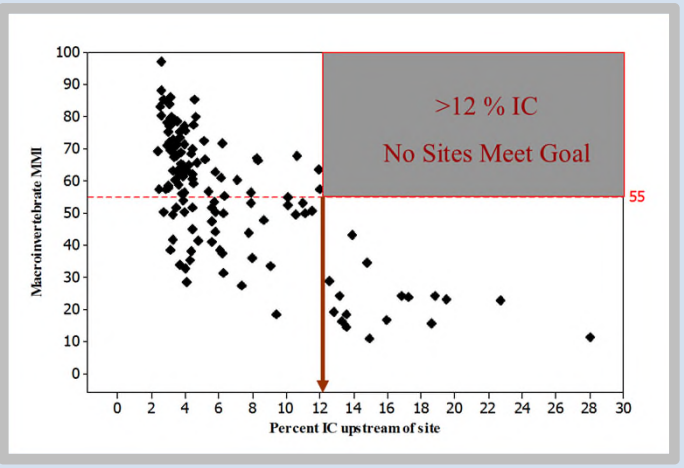
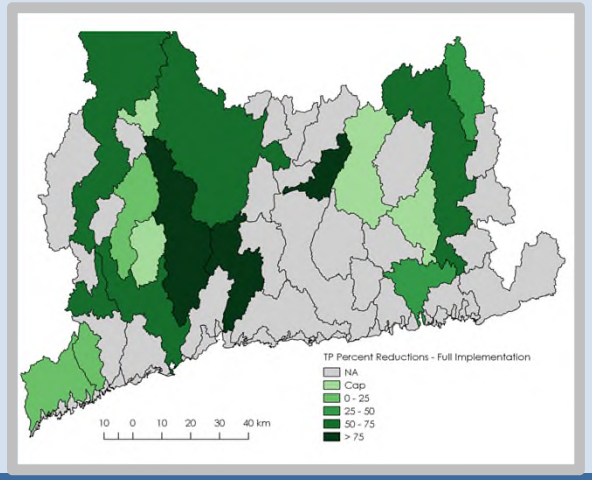
Turning Data into Information to Influence Water Management Policy: Examples from Connecticut





Chris Bellucci
National Water Quality Monitoring Conference
Denver, CO
March 28, 2019

Connecticut Department of Energy and Environmental Protection

Change is Hard!

Caution: Cigarette smoking may be hazardous to your health

Warning: The Surgeon General has determined that cigarette smoking is dangerous to your health

Surgeon Generals Warning: Smoking causes lung cancer, heart disease, emphysema and may complicate pregnancy.

Change is Hard!

Premise	Support
Scientifically Sound Data	Medical research and Surgeon General says smoking is bad for you
Data Turned Into Understandable Information	Surgeon General puts notice right on the cigarette pack
Timing/Political Climate	A bunch of people have gotten sick and even died so we should try to do something about it
Implementation must be reasonable	Smoking might kill you, makes your breath smelly, makes your loved ones mad at you, and costs a lot of money

Data Into Information

MNBVCXZLKJHGFDSAPOIUYTREWQ – Raw Data

ABCDEFG HIJKLMNOP QRSTUV WXYZ - Analysis

Information

NO STREAM IN CT MEETS WATER QUALITY GOALS ONCE WE GET ABOVE 12% IMPERVIOUS COVER

STREAM DIATOMS RESPOND TO VARYING PHOSPHORUS LEVELS

PUMPING FROM GROUNDWATER WELLS LOCATED NEAR STREAMS CAN RESULT IN DISCONNECTED FLOW AND AQUATIC HABITAT

Story 1 -Impervious Cover and Water Quality

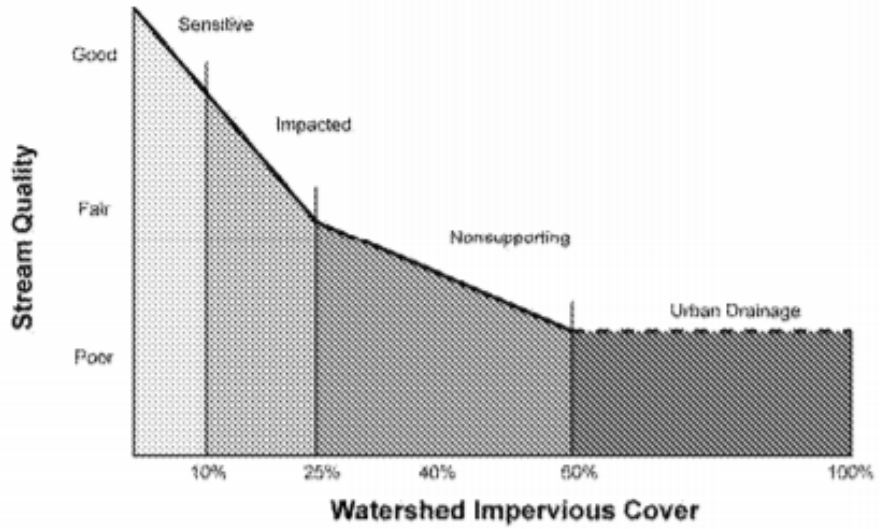


Fig. 1. Impervious cover model [adapted from CWP (1998)]

Center for Watershed Protection (CWP). 1998. Rapid watershed planning handbook.

