

Vulnerability Assessments

What's Applicable at the Federal Level?

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Vulnerability Definitions

- No universal agreement
- Common to nearly all – “measure of the susceptibility of a natural or social system to harm when exposed to a hazard”
- Key elements
 - ✓ exposure
 - ✓ sensitivity
 - ✓ adaptive capacity

VULNERABILITY ASSESSMENT



Exposure

- Exposure to key hazards or threats
 - health and safety hazards
 - economic & environmental threats
- Exposure of key populations & resources
 - people in harm's way
 - infrastructure in high risk areas
 - natural resources at risk



Sensitivity

- Sensitivity to potential effects of hazards
 - increased flood frequency or depths
 - changing resource demands & supplies (water, energy)
 - habitat migration
- Sensitivity of populations & resources
 - demographic strength & vulnerability factors
 - infrastructure condition & codes
 - ecosystem health and stressors



Adaptive Capacity

- Adaptive capacity of populations and resources to respond to impacts
 - plans, policies, strategies in place
 - monitoring & evaluation
 - flexible strategies

Impact Assessment

Roadmap Approach





Put a climate impact lens on your existing program efforts

- Social Services
- Transportation
- Natural Resources
- Emergency Management
- Housing
- Economic Development
- Others...

Climate Impacts

Assess how climate trends are most likely to affect programs & issues given current & future conditions



Heat-Related Health Issues



Precipitation Issues



Hurricane and Storm Impacts



Coastal Land Loss Impacts



Don't get too
overwhelmed or
caught up in the
details of climate
change projections at
this stage...

use what's available!



People & Communities

Assess societal vulnerabilities by looking at exposure, sensitivities, and adaptive capacities of key populations



Consider potential social vulnerability factors

- Poverty and resources
- Elderly populations
- Children
- Health and disabilities
- Transportation access
- Exposure in high hazard areas



