# Slow the Flow for Climate Resilience:

## Managing the Connecticut River Watershed in an Uncertain Future

May 17, 2018

Workshop Synthesis Report

The Center for Agriculture, Food and the Environment

NE CSC Northeast Climate Science Center

The Nature Conservancy

# Table of Contents

# Executive Summary

On May 17th, 2018, the Northeast Climate Adaptation Science Center (NE CASC), UMass Extension and The Nature Conservancy hosted the "Slow the Flow for Climate Resilience: Managing the Connecticut River Watershed in an Uncertain Future" workshop for practitioners and decision-makers interested in climate adaptation actions that mitigate anticipated extreme flows.. The workshop was the first of two planned in the northeast region. Thirty-two attendees represented organizations such as the Environmental Protection Agency, US Geological Survey, US Fish and Wildlife Service, National Weather Service, Trout Unlimited, VT Department of Conservation, MA Executive Office of Energy and Environmental Affairs, Pioneer Valley Planning Commission, and Capital Region Planning Commission. Participants broke out into discussion groups for practitioners and for policy and decision-makers to dive deeper into topics such as how they measure success and barriers to implementing actions on-the-ground. Participants will be invited to continue these discussions as part of a Slow the Flow expert work group, similar to others coordinated by UMass Extension on adaptation issues that require cross-organization cooperation. This report details the workshop proceedings, complete notes, takeaways, and next steps.

# Introduction

## What is Slow the Flow?

The slow the flow approach explores the value of increasing natural water storage in a climate-altered future where we forecast increases in both droughts and floods. Slow the flow is a lens through which management actions, including floodplain restoration or reconnection, conversion of impervious surfaces, or restoring complexity to stream channels can be integrated into multi-objective planning and integrated watershed management. These actions can also produce co-benefits for fish, wildlife, and natural resources.

## Workshop Purpose

The Northeast Climate Adaptation Science Center (NE CASC), UMass Extension and The Nature Conservancy hosted the "Slow the Flow for Climate Resilience: Managing the Connecticut River Watershed in an Uncertain Future" workshop for practitioners and decision-makers interested in climate adaptation actions that mitigate anticipated extreme flows.

The workshop provided the opportunity to:

- Build a community to explore this topic
- Learn from each other's work on policy and practice
- Consider how to get the most adaptation value from our management actions
- Identify existing resources and expertise from the NE CASC
- Assess interest in and the potential objectives of an expert work group to collaboratively continue the conversation moving forward

Topics for discussion included:

- Barriers and challenges to implementing the slow the flow approach
- Identification of management actions and metrics for measuring success
- Communication of the value of integrated watershed management using a slow the flow framework

# Workshop Agenda

**Slow the Flow for Climate Resilience:**

***Managing the Connecticut River Watershed in an Uncertain Future***

***UMass Amherst, John Olver Design Building, Room 170***

***May 17, 2018***

---

| | |
|---|---|
| 10:00 | Morning Refreshments & Networking |
| 10:30 | Welcome, Overview of Day & Goals |
| 10:35 | **Rick Palmer**, UMass Amherst & Northeast Climate Science Center, *Climate and hydrologic changes in the Connecticut Basin, Unexpected things to begin to expect*<br>**Keith Nislow**, US Forest Service & Northeast Climate Science Center, *Slowing the Flow for Climate Resilience* |
| 11:15 | **Scott Jackson**, UMass Amherst & UMass Extension,<br>*Case study on road-stream crossings*<br>**Kim Lutz**, The Nature Conservancy,<br>*Case study on floodplain reconnection* |
| 11:45 | Report Out on Workshop Pre-Survey Results |
| 11:55 | Group Discussion & Introductions |
| 12:30 | Networking Lunch (provided) |
| 1:15 | Breakout Discussions - Practitioners & Policy and Decision-Makers |
| 2:20 | Group Discussion<br>How to Advance Together<br>Work Group Transition |
| 3:00 | Closing & Next Steps |
| 3:15 | Evaluations |

