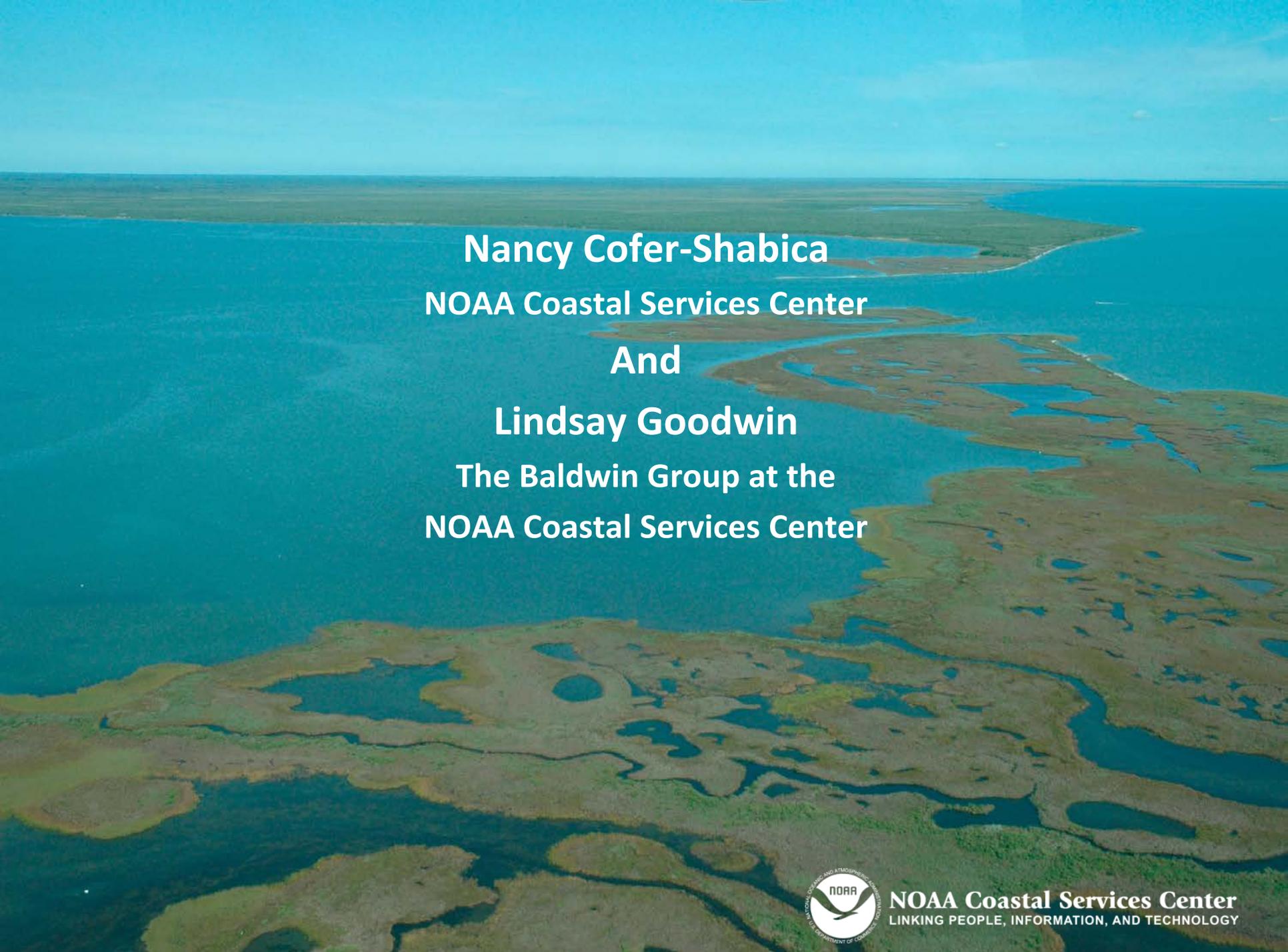


Introducing Green Infrastructure for Coastal Resilience

National Oceanic and Atmospheric Administration (NOAA)
Coastal Services Center



NOAA Coastal Services Center
LINKING PEOPLE, INFORMATION, AND TECHNOLOGY



Nancy Cofer-Shabica
NOAA Coastal Services Center
And
Lindsay Goodwin
The Baldwin Group at the
NOAA Coastal Services Center



Course Objectives

Planning for Coastal Resilience Using Green Infrastructure

Participants will . . .

- Become familiar with Green Infrastructure (GI) terms and concepts
- Understand some ecological, economic, and societal benefits of GI
- Consider local natural assets and their role in community resilience
- Consider stakeholders important for GI planning and implementation
- Know where to go for additional information and training

GREEN INFRASTRUCTURE SOLUTIONS



CONSERVATION SCIENCE
BIODIVERSITY

SMART GROWTH
GREENWAYS

LID BMP
URBAN FORESTRY
GREEN BUILDING



Source: The Conservation Fund

RURAL

URBAN

SITE/PARCEL REGION/LOCAL LANDSCAPE

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Course Outline

Planning for Coastal Resilience Using Green Infrastructure

1. Green Infrastructure Concepts and Principles
2. An Introduction to Green Infrastructure
Planning Processes
3. Getting on the Ground: Green Infrastructure
Network Design
4. What Next? Resources for Moving Forward



Section 1

Green Infrastructure Concepts and Principles



Resilient Communities Have...

- Healthy ecosystems
- Ecosystems that protect and provide services for people and places
- People capable of handling the impacts from hazards
- Development out of high hazard risk areas

Green Infrastructure Is . . .

Green Infrastructure Concepts and Principles



A strategic planning approach



Landscapes that provide ecological benefits to support community goals

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Green Infrastructure Planning Approach

Green Infrastructure Concepts and Principles

- Strategic
- Ecologically based
- Community-oriented
- Multi-objective



Green Infrastructure on the Ground

Green Infrastructure Concepts and Principles

A strategically planned and managed network of natural lands, working landscapes, and other open spaces that conserves ecosystem values and functions and provides associated benefits to human populations



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Ecosystem Services

Green Infrastructure Concepts and Principles

The processes by which the environment produces resources that we often take for granted, such as clean water, timber, and habitat for fisheries, and pollination of native and agricultural plants



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Ecosystem Services

Green Infrastructure Concepts and Principles

- Hazard mitigation, flood control
- Soil conservation and generation
- Filtering and cooling of water
- Fisheries support
- Climate regulation
- Species habitat

Benefits to Coastal Communities

Green Infrastructure Concepts and Principles

- Addresses growth pressures and their impacts
- Preserves “coastal character”
- Increases resilience to coastal hazards



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Think About . . .

Green Infrastructure Concepts and Principles

How does the natural environment help make your community “resilient”?





Human Benefits

Green Infrastructure Concepts and Principles

- Flood storage
- Erosion control
- Storm surge buffer
- Water quality maintenance
- Recreational opportunities
- Sense of place

Ecological Benefits

Green Infrastructure Concepts and Principles

- High-quality habitat
- Healthy landscapes that support...
 - Water recharge and filtering
 - Protection from storm impacts
- Ability to adapt to disturbance



Economic Benefits

Green Infrastructure Concepts and Principles

- In 2008, total commercial fishing revenue for South Carolina was estimated at over \$62 million
- Lands preserved for flood storage have a 8:1 dollar savings over human flood-control structures



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Green Infrastructure for Coastal Resilience

Green Infrastructure Concepts and Principles

- Healthy, functional ecosystems more adaptable to changing conditions
- Natural buffers for people during hazards events
- Strengthened connection between people and environment and people and place



Green Infrastructure Network

Green Infrastructure Concepts and Principles

- Landscapes delineated using ecological principles
- Connections between landscapes are maintained



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Green Infrastructure is *Not* . . .

