



Low Impact Development Basics for Water Quality Protection

April 16, 2025



National Estuarine Research Reserve System



What is an estuary?





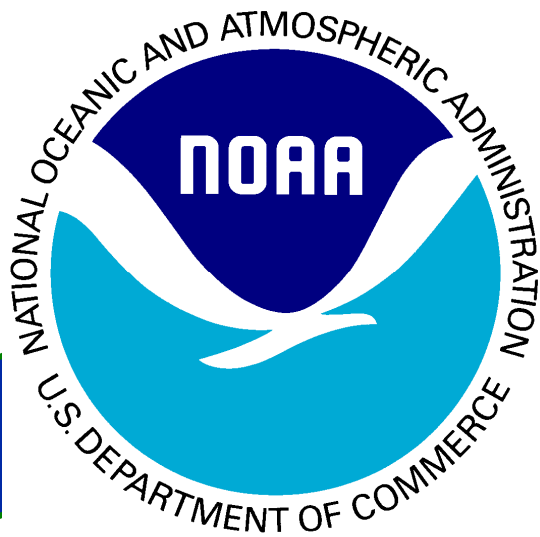
Natural Infrastructure



Wetlands and reefs
and mangroves...**oh my!**



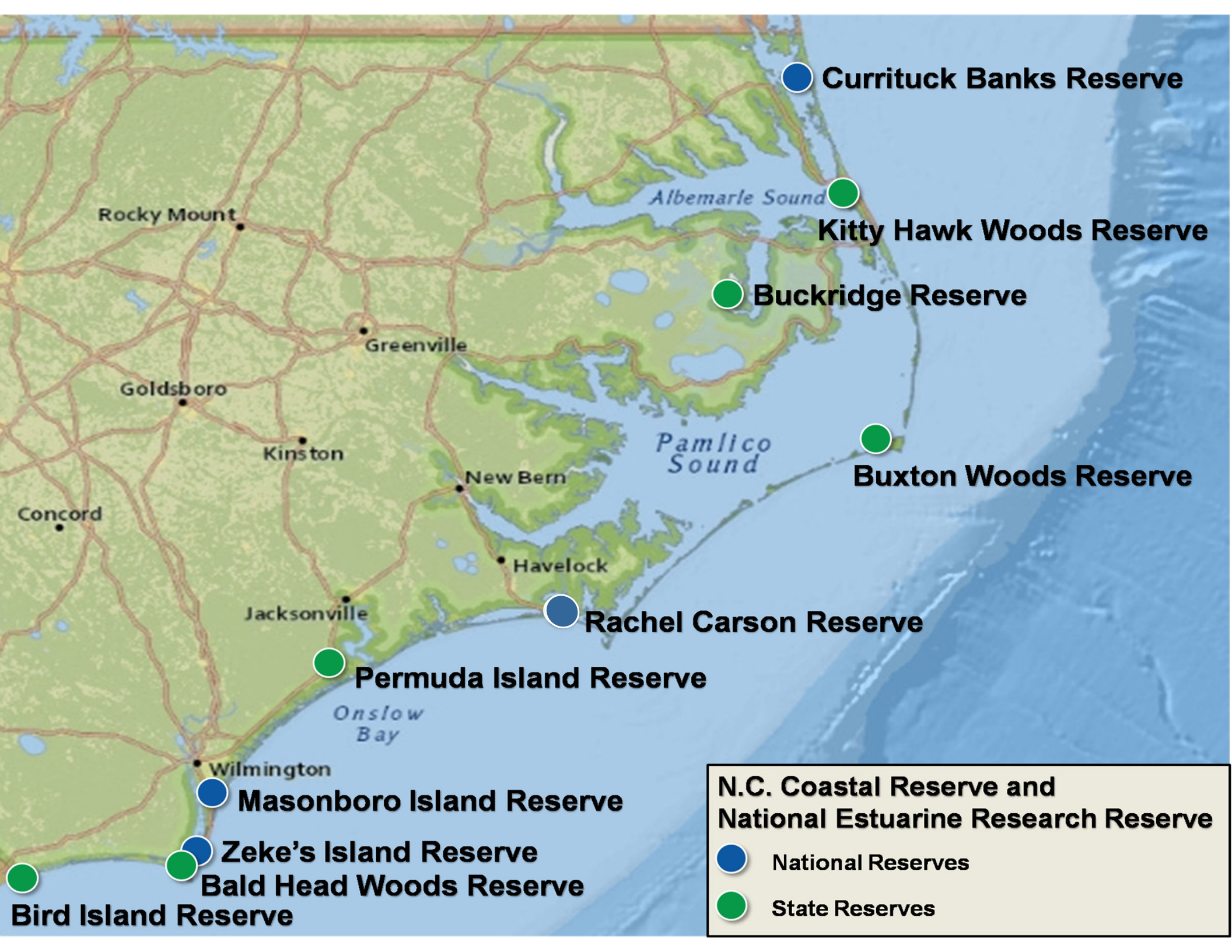
Billions in savings (\$23 billion/year),
services (water quality and storm protection),
and value (37% higher property value).



