2021

A Quick Guide to Resilience

Virginia Coastal Policy Center, William & Mary Law School

A Quick Guide to Resilience

This Guide was made possible by generous funding from
The Virginia Environmental Endowment.

Virginia Environmental Endowment

William & Mary Law School | Virginia Coastal Policy Center

Special thanks to VCPC student Ryan Franklin and
VCPC Summer Fellow Sarah Henshaw for their invaluable assistance with this Guide.

A Quick Guide to Resilience

The Virginia Coastal Policy Center (VCPC) developed this Guide as a reference for citizens and local governments in Virginia. The Guide also may be used as a resource by local governments as they use the PREP (Planning for Resilience: Evaluation and Prioritization) Tool discussed below.

Each entry in the Guide contains hyperlinks offering the source of each definition and additional information, with Virginia-specific examples where available.

Resilience is the ability to prepare and plan for, absorb, recover from, or more successfully adapt to actual or potential adverse events. This Guide is designed to offer accessible resiliency resources for Virginia citizens and local government staff on the following broad topics:

1. *Essential Links* – Resources on flooding, sea level rise, and resilience efforts.
2. *Causes of Flooding* – Short definitions of factors influencing flooding.
3. *Flooding Policies and Initiatives*- Planning efforts and policies for recurrent flooding.
4. *Strategies to Mitigate and Adapt to Flooding*- Planning, infrastructure, and retreat options, including local examples.
5. *Paying for Resilience Measures* - Funding strategies to pay for resilience measures, considering private, local, state, and federal sources.
6. *Addressing the Resilience Needs of Socially & Physically Vulnerable Populations*– Defines social vulnerability and provides resources to assess it in your area.

➢ Essential Links

A. **ADAPTVA** – AdaptVA is an information hub for climate change adaptation created by the Virginia Institute of Marine Science (VIMS) in partnership with VCPC and the nonprofit Wetlands Watch.

   i. **Forecasts –** View tide forecasts, sea level projections, temperature and precipitation information available to help mitigate climate impacts and plan resilient communities.

   ii. **Planning & Policy –** Local and state management strategies, guidance on how to qualify communities for the Community Rating System, and examples of flood-aware building codes that have been successfully adopted in other communities.

   iii. **Tools –** Tools designed to assess risk, inform preparation, and respond to a changing environment using risk maps, shoreline recommendations, and an interactive map of adaptation strategies.

   iv. **Interactive Map –** Information on water levels, social vulnerability, infrastructure, and natural capital available in one interactive map.

B. **Planning for Resilience: Evaluation and Prioritization (PREP) Tool** - The PREP Tool is a three-step self-assessment process to help local governments establish a set of resilience priorities informed by their level of risk, resilience efforts to-date, and best

practices in resilience planning. The online tool provides a starting point for local governments that have not yet created a holistic resilience strategy, to both assess their current capacity and actions and identify appropriate next steps towards resilience.

C. **Commonwealth Center for Recurrent Flooding Resiliency (CCRFR)** –A partnership between VIMS, VCPC and Old Dominion University created by the legislature. The CCRFR serves as a resource for state agencies, localities, and other entities by providing scientific and technical support concerning flooding resiliency. The CCRFR website includes reports on land subsidence, sources for water level prediction, community engagement and self-assessment opportunities, links to relevant law and policy analyses, and reports on the economics of resiliency and severe weather events.

D. **VIMS Comprehensive Coastal Resource Management Portals (CCRMPs) –** Select a locality from the list to access current and historic shoreline management information including interactive mapping tools, shoreline and tidal marsh inventory reports, sea level rise and flooding information, GIS data for downloading, and other locality-specific VIMS shoreline publications.

E. **Virginia Flood Risk Information System (VFRIS) –** A map tool that helps communities, real estate agents, property buyers and property owners understand an area's flood risk. VFRIS enables users to quickly determine whether their property is in a FEMA Special Flood Hazard Area (SFHA), where homes and businesses with government-backed mortgages are required to obtain flood insurance. The FEMA-administered National Flood Insurance Program (NFIP) provides insurance to property owners, renters and businesses in participating NFIP communities. The FEMA Flood Insurance Rate Maps (FIRM) show how likely it is that an area will flood. They indicate high-risk "100 year" flood zones, which means that there is a 1 in 100 (or 1%) chance of flooding at that level or greater occurring there in any year, based on historical data (in other words, there is at least a one-in-four chance of flooding during a 30-year mortgage for properties in those zones).

F. The **Resilience Adaptation Feasibility Tool (RAFT) -** The RAFT is a collaborative, community-driven process and full-service tool developed to help Virginia's coastal localities assess and improve resilience to flooding and other coastal storm hazards, while remaining economically and socially viable. The RAFT process involves three steps provided at no cost to localities: assessment of resilience using the RAFT scorecard; a workshop to develop an action list based on the scorecards; and a year of implementation assistance with resilience projects by the RAFT university collaborative.

G. **Regional Efforts –** Coastal planning district commissions also offer region-specific resources and programs concerning sea level rise, flooding and resilience. Examples include the Accomack-Northampton Planning District Commission's Climate Adaptation

Working Group, the Hampton Roads Planning District Commission's coastal resiliency initiatives, the Middle Peninsula Planning District Commission's Fight the Flood Program, the Northern Neck Planning District Commission's flood hazard mitigation program, and the Northern Virginia Regional Commission's Resiliency Planning Work Group.

H. **Intertidal Jurisdiction Chart –** This chart illustrates which areas of Virginia's shoreline are under local, state, or federal authority.

I. Projected Sea Level Rise Maps and Information (2020-2100)
   i. **VIMS Sea Level Rise Viewer**
   ii. **Mid-Atlantic Regional Integrated Sciences and Assessments Program**
   iii. **National Oceanic & Atmospheric Administration**
   iv. **Climate Central**

➢ Causes of Flooding

Note: Each term is a hyperlink to the source of the information listed below the term.

A. **Sea Level Rise**

Sea level rise is an increase in the level of the world's oceans due to the effects of global warming. Relative sea-level rise measures the current sea level in relation to the land where the measurement is taken, meaning low-lying areas like Norfolk are experiencing greater relative sea-level rise due to localized land subsidence.

B. **Storm Surge**

Storm surge is the abnormal rise in sea level during a storm, measured as the height of the water above the normal predicted tide. The surge is caused primarily by storm winds pushing water onshore, often resulting in major flooding in the area where the water meets the land.

C. **Land Subsidence**

Land subsidence occurs when large amounts of groundwater are withdrawn from between sediment layers, causing the layers to collapse. Most of the nation's identified subsidence is due to exploitation of underground water, but other causes include aquifer-system compaction, drainage of organic soils, underground mining, sinkholes, and thawing permafrost.

D. **Limited Capacity to Deal with Increased Precipitation**

Heavy precipitation events are projected to become more prevalent in some regions of the world, resulting in greater land mass exposed to flood risk as global temperatures rise. In addition, gray infrastructure can limit the capacity to deal with this increase in precipitation. Gray infrastructure consists of hard structures such as dams, seawalls, roads, pipes, or water treatment plants. Traditional gray stormwater infrastructure is designed to move stormwater away from the built

environment, ultimately affecting natural stormwater infiltration rates, increasing polluted urban stormwater runoff, and potentially leading to urban flooding during extreme weather events. Asphalt pavement, concrete, roofs and other hard building materials increase the amount of impervious surfaces and as a result, developed landscapes are less able to absorb water quickly during high precipitation or flooding events.

E. King Tides

King Tides are the highest predicted high tide(s) of the year, occurring once or twice annually in coastal areas when the orbits and alignment of the Earth, moon, and sun combine to produce the greatest tidal effects. King tides can cause local flooding and provide a preview of how sea level rise may affect coastal places. The National Oceanic and Atmospheric Administration (NOAA) predicts these high tides. VIMS hosts the world's largest community environmental survey, the "Catch the King" event, in an effort to validate and improve predