

# Natural Defenses for Coastal Hazards

## Helping Communities Plan



**Bethney Ward**

**Office for Coastal Management**



# Coastal Communities Are at Risk

## Coastal Shoreline Counties

**123.3 million**

Coastal Shoreline County population in 2010.

**39%**

Percent of the U.S. population that resides in Coastal Shoreline Counties in 2010.

**34.8 million**

Coastal Shoreline County population change from 1970 to 2010, a 39% increase. (U.S. average 52%)

**10 million**

Projected population change in Coastal Shoreline Counties from 2010 to 2020, an 8% increase. (U.S. average 10%)



Humpback Whale National Marine Sanctuary. Credit: Fiona Langenberger

## Population

Figure 3 | Population Change in Coastal Shoreline Counties: 1970-2010

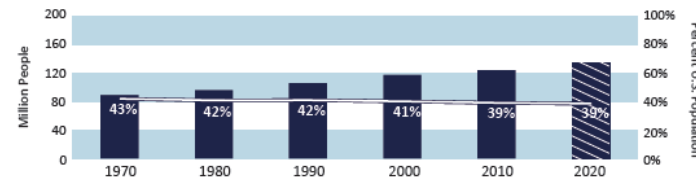
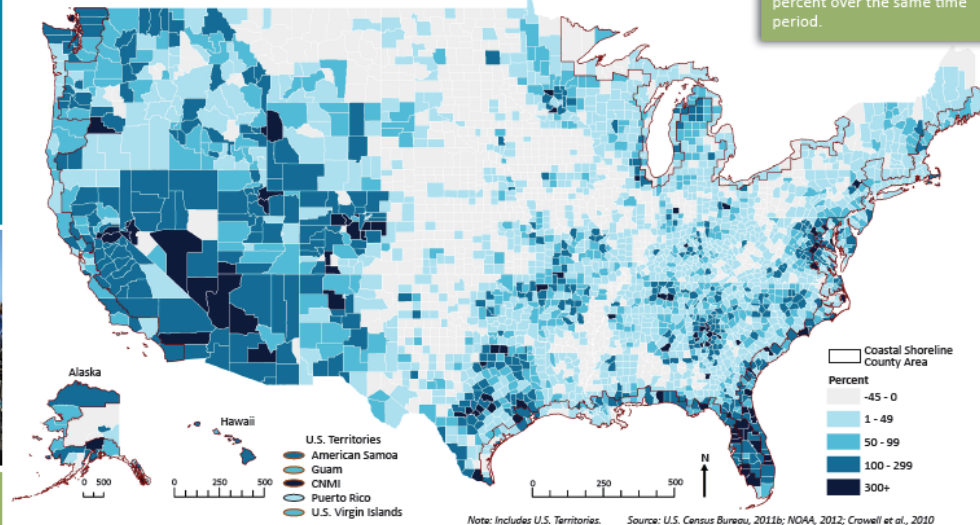


Figure 4 | Percent Population Change in U.S. Counties, Highlighting Coastal Shoreline Counties: 1970-2010



## The Bottom Line

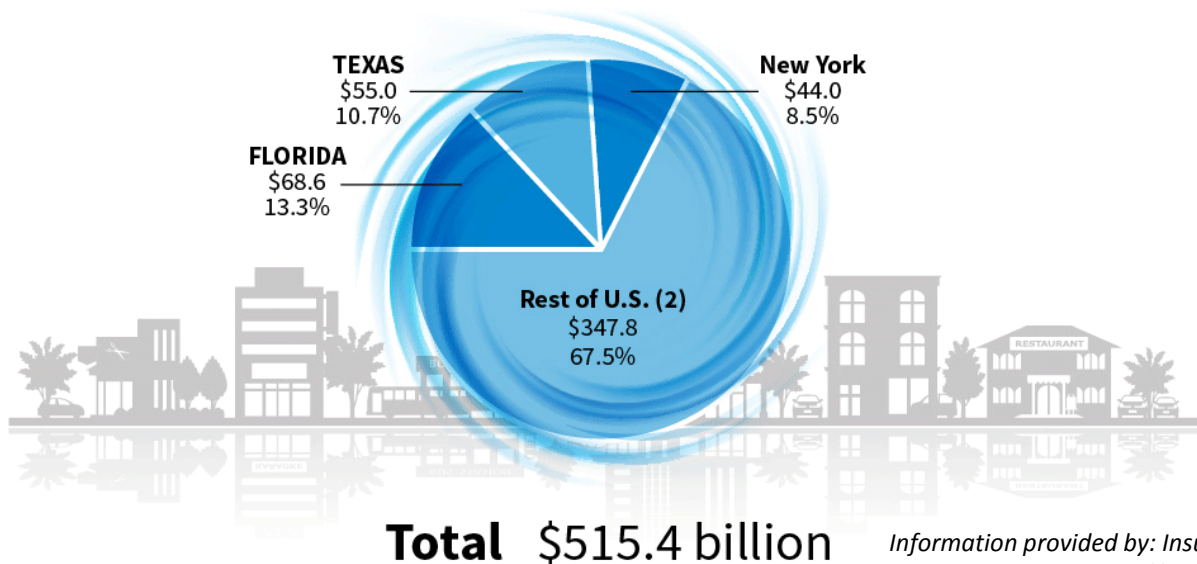
In 2010, 123.3 million people, or 39 percent of the nation's population lived in Coastal Shoreline Counties. Population growth in these counties occurred at a lower rate than the nation as a whole from 1970 to 2010. The population in Coastal Shoreline Counties increased by 34.8 million people, a 39 percent increase, while the nation's entire population increased by 52 percent over the same time period.