North Carolina Coastal Reserve



**North Carolina
National Estuarine Research Reserve**



Currituck Banks Reserve

Kitty Hawk Woods Reserve

Buckridge Reserve

Buxton Woods Reserve

Rachel Carson Reserve

Permuda Island Reserve

Masonboro Island Reserve

Zeke's Island Reserve

Bald Head Woods Reserve

Bird Island Reserve

**N.C. Coastal Reserve and
National Estuarine Research Reserve**

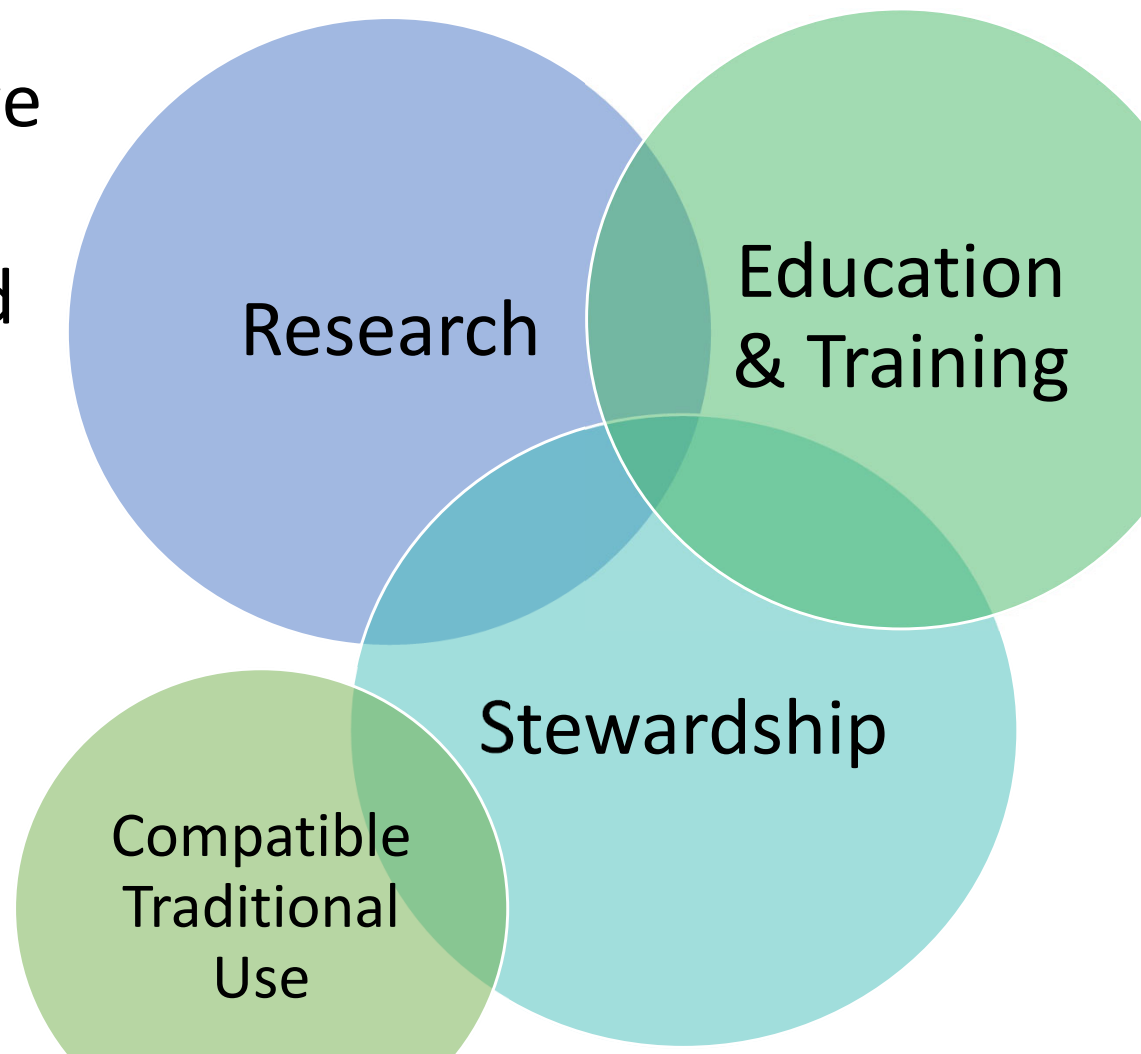
National Reserves

State Reserves

Mission



To practice and promote stewardship of coasts and estuaries through innovative research, education, and training using a place-based system of protected areas.



Social Media



North Carolina Coastal Reserve



Rachel Carson Reserve



Masonboro Island Reserve



@NCReserve



Presentations Available Online



Past Workshop Resources



To obtain additional course documents from past workshops, please contact Coastal Training Program Coordinator [Whitney Jenkins](#) at 252-838-0882.

Coastal Training Program

[Scheduled Workshops](#)

Past Workshops

<https://deq.nc.gov/past-workshops>

Today's Purpose

- Learn how land use decisions impact water quality.
- Learn how Low Impact Development techniques and native plants help protect water quality.
- Learn about managing stormwater control measures (SCMs) to meet state and local regulations and to maintain functionality and aesthetics.
- Provide you continuing education credits while increasing your professional knowledge.

