
DELAWARE CENTER FOR THE
INLAND BAYS
Research. Educate. Restore.
Good Evening! Thank you for joining the meeting! Sit tight, you are muted temporarily, and we'll get started shortly.

Introductions

- CIB is a private non-profit dedicated to protecting and restoring Delaware's Inland Bays
- **Chris Bason, Executive Director**
- B.S. in Agriculture from UD, M.S. in Biology from ECU
- 23 years of experience researching and restoring wetlands and estuaries
- Started with CIB in 2004

Meeting flow and etiquette

- Meeting presentation will be posted to website
- Presentation will appear on your screen for those connecting in zoom
- Participants will be muted during presentation
- Questions can be typed into chat during the presentation and will be moderated by Nivette
- Discussion will follow presentation
- Request courtesy for all points of view and constructive criticism
- Participants please during discussion monitor any background noises and mute yourself, state your name before speaking at least the first few times and be respectful to share time with others

Purpose of the Meeting

- Educate about the function and importance of better buffers
- Educate about the County's proposed buffer ordinance
- Present Center's requested amendments on the ordinance to the County
- Answer questions/hold discussion

Resources

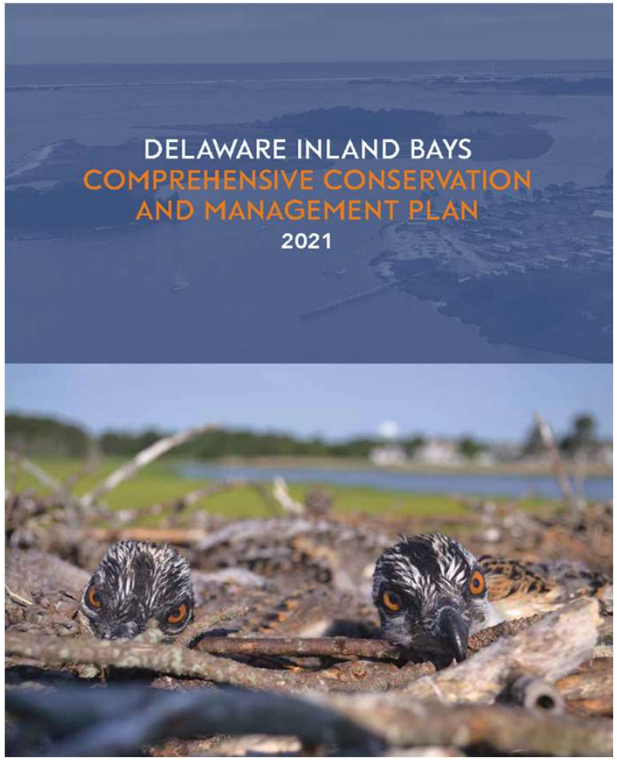
- Center for the Inland Bays Recommendations for Water Quality Buffers 2008
- Center fact sheet on buffers (dated)
- County Proposed Ordinance
- Council Meeting agenda (instructions for remote access and participation on page 4)
- This presentation

Contents

- Inland Bays Comprehensive Conservation and Management Plan
- History of Efforts to Achieve Better Buffers
- Status of Resources
- Review of Purposes and Function of Buffers
- Achievements and Assessment of Ordinance Effectiveness
- Requested Amendments to the Ordinance
  - Requirement for forests and replanting
  - Removal of Options (Section G.)
  - Minor amendments
  - Addition of specific enforcement requirements

Buffers are an important action of the 2021 Inland Bays CCMP

- 67 actions focused on
  - reducing nutrient pollution to achieve water quality
  - protecting and restoring natural habitats
  - public education and engagement
  - mitigating & adapting to flooding and climate change
- County 1 of 7 Plan Signatories
- 60% of 500 public surveyed identified runoff from developments as the biggest threat.
- Increasing protection of buffers is in 1995 CCMP, 2012 Addendum, and 2021 Revision.
- CM 2-5: Revise the Sussex County Code related to buffers for improved water quality.
- Buffers also action in 2018 County Comprehensive Plan

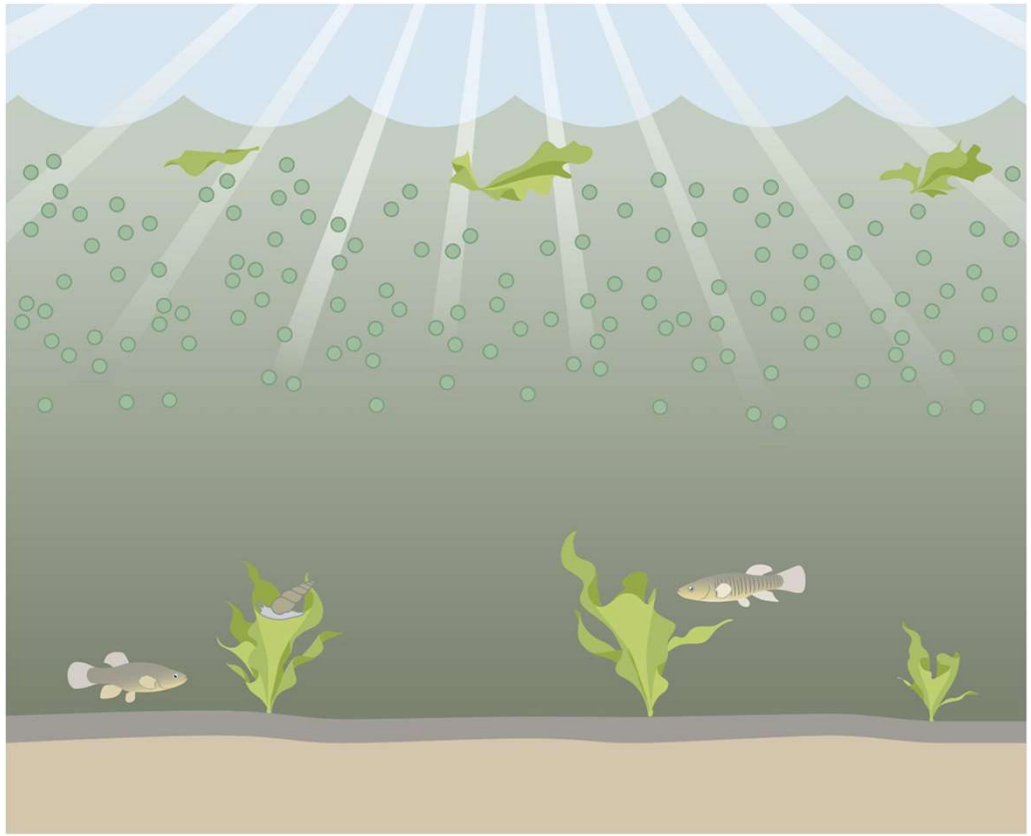



Bay Grasses
Love Creek

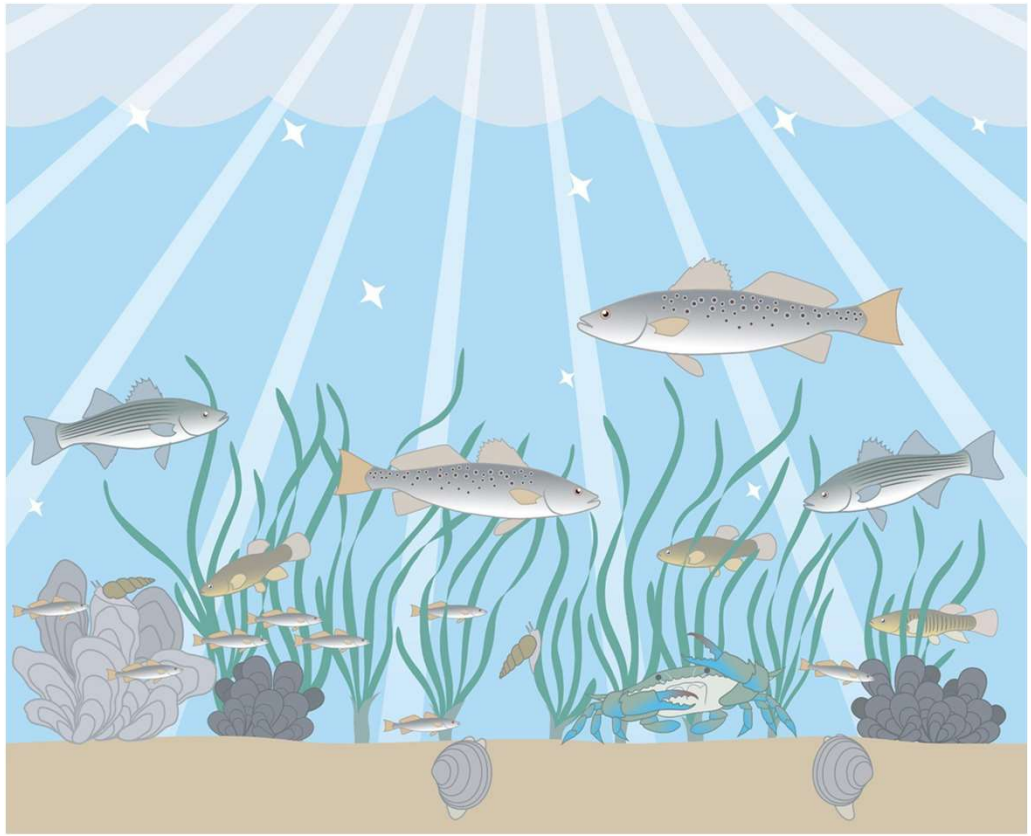
History of Efforts to Realize Better Buffers in Sussex

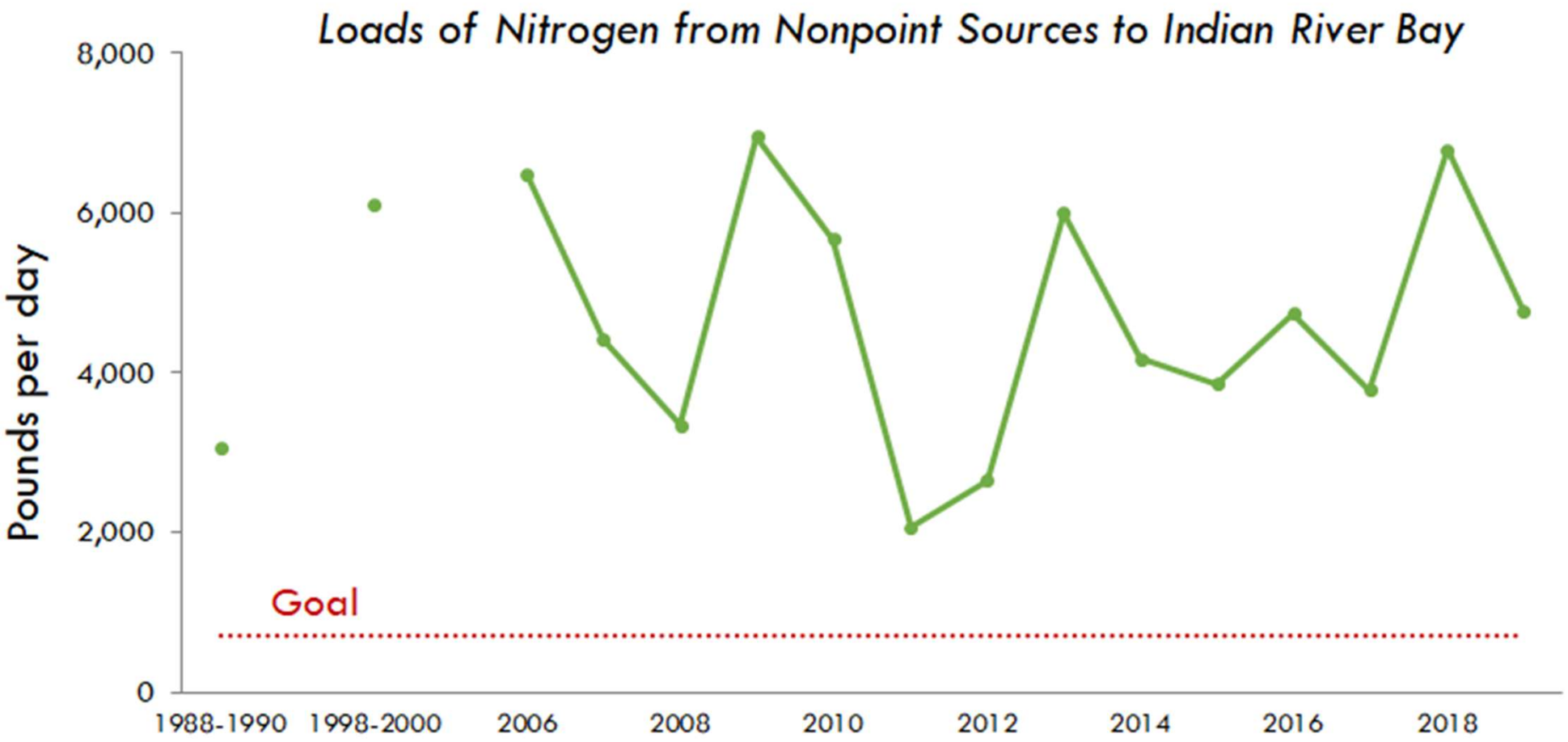
- 1988 -- existing Co. 50-ft buffer ordinance enacted; inconsistently applied, enforced.
- 1995 -- CCMP adopted with Co. action to expand shoreline setback to 300 feet.
- 2008 -- Center published science based buffer system recommendations.
- 2008 -- DNREC PCS passed with buffer of up to 100 feet
- 2011 -- PCS buffer struck by DE Supreme Court
- 2012 -- CCMP updated to include Co. ordinance based on Center's recommendations
- 2018 -- Exploration of buffer ordinance included in Sussex Comp Plan
- 2019 -- County forms buffer workgroup
- 2020 -- Workgroup effort suspended
- 2021 -- Buffer ordinance introduced, P&Z hearing held