The Center for Agriculture, Food and the Environment

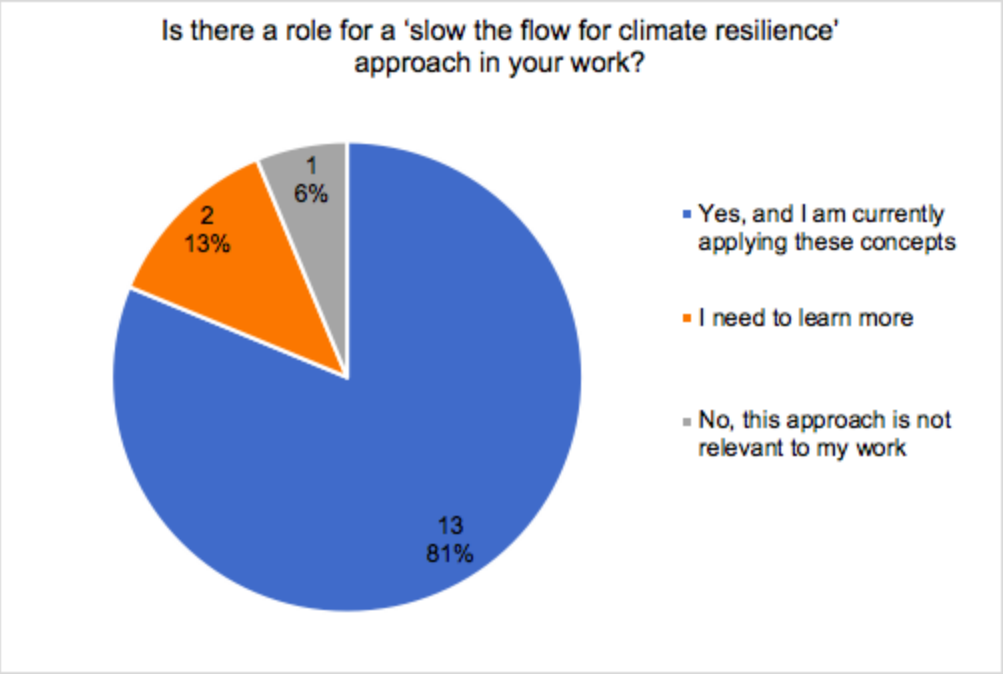
NE CSC Northeast Climate Science Center

The Nature Conservancy

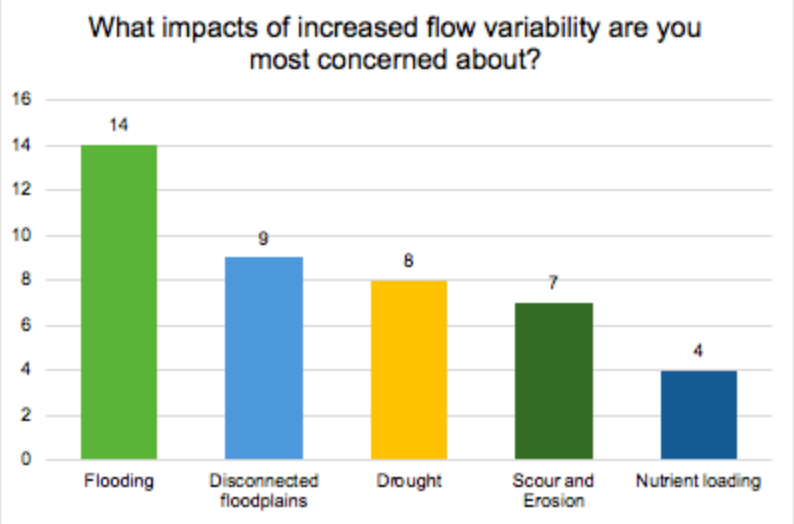
# Summary of Pre-Survey Responses

Prior to the workshop, a pre-survey was sent to invited workshop participants to gather information to guide the workshop discussions, particularly for use in the breakout discussions. The survey consisted of 6 questions. The 16 respondents included workshop attendees as well as others unable to attend. Survey questions and responses are summarized below.

*Question 1:* Is there a role for a 'slow the flow for climate resilience' approach in your work?




*Question 2:* What impacts of increased flow variability are you most concerned about?




*Questions 3 & 4:* Management Actions & Linked Metrics .

3. What management strategies, actions, or interventions are you currently using to address the impacts of extreme flow variability due to climate change?

4. What metrics do you use to evaluate success of the above activities, if applicable?

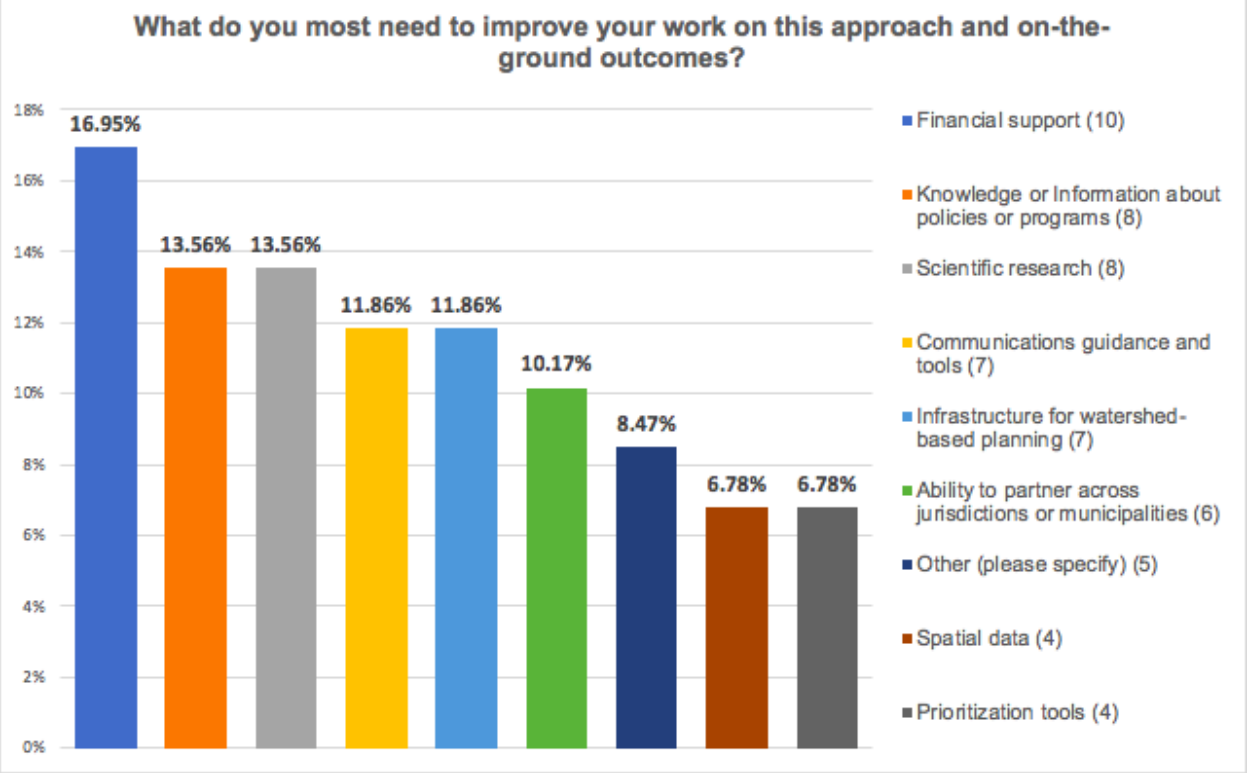
| 3. Management Actions | 4. Linked Metrics |
|---|---|
| | |
| ***Conservation, restoration and connectivity*** | |
| wetlands conservation | acres protected |
| floodplain and river corridor conservation | lateral, longitudinal, vertical, and temporal connectivity |
| floodplain restoration | acres restored; natural erosion and deposition processes |
| reconnecting floodplains | reduced flood extent and damages |
| aquatic connectivity/reconnection | Stream Equilibrium |
| dam removal | |
| culvert replacement | |
| | |
| ***Green Infrastructure and Stormwater Management*** | |
| increase surface storage | |
| increase filtration | |
| upland habitat protection & restoration for infiltration | acres protected / restored |
| best management practice (BMP) implementation | # gallons captured / treated |
| impervious cover (IC) disconnection | |
| | |
| ***Instream Projects*** | |
| increase instream wood | evidence of overland flow on floodplains; natural sediment sorting; in-stream habitat diversity/stream depth heterogeneity |
| engineered log jams for bank stabilization | reduced bank failure / maintain stability |
| manage riparian forests to improve woody recruitment over time | natural woody material recruitment |
| | |
| ***Landowner and Public Outreach*** | |
| work with landowners to restore floodplain habitat/function | municipalities enrolled in Community Rating System; floodplain regulations enacted |
| public outreach | |
| | |
| ***Decision making, Policy making and Regulatory Activity*** | |
| encouraging towns to adopt LID regulations | |
| updating land use regulations | |
| municipal zoning for river corridor protection | # towns with zoning protections |
| facilitate municipal protection and restoration of floodplains | |
| work with different levels of govt and | pre/Post Survey |