# Coastal Communities Are at Risk



## HURRICANES: Catastrophic Losses

Insured Losses, 1986-2015, Adjusted for Inflation



# Shifting Attention to Natural Defenses

Superstorm Sandy

## Wetland Benefits

\$625 million in damages prevented.



*Information provided by: Narayan, and others 2016. Llyod's Tercentenary Research Foundation*

# Coastal Green Infrastructure



URBAN FORESTRY

FORESTED WETLAND

OPEN SPACE

COASTAL WETLANDS

LIVING SHORELINE

SAND DUNES

OYSTER BEDS AND SEA GRASSES

GREEN ROOF

CORALS

# Coastal Green Infrastructure Benefits

- Buffer wave action and storm surge
- Store floodwaters, recharge aquifers
- Reduce runoff, improve water quality and clarity
- Stabilize shorelines
- Capture blue carbon
- Provide habitat for fish and wildlife
- Offer recreational, job opportunities
- Protect property and improve property value (aesthetics)
- Many more!



## Put Green Infrastructure between Your Community and the Next Coastal Storm.

There are many benefits.

### Tidal and Forested Wetlands

- Slow waves
- Filter and clean floodwaters
- Provide food and jobs

### Green Streets

- Capture and clean stormwater
- Beautify streets and encourage economic development
- Provide pedestrian-friendly walkways

### Oyster and Coral Reefs

- Slow storm surge
- Provide food
- Clean water

### Sand Dunes

- Buffer waves as a first line of defense
- Build economy through tourism

### Open Space and Parks

- Store floodwaters and recharge aquifers
- Increase property values

### Urban Trees

- Reduce runoff and absorb floodwaters
- Shade and cool homes and businesses
- Provide clean air and water

### Living Shorelines

- Slow waves and reduce erosion
- Protect property

# Green Infrastructure Planning



**Landscape**



**Community  
and Site**



**Shoreline**



# Understanding and Communicating

## Introducing Green Infrastructure for Coastal Resilience Training



## Protective Services Animation





# Assessing Flood Exposure and Impacts

## Coastal Flood Exposure Mapper

Coastal Flood **Exposure Mapper**

### Select the Flood Hazards Map or One of the Community Exposure Maps

Select a section below to view maps showing flood hazards or different aspects of community exposure to those flood hazards.

First-time user? Starting with Flood Hazards is a good idea.



#### Flood Hazards

Flooding events are among the more frequent, costly, and deadly hazards that can impact coastal communities. There are two types:

- Short-term (episodic) – Temporary flooding caused by extreme conditions, including storm surge, tsunamis, inland flooding, and shallow coastal flooding.
- Long-term (chronic) – Flooding caused by a rise in relative sea



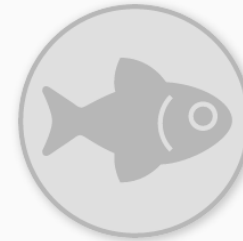
#### Societal Exposure

Understanding the populations that live in or near coastal flood-prone areas is an important information need, since residents who are elderly, who live in high-density areas, or who are impoverished may merit special considerations.



#### Infrastructure Exposure

Community infrastructure, including roads, bridges, and water and sewer systems, can be damaged by coastal flooding. Communities should first assess infrastructure vulnerabilities and associated environmental and economic issues to determine what steps are needed to protect these assets.