Agenda

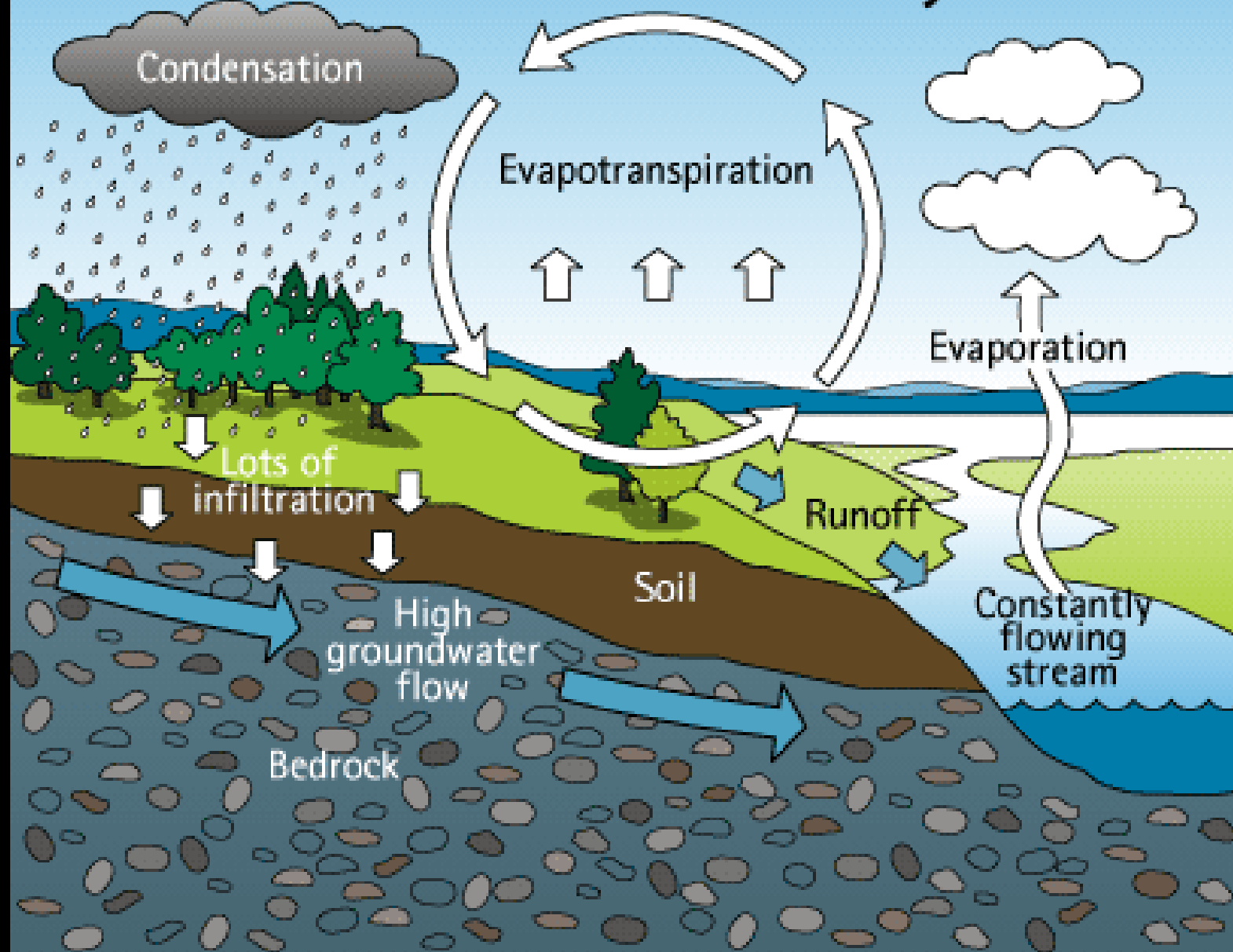
- The Land Use - Water Quality Connection – Whitney Jenkins
- The North Carolina Watershed Game
- Break
- Debrief from the Watershed Game
- Maximizing Property Value with SmartYards – Bonnie Mitchell, North Carolina Coastal Federation
- Break
- Rooted in Nature: Conserving NC's Coast Using Native Plants and Trees – Krystyna Ochota & Amy Mead, North Carolina Cooperative Extension
- Break
- Maintenance Costs of Stormwater Control Measures in North Carolina – Amber Ellis, North Carolina State University
- Adjourn

Logistics

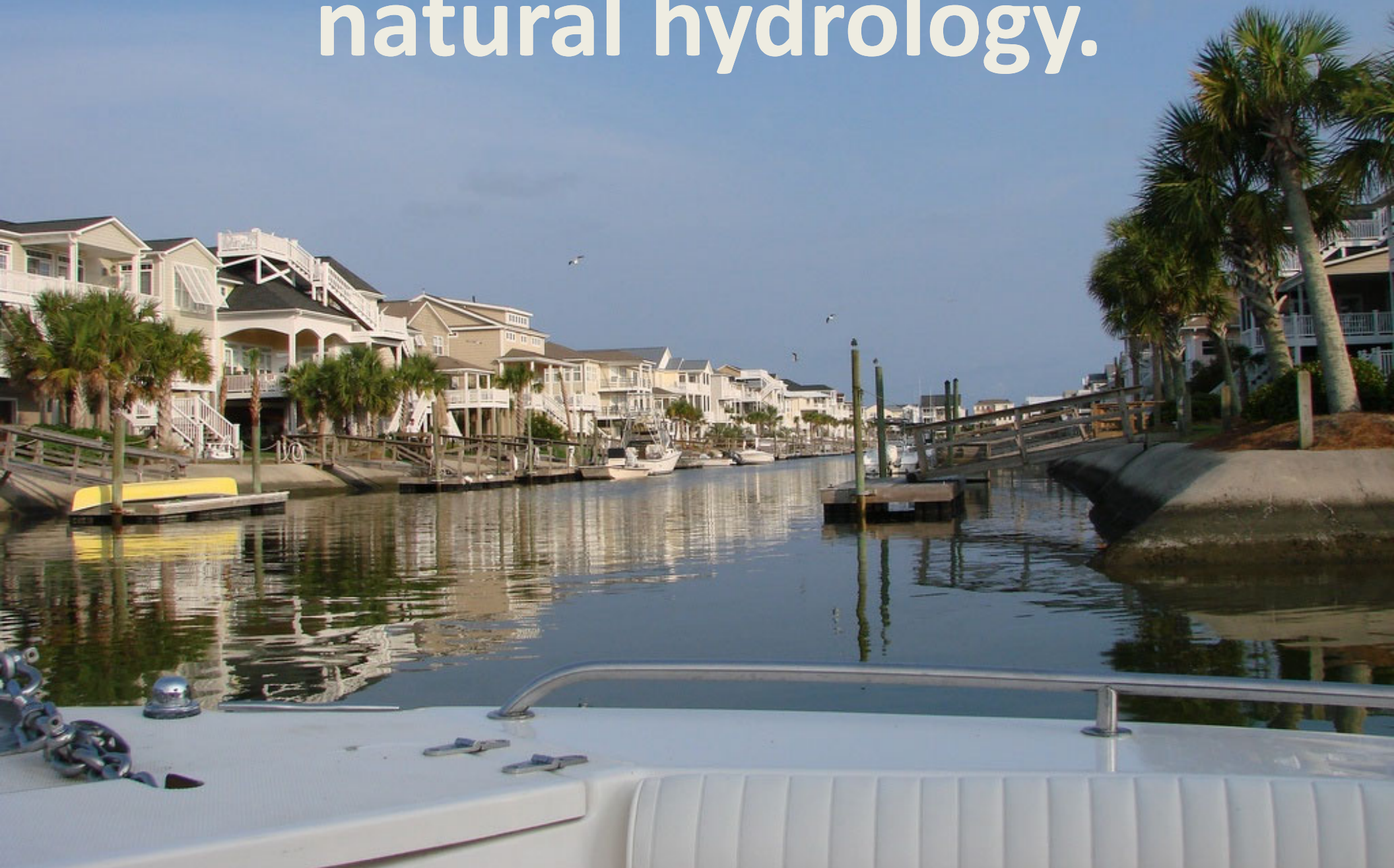
- Your certificate of completion will be available at the end of today's class
- I will upload your license numbers to the NC Real Estate Commission tomorrow
- QR code on agenda and an email tomorrow:
 - Workshop web page with links to presentations and resources
 - Workshop evaluation

The Land Use – Water Quality Connection

The natural water cycle



We have changed the
natural hydrology.