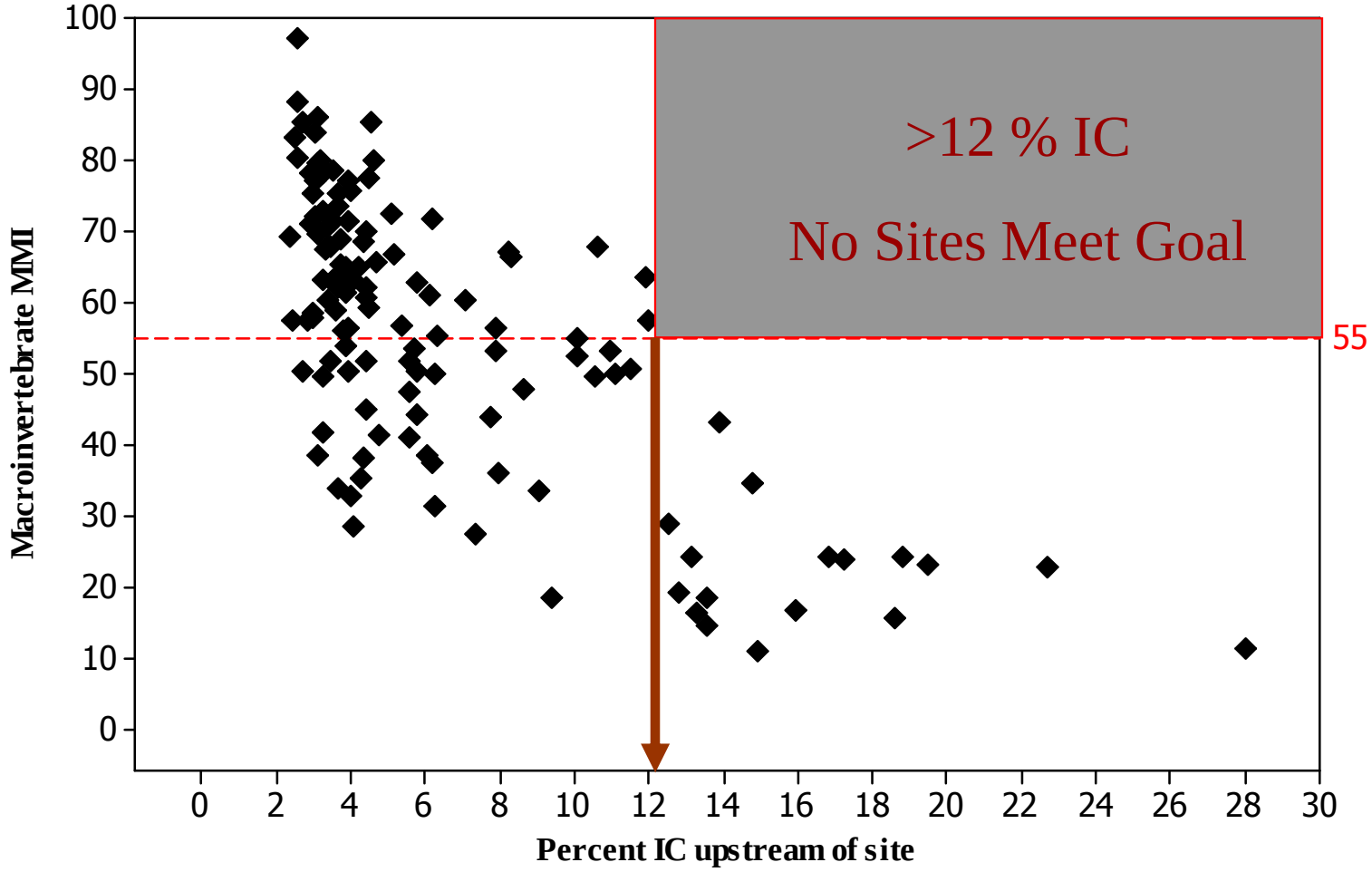
Schueler et al 2009 . J Hydrologic Engineering

Disclaimer

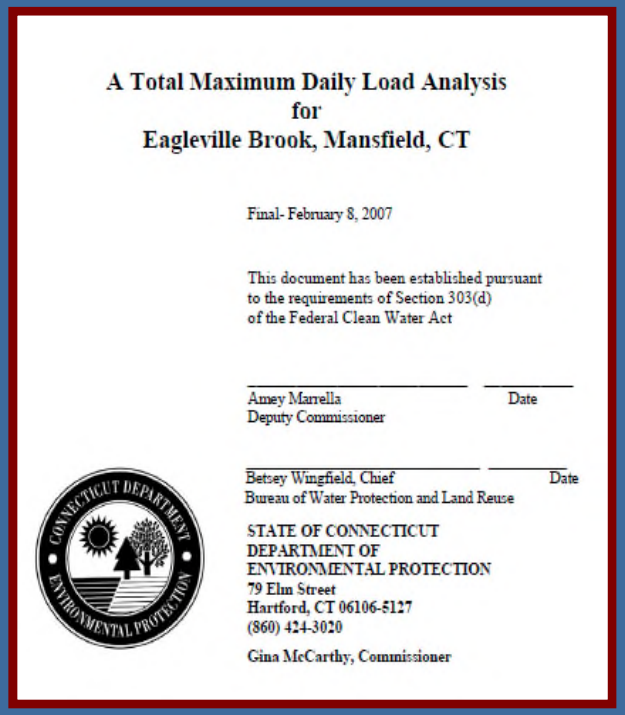
IC predictions are general and may not apply to every stream. Factor such as stream gradient, stream order, stream type, age of subwatershed development, prior land use, past management practices can and will make some streams depart from these predictions.

Must be 18 or older. Not valid in TX, UT, and AK. APR of 6.15%. You can never win. I am not liable for any damages and I don't have any money even if I was.

Story 1 -Impervious Cover and Water Quality



Impervious Cover as TMDL Surrogate



A Total Maximum Daily Load Analysis
for
Eagleville Brook, Mansfield, CT

Final- February 8, 2007

This document has been established pursuant
to the requirements of Section 303(d)
of the Federal Clean Water Act

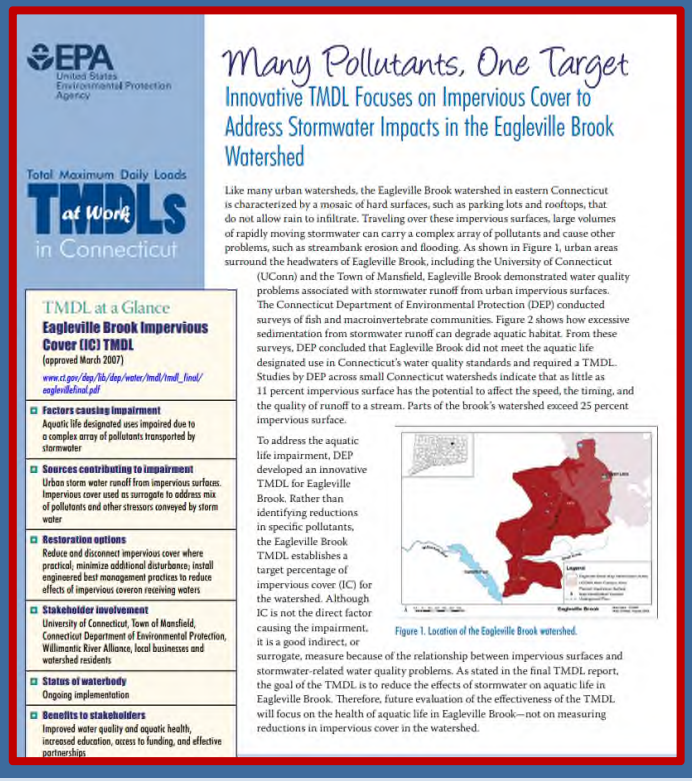
Amey Marrella — Date
Deputy Commissioner

