

# Climate & Weather Information for Water Utilities & Stormwater Managers New England

## Connecticut Utilities - Building Resilience

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# What is resilience?

Resilience is the ability of system to **prepare** for, **withstand**, **recover** from, and **adapt** to a range of climate-related (or other) threats.

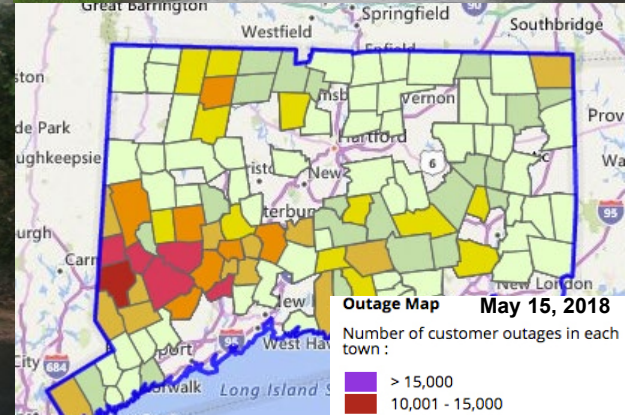
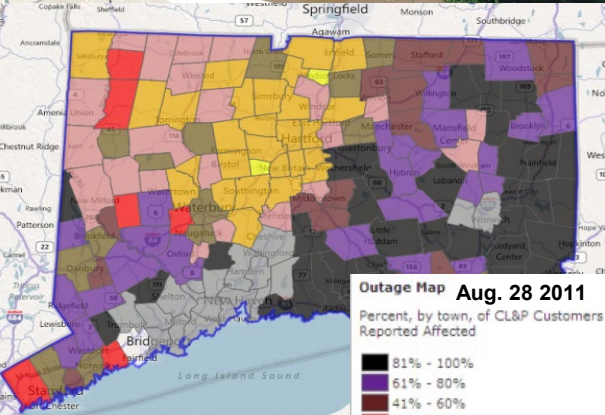
A long-term **process that balances risk and resources**, to **flexibly** prepare for, cope with, respond to, recover from, and **transform** in **anticipation** of or in response to events.

– (Comfort et al. 2010)

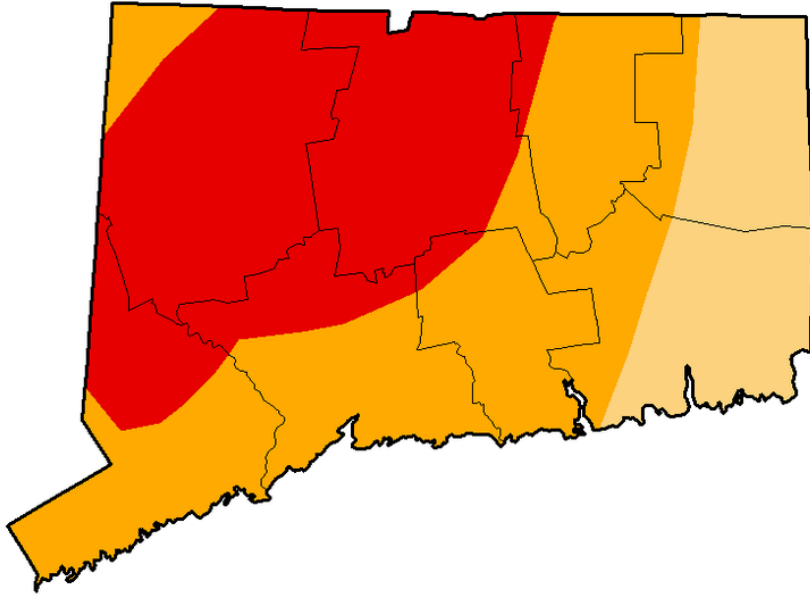
# Earliest Motivation: Sandy, Irene, & other storms



Source: PVWPCF



# Recent Motivation: Drought, water quality, etc.



Gov. Malloy: After State's First-Ever Drought Watch Issued, Residents Asked to Voluntarily Reduce Water Use When Possible

Drought Watch Issued for the First Time Ever in Six of Connecticut's Eight Counties



## Other stresses:

Demand reduction, Aging infrastructure, Workforce issues, etc.

