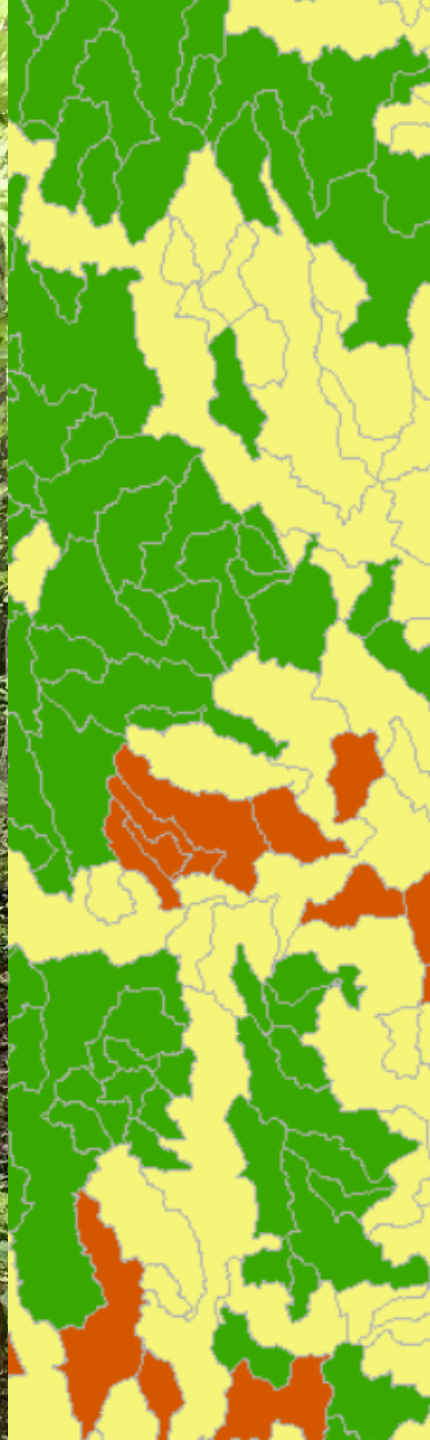
UCONN | UNIVERSITY OF CONNECTICUT

An online tool to assess the health of local watersheds



Qian Lei-Parent and Chet Arnold, CLEAR Webinar Series, Fall 2022

Today's Presentation

- Land cover & watershed health
- Project data & methods
- A few results
- DEMO!

Project Partners

CLEAR
University of Connecticut

Chet Arnold, Qian (Rachel) Lei-Parent, Cary Chadwick, Dave Dickson, Emily Wilson

FOOTPRINTS IN THE WATER

Paul Stacey

Connecticut Department of
ENERGY & ENVIRONMENTAL PROTECTION

Kelly Streich, Chris Bellucci, Mary Becker

Long Island Sound Study
A Partnership to Restore and Protect the Sound

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- A few results
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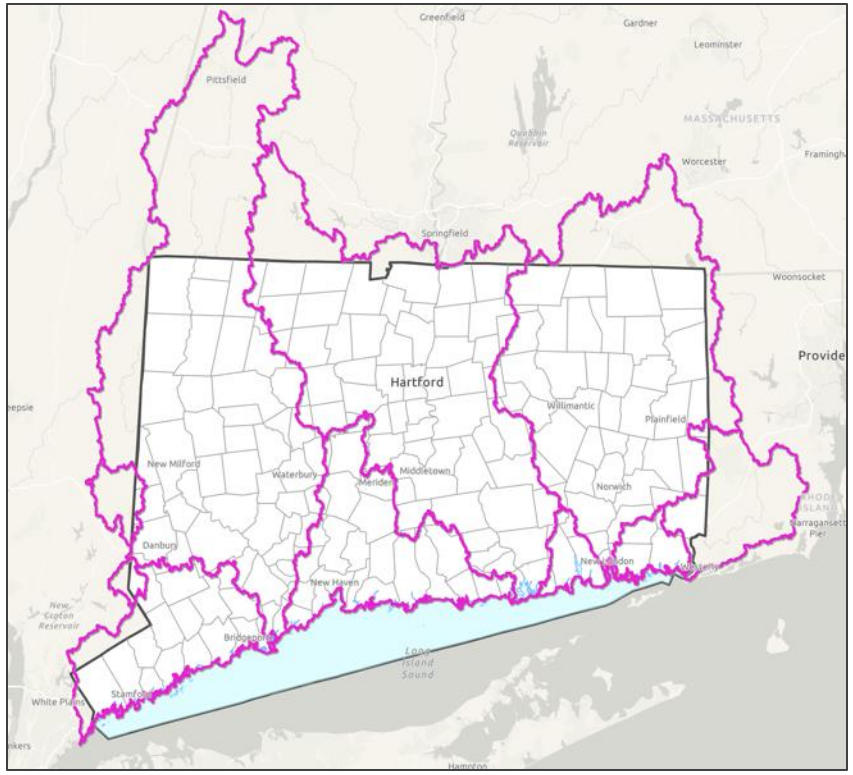
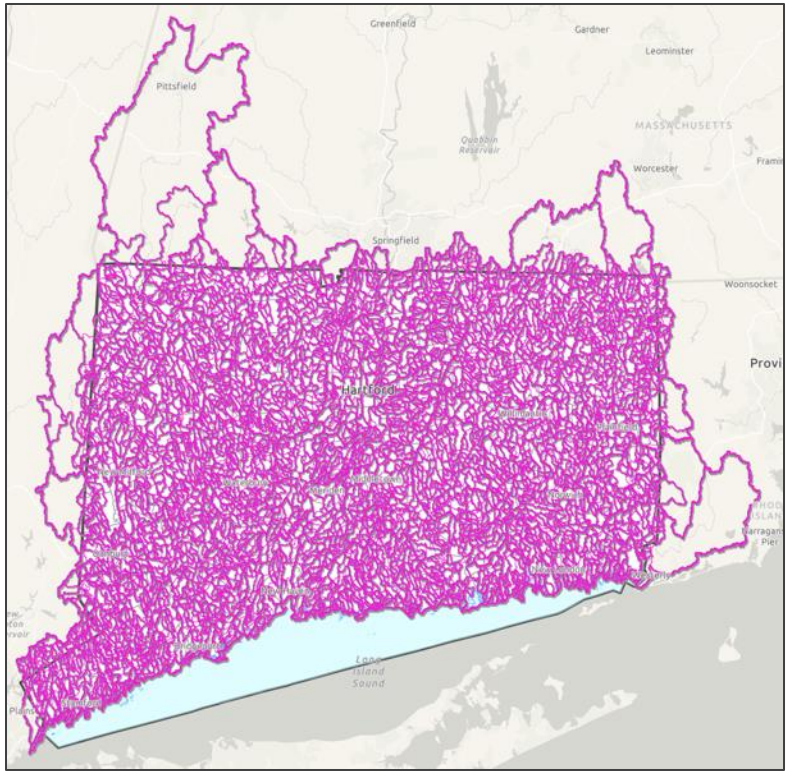
Watersheds

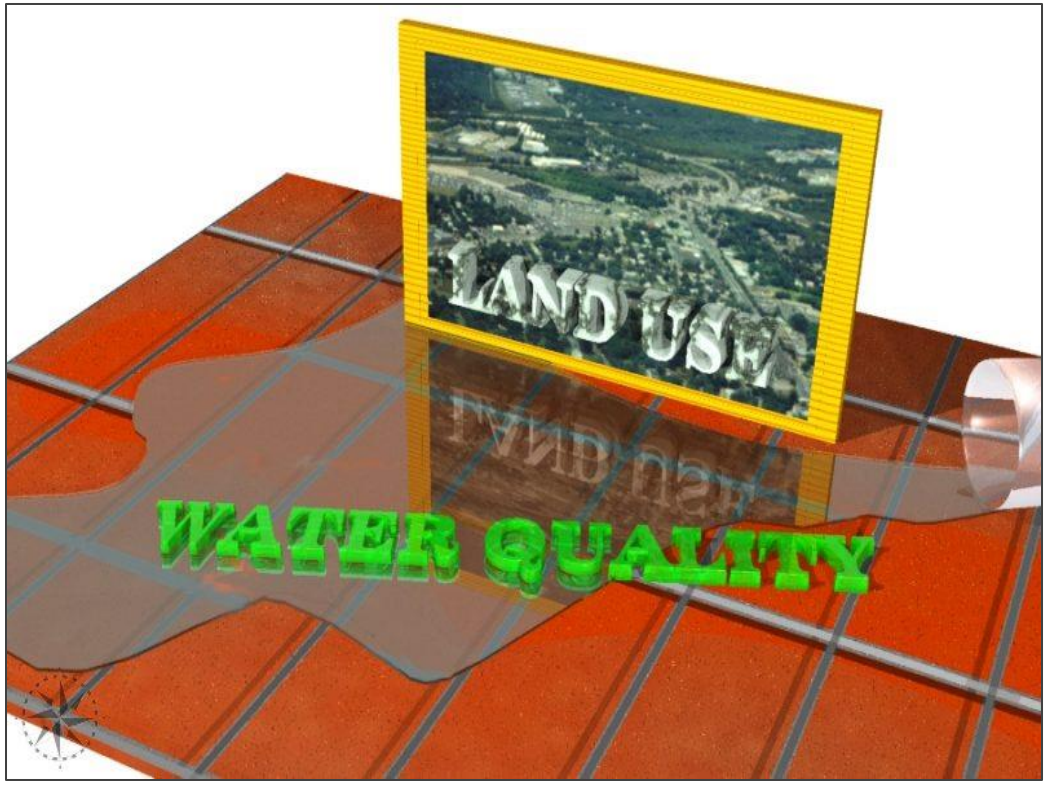


Major basins
(10)



Drainage basins
(7000+)

and we know that...

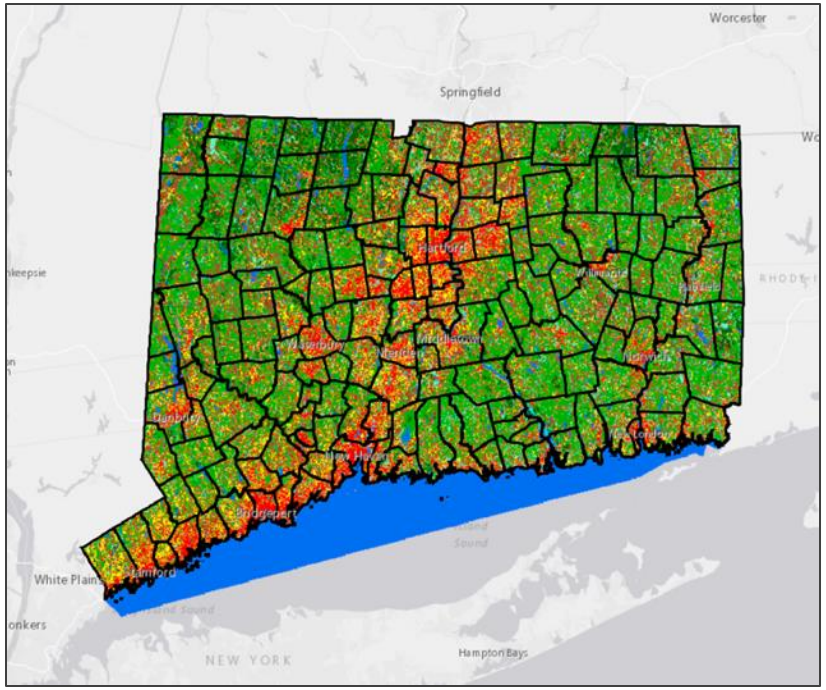


*

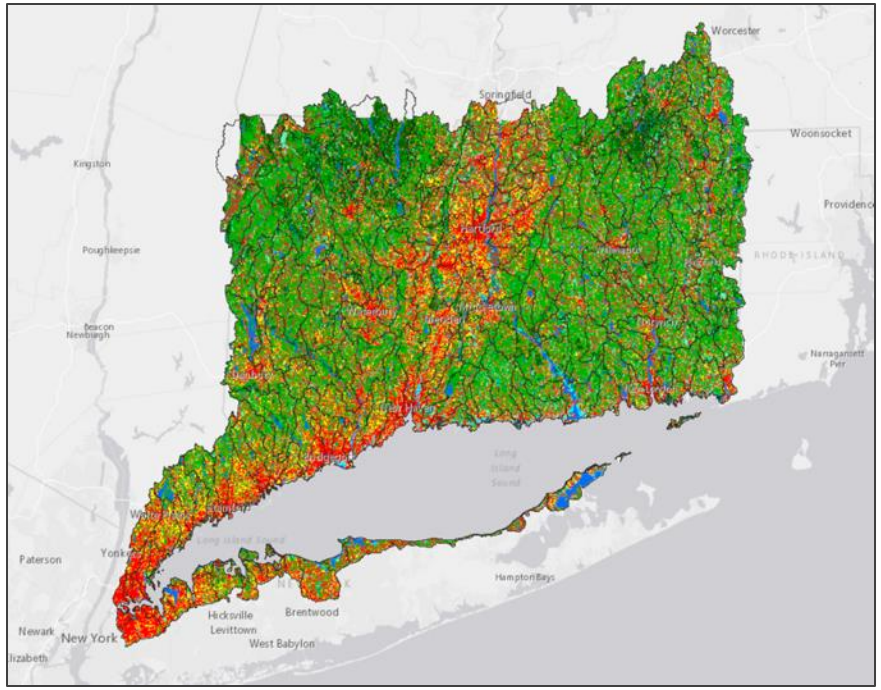
*Oldest continuously operating cheesy 3D image