Green Infrastructure Concepts and Principles

- A regulatory program
- A short-term solution
- An isolated effort
- No-growth or anti-development
- A few “green” engineered structures*



Exercise 1 (Individual)

Green Infrastructure Concepts and Principles

How do natural areas benefit your community and increase its resilience?

Exercise 1 (Individual)

Green Infrastructure Concepts and Principles

	Example	Group	Individual
Exercise 1: Ecosystem Services that are increasing resilience in your community	buffer storm surge		1

Exercise 2 (Small Group)

Green Infrastructure Concepts and Principles

Look at the ecosystem services that each group identified, and then work together to identify the landscape types that provide each of these services for your community

Exercise 2 (Small Group)

Green Infrastructure Concepts and Principles

	Example	Group	Individual
Exercise 1:	buffer storm surge	2	
Exercise 2: What landscapes types in your community help provide these services?	salt marsh, dunes	3	



Exercise 2 (Small Group)

Green Infrastructure Concepts and Principles

Ecosystem Service

- Mitigate flooding
- Protect coastal communities from erosion by waves
- Outdoor recreation opportunities
- Filter and improve water quality



Landscape

- Salt marsh, riparian wetlands
- Beaches and dunes, maritime forests
- Parks, greenways, waterways, trails
- Forestlands, wetlands, riparian forests



Section 2

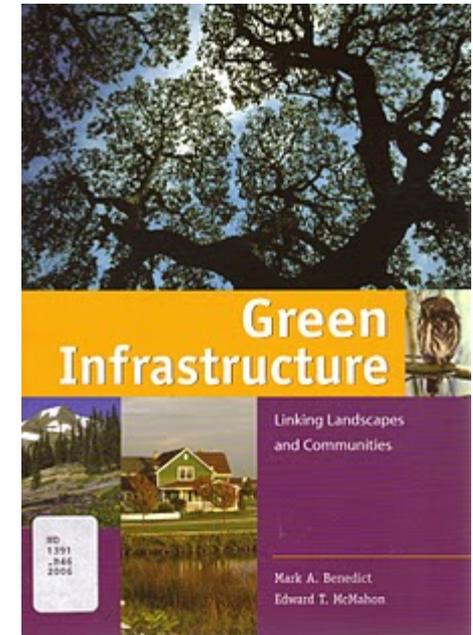
An Introduction to Green Infrastructure Planning Processes



Green Infrastructure Planning

An Introduction to Green Infrastructure Planning Processes

- Based on the publication ***Green Infrastructure: Linking Landscapes and Communities***
- Uses spatial information and maps to identify priority lands



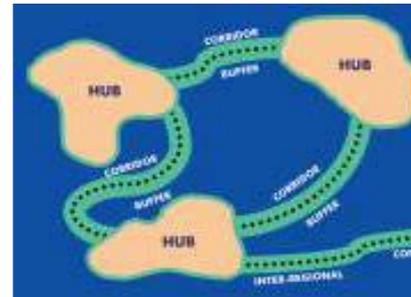
Green Infrastructure Planning

An Introduction to Green Infrastructure Planning Processes

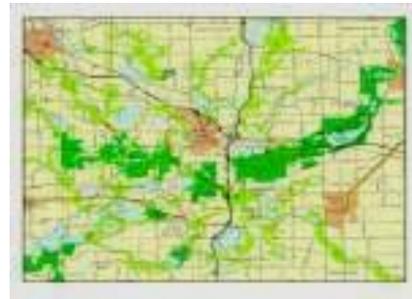
Visioning



Network Design



Implementation



Stakeholders: When? Why?

An Introduction to Green Infrastructure Planning Processes

- A Green Infrastructure planning process is strategic, multi-objective, community-oriented
- How you plan *and* implement down the road will drive who is involved



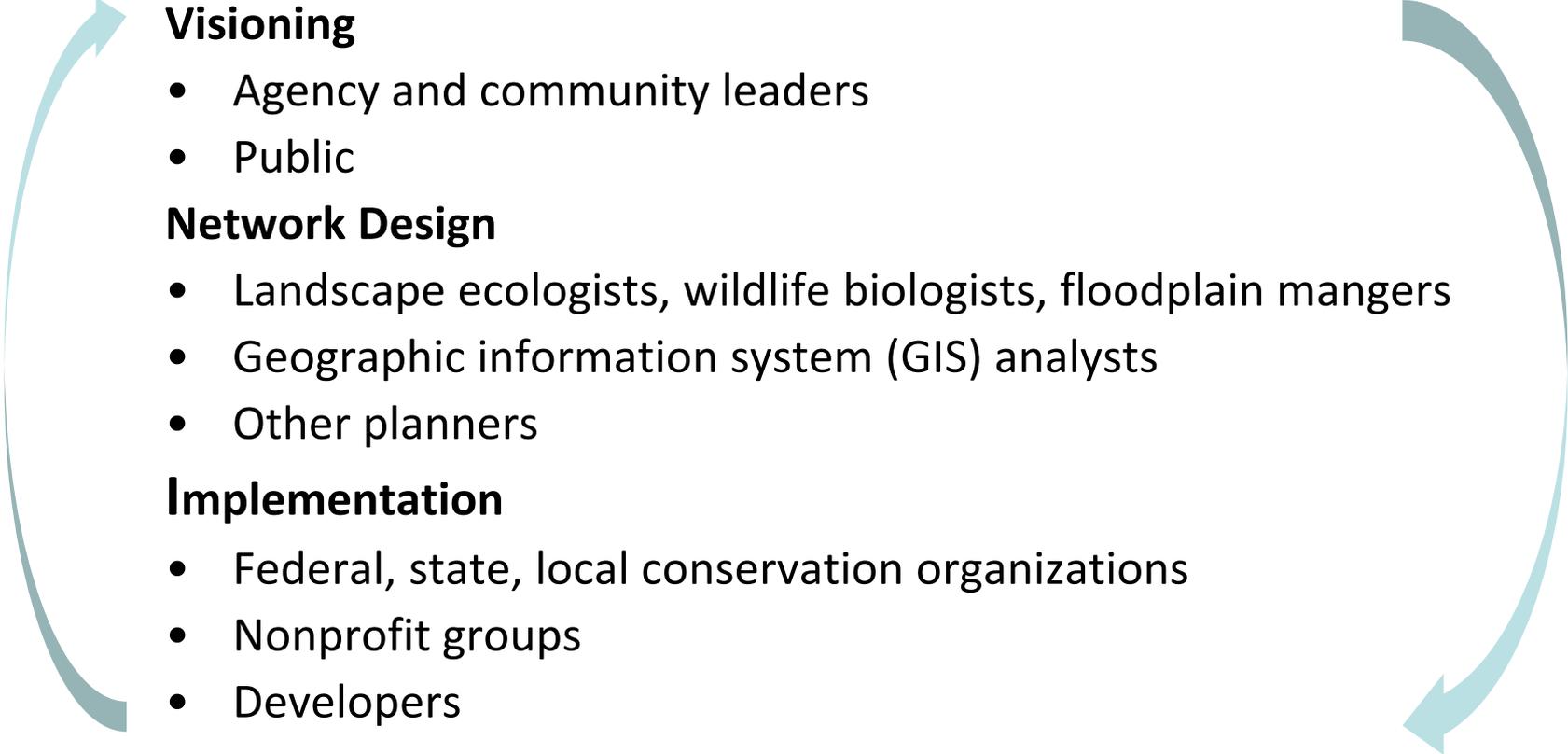
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Stakeholder Involvement