Betsey Wingfield, Chief — Date
Bureau of Water Protection and Land Reuse

STATE OF CONNECTICUT
DEPARTMENT OF
ENVIRONMENTAL PROTECTION
79 Elm Street
Hartford, CT 06106-5127
(860) 424-3020

Gina McCarthy, Commissioner

Identified opportunities for better stormwater management



EPA United States Environmental Protection Agency

Total Maximum Daily Loads TMDLs at Work in Connecticut

Many Pollutants, One Target

Innovative TMDL Focuses on Impervious Cover to Address Stormwater Impacts in the Eagleville Brook Watershed

Like many urban watersheds, the Eagleville Brook watershed in eastern Connecticut is characterized by a mosaic of hard surfaces, such as parking lots and rooftops, that do not allow rain to infiltrate. Traveling over these impervious surfaces, large volumes of rapidly moving stormwater can carry a complex array of pollutants and cause other problems, such as streambank erosion and flooding. As shown in Figure 1, urban areas surround the headwaters of Eagleville Brook, including the University of Connecticut (UConn) and the Town of Mansfield, Eagleville Brook demonstrated water quality problems associated with stormwater runoff from urban impervious surfaces. The Connecticut Department of Environmental Protection (DEP) conducted surveys of fish and macroinvertebrate communities. Figure 2 shows how excessive sedimentation from stormwater runoff can degrade aquatic habitat. From these surveys, DEP concluded that Eagleville Brook did not meet the aquatic life designated use in Connecticut's water quality standards and required a TMDL. Studies by DEP across small Connecticut watersheds indicate that as little as 11 percent impervious surface has the potential to affect the speed, the timing, and the quality of runoff to a stream. Parts of the brook's watershed exceed 25 percent impervious surface.

To address the aquatic life impairment, DEP developed an innovative TMDL for Eagleville Brook. Rather than identifying reductions in specific pollutants, the Eagleville Brook TMDL establishes a target percentage of impervious cover (IC) for the watershed. Although IC is not the direct factor causing the impairment, it is a good indirect, or surrogate, measure because of the relationship between impervious surfaces and stormwater-related water quality problems. As stated in the final TMDL report, the goal of the TMDL is to reduce the effects of stormwater on aquatic life in Eagleville Brook. Therefore, future evaluation of the effectiveness of the TMDL will focus on the health of aquatic life in Eagleville Brook—not on measuring reductions in impervious cover in the watershed.

Figure 1. Location of the Eagleville Brook watershed.

TMDL at a Glance

Eagleville Brook Impervious Cover (IC) TMDL
(approved March 2007)
www.ct.gov/dep/lib/dep/water/tmdl/tmdl_final/eaglevillefinal.pdf

Factors causing impairment
Aquatic life designated uses impaired due to a complex array of pollutants transported by stormwater

Sources contributing to impairment
Urban storm water runoff from impervious surfaces. Impervious cover used as surrogate to address mix of pollutants and other stressors conveyed by storm water

Restoration options
Reduce and disconnect impervious cover where practical; minimize additional disturbance; install engineered best management practices to reduce effects of impervious coveron receiving waters

Stakeholder involvement
University of Connecticut, Town of Mansfield, Connecticut Department of Environmental Protection, Willimantic River Alliance, local businesses and watershed residents

Status of waterbody
Ongoing implementation

Benefits to stakeholders
Improved water quality and aquatic health, increased education, access to funding, and effective partnerships

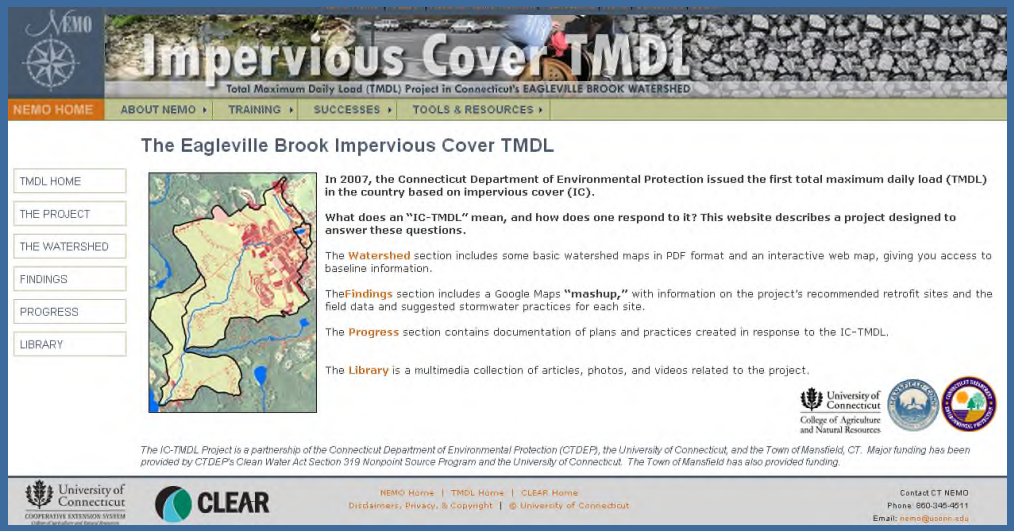
2007 -First TMDL in nation to use Impervious Cover as surrogate measure fro stormwater impacts

Impervious Cover as TMDL Surrogate

-Region 1 EPA was supportive of concept and worked hard to support approval

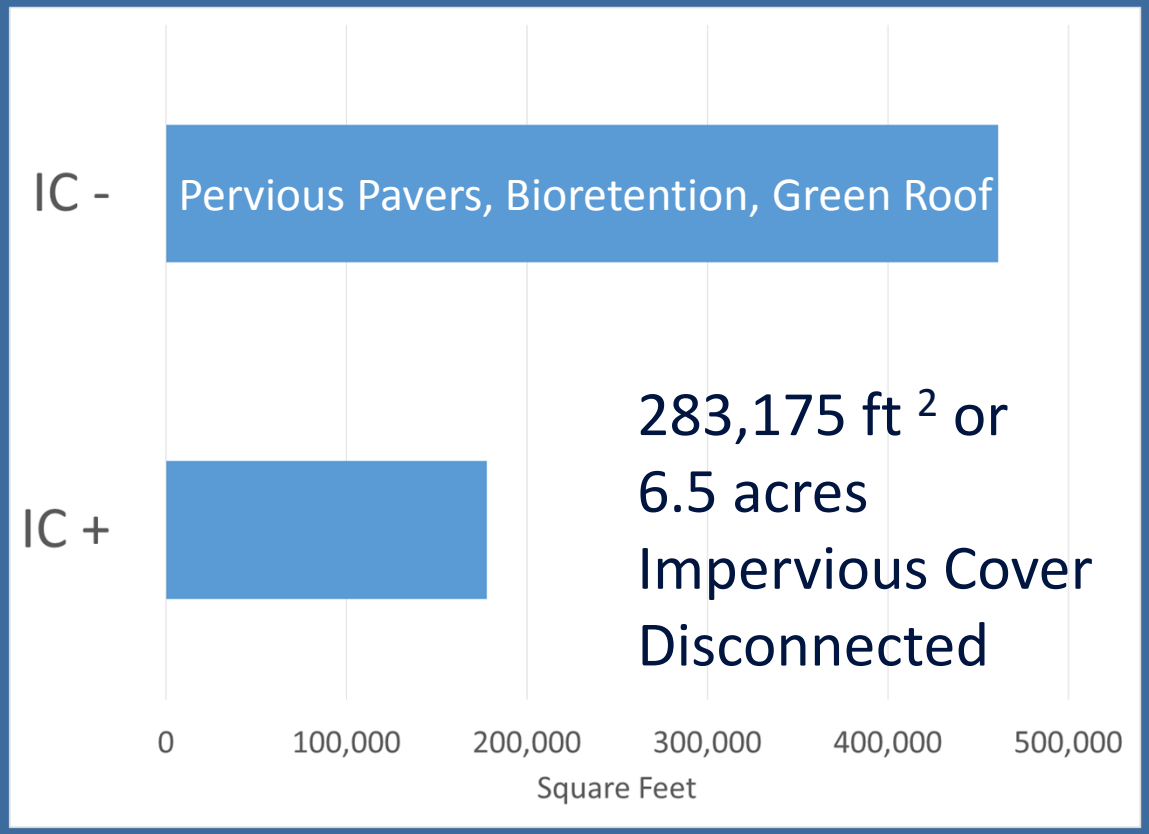
-"We get it, now what would you like us to do?"

-Department and UCONN Support for Implementation Plans and Monitoring



http://clear.uconn.edu/projects/tmdl/

Result so far….



Part of Eagleville Brook was delisted for aquatic life in 2012 based on fish and macroinvertebrate samples

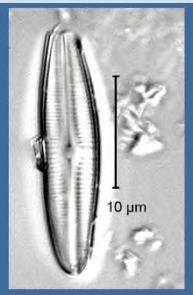
Arnold et al 2010. Watershed Science Bulletin 1:11-18

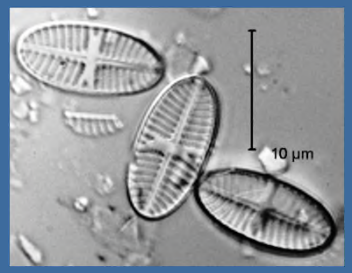
http://clear.uconn.edu/eagleville/Eagleville_TMDL

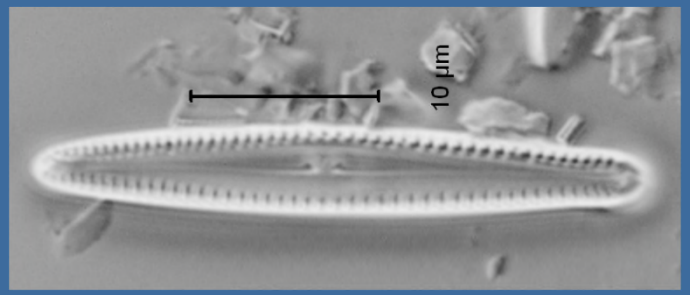
Common Thread to Success

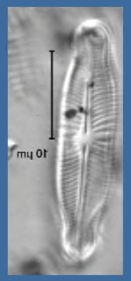
Premise	Support
Scientifically Sound Data	CT has strong urbanization gradient. Reasonable that the increased urbanization impacts macroinvertebrate communities
Data Turned Into Understandable Information	Scatterplot - > 12% impervious cover, no streams meet aquatic life goals
Timing/Political Climate	Stormwater big issues for urbanized states, EPA support for the approach, Opportunity for research, Opportunity to go green, TMDL, Incorporated into MS4 Permits
Implementation must be reasonable	Do not rip up impervious cover but rather be opportunistic in retrofitting to green technology when possible and green technology when building new

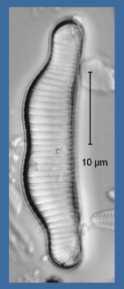
Story 2- Stream Diatoms and Phosphorus



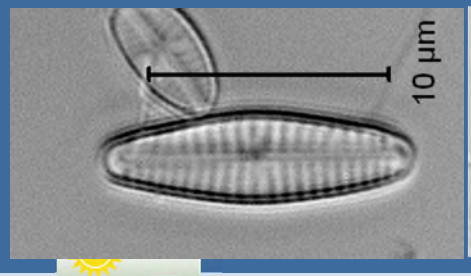


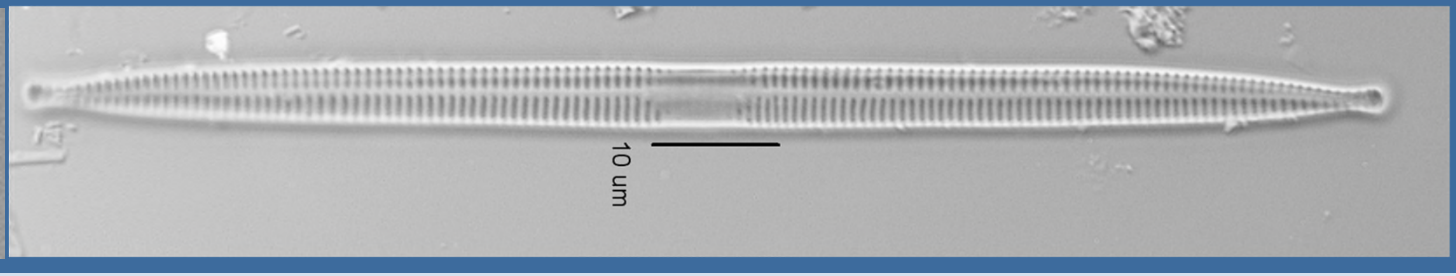






- How to inform phosphorus policy statewide with a critter that most people do not even know exists ????
- Used local information to make management decisions rather than rely on EPA recommended numeric benchmarks
- When fully implemented, this strategy will substantially reduce phosphorus loading in streams

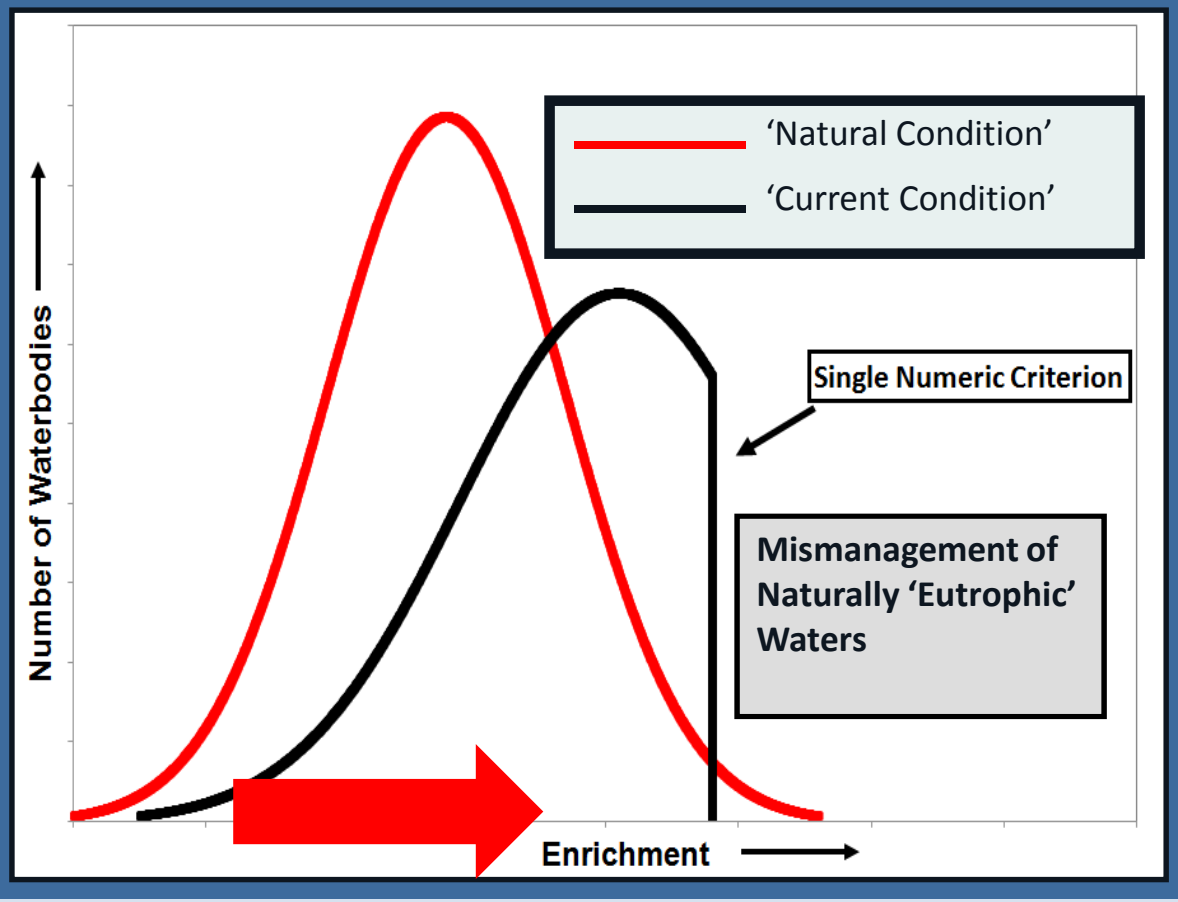




Phosphorus Occurs Naturally and is not a Toxic Pollutant

Nutrients / Cultural Eutrophication

Endpoint: changes in trophic condition that lead to indirect effects varying spatially and temporally



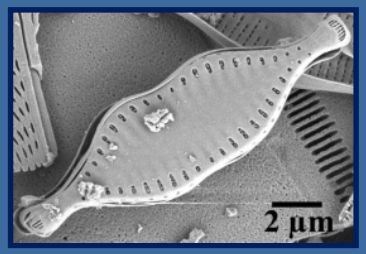
CT Approach to Phosphorus Management

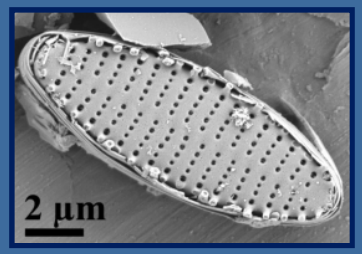
STEP 1: Calculate the Export of Phosphorus to Streams From Human Sources

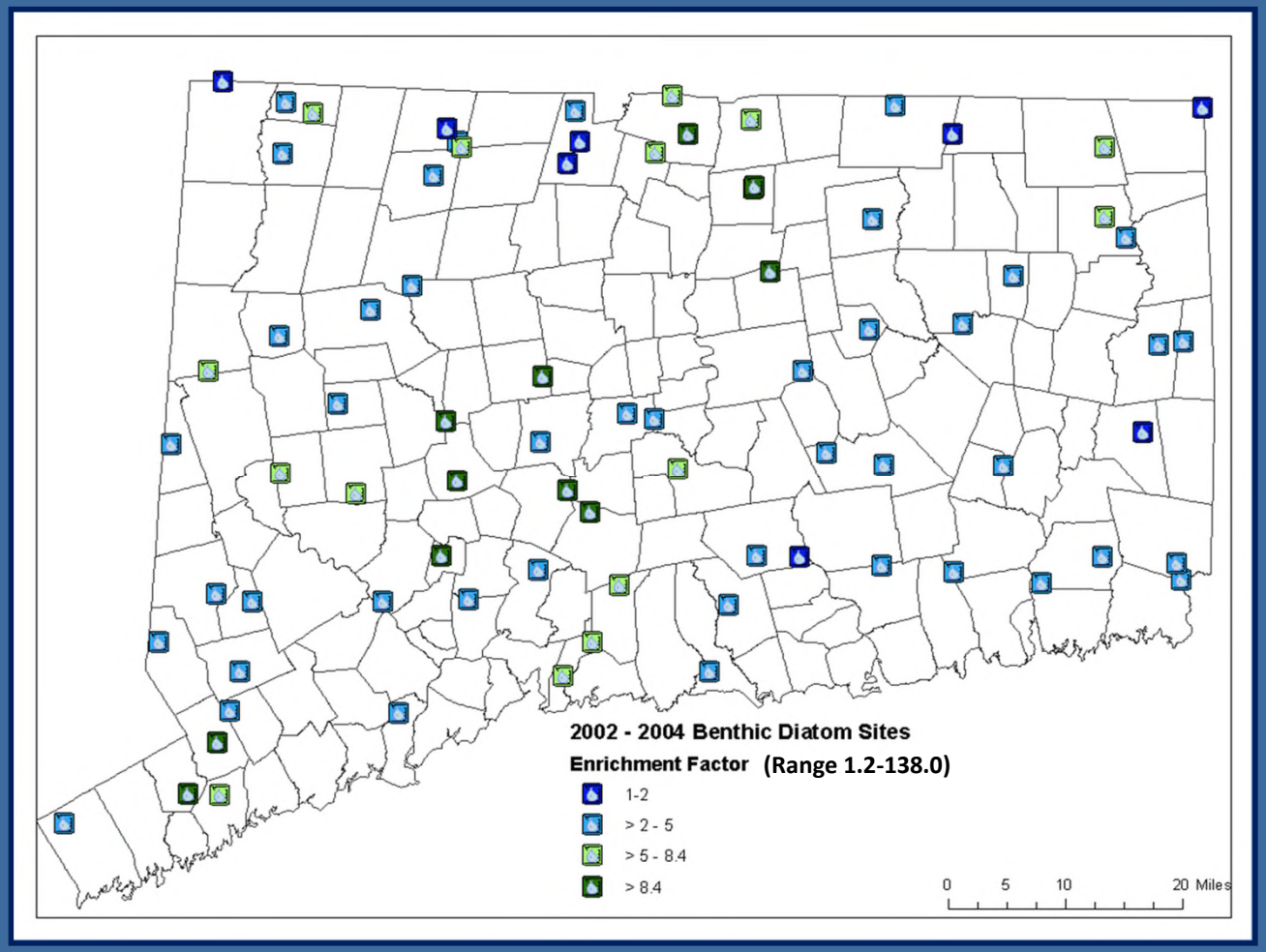
- **Estimated point source phosphorus contribution to rivers and streams**
- **Estimated phosphorus contribution from non-point sources using CT stream data**

