
Connecticut Department of Public Health
Private Well Program

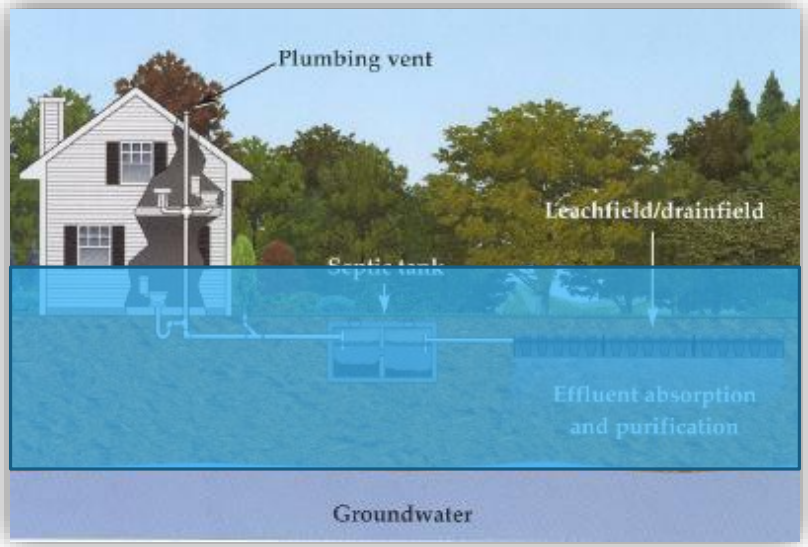
Extreme Weather Events

Impacts to private wells during heavy rain events

- Wells located in pits are subject to being submerged if the well pit is not watertight or properly drained.

Extreme Weather Events

Flooding impacts to private wells:



Well caps are vented to atmosphere

- When a well is submerged contaminants can get into the well.
- After floodwaters have subsided, the well must be flushed, disinfected, and tested before using water for domestic use.

Information for Private Well Owners

www.ct.gov/dph/privatewells

Publications and Fact Sheets
- Water Testing
- Water Treatment
- Well Construction
- Well Maintenance
- Contaminants

Well Disinfection Procedure

What do I test my private well for?

PRIVATE DRINKING WATER IN CONNECTICUT

Publication Date: January 2017

Publication No. 24: Private Well Testing

Testing your well water provides you with information on the quality of your drinking water. Testing is the best way to ensure that your drinking water supply is safe from harmful chemicals. In addition, water testing can determine whether nuisance impurities, such as iron and manganese are present and at what levels. The purpose of this fact sheet is to assist private well owners in deciding how frequently to test their private well water and what to test for. It also provides homeowners with information about how to get their water tested, understanding their water test results and protecting their well from contamination.

Private Water Supplies

Homeowners with private wells are responsible for the quality of their own drinking water. They are generally not required to test their drinking water. However, testing is a good idea even if you do not suspect a problem because testing is the only way to be sure your water is safe to drink. An especially good time to test water quality is when buying a home so that you can make any contamination findings part of your home purchase decision. A good time of year to test is after a heavy period of rain, generally in the spring or fall. Even if your current water supply proves to be clean and safe to drink, regular testing is important because it establishes a record of water quality that may help identify and solve future problems.

In accordance with Section 19-13-B101 of the Public Health Code, testing is required for new wells. However, the required tests do not cover all contaminants. Water tests done during home purchases are usually required by the bank providing the mortgage. Contrary to common belief, such tests are not required by law. Water tests done for a home purchase do not necessarily cover all contaminants.

This publication provides general guidelines for private well water testing. However, these are just guidelines. Check with your Local Health Department to find out whether there are water quality problems specific to your area. It is also a good idea to ask your neighbors whether they have ever had water quality problems. The Connecticut Department of Public Health (DPH) Private Well Program is also a resource for questions about private well testing. DPH's Environmental and Occupational Health Assessment Program is a resource for questions about safe limits of chemicals in water and health concerns. Contact information is provided at the end of this fact sheet.

What To Test For? How Frequently to Test?

Even if you do not suspect any well water problems, it is important to test your water to ensure that it is safe to drink. Table 1 lists the tests we recommend for all private wells even if you do not notice any problems with your water. Table 3 lists water quality issues you might encounter and what tests you should perform if you have a particular issue with your water. Whenever you notice a change in the taste, color, odor, or clarity of your water, contact your Local Health Department or the Connecticut Department of Public Health (CT DPH), Private Well Program for assistance.

Produced by The State of Connecticut Department of Public Health
Environmental Health Section, Private Well Program
450 Capitol Avenue, MS#51REC, PO Box 340308, Hartford, CT 06134
Phone: 860-509-7296 Fax: 860-509-7295

Table 1. Recommended Test for All Private Wells

Type of Test	When?	Why?
Basic Indicators *(See table 2 below)*	**Every Year** Also test after repair or replacement of your well, pump or water pipes.	Provides a general indication of water quality. Required for all new wells. Some basic indicators above their acceptable limit are associated with health concerns.
Lead *(2 samples; a first draw sample and a flushed sample should be collected when testing for lead in drinking water)*	**At Least Once** Also when planning a pregnancy or have a child under 6 years old in the home. *If your water is considered corrosive, test every 3-5 years.*	Lead can leach from your home's plumbing (pipes, faucets, valves, etc.) system. Corrosive water leaches lead more readily. Lead above the acceptable limit is associated with health concerns. Young children are especially susceptible to harmful effects from lead exposure.
Arsenic, Uranium, Radon	**At Least Once** Ideally, repeat test every 5 years	Arsenic, uranium and radon are naturally occurring in groundwater in some areas of CT and are associated with health concerns above their acceptable limit. Private wells with high levels have been found sporadically around CT, and levels may fluctuate.
Volatile Organic Compounds (VOCs)	**At Least Once** More often if a problem is identified or suspected	Gasoline, oil, solvents or industrial chemicals spilled or leaked on the ground could get into your well water. VOCs above their acceptable limit are associated with health concerns.
Fluoride	**Every 5 years when a child under 12 is present**	Fluoride can occur naturally in wells throughout CT. A child's permanent teeth can become discolored from excess fluoride. Too little fluoride can increase risk of tooth decay. Your child's dentist will likely ask you about the fluoride level in your well water.

*Some drinking water standards are based on aesthetics and some are based on health risk. If your water exceeds a drinking water standard, contact your Local Health Department or CT DPH for assistance. For more information refer to the types of drinking water standards hyperlinked below.

DRINKING WATER STANDARD TYPES:
CT DPH Action Levels
US EPA Maximum Contaminant Levels (MCLs)
US EPA Secondary MCLs

For More Information Contact:

Health related: CT DPH, Environmental & Occupational Health Assessment Program, (860) 509-7740

All other questions (i.e., testing, treatment, etc.): CT DPH, Private Well Program, (860) 509-7296

Table 2. Basic Indicators Test

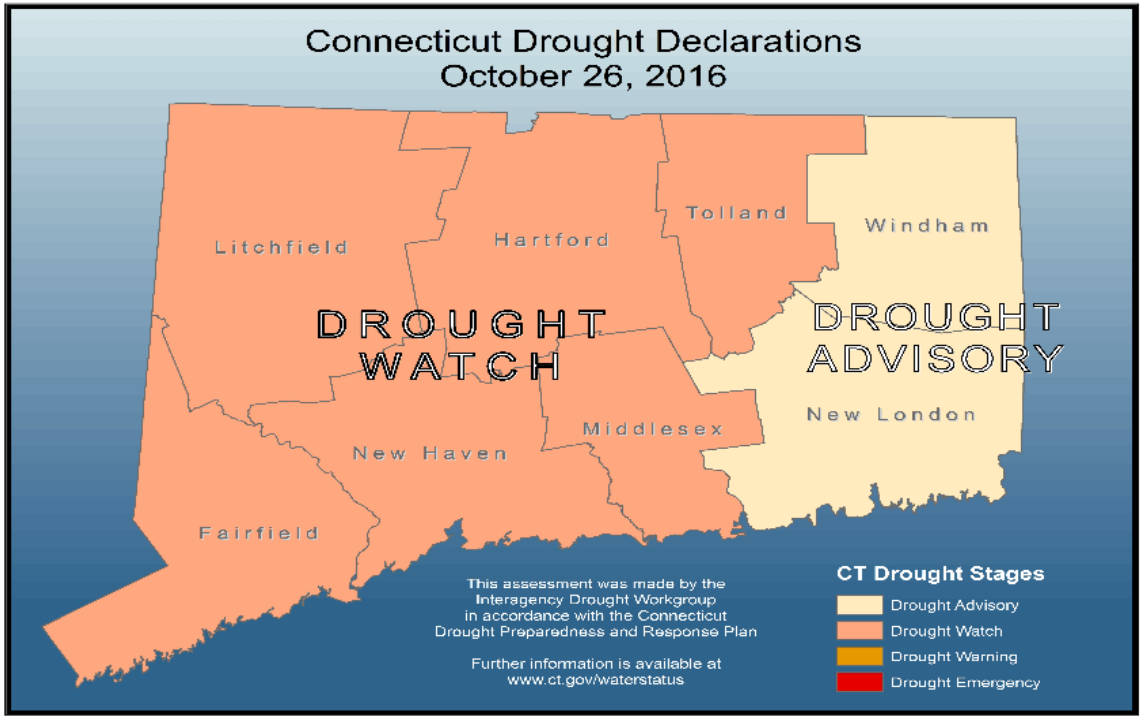
Parameter	Applicable Drinking Water Standard*
Total Coliform Bacteria	None Present
Nitrate-Nitrogen	10 milligrams/liter (mg/L)
Nitrite-Nitrogen	1 mg/L
pH	6.4 - 8.5 standard units (SU)
Odor	Less than 2
Chloride	250 mg/L
Hardness	150 mg/L
Apparent Color	Less than 15 SU
Sulfate	250 mg/L
Turbidity	Less than 5 SU
Iron	0.3 mg/L
Manganese	0.05 mg/L (Aesthetic based) 0.5 mg/L (Health based)

Drought Status In Connecticut

Current Water Conditions:

Drought Watch in Effect for Litchfield, Hartford, Tolland, Middlesex, New London, and Fairfield Counties

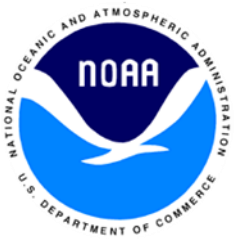
Drought Advisory in Effect for New London and Windham Counties



Connecticut's Interagency Drought Workgroup

State Agency Representatives:

Technical assistance from:



Drought Information and Resources

Connecticut

Drought Preparedness and Response Plan

August 4, 2003

Prepared by Interagency Drought Work Group
as accepted by the
Connecticut Water Planning Council

www.ct.gov/waterstatus

Drought Advisory

Drought Stage Criteria

A decision to issue a Drought Advisory is based on assessing the current and forecasted conditions of surface waters, ground water, reservoirs, soils, and vegetation relative to normal conditions. Each measure and index serves only as a relative guide. Recommendations can be based on what the majority of the indicators show. The criteria for consideration are as follows:

Precipitation:	Two months cumulative below 65% of normal,
Ground Water:	Three consecutive months below normal,
Streamflow:	Two out of three months below normal,
Reservoirs:	Average levels less than 80% of normal.
Palmer Drought Severity Index:	-2.0 to -2.99
Crop Moisture Index:	-1.0 to –1.99 abnormally dry,
Fire Danger:	Moderate.

Drought Watch

Drought Stage Criteria

A decision to issue a Drought Watch is based on assessing the current and forecasted condition of surface waters, ground waters, reservoirs, soils, and vegetations relative to normal conditions and shall be guided by the following criteria:

Precipitation:	Three months cumulative below 65% of normal,
Ground Water:	Four consecutive months below normal,
Streamflow:	Four out of five months below normal,
Reservoirs:	Average levels less than 70% of normal.
Palmer Drought Severity Index:	-3.0 to -3.99
Crop Moisture Index:	-2.0 to –2.99 excessively dry,
Fire Danger:	High.

USGS
science for a changing world

USGS Home
Contact USGS
Search USGS

Groundwater Watch — Latest News...