An Introduction to Green Infrastructure Planning Processes



Visioning

- Agency and community leaders
- Public

Network Design

- Landscape ecologists, wildlife biologists, floodplain managers
- Geographic information system (GIS) analysts
- Other planners

Implementation

- Federal, state, local conservation organizations
- Nonprofit groups
- Developers

Visioning

“Begin with the end in mind”

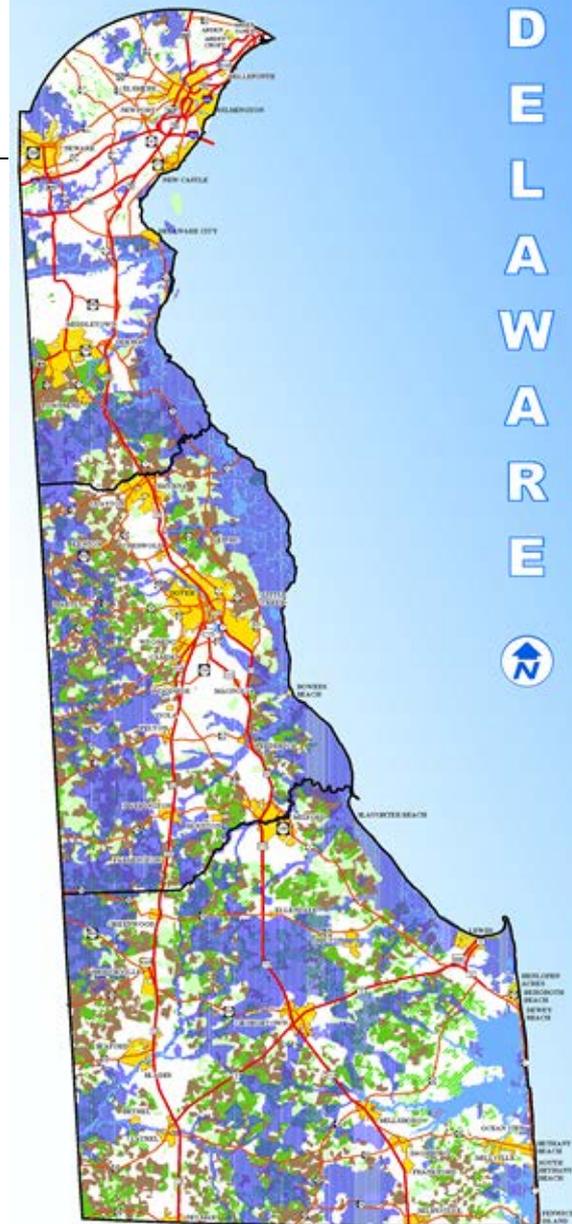


Visioning

An Introduction to Green Infrastructure Planning Processes

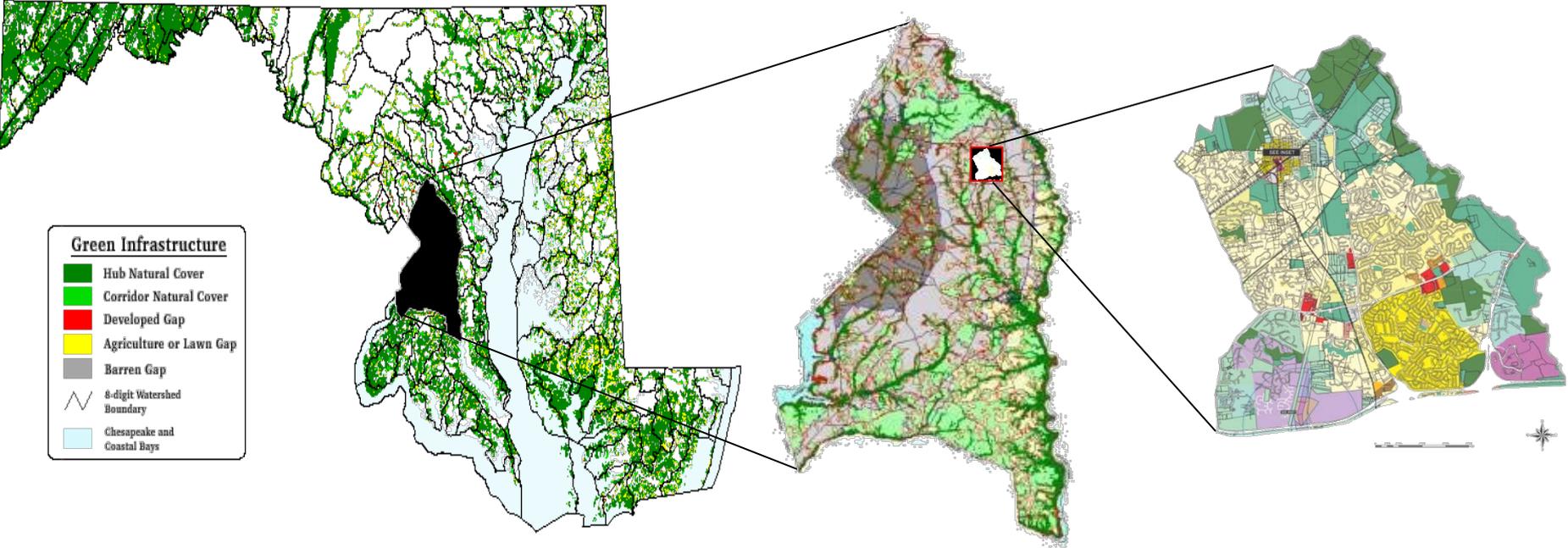
Sample Goals:

- Prevent flooding
- Support and enhance biodiversity and functional ecosystems
- Provide opportunities for profitable farming and forestry enterprises
- Foster ecotourism
- Protect native plant and animal species



Network Design

An Introduction to Green Infrastructure Planning Processes



Maryland State Plan

Prince George's County

Bowie Planning Area

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Implementation

An Introduction to Green Infrastructure Planning Processes

How will you implement?

- Partnerships
- Purchases
- Regulations and incentives
- Plans and assessments
- Linkages to “gray infrastructure” planning

Implementation

An Introduction to Green Infrastructure Planning Processes

How will you implement?

- Partnerships
- Purchases
- Regulations and incentives
- Plans and assessments
- Linkages to “gray infrastructure” planning

“A Sample Menu”

- *Fee-Simple Acquisition*
- *Conservation Easements*
- *Nonstructural Storm Water Management Programs*
- *Mitigation Banking*
- *Best Management Practices for Working Lands*
- *Floodplain Regulations*
- *Conservation Development*
- *Parks and Open Space Programs*
- *Historic and Archaeological Site Protection*

Some additional food for thought:

[Greenseams Video](#) . . .