CT Approach to Phosphorus Management

STEP 2: Identified What Diatoms Were Present in CT Streams

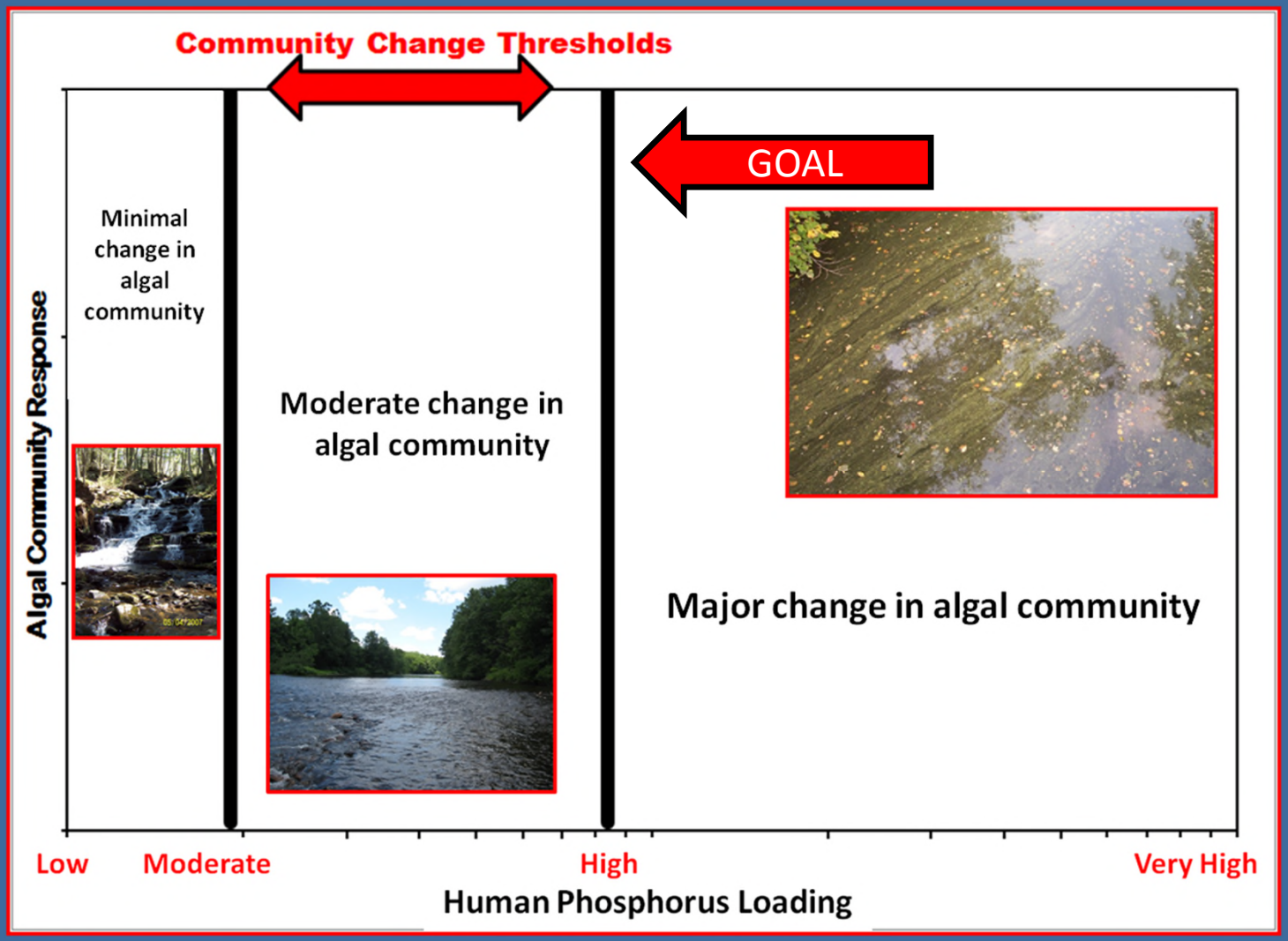






CT Approach to Phosphorus Management

STEP 3: Conducted a statistical analysis to identify diatoms response to excess phosphorus