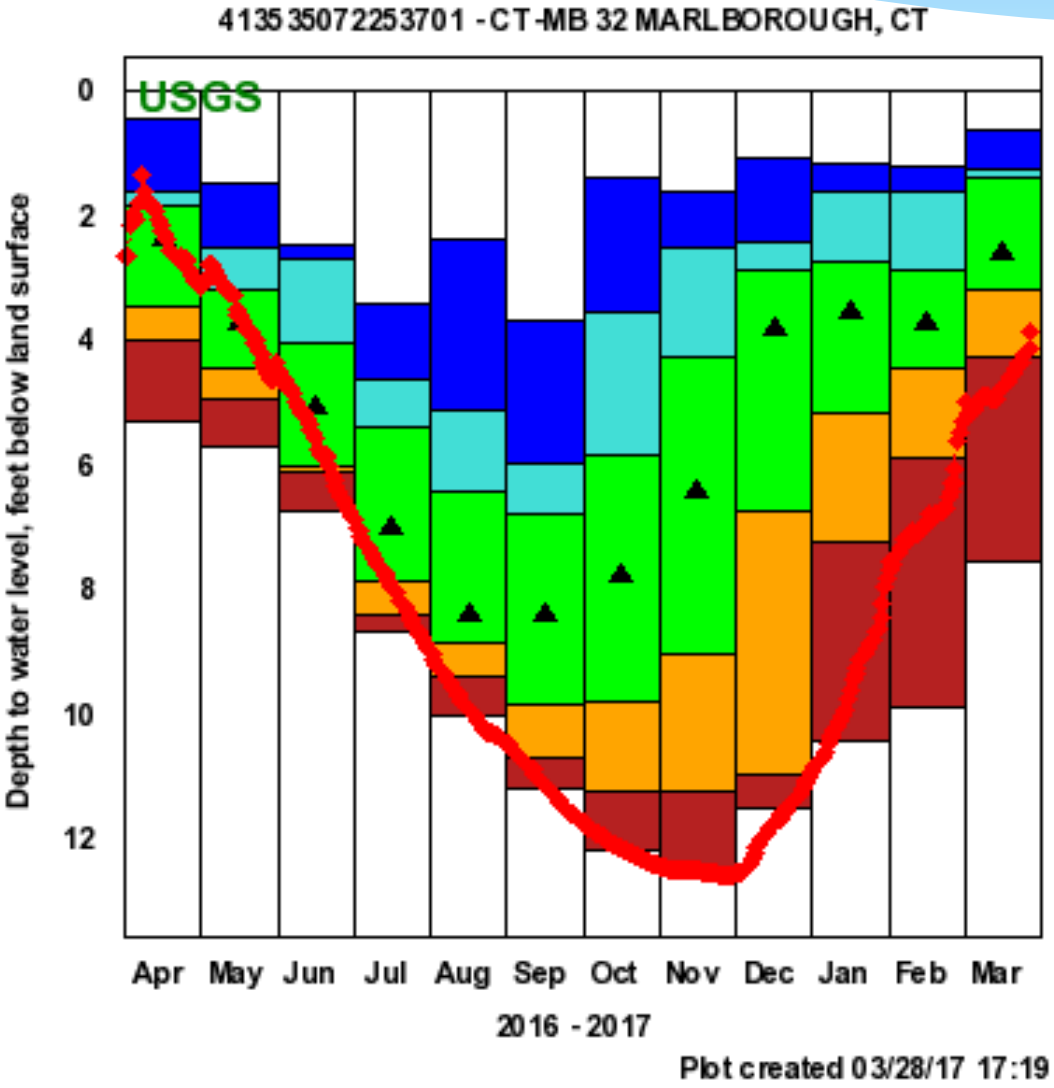
Connecticut Real-Time Groundwater Level Network

Click site symbol to open information pop-up. Click Station ID in pop-up for information and data.

Explanation - Percentile classes (symbol color based on most recent measurement)							
Low	<10	10-24	25-75	76-90	>90	High	Not Ranked
	Much Below Normal	Below Normal	Normal	Above Normal	Much Above Normal		

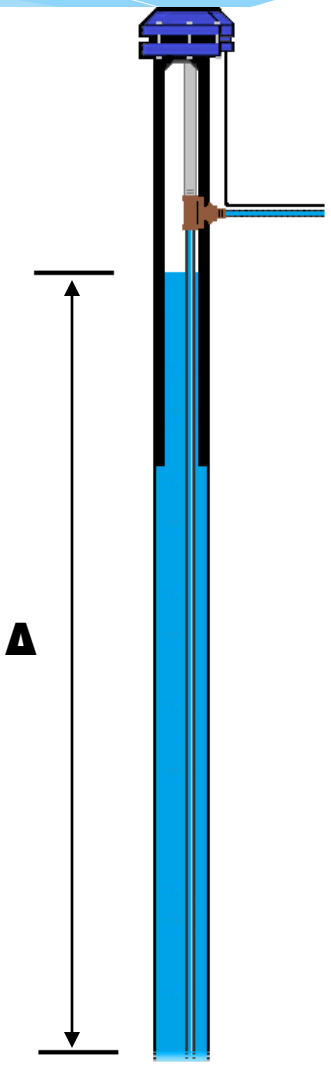
Wells	Springs
○ Real-Time	■
□ Continuous	◪
△ Periodic Measurements	◪

Groundwater Monitoring Well Data



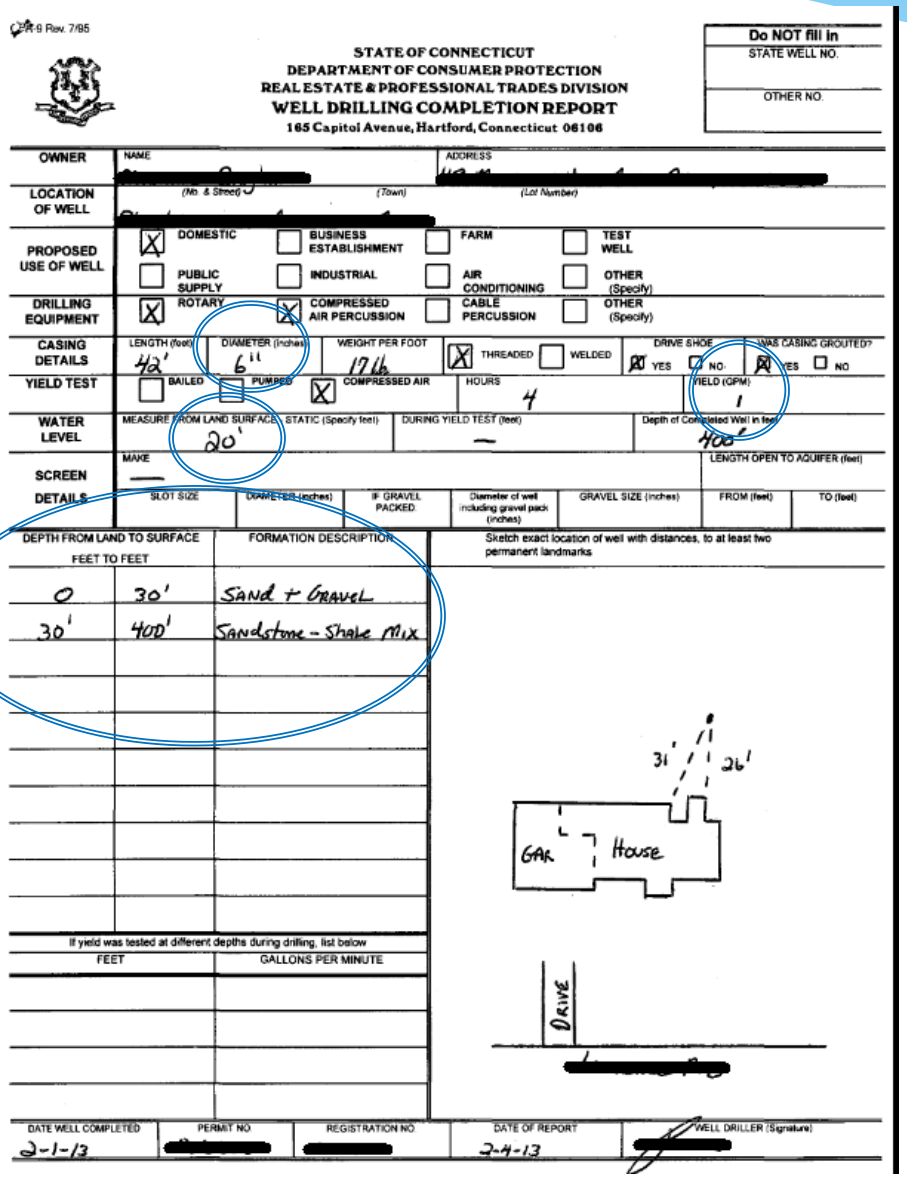
Water Conservation

Activity	Normal	Gallons	Conservation Measure	Gallons	Savings of:
Shower	Water running	25	Wet Down, Soap up, Rinse	9	*16 gallons*
Brushing Teeth	Tap Running	10	Wet Brush, Rinse Briefly	½	*9 ½ gallons*
Bath	Full	35	Minimal (1/4 full)	10-12	*25-27 gallons*
Shaving	Tap Running	20	Partially Fill Sink Basin	1	*19 gallons*
Washing Dishes	Tap Running	30	Wash & Rinse in Partially Filled Sink Basin	5	*25 gallons*
Dishwasher	Full Cycle	16	Short Cycle	7	*9 gallons*
Washing Hands	Water running	2	Fill Sink Basin (or just to wet & rinse)	1	*1 gallon*
Toilet Flushing	Average	5-7	With tank displacement New toilet	3-6 2-3	*1-2 gallons* *3-4 gallons*
Washing Machine	Full cycle, top water level	60	Short Cycle, Minimal Water	27	*33 gallons*
Outdoor Watering	Per minute	10	Hand Watering		
Leaky Faucet	1/32" leak	170/24 hrs.	Fix Leak	0	*170/24 hrs.*



In a 6 inch diameter well, for every feet of casing there is about 1.5 gallons of water. Water conservation efforts will maintain storage in the well for a longer period of time.

Well Completion Reports



STATE OF CONNECTICUT
DEPARTMENT OF CONSUMER PROTECTION
REAL ESTATE & PROFESSIONAL TRADES DIVISION
WELL DRILLING COMPLETION REPORT
165 Capitol Avenue, Hartford, Connecticut 06106

Do NOT fill in
STATE WELL NO.
OTHER NO.

OWNER — NAME [redacted] — ADDRESS [redacted]
LOCATION OF WELL — [redacted] (No. & Street) (Town) (Lot Number)
PROPOSED USE OF WELL — [X] DOMESTIC [ ] BUSINESS ESTABLISHMENT [ ] FARM [ ] TEST WELL; [ ] PUBLIC SUPPLY [ ] INDUSTRIAL [ ] AIR CONDITIONING [ ] OTHER (Specify)
DRILLING EQUIPMENT — [X] ROTARY [X] COMPRESSED AIR PERCUSSION [ ] CABLE PERCUSSION [ ] OTHER (Specify)
CASING DETAILS — LENGTH (feet) 42' — DIAMETER (inches) 6" — WEIGHT PER FOOT 17 lb. — [X] THREADED [ ] WELDED — DRIVE SHOE [X] YES [ ] NO — WAS CASING GROUTED? [X] YES [ ] NO
YIELD TEST — [ ] BAILED [ ] PUMPED [X] COMPRESSED AIR — HOURS 4 — YIELD (GPM) 1
WATER LEVEL — MEASURE FROM LAND SURFACE: STATIC (Specify feet) 20' — DURING YIELD TEST (feet) — — Depth of Completed Well in feet 400'
SCREEN DETAILS — MAKE — — LENGTH OPEN TO AQUIFER (feet)
SLOT SIZE | DIAMETER (inches) | IF GRAVEL PACKED | Diameter of well including gravel pack (inches) | GRAVEL SIZE (inches) | FROM (feet) | TO (feet)

DEPTH FROM LAND TO SURFACE FEET TO FEET		FORMATION DESCRIPTION
0	30'	Sand + Gravel
30'	400'	Sandstone - Shale Mix

Sketch exact location of well with distances, to at least two permanent landmarks

If yield was tested at different depths during drilling, list below

FEET	GALLONS PER MINUTE

DATE WELL COMPLETED 2-1-13 — PERMIT NO [redacted] — REGISTRATION NO [redacted] — DATE OF REPORT 2-4-13 — WELL DRILLER (Signature) [redacted]

Valuable information:

- Diameter of well
- Completed depth of well
- Static water level
- Well yield

Questions?

Water: Too Much or Not Enough?