Exercise 3 (Small Group)

An Introduction to Green Infrastructure Planning Processes

Identify the organizations, agencies, businesses, or community groups that have a stake in the ecosystem services and landscapes that you've identified

Exercise 3 (Small Group)

An Introduction to Green Infrastructure Planning Processes

	Example	Group	Individual
Exercise 1:	buffer storm surge		
Exercise 2:	salt marsh, dunes		
Exercise 3: What agencies and organizations have a vested interest in these landscape types and services?	USFWS, State DNR	4	





Section 3

Getting on the Ground: Green Infrastructure Network Design



Design Concepts

Green Infrastructure Network Design

- Identify landscapes that support your project goals
- Design elements are based on conservation science principles
- Design methods are repeatable and grounded in science



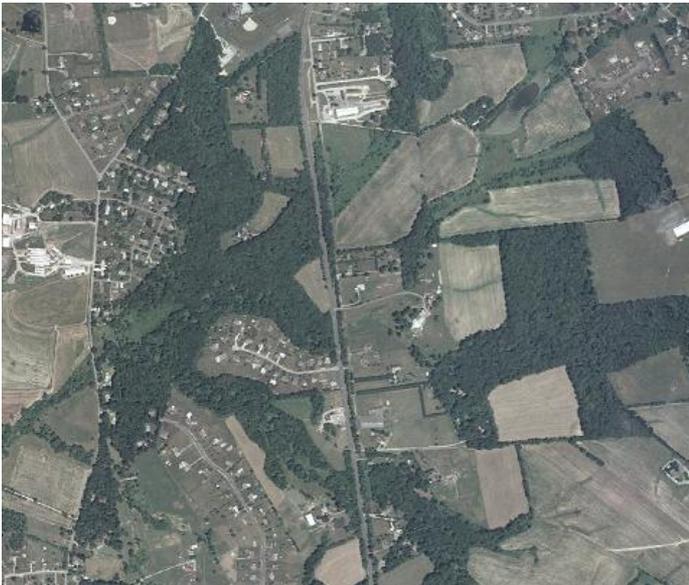
Design Concepts

Green Infrastructure Network Design

**Less fragmentation
and alteration**

=

**Better ecosystem
health and quality**



Fragmented Landscape



Intact, Healthy Landscape

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Design Concepts

Green Infrastructure Network Design

Area



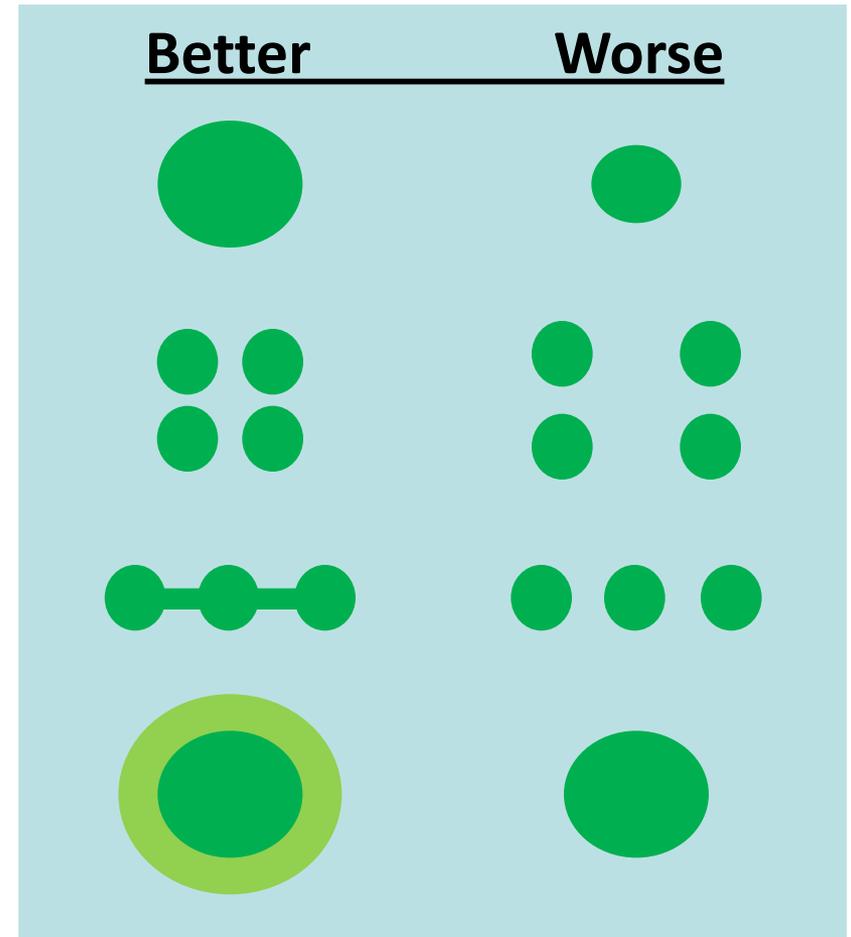
Proximity



Connectivity



Buffer



Design Concepts

Green Infrastructure Network Design

Area



Better



Worse

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Design Concepts

Green Infrastructure Network Design

Proximity



Better



Worse

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Design Concepts

Green Infrastructure Network Design

Connectivity



Better



Worse

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Designing for Resilience

Green Infrastructure Network Design

Better ecosystem health and quality = Ability to adapt to and recover from disturbance



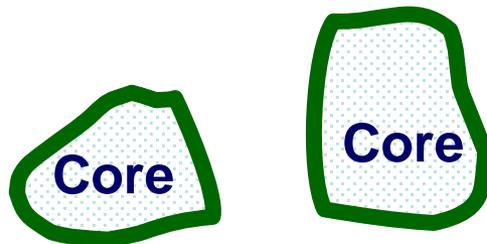
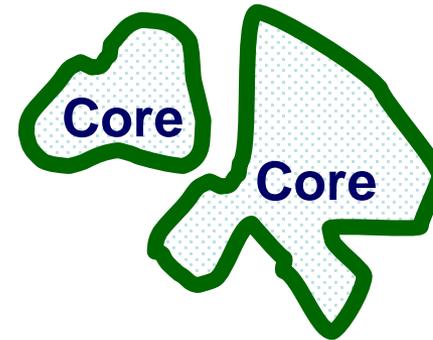
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Network Components