# Climate information - changing risk

## Flood Risk

- Two times (up to 4x) more extreme precipitation
- Current 1 in 20 yr flood may occur once in every 5 yrs

## Drought Risk

- More frequent and more extreme summer droughts likely
- Current 1 in 20 yr drought may occur once every every 3-10 years by mid-century

# Overview

## Wastewater VA

- Sea level rise analysis
- Hydrologic / flooding analysis
- Legal analysis
- Spatial data gathering
- Surveys and interviews

**Output:** Pilot town resiliency plans and WW guide available at:  
<https://kirchhofflg.weebly.com/research.html>

## Water System V & Resilience

- Climate change analysis
- Private wells flood susceptibility
- Policy Analysis
- Spatial data analysis
- Surveys and interviews

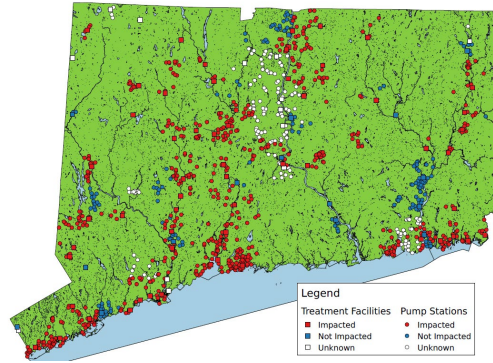
**Output:** State DW resiliency plan

<https://portal.ct.gov/DPH/Drinking-Water/DWS/Drinking-Water-Vulnerability-Assessment-and-Resilience-Plan-DWVAR-Plan>

# Approach

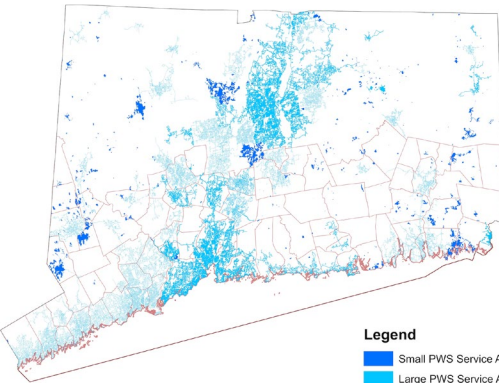
- Started with literature review (resilience, vulnerability, and adaptive capacity) as foundation for interrogating resilience, especially the human dimensions
  - Eakin et al. (2014) define two types of adaptive capacities: generic (e.g., funding, knowledge, leadership) and specific (e.g., specific interventions and capacity for intervention)
- Use social science research methods (surveys & interviews) to understand W&WW managers':
  - Experience with extreme events; changes; factors that influence learning and change; resilience perspectives and thinking

# Methods



- Surveys (n=173) & interviews (n=53) of CT wastewater (WW) and water (W) systems

- WW surveys and interviews were conducted in 2015-2016



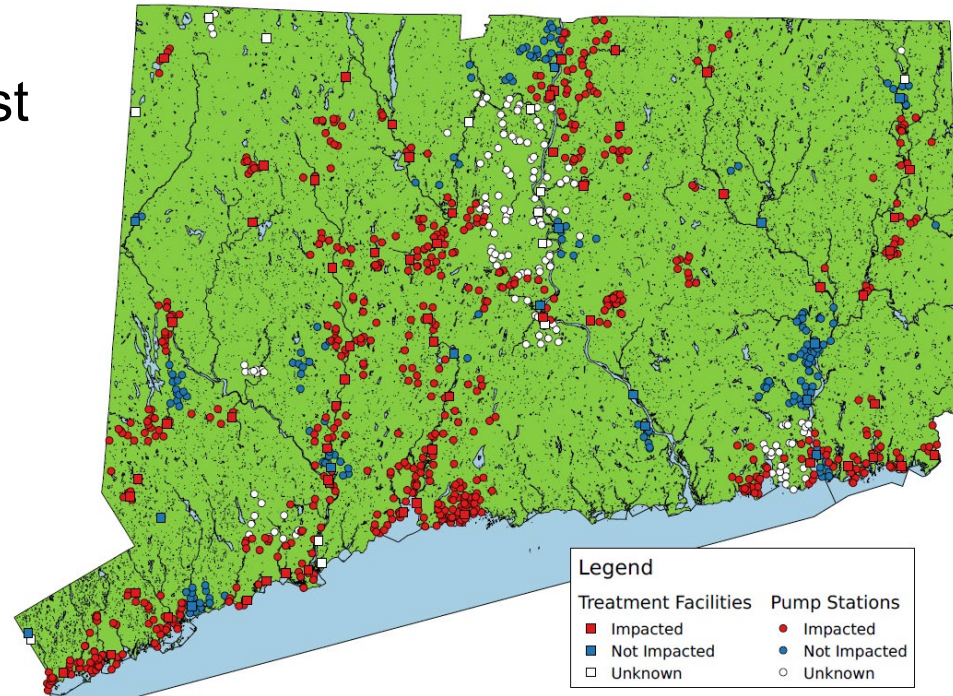
- Interviews with water managers were conducted from 2017-2018 followed by a survey in 2018