Ensuring Adequate, Clean Public & Private Drinking Water Supplies in the Face of a Changing Climate

David Radka, Director of Water Resources & Planning
The Connecticut Water Company

Ryan Tetreault, Supervising Environmental Analyst
CT Department of Public Health

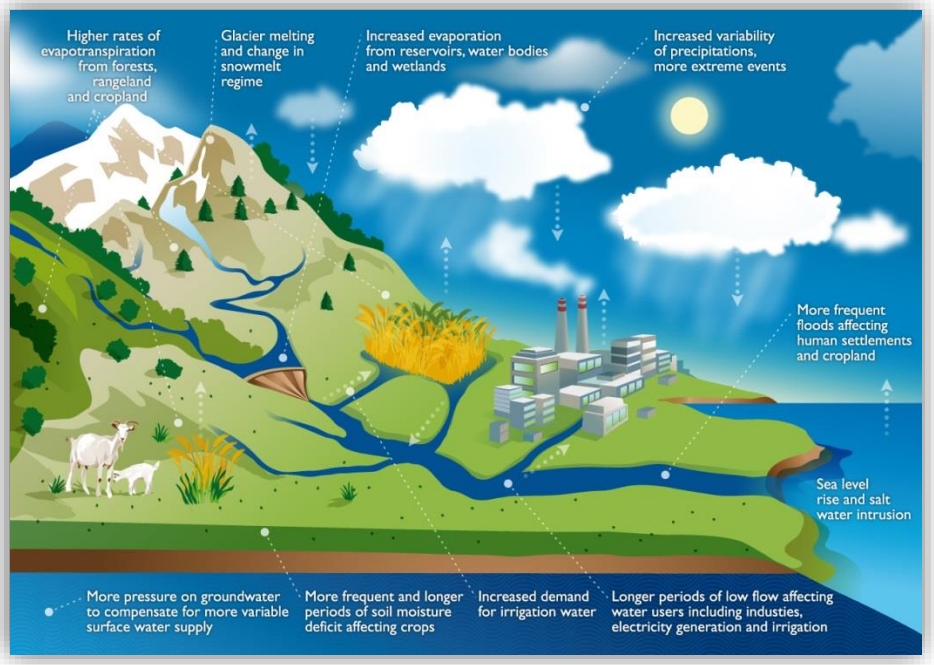
ConnecticutWater

Keeping Connecticut Healthy
DPH
Connecticut Department of Public Health

"The Times They Are a-Changin'…"

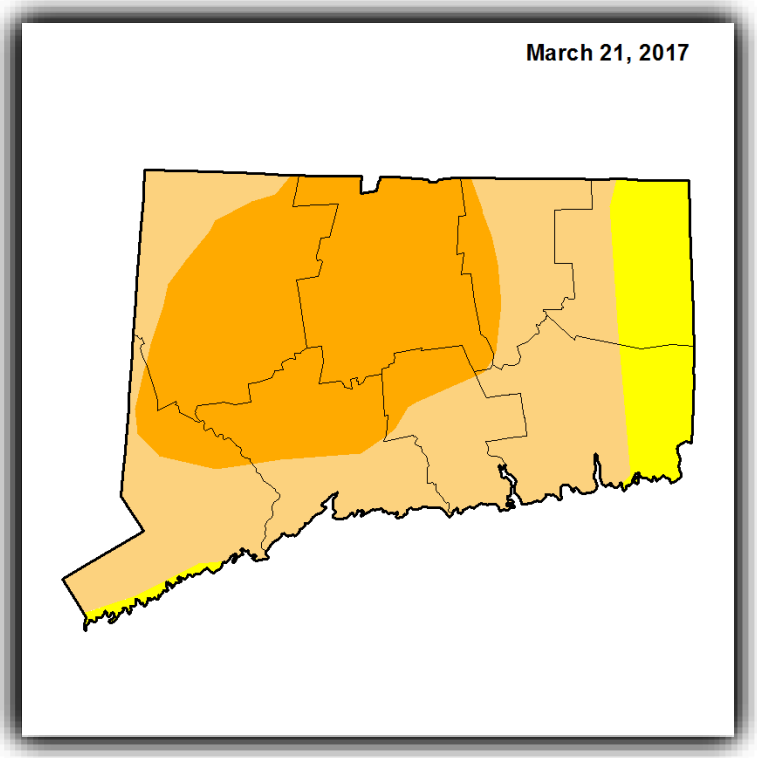
"Climate change is projected to continue to follow already observable trends. Temperature rise, shifts in precipitation patterns and timing, and altered hydrologic cycles can be expected." (US EPA, 2015)

- Extreme Weather Events
- Drought
- Flooding
- Coastal Storm Intensity & Sea Level Rise
- Variability & Seasonality



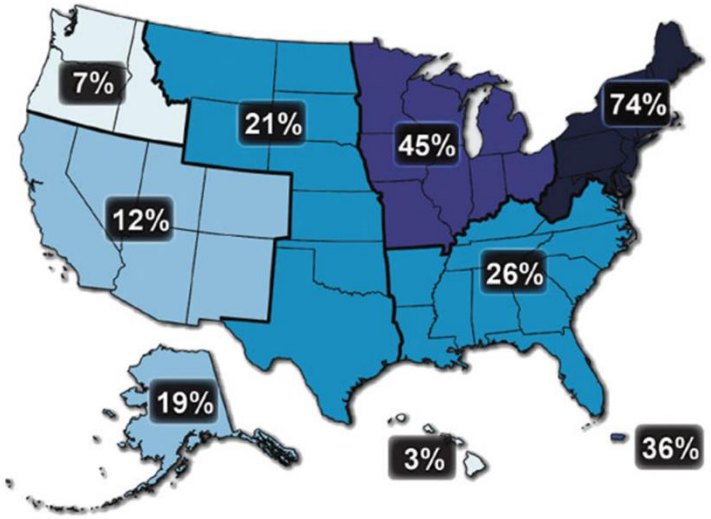
Temperature & Drought

- Higher temperatures, especially in summer
  - ✓ Avg and extreme heat days
- Longer heat waves and increased evaporation
- Changes in Runoff and Loss of Snowpack
- Decline in summer precipitation
- Increased Drought Frequency & Duration
  - ✓ Short-term droughts as frequently as each summer



Rain Bombs & Flooding

- Increase in precipitation: + 5”
- Extreme Precipitation (heaviest 1% of all daily events) up 74%
  - ✓ More 2+ inch storms
- Winter precipitation as rain
- More development, paved areas
- Increase in frequency of Category 4 and 5 hurricanes
- Fewer buffering marshes and estuaries
- Sea Level Rise – 1 to 4’



Water Supply Challenges

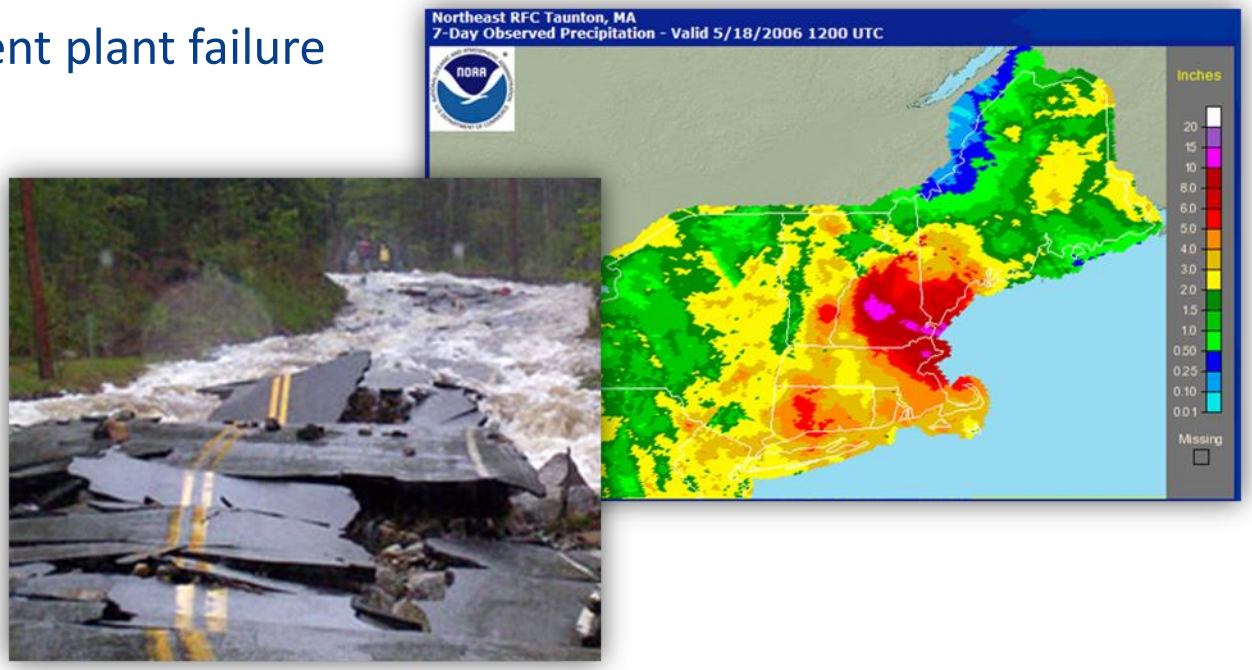
"The biggest challenges for water utilities are forecasting demand from a growing population, planning for extreme weather events and updating aging infrastructure. At the same time, the industry has to deliver consistent and clean water to its users at an affordable rate." (Barclays and the Columbia Water Center, 2017)

- Physical Infrastructure
- Water Quality Degradation
- Safe Yield & Available Supply
- Managing Uncertainty

Challenges – Infrastructure

Physical Infrastructure

- Flooding, Hurricane/Coastal Storm Impact, Sea Level Rise
- Dam Safety
- Supply, Treatment & Distribution System Integrity
  - ✓ Failure, Flooding, Power Loss
- Drainage infrastructure overwhelmed during heavy precipitation and high runoff events
- Wastewater treatment plant failure



Challenges – Water Quality

Water Quality Degradation

- Flooding: erosion, sedimentation, nitrogen, herbicides, pesticides, turbidity and pathogens
- Watersheds and natural ecosystems degraded
- Salt-Water infiltration and impacts to freshwater systems
- Thermal stratification of reservoirs increasing
  - ✓ Mixing may be eliminated in shallow lakes, decreasing dissolved oxygen and releasing excess nutrients, metals, etc.
- Reservoirs less likely to freeze
  - ✓ Algae blooms increase
- Tap water temperature challenges
  - ✓ Disinfection byproducts

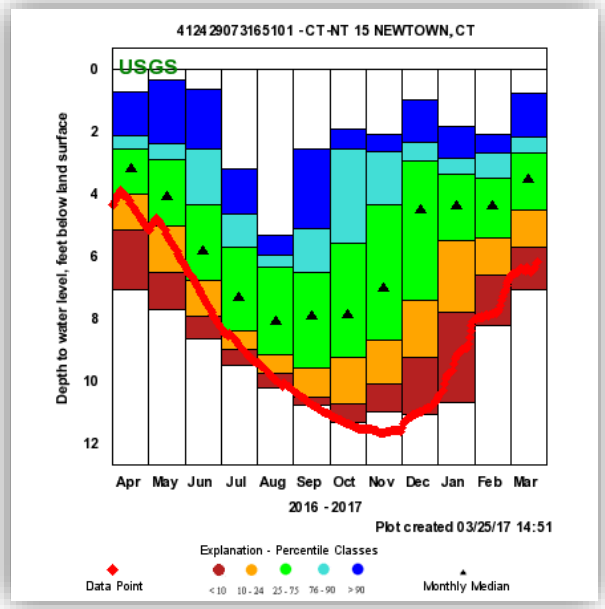
Challenges – Ability to Meet Demand

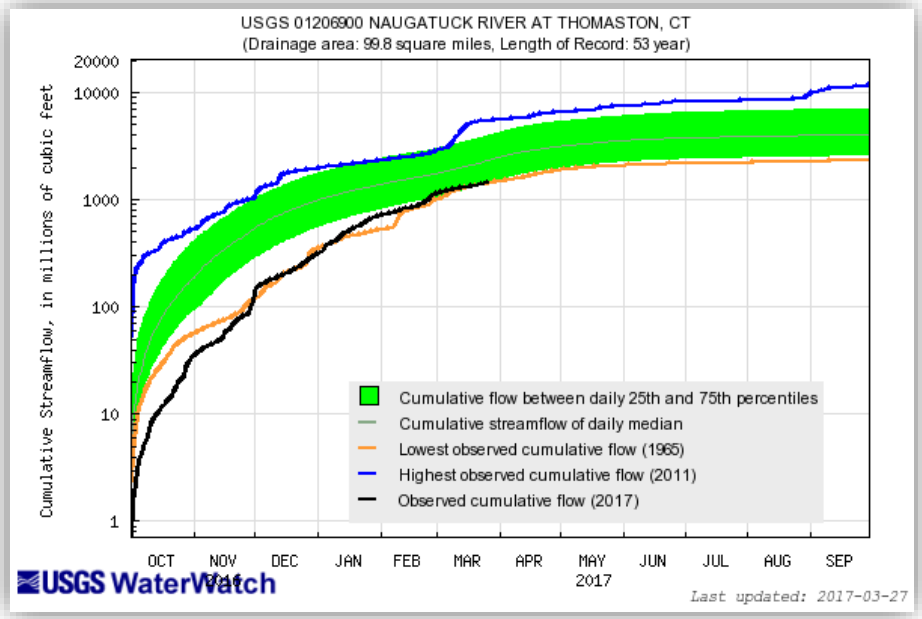
Safe Yield & Available Supply

- Lower Res Levels
- Reduced GW Recharge

Water Demand

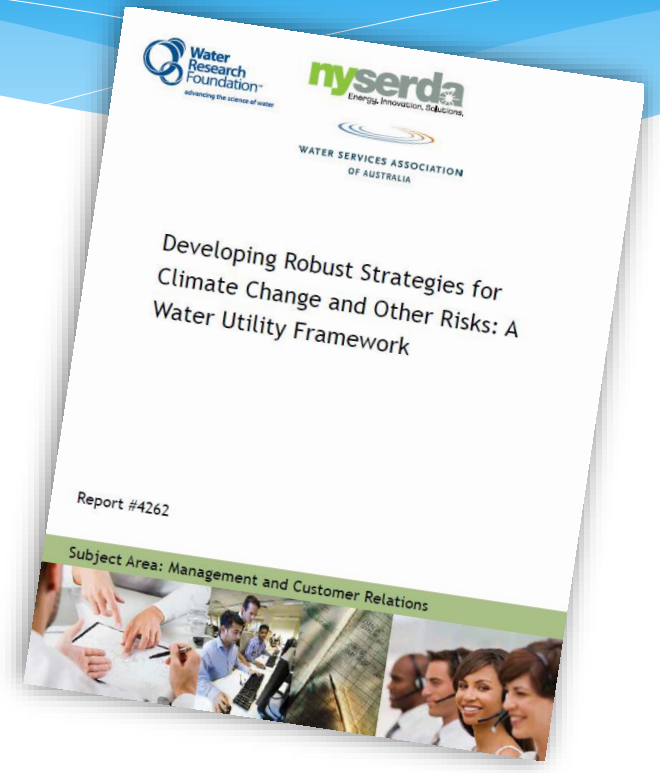
- Increased Seasonal Demand
- Environmental Pressures