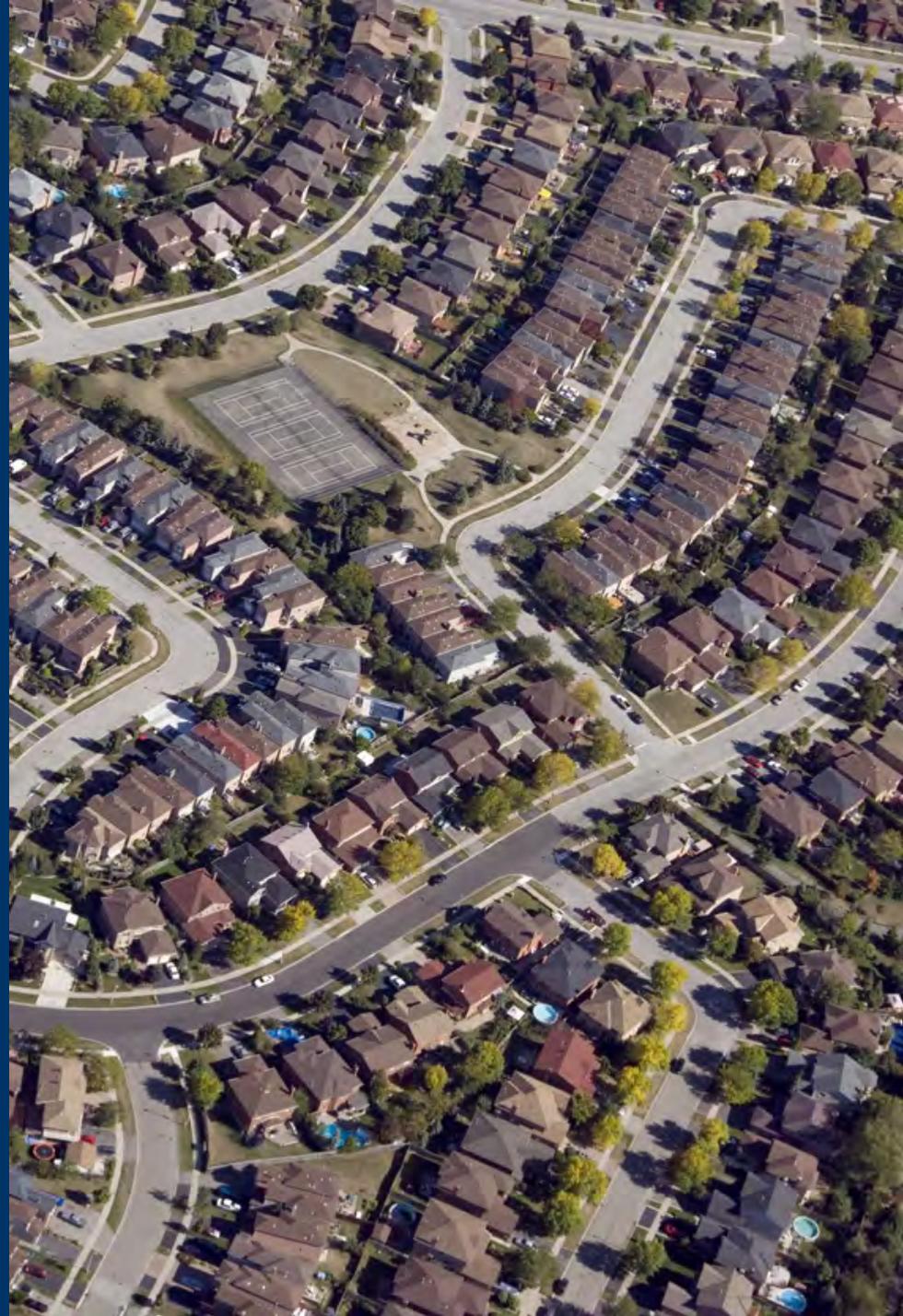
Consider community resilience factors

- Community engagement
- Cultural cohesion
- Social networks
- Sense of place
- Community identity



Consider the effects of current and projected trends on vulnerability and resilience

- Language and culture
- Aging populations
- Economic conditions
- Family structure
- Community structure