| | |
|---|---|
| stakeholders to develop supportive and viable policy approaches | |
| supporting towns' and land trusts' efforts to secure grant funding for open space preservation | annual report of # of grants awarded for which we have written letter of support |
| creating decision-support relationships -scientist and manager | |
| encouraging science-based decision making | |
| | |
| ***Best Available Science and Data*** | |
| use geomorphic based assessments and analysis | |
| update FEMA | |
| include conservative estimates and margins of safety included in flow frequency estimates | |
| data-driven increases in design storm depths where possible | |
| | ***Additional Metrics Used*** |
| | ratio between high and low flows |
| | 7Q10 |
| | mean August flows |
| | peak CFSM flows |
| | statistics |
| | long-term monitoring |
| | models |

*Question 5:* What are the barriers to implementing management actions or interventions?

| **5. Challenges to Implementation** |
|---|
| |
| ***Lack of funding*** |
| funding or costs, conservation and buyout funding* *7 responses* |
| |
| ***Lack of our own time and capacity*** |
| staff time |
| reaching each municipality where it is and tailoring solutions to their particular needs and challenge |
| |
| ***Lack necessary approach*** |
| watershed approach |
| interdisciplinary teams |
| need for different management approach |
| |
| ***Lack of awareness or understanding by decision makers and managers*** |
| getting attention of policy makers and advocates |
| lack of understanding/appreciation |
| decisionmakers don't value science |
| managers in damage control mode |
| |
| ***Landowner-related barriers*** |
| property rights / takings, concern of private landowners about property rights |
| landowners willing to reconnect floodplain |
| lack of compelling package to offer landowner |
| |
| ***Lack of scientific information and spatial data*** |
| lack of integrated research, models, and data |
| lack of downscaled projections and hydrological analysis to decision making at a local level |
| |
| ***Lack of trained experts and expertise*** |
| proper engineering/design and availability of qualified engineers |
| availability of contractors trained in in-stream work and protection |
| |
| ***Regulatory or permitting issues*** |
| permitting |
| out-dated regulatory programs |
| options for inclusion are sometimes limited by establish rule and regulatory framework |
| insufficient land use regulation of new encroachments |
| |
| ***Space issues*** |
| limited space |
| existing river and floodplain encroachments |

*Question 6:* What do you most need to improve your work on this approach and on-the-ground outcomes? Check all that apply. "Other" includes ease of access to flood insurance claim information, clarity about policymakers' and stakeholders' priorities for research, long-term monitoring of core ecological and socio-economic factors controlling change, short range versus long range planning, and better statutory authority and land use rules. Number of responses is reported in parentheses.




# Links to products referenced in presentations

- SCE.ecosheds.org
  - This interactive tool helps locate road-stream crossings. It can be used to locate and prioritize stream crossings that meet user defined criteria such as ecological disruption or transportation vulnerability. This pilot version only includes data from the Deerfield Watershed in MA. An expanded 13-state version is being developed with existing data on the ecological attributes. Presented at the workshop by Scott Jackson.
- Climate projections
  - These climate reports by the NE CASC provide data on states across the Northeast and Midwest. They consider how the climate of a given state may change by the time the annual mean global temperature reaches 3.6ºF above pre-industrial levels. Links to individual states can be found here. Referenced by Richard Palmer.
- "Sustainable Floodplains Through Large-Scale Reconnection to Rivers"
  - This article was written by Jeffrey J. Opperman, Gerald E. Galloway, Joseph Fargione, Jeffrey F. Mount, Brian D. Richter and Silvia Secchi and published in 2009 in *Science* magazine. Referenced by Richard Palmer.
- UMass Riversmart Recommendations for Policymakers