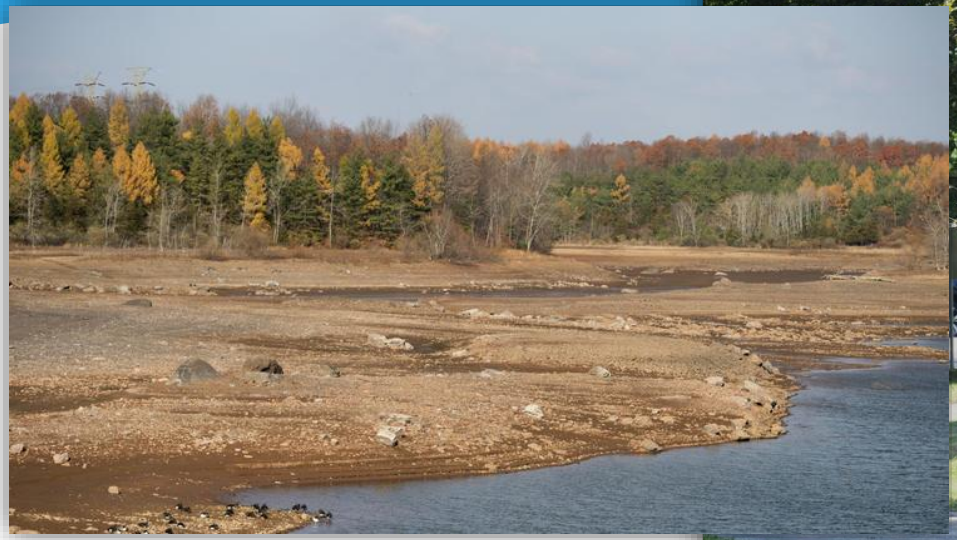


Mitigating Risk

- Supply & Demand Management
- Redundancy
  - ✓ Critical Infrastructure
  - ✓ Interconnections
- Emergency Response Planning
  - ✓ ECPs
  - ✓ CT WARN
- Managing Uncertainty
  - ✓ Adaptive Management



"Water agencies have always faced uncertainty when planning for the future. Traditional planning methods are based on the assumption of hydrologic stationarity—that future hydrologic conditions will be statistically similar to those recorded in the recent historical record… Scientific evidence is mounting, however, that future climate and hydrologic conditions will be significantly different from those in the past." (Water Research Foundation, 2014)




NO OUTDOOR
WATER USE

Looking Ahead

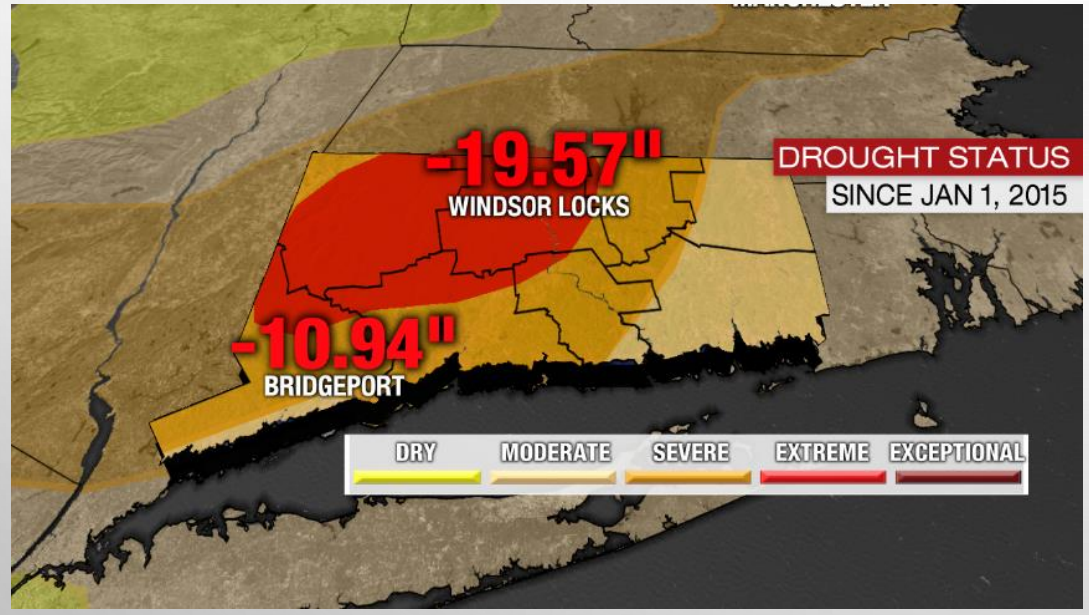
"Generally, the past decade has seen ***considerable interest by the water utility community in exploring the potential impacts*** *of climate change. This period has been referred to… as an era of assessment, as there are very few examples of water utility actions or adaptations directly linked to "climate change".* ***The next era will be one of action, as water utilities grapple with large infrastructure investment decisions, and include climate change in their risk management and decision processes.*** *" (Water Research Foundation, 2014)*

SMALL FARM
VS.
BIG DROUGHT

IAN GIBSON, MANAGER

WELLSTONE FARM, HIGGANUM CT

A TOUGH 48 MONTHS……..



- DROUGHT HAS A SYSTEMIC IMPACT OF ALL FACETS OF AGRICULTURE – REGARDLESS OF SCALE
- ONLY POSITIVE – A MILD DROUGHT IS A BETTER FATE THAT A TORRENTIALLY RAINY SUMMER.

IN AGRICULTURE, DROUGHT = STRESS

- STRESS TO CROPS
- STRESS TO THE FARMERS AND LABOR
- STRESS TO FARM WATER RESOURCES
- STRESS TO EQUIPMENT AND INFRASTRUCTURE

WATER: A PRIMARY LIMITING (BIOLOGICAL) RESOURCE

- PHOTOSYNTHESIS
- TRANSPIRATION
- SUPPORT
- NUTRIENT TRANSPORT

POTATO CULTURE: MOISTURE IS THE DIFFERENCE

IMPACTS OF INCREASED DROUGHT CONDITIONS

BLOSSOM END ROT (CALCIUM DEF.)

YELLOW/GREEN SHOULDERS (POTASSIUM DEF.)

IMPACTS OF INCREASED DROUGHT CONDITIONS

INCREASED ALTERNARIA BLIGHT (EARLY BLIGHT)

INCREASED NUTRIENT DEFICIENCY

KEY FACTORS IN DROUGHT MITIGATION

WATER RETENTION

- DRIP IRRIGATION
- MULCHES (PLASTIC AND ORGANIC)
- APPLIED BARRIERS
- DROUGHT RESISTANT CULTIVARS
- CULTURAL ADAPTATION

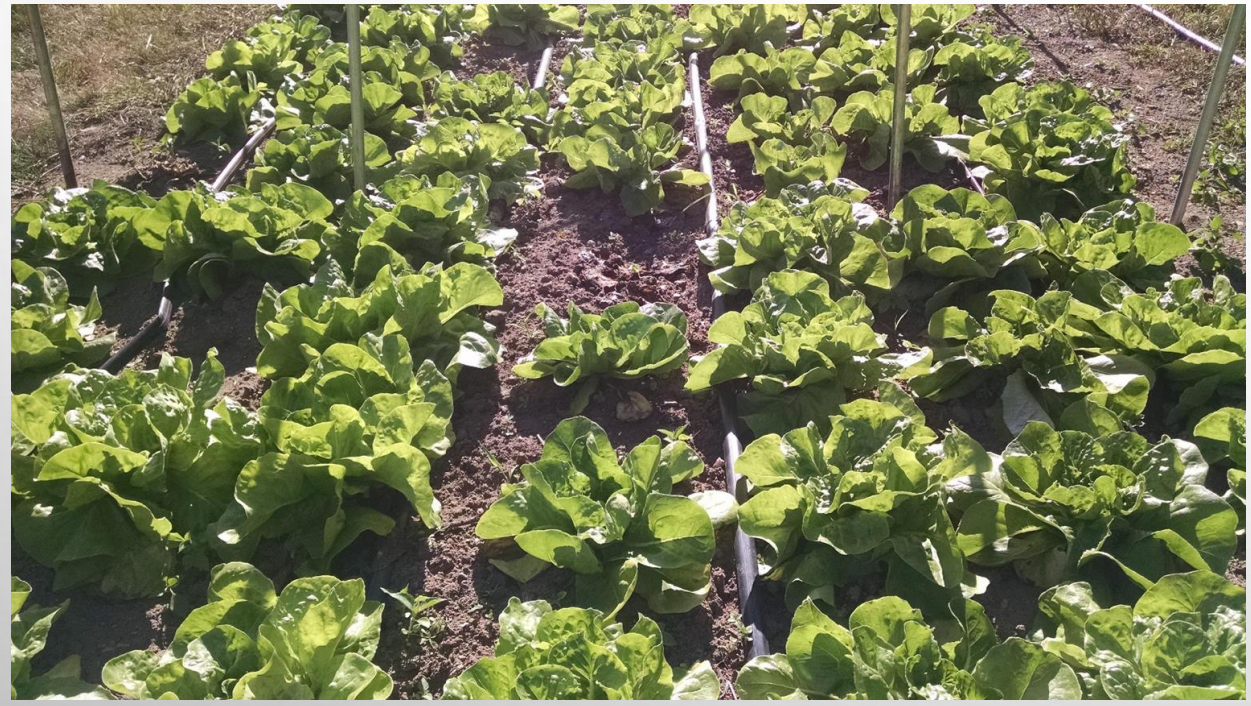
WATER AVAILABILITY

- WELLS
- SURFACE WATER
- RAINWATER CATCHMENT
- DRY FARMING
- WATER HAULING

WELLSTONE FARM

WATER AVAILABILITY AT WELLSTONE FARM – YE OLDE HOUSE WELL

DRIP IRRIGATION: HIGHLY EFFICIENT WATER USE



PLASTICULTURE: WATER RETENTION & WEED MGMT.

WOVEN LANDSCAPE FABRIC: LONG-TERM USE

SHADE NETTING: HEAT AND EVAPORATION REDUCTION

KAOLIN CLAY (SURROUND WP): DECREASES HEAT & TRANSPLANT STRESS

Mosquito Control from Drought to Deluge

Water: Too Much or Not Enough
Symposium presented by Rockfall Foundation and UConn Climate Adaptation Academy
March 31, 2017

Connecticut Department of Energy and Environmental Protection

Connecticut Department of
ENERGY & ENVIRONMENTAL PROTECTION

Roger Wolfe (roger.wolfe@ct.gov)

Wetland Restoration/Mosquito Management Coordinator

CT DEEP Wetlands Habitat and Mosquito Management Program (WHAMM)

Connecticut Mosquito Management Program

- Mosquito surveillance - CAES
- Domestic bird and animal - DoAg, UCONN
- Human surveillance - DPH/LHD
- Mosquito control/tech assistance - DEEP
- Communication and public awareness - DPH/DEEP/CAES

Mosquitoes

- 53 species in CT (~3000 worldwide, >200 in US)
- Only female bites (irritation and disease transmission)
- Floodwater vs. stagnant surface
- Univoltine vs. multivoltine (>risk)
- Overwintering strategies
- Specific vs. general feeding (>risk)

Natural Mosquito Habitats

Artificial mosquito habitats

Created Wetlands/Stormwater BMP's:

"If you build it they will come." (?)