CLEAR's "Changing Landscape" land cover

30-year period (1985 – 2015), 7 dates, 30m resolution

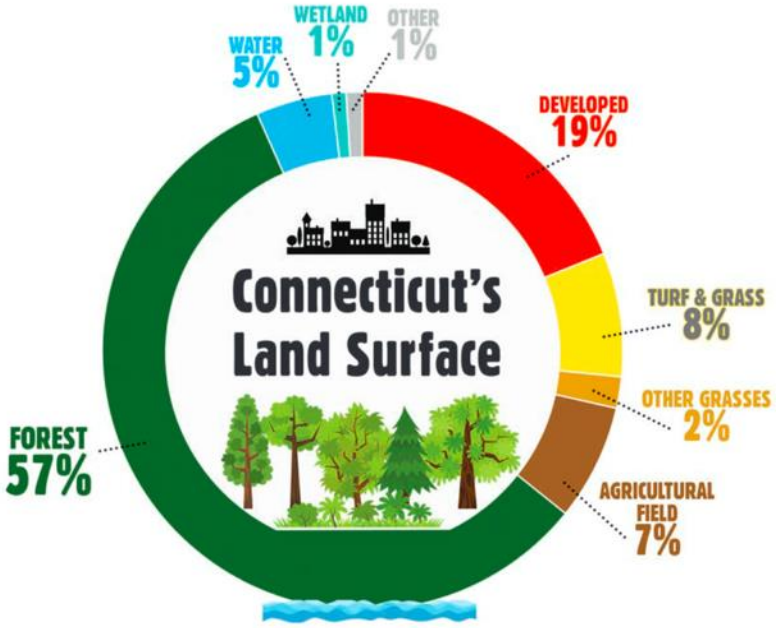


Connecticut
(by town)

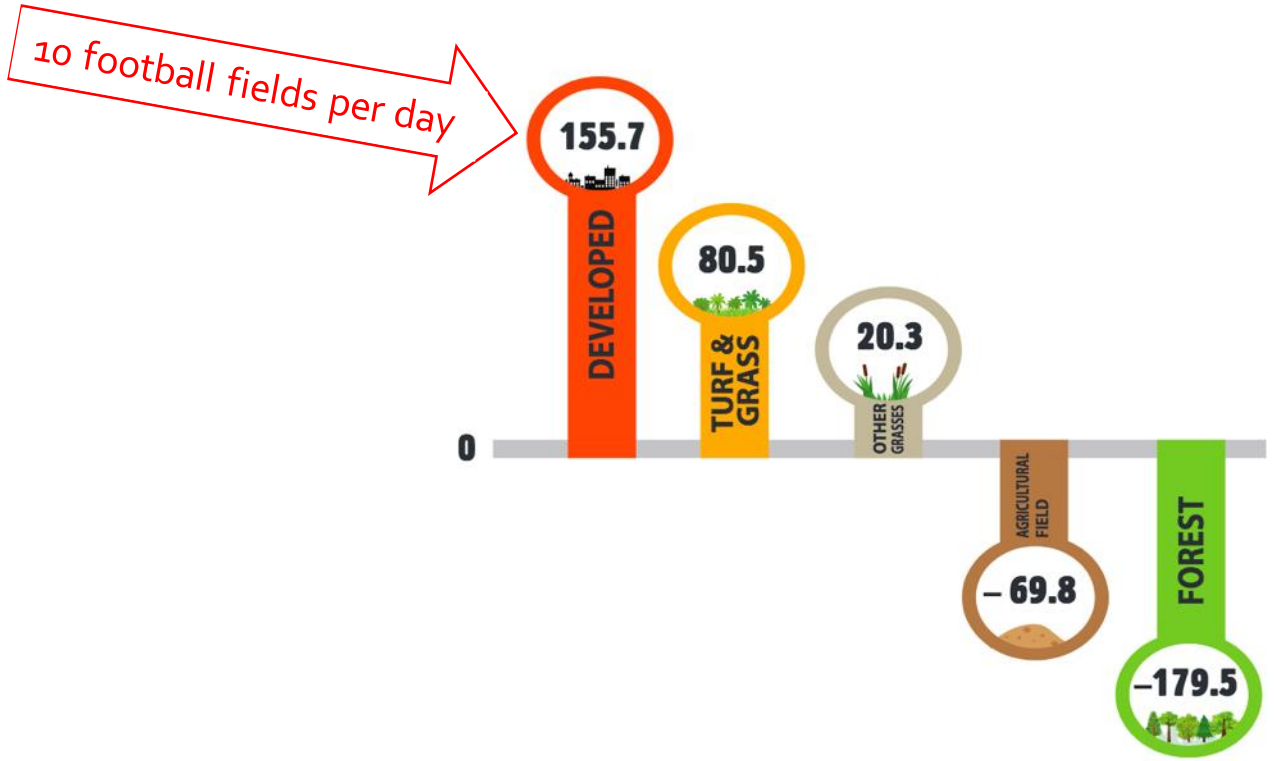


Lower LIS Watershed
(by HUC-12 basin)

We live in an urbanizing state & region



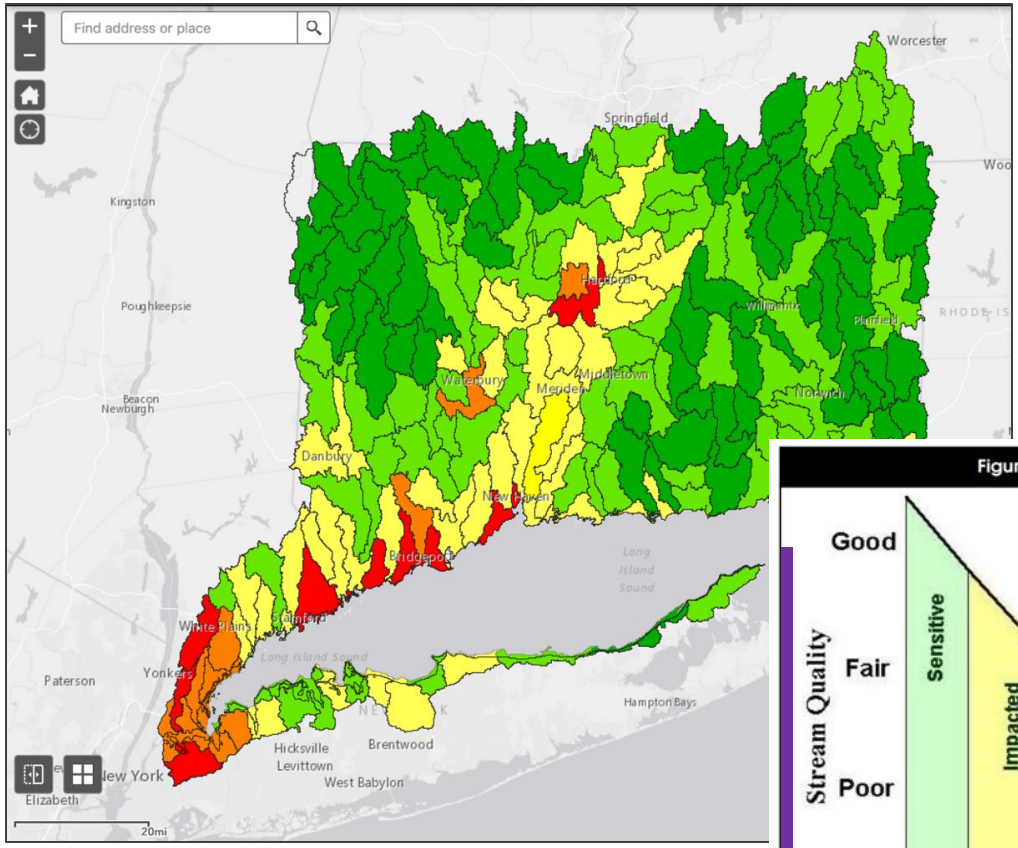
2015 Land Cover

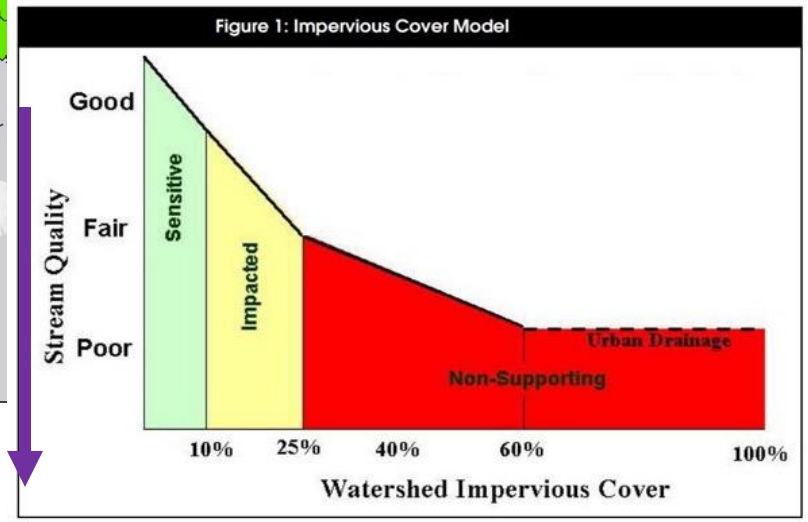


Land Cover Change, 1985-2015 (mi^2)

Graphics by CT Sea Grant

Everyone's favorite land cover indicator: IC

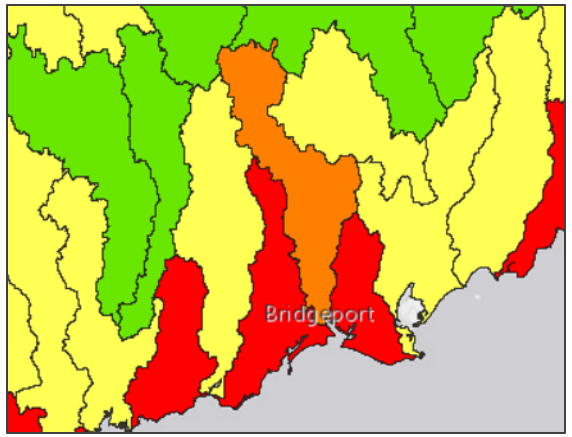




More than just IC

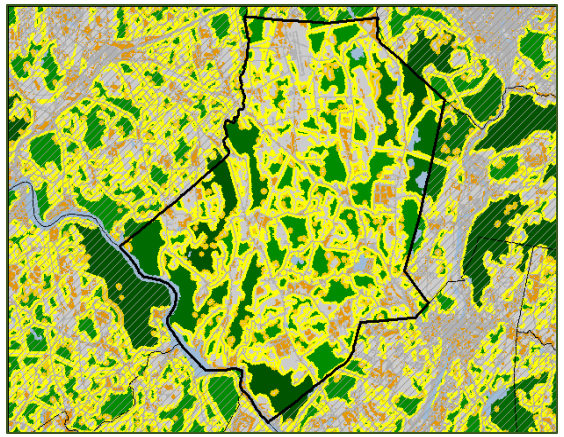
The scientific literature points to the critical role that various land cover factors have in watershed health, including impervious cover, riparian cover, forest cover and core forest.