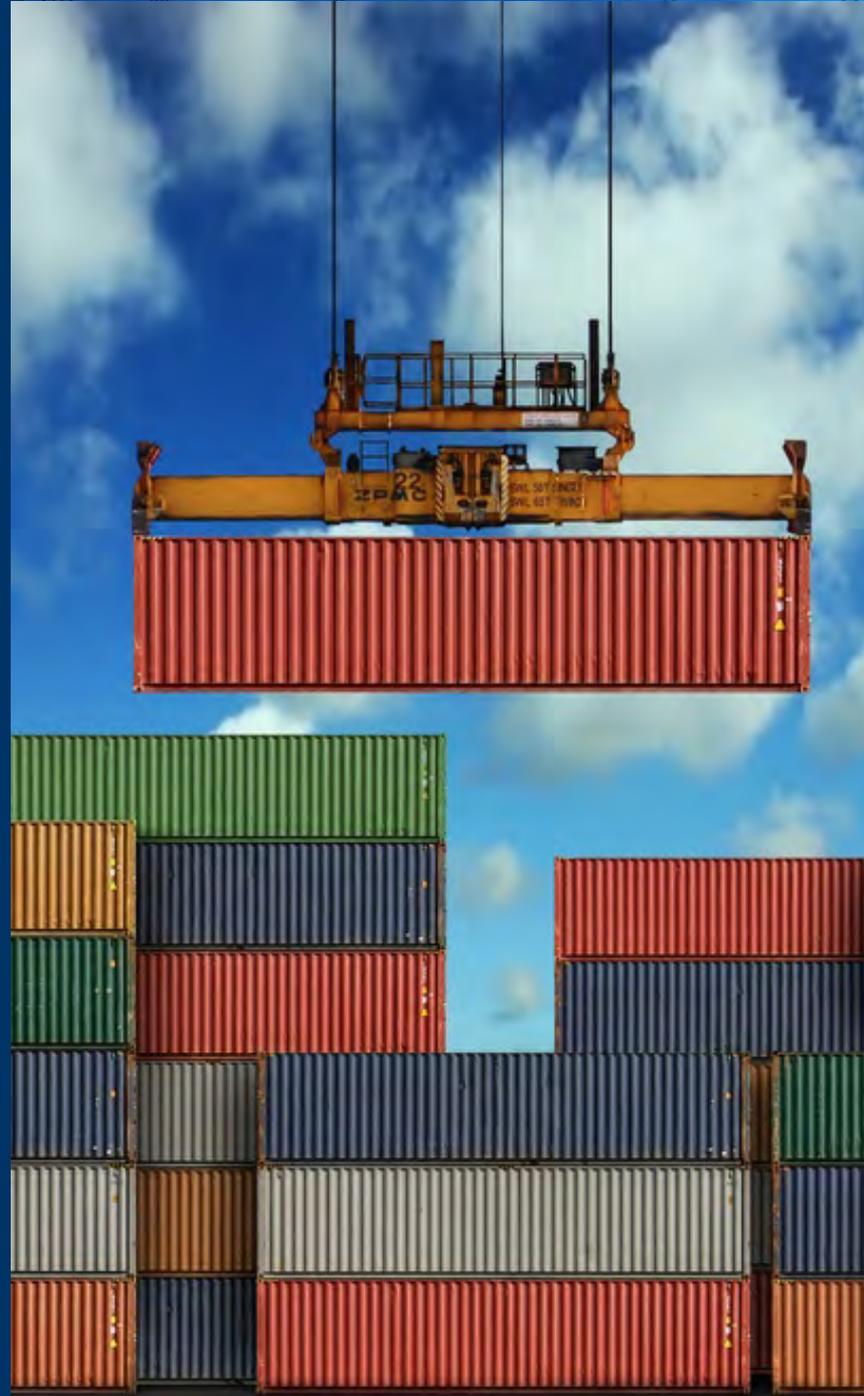
Built Environment

Assess vulnerability
by looking at
exposure, sensitivity,
and adaptive
capacities of key
infrastructure
categories



Consider vulnerabilities for all types of infrastructure

- Transportation
- Utilities
- Water and wastewater
- Housing
- Business and commerce



Consider potential vulnerability factors

- Construction codes and practices
- Age and condition
- Susceptibility to damages (repetitive losses)
- Criticality of function
- Exposure in high hazard areas



Consider the effects of existing policies on future vulnerability of infrastructure

- Economic drivers
- Planning and decision-making processes
- Development standards and policy framework
- Incentives and disincentives for growth in high hazard areas



Natural Resources

Assess the value, threats and resilience capacity of critical environmental resources



Consider the protective functions of key natural resources

- Storm buffering
- Flood protection
- Stormwater management
- Erosion control
- Climate regulation



Consider additional benefits of key natural resources

- Clean air and water
- Healthy fisheries and wildlife habitat
- Recreation and tourism opportunities
- Sense of place



Consider potential stressors to key natural resources

- Development patterns
- Unsustainable uses
- Pollution
- Hazardous materials

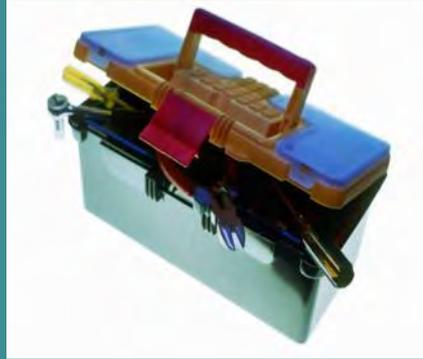


Consider current policy effects on the future vulnerability of natural resources

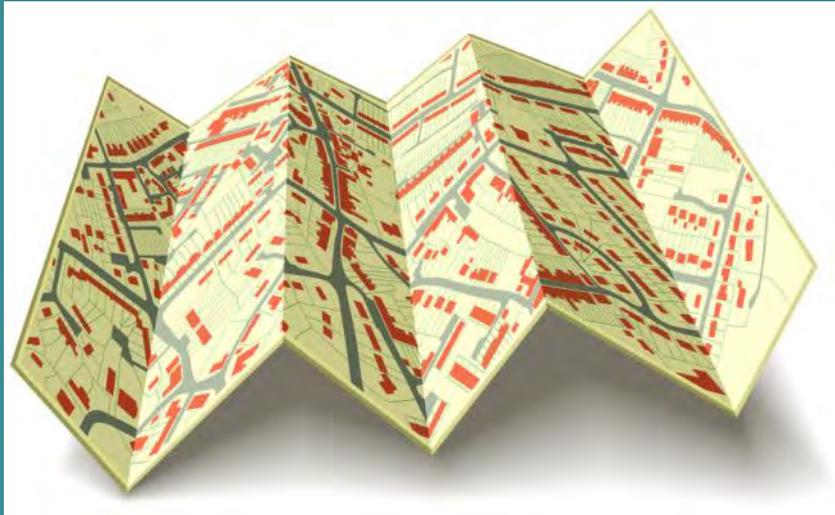
- Continued development in floodplain
- Site specific planning
- Altering the natural landscape



Tools and Resources

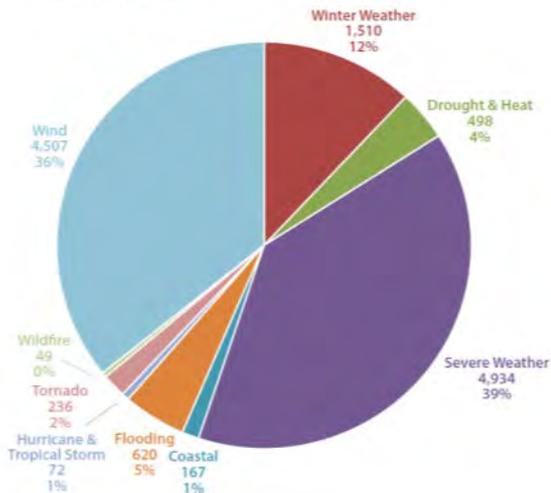


**Tools and resources for
assessing vulnerabilities
(Examples)**

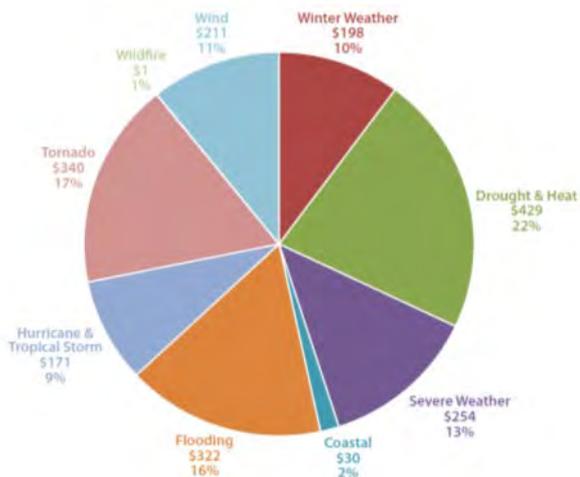


Spatial Hazard Events and Losses Database for the United States (SHELDUS)

Distribution of Hazard Events
(number of events)



Distribution of Losses by Hazard Type
(in 2009 USD million)



Winter Weather losses in Prince George Co., Maryland

Date	Injuries	Fatalities	Property Damage	Crop Damage	Total Damage
2/18/1960	0	0	2083.33	0	2083.33
2/18/1960	0	0	2083.33	0	2083.33
3/3/1960	0	0	2083.33	0	2083.33
1/19/1961	0	0.22	21739.13	0	21739.13
12/24/1961	0	0	2083.33	0	2083.33
3/5/1962	0	0	3125	312.5	3437.5
7/21/1962	0	0	2083.33	208.33	2291.66
12/23/1963	0	0.04	208.33	0	208.33
1/1/1964	4.17	0.13	208.33	0	208.33
1/12/1964	0	0.29	208.33	0	208.33
2/10/1964	0	0	208.33	0	208.33
2/18/1964	0	0	33.33	0	33.33
1/29/1966	0	0.5	0	0	0
1/29/1966	0	0.48	0	0	0
12/10/1967	0	0	555.56	0	555.56
6/27/1968	0	0	4166.67	0	4166.67
11/11/1968	0	0	20833.33	0	20833.33
1/8/1969	0	0	277.78	0	277.78
1/28/1969	29.17	0	2083.33	0	2083.33
1/8/1970	0	0	1041.67	0	1041.67
1/20/1970	0	0	7142.86	0	7142.86
2/2/1970	0	0	263.16	0	263.16