Photo: N. Read

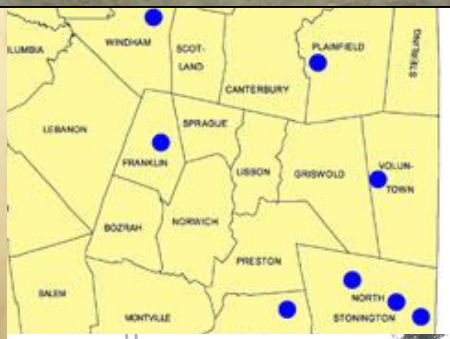
Recommendations

- 1:3 or 1:4 side slopes
- Veg/beaver management
- <72 hrs. detention
- **maintenance!**

IPM for Mosquito Control

- Monitoring and Surveillance
- Education
- Source Reduction
- Personal Protection
- Biological control
- Chemical control
  - -Larvaciding
  - -Adulticiding

Trapping S

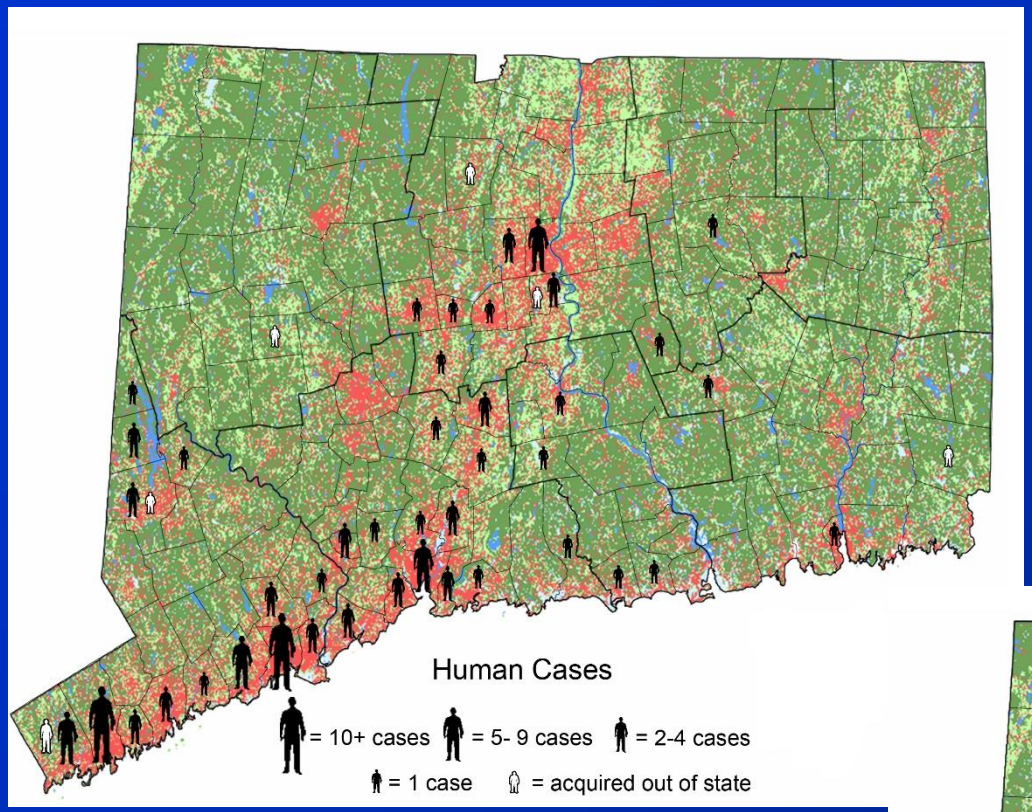


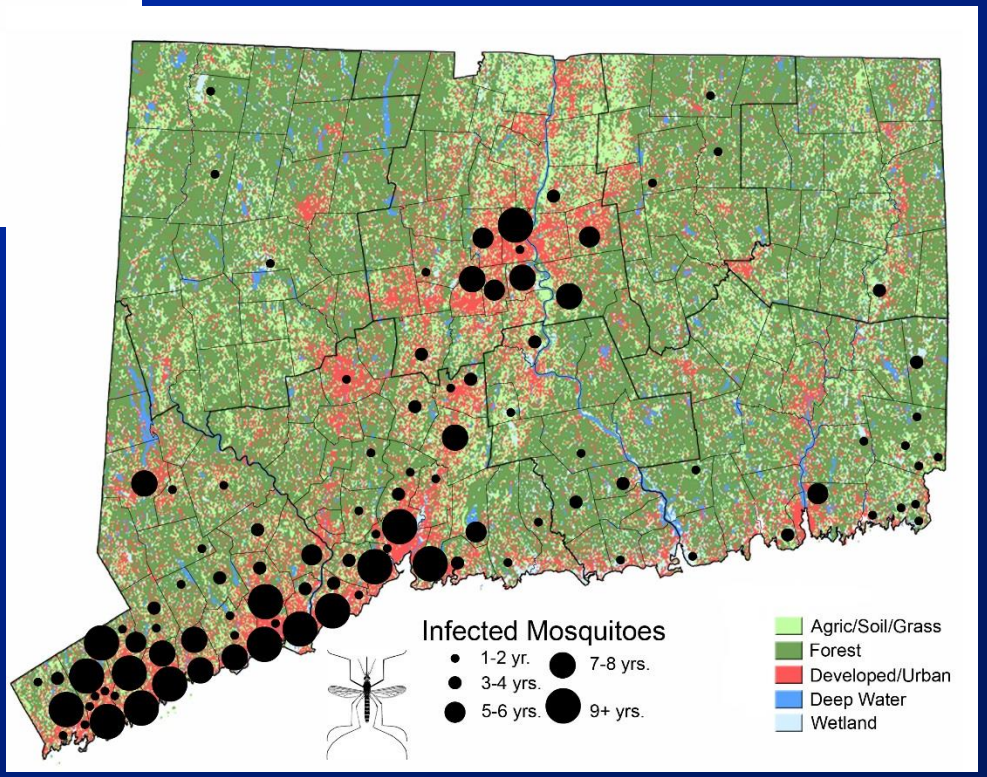
● = Trapping Statio

Mosquito-Borne Disease

- Eastern Equine Encephalitis (EEE)
- West Nile virus (WNV)
- St. Louis Encephalitis (SLE)
- LaCrosse virus (LAC)
- malaria
- dengue (DHF)
- chikungunya
- Zika
- Powassan
- Canine heartworm (filariasis)

WNV 2000-2016: 131 human cases





Source reduction

Eliminate standing water around home and workplace.

Once a week: flush bird baths, wading pools, planters, toys, trash containers.

Rain barrels: cover with wire mesh smaller than a mosquito.

Exotic species

Aedes albopictus

Aedes japonicus

Personal Protection Measures to Prevent Mosquito Bites

- Minimize outdoors activities at dawn and dusk.
- Wear light colored, loose fitting clothing. Long sleeves, pants.
- Repair holes or replace screens.
- Use A/C.
- Avoid camping near swampy areas. Use netting on tents.
- Consider using a repellant.

Personal Protection Measures to Prevent Mosquito Bites: Repellants

- DEET (<30-40%), picaridin, oil of lemon eucalyptus, IR3535 or para-menthane-diol applied on clothes or skin; permethrin products on clothes only.
- Have an adult apply repellants to children. <10% DEET on children - not around eyes/nose/mouth.
- Reapply as needed (e.g., after swimming)
- Wash off when you come indoors.

Larvacides

Products applied to larval habitats that kill mosquito larvae. Some can be applied as a pre-emergent.

- Biologicals (Bti, Bs, spinosad)
- IGR's* (methoprene)
- oils* (MMF, alcohols, esthers)
- chemical* (temephos)

(*permit required)

Larvaciding
backpack application

Adulticiding (“spraying”)

Ultra Low Volume (ULV) adulticiding

Barrier spray

Elements of a Municipal Mosquito Control Program

- Educate your constituents (sources of mosquitoes).
- Clean up yards/neighborhoods. Stress source reduction/personal protection.
- Enforce public health regs: e.g., abandoned pools
- If contracting with private company, use only DEEP licensed applicators (Cat. 7f)
- Consider catch basin larvaciding. Coordinate with DPW clean outs. Also parks, schools (check regs).
- Judicious use of adulticides is OK.

Open Marsh Water Mangement (OMWM) source reduction and habitat enhancement

Want to know more?

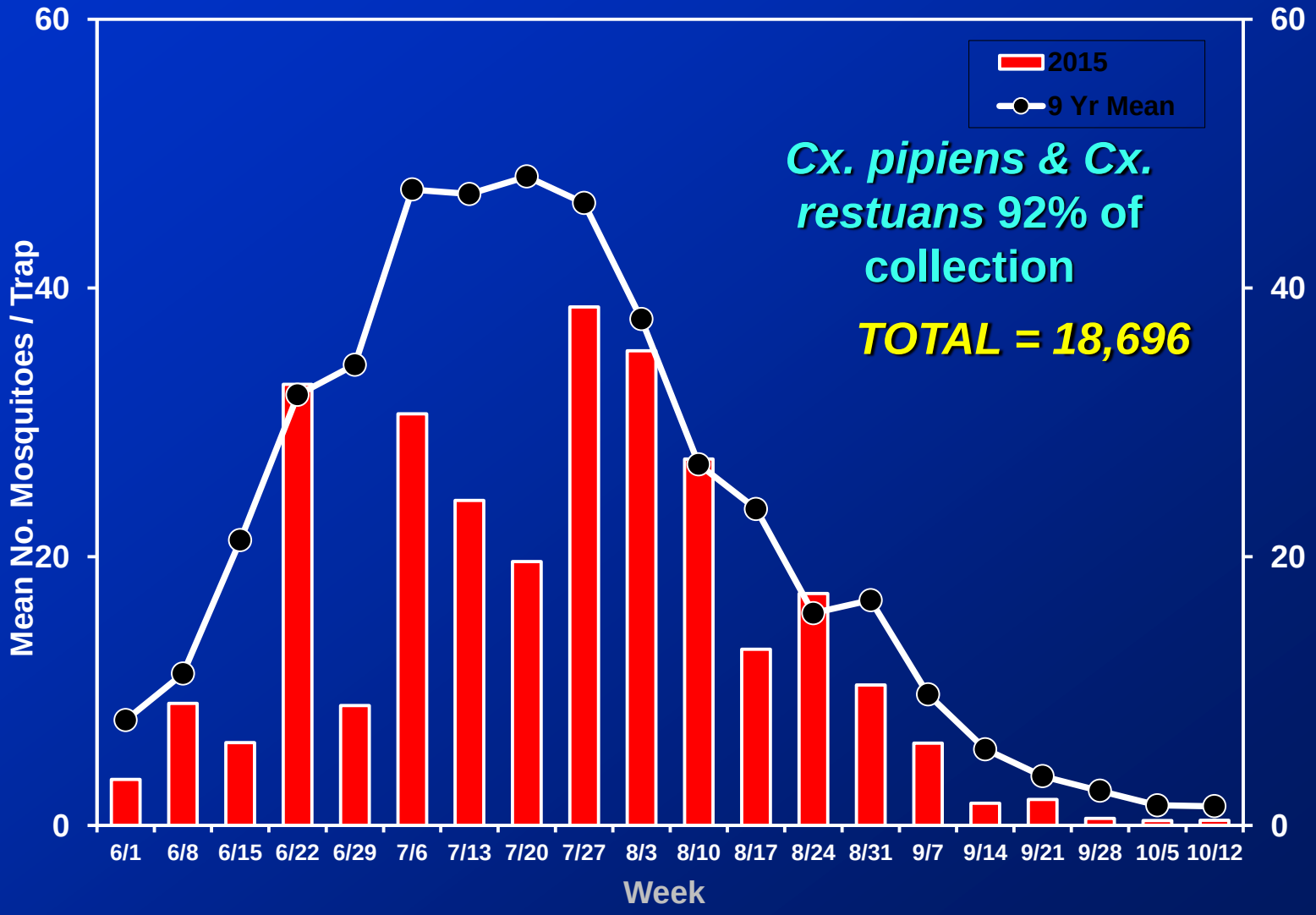
CT Mosq. Mgt Program: www.ct.gov/mosquito

Amer. Mosq. Control Assoc: www.mosquito.org

Nat'l Cent. Disease Contr. and Prev: www.cdc.gov

Rutgers Cntr for Vect Bio: vectorbio.rutgers.edu/outreach

Timing of application for Culex control



TOO MUCH WATER | NOT ENOUGH WATER

OBSERVATIONS FROM THE FIELD

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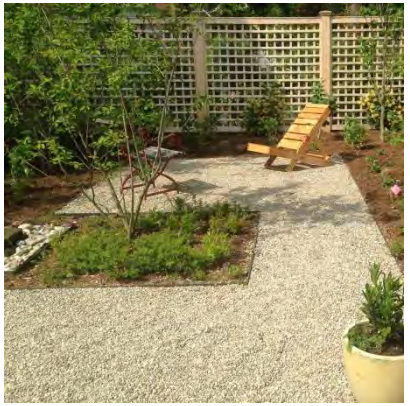
LANDSCAPE ARCHITECTURE

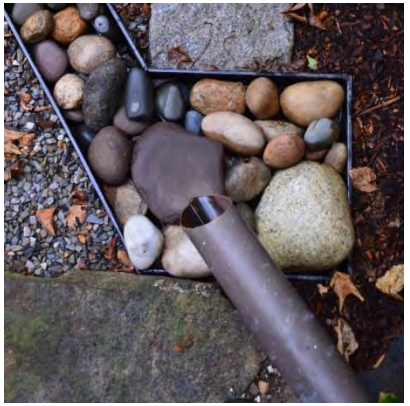
ANNE LACOUTURE PENNIMAN, ASLA

TOO MUCH WATER | NOT ENOUGH WATER

Allow for infiltration however and whenever possible

Permeable Surfaces
Irregular/unsmooth planted surfaces
Collect/Channelize
Percolate/Infiltrate



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TOO MUCH WATER | NOT ENOUGH WATER

Allow for infiltration however and whenever possible

Harness the wisdom of the forest

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TOO MUCH WATER | NOT ENOUGH WATER