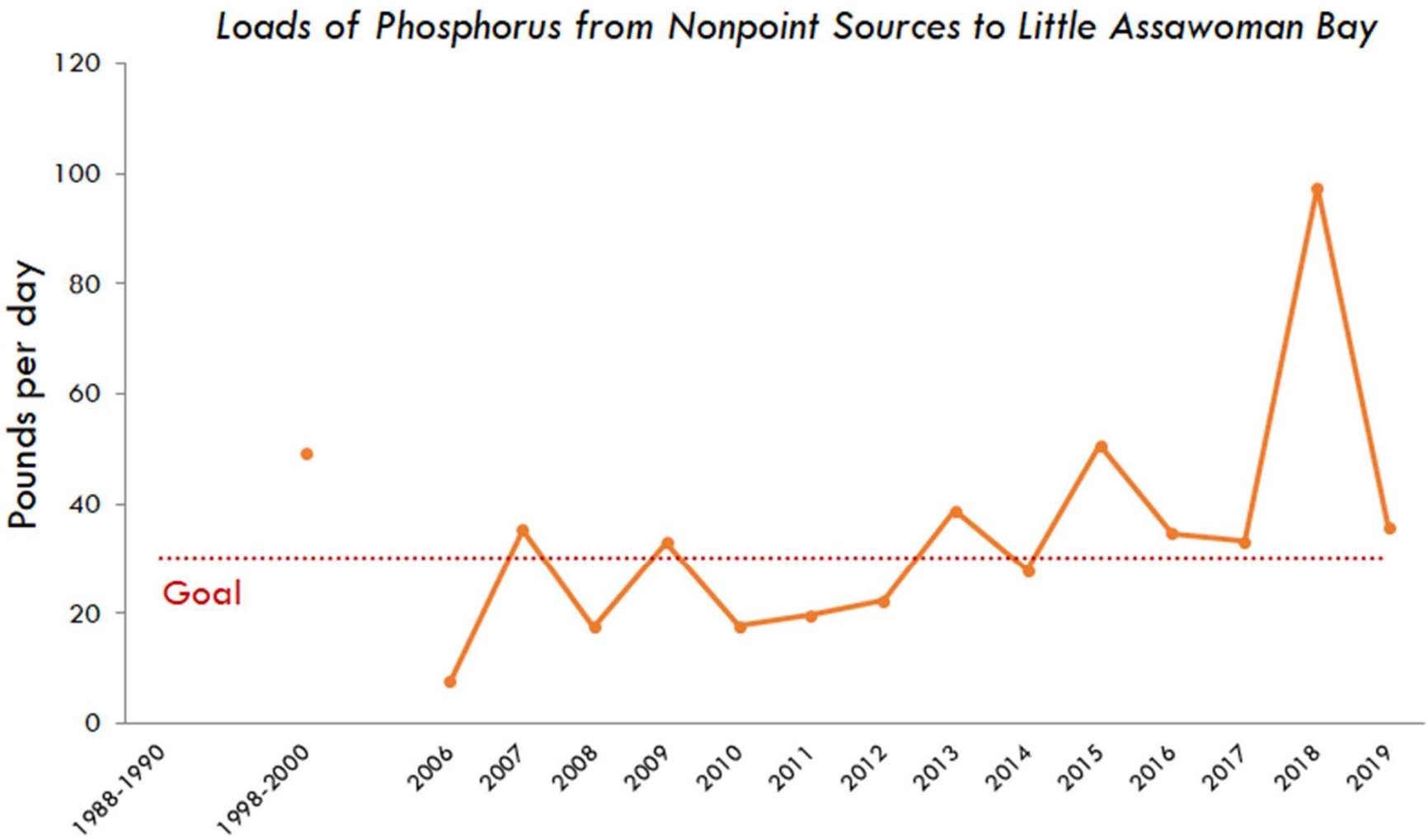
Excess Nutrients: Current Condition

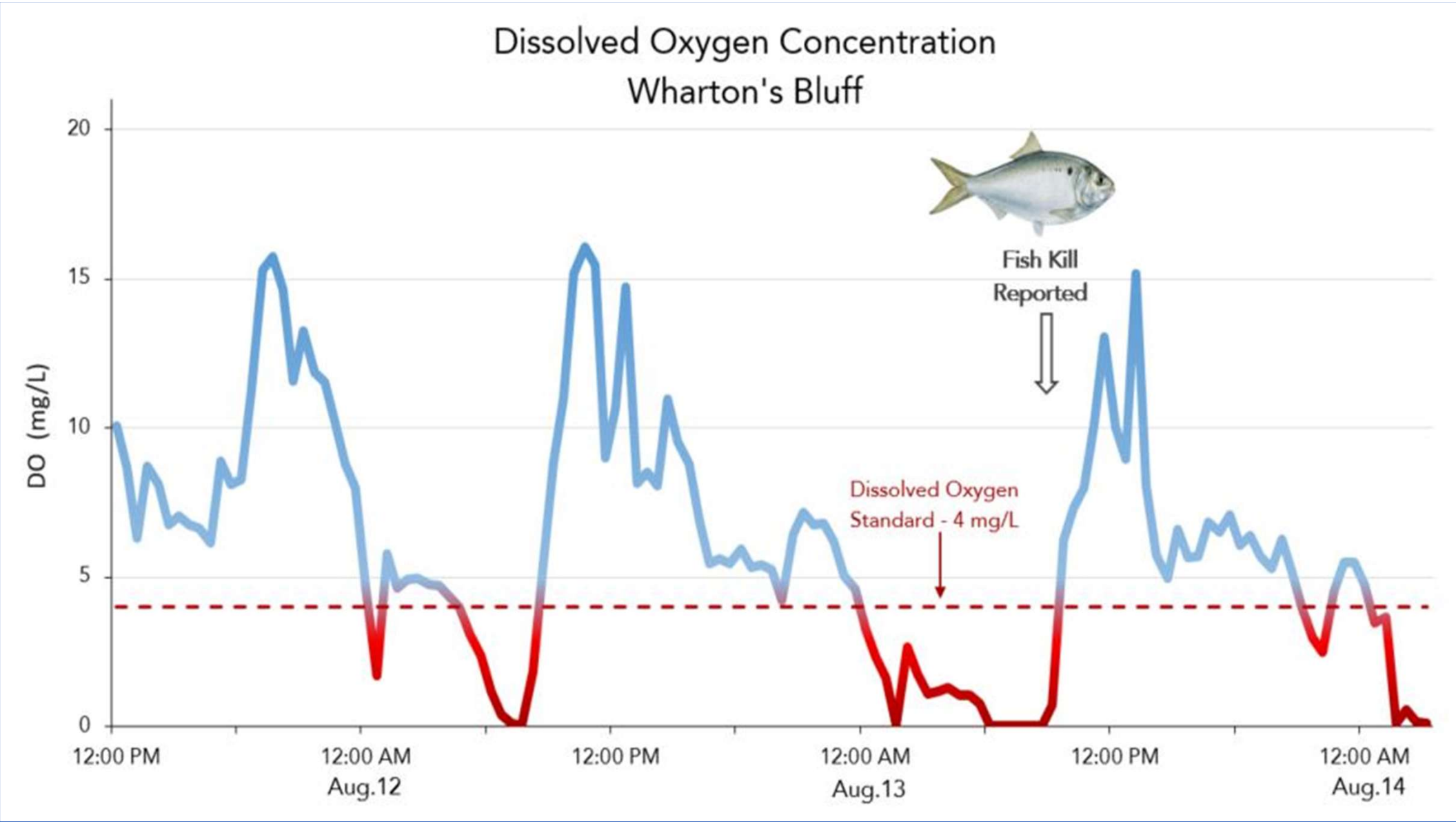


Healthy Bay: Restoration Target



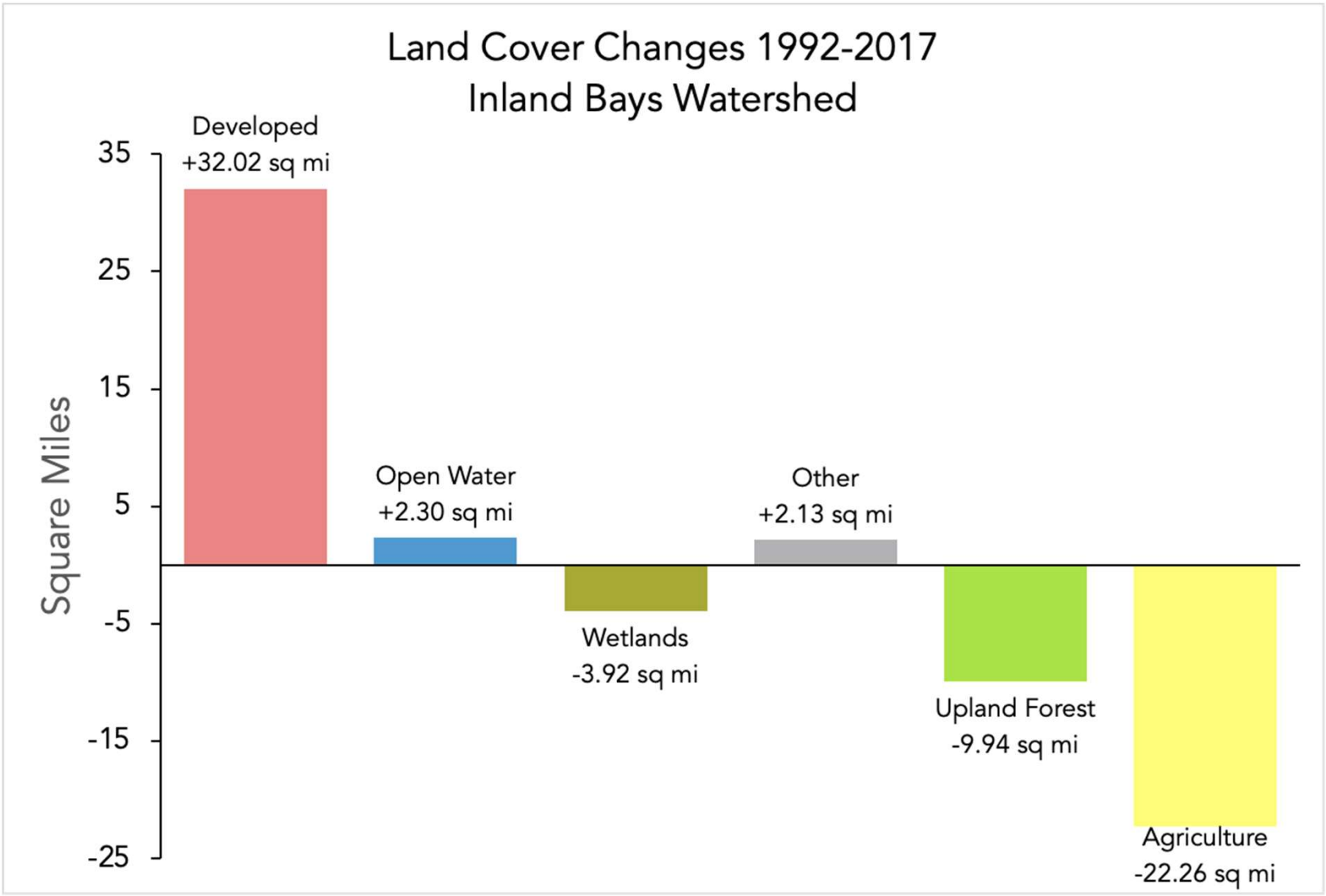

Loads of Nitrogen from Nonpoint Sources to Indian River Bay
Pounds per day
8,000
6,000
4,000
2,000
0
Goal
1988-1990
1998-2000
2006
2008
2010
2012
2014
2016
2018


Loads of Phosphorus from Nonpoint Sources to Little Assawoman Bay
Pounds per day
120
100
80
60
40
20
0
Goal
1988-1990
1998-2000
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019


Dissolved Oxygen Concentration
Wharton's Bluff
DO (mg/L)
20
15
10
5
0
Fish Kill
Reported
Dissolved Oxygen
Standard - 4 mg/L
12:00 PM
12:00 AM
Aug.12
12:00 PM
12:00 AM
Aug.13
12:00 PM
12:00 AM
Aug.14

2021 set record for number of Inland Bays fish kills

- 15 recorded
- In canals creeks and open waters
- ~2 million fish mostly menhaden
- Low dissolved oxygen


Land Cover Changes 1992-2017
Inland Bays Watershed
Square Miles
35
25
15
5
-5
-15
-25
Developed
+32.02 sq mi
Open Water
+2.30 sq mi
Wetlands
-3.92 sq mi
Other
+2.13 sq mi
Upland Forest
-9.94 sq mi
Agriculture
-22.26 sq mi

Changes in Upland Forest Cover Over Time

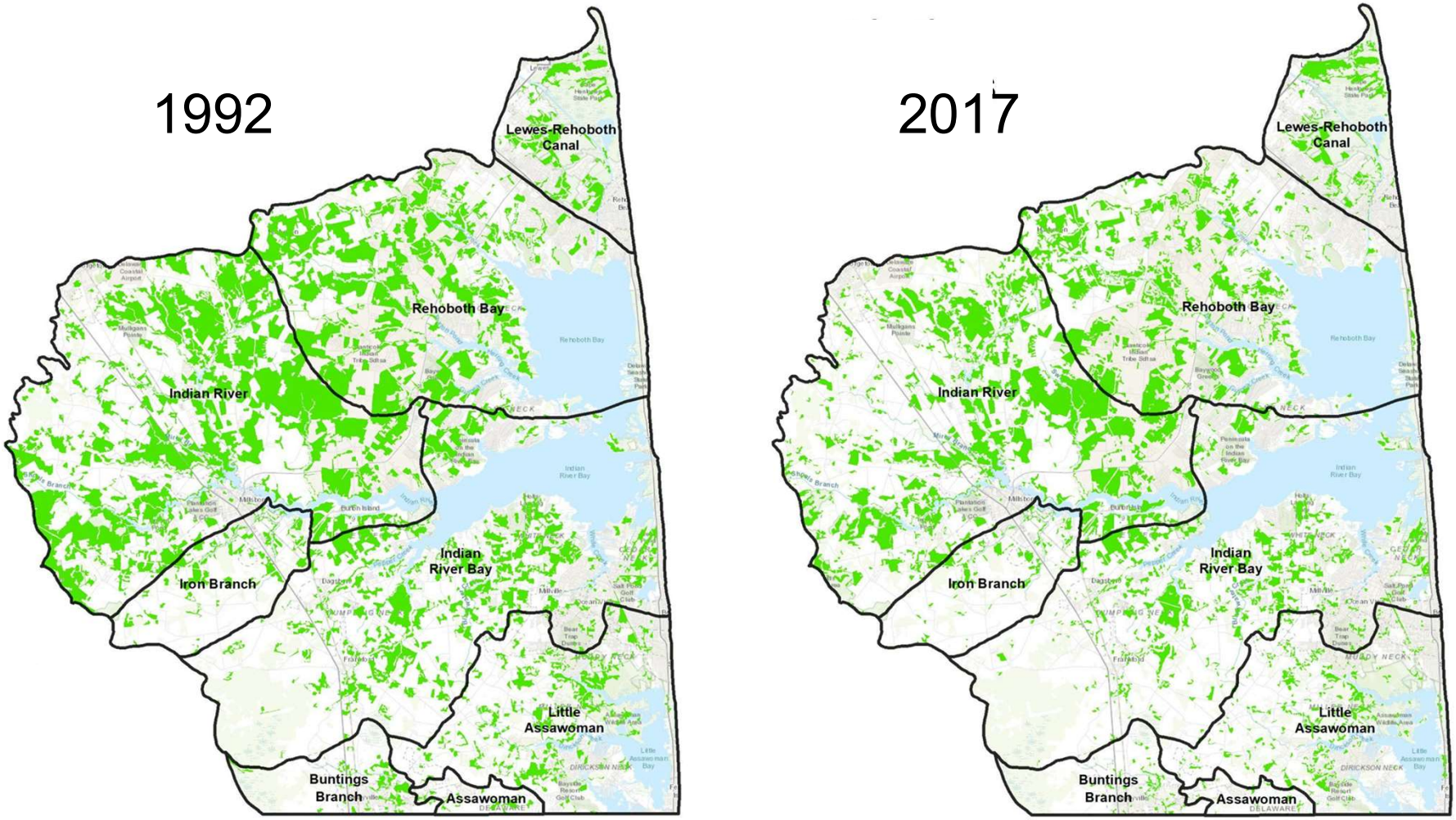



Photo: Driscoll Drones


On average, 51% of forest in a proposed Sussex development is cleared.
From 108 Preliminary Land Use Applications over 2017-2019, 2 square miles of forest were intended for clearing.
White Creek

Building happening in flood prone areas

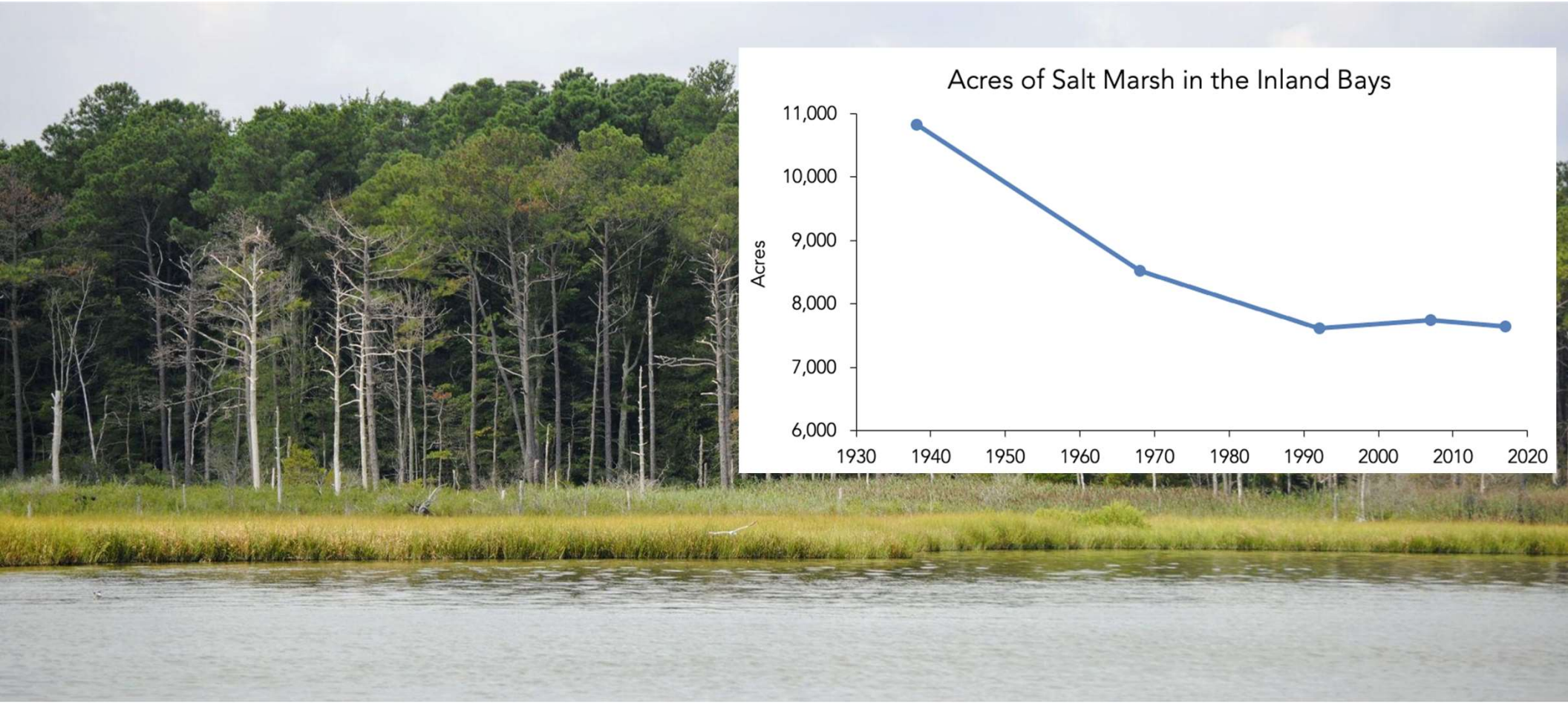
From 2010 to 2017 Sussex Co. had 3rd-highest number of homes built in 10-year flood risk zone of any ocean coastal county in US.

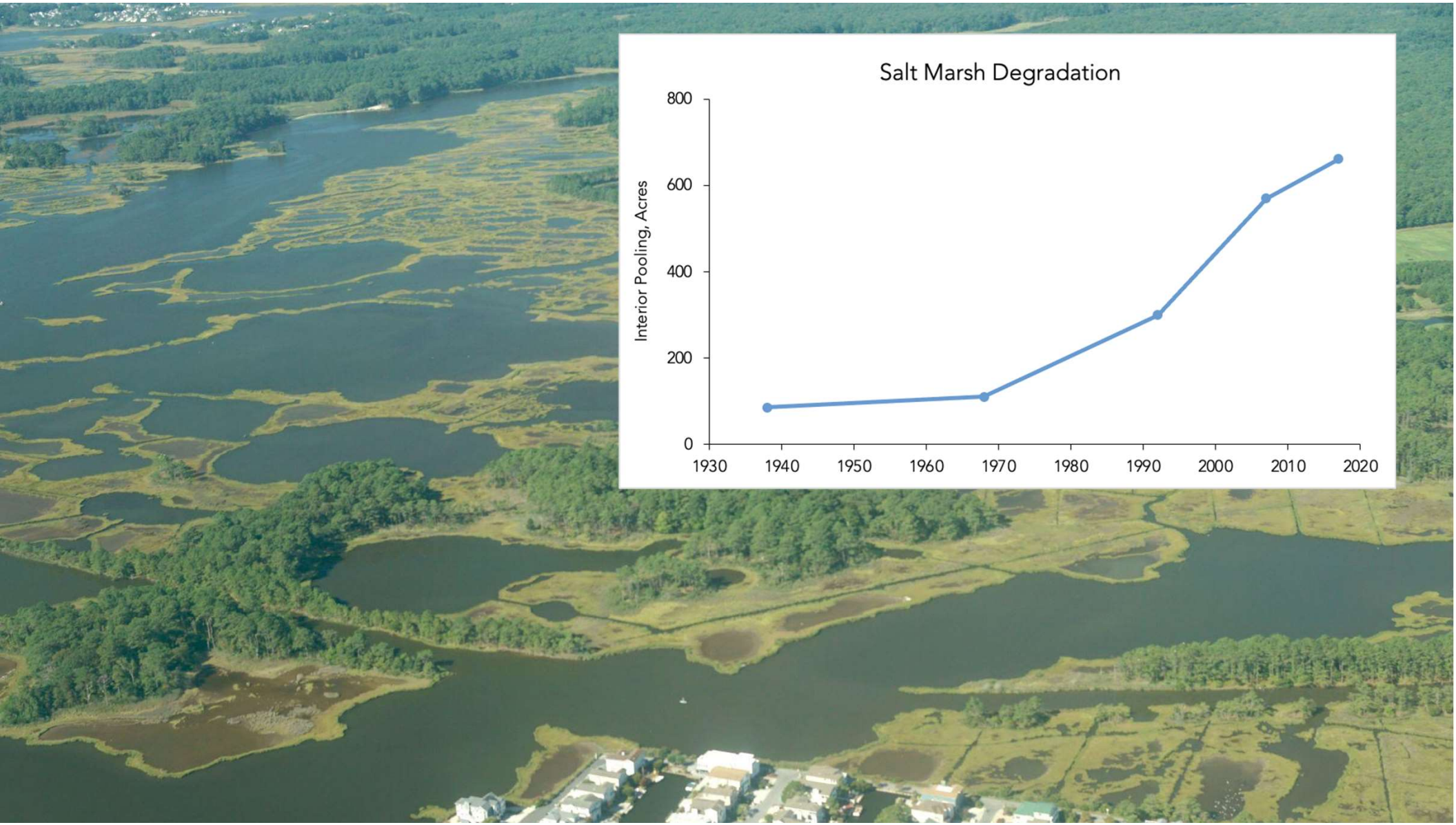
Flood risk zone defined as area projected to be exposed to at least a 10-year flood threat in yr 2050 under sea level rise projections corresponding to moderate green house gas emission cuts.

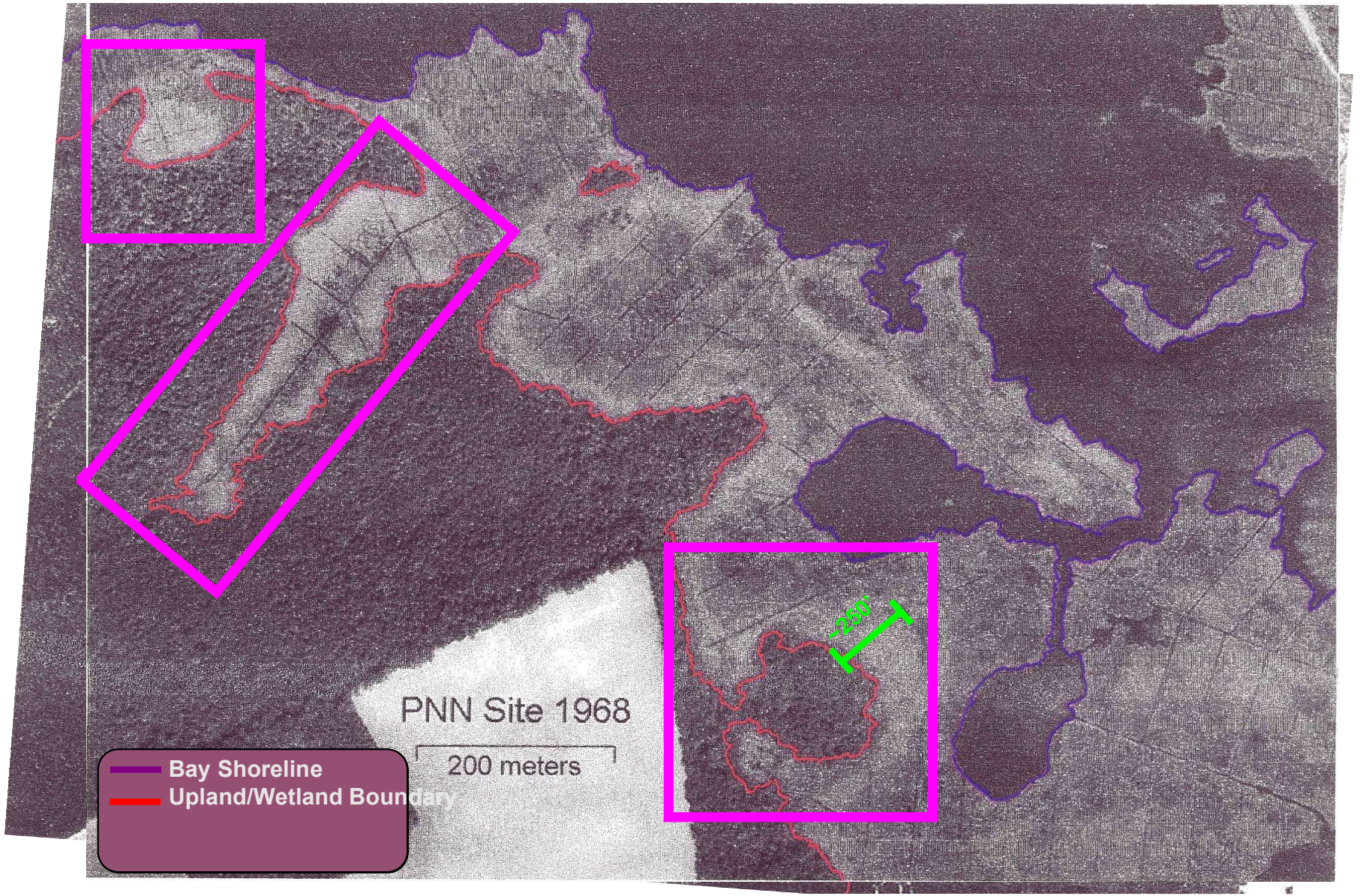
From *Ocean at the Door: New Homes and the Rising Sea 2019 Edition. Climate Central.*

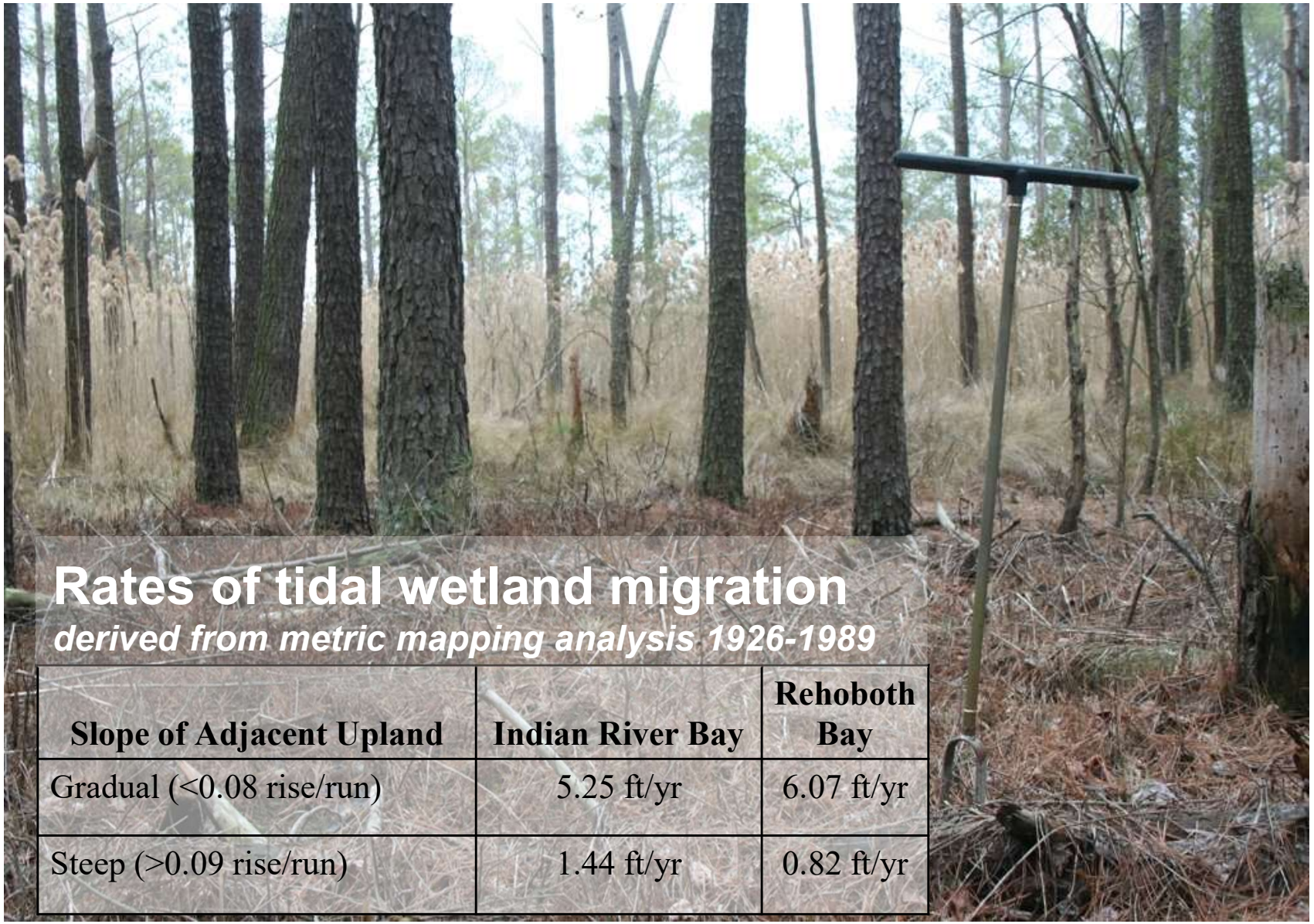
Long Neck 2019 - credit Driscoll Drones

Salt Marsh Acreage and Condition Trends




Salt Marsh Degradation
Interior Pooling, Acres
800
600
400
200
0
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020


PNN Site 1968
200 meters
Bay Shoreline
Upland/Wetland Boundary



Rates of tidal wetland migration

derived from metric mapping analysis 1926-1989

Slope of Adjacent Upland	Indian River Bay	Rehoboth Bay
Gradual (<0.08 rise/run)	5.25 ft/yr	6.07 ft/yr
Steep (>0.09 rise/run)	1.44 ft/yr	0.82 ft/yr

Flooding on the rise

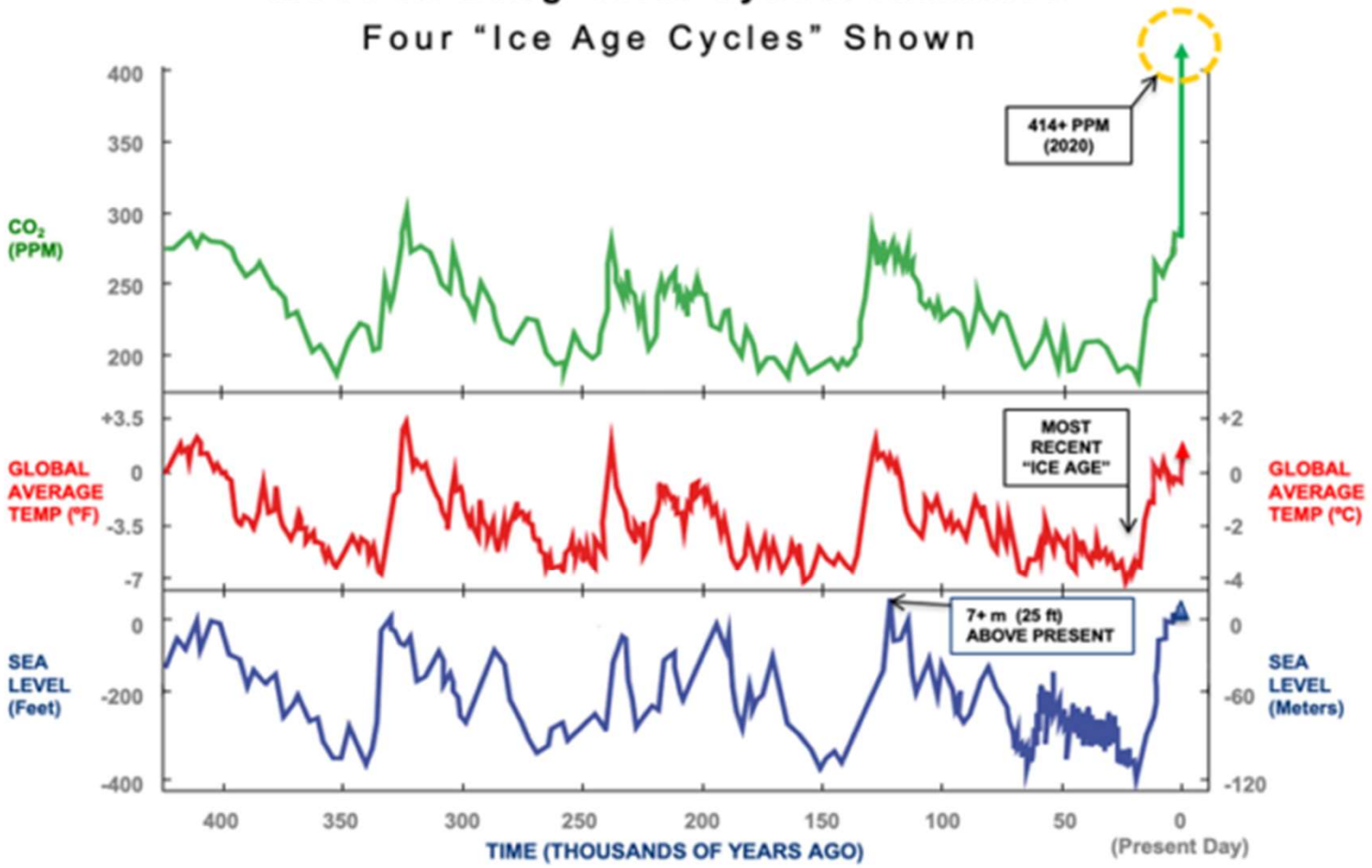
- 2021 State of High Tide Flooding for Lewes by NOAA
  - 4 high tide flood days in yr 2000
  - 8 high tide flood days in yr 2020
  - 15-30 high tide floods days projected for yr 2030
- Sea level rise off our coast is 1.3 to 2.2 in/decade (NOAA); global and atlantic coast hotspot for rise
- Sea level rise projections from Delaware Geological Survey are*
  - 1.5 feet by 2050
  - 3.3 feet by 2080

2008 Bethany

Carbon Dioxide (CO_2), Temperature, & Sea Level

Move in Long-Term Synchronization

Four "Ice Age Cycles" Shown



Adapted from Drs. James E. Hansen & Makiko H. Sato / csas.earth.Columbia.edu

Values of Wetlands

- Sussex County has 47% of DE's wetlands.
- Protect drinking water, streams, and bays by filtering pollutants.
- Protect property by storing flood waters and buffering coastal storm surge.
  - East coast wetlands avoided $625 million in direct flood damages during Hurricane Sandy (Narayan et al. 2017. Scientific Reports.)
- Provide biodiversity and hold high concentrations of rare species
  - 41% of wetland plant species in Delaware are rare.
- Delaware's wetlands estimated to provide $1 billion to $3 billion in annual economic value *(Kauffman, G.J. 2018. Socioeconomic Value of Delaware Wetlands)*


2008 Nor'easter:
Indian River Bay


Half Way Point:
Questions?

Achievements of Ordinance

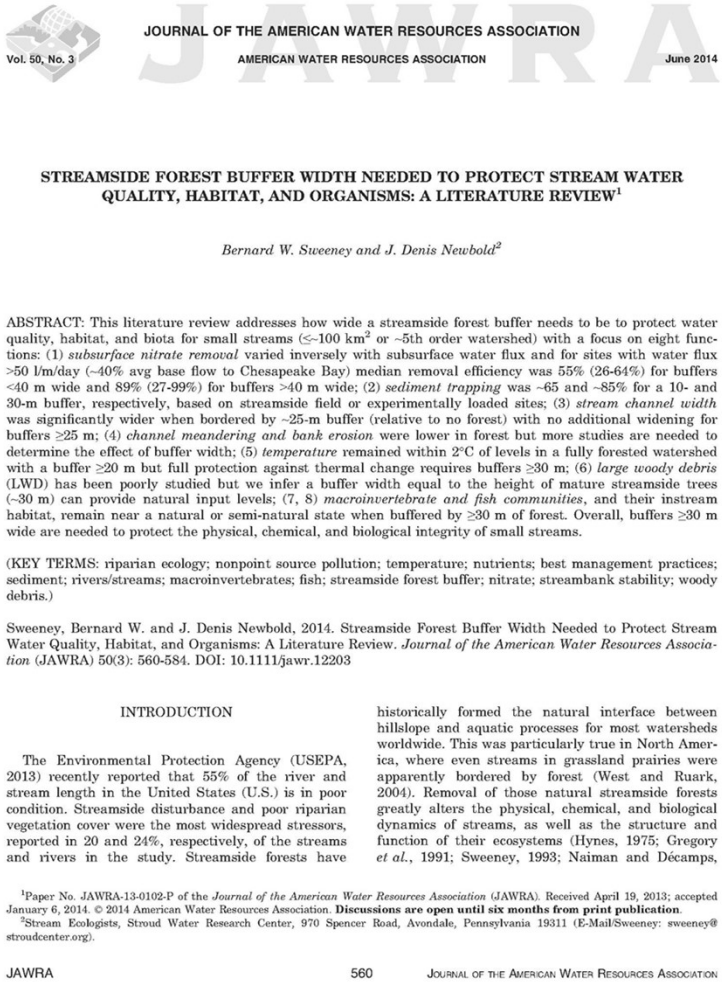
- Includes consensus points of buffer work group regarding features, widths, activities, and site design flexibility (buffer averaging only)
- Specifies purposes of buffer
- Requires Management Plan
- Excludes lot lines from the buffer
- Addresses invasive species
- Includes access to features through easement

Review of Ordinance Purposes

- Protect the Resources and their associated functions.
- Improve/protect water quality via sediment filtration, reduce impact of nutrient loading on Resources, moderate water temperature, and enhance infiltration and stabilization of channel banks.
- Provide wildlife habitat via nesting, breeding, and feeding opportunities; provide sanctuary/refuge during high water events; protect critical water's edge habitat; and protect rare, threatened, and endangered species associated with each Resource and its upland edge.
- Enhance and/or maintain the floodplain storage functionality via reduction of flood conveyance velocities as well as dissipation of stormwater discharge energy.

Buffer Widths

- The wider the buffer the more functional, to a point
- Minimum effective widths vary by buffer purpose and buffer type
- Very wide buffers needed for marsh migration and wildlife protection
- Narrow parts of the buffer can reduce effectiveness
- Streamside buffers often recommended at 100 feet minimum



JOURNAL OF THE AMERICAN WATER RESOURCES ASSOCIATION
Vol. 50, No. 3 AMERICAN WATER RESOURCES ASSOCIATION June 2014

STREAMSIDE FOREST BUFFER WIDTH NEEDED TO PROTECT STREAM WATER QUALITY, HABITAT, AND ORGANISMS: A LITERATURE REVIEW[1]

Bernard W. Sweeney and J. Denis Newbold[2]

ABSTRACT: This literature review addresses how wide a streamside forest buffer needs to be to protect water quality, habitat, and biota for small streams (≤~100 km^2 or ~5th order watershed) with a focus on eight functions: (1) *subsurface nitrate removal* varied inversely with subsurface water flux and for sites with water flux >50 l/m/day (~40% avg base flow to Chesapeake Bay) median removal efficiency was 55% (26-64%) for buffers <40 m wide and 89% (27-99%) for buffers >40 m wide; (2) *sediment trapping* was ~65 and ~85% for a 10- and 30-m buffer, respectively, based on streamside field or experimentally loaded sites; (3) *stream channel width* was significantly wider when bordered by ~25-m buffer (relative to no forest) with no additional widening for buffers ≥25 m; (4) *channel meandering and bank erosion* were lower in forest but more studies are needed to determine the effect of buffer width; (5) *temperature* remained within 2°C of levels in a fully forested watershed with a buffer ≥20 m but full protection against thermal change requires buffers ≥30 m; (6) *large woody debris* (LWD) has been poorly studied but we infer a buffer width equal to the height of mature streamside trees (~30 m) can provide natural input levels; (7, 8) *macroinvertebrate and fish communities*, and their instream habitat, remain near a natural or semi-natural state when buffered by ≥30 m of forest. Overall, buffers ≥30 m wide are needed to protect the physical, chemical, and biological integrity of small streams.

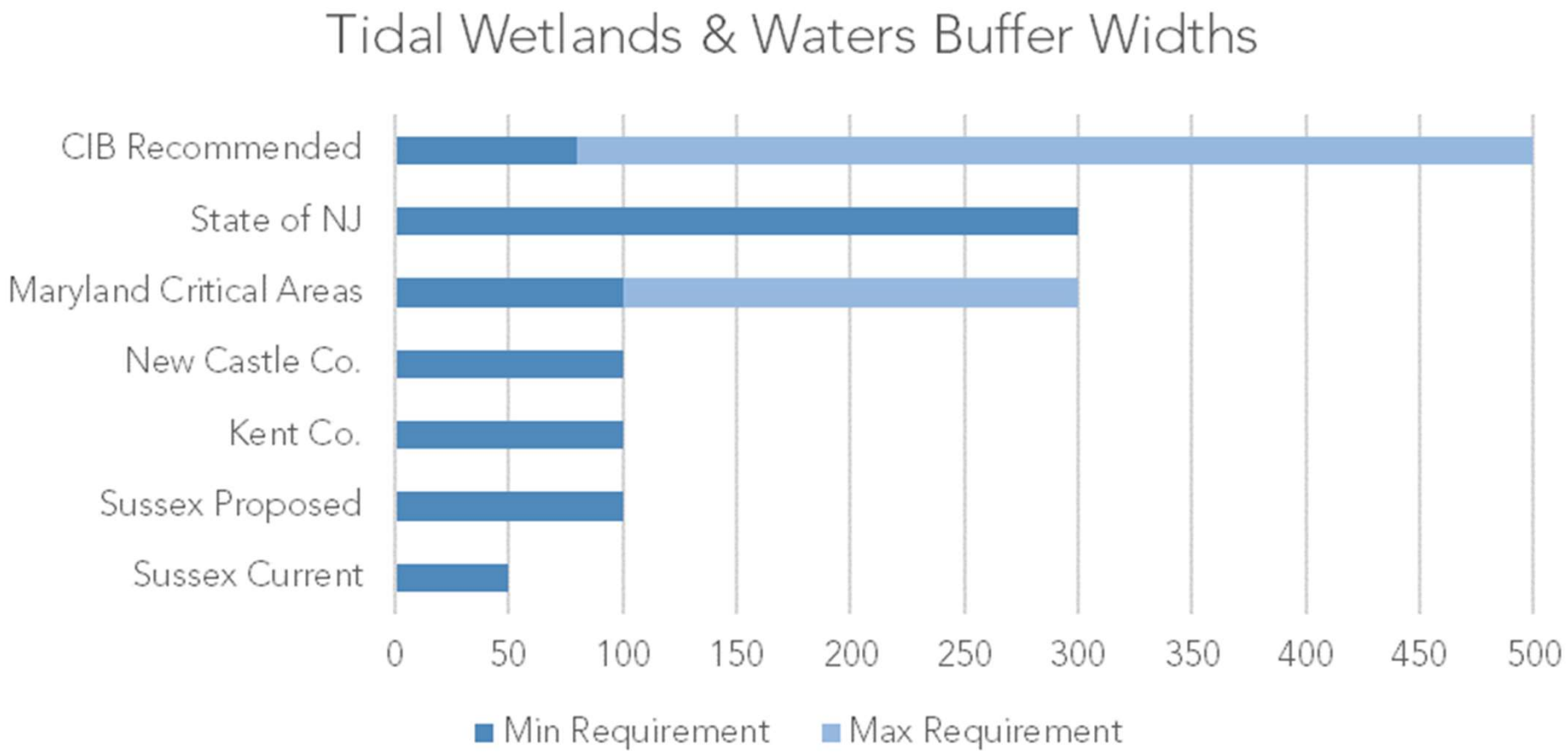
(KEY TERMS: riparian ecology; nonpoint source pollution; temperature; nutrients; best management practices; sediment; rivers/streams; macroinvertebrates; fish; streamside forest buffer; nitrate; streambank stability; woody debris.)

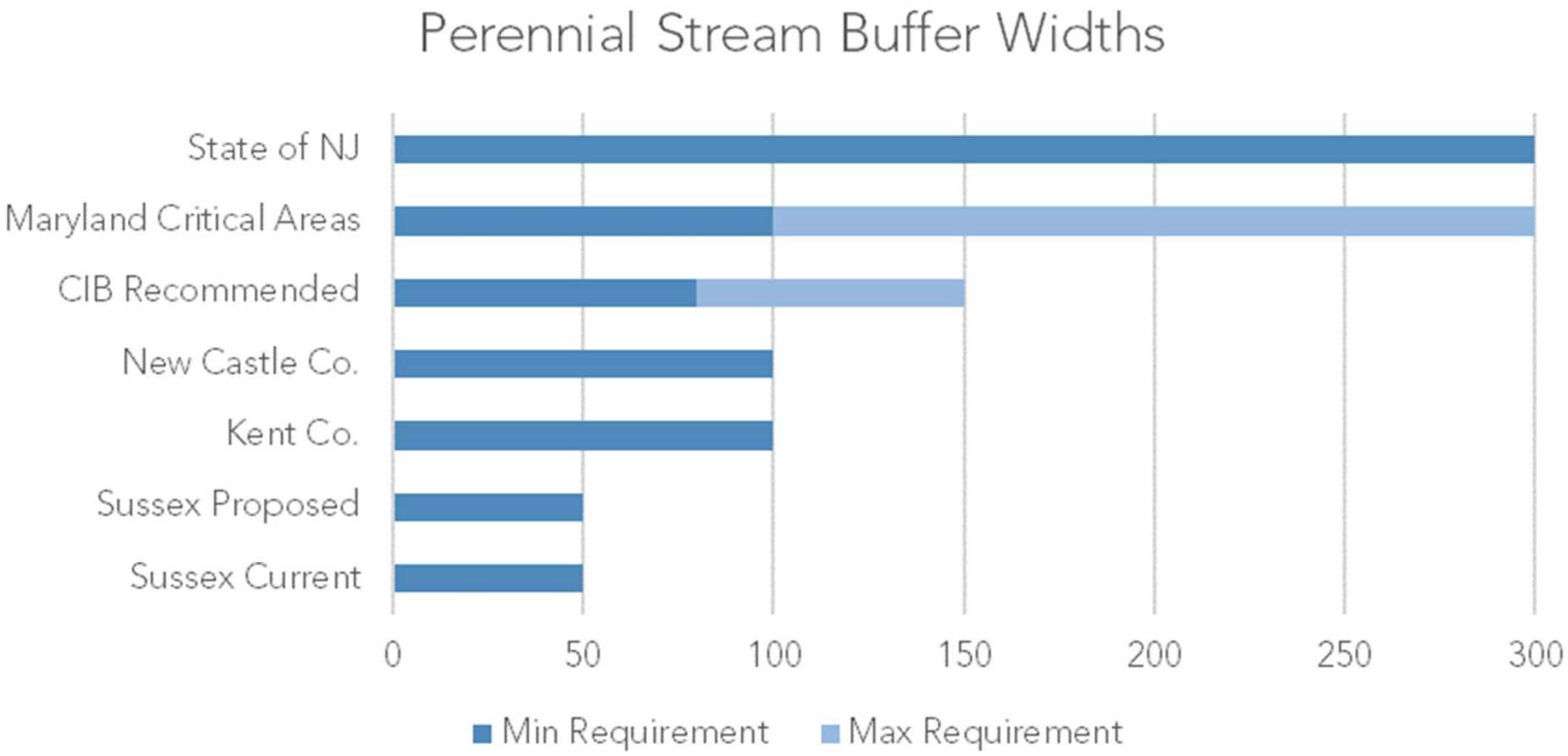
Sweeney, Bernard W. and J. Denis Newbold, 2014. Streamside Forest Buffer Width Needed to Protect Stream Water Quality, Habitat, and Organisms: A Literature Review. *Journal of the American Water Resources Association* (JAWRA) 50(3): 560-584. DOI: 10.1111/jawr.12203

INTRODUCTION

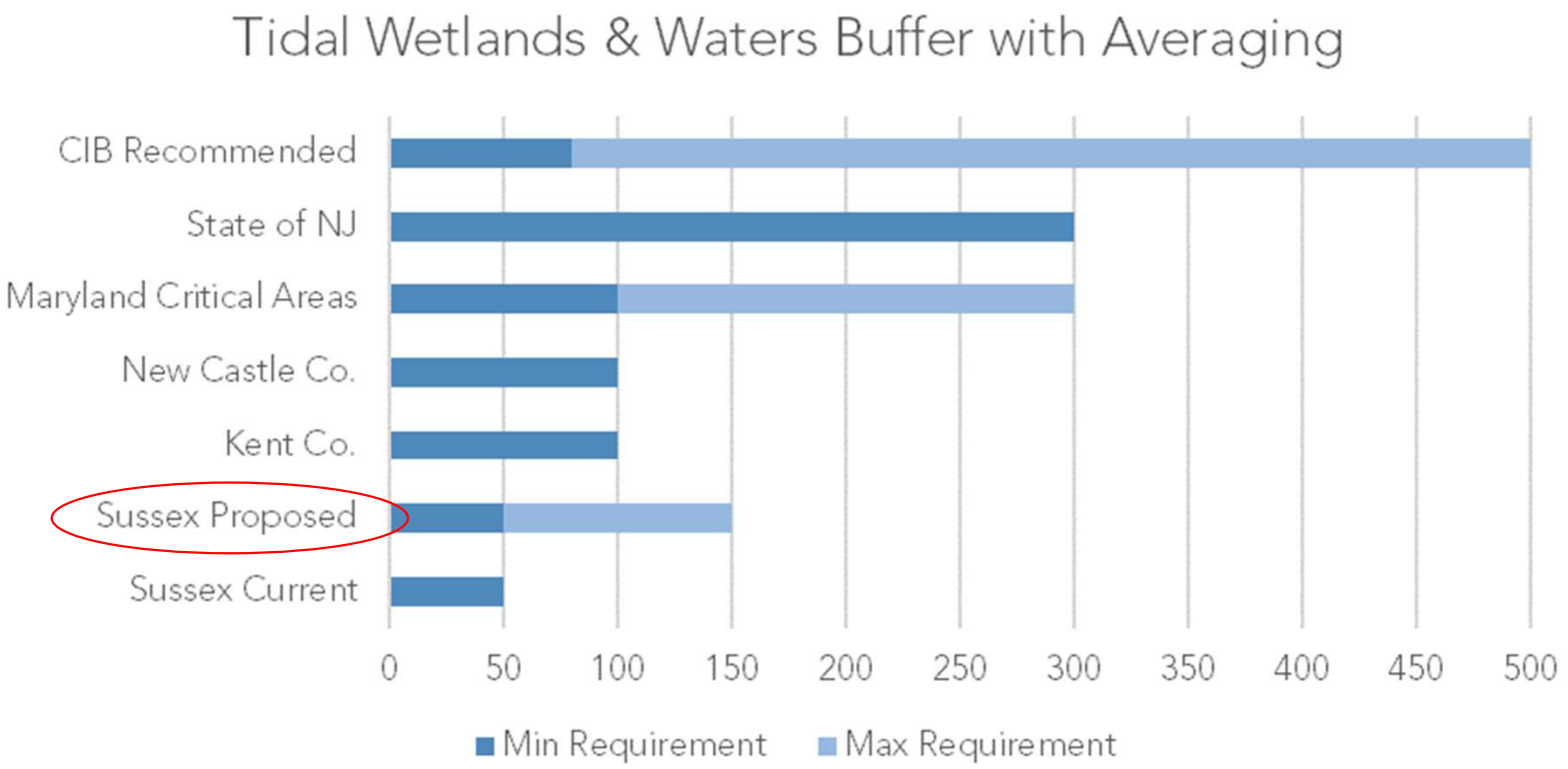
The Environmental Protection Agency (USEPA, 2013) recently reported that 55% of the river and stream length in the United States (U.S.) is in poor condition. Streamside disturbance and poor riparian vegetation cover were the most widespread stressors, reported in 20 and 24%, respectively, of the streams and rivers in the study. Streamside forests have historically formed the natural interface between hillslope and aquatic processes for most watersheds worldwide. This was particularly true in North America, where even streams in grassland prairies were apparently bordered by forest (West and Ruark, 2004). Removal of those natural streamside forests greatly alters the physical, chemical, and biological dynamics of streams, as well as the structure and function of their ecosystems (Hynes, 1975; Gregory *et al.*, 1991; Sweeney, 1993; Naiman and Décamps,

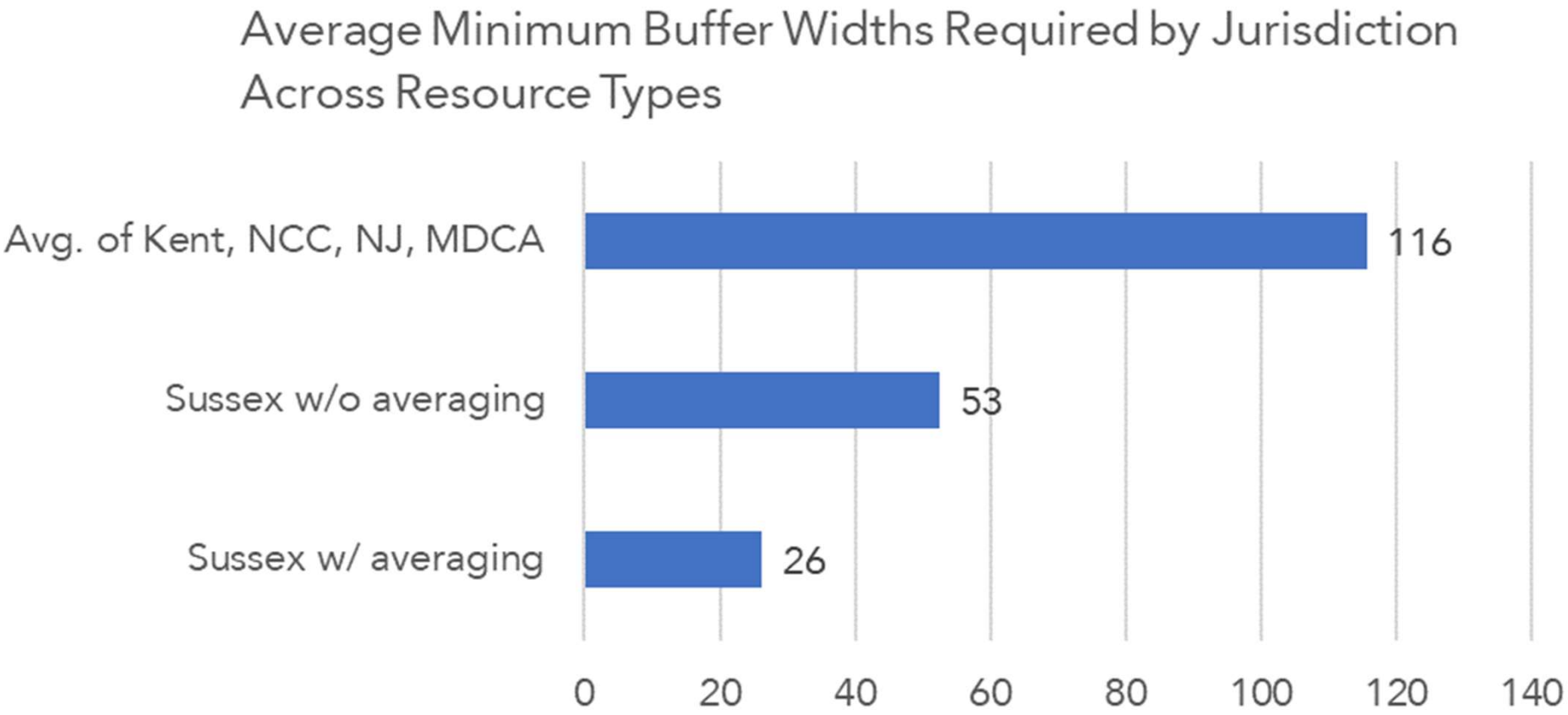
[1]Paper No. JAWRA-13-0102-P of the *Journal of the American Water Resources Association* (JAWRA). Received April 19, 2013; accepted January 6, 2014. **Discussions are open until six months from print publication.**
[2]Stream Ecologists, Stroud Water Research Center, 970 Spencer Road, Avondale, Pennsylvania 19311 (E-Mail/Sweeney: sweeney@stroudcenter.org).


Tidal Wetlands & Waters Buffer Widths
CIB Recommended
State of NJ
Maryland Critical Areas
New Castle Co.
Kent Co.
Sussex Proposed
Sussex Current
0
50
100
150
200
250
300
350
400
450
500
Min Requirement
Max Requirement


Perennial Stream Buffer Widths
State of NJ
Maryland Critical Areas
CIB Recommended
New Castle Co.
Kent Co.
Sussex Proposed
Sussex Current
0
50
100
150
200
250
300
Min Requirement
Max Requirement

Buffer Averaging Allowed for Design Flexibility





Sussex is as Proposed but does not include Options for Sussex Ordinance (Section G.)
NCC = New Castle County, DE; MDCA = Maryland Critical Areas

Wetlands and Waterways Buffer Policy Comparison

Character-istic	Sussex Co. Crnt.	Sussex Co. Prpsd.	CIB Reco-mends	Kent Co.	New Castle Co.	State of NJ	State of MD Critical Areas.
Veg. Type	Natural	Forest or meadow***	Natural/ Forest	Natural/ Forest	Natural/ Forest	Existing Veg. or Natural/ Forest	Natural/ Forest
Protects Existing Forest	Yes, but not enfrcd.	No	Yes	Yes	Yes	Yes	Yes
Reveg. with Trees	Yes, not enfrcd.	No	Yes	Yes	Yes	Yes	Yes

Requested Amendments to the Proposed Ordinance

- Requirement for protecting and restoring forest in Resource Buffer Standards (Section D. begins at line 701.)
- Removal of Resource Buffer Options (Section G. begins at line 781)
- Clarify Maintenance of Drainage Conveyance
- Specify enforcement and penalties

Buffers should be forested

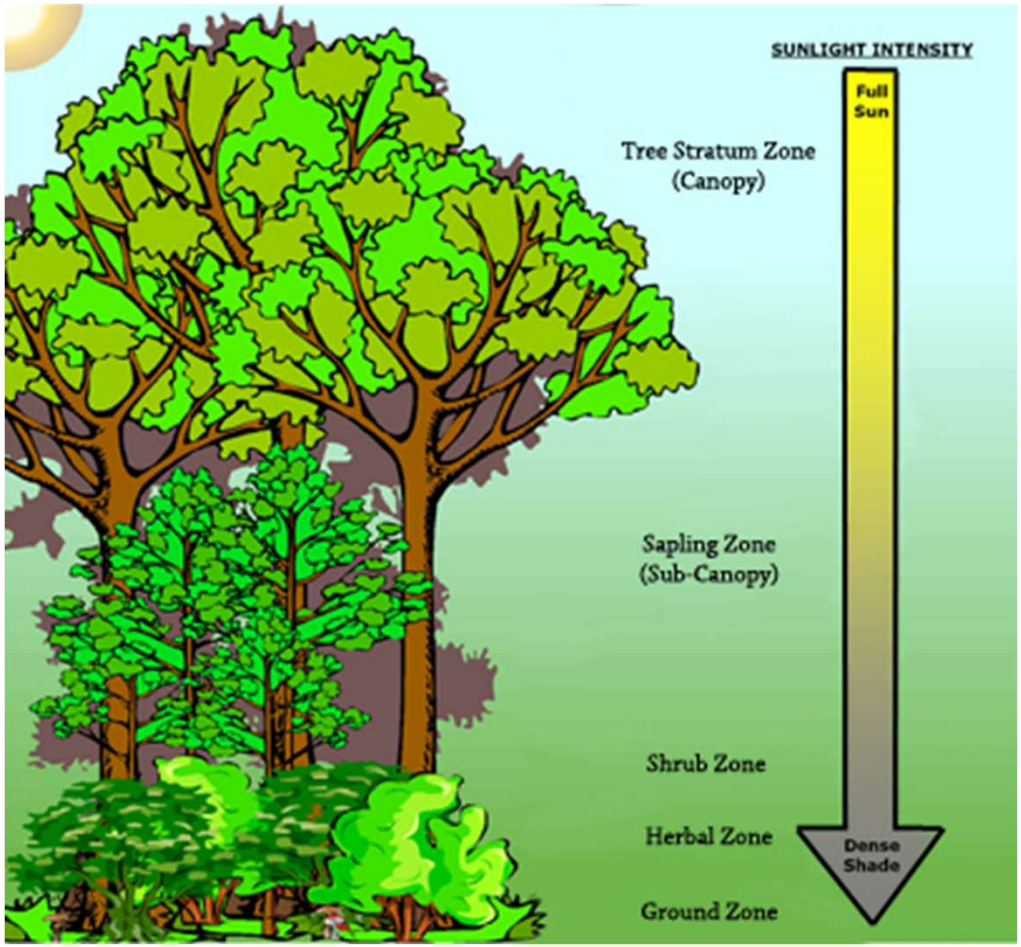
'Forests are the most beneficial land use for protecting water quality, due to their ability to capture, filter, and retain water, as well as air pollution from the air. Forests are also essential to the provision of clean drinking water to over 10 million residents of the watershed and provide valuable ecological services and economic benefits including carbon sequestration, flood control, wildlife habitat, and forest products'.

-- Chesapeake Bay Executive Council, 2006

Forests provide better water quality protection

- Forested buffers remove 36% more nitrogen on average than grassed buffers *(Mayer et al. 2007 Journal of Environmental Quality)*
- Forested buffers take up 11 – 37 lbs of nitrogen and 2 – 5 lbs of phosphorus per acre per year into wood
- Soil organic matter is over twice as high in forested buffers
- Forested buffers improve instream processing of nutrients
- Forested buffers support wildlife habitat and don’t contribute pollution

FOREST STRUCTURE

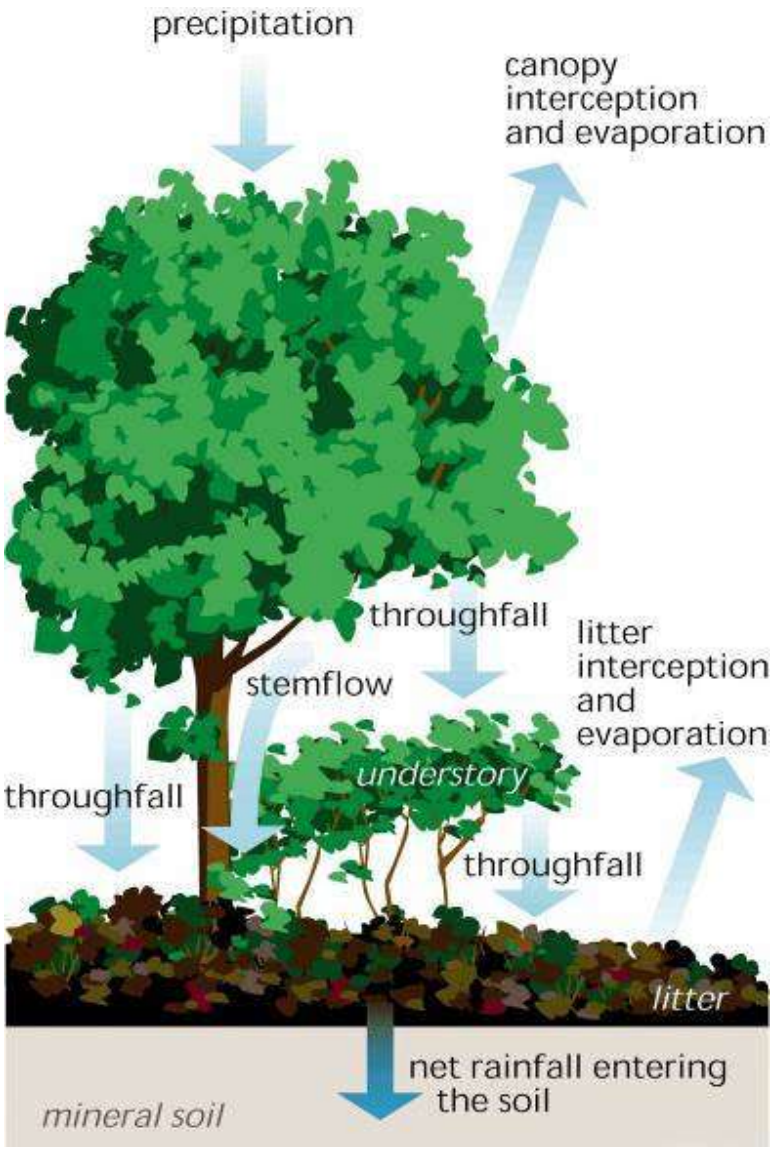


Native forests are essential for habitat

- The amount of forest in an estuary's watershed, particularly near the water, has significant positive influence on the health of the estuary's baygrasses, crabs, and marsh birds (*Li et al. 2007. Estuaries and Coasts. 30, 840-854; and references therein)*

- Each layer provides habitat niches for wildlife and physical buffering

  Native species essential to support the foodweb



Forests control the flow of water

- Huge biomass and organic matter in soil
- Intercepts precipitation
- Increases evaporation and transpiration
- Forest floor/leaf litter acts as giant sponge ecosystem
- Reduces runoff
- Large root systems provide infiltration channels

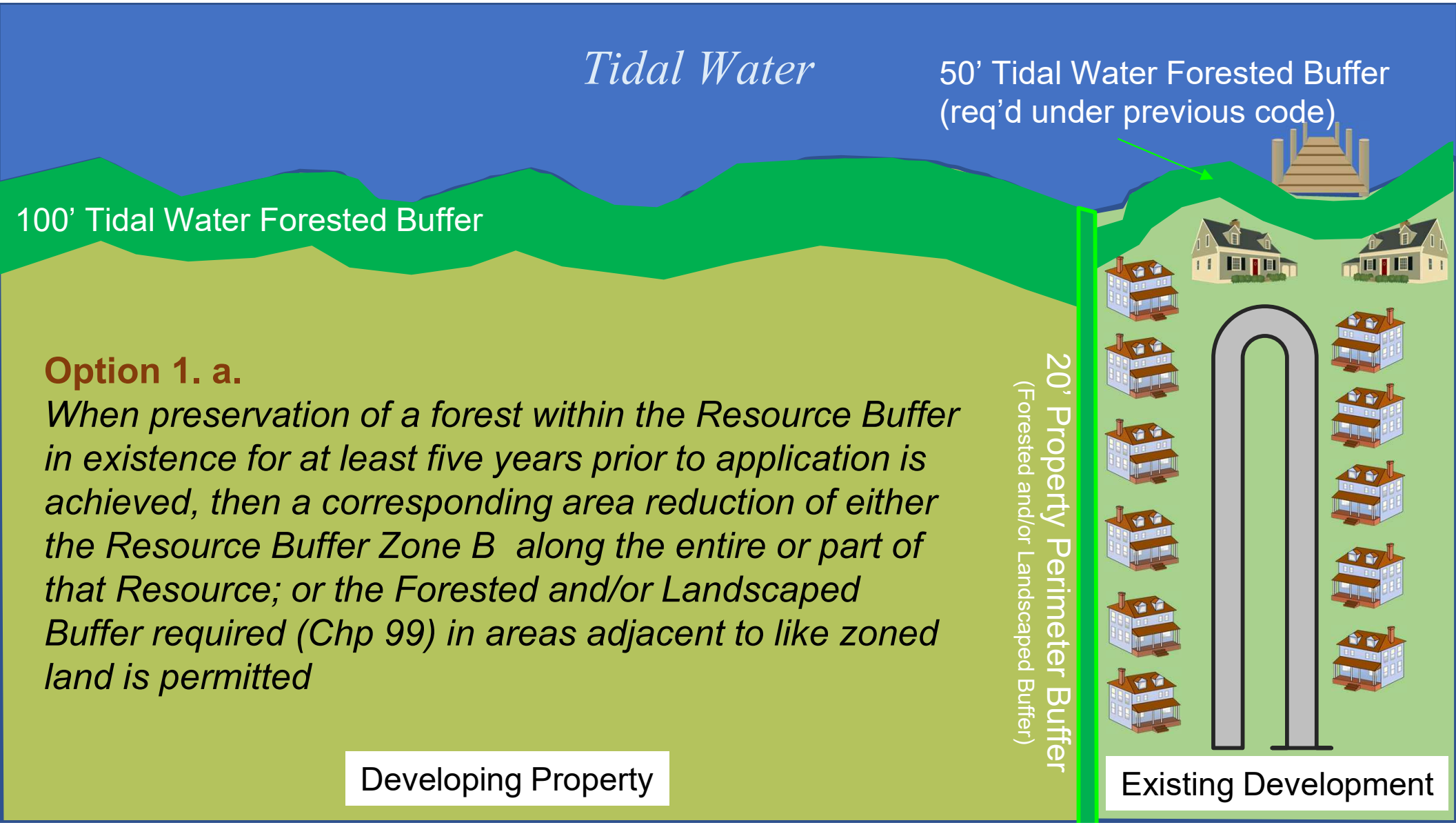
Protection and Restoration of Forest

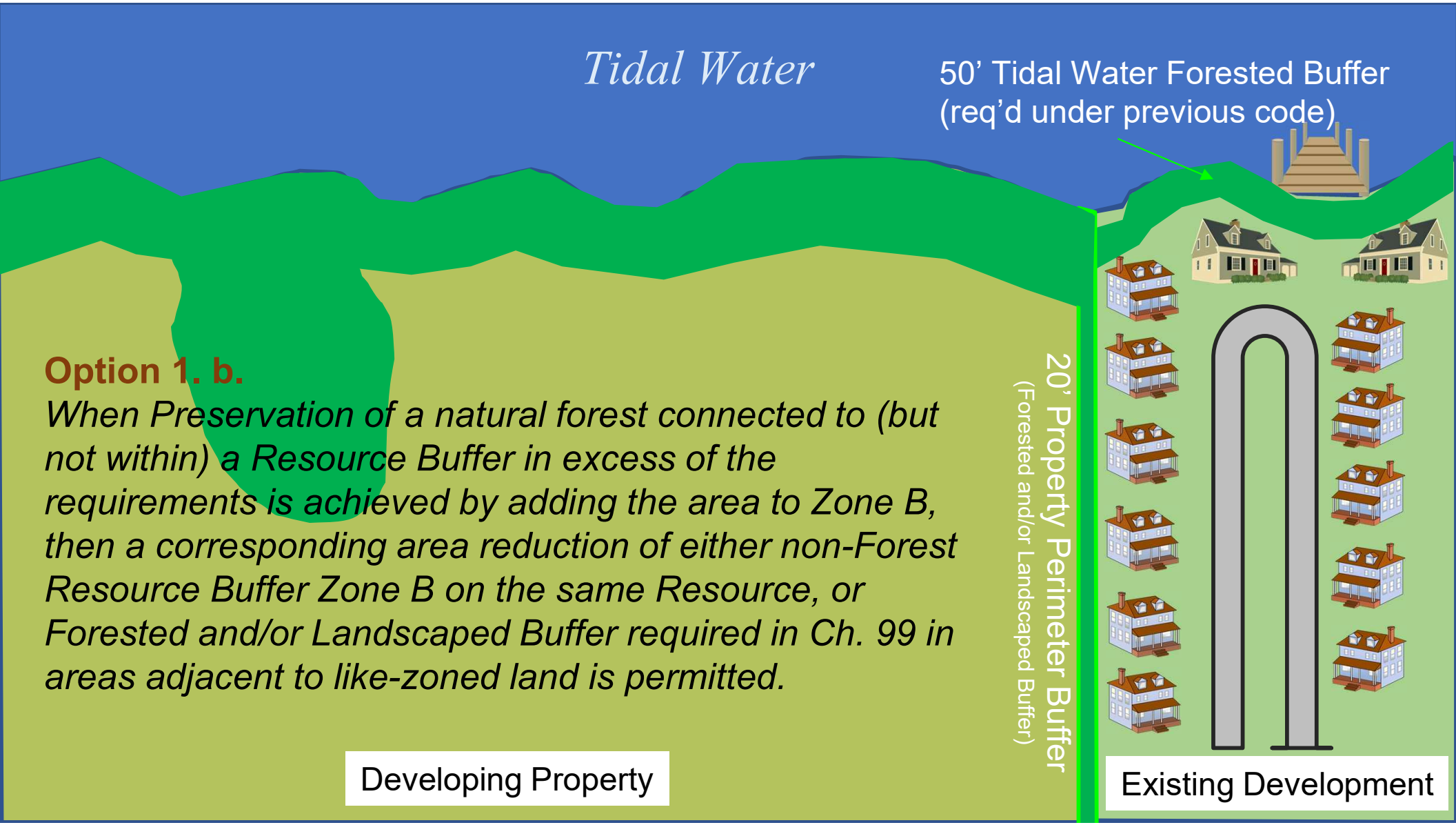
- Eliminate non-forest buffer standard and require forest in all buffer areas except where otherwise permitted by activities list.

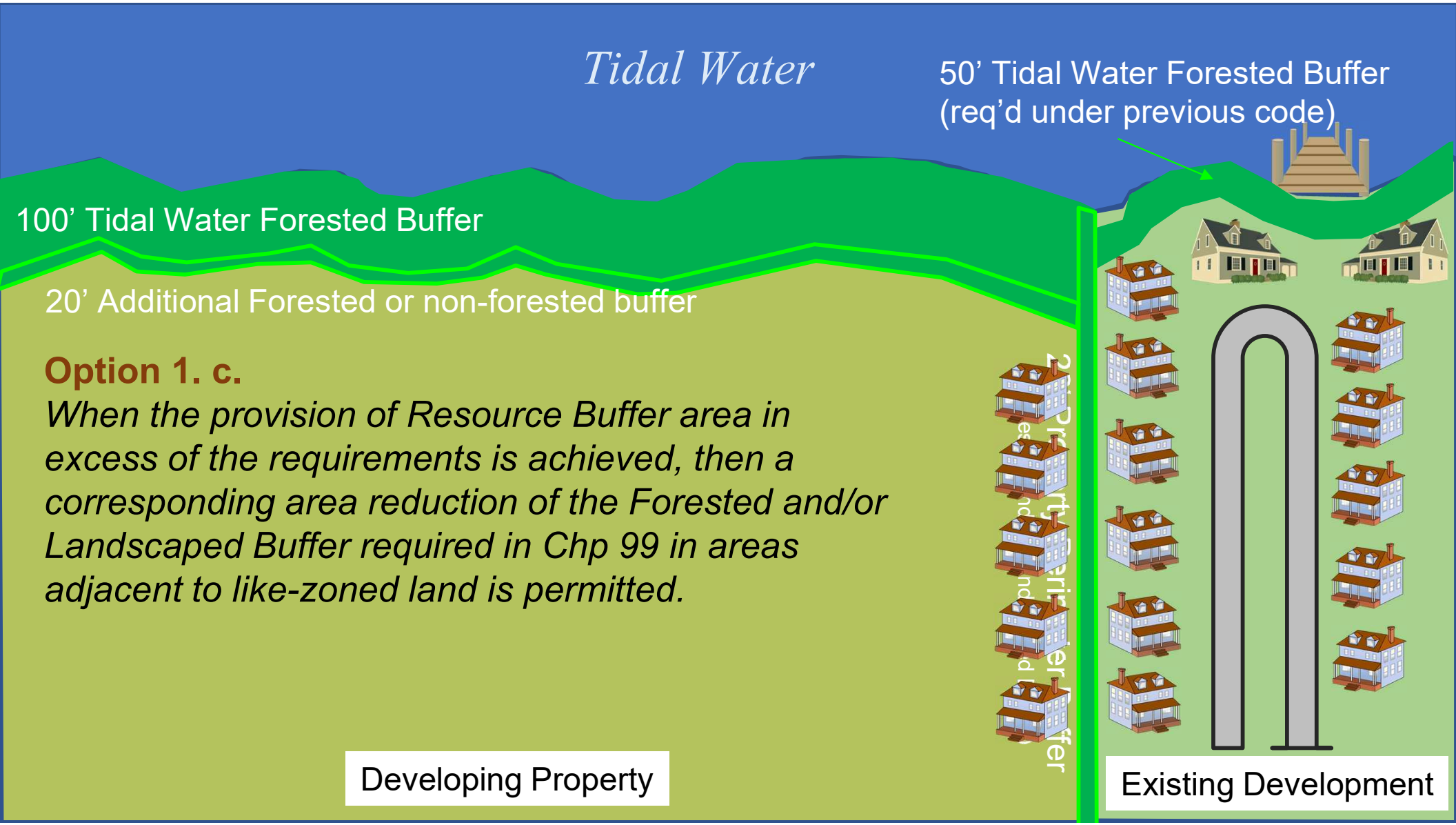
- Buffers without forest at time of application must submit native species planting plan and invasive species control plan to restore native forest to defined standard and time period
  - similar in approach to forested and/or landscape buffer strip code
  - Include forest maintenance requirement in management plan
  - diversity of Delaware natives trees and shrubs required
  - planting and survival standards by stock size
  - Natural revegetation allowed within 25 feet of mature native forest

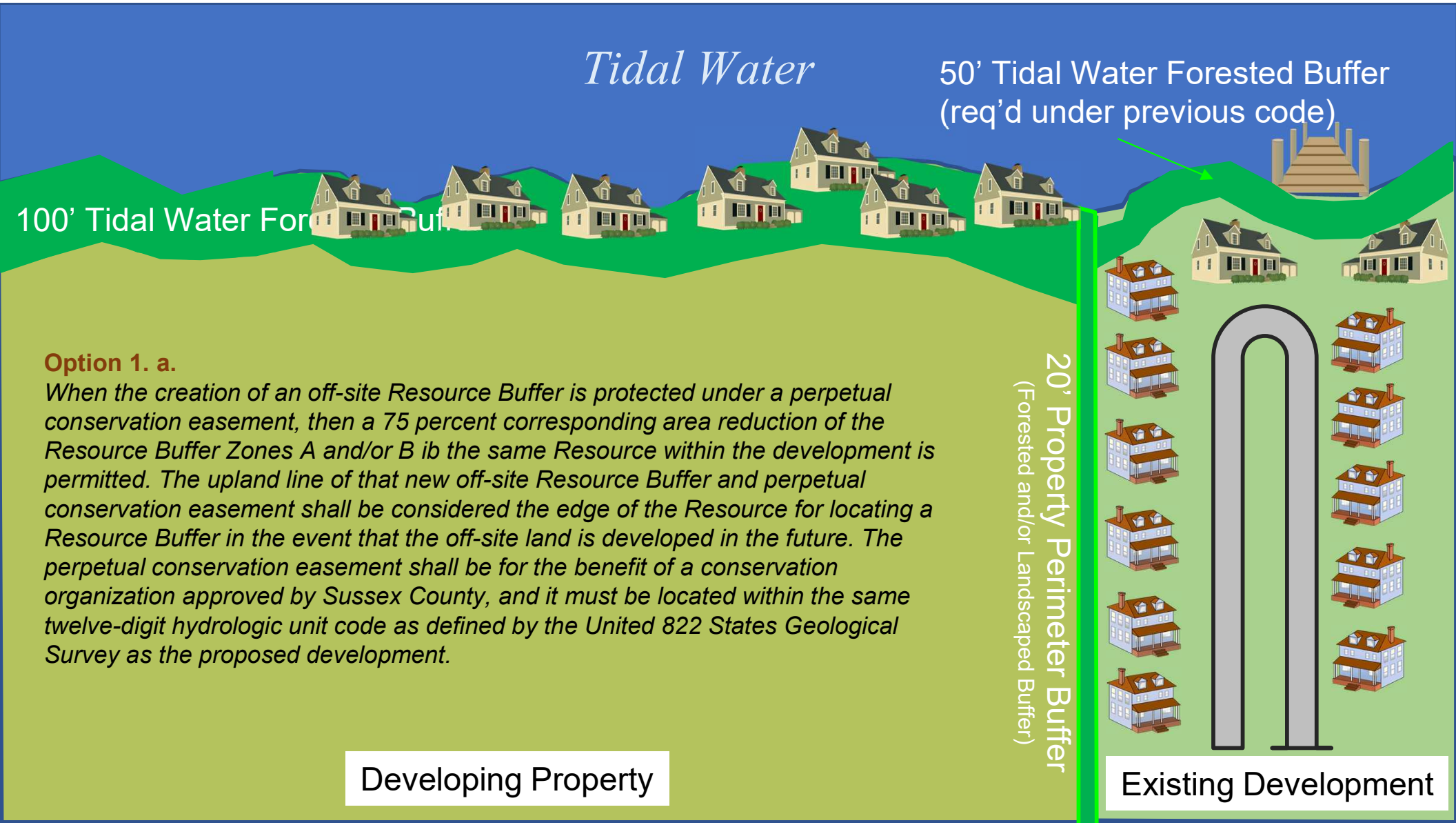
Resource Buffer Options Description

- Retaining forest in a buffer allows reduction of buffer width by half.
- Retaining forest in a buffer allows reduction of development perimeter buffer.
- Retaining forest connected to but not within buffer allows reduction in buffer width by half.
- Retaining forest connected to but not within buffer allows reduction of development perimeter buffer.
- Preserving wider wetland buffers allows reduction in development perimeter buffers.

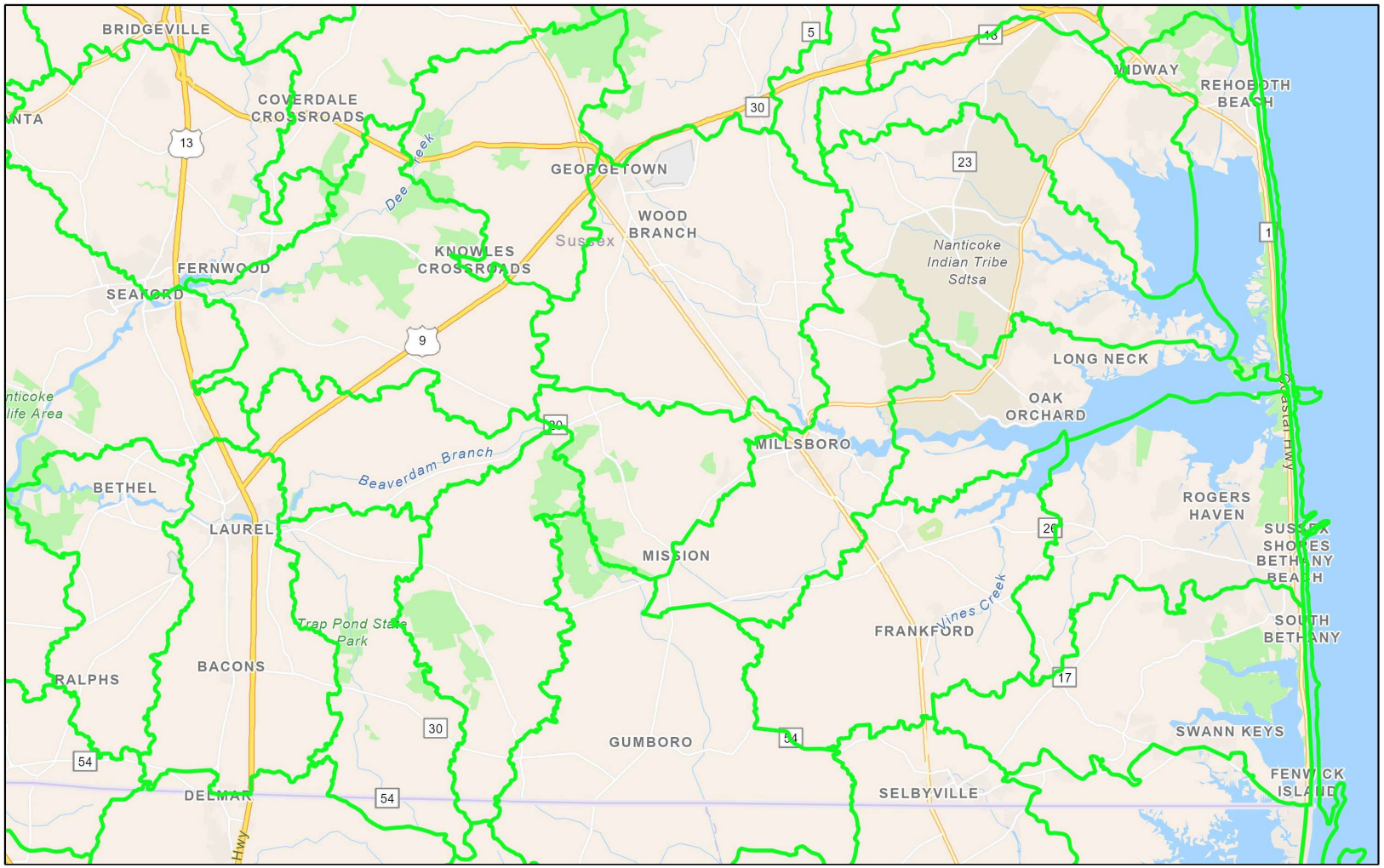

Tidal Water
50’ Tidal Water Forested Buffer
(req’d under previous code)
100’ Tidal Water Forested Buffer
Option 1. a.
When preservation of a forest within the Resource Buffer in existence for at least five years prior to application is achieved, then a corresponding area reduction of either the Resource Buffer Zone B along the entire or part of that Resource; or the Forested and/or Landscaped Buffer required (Chp 99) in areas adjacent to like zoned land is permitted
20’ Property Perimeter Buffer
(Forested and/or Landscaped Buffer)
Developing Property
Existing Development


Tidal Water
50’ Tidal Water Forested Buffer
(req’d under previous code)
Option 1. b.
When Preservation of a natural forest connected to (but not within) a Resource Buffer in excess of the requirements is achieved by adding the area to Zone B, then a corresponding area reduction of either non-Forest Resource Buffer Zone B on the same Resource, or Forested and/or Landscaped Buffer required in Ch. 99 in areas adjacent to like-zoned land is permitted.
20’ Property Perimeter Buffer
(Forested and/or Landscaped Buffer)
Developing Property
Existing Development


Tidal Water
50’ Tidal Water Forested Buffer
(req’d under previous code)
100’ Tidal Water Forested Buffer
20’ Additional Forested or non-forested buffer
Option 1. c.
When the provision of Resource Buffer area in excess of the requirements is achieved, then a corresponding area reduction of the Forested and/or Landscaped Buffer required in Chp 99 in areas adjacent to like-zoned land is permitted.
Developing Property
Existing Development


Tidal Water
50’ Tidal Water Forested Buffer
(req’d under previous code)
100’ Tidal Water For
Option 1. a.
When the creation of an off-site Resource Buffer is protected under a perpetual conservation easement, then a 75 percent corresponding area reduction of the Resource Buffer Zones A and/or B ib the same Resource within the development is permitted. The upland line of that new off-site Resource Buffer and perpetual conservation easement shall be considered the edge of the Resource for locating a Resource Buffer in the event that the off-site land is developed in the future. The perpetual conservation easement shall be for the benefit of a conservation organization approved by Sussex County, and it must be located within the same twelve-digit hydrologic unit code as defined by the United 822 States Geological Survey as the proposed development.
20’ Property Perimeter Buffer
(Forested and/or Landscaped Buffer)
Developing Property
Existing Development

HUC – 12 Watersheds



1/8/2022

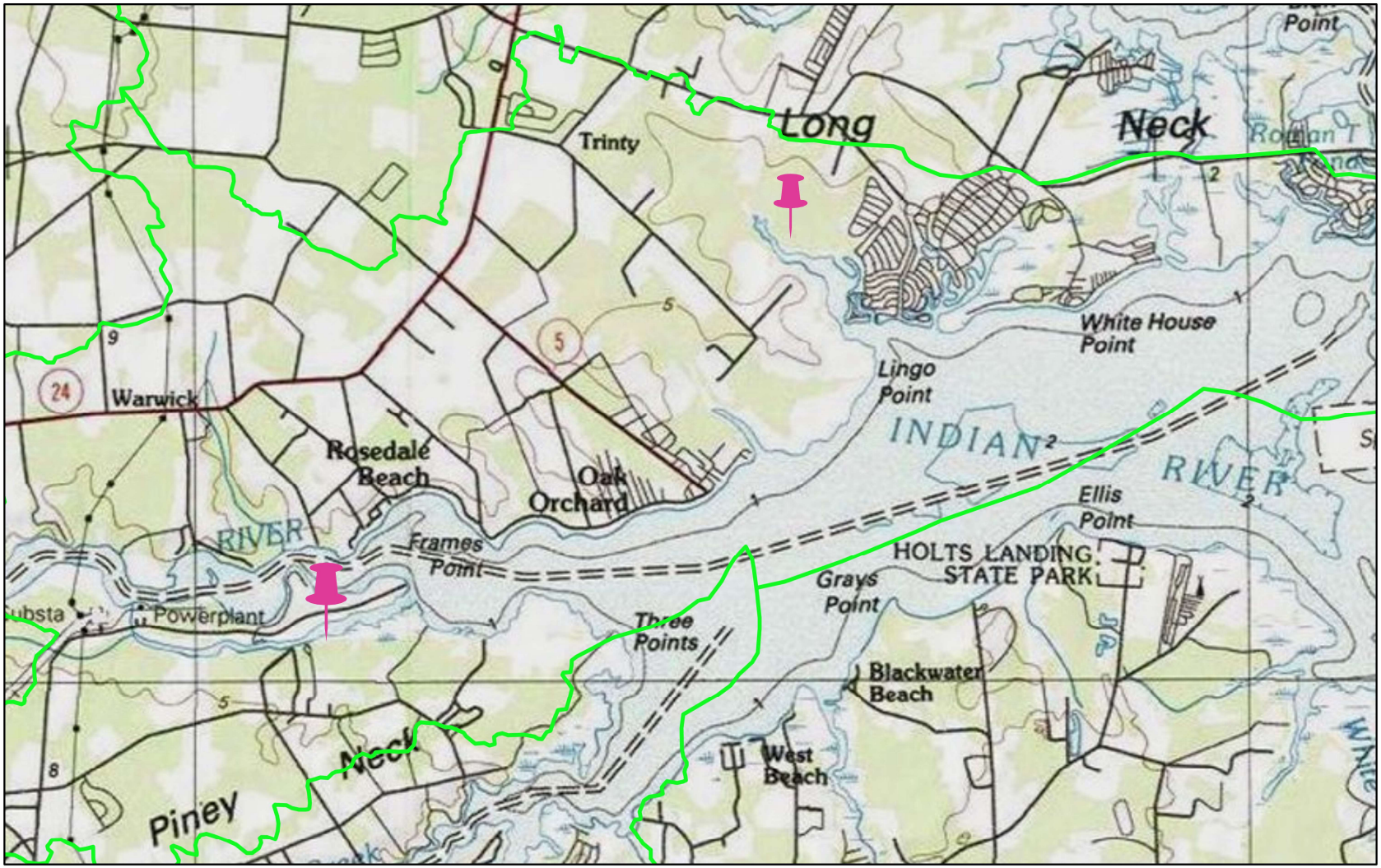
HUC 12

1:288,414

0 2 4 8 mi

0 3 6 12 km

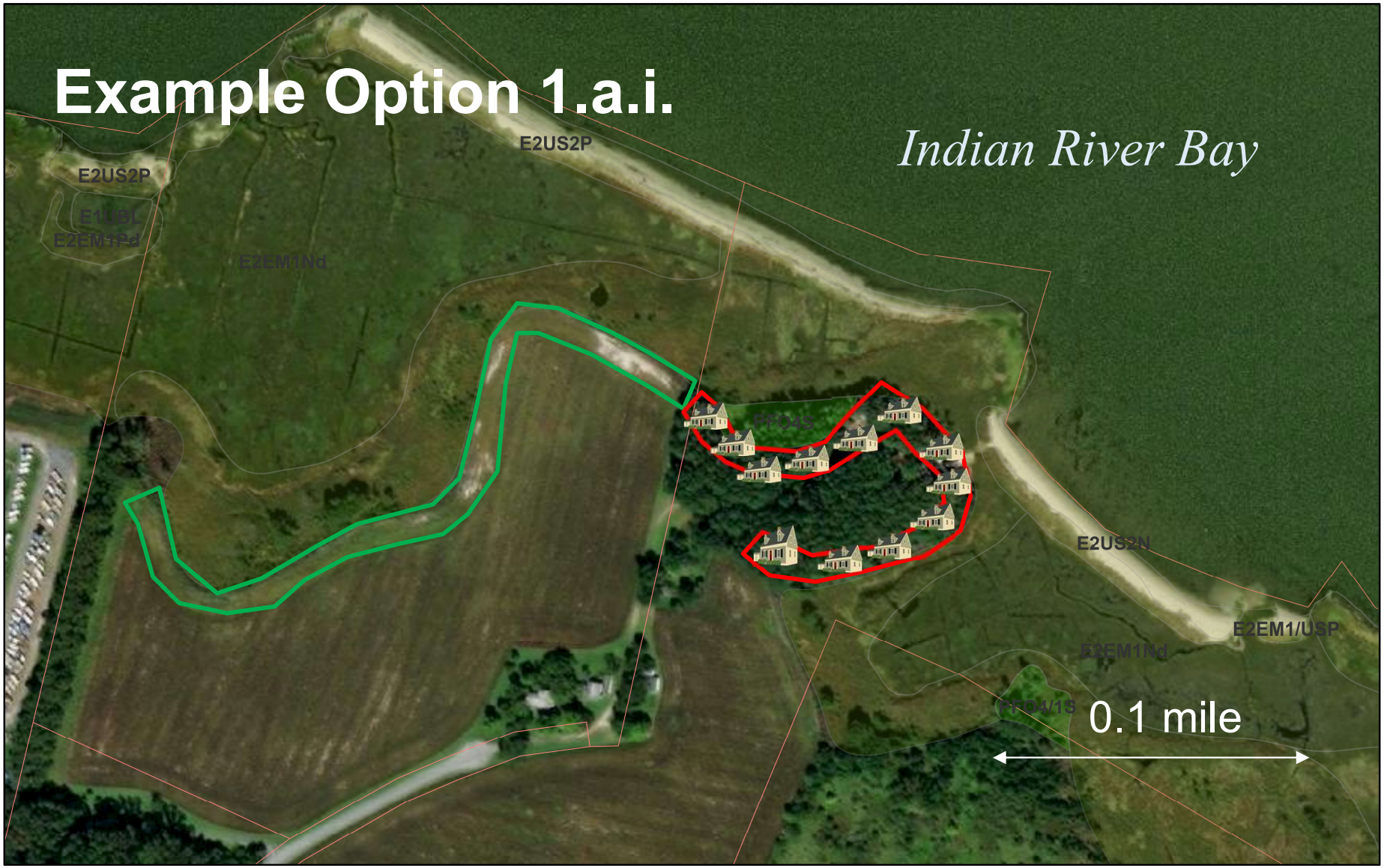
U.S. Geological Survey, County of Sussex, DE, Delaware FirstMap, VITA,

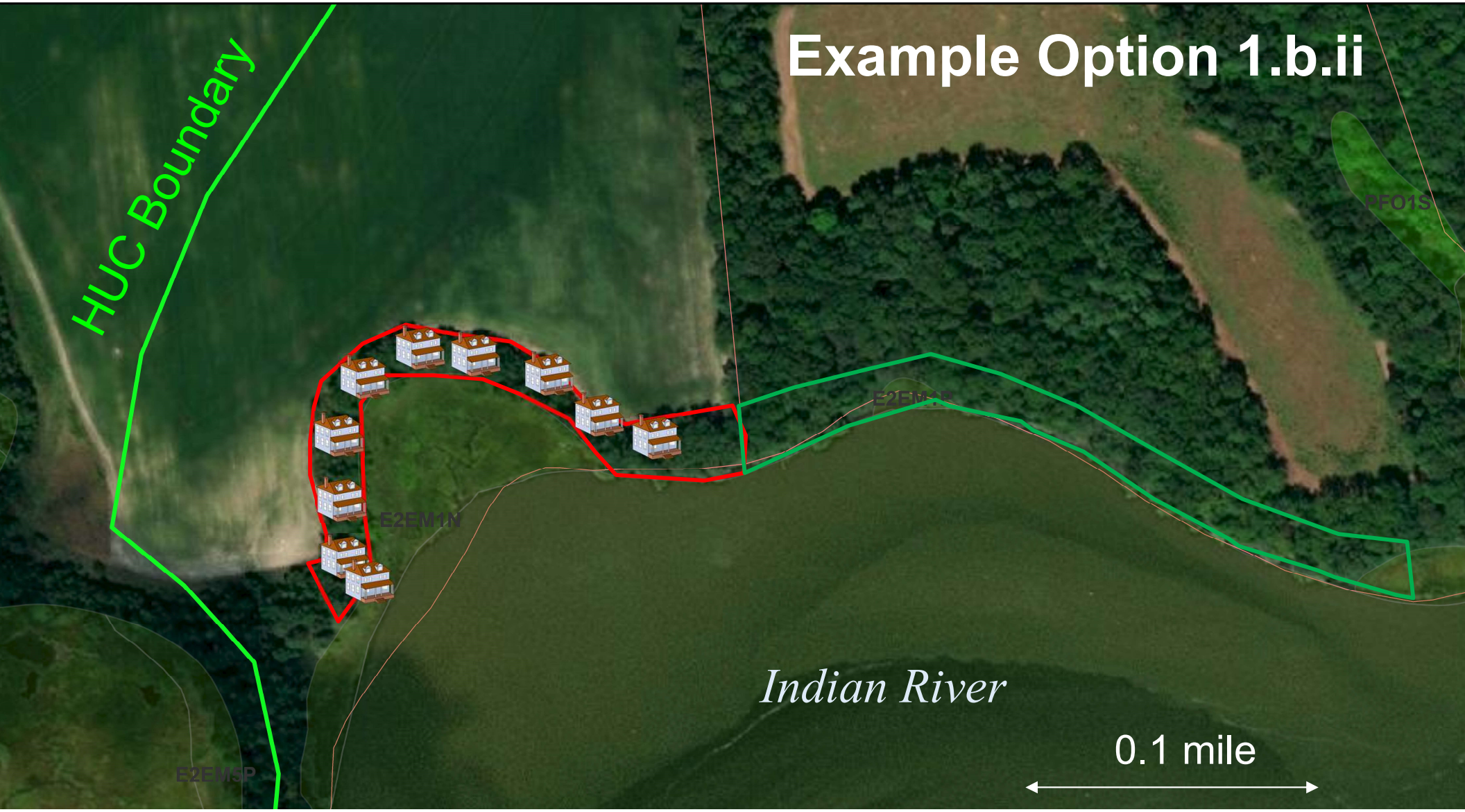


1/8/2022

1:65,528

0 0.42 0.85 1.7 mi


Example Option 1.a.i.
Indian River Bay
E2US2P
E2US2P
E1UBL
E2EM1Pd
E2EM1Nd
PFO4S
E2US2N
E2EM1/USP
E2EM1Nd
PFO4/1S
0.1 mile


Example Option 1.b.ii
HUC Boundary
E2EM1N
E2EM1P
PFO1S
E2EM5P
Indian River
0.1 mile

Remove Resource Buffer Options

- Need for flexibility in site design provided by buffer averaging.

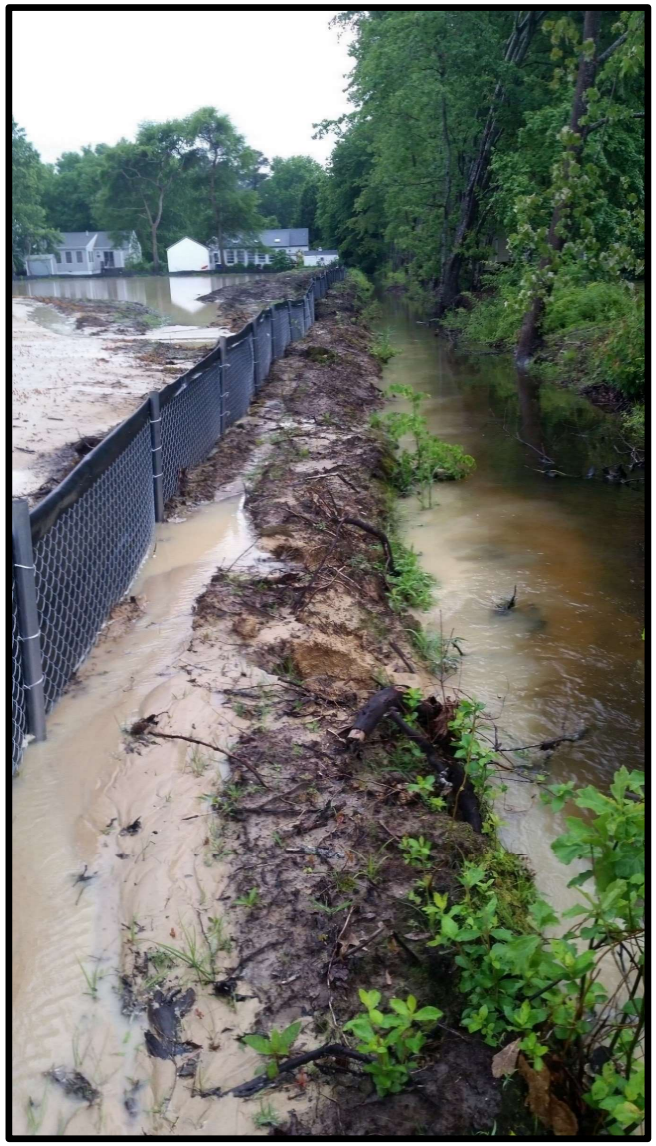
- Options should not reduce width of buffers which are already on the low end of effectiveness.

- Options should not reduce the effectiveness of another ordinance with a separate purpose (perimeter buffer) to attempt to create an effective waterway and wetland buffer ordinance.

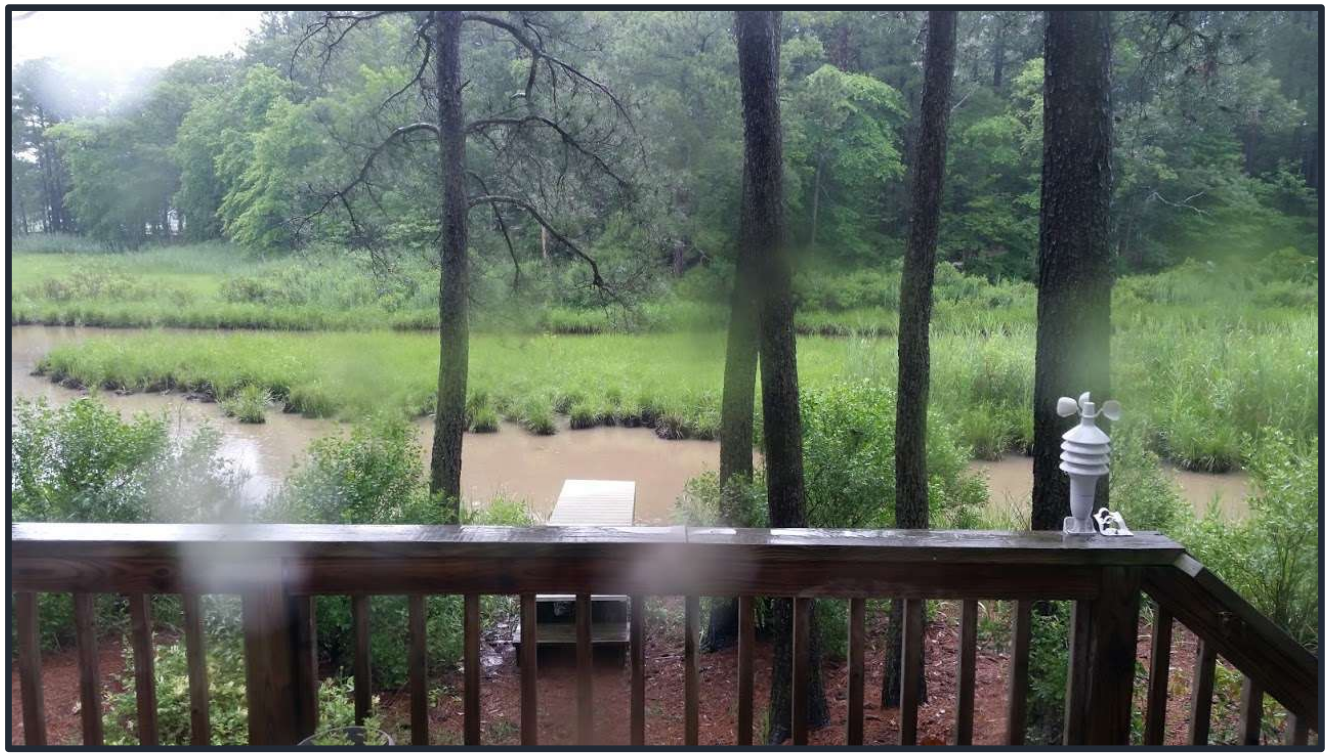
Stormwater Wet and Dry Ponds Should not be allowed in Buffer

Specific Language on Enforcement Mechanisms and Penalties should be Added


Tidal
Wetland



White Creek watershed pollution due to lack of buffers




ZIPsystem

Questions/Discussion

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www.inlandbays.org

Watershed Trends Show Mixed Results That Differ for Nitrogen and Phosphorus

USGS updates trends in total nitrogen and phosphorus on the basis of data from the nontidal monitoring network. Trends (fig. 1) are normalized for watershed area and the magnitude of stream flow, to make it easier to compare sites and distinguish trends resulting from human actions.

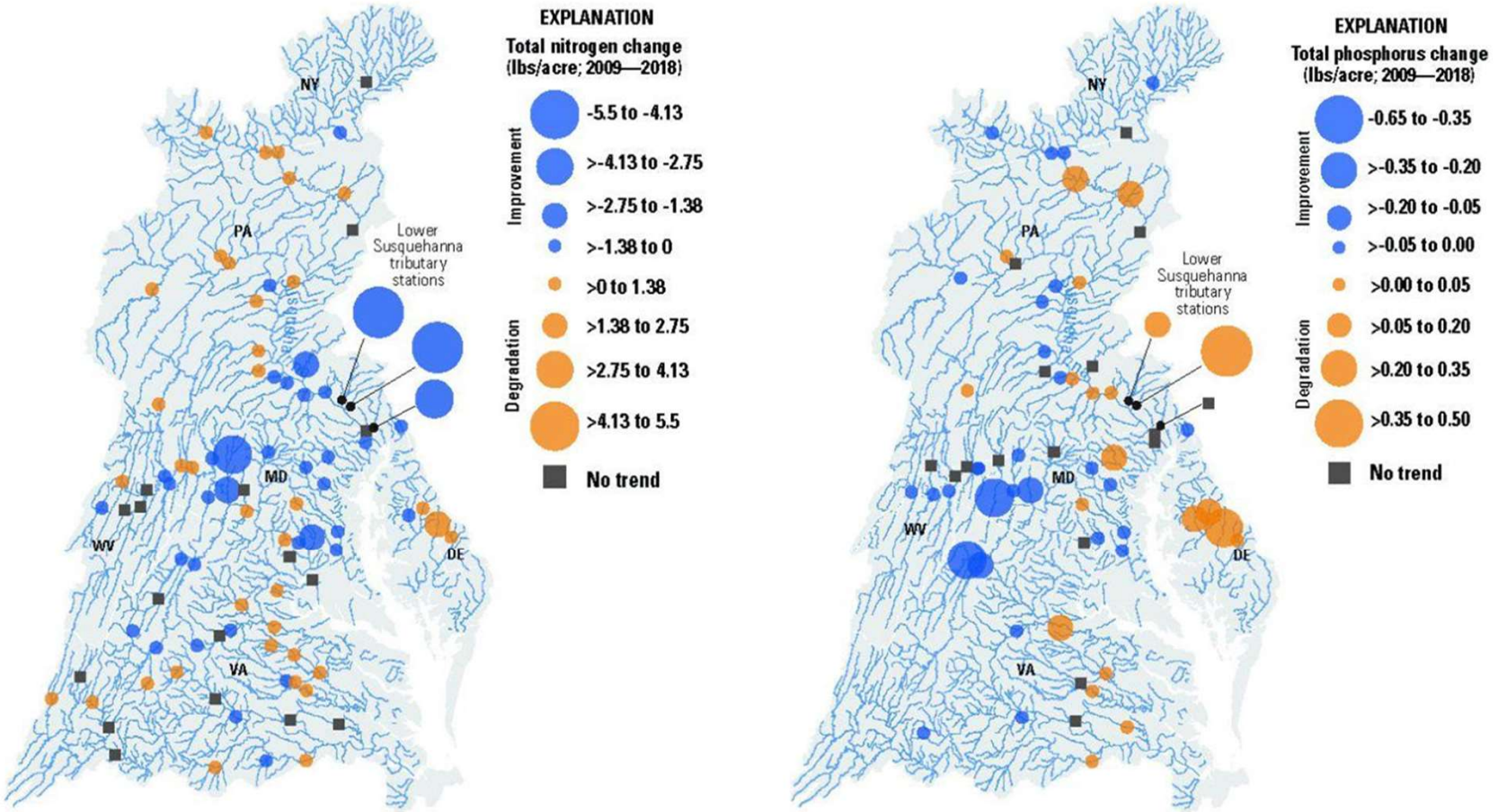

Figure 1. Total nitrogen and total phosphorus trends at nontidal monitoring stations in the Chesapeake Bay watershed. Data from Moyer and Langland (2020). (lbs, pounds; NY, New York; MD, Maryland; PA, Pennsylvania; VA, Virginia; WV, West Virginia; DE, Delaware)

CREDIT USGS

Clarification of Maintenance of Drainage Conveyances

- Page 27, Line 763. "The location of any stream blockages such as debris jams, fallen or unstable trees, beaver dams or similar impediments to conveyance..."
- Add... "that have a high likelihood of causing flooding resulting in damage to property and infrastructure."
- Clarifies that these are natural and beneficial features of streams to be managed appropriately.
- Define "positive conveyance."