Impervious Cover

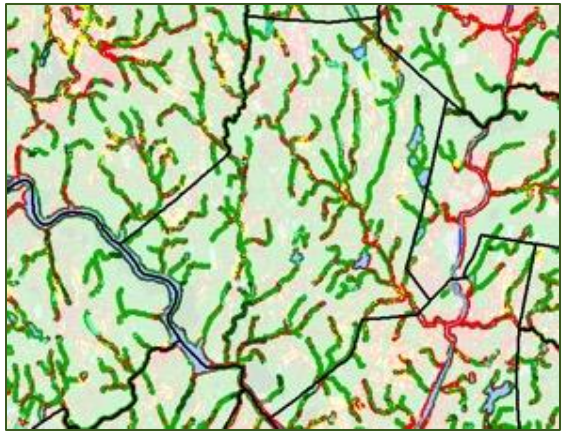


Forest Cover

Core Forest



Riparian Corridors



Generally, these indicators are more accurate at smaller watershed sizes

Today's Presentation

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- A few results
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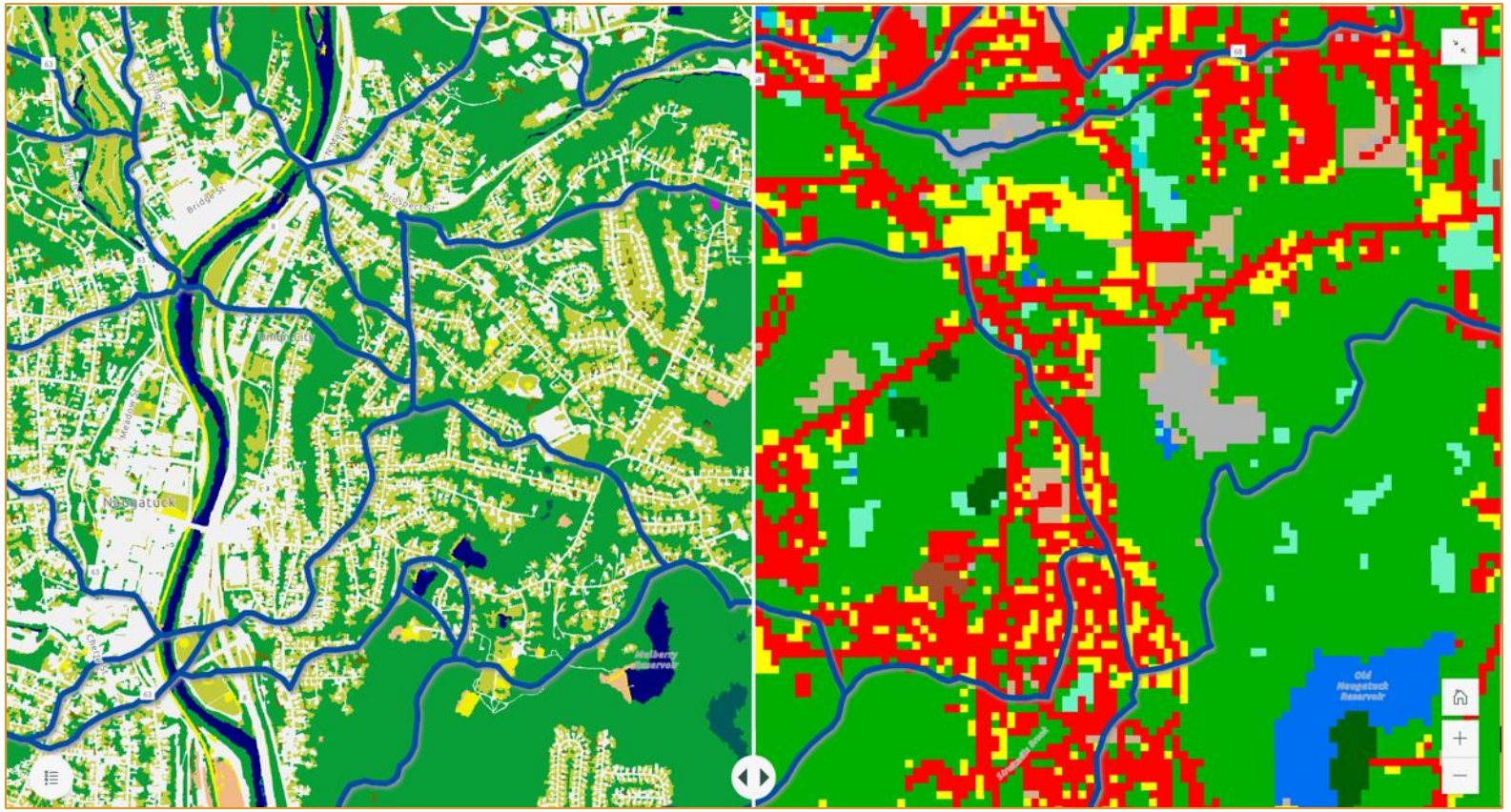
Project catalyst #1: a leap in land cover resolution

New 1m resolution NOAA C-CAP land cover dataset (2016 imagery) enables us to explore the land cover-watershed health relationship at a level of geographic resolution that was previously impossible

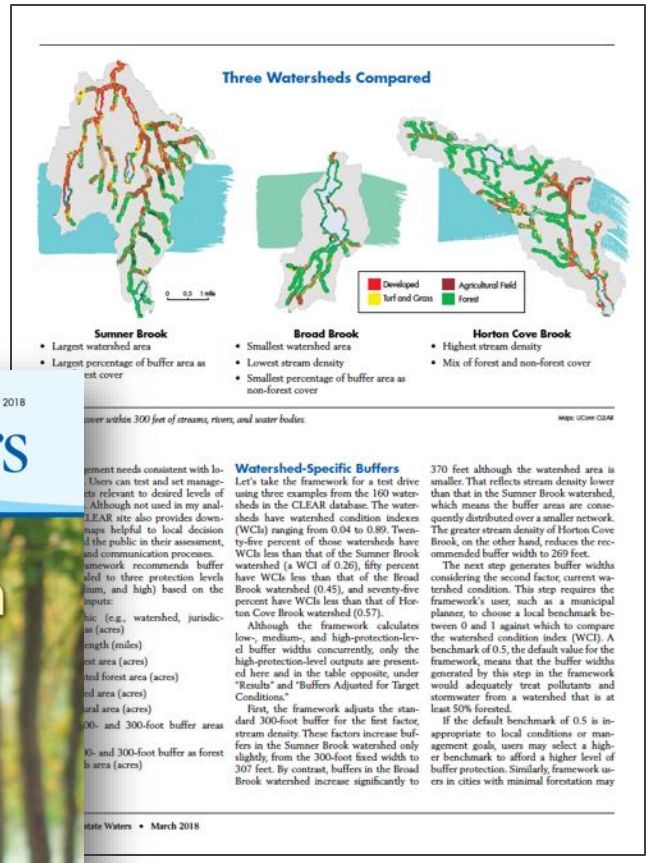


Project Catalyst #2: a reminder of the importance of riparian land cover (2018)

Riparian services

- slow runoff
- protect shorelines from erosion
- aid in flood control
- filter or trap pollutants
- provide habitat and corridors for wildlife
- shade waters for fisheries enhancement

➢ first line of defense against the impacts of development


Three Watersheds Compared

Developed
Agricultural Field
Turf and Grass
Forest

Sumner Brook
- Largest watershed area
- Largest percentage of buffer area as

Broad Brook
- Smallest watershed area
- Lowest stream density
- Smallest percentage of buffer area as non-forest cover

Horton Cove Brook
- Highest stream density
- Mix of forest and non-forest cover

cover within 300 feet of streams, rivers, and water bodies.

Maps: UConn CLEAR

Watershed-Specific Buffers

Let's take the framework for a test drive using three examples from the 160 watersheds in the CLEAR database. The watersheds have watershed condition indexes (WCIs) ranging from 0.04 to 0.89. Twenty-five percent of those watersheds have WCIs less than that of the Sumner Brook watershed (a WCI of 0.26), fifty percent have WCIs less than that of the Broad Brook watershed (0.45), and seventy-five percent have WCIs less than that of Horton Cove Brook watershed (0.57).

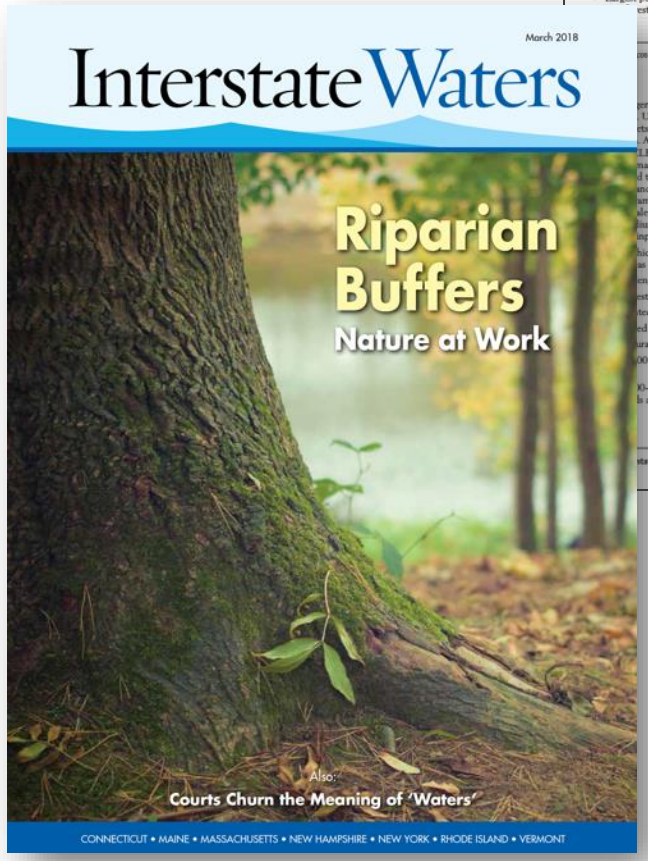
Although the framework calculates low-, medium-, and high-protection-level buffer widths concurrently, only the high-protection-level outputs are presented here and in the table opposite, under "Results" and "Buffers Adjusted for Target Conditions."

First, the framework adjusts the standard 300-foot buffer for the first factor, stream density. These factors increase buffers in the Sumner Brook watershed only slightly, from the 300-foot fixed width to 307 feet. By contrast, buffers in the Broad Brook watershed increase significantly to 370 feet although the watershed area is smaller. That reflects stream density lower than that in the Sumner Brook watershed, which means the buffer areas are consequently distributed over a smaller network. The greater stream density of Horton Cove Brook, on the other hand, reduces the recommended buffer width to 269 feet.