#### Ecosystem Exposure

Natural areas provide important benefits to coastal communities, including hazard protection, flood storage, water quality maintenance, fisheries support, and recreational opportunities. Communities can increase resilience by protecting natural areas along the coast that are exposed to flooding and adjacent inland areas.

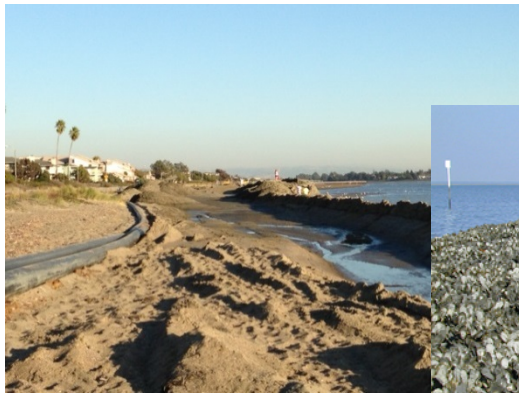
# Green Infrastructure Approaches



Source: EPA

← Landscape Conservation

→ Low Impact Development



← Dune or Oyster Reef Restoration



Source: EPA

# GIS Online Guide

## Green Infrastructure Mapping Guide

The screenshot shows the homepage of the GIS Online Guide. At the top, there are navigation tabs for 'Intro', 'Work Plan', 'Case Studies', 'Resources', and 'FAQ'. The main heading is 'Getting Green Infrastructure in Your GIS'. Below this, there is a paragraph explaining the guide's purpose for spatial analysts. A list of bullet points includes downloading worksheets, reading case studies, and accessing resources. A map of the United States is visible in the background. At the bottom, there is a 'Directions' button.

### Write GIS Goal.

The GIS goal describes the spatial product you will create, and what it will show.

For green infrastructure work, the final product will typically be a map or layers that identify **most suitable conservation areas**. You determine the "most suitable" areas using the details gathered from the **project goals or objectives**.

The project team may have provided information about the larger green infrastructure project, and what their GIS needs entail. Make sure you clearly understand the overall project goals. Sufficient project goals are critical to move forward because they lay the groundwork for your mapping work. See "[Why Project Goals are Important to You](#)" for more information.

**OUR EXAMPLE PROJECT**      **SEE HOW OTHERS DID IT**

Create a spatial layer that locates and prioritizes healthy wetlands along the States coast that can provide flood protection from hurricane storm surges.

- [Adapting for Sea Level Rise through Conservation Mapping \(Maryland\)](#)
- Coastal Protection & Green Infrastructure for Jamaica Bay
- Coastal Marshes for Protection on Long Island

### Write Mapping Objectives.

Mapping objectives define the individual GIS analyses and outputs that will contribute to your final prioritization layer.

Examine your GIS goal, and the other project information you have. Extract the spatial features that must be identified from these statements. Draft the mapping objectives to clearly state what must be done in the GIS.

Some mapping objectives can be developed directly from your GIS goal. Others may be extracted from [larger project goals](#). You may need to brainstorm and collaborate with experts, stakeholders, and the project team.

**OUR EXAMPLE PROJECT**      **SEE HOW OTHERS DID IT**

- [Adapting for Sea Level Rise through](#)

Create a spatial layer that locates and prioritizes healthy wetlands along the States coast that can provide flood protection from hurricane storm surges.

### Assign Spatial Criteria.

Criteria define the characteristics you need to map. Green infrastructure

#### Green Infrastructure Spatial Considerations: Find large area.

Large patches of habitat are best for achieving green infrastructure outcomes because they have greater potential for ecological biodiversity and function. This makes the habitat itself stronger, and therefore more resilient to storms. Areas with higher resilience (the ability to bounce back) can offer more protection to coastal communities.

The shape of the habitat area should also be considered. For example, long and narrow areas will not provide the same benefits as short but wide areas.