Allow for infiltration however and whenever possible

Harness the wisdom of the forest

Work with existing soil character

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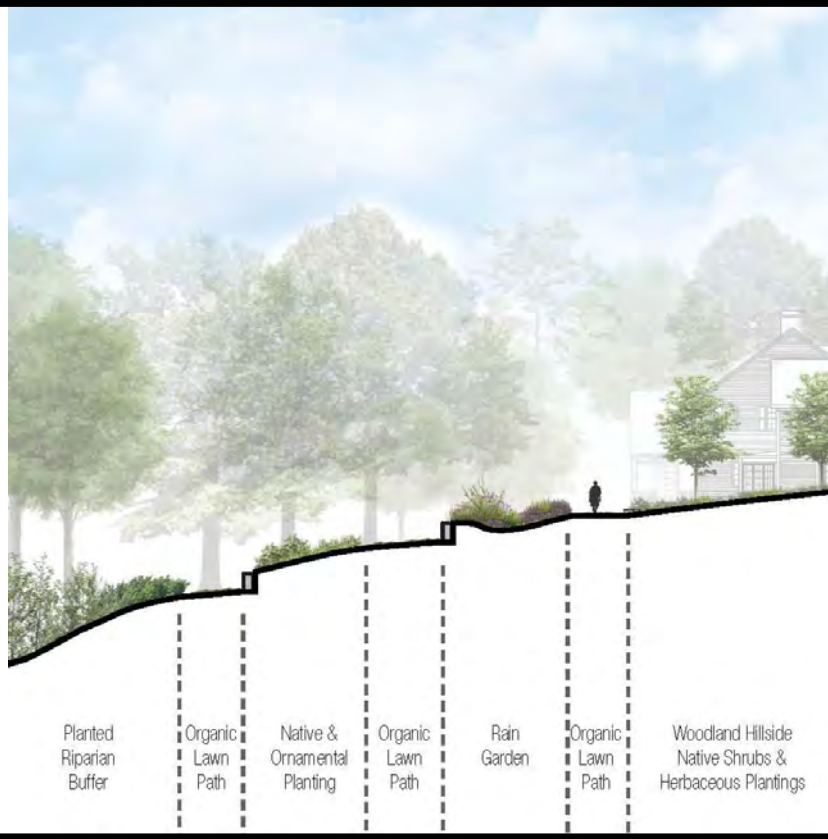
TOO MUCH WATER | NOT ENOUGH WATER

Allow for infiltration however and whenever possible

Harness the wisdom of the forest

Work with existing soil character

Employ multiple strategies



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TOO MUCH WATER | NOT ENOUGH WATER

Allow for infiltration however and whenever possible

Harness the wisdom of the forest

Work with existing soil character

Employ multiple strategies

Careful attention to the ground plane

Central Park

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TOO MUCH WATER | NOT ENOUGH WATER

Allow for infiltration however and whenever possible

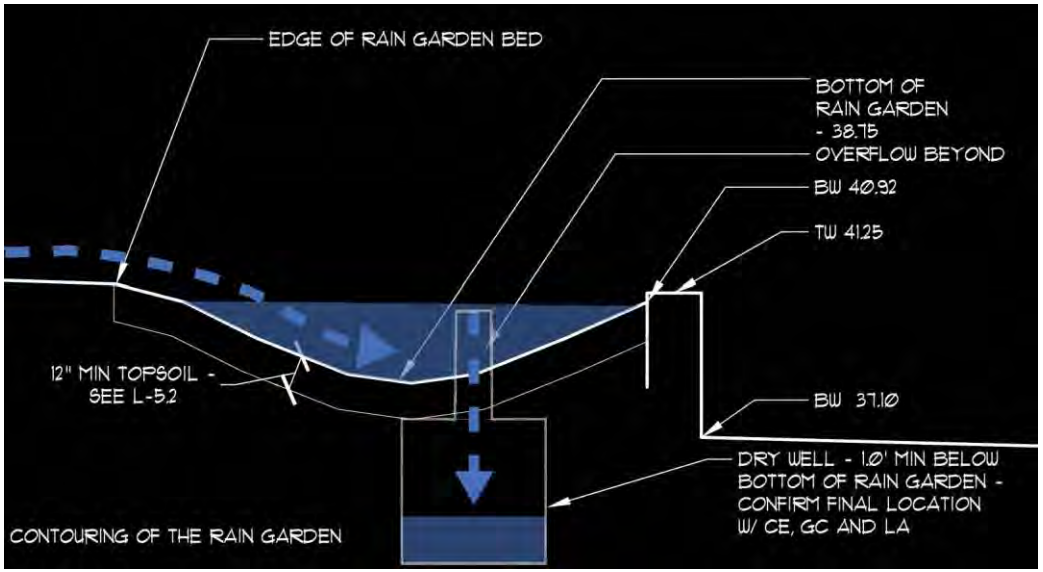
Harness the wisdom of the forest

Work with existing soil character

Create opportunities for infiltration

Careful attention to the ground plane

Belt and suspenders



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RURAL | URBAN

Connecticut River Compound

CTASLA HONOR AWARD, 2017

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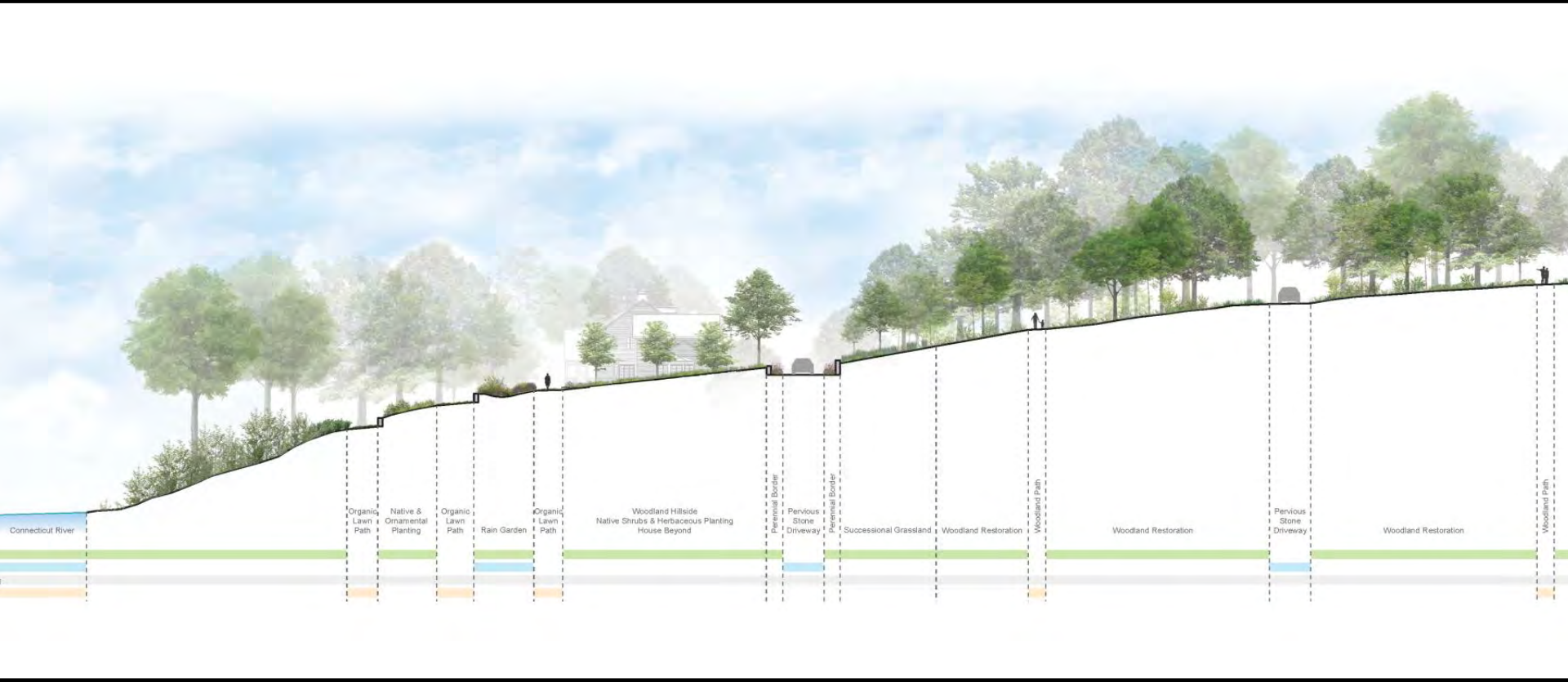

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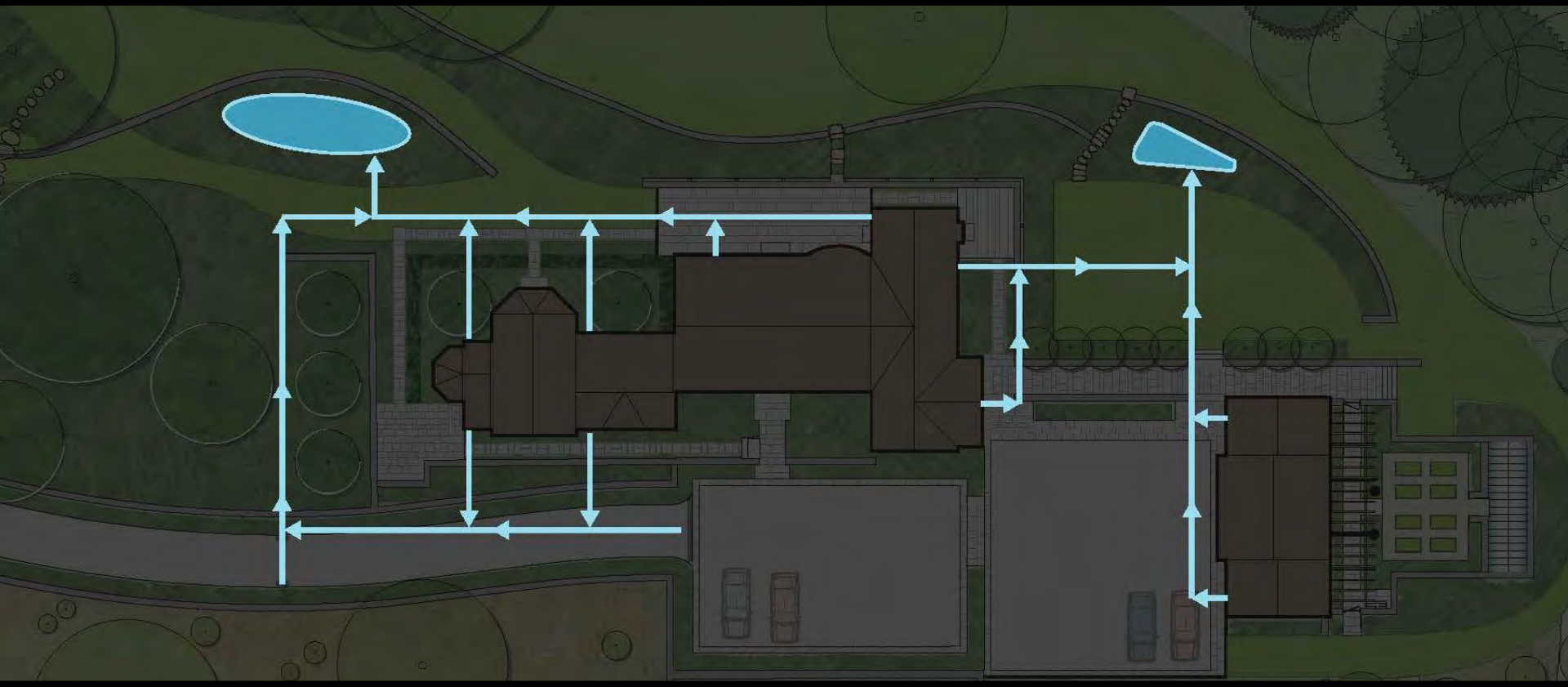
RURAL | URBAN