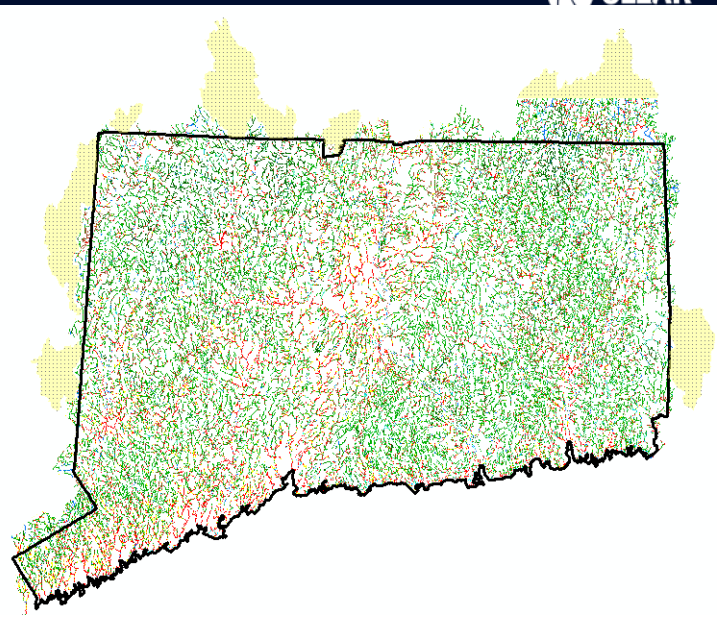
The next step generates buffer widths considering the second factor, current watershed condition. This step requires the framework's user, such as a municipal planner, to choose a local benchmark between 0 and 1 against which to compare the watershed condition index (WCI). A benchmark of 0.5, the default value for the framework, means that the buffer widths generated by this step in the framework would adequately treat pollutants and stormwater from a watershed that is at least 50% forested.

If the default benchmark of 0.5 is inappropriate to local conditions or management goals, users may select a higher benchmark to afford a higher level of buffer protection. Similarly, framework users in cities with minimal forestation may

tate Waters • March 2018



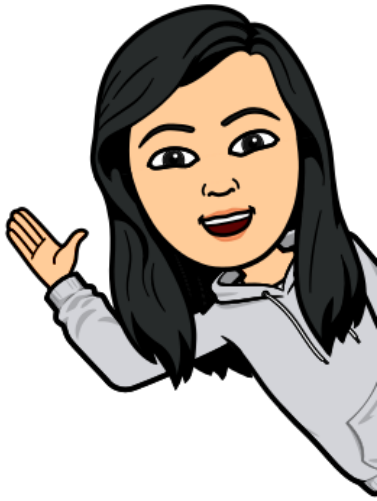
Project Objectives



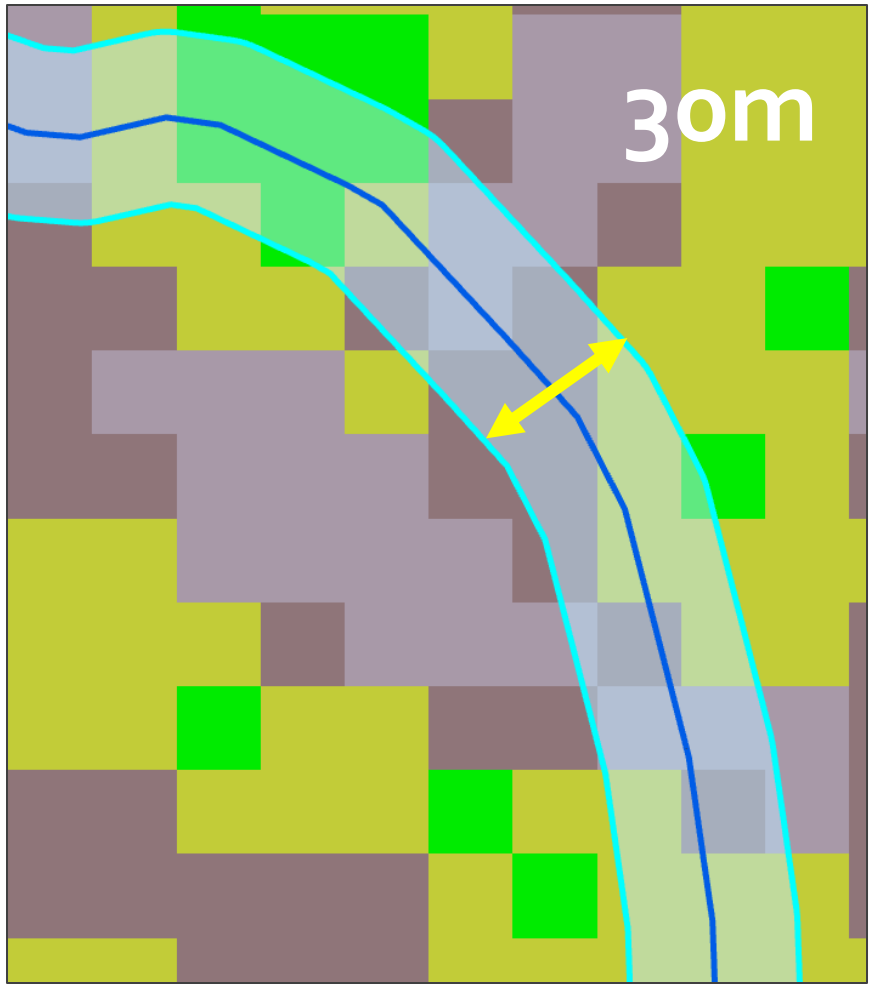
- Compare 1m land cover to previous datasets
- Develop fine-grained watershed health index based on the relationship of land cover to CT DEEP's Macroinvertebrate Multimetric Index (MMI)
- Relate this index to N loadings
- Create online application / decision support tool

Project data

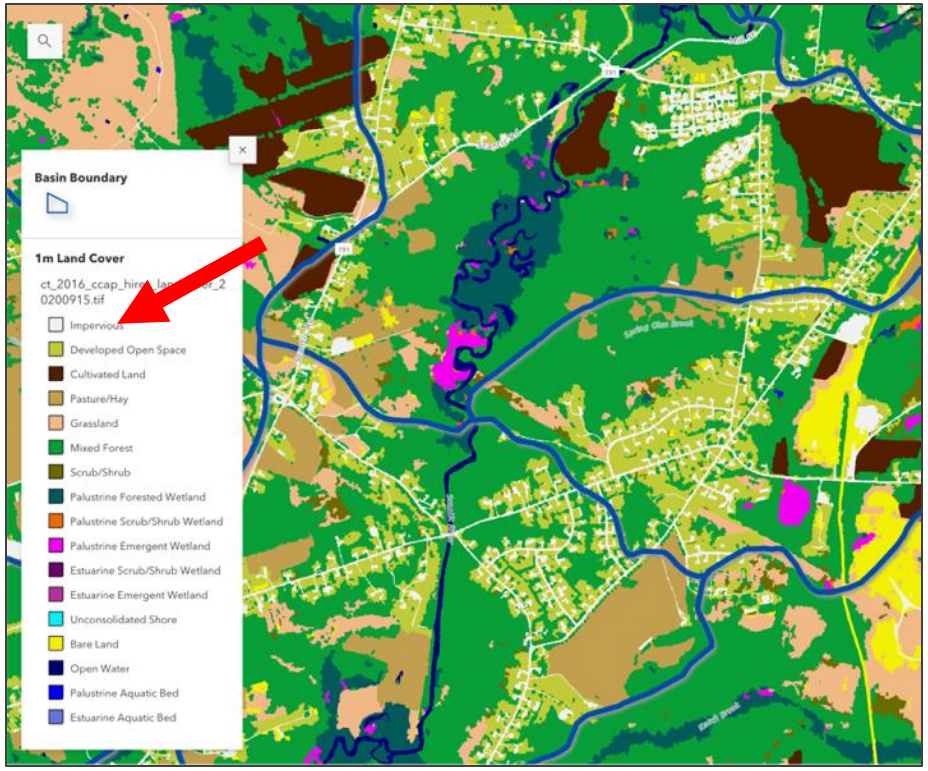
- ✓ Land cover dataset?
- ✓ Watershed size/level?
- ✓ Width of riparian zone to use?
- ✓ Water quality/ecological condition?



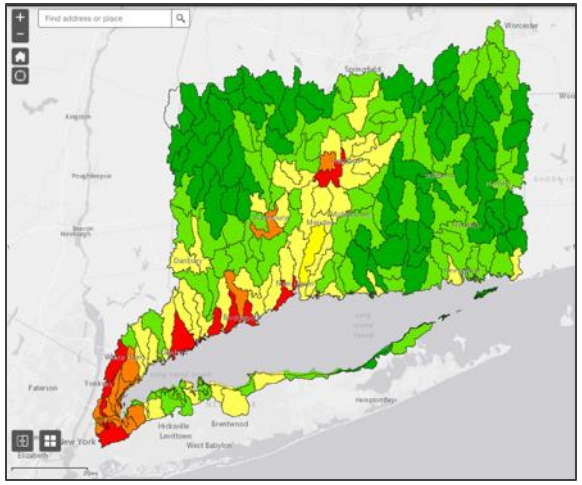
Land cover dataset….1m (duh)