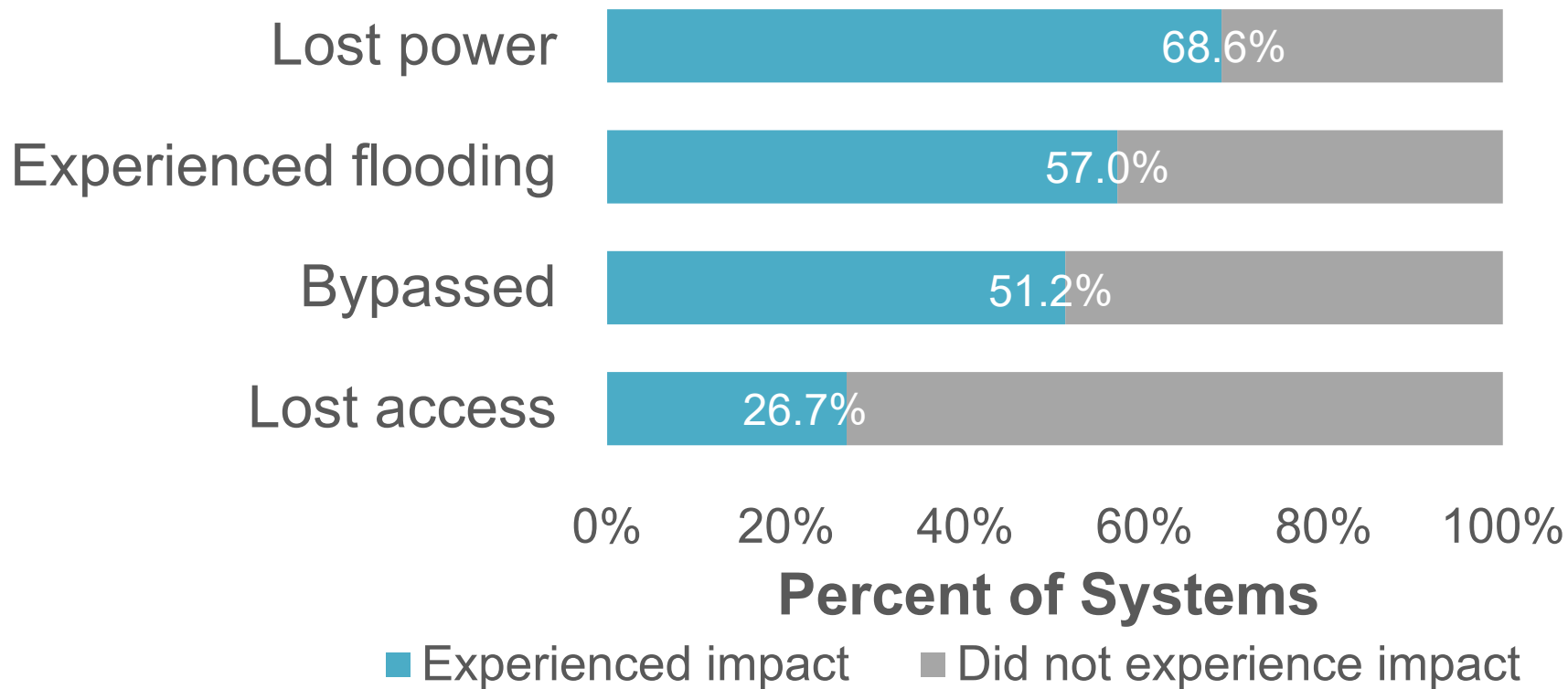
# **IMPACTS OF PAST EXTREME EVENTS**

# Most WW Systems Impacted

- 72% of respondents experienced impacts from past extreme storm events
- Large and small systems and inland and coastal systems impacted