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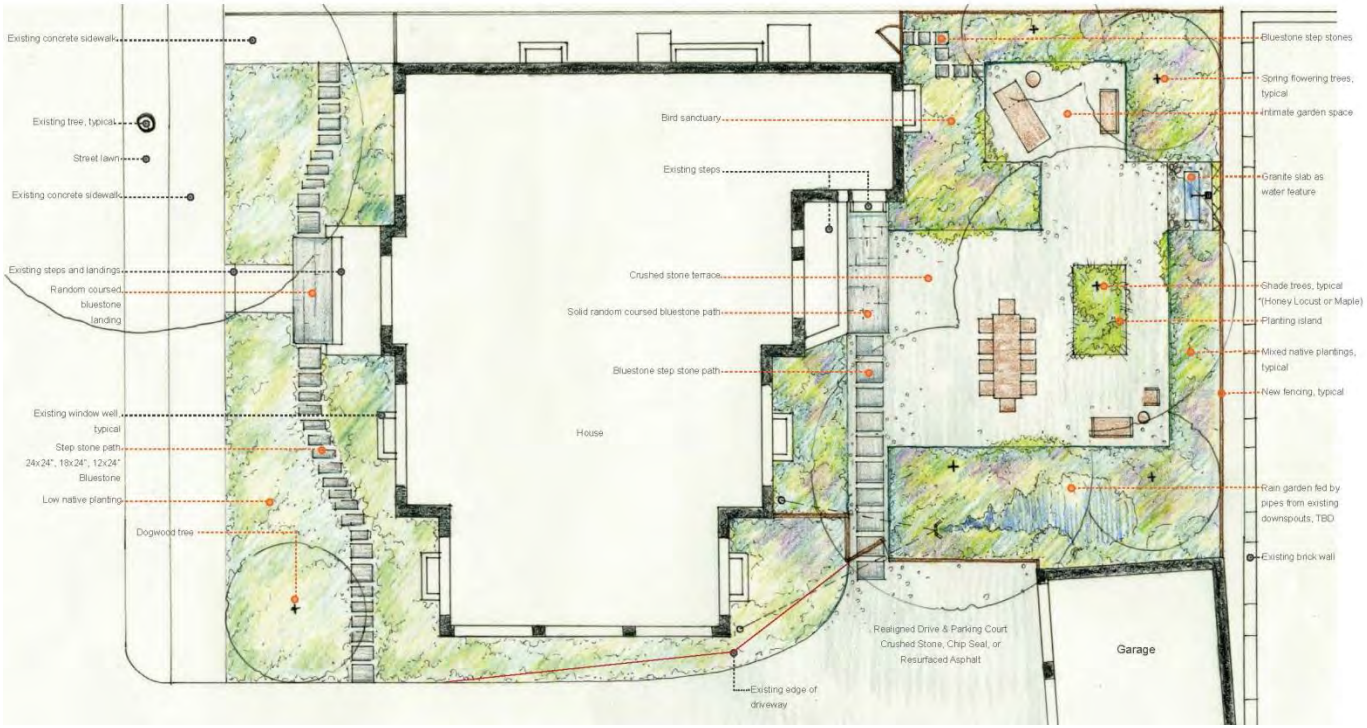
New Haven Residence



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TOO MUCH WATER | NOT ENOUGH WATER

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TOO MUCH WATER | NOT ENOUGH WATER

Observe nature

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TOO MUCH WATER | NOT ENOUGH WATER

Observe nature

Plant natives

Rhododendron periclyminoides – Pinxter Azalea

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TOO MUCH WATER | NOT ENOUGH WATER

Observe nature

Plant natives

Right plant/Right place

Parthenocissus quinquefolia – Virginia Creeper

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LANDSCAPE ARCHITECTURE

TOO MUCH WATER | NOT ENOUGH WATER

Observe nature

Plant natives

Right plant/Right place

Draw inspiration from resilient plant communities

Myrica, Viburnum, & Amelanchier

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LANDSCAPE ARCHITECTURE

TOO MUCH WATER | NOT ENOUGH WATER

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TOO MUCH WATER | NOT ENOUGH WATER

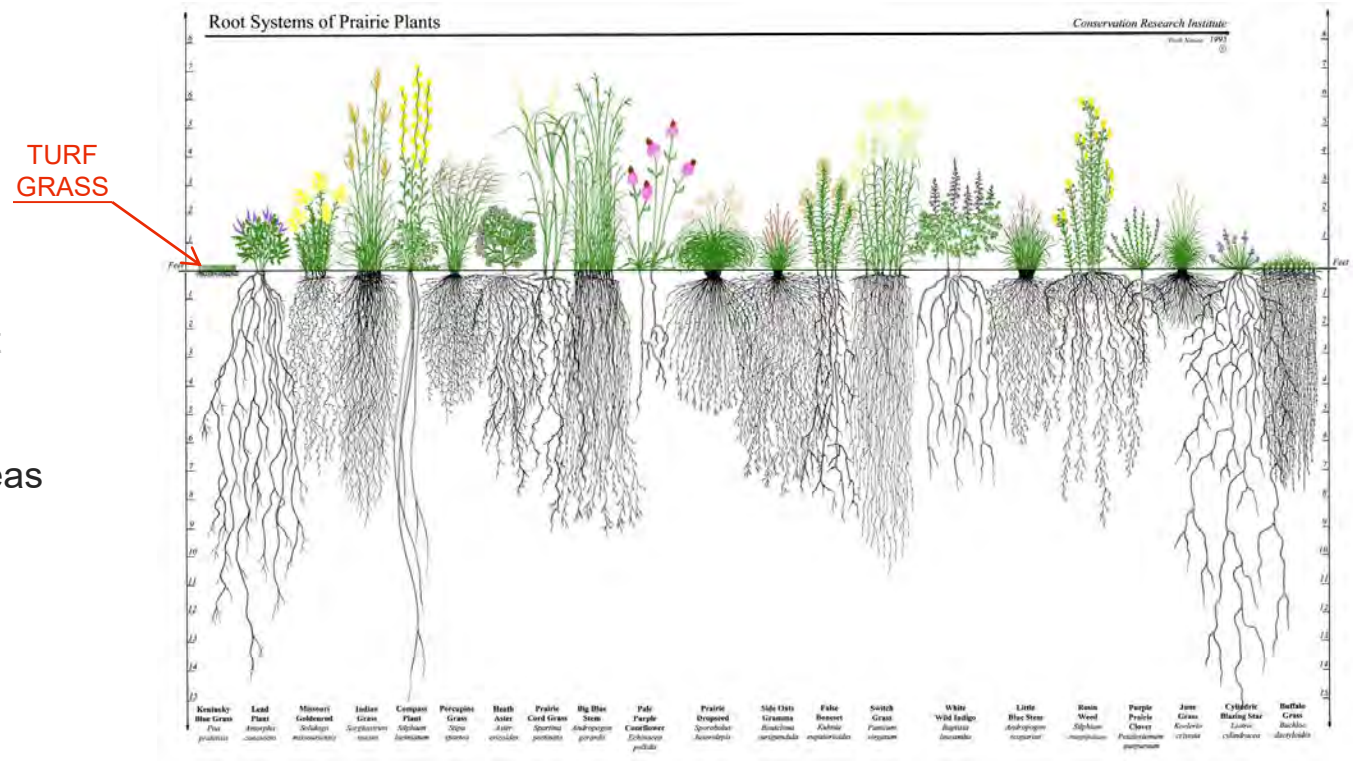
Observe nature

Plant natives

Right plant/Right place

Draw inspiration from resilient plant communities

Reduce water-thirsty lawn areas



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TOO MUCH WATER | NOT ENOUGH WATER

Use Water W I S E L Y

Monitor and irrigate new plantings as necessary

Understand that new plantings need approximately 1” rain/water per week

Use drip irrigation judiciously

Do not water established plants, but monitor them during drought periods

TOO MUCH WATER

NOT ENOUGH WATER

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FARM | GARDEN | LAB

Find ways to celebrate water as an artful, aesthetic, and necessary feature of the landscape.

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FARM | GARDEN | LAB

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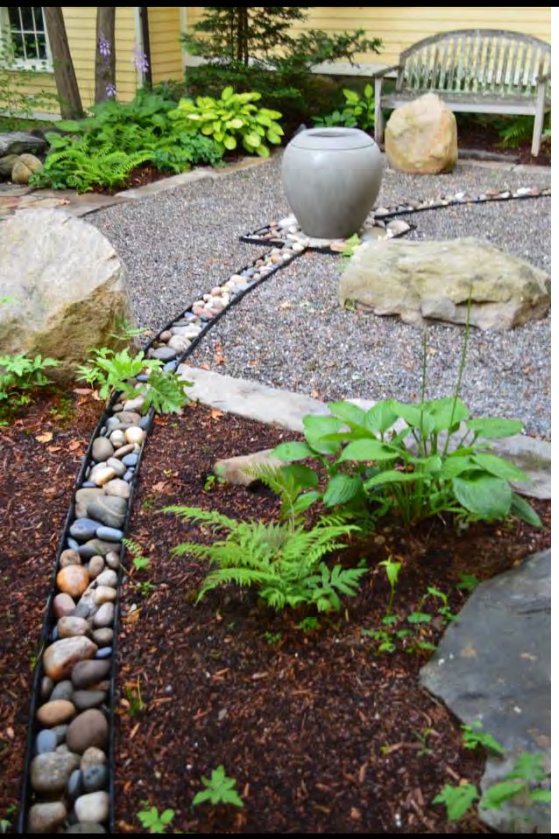
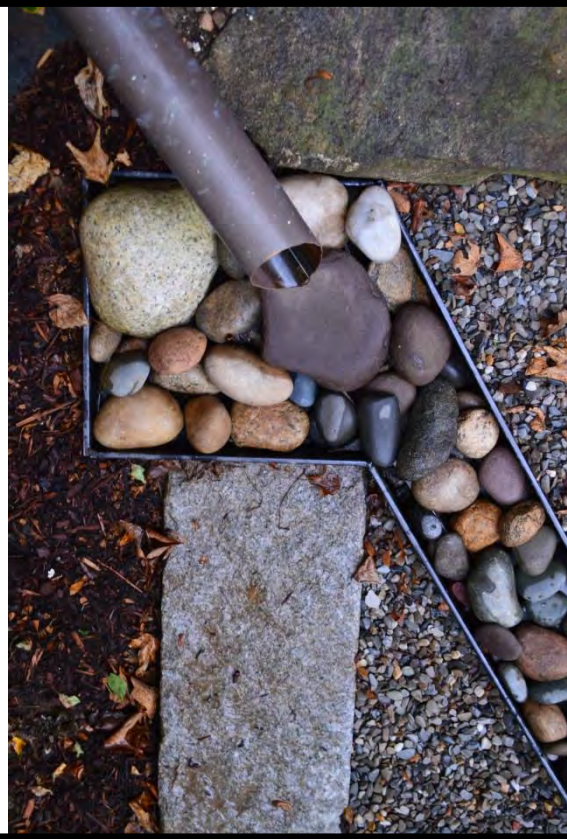
FARM | GARDEN | LAB





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Thank you!

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Rockfall Foundation

The Connecticut Water Planning Council

State Water Plan CONNECTICUT

March 2017

Kirk Westphal, PE

Connecticut State Water Plan Update

NEIWPCC New England Interstate Water Pollution Control Commission | CDM Smith | Milone & MacBroom® | DPH | OPM | PURA

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Topics to Discuss

- State Water Plan Goals
- Review of the planning process
- Major components of the Plan:
  - Technical
  - Policy
  - Next Steps
- Upcoming opportunities to stay involved

Goals of the Plan

Goals of the Plan

The Plan is Aimed at:

- Building on work to date of Committees and Advisory Group
- Addressing each of the 17 Primary Goals outlined in the Statute, as a minimum
  - Consensus Policy Recommendation
  - Pathway Forward
  - Acknowledgment of Evaluation Elsewhere
- Identifying a balance: *The right quantity and quality for each need.*

The Plan is NOT Aimed at:

- Solving all of Connecticut's Water Issues

Summary of High-Level Plan Objectives

Synopsis

- Provide balanced water use for all needs.

“Soundbites” (Not prioritized)

- Provide reliable and resilient supply for all uses
- Promote public health and quality of life with high quality water
- Protect the environment
- Manage water cost-effectively for all users
- Develop an implementable plan
- Prepare for uncertain future climate
- Use science and data to recommend action
- Involve Connecticut citizens in water management

Make Progress on Each Identified Water Management Option or Challenge

Plan can include **pathways forward and decision processes** for issues that cannot be resolved within the 1-year planning process

Plan can include **policy recommendations** for well developed options with general consensus

Plan can acknowledge that certain options are being addressed elsewhere

Plan will include technical information on current and future water needs for human health, environmental health, industry, agriculture, and energy

Roles of the Working Committees

Review policy white papers
Help pre-screen options for consensus
Draft policy language for consensus-based options

Policy Work Group

Science/Tech Work Group

Peer review of technical work products
Help confirm or fill data gaps
Identify case study opportunities to test recommendations

WPC Steering Committee

Consider future management structure

Recommend the Plan to the Legislature

Water Planning Council DEEP, DPH, PURA, OPM

WPC Advisory Group

Help develop local implementation guidelines
Consider process for rapid approval of Draft Plan in 2017