HAZARDS & VULNERABILITY
RESEARCH INSTITUTE

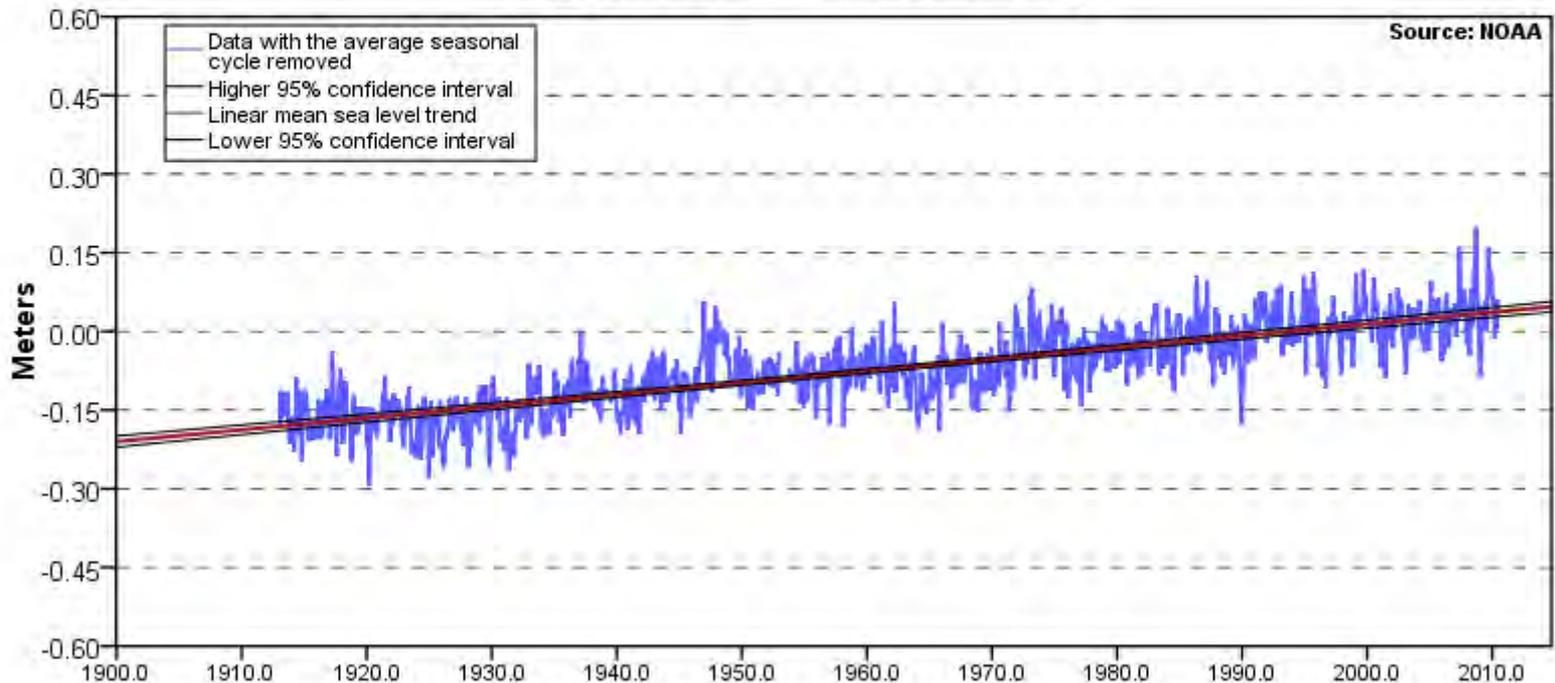
Carolina

Sea Level Trends

- Alabama
- Alaska
- California
- Connecticut
- Delaware
- Florida
- Georgia
- Hawaii
- Louisiana
- Maine
- Maryland
- Massachusetts
- New Jersey
- New York
- North Carolina
- Oregon
- Pennsylvania
- Rhode Island
- South Carolina
- Texas
- Virginia
- Washington
- Washington DC
- Island Stations
- Global Stations