Green Infrastructure Network Design

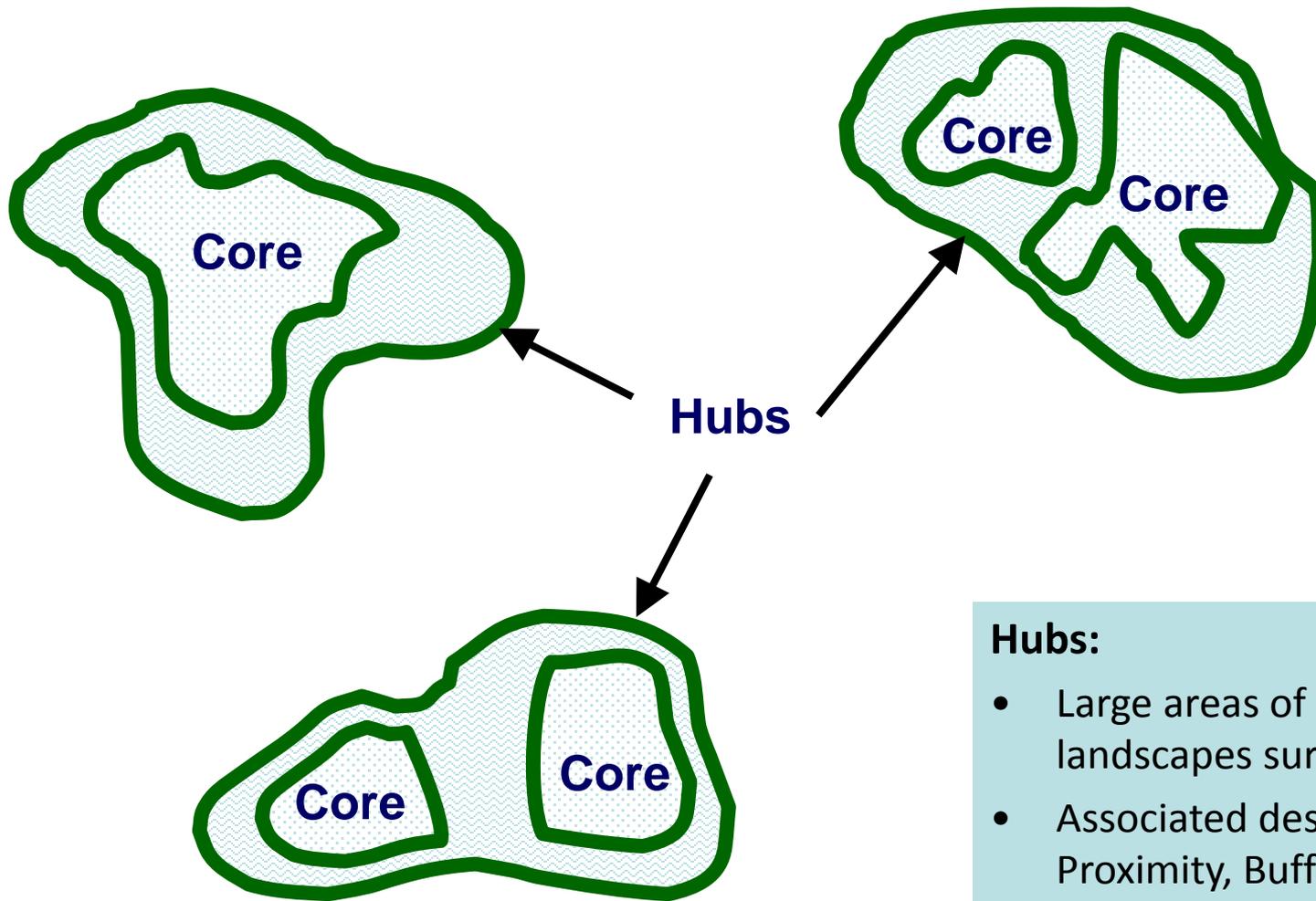


Core Areas:

- Large areas of high-quality, intact habitat
- Associated design concept: Area

Network Components

Green Infrastructure Network Design

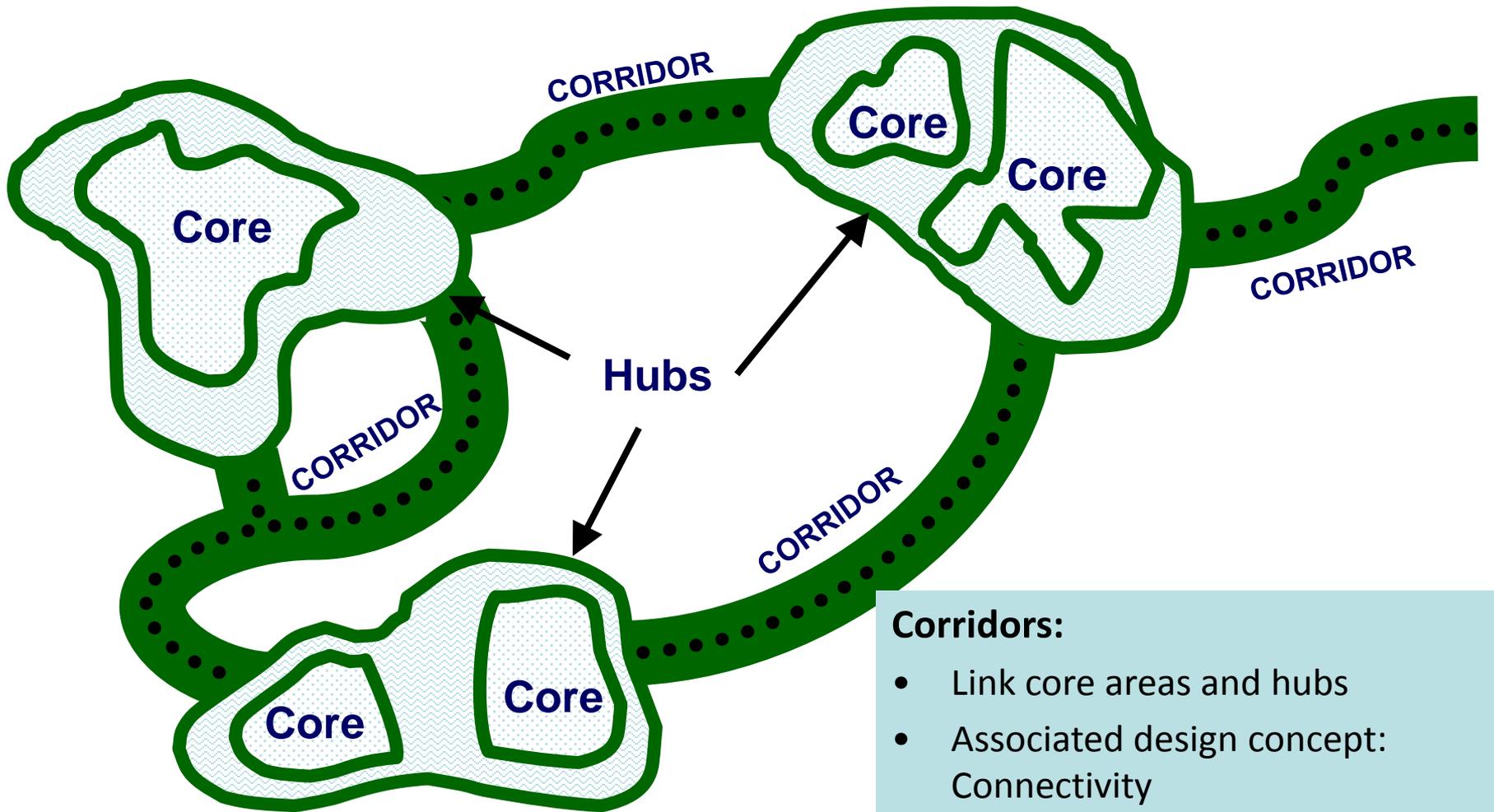


Hubs:

- Large areas of supporting landscapes surrounding cores
- Associated design concepts: Proximity, Buffer