    - A compilation of publications for policymakers including the 2016 RiverSmart Policy Recommendations Report. Shared by Eve Vogel.
- "Science to Inform Management of Floodplain Conservation Lands under Non-Stationary Conditions"
    - This project explores what floodplain managers along the Mississippi and Missouri Rivers identify as the information most needed to understand non-stationary conditions. The report includes data and tools developed to apply to conservation lands to improve decision making. Referenced by Keith Nislow.
- "Reconnecting Floodplains and Restoring Green Space as a Management Strategy to Minimize Risk and Increase Resilience in the Context of Climate and Landscape Change"
    - This research identifies opportunities for long-term river flow management, connectivity, and landscaping to support human communities and ecosystems. Referenced and written by Keith Nislow, Cathy Bozek, Kathryn Kennedy, Kim Lutz, and Christian O. Marks.
- "Restoring Floodplains in the Connecticut River Basin: A Flood Management Strategy"
    - Abigail Ericson's thesis investigates how changes to floodplains in the Connecticut River Basin impact flood events. Referenced by Keith Nislow and Richard Palmer.
- Massachusetts Ecosystem Climate Adaptation Network (Mass ECAN)
    - A community of practice for climate adaptation practitioners and researchers interested in ecosystem resilience and natural resources conservation and working in Massachusetts. Coordinated by UMass Extension and referenced by Melissa Ocana.
- Connecticut River Flow Restoration Study
    - This is a watershed-scale assessment of the potential for flow restoration through dam re-operation. The study examined whether operational changes at the watershed's largest dams could restore more natural flow patterns, creating environmental benefits, while maintaining important services, including drinking water, flood management, and hydropower. The study focused on 14 flood-management dams operated by the USACE. Other partners included the U.S. Geological Survey, UMass Amherst's Dept. of Environmental and Water Resource Engineering, and USACE Hydrologic Engineering Center. A study overview can be found here. Referenced by Kim Lutz.

# Takeaways

**Overarching themes from notes**
This workshop generated thoughtful discussion; common threads from that discussion that were highlighted as takeaways include:

Climate change

- Climate change is adding variability to an already variable system of flows
- This additionality means that we may need to go above and beyond our current efforts or be better coordinated at the watershed-scale
- The NE CASC and partners have some existing resources and climate projections that could be useful for practitioners and policymakers

Metrics, Prioritization, and On-the-ground work

- Can we learn from what has been done around water quality (metrics, policies) and apply some of that to water quantity issues?
- Interest in identifying common metrics but if common metrics are difficult to find,
    - common frameworks are still valuable
    - being able to discuss trade-offs still important
- Financial indicators and metrics are useful motivators for change
- Importance of considering co-benefits
- Additional tool or model development to visualize different management actions in different locations as a way to set priorities
- Do we need to shift from just opportunistic to more strategic and prioritized implementation of actions?
- Can we manage conserved lands to increase storage?

Communications

- Compelling storytelling is essential to conveying the importance of this work
- We need to change culture and understanding about the actions that are needed to mitigate extreme flows in a changing climate, with landowners and policy makers, in particular
- Loop in others (i.e. legislators, government officials, etc.) to communicate the need for slow the flow related policy change and action -- peer-to-peer contact is impactful
- Social media can be a useful tool to highlight these issues

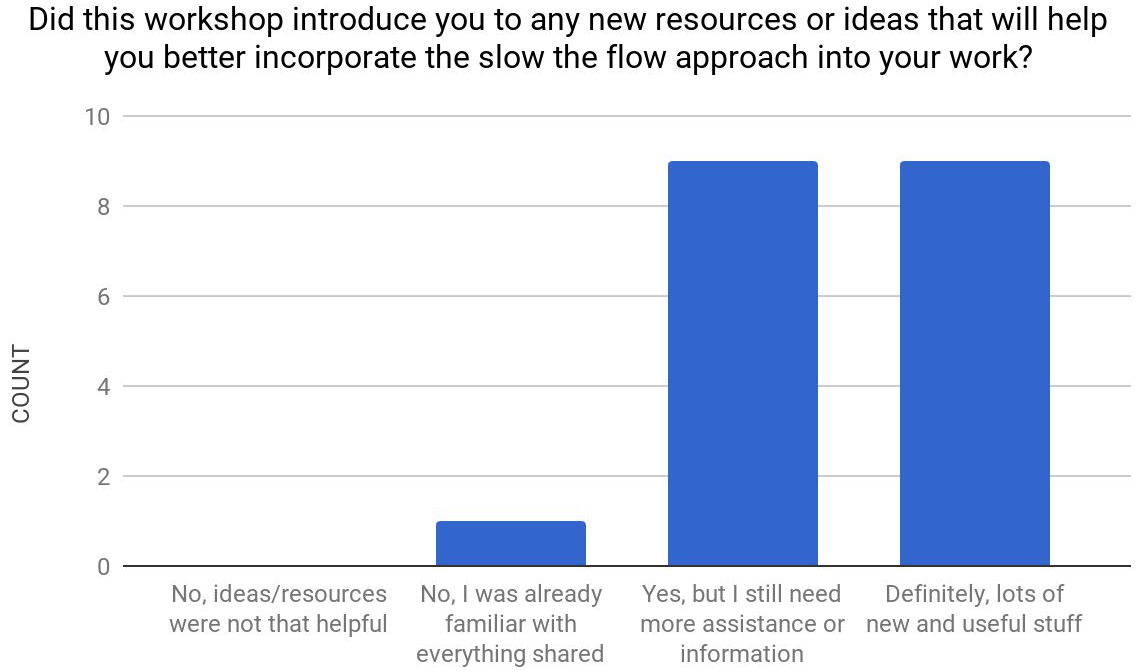
Moving forward together in a coordinated way

- What are best practices for fundraising for green infrastructure and flood protection methods?
- There was interest in continuing to discuss and collaborate on slow the flow efforts
- Importance of watershed-based/level planning
    - There is little inter-state work being done, but a lot of opportunity
- Benefit of having a common framework and plan in place for easier collaboration and progress across multiple stakeholders, towns, and organizations
- Interest and benefit of having more cooperation among towns and organizations for broader (e.g. watershed level) effect

**Feedback on workshop**

Based on workshop evaluations, the first Slow the Flow workshop was a success. At the end of the workshop, participants were asked to evaluate the event. In total, 18 attendees submitted evaluations. The number of respondents was split evenly between the Practitioner breakout group and the Policy & Decision Maker breakout group. Some results from the evaluations are excerpted below. All of the information received will be useful in planning future workshops and advancing next steps.