Mean Sea Level Trend
8724580 Key West, Florida

Key West, FL 2.24 +/- 0.16 mm/yr



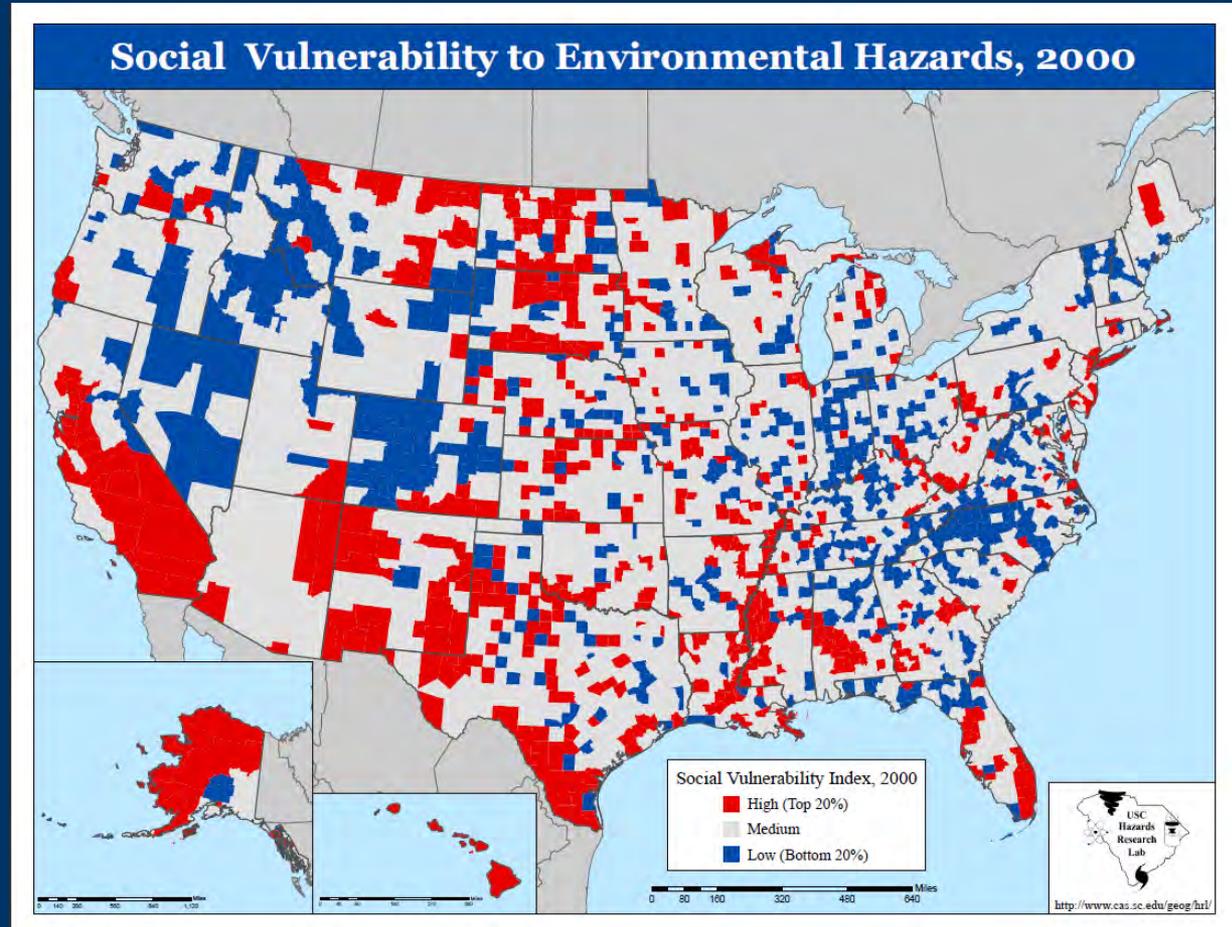
2.24 mm/year rise from 1913 to 2006
Equivalent to 0.73 feet in 100 years

Social Vulnerability Index (SoVI)

42 socioeconomic and built environment variables

Examples

- Socioeconomic status
- Gender
- Race and ethnicity
- Age
- Employment loss
- Renters
- Occupation
- Family structure
- Education



Flood Exposure Snapshot

Quick look at county-level exposure in flood zone



From Digital Coast Inundation Toolkit

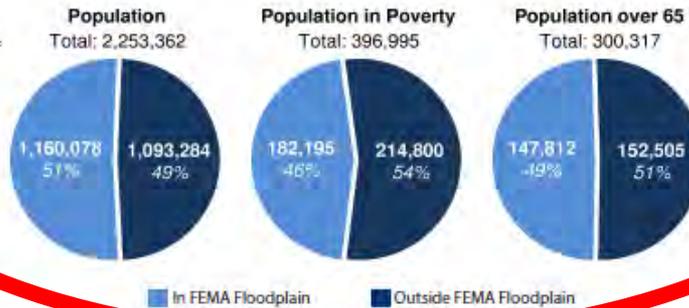
- Includes demographics, infrastructure, and environment
- Based on national data sets
- Printable reports

Hazard Exposure Information for

Miami-Dade County, Florida

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, disabilities) are involved, since people at greatest flood risk may have difficulty evacuating or taking action to reduce potential damage.

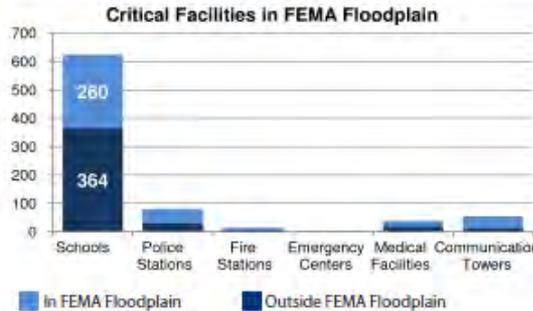


Based on 2000 U.S. Census records.

Community Infrastructure + Floodplains = Bad News

46% of critical facilities and 53% of road miles (5234 miles) in Miami-Dade County are within the floodplain.

Hospitals, Roads, Schools, Shelters. These facilities play a central role in disaster response and recovery. Understanding which facilities are exposed, and the degree of that exposure, can help reduce or eliminate service interruptions and costly redevelopment. Incorporating this information into development planning helps communities get back on their feet faster.

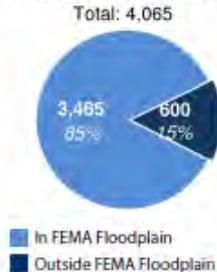


Based on Critical Facilities from FEMA HAZUS database.

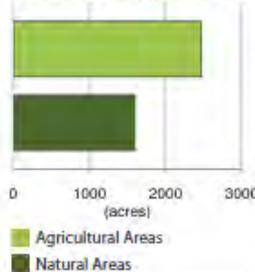
Increasing Development in Floodplains = More People in Harm's Way
Loss of Natural Buffers = Less Protection

A county with more natural areas (wetlands, forests, etc.) and less development within floodplains typically has lower exposure to flooding. A county that monitors land cover changes within the floodplain will detect important trends that indicate whether flood exposure is increasing or decreasing. Armed with this information, local leaders can take steps to improve their safety and resilience.

Amount of Land Converted to Development 2001-2006 (acres)



Type of Land Converted to Development 2001-2006



Based on NOAA land cover data.



Exposure of vulnerable populations in high-risk flood areas

C-CAP Land Cover Atlas

Land cover and land change information for coastal regions



Available through
the Digital Coast

- Provides useful county-level summaries
- Data are available for download and use in GIS
- Produces printable PDF reports

County Land Cover Change Atlas Example

Land Cover Categories*	Area 1996	Area Lost	Area Gained	Area 2006	Net Change	Percent Change
High/Medium Intensity Developed (HID)	200.12	1.86	17.94	216.20	16.08	8.03%
Low Intensity Developed (LID)	104.15	1.89	7.53	109.79	5.64	5.42%
Open Space Developed (OSD)	26.92	2.87	1.98	26.03	-0.89	-3.32%
Grassland (GRS)	6.09	0.83	1.17	6.43	0.34	5.65%
Agriculture (AGR)	118.49	15.04	1.57	105.02	-13.47	-11.37%
Forested (FOR)	0.48	0.02	0.01	0.47	-0.01	-1.31%
Scrub/Shrub (SCB)	9.27	5.03	0.39	4.62	-4.64	-50.11%
Woody Wetland (WDW)	311.96	19.09	3.34	296.21	-15.75	-5.05%
Emergent Wetland (EMW)	1146.42	10.10	11.06	1147.37	0.95	0.08%
Barren Land (BAR)	6.27	4.73	10.98	12.52	6.25	99.64%
Open Water (WTR)	496.51	0.74	6.23	502.00	5.49	1.11%

Units are in square miles. Source: NOAA's Coastal Change Analysis Program (C-CAP) - www.cic.noaa.gov/landcover/



Land cover change data sheet for 1996 to 2006

Net Change: What Does It Mean? Area Gained - Area Lost = Net Change

Net change numbers can be deceiving; forests may be lost on one side of the county, while another area may experience an increase. The net change might be minimal, yet the total area of change could be substantial, and the quality of new growth areas may be different than those lost. It is important to look at these offsetting losses and gains, in addition to the overall net difference.

 Area Gained
 Area Lost



Area Lost and Gained by Land Cover Class (square miles)

Training

Roadmap for Adapting to Coastal Risk

Developed and delivered by the [NOAA Coastal Services Center](#)

Overview

Process

Training

Resources

In Action

Resources

Below is a collection of tools and resources that can be useful for various aspects of a community's risk assessment. Most of these tools and resources are briefly introduced during the Roadmap for Adapting to Coastal Risk training. This page offers a platform for users to quickly access each product. We hope to add links to this page as we become aware of additional useful tools and resources. Please help us out and pass along information about any product that you think should be added to this page. E-mail us at csc.roadmap@noaa.gov.

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<http://www.csc.noaa.gov/digitalcoast/training/roadmap/resources.html>

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