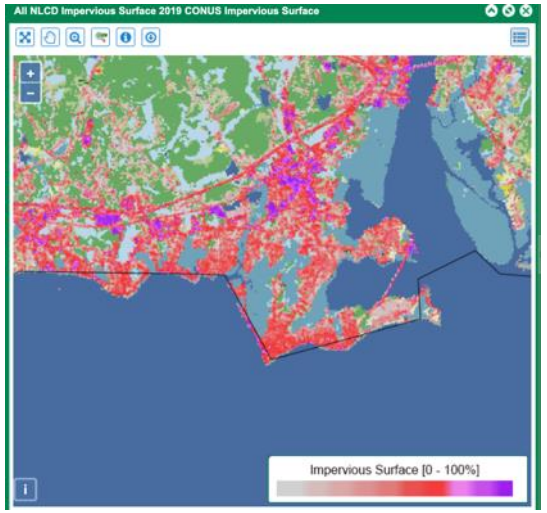
More accurate IC estimates



NOAA C-CAP 1m
Separate IC class

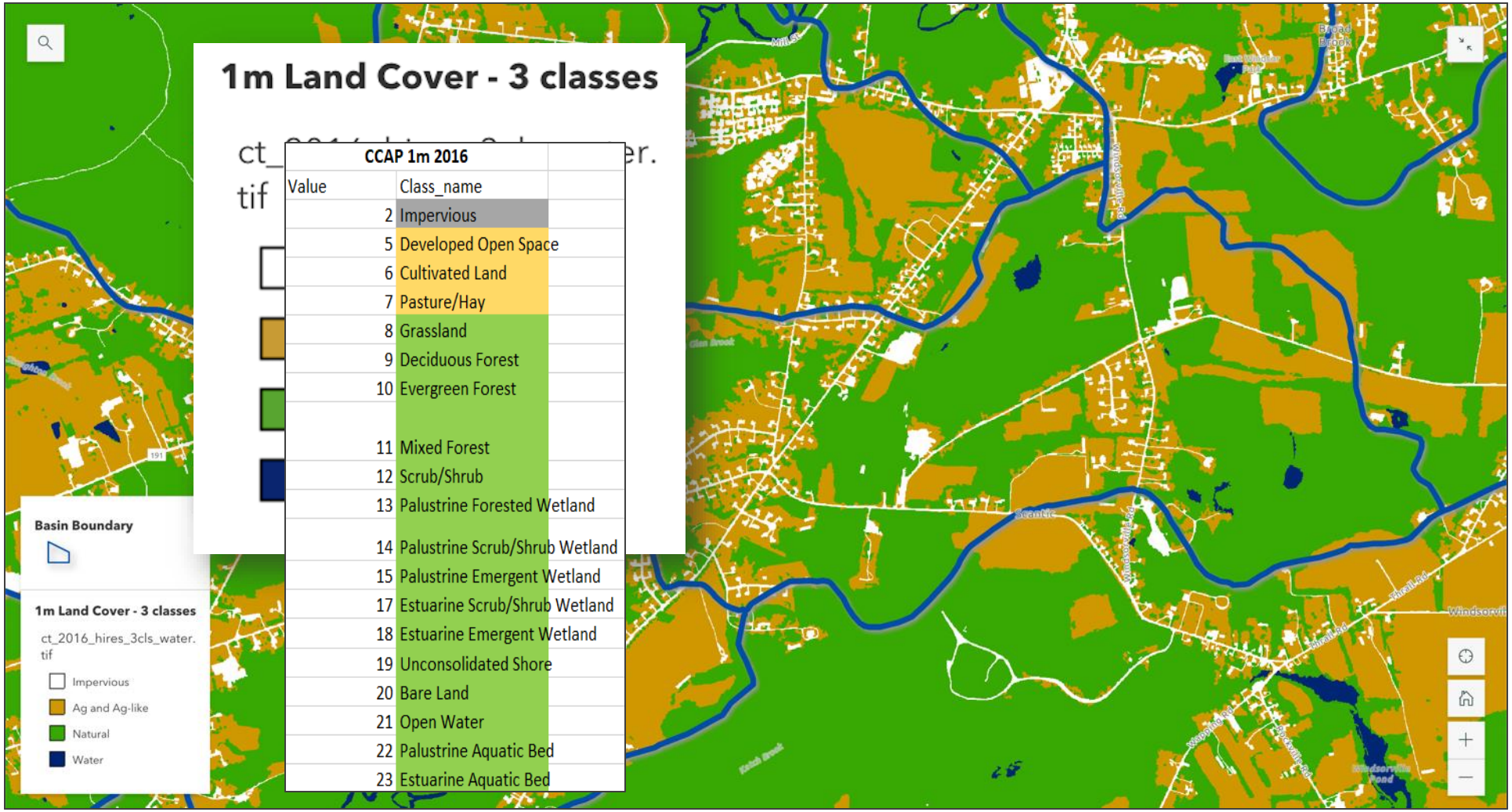


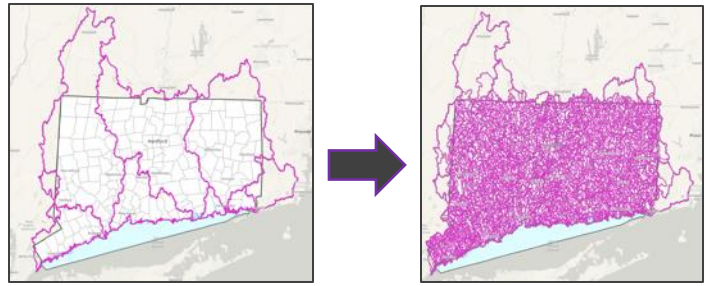
CLEAR CL land cover
ISAT Model → watershed-wide estimate



National land cover (NLCD), (C-CAP)
% developed surface for each 30m pixel

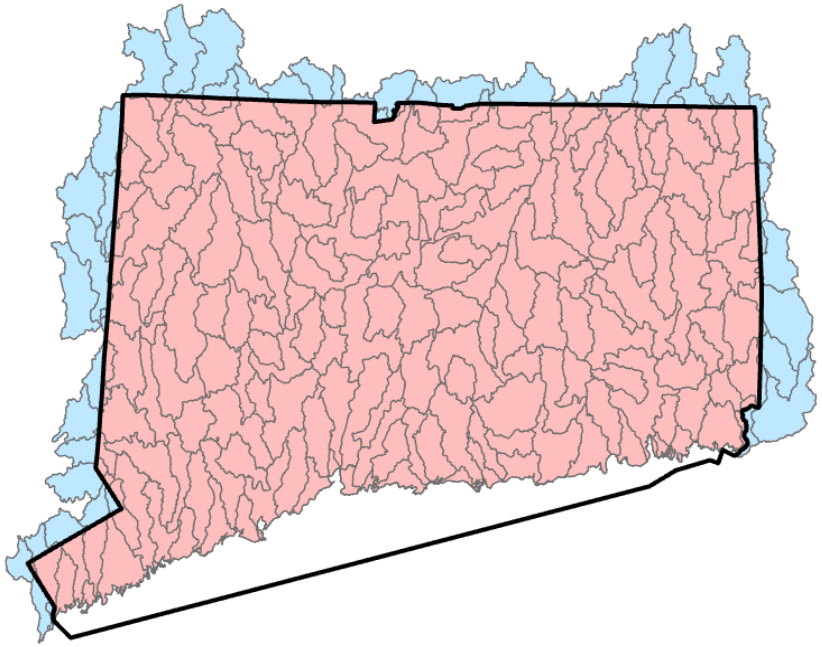
Simplifying the land cover classes





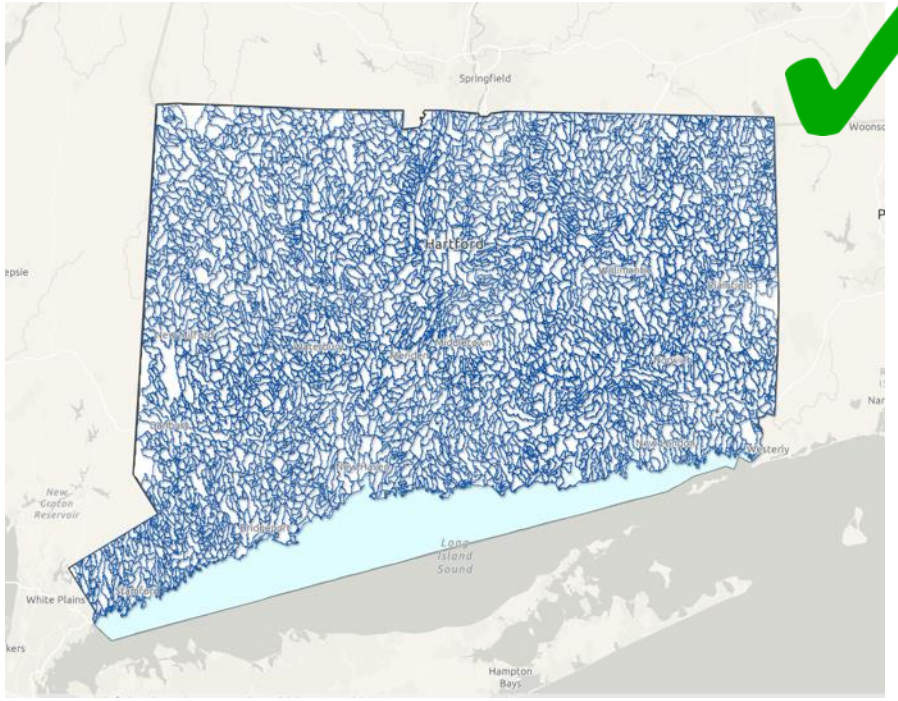
Watershed size?

HUC-12 basins



- number: 244
- ave size: 21,056 ac

(modified) local basins



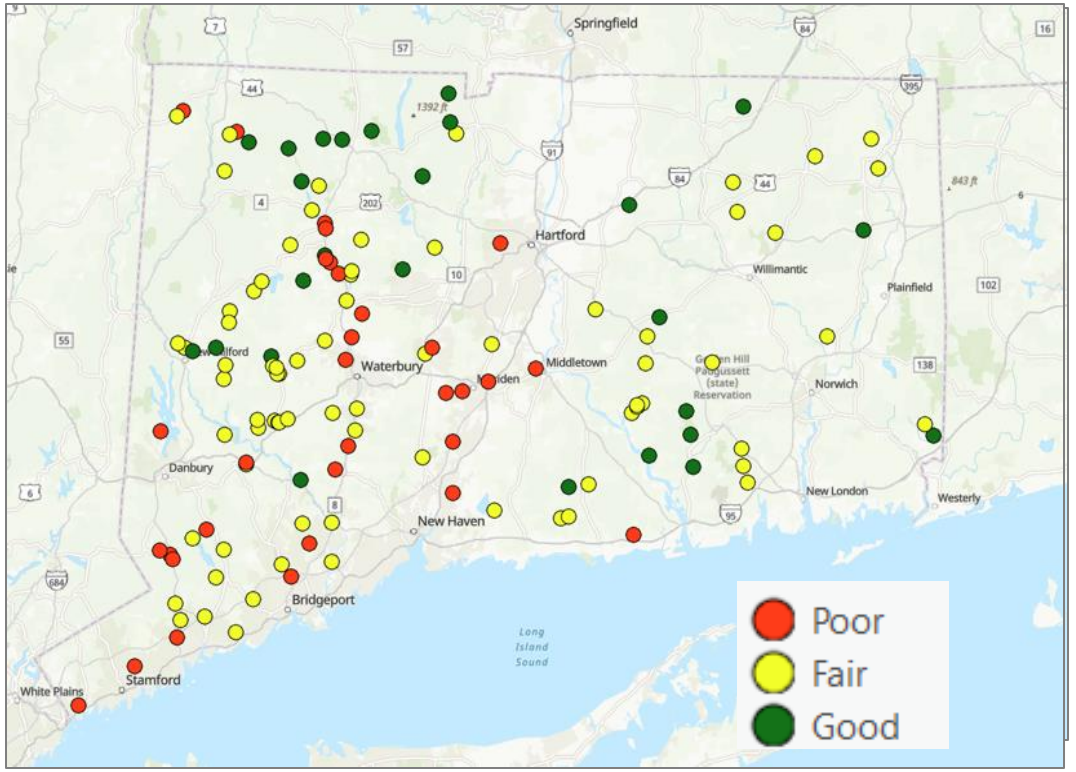
- number: 4,362
- ave size: 786 ac

Riparian Zone width: 100 ft

- Most common IWWC watercourse “upland review area” used in CT communities
- Most common width used in previous studies (e.g., Goetz et al.)
- Recommended in several studies as width that is protective of water quality

Water Quality/Ecological Condition

- Macroinvertebrate Multi-Metric Index (MMI) is an integrative indicator of ecological health.
- MMI ranges from 0 - 100.
  - *Higher MMI score indicates better water quality.*
- CT DEEP has 200+ MMI sample sites to monitor stream and river water quality.