*Figure 1:* Did this workshop introduce you to any new resources or ideas that will help you better incorporate the slow the flow approach into your work?




Respondents found the morning presentations particularly useful. Respondents noted that the presentations provided new or confirmed climate projections for the area and introduced the newly developed and publicly available *Stream Crossings Explorer* site sce.ecosheds.org.

Breakout sessions were an integral part of the workshop. Overall, attendees responded positively to the breakout sessions. Some attendees found it difficult to select which breakout (Practitioner or Policy & Decision Maker) to attend. We realize that many attendees did not fit squarely into one group or the other and thank everyone for participating. One respondent critiqued the 1.5 hour breakout sessions was too short. Three respondents wrote that the breakout sessions allowed for more detailed attention to the challenges, successes and opportunities for improvement.

Every respondent reported meeting a new colleague or potential collaborator at the workshop.

# Next Steps

**Infographic**

Workshop participants emphasized the importance of being able to tell a compelling story about the slow the flow framework. We are working with a graphic designer to create an infographic to help visualize and translate these concepts to be more accessible to a general audience. We anticipate having a draft infographic ready in early Fall. We will post the infographic on the project webpage, as we have been with all other workshop outputs.

**Upcoming Coastal Workshop**

A similar workshop is being organized for coastal practitioners and decision-makers from Northeast coastal states and the Great Lakes. The date and locations are still being finalized but, at the least, there

will a location on the Coast of Massachusetts in October 2018. This hybrid workshop will address what these two regions can learn from each other as they tackle the slow the flow framework for water as well as nutrients.

**Expert Work Group**

Acknowledging that there is only so much that can be accomplished in a one-day workshop, that many attendees have been working on slow the flow-related initiatives for many years, and that our time together was only a small step in a larger needed effort, we propose creating a Slow the Flow expert work group growing out the discussions at this and the upcoming coastal workshop.

UMass Extension is coordinating a number of ad-hoc expert work groups to address complex climate adaptation issues that require cross-organization cooperation. Work groups are lead by experts working on the issue in Massachusetts, but often have regional contributors from neighboring states.

Each group decides what to tackle together, but activities may include:

- Increasing coordination and collaboration
- Assessing vulnerability
- Creating adaptation actions or plans
- Setting strategic research agenda
- Working on barriers to implementation
- Seeking funding together for on-the-ground projects or research

We anticipate that the Slow the Flow work group will kick off later this year, after the Fall coastal workshop. Workshop attendees will be invited to be part of this group or to just be kept aware of outputs. The proposed scope for this group will be based on the workshops, with the experts ultimately deciding what body of work to pursue.

A closely related work group on Mainstreaming Nature Based Solutions is also starting this year and we will keep interested workshop attendees updated on that as well. Nature Based Solutions (NBS) incorporate and/or use natural systems, mimic natural processes, or work in tandem with traditional approaches to address natural hazards. Some attendees may feel better suited as experts on that work group and will be invited to join. The NBS group is anticipated to be bigger picture than the Slow the Flow group. It will explore the barriers to statewide adoption of these practices as strategies for achieving climate resilience and make recommendations for overcoming common obstacles. For those working in Massachusetts, the easiest way to stay updated on all the expert work groups is to join the Mass ECAN community of practice.

# Appendix A. Complete Workshop Notes

---



---

## Morning Presentations

- See presentations here (scroll to bottom of page). The following are recorded questions on the presentations.
- Palmer: *Climate and hydrologic changes in the CT Basin, Unexpected things to begin to expect*
    - Q: How do we handle/incorporate snow cap in the model?
        - A: Quite well!
- Nislow: *Slowing the Flow for Climate Resilience*
    - Q: Any thoughts on scaling up & quantifying potential impacts?
        - A: Yes. The principle is similar to case study but will take more time and resources. Hoping to generate models to apply to larger and smaller scale projects
- Jackson: *Case study on road stream crossings*
    - Q: Could the model account for a culvert that is relatively newly built but undersized hydrologically?
        - A: A culvert that is newly built would probably have low structural risk of failure but if undersized, could have high risk of failure for geomorphic or hydraulic, which you can see in the tool. But, this is one tool, but not the end all.
    - Q: Is this model only useful for small regions?
        - A: Next step is working with collaborators to expand its reach. This current version is just for the Deerfield Watershed MA.
    - Q: Is it possible to look into problem with culverts getting washed out in high flows (or different flow levels)?
        - A: The SCE tool includes risk of failure data for the Deerfield Watershed, including hydraulic risk (based on flows and that can result in overtopping of roads and culverts washing away) for mid and end of century.
    - Q: Does the model incorporate not just whether there is or isn't impervious surfaces, but where they are located in relation to water?
        - A: There is a data layer weighting culvert importance based on proximity to water.
    - Q: How can we access information behind this map? Eg. for future projections of site building?

        - A: Source information is available on the site.
- Lutz: *Case study on Floodplain Reconnection*
    - Q: Looked at planning with municipalities on locations where floods hit hardest--saw connections to environmental justice.
        - A: The science community can do more look into who is hit hardest during floods. Presenting the cross sections included in environmental justice might yield increased collaboration and *ideally* funding.
- Jackson: *Framing the Challenges*
    - Comment: on "Watershed position" = your take on the problem and subsequent management actions depends on your position in the watershed (e.g. upstream vs. downstream effects)
    - Q: How do management actions and conservation tags connect?
        - Noted relationship between land use and changing water storage (increasing droughts and floods)

## Practitioner Breakout Notes

Facilitated by Scott Jackson.

Introduction: The discussion revolved around three questions as a starting point:

1) Common currency: How do we measure and compare impacts/benefits?

2) Context: Priorities need to be spatially explicit

3) Which other barriers to implementation would the group like to discuss (from the survey responses or earlier discussion)

1 & 2)

- Does anyone know of a watershed-based initiative that has good metrics for evaluating success toward goals?
    - VT – document river miles opened for passage, acres of restoration
    - Larger scale initiatives, like Great Lakes or Chesapeake Basin restoration. Focused on metrics – implementation – how much stormwater is this action going to store? EPA hadn't been satisfied with relationship being given previously and has asked for additional metrics.
- Where are we in terms of demand for kinds of metrics? Where would we like to be?
    - Have to document lbs of P or N reduced
        - Every practice is linked to lbs of nutrients to meet TMDLs (VT has for P, not N)
        - Stormwater, agriculture, and road practices are linked
        - Not required to actually monitor nutrients
        - Maintenance/operations and management agreement required
    - Difficult paradigm shift to go from gray to green infrastructure
        - learning curve as it requires more soil science than regular engineering backgrounds, for example
        - Hard for municipal practitioners to implement green infrastructure
    - Why might it be better to not be required to monitor?
        - 303d is way to determine success. See Berry Brook UNH Center report - they saw changes and benefits at watershed scale.

        - Difficult to monitor! Just before Ms4 discharges, the flow regime is very turbulent. Can't ask municipal practitioners to monitor because of complexity of physical and chemical monitoring, such as in situ monitoring probes to get N right off the sensor. Fundamentally, the cost is so high and resource intensive.
    - Alternatively, require good models to estimate impact (if too hard to actually measure). Need data to parameterize models.
- What's already in place and what's needed in terms of metrics and monitoring?
    - N and P already have common currency, does that exist for slow the flow?
    - Square feet of impervious surfaces vs linear feet restored, etc.
    - Parameter in model - Manning's N measures roughness at different intervals – in situ measurements and could gauge within stream or watershed
    - Decision support model, put in BMPs, run over 10 yrs, flow on flow duration curve - model reference attaining watersheds and compare to urban ones, run model with all changes plan to make until matches. Measuring discharge and flow. Volume/sq mile
    - MA and CT state agencies are partnering with USGS to get sampling going at key stream gauges – Connecticut River mainstream - including in situ sensors. Considering if the Clean Water Act make any difference for Long Island sound? Yes, can look at point sources.
    - As of 3 months ago, MA funding supergauge at VT, NH, MA line in Northfield to measure flow
- How might we apply what's been done on water quality to water quantity question?
    - Trying to shift hydrograph – how the water goes by makes a difference (same amount of water)
        - Where to express/know hydrograph? Many mouths along the way
            - Basin and the node (infrastructure)
            - Measure as comes into the node if interested infrastructure resilience as consequence of other actions
    - In Abigail and Rick's study, they change roughness values and transient storage in models and reflect in deviation from some reference hydrograph
        - Links actions to metrics
        - Deviation to a future predicted hydrograph
        - Reference basin
        - Integrative metric of actions– some could be increasing storage, roughness
        - Picked a range of recurrence interval floods to model because different and potentially nonlinear over size of floods, if get into the floodplain
    - Reconsider – not just thinking about same amount of water and how does it flow – but if increase evaporation transpiration or interception could be removing water. So, volume of water could be a metric especially in upper watershed (where may want to infiltrate into ground)
- What else to consider in terms of metrics?
    - Metrics specific for project area as well
        - If do 15 acre floodplain restoration – how much water holding back?
    - Understanding upstream and downstream tradeoffs
    - Elevation gradient (whether a project is located in the headwaters or further down in the watershed. Storage in the headwaters provides an added benefit of supplementing base flow during dry periods.)

- Metrics of how project contributes to bigger watershed picture
- If trying to propose an action, do you need full model that shows increasing x roughness in trib a does y to hydrograph. Or you have x increase in roughness. Or x increase in storage. With storage can express as proportion of predicted annual flow.
- A log jam could slow flow and create scour, but if placed at entrance of floodplain so flow moves there sooner then it is both roughness and storage.
- Other alternatives exist downstream – raising houses or moving people out of the way

Moving into a discussion of tools--

- How to pick best project for biggest bang with limited funding available?
  - Creating a tool that allows optimization – in this watershed, you create wetlands, connect floodplains, restore forest, etc., where you can rank in each category. But how do we try to compare between practices?
  - Could look at co-benefits – if do wetland get storage, habitat, etc. vs If do stormwater pond, you get x,y, z benefits.
- How to get commitment from town to put in $x to match funding that state can provide?
  - There need to be identified benefits to community
- How to know if table of actions are enough?
  - Evaluate options but want to know cumulatively if they'll be enough 50 years down the road
  - Progress in huge waterbody is so incremental
- Good to acknowledge multiple benefits and consequences.
- Always some level of uncertainty in whatever the metric is (deviation from hydrograph or storage). When there is uncertainty, can fall back on other measures.
- Finescale lidar coverage becoming available – maybe can do modeling at finer scale than thought possible
- How can tools evolve to accommodate metrics?
  - Since not constant, may be difficult because increased precipitation may make changes hard to see (notwithstanding the increase in precipitation)
    - E.g., Stream river height per 5 inch rain event
    - Modelled 5 inch storm versus actual because in Feb different from Aug or when groundwater levels high
    - In what units?
  - Could use a combination of a) changing the shape of the hydrograph (e.g. make it flatter) and b) establish a threshold with a goal to keep peak flows below that threshold. But, can only do at certain places?
  - Also, can quantify at source where action taken and see amount of water lost
  - What is a good metric of delay? Roughness? Gallons or cubic feet.
  - Maximum reduction in peak discharge per acre of land
  - But what about drought? The amount of water you can put into the ground is important for drought
  - National Climate Change Wildlife Science Center (USGS) – initiative on ecological drought – some indications that we may be seeing more drought in Northeast
  - Using one set of metrics as intention – correlaries or consequences
  - Peak flows as one example – what does that mean for the rest of the hydrograph including the low flow hydrograph?