Parking Lots



Parking Lots Continued



Parking Lot & Street Runoff



Ditching





Cul-De-Sacs

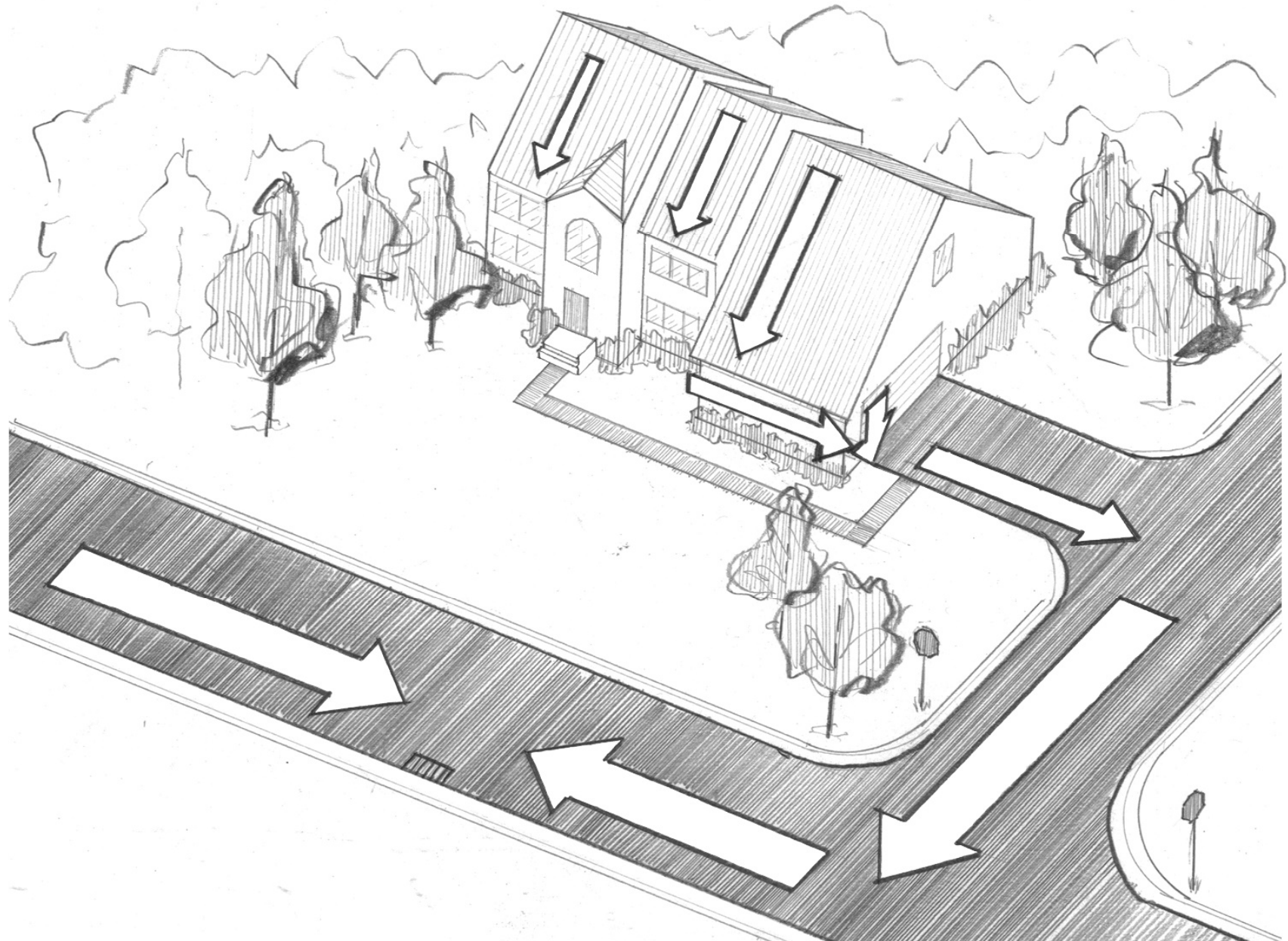
Rooftop Runoff



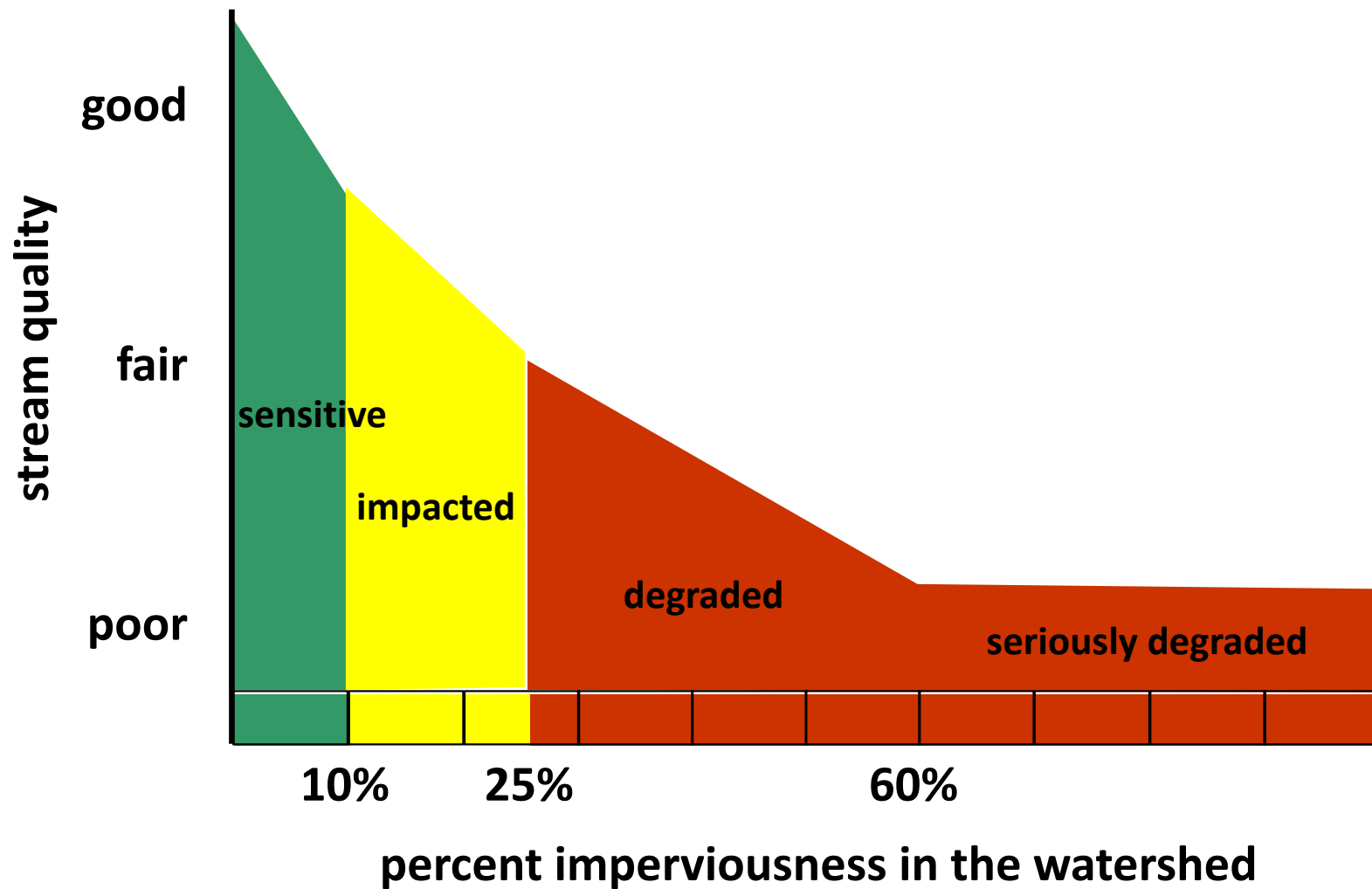
Curbs and Gutters