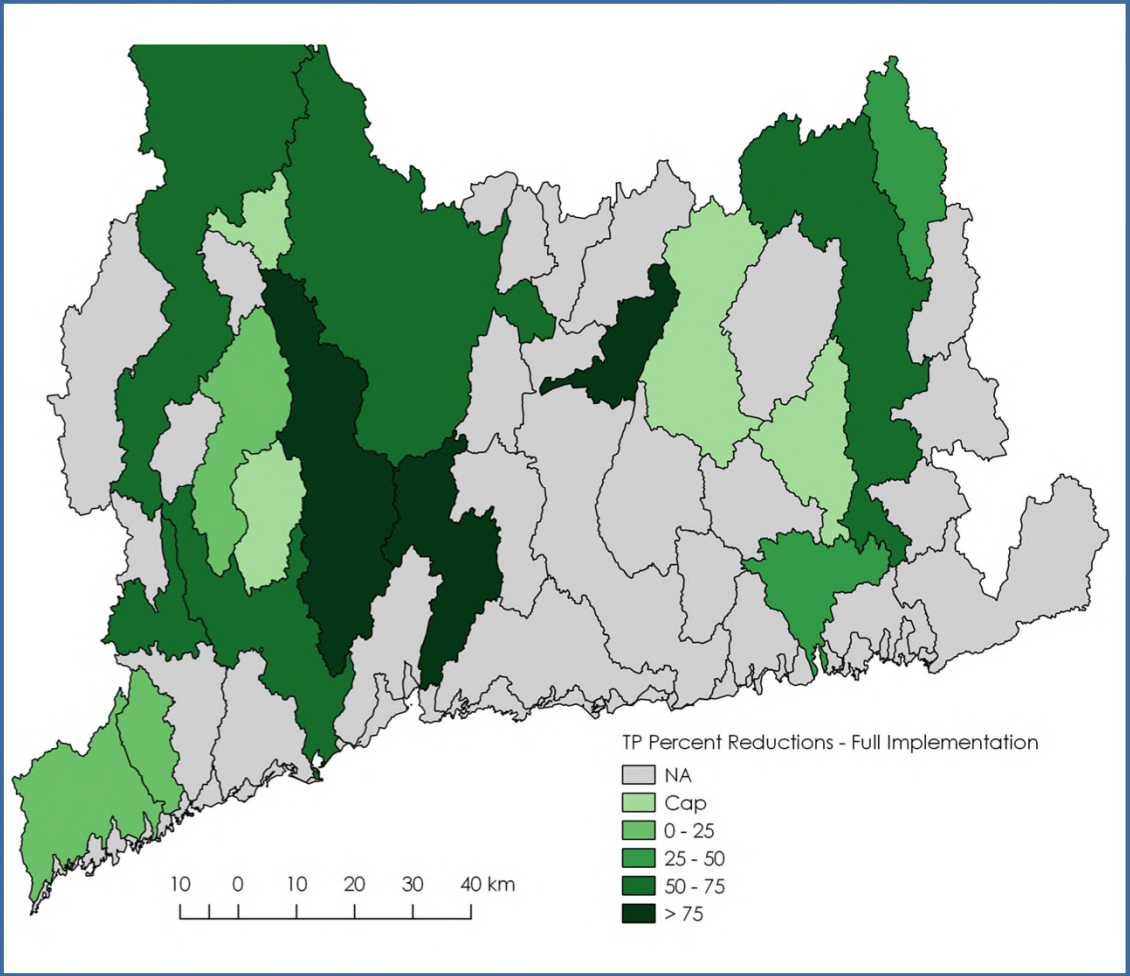


CT Approach to Phosphorus Management

STEP 4: Implement Strategy to Reduce TP

-Incorporate Reduction in Permit Limits

-Priority Clean Water Grant Funding For Phosphorus Reduction Projects



Up to 90% Phosphorus Load Reductions in Some Watersheds

CT Approach to Phosphorus Management

STEP 5: Monitor Streams for Response

-Working with USGS to Measure Continuous Dissolved Oxygen and Evaluate Gross Primary Production and Ecosystem Respiration

-Incorporate Diatoms into Biological Assessments in Streams and Develop Tools* to Detect Biological Response to Phosphorus Reductions

**Smucker N, Becker M, Detenbeck, N & Morrison A. 2013. Using algal metrics to evaluate multiple ways of defining concentration-based nutrient criteria in streams and their ecological relevance. Ecol Indic. 32: 51-61.*

** Becker M.E., Becker T.J. & Bellucci C.J. 2018. Diatom tolerance metrics to identify total phosphorus as a candidate cause of aquatic life impairment in CT, USA freshwater streams. Ecol. Indic. 93, 638-646.*

Common Thread to Success

Premise	Support
Scientifically Sound Data	CT has a strong phosphorus gradient. Reasonable that diatom communities in streams with low[phosphorus] are different than those with high [phosphorus]. Science peer reviewed by Connecticut Academy of Science and Engineering
Data Turned Into Understandable Information	Simplified statistical analysis into graphics that showed relationship between phosphorus load and diatoms
Timing/Political Climate	Local data and tiered implementation approach preferred over one size fits all numeric approach
Implementation must be reasonable	Tiered approach to permit limits relates to reasonable potential for phosphorus to cause problems in streams. Funding available to assist with implementation