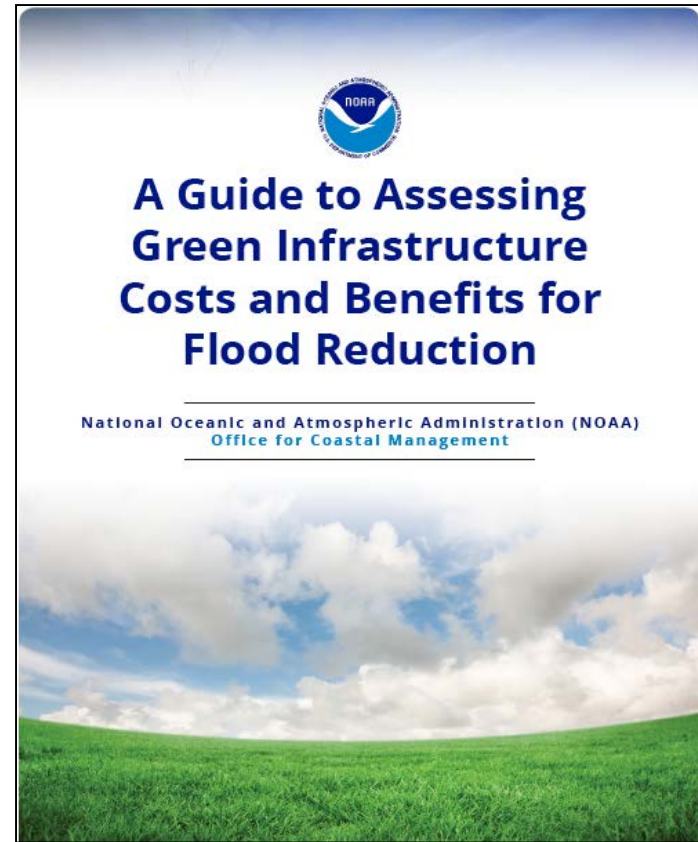
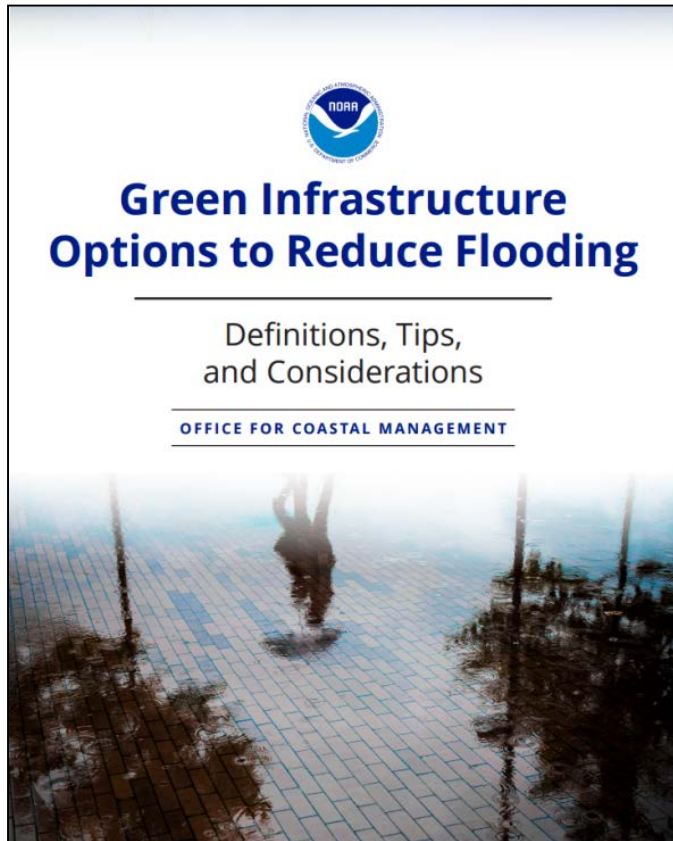
Area is often used as a proxy for ecological health, where the larger the area, the "healthier" the habitat may be. A common practice in conservation biology is using an umbrella species' habitat requirement to define a sufficient, "healthy" area. Umbrella species are species with large habitat requirements whereby conserving their habitat automatically conserves habitat for a host of other species.

[Proximity-->](#)

[Back to Considerations](#)