The Stormwater “Super-Highway”



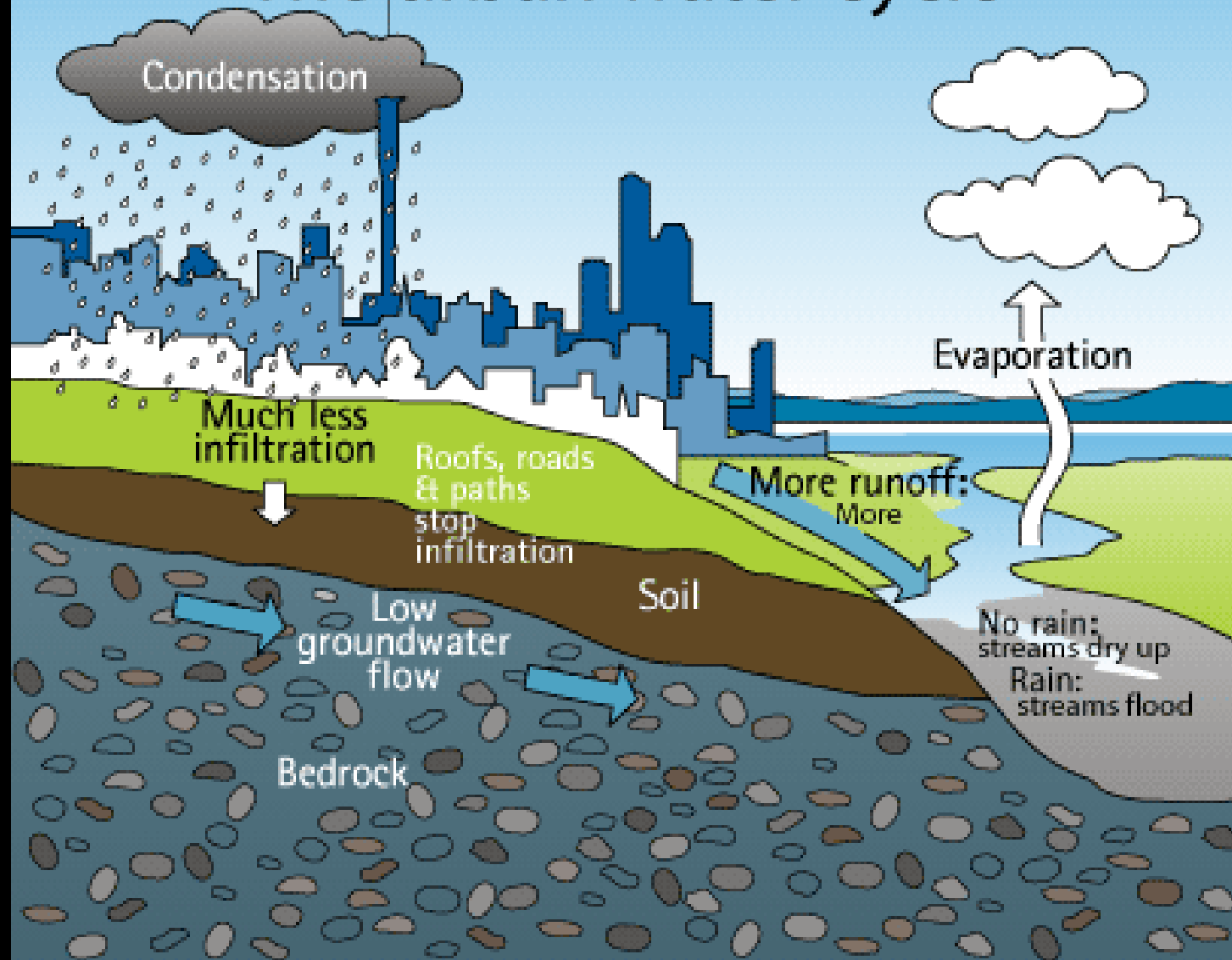
Imperviousness effects stream quality



Vegetated Buffers & Living Shorelines



The urban water cycle



What is a watershed?