Network Components

Green Infrastructure Network Design

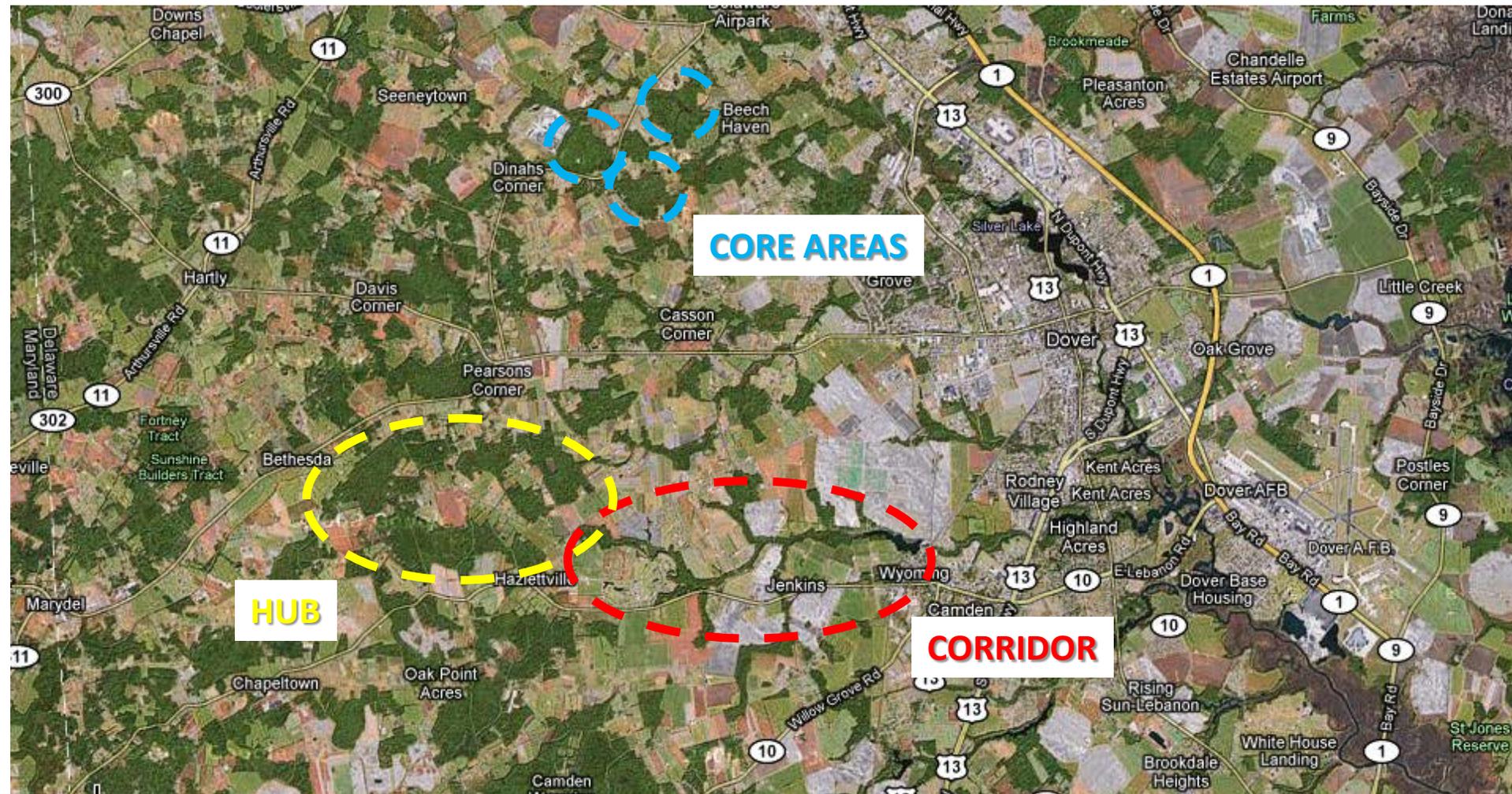


Corridors:

- Link core areas and hubs
- Associated design concept: Connectivity

Network Components

Green Infrastructure Network Design



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Visualization Tools

Green Infrastructure Network Design

Wetland Benefits Snapshot
Jasper County, South Carolina

COASTAL COUNTY SNAPSHOTS
www.csc.noaa.gov/snapshots

Protecting Wetlands = Coastal Communities That Are Safer, Cleaner, and More Economically Productive

Healthy wetlands provide more than just a pretty view. Wetlands are a pivotal part of the natural system, supplying tremendous benefits for coastal communities. Even small acreages can provide some level of benefit. The location, health, and size of individual wetlands also play a role. This snapshot demonstrates three key benefits of wetlands in Jasper County.

Based on [2006 NOAA land cover](#).

44%
 185,198 acres of Jasper County is wetland.

More Economically Productive: Wetlands Support Fishing Economies

Coastal wetlands provide habitat for many aquatic species that contribute to local food supplies and fishing-related industries.

In addition to providing a base for commercial fishing jobs and revenue, wetlands also support recreational and charter fishing. These economic benefits extend beyond county boundaries.

Based on [2008 NOAA ENOW](#) and [2008 U.S. Census Nonemployer Statistics](#).

Commercial Fishing	County	State
Jobs	11	1,930
Output from businesses	unavailable*	\$11.3 million
Revenue from self-employed	\$206,000	\$62.1 million

See the [frequently asked questions](#) page to learn why this data is not available.

C-CAP Land Cover Atlas
 NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

South Carolina | Beaufort

Date Range: 1996 | 2001 | 2006

General | Developed | Forests | Wetlands | Search

General Statistics
 Beaufort County, South Carolina
 1996 to 2006

What's on the map?
 All changes from 1996 and 2006

Percent of Beaufort County that changed

5.18%

Distribution of land cover by type

Land Cover Class	1996	2006
HID	~10	~10
LID	~10	~10
OSD	~10	~10
GRS	~10	~10
AGR	~10	~10
FOR	~10	~10
SCB	~10	~10
WOW	~10	~10
EMW	~10	~10
BAK	~10	~10
WTK	~10	~10

Scale: 1:1977,791 | Lat: 32.6357 | Long: -81.2943

Contact Us | Privacy Policy | Link Disclaimer | USA.gov

Land Cover Atlas

Flood Exposure Snapshot
Beaufort County, South Carolina

COASTAL COUNTY SNAPSHOTS
www.csc.noaa.gov/snapshots

**People + Floodplains = Not Good
 High-Risk Populations + Floodplains = Even Worse**

The more homes and people located in a floodplain, the greater the potential for harm from flooding. Impacts are likely to be even greater when additional risk factors (age, income, capabilities) are involved, since people at greatest flood risk may have difficulty evacuating or taking action to reduce potential damage.

Based on 2000 [U.S. Census records](#).

Population	Population over 65	Population in Poverty
Total: 120,937	Total: 18,885	Total: 12,194
Inside FEMA Floodplain: 71,541 (59%)	Inside FEMA Floodplain: 11,693 (62%)	Inside FEMA Floodplain: 7,043 (58%)
Outside FEMA Floodplain: 49,396 (41%)	Outside FEMA Floodplain: 7,192 (38%)	Outside FEMA Floodplain: 5,151 (42%)

County Snapshots

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The Benefits of Maps and GIS

Green Infrastructure Network Design

Visualize

- Maps provide a way for stakeholders to see the network and provide input

Analyze

- GIS provides the ability to analyze, organize, and manipulate data to draw conclusions