Connecticut Department of ENERGY & ENVIRONMENTAL PROTECTION

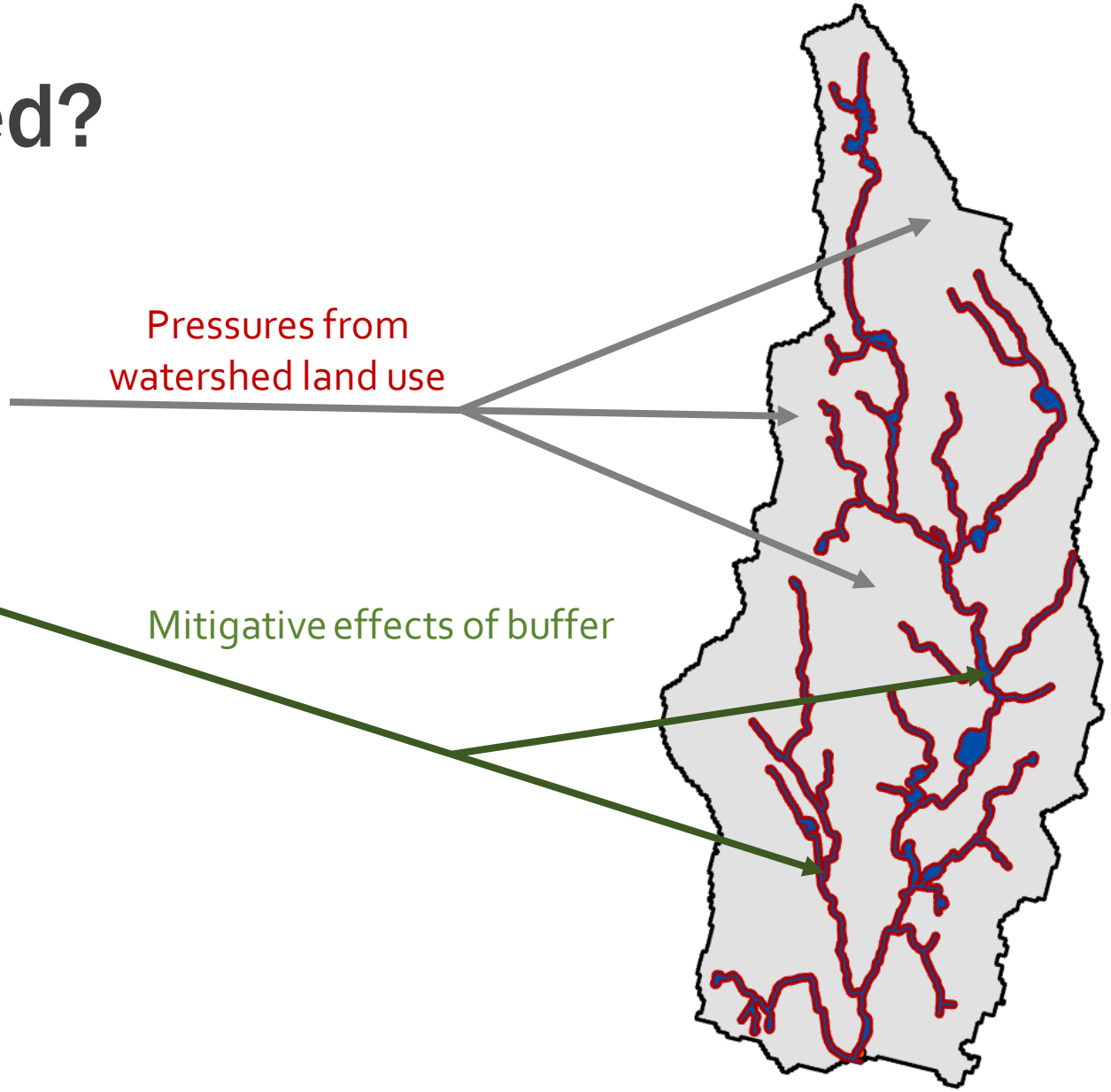
The Combined Condition Index (CCI)

A Biological Condition Gradient approach

- **Combined Condition Index** is a metric that describes the probable health of a watershed based on land cover within the watershed.
- CCI is calculated to have best fit with Macroinvertebrate Multi-metric Index (MMI)
- CCI ranges between 0 (poor) and 1 (excellent). Higher CCI score indicates better water quality.
- CCI is based on the land cover characteristics of riparian buffer and upland watershed.

How is CCI Calculated?

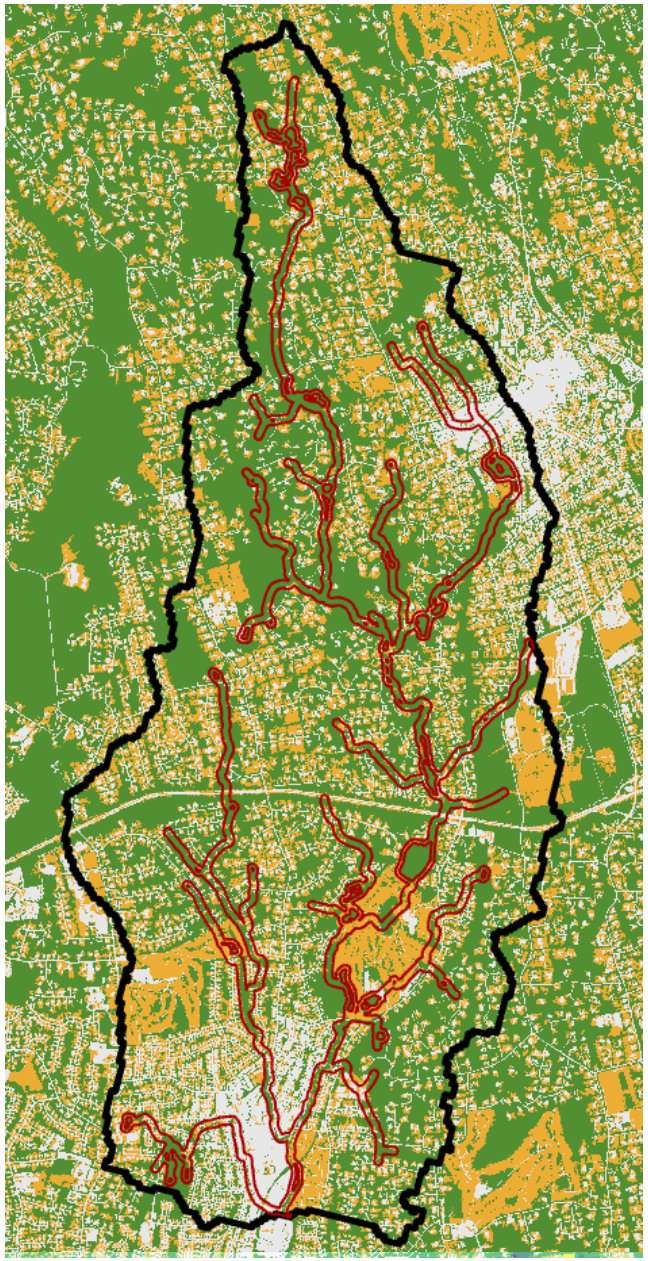
1. Divide a watershed into
   - upland watershed (everything outside the buffer)
   - 100' riparian buffer



How is CCI Calculated?

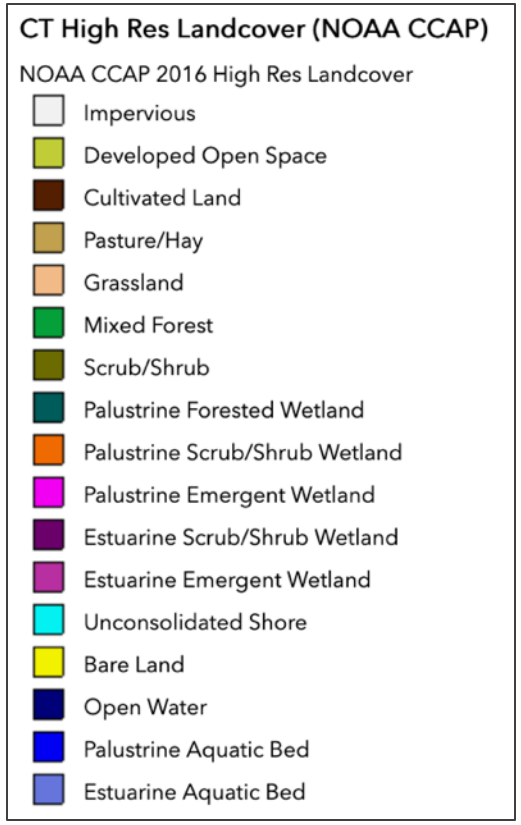
2. Compare percentage of natural land in the upland watershed vs natural land in the 100' buffer.

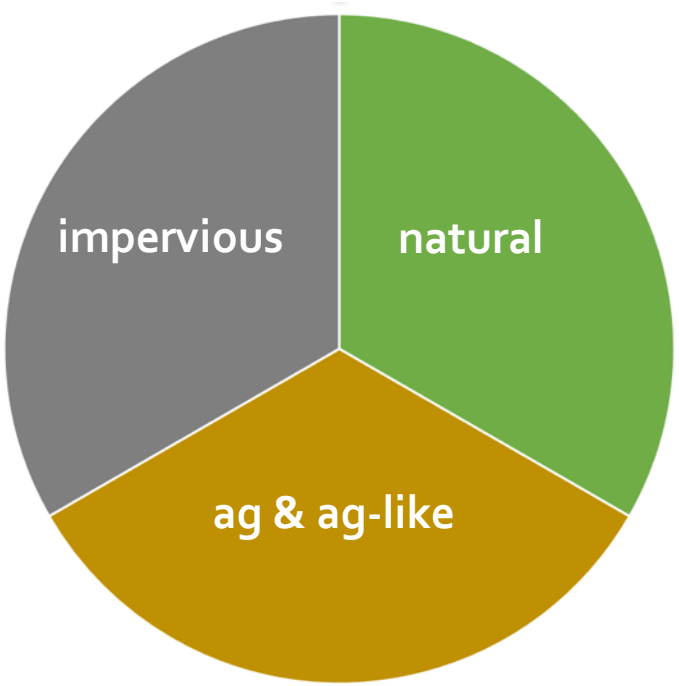
- Natural (N)
- Impervious (IC)
- Agriculture-like (AL)

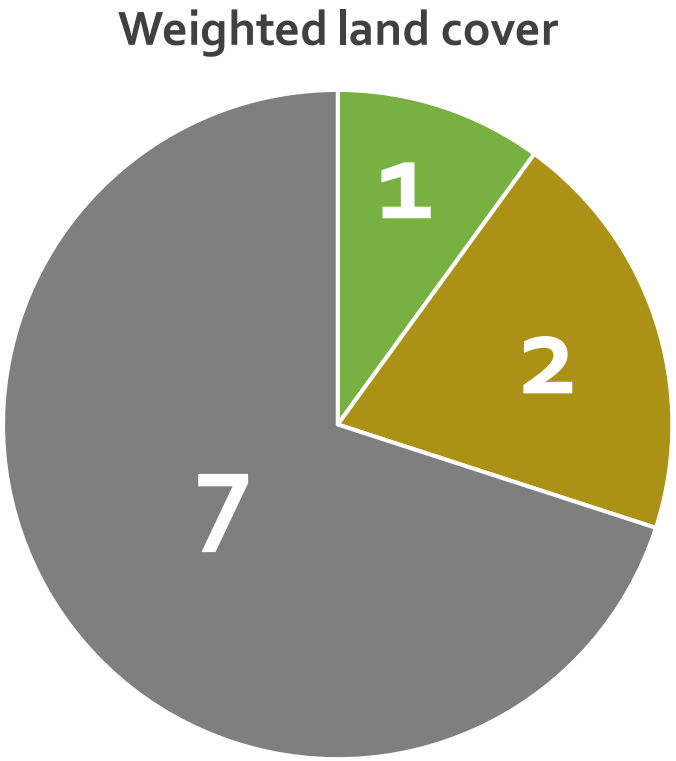


But all land cover classes are not alike!

Weighting factors based on best fit with MMI data but also are in line with the literature on the relative loading rates of different land covers.







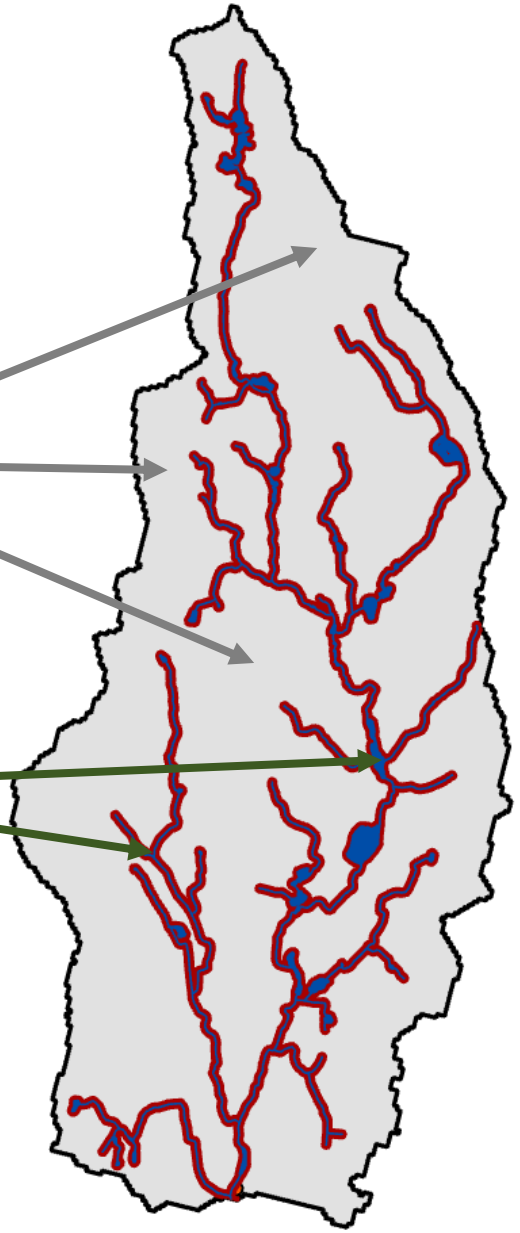
How is CCI Calculated?