Story 3- Well Pumping

September 16, 2016

Upstream

Downstream

Picture Standardization – Trail Cameras

Disconnected Flow-Habitat

Dry

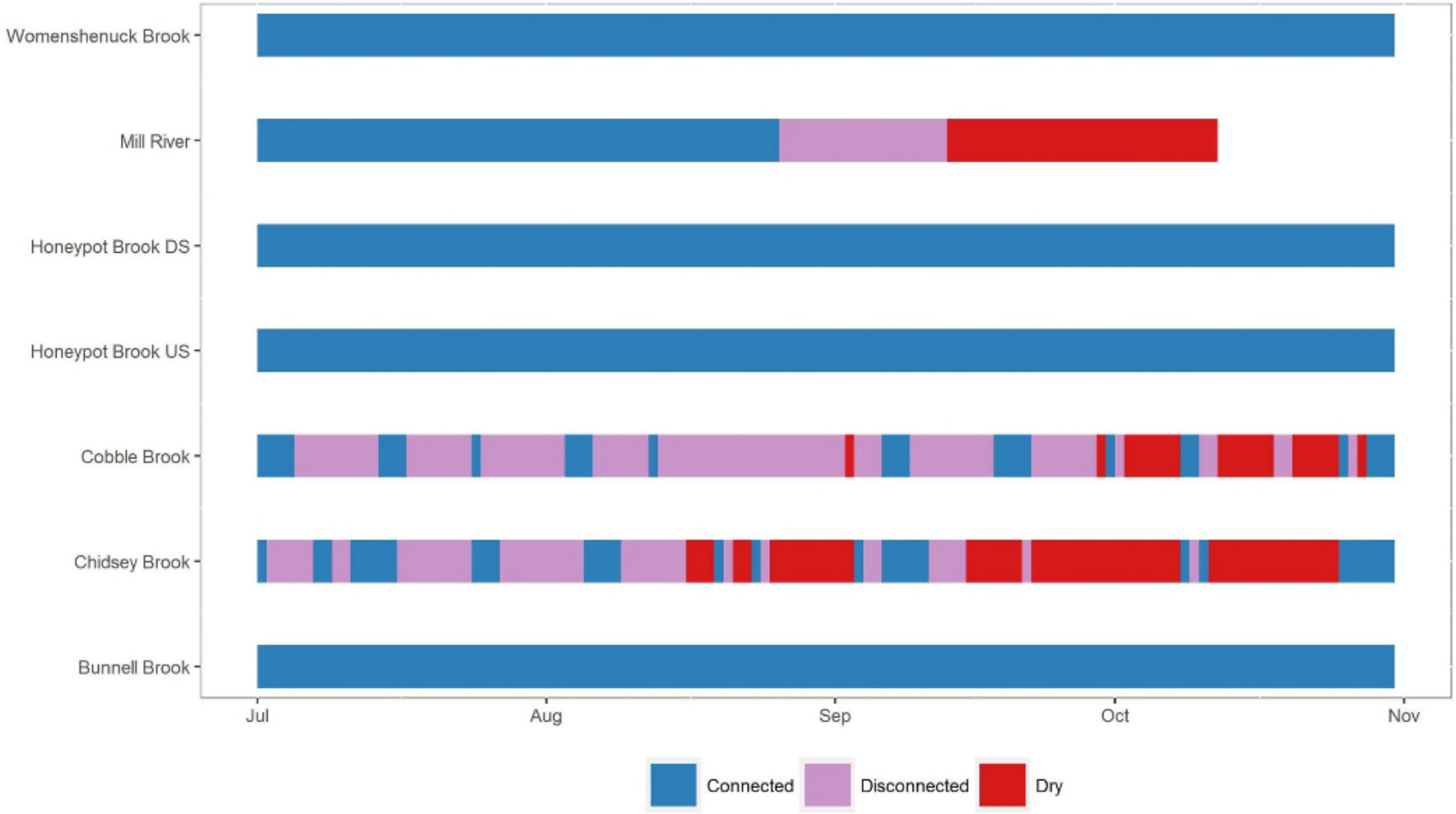
No Flow

Connected Flow-Habitat

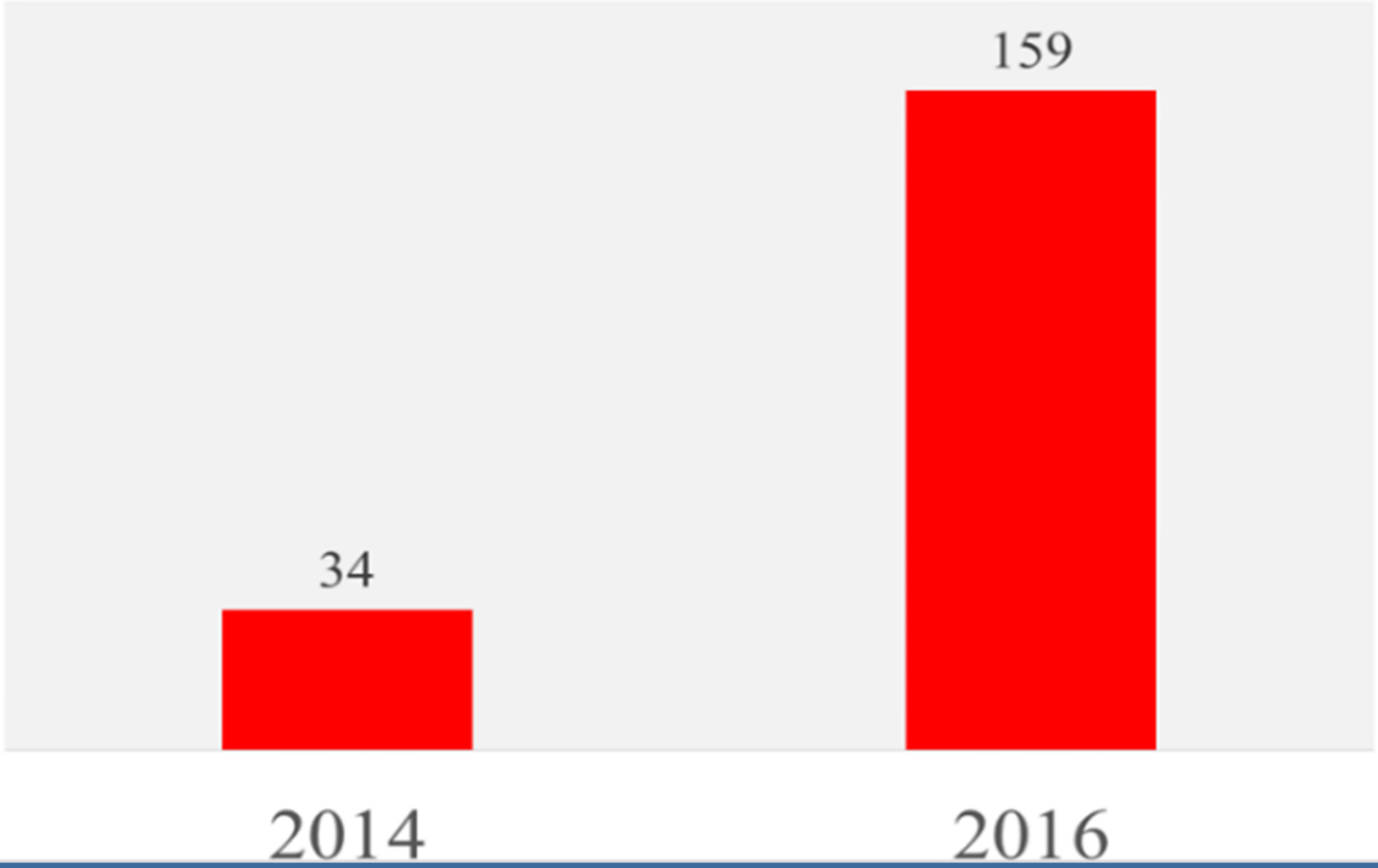
Normal

Below Bankfull

Flow habitat metrics



Better Accounting of Flow Imparments



Common Thread to Success

Premise	Support
Scientifically Sound Data	Shallow aquifers are hydrologically connected to surface waters and subject to drying if well pumping occurs near the stream channel
Data Turned Into Understandable Information	Pictures can document stream drying and trail cameras are a nice tool since they can be deployed and provide a daily record of conditions. Images can be turned into metrics and can help quantify the impacts.
Timing/Political Climate	Building data set - waiting for right political time/climate
Implementation must be reasonable	Human and ecological needs for water and creative solutions where known problem streams exist should be discussed.

CONNECTICUT DEPARTMENT OF ENERGY AND ENVIRONMENTAL PROTECTION

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Connecticut Department of
ENERGY & ENVIRONMENTAL PROTECTION