Analysis Tools and Resources

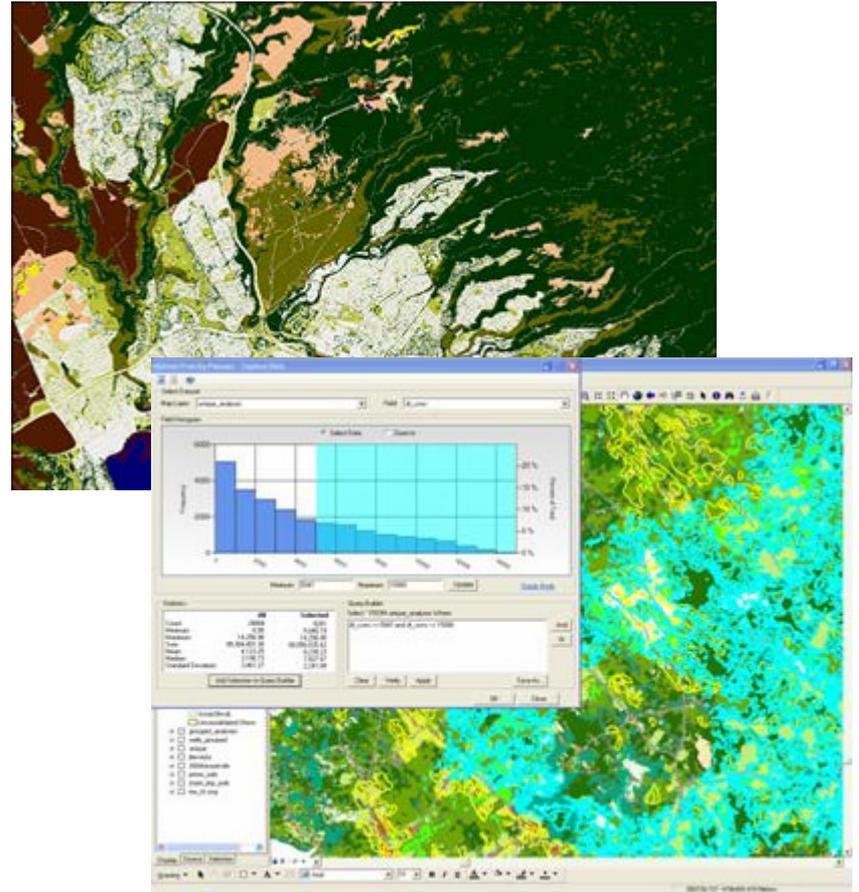
Green Infrastructure Network Design

Data

- Land cover
- Species locations
- Floodplains
- Population density

Tools

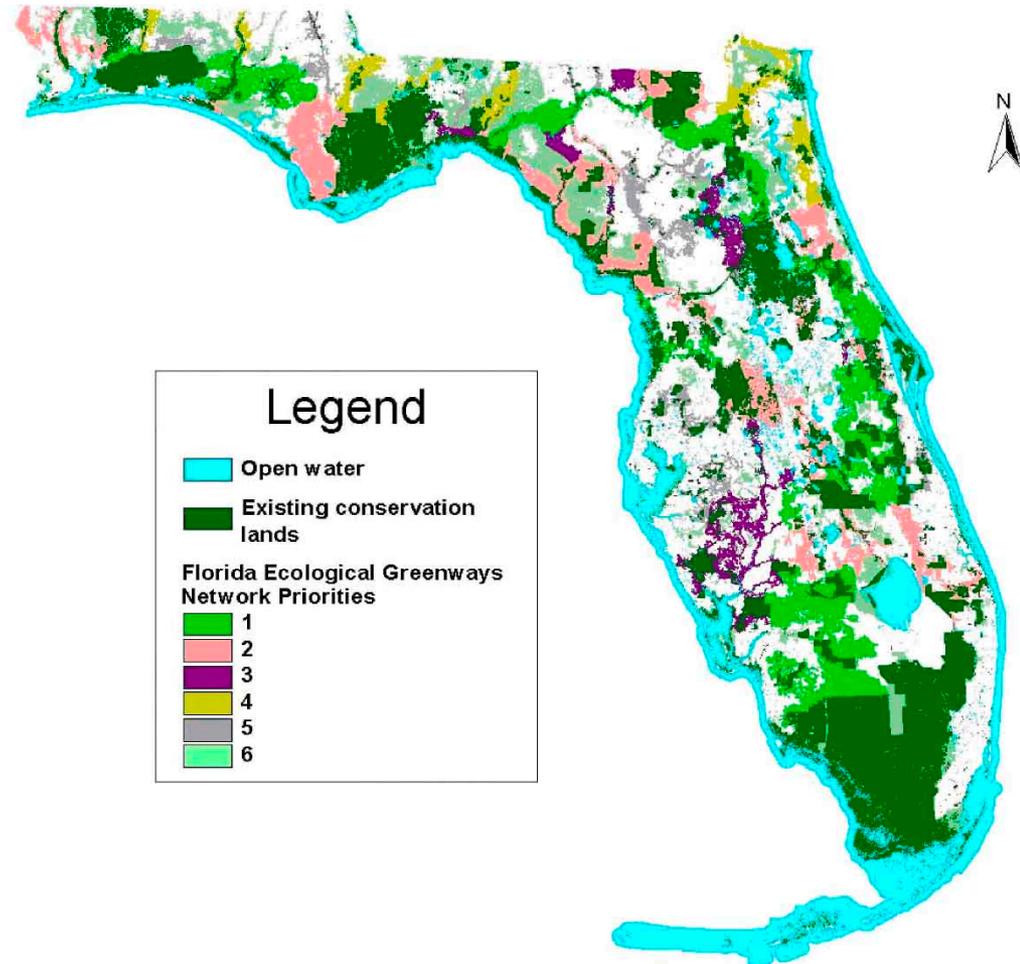
- Habitat Priority Planner
- CorridorDesigner



A Design on the Ground

Green Infrastructure Network Design

- Your network tells you *where* to implement—not *how*



Exercise 4 (Small Group)

Green Infrastructure Network Design

Consider what information the stakeholder organizations, agencies, businesses, and community groups have that will help you use maps to plan and protect your critical green infrastructure landscapes

Exercise 4 (Small Group)

Green Infrastructure Network Design

	Example	Group	Individual
Exercise 1:	buffer storm surge		
Exercise 2:	salt marsh, dunes		
Exercise 3:	USFWS, State DNR		
Exercise 4: What data and Information could these groups provide to show services or existing landscapes on the ground?	wetlands locations (NWI data)	5	



Section 4

What Next?

Resources for Moving Forward



Think About . . .

What Next?

What planning processes are, or could be, occurring in your area? How could you integrate green infrastructure concepts into these efforts?

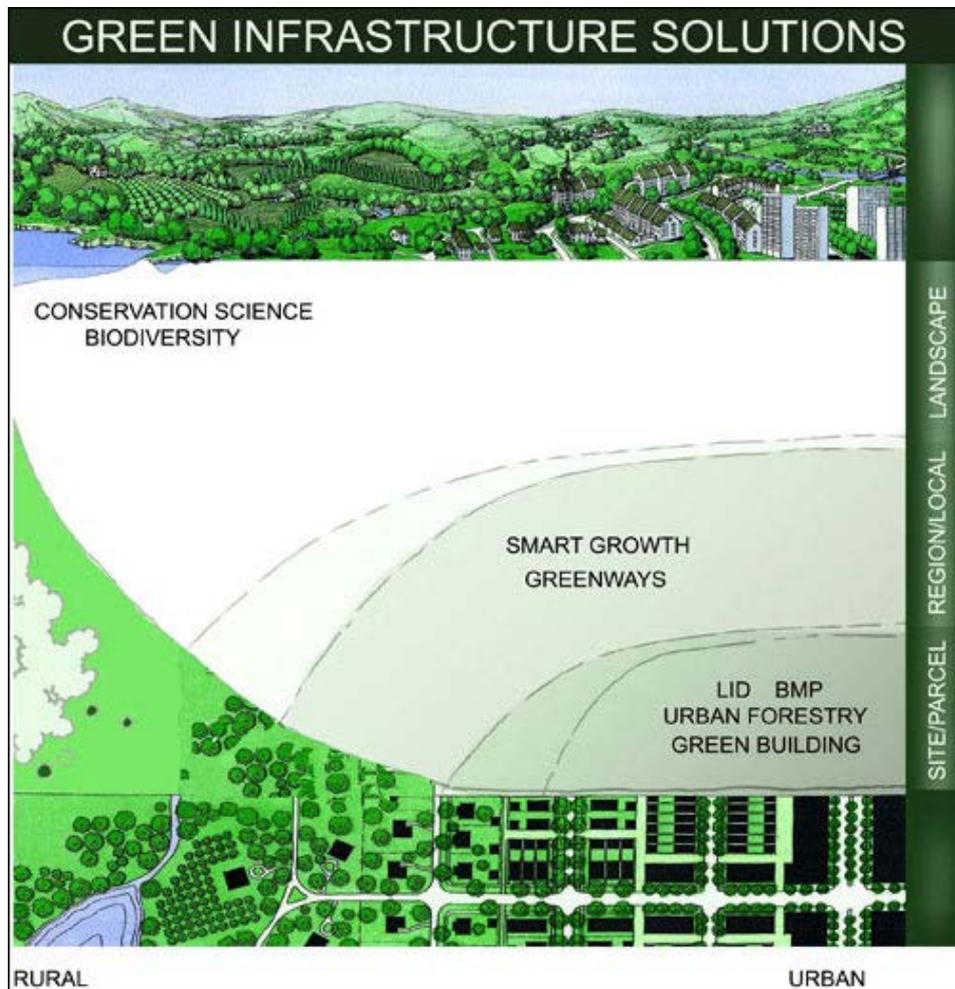
Exercise 5 (Individual/Small Group)

What Next?