Watershed Condition Index
(WCI)

Pressures from
watershed land use

Buffer Condition Index
(BCI)

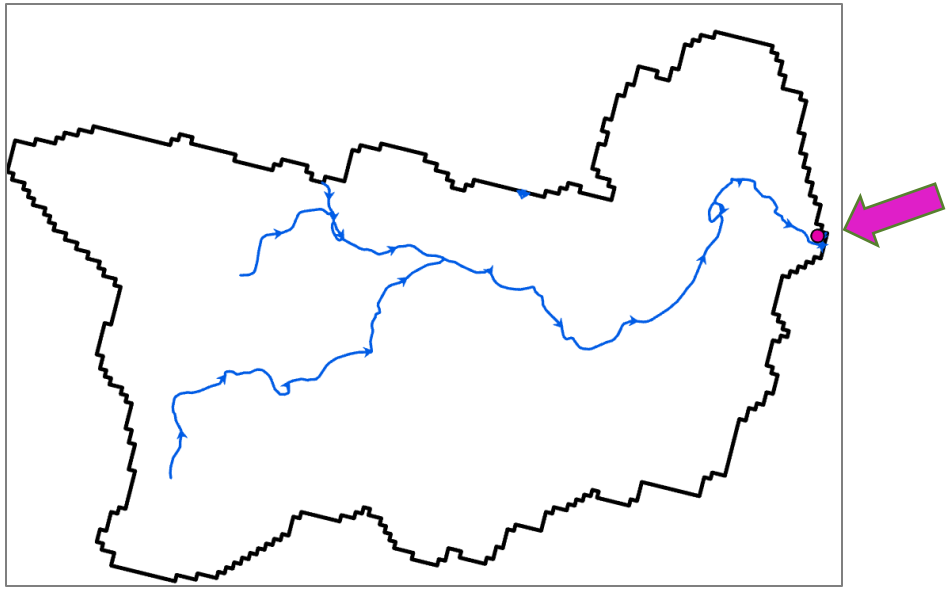
Mitigative effects of buffer

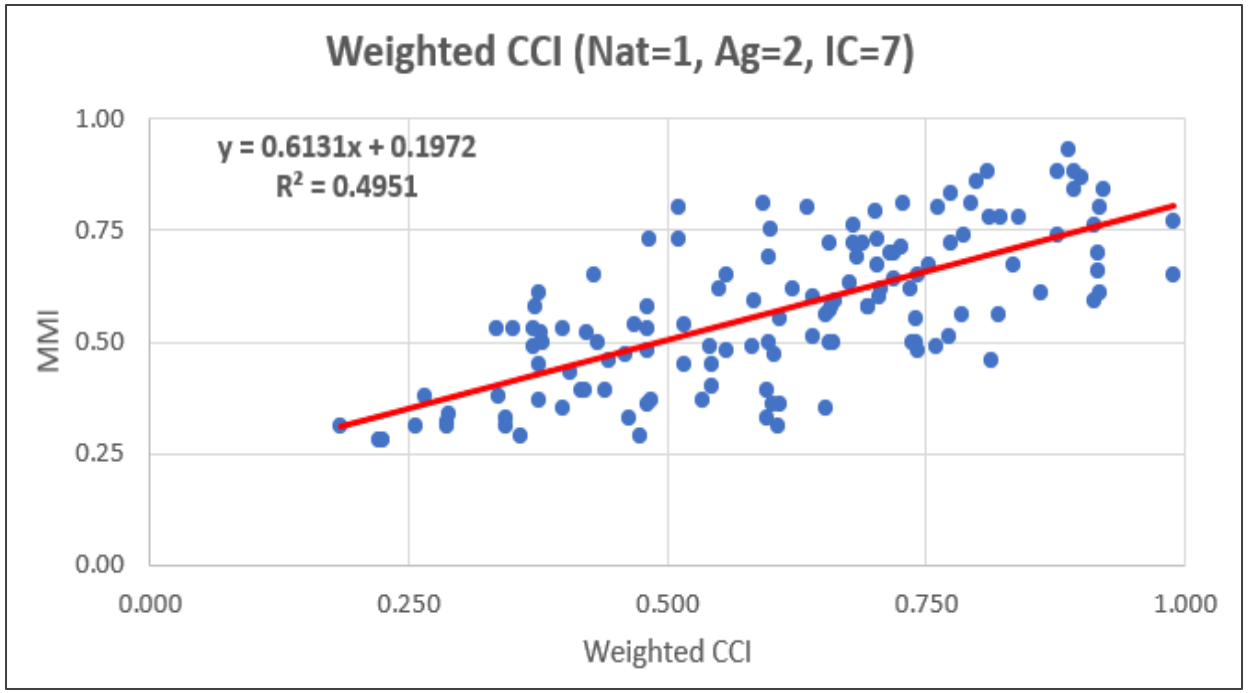


CCI

Relating CCI to MMI

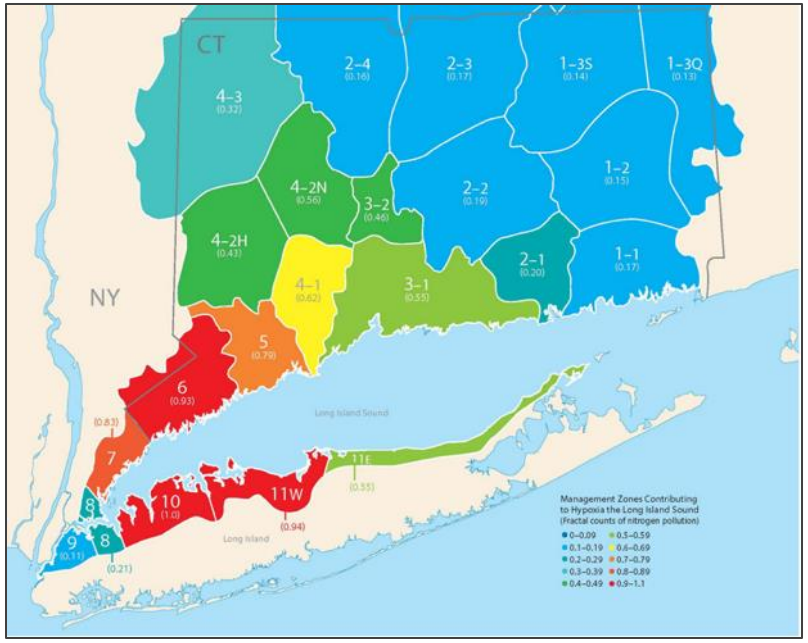
- Compare CCI with MMI (160 samples from 144 sites)
  - delineate upstream watershed
  - calculate CCI for each site
  - empirical regression analysis





Nitrogen Enrichment Factor (EF)

- CCI was compared to loading estimates from USGS gauging station data, and the USGS SPARROW model
- Relationship is normalized to Enrichment Factor, where 1 = “natural” condition
- EF thus is a ratio of expected N load to a theoretical natural load, i.e., a measure of **PROPORTIONAL DOSING**



Long Island Sound Study N Management Zones

- ✓ allows comparison between basins (vs loading)
- ✓ easier for non-technical people to understand(?)

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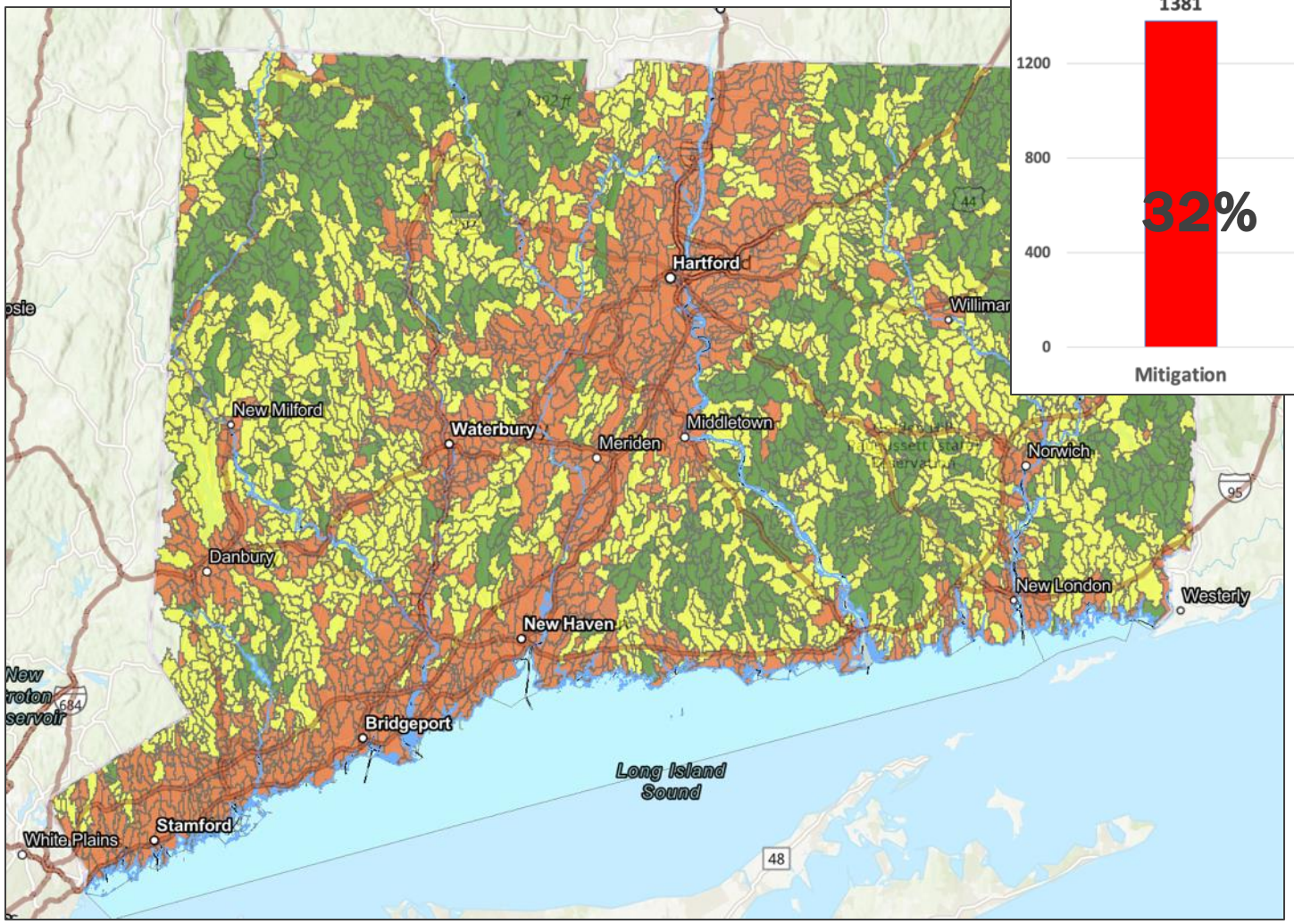
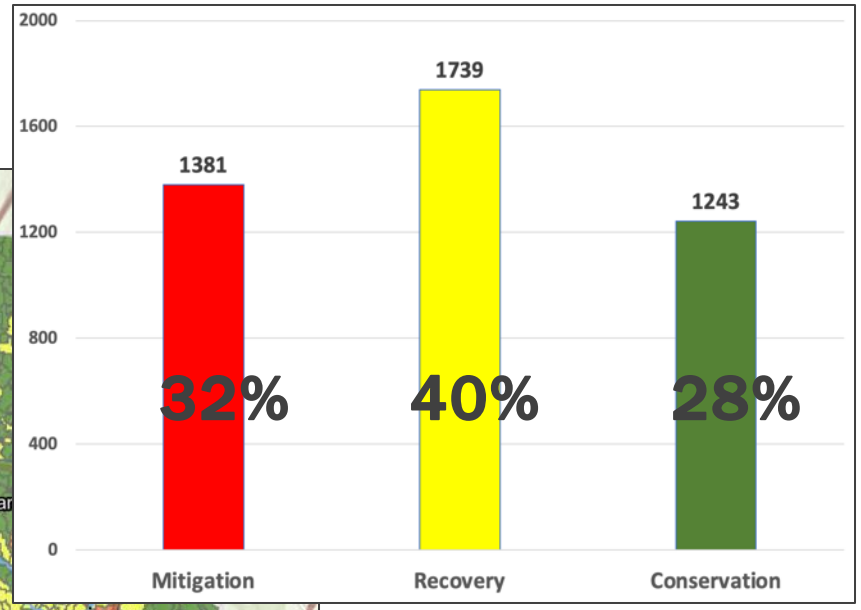
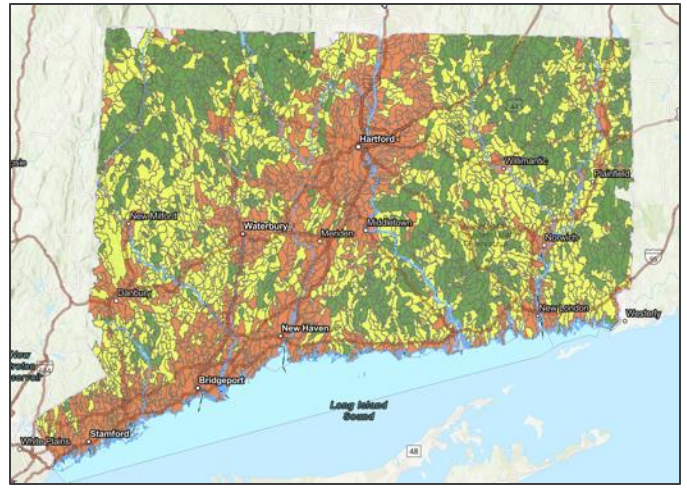
CCI map of CT


Hartford
New Milford
Waterbury
Meriden
Middletown
Norwich
Danbury
New London
Westerly
New Haven
Bridgeport
Long Island Sound
Stamford
White Plains
48
95
684


2000
1600
1200
800
400
0
1381
1739
1243
32%
40%
28%
Mitigation
Recovery
Conservation

CCI Recovery Categories

Recovery Category indicates the state of, and suggested land use strategy for, a local basin, based on the current CCI value.

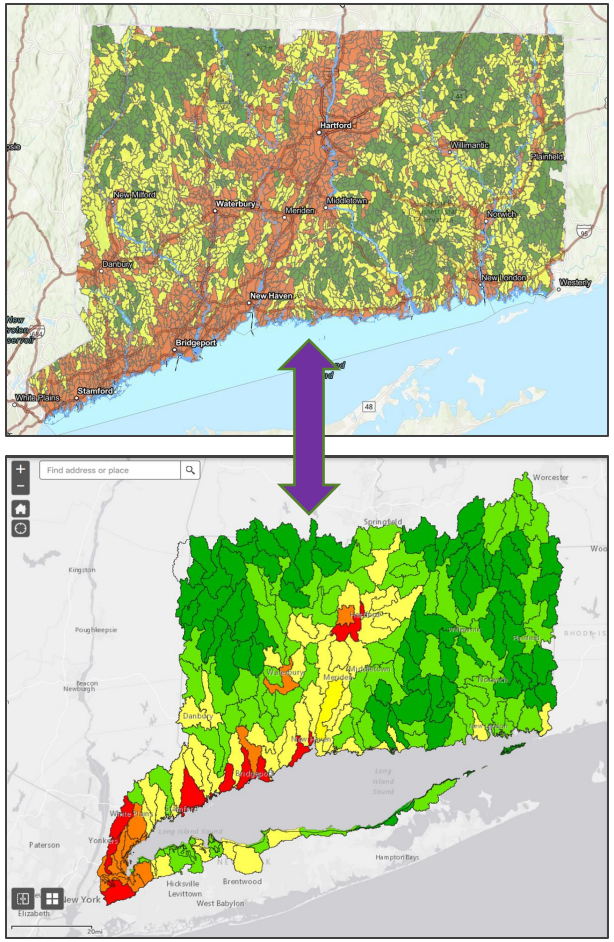


- **Conservation if CCI >= 0.75.** This means that the health of the watershed is likely to be good, and should be protected by land conservation and riparian protection strategies.

- **Recovery if 0.43 <= CCI < 0.75.** This means the health of the watershed is likely to be impaired but could be improved with conservation and reforesting of key area and riparian restoration.

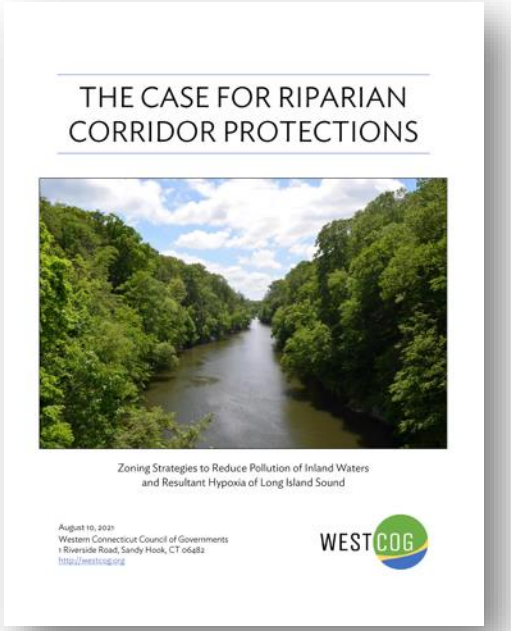
- **Mitigation if CCI < 0.43.** This means that the health of the watershed is likely to be significantly impaired, but can be improved with an emphasis on restoration activities within the riparian zone and projects such as those designed to increase the urban tree canopy.

So where are we now?



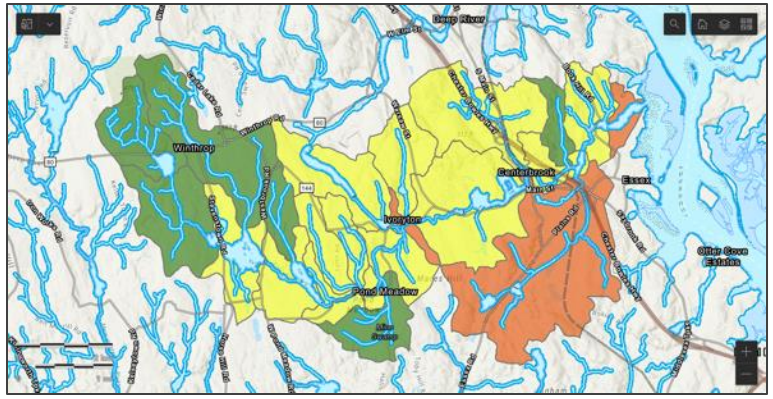
- ✓ Finer resolution = more accurate land cover data
- ✓ Finer resolution = ability to better assess smaller landscape elements such as riparian corridors
- ✓ Finer scale = more reliable indicator
- ✓ Finer scale = information more suitable for local consideration/action
- ✓ CCI is tied directly to state wq/biocondition data (MMI)
- ✓ Project analysis and tools support more specific mitigation and protection strategies & targets
- ✓ New focus on riparian corridors

And where to go from here?



Riparian protection

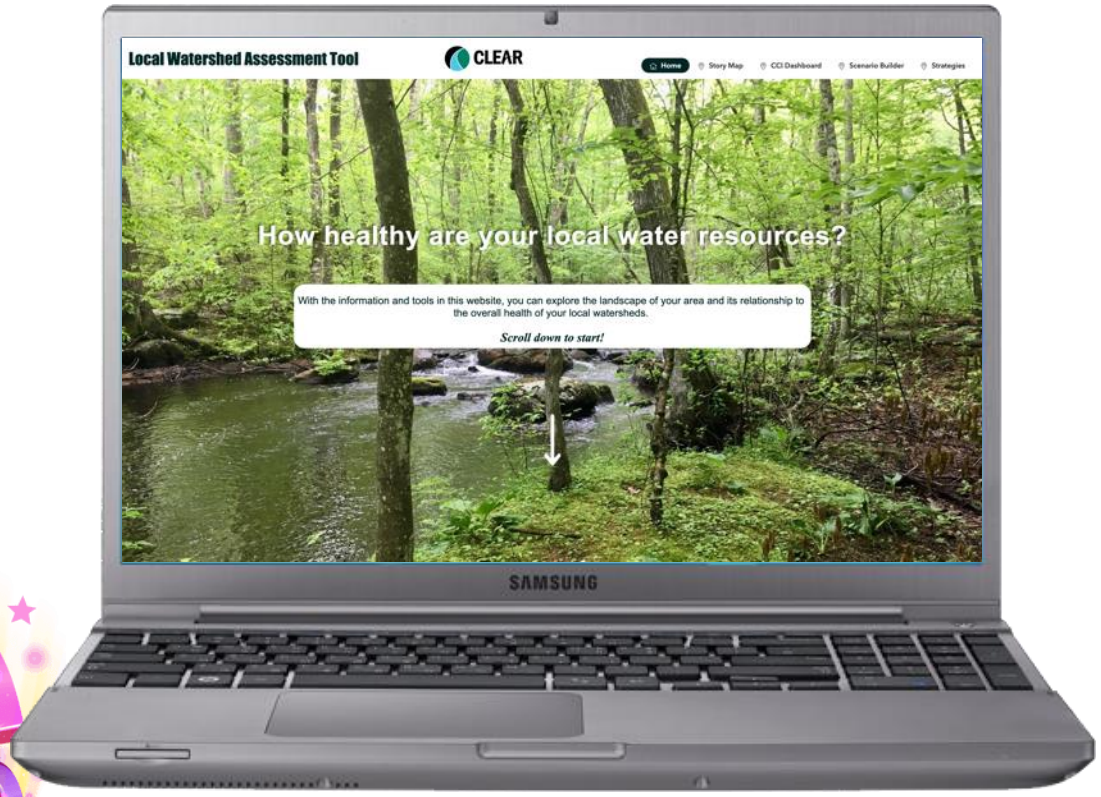
IC Mitigation (LID)

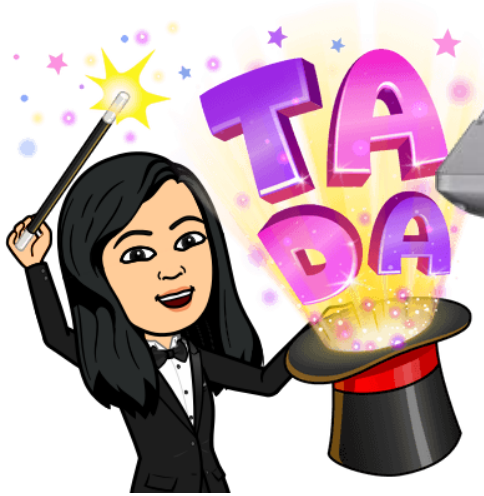


Land conservation

Your Favorite Here

Demo time!!


Local Watershed Assessment Tool
CLEAR
Home
Story Map
CCI Dashboard
Scenario Builder
Strategies
How healthy are your local water resources?
With the information and tools in this website, you can explore the landscape of your area and its relationship to the overall health of your local watersheds.
Scroll down to start!
SAMSUNG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