- Base flow fraction - what of flow can be attributed to base flow in National Land Cover Dataset?
- Flood management about replenishing groundwater stores that are contributing to the stream

3) Impediments to moving forward –
- Lack data and modeling to show impacts
- Need landowner buy in to having land flooded or wood in stream
  - Being able to tell story of impacts and alternatives in a conversation
  - Part of big picture – including explanation of downstream beneficiaries
- Changing perceptions of what's good for the system
- Who's responsible for taking this on?
- Winners and Losers: How downstream can incentivize upstream
- Myopic focus on water quality, but stormwater and flow not as considered. If get the flow, you'll get the water quality.
- Heat island relations to impervious cover.
- UMass Extension also starting a Mainstreaming NBS work group that is complementary to this topic -- focused on how to make nature based solutions more of a default and increase their adoption by identifying barriers and potential solutions through policy, cultural change, education, etc.
- Connections to other ecological aspects of filtration and groundwater
  - Not just about drinking water
  - What about species of concern that are losing habitat? Such as Bicknell's Thrush losing hemlock tree species that require moister soil – can you do LID on mountaintops? Look for compelling stories.
- How to value actions in terms of climate adaptation? Does it help sell actions? Is that a barrier or opportunity?
  - If focus isn't just on restoring hydrograph, but on mitigating potential change – then more on difference than actual storage number – more on how much in relation to some climate-predicted volume or hydrograph
  - Conservation of existing services that hydrograph in current form provide
  - Potential added value of actions with prospect of climate change
- What can agencies do with land that they own?
  - This land is probably already in good shape
  - May need to go beyond restoring to compensate for extra water.
  - Maybe more in-stream flow work on state and private conservation lands to increase sinuosity and wood
  - Opportunities to manage for retaining water in the upper watersheds.
  - Some of this is radical because normally just leave it, don't touch it, will be fine. Gets to agency culture.
- Economy of scale -
  - Quantity of green infrastructure needed to actually compare to gray infrastructure – whatever ecosystem service talk about - where can put in 1000 versus one at a time.
  - Restoration is expensive. How can we bring down cost of restoration?
- How can we avoid the need for some of this work through preservation?

# Policy and Decision Maker Breakout Group Notes

Facilitated by Kim Lutz (lead) and Richard Palmer

Introduction: The discussion revolved around three questions:

1. What metrics are important for policy making?
2. Who is responsible for institutional planning?
3. What have been successful communication/collaboration strategies?

**What metrics are important for policy making?**

- Benefit Cost Analysis
- The issue, not necessarily the metric, needs to be promoted outside of interested policy makers
- Emotions, not science, to build momentum for increased impact
    - Need to keep the image of these disasters (i.e. Irene, Sandy) fresh in order to elevate the issue to something people still notice
- How are people impacted in emergencies? Understanding the human dimension motivates action

- Question isn't necessarily what metrics, but what tools are necessary?
- Sometimes you can't find common currency, but you can find common framework
- Would there be a metric/indicator to entice a town downstream to invest money in upstream town resource (for inevitable downstream protection)?
    - Right now there is no mechanism to allow a town to purchase land in another town (say upstream). Could a town bond help secure such land for increased flood protection?
- VT recently installed policy where state forgives debt if municipality invests in flood protection approach. The debt forgiveness would cancel out any cost for protection investment. The program doesn't have a name yet but it's part of the state revolving loan fund.
    - If emergency relief and disaster funds are needed, funds may be
        - 75% federally sourced
        - 25% state/municipality sourced
        - Pros:
            - If the town employs more natural infrastructure, the state will pick up more of the cost.
            - Reduced interest in state loan incentive
    - The bill passed easily in VT, partly with help of one excellent delegate
    - The bill incentivizes localities into making these flood security changes
    - Look at http://floodready.vermont.gov/ to see the metrics used to calculate costs and benefits
    - Was the state ready to jump on this bill because of Irene?
        - Irene helped, but we'd been moving in that direction before Irene.

- Through WaterSMART initiative, USGS has just started to put stream pressure transducer gauges on streams around the country, so it would be great to find out how to link with others employing stream gauges and pressure transducers.

    - Installation of pressure transducers are a relatively inexpensive way to gather data on flood flow
    - There may be opportunity to link USGS gauges and data to others using stream gauges. The Nature Conservancy has started looking into stream gauges in the CT watershed.

- While we have seen more frequent and severe flooding, we are also experiencing more regular droughts in Connecticut. How have others measured drought and its related problems?
    - Rick Palmer's group at UMass assesses the damage function at different areas in different flows. You could probably do a similar thing with drought modeling.

- How do we normalize the cost on people?

- From a climate adaptation perspective, did modeling take into account projections of floodplain restoration?
    - After hurricane Sandy, there was a lot more reporting from US Fish & Wildlife Service on coastal restoration projects across states hit hard.
    - It was incredible to see the change in new culverts on the drive down (to UMass) from White Mountains. So much more robust, seemingly post-Irene.
    - Post-Sandy + Post-Irene, many towns are doing work but are they coordinating at all? No.

**Who is responsible for institutional planning**

- Who could/do we need to implement slow the flow at the watershed level?

- In our [small] town [in NH], since Irene, we've rebuilt a lot of water crossing structures to old standards. It's a cost thing and an old-school thing. They don't want new crossings and probably can't/don't want to pay for new crossings.

- The Salmon River watershed (CT) spans several municipalities. How do municipalities in different states rally funding/interest in projects?
    - We rely on cooperative frameworks because we can't tax, build, etc. upstream (for example) to protect our town downstream if upstream is a different town
    - Cooperation. District technical assistance that can be used.
    - We've been working on town models that can relate to other town models for a fuller picture.