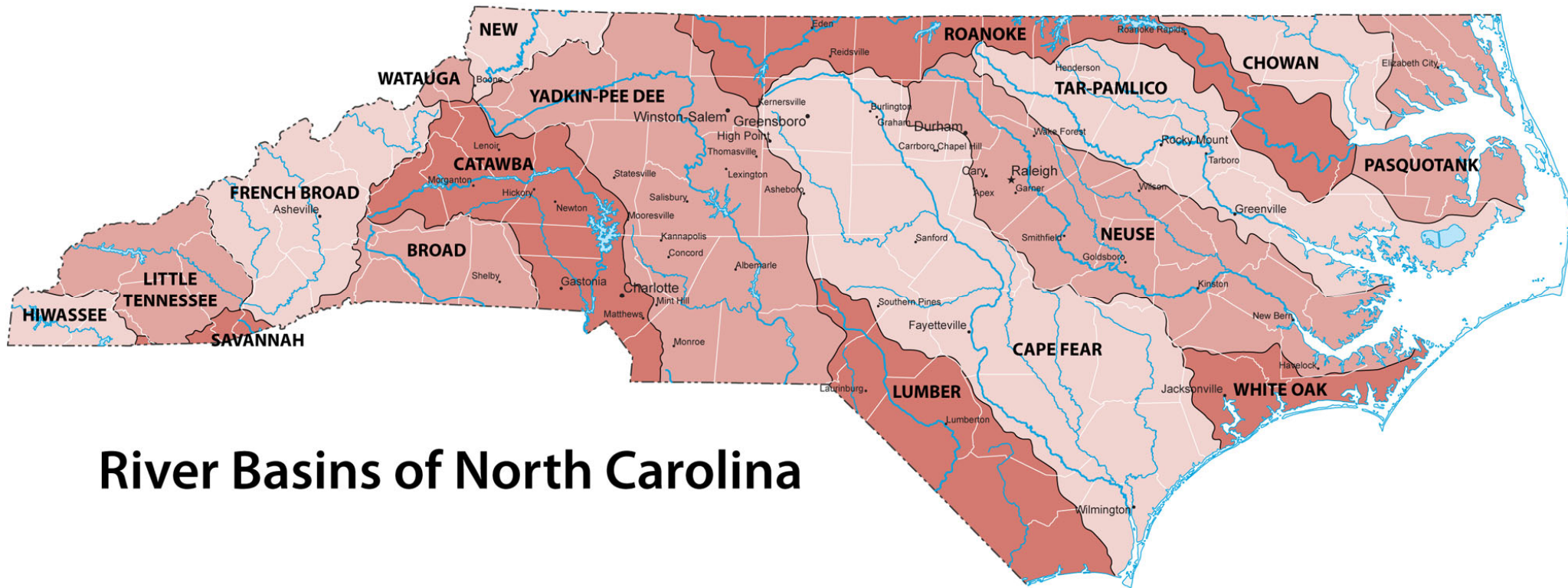
- A. An area of land defined by topography, not political boundaries?
- B. An area of land that catches rain and drains or seeps into a marsh, stream, river, or groundwater
- C. An area of land located in a river basin
- D. All of the above

What is a Watershed?



What North Carolina River Basin do you live in?

- A. Cape Fear
- B. Chowan
- C. Lumber
- D. Neuse
- E. Pasquotank
- F. Roanoke
- G. Tar-Pamlico
- H. White Oak
- I. Other
- J. Don't know



River Basins of North Carolina



What are the intended uses of our water resources?

- A. Aquatic life habitat
- B. Drinking water
- C. Swimming and fishing
- D. All of the above

Intended Uses of Water Resources



- Aquatic life habitat
- Drinking water
- Swimming
- Fishing

What is a Water Quality Impairment?

The inability of a water resource to meet its intended uses.

For example, an estuary is impaired when high levels of bacteria ban the harvesting of oysters.

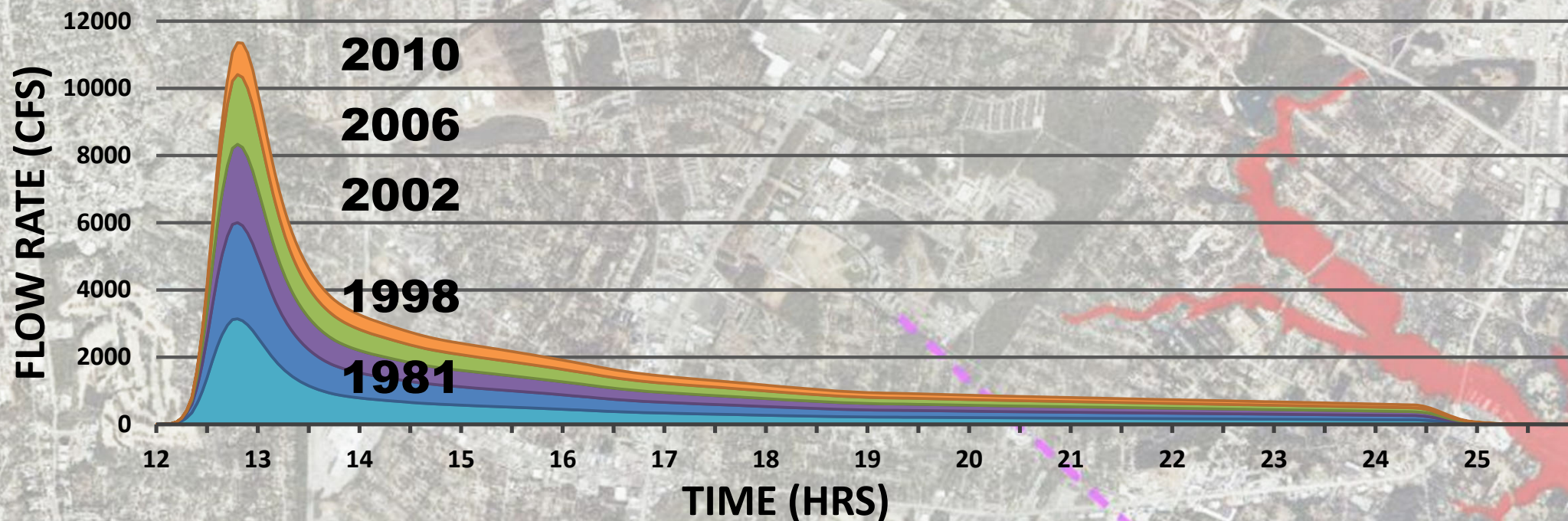
Shellfish Water Harvest Closure Map

<https://ncdenr.maps.arcgis.com/apps/webappviewer/index.html?id=5759aa19d7484a3b82a8e440fba643aa>

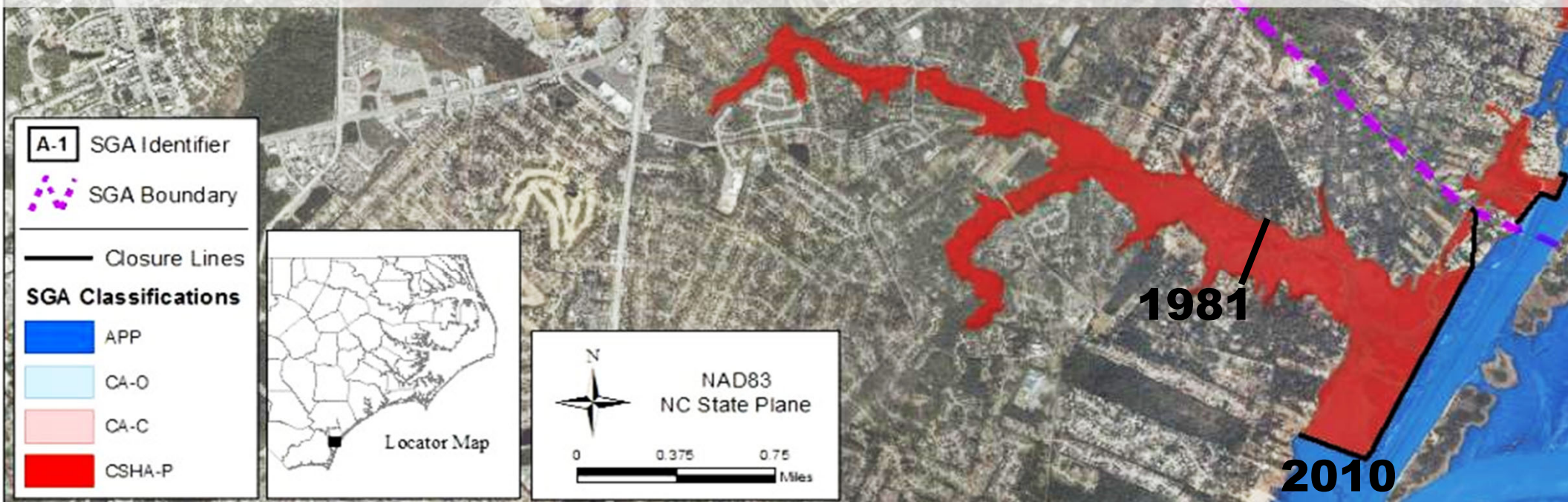
Swimming Advisory Map

<https://ncdenr.maps.arcgis.com/apps/webappviewer/index.html?id=3a38378983874a88aeaf6c3027292587>

HEWLETTS CREEK WATERSHED 1-YR STORM HYDROGRAPHS



CHANGES IN SHELLFISH CLOSURE BOUNDARIES



Pollution Sources: Point Source



Pollution Sources: Nonpoint Source



Pollutants of Concern

- **Nutrients**- nitrogen and phosphorus can lead to algal blooms, eutrophication, and fish kills
- **Microbes**- public health risk, can lead to closure of fishing areas and loss of revenue (i.e. bacteria, viruses, parasites)
- **Sediment**- clogs drainageways, clouds rivers, and degrades aquatic habitat