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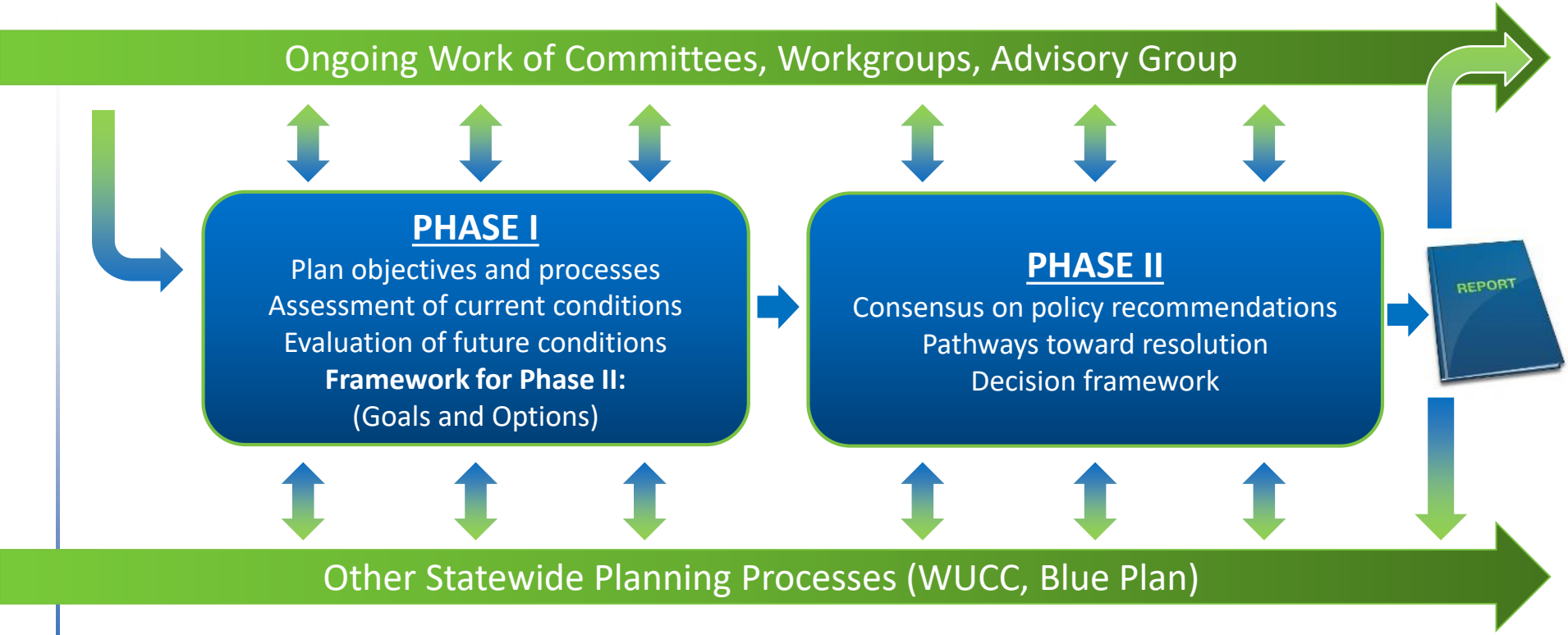
Phasing of Plan Development



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Stakeholder Workshops and Public Meetings

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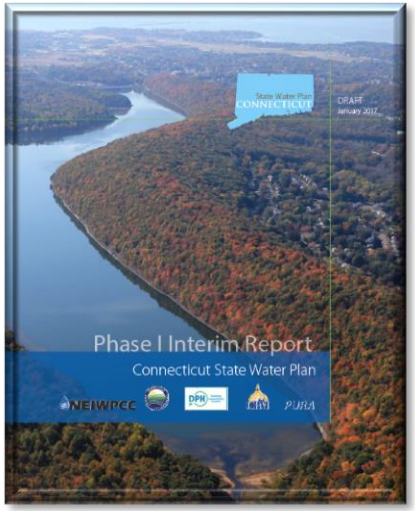
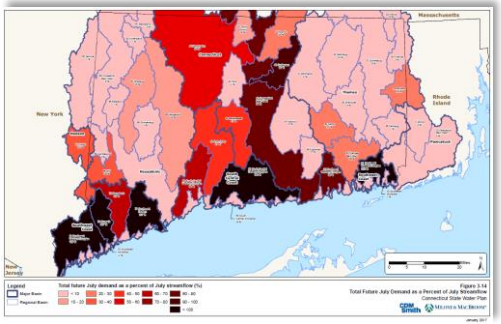
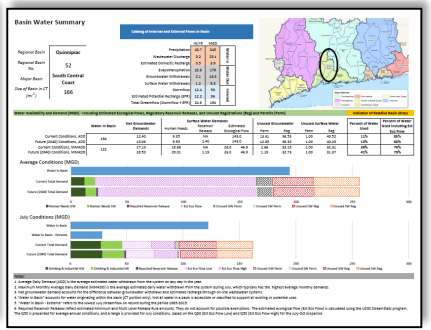
Key Elements of the Plan

Background: Current Policies, Future Options



Technical information: Water Needs, Climate Change, Conservation





Recommendations

- Recommended **Policies** as guiding principles for future laws and regulations based on stakeholder consensus
- "**Pathways Forward**":
  - Data Needs
  - Partnerships
  - Consensus Building
- **Implementation**
  - Outreach
  - Funding
  - Priorities

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Background White Papers

- Current Water Management Structure
- Land Conservation and Economic Development
- Future Water Management Options
- Future Water Management Challenges


Task 1B-4 White Paper – Revised DRAFT JAN 2017
Future Water Management Challenges

- All are available at: http://www.ct.gov/water

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Technical Information

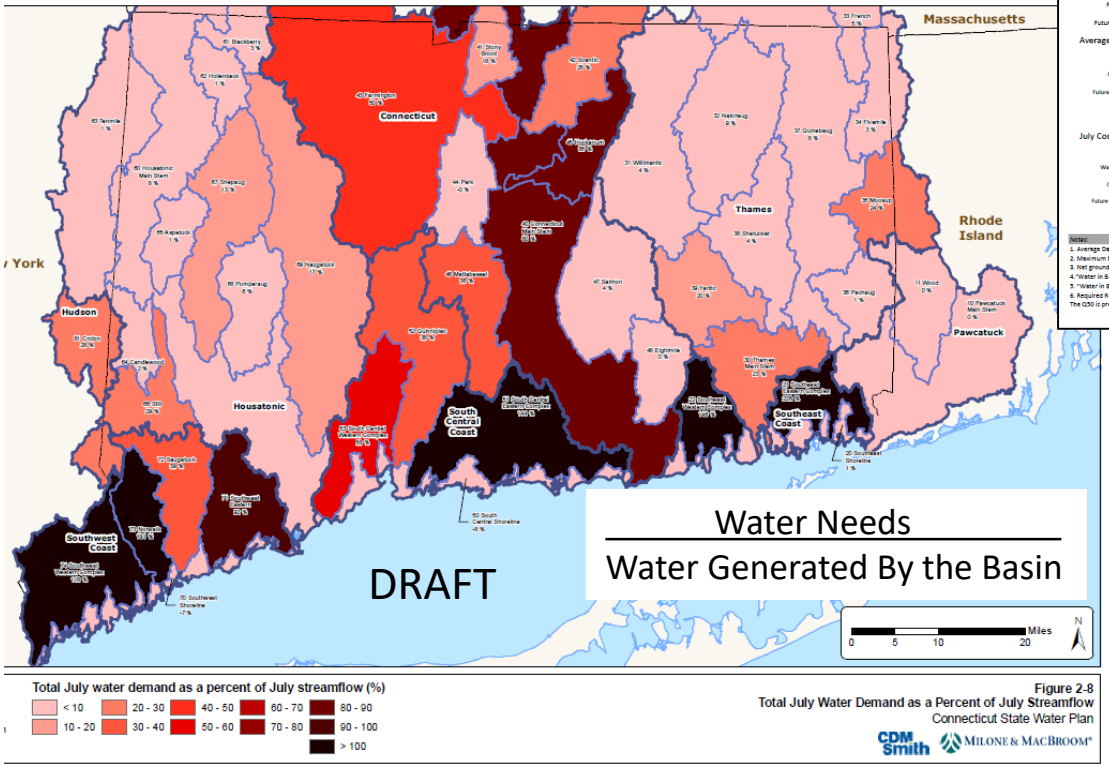

Figure 2-8
Total July Water Demand as a Percent of July Streamflow
Connecticut State Water Plan

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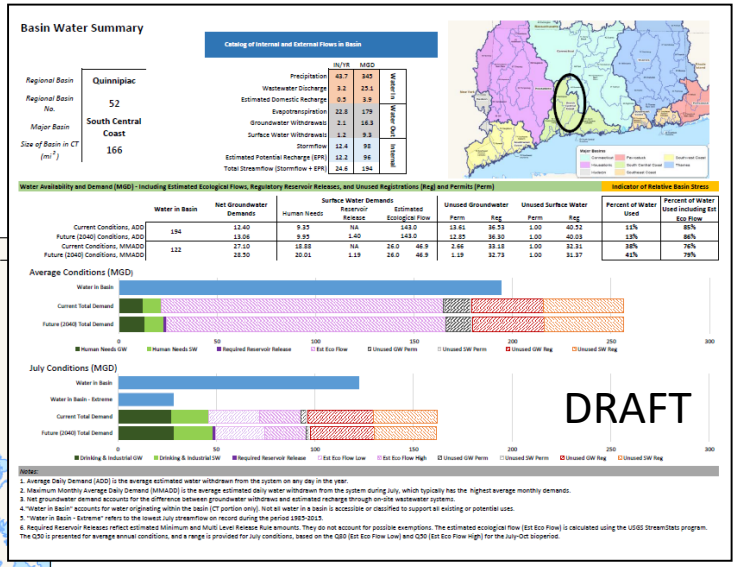

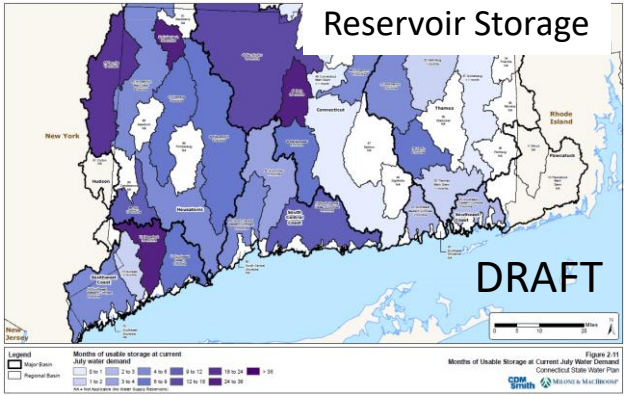

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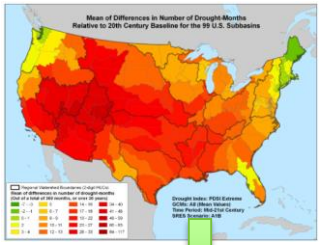
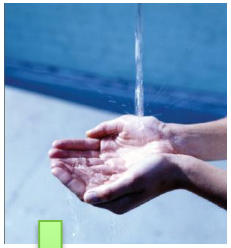
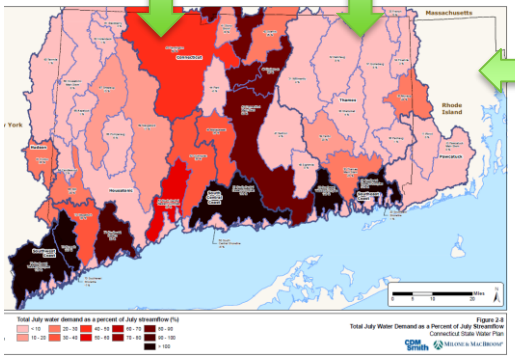
Forthcoming Technical Information

How could climate change and water conservation change these maps?

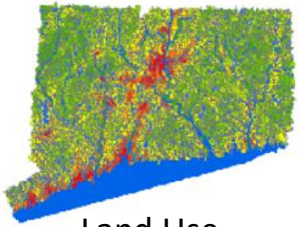






How can an improved understanding of ecological flow needs affect these maps?

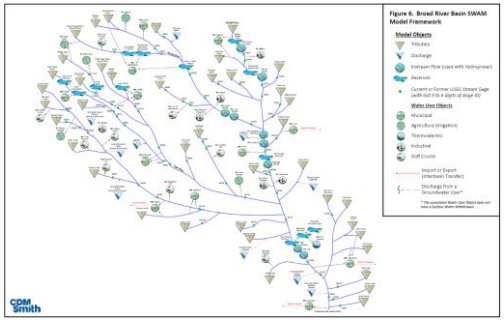
Are there other indicators of potential basin stress?



Land Use
(from CLEAR)

High Seasonal Water Use

Can models of basins help?



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Policy Recommendations

1. Land Use Practices and Protection Related to Water
2. Water Quality Impacts of Land Use
3. Water Conservation
4. Consistency with Existing State Plans
5. Monitoring for Plan Implementation
6. Agricultural Practices
7. Unused Registered Water Diversions
8. Implementation of Minimum Stream Flow Regulations
9. Outreach, Education and Public Engagement
10. Regionalization of Water Systems
11. Class B Water for Non-Potable Uses Only
12. Data Needs
13. Coordination with Water Utility Coordinating Committees (WUCCs)

- Each of these contains many specific recommendations.
- The Policy Committee is prioritizing the Top Ten policies

Pathways Forward:

Next Steps for Issues that Cannot be fully resolved now

- Conservation
- Regionalization/Interconnections
- Unused Registered Water Diversions
- Aging Infrastructure
- Economic Impacts
- Funding for Implementation
- Future Class B Water for Non-potable Uses
- Statewide Drought Planning
- Wastewater and Water Reuse
- Water Use Accounting
- Overcoming Future Challenges
- Technology Issues

- Some of these issues have agreeable aspects and have policy recommendations.

- Next Steps include:
  - Data Neets
  - Partnerships
  - Outreach

Upcoming Workshops and Public Meetings

Workshop #6

Thursday, April 20, 2017
1-5PM - *PURA*

Final Public Meeting

Thursday, April 13, 2017
1-3PM - *PURA ??*

Documents Posted to Date at http://www.ct.gov/water:

- Background white papers
- Phase I Interim Report
- Workshop and meeting presentations and summaries

Rockfall Foundation

The Connecticut Water Planning Council

State Water Plan CONNECTICUT

Connecticut State Water Plan Update

NEIWPCC New England Interstate Water Pollution Control Commission

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