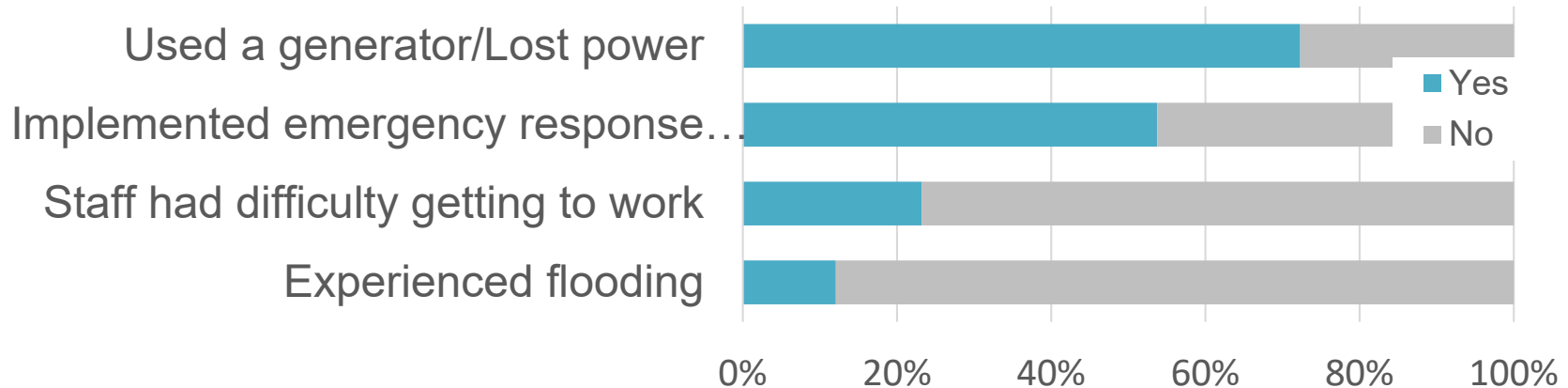


# Impacts Experienced by WW



# Storm Impacts for CWS

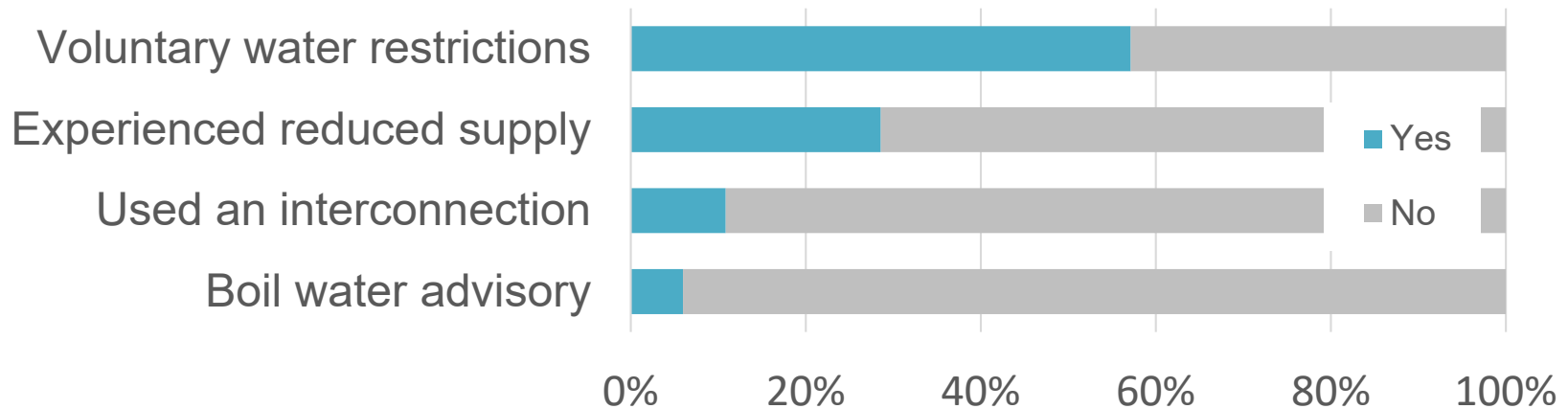
- Most systems experienced some kind of storm impact; but, storm impacts generally less severe than drought impacts



# Drought Impacts for CWS

(e.g., from 2015 – 2016 drought)

- Most systems experienced some kind of drought impact; but few experienced really severe impacts



# **RESILIENCE ACTIONS**

# Most WW Systems (>75%) Made Changes

- Some changes low cost, temporary

*“...our local machine shop made up stop gates. ...we just drop them in and it holds back the water” (S24).*



- Some are permanent & more costly

*“[W]ith the flooding ..., we lost a few generators. When we replaced them, ... we [built them up] on a cement pier using the high water mark from that [flood] event” (S09).*

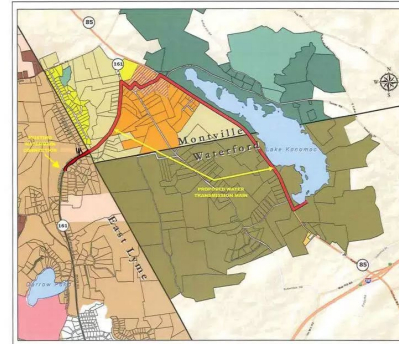


- Not only equipment but managerial and operational changes too

# CWS Actions to Prepare, Cope, Recover

- Permanent Equipment/Technology

- Backup generator
- Remote Sensing / SCADA
- Establish an interconnection
- Invest in the watershed



- Managerial and operational changes

- Revise response plans
- Educate staff
- Raise rates



# **MOTIVATION FOR CHANGE**

# WW Drivers of Change

- Experience with multiple disruptive, damaging impacts (median 3 vs. 1,  $U = 297.5$ ,  $p < 0.001$ )
- Organizational leadership including being entrusted and empowered to make decisions & creating a culture of continuous improvement
- Some (but mixed) evidence concern for future climate-related risks helps drive change

# W System Drivers of Change

- Regulatory compliance is the biggest motivator as is availability of funds (e.g., for generators)
- Climate change is not a huge driver or concern

*“...in all honesty, that [climate change] really doesn't affect us. ... As much as you know you want to say you're concerned about the environment or climate change, it's not affecting my water system.”*

*--Public utility manager*

# **RESILIENCE & RESILIENCE GAPS**

# WW Managers Want Resiliency

*“Our focus has been ... hardening facilities” to increase  
“...survivability due to extreme weather events. I think we  
basically call it, the new buzz term is, **resiliency**” (S23).*

# But, mostly resilience to the past

- Elevating equipment to at or just above past flood levels
- Incremental, reactive changes based on improving coping, recoverability of past storms
- Can get stuck – complacent, if perceived threat risk is sufficiently reduced

# Resilience to future change

- Driven mostly by new regulations requiring that CWSRF monies address expected climate change impacts

*“Our upgrade that is in the planning stages and includes one hundred plus three is driven by state requirements” (S16).*

# Resilience to future change

- Most CWS aware that climate change will bring more frequent or severe droughts and storms but only high capacity systems are thinking about these changes and only in terms of strategic (very high level) planning



# Resilience is a Human-Driven Process

- High amounts of generic adaptive capacity (e.g., leadership, experienced staff, funding, knowledge) is crucial for:
  - Fostering good day-to-day and emergency operations
  - Facilitating a culture of ongoing change & adaptive management
  - Build and deploy more and more diverse types of adaptive changes (specific adaptive capacities); ideally, within an adaptive management framework
  - Seek and use information to inform ongoing risk assessment, anticipation and proactive response

# Questions and Resources

## Acknowledgements

- Thanks to CT W and WW managers who provided their time and insight
- DPH & DEEP, MMI for collaboration and my other collaborators/co-authors

## Resources

<https://kirchhofflg.weebly.com/research.html>

<https://portal.ct.gov/DPH/Drinking-Water/DWS/Drinking-Water-Vulnerability-Assessment-and-Resilience-Plan-DWVAR-Plan>

## Contact Information

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