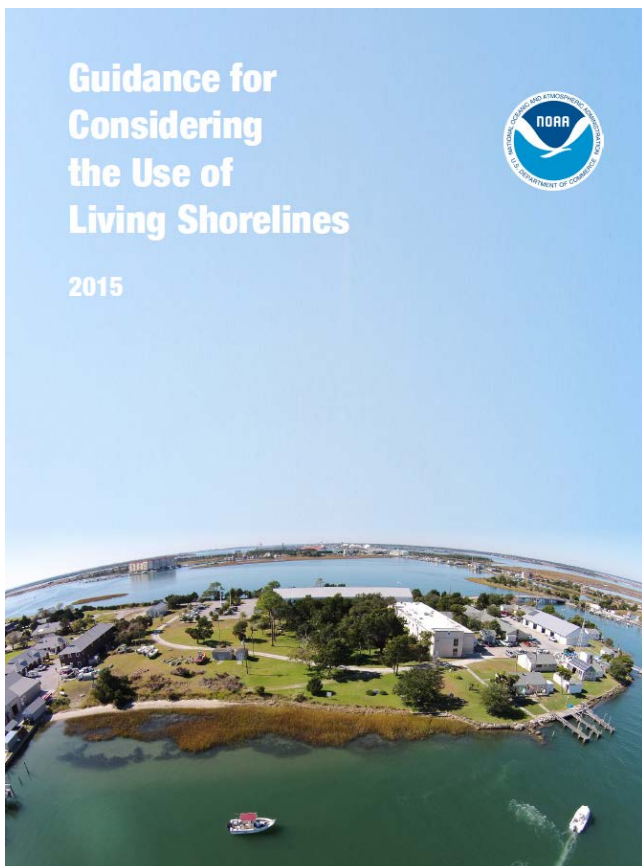
Better      Worse

# Evaluating Green Infrastructure Options, Costs, and Benefits



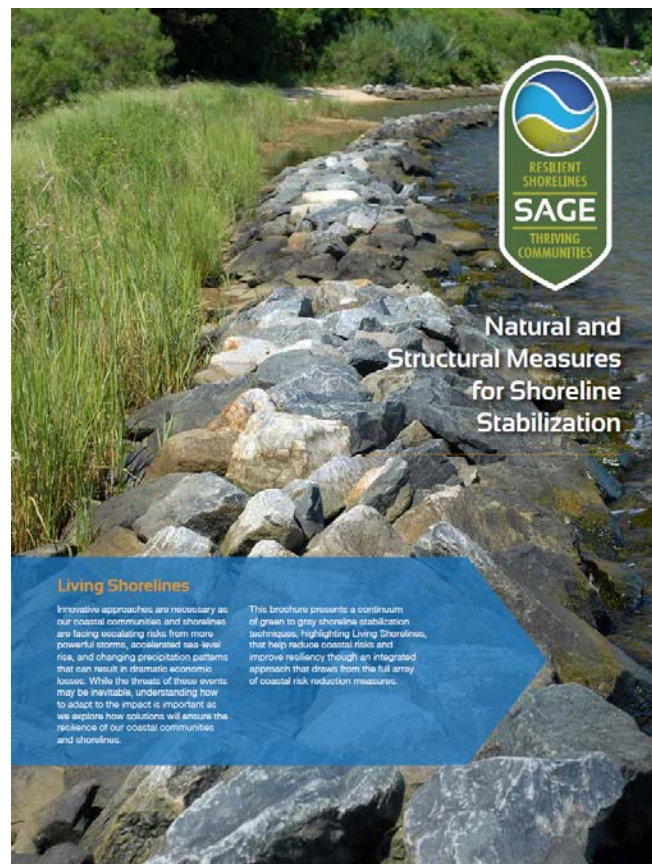
# Living Shorelines Guidance

NOAA Guidance for Considering  
the Use of Living Shorelines



[www.habitatblueprint.noaa.gov/living-shorelines](http://www.habitatblueprint.noaa.gov/living-shorelines)

SAGE: Natural and Structural  
Measures for Shoreline Stabilization



[www.sagecoast.org](http://www.sagecoast.org)

# Green Infrastructure Effectiveness

Green Infrastructure Effectiveness Literature Database (*coming soon!*)

The screenshot shows the NOAA logo in the top left corner and a "Help" button in the top right. The main heading is "Literature Database on Green Infrastructure for Coastal Resilience". Below this, a descriptive sentence states: "This database is a compilation of literature resources documenting the effectiveness of using green infrastructure to reduce impacts from coastal hazards." A search input field contains the text "e.g., Chesapeake Bay, dune restoration, vegetation". Below the search field is a link: "Want to filter on specific items? Show advanced search". The background of the lower half of the page is a blue-tinted image of coastal vegetation. A "RECENTLY ADDED" pop-up window is overlaid on this image, displaying the following information:

- Assessing urban strategies for reducing the impacts of ...
- Author(s):** Pregolato, Maria; Ford, Alistair; Robson, Craig; Glenis, Vassilis; ...
- Green Infrastructure:** Green roof/blue roof
- Region(s):** International

A "Show" button is located at the bottom right of the pop-up window.

# Questions?

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*[coast.noaa.gov/digitalcoast/](http://coast.noaa.gov/digitalcoast/)*