	Example	Group	Individual
Exercise 1:	buffer storm surge		
Exercise 2:	salt marsh, dunes		
Exercise 3:	USFWS, State DNR		
Exercise 4:	wetlands locations (NWI data)		
Exercise 5:	hazard mitigation planning	6	
Notes on existing or future planning processes that are, or could be, incorporating this information			

What Next?

What Next?



Source: *The Conservation Fund*

Additional resources
are available to help
with your next steps

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Green Infrastructure Planning

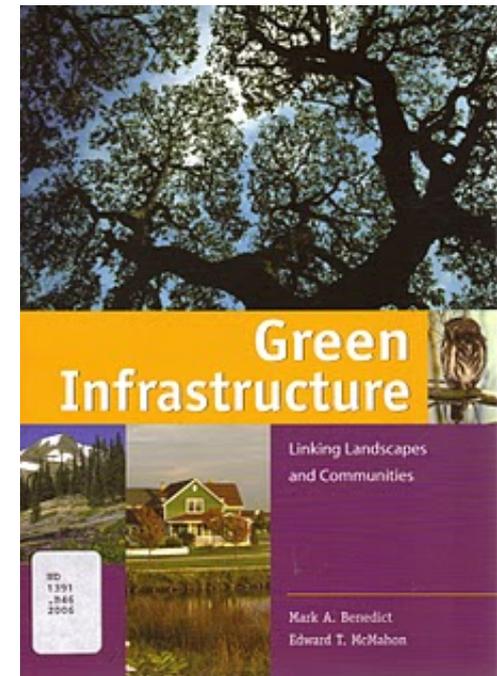
What Next?

Courses

- Strategic Conservation Planning Using a Green Infrastructure Approach
- GIS Tools for Strategic Conservation Planning

Resources

- *Greeninfrastructure.net*
- The Green Infrastructure Center
- National Association of Counties (NACo)



Hazards Planning

What Next?

Courses

- Roadmap for Adapting to Coastal Risks

Resources

- NOAA Coastal Services Center's Coastal County Snapshots
- Environmental Protection Agency's (EPA) Managing Wet Weather
- Digital Coast Partnership's Coastal Inundation Toolkit
- Federal Emergency Management Agency-funded property acquisitions



Smart Growth Planning

What Next?

Courses

- Coastal Community Planning and Development

Resources

- EPA-NOAA *Smart Growth for Coastal and Waterfront Communities*
- Smart Growth America

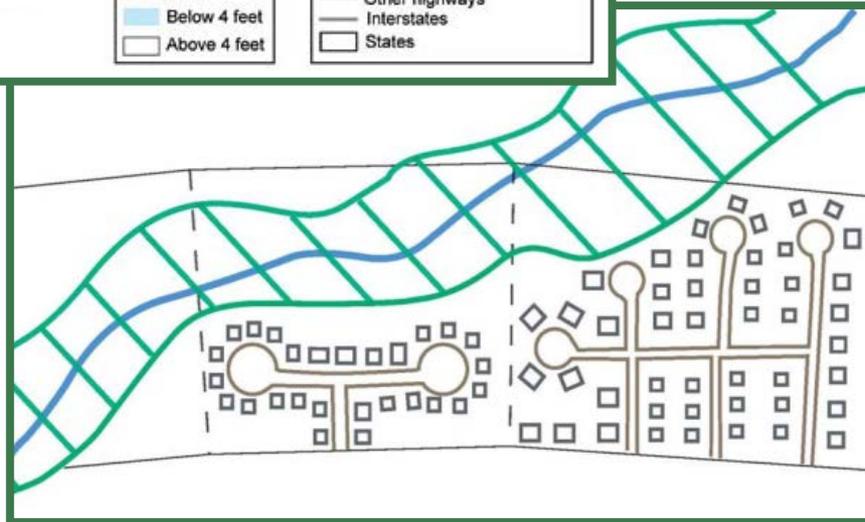


Transportation Planning

What Next?



U.S. Department of
Transportation's Federal
Highway Administration



National Park Service's
Rivers, Trails, and
Conservation Assistance
Program

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Watershed Planning

What Next?



- EPA Healthy Watersheds Initiative
- Southeast Watershed Forum

Climate Adaptation

What Next?

Courses

- Adapting to Climate Change: A Short Course for Land Managers

Resources

- NERR Planning for Climate Change workshop resources online
- Sea Level Rise and Coastal Flooding Impacts Viewer

Ecosystem Services

What Next?

Resources

- U.S. Department of Agriculture Forest Service's Ecosystem Services program
- Gulf of Mexico Ecosystem Services Database
- Ecosystem Services fact sheet
- State and county reports



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Stakeholder Engagement

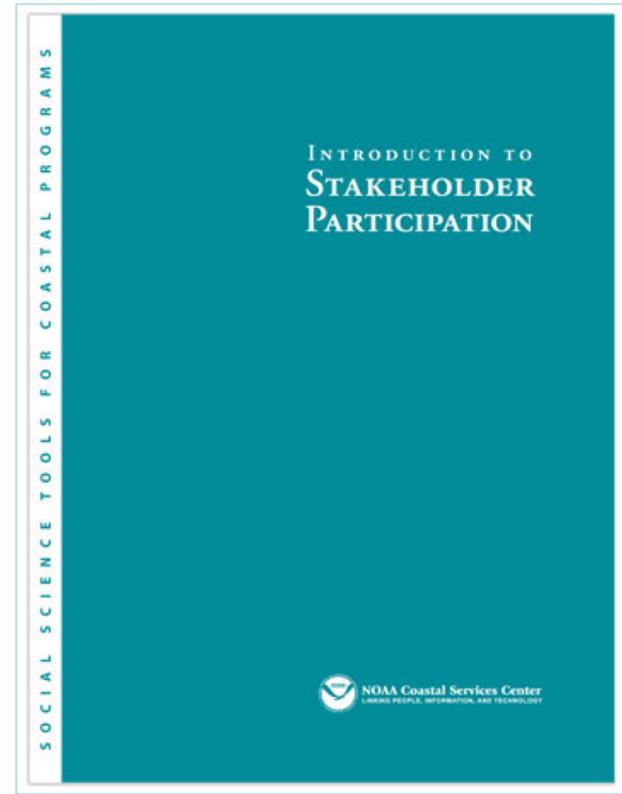
What Next?

Courses

- Negotiating for Coastal Resources
- Public Issues and Conflict Management

Resources

- *Introduction to Stakeholder Participation*



What Next?

What Next?

What will **you** do next?



Thank you

Please fill out the evaluation form!

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Lindsay.Goodwin@noaa.gov