- Engineers hired by municipalities were brought together in workshops along with others- broad thinking people and those with niche focuses. We brought together not just the regulars but new voices and perspectives, which was a big boon. This came about not as a focal point but because of ongoing concerns about clean water.
    - Has this happened anywhere else in New England?
    - The Salmon River Watershed Partnership is a collaborative effort across 10 CT towns developed with the help of The Nature Conservancy.
        - Multiple actors are needed

        - NGOs such as TNC, Kestrel bringing legislators and decisionmakers together
        - At municipal level, capitalize improvement plans
- The Massachusetts Statewide Stormwater Coalition is made up of approximately 90 towns with the goals of sharing tools, managing costs, and improving collaboration across watersheds/ the state

- Salmon River has started something in the last few years. The municipal collaboration was not as ad hoc as in Connecticut but a bit formalized in terms of contributors
- Any stories from across states?
    - The Pioneer Valley Planning Commission (PVPC) initiated the Connecticut River Stormwater Committee.
    - NOAA multi-state study
- Opportunities for storm water permits (MS4) to suggest what decision makers might do to be more resilient

**What have been successful communication/collaboration strategies?**

- Asking questions about cohesion across agencies...are the same policies/programs baked in across municipalities?
- How do we change our communication (and associated metrics) to work in this specific political climate or generally in a political climate that does not favor environmental protection (or specifically climate change related policy, flood policy, etc)?
- We targeted a MA state legislator who lived in a town with a dam that was on the verge of falling to help take on dam restoration and safety...Strike before disaster strikes!
- How to create opportunities for cross-town and cross-state collaboration for a watershed level approach
    - Developing relationships across municipalities in watershed
    - COGs/RPAs build on existing cooperative efforts
    - Local technical assistance from state to get together for increased assistance and resource/information sharing
    - Model regulations for towns instead of each needing to create them on their own
    - Salmon River Partnership example
    - Conservation commissions/ Chief executive in municipalities
- Make direct connection to what people value and want
    - Recreation
    - View shed
- Who is telling the stories is critical...not just the old folks involved, i.e. the ecofriends...how do we get the key politicians, individuals, popular media. Peer to peer contact is impactful.
- Also important to create the space for communication. I went to a friendly mayor to see about hosting a comfortable environment for having these conversations.
- And use social media!

## Wrap-Up

**Kim report back**

Metrics

- Importance of telling the human story – metrics in service of storytelling
- Importance of financial metrics
    - Detailed costs of avoided damages
    - VT is using financial benefits
    - Emergency relief and disaster funding source - incentivizes good procedures in towns and pay less money
- Additional data on flows (in addition to USGS gauges) – targeted gauging together – pressure transducers in area where implemented a lot of green infrastructure vs where haven't.
    - New USGS program to get targeted data on how Green Infrastructure projects are actually working
    - What can we add to supplement this data collection?
- Comprehensive look at what restoration projects are even considering climate change – and are these working better and how?

Institutional capacity

- Idea but never really happened: CT River Basin Commission
- Salmon River watershed has one coordinator and is making great progress
- Building municipal coalitions – how to foster multiple town entities – COGs have existing MOUs for stormwater of MS4 permitting as catalysts for multi town initiatives
- Not much multistate collaboration, but a NOAA funded study is in the works.

Connecting

- Tell stories about impacts
- Personal
- Financial
- Peer to peer – real people and constituents – using networks to communicate at a higher level
    - E.g. local business person makes bigger splash than Kim from TNC in lobbying the Hill.
    - If mayor hosts a Slow the Flow meeting, other mayors will show (more so than if a practitioner hosts a meeting)
- Connecting things people value and community benefits to the work (e.g. recreation, jobs, drinking water, etc.)
- Use social media

**Scott report back**

Metrics and Prioritization

- Metrics that are easy to measure are often useful at a local scale for a particular purpose – like sq feet of something – to show impact
- When try to compare among different actions it breaks down – how would you equate linear feet with sq feet of impervious surface removal?
- What's relevant to all different strategies?
- When thinking about water quality,there is a common currency. Is there something comparable around water quantity?

- But not just amount water removed – sometimes it's delay and spreading it and changing hydrograph downstream
- Trying to keep peak flows below a certain threshold level
- Could use models to evaluate different actions and locations to see how much can affect the hydrograph and use as way to evaluate options and set priorities
- Doesn't deal well with drought side and need to store water in soil and upper watershed – what other metrics for that?
    - Base flow and base flow factor
    - Water infiltration – storage
- Models – important tool in context of extreme events – when can't actually monitor if actions worked (model likely effects)
- Emerging tools like Lidar visualization may make this an easier lift in the future
- Benefits of considering multiple co-benefits – and not base on one hydrological impact –
- If can get relative impacts, can get prioritization. But also want to find out if combined efforts sufficient to meet overall goals

Barriers

- Hard to be strategic because dependent on willing landowners and limits where can do it
- Ends up being opportunistic instead
- Expensive – how to do with economies of scales to compete with gray options
- Managing conservation lands in a way to provide additional storage – keep water up high though LID, instream habitat work
- Need to change perceptions to see actions as positive - Cultural changes - for example, putting wood into stream
- Work with land management agencies not always easy because not a priority or don't want others on property – getting buy-in from state landowners as well as long-term strategy

**Additional Group Discussion:**

- Be there to work with officials during recovery process to avoid trouble from things done poorly during last disaster recovery
- Having a plan, having mitigation projects lined up to be ready when there's funding for restoration
- Need common framework – may not be able to find common currency but can illustrate tradeoffs

**Keith wrap up**

- Making comparisons with other water quality targets is a good bridge to coastal workshop we're planning for Fall
- Please keep in touch with us
- Communication and storytelling importance
    - Infographic idea – visualize this concept to audiences and stakeholders
- Understanding the consequences of going green or grey – and our responses are important as we prepare for a climate altered future

For updates on the Slow the Flow project, visit:

https://necsc.umass.edu/projects/slowing-flow-climate-resilience-sfcr-reducing-vulnerability-extreme-flows-and-providing

For questions about the Connecticut River Workshop,
contact Melissa Ocana at mocana@umass.edu.