Nutrients



Nutrients



Eutrophication



Nutrients & Microbes



Nutrients & Microbes



Nutrients & Microbes

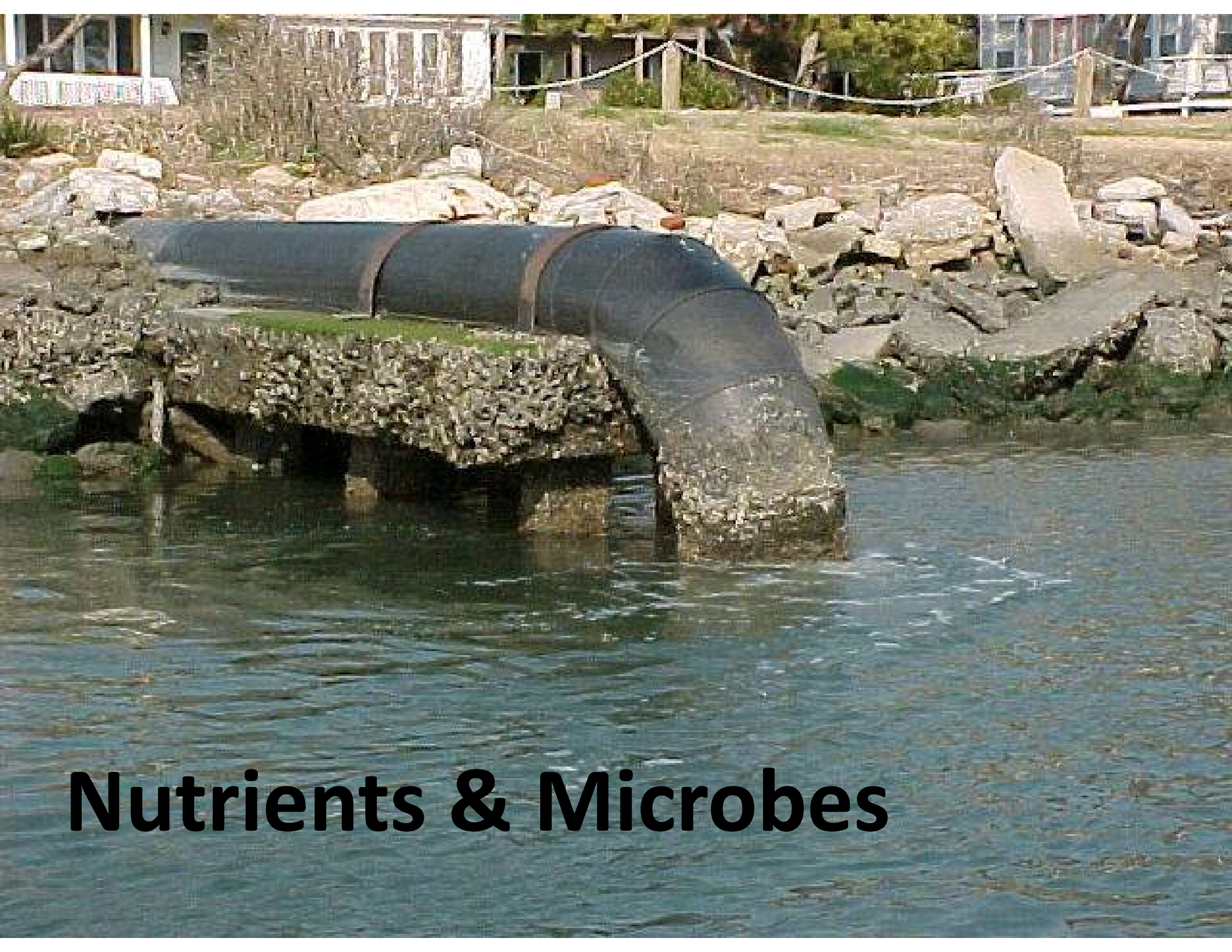




Nutrients & Microbes



Nutrients & Microbes



Nutrients & Microbes

Nutrients & Microbes



Nutrients & Microbes



CLOSED AREA

**UNLAWFUL TO TAKE OYSTERS,
CLAMS, OR MUSSELS.
SHELLFISH MAY CAUSE
SERIOUS ILLNESS IF EATEN.**



NC MARINE FISHERIES



ATTENTION

**SWIMMING IN THIS AREA
IS NOT RECOMMENDED.**

**BACTERIA TESTING
INDICATES LEVELS OF
CONTAMINATION THAT
MAY BE HAZARDOUS TO
YOUR HEALTH. THIS
ADVISORY AFFECTS
WATERS WITHIN 200'
OF THIS SIGN.**

OFFICE OF THE STATE HEALTH DIRECTOR

Sediment





Sediment



Sediment

Stormwater pollutants also include any materials that can build up on impervious surfaces: oil, grease, trash, auto fluids, dirt, etc.



So what's the bottom line...

- Everything is connected
- What we do on the land affects...
 - Water quality
 - Animal habitat
 - Our economy (i.e. tourism, commercial fishing)
 - Our quality of life
- It has been proven that conventional development does not protect water quality
- We can develop the land AND protect water quality

Towards a more sustainable urban water cycle



Watershed Game

Overall Goals:

- Introduce concepts
- Be involved in land use decisions
- Wear different hats
- Learn from each other

Watershed Game

- Board is a fictional watershed
- Currently, there are 300 pollution units entering the waterbody, including upstream sources

Algal blooms are occurring periodically
& there were fish kills this summer.
What can cause this?

- A. Excess nutrients
- B. Bacteria
- C. Viruses
- D. Sediment
- E. All of the above

Submerged aquatic vegetation (or seagrass) has been lost in some areas of the sound because the sunlight cannot reach the plants. What can cause this?

- A. Excess nutrients
- B. Bacteria
- C. Viruses
- D. Sediment
- E. All of the above

Oyster beds have been closed to harvesting. This is due to high levels of bacteria found in the water. Where are the microbes coming from?

- A. Pet waste
- B. Wildlife waste
- C. Failing septic systems
- D. Sewer system overflows
- E. Improperly managed livestock
- F. Marinas with no pump-out stations
- G. All of the above

Watershed Game

This waterbody isn't meeting its intended uses!

Watershed Game

- There needs to be a reduction in pollution reaching the waterbody
- **Goal:** Reduce the pollution load to the sound to the pre-established limit of **130 pollution units**
- Local government, businesses, & residents have decided to reduce pollution coming from stormwater before new rules are imposed upon them

Watershed Game

- There are five land uses on this game board
 - Agriculture/Forest
 - Residential
 - Downtown
 - Commercial
 - Park/Golf Course/Undeveloped
- You will be divided into game groups
- Two or three-person teams for each land use
- Each land use has five “solution cards” that can be played to reduce pollution, but all cost “money”

Rules of Game

- Each team gets a budget of 6 candies
- Each team plays 1 solution card per round and explains the card and why it was chosen
- Pay the banker after playing the solution card
- Teams cannot swap solution cards
- After each round the banker will determine the new pollution unit amount for the waterbody
- Goal: reduce pollution (as a group) from 300 to 130 units
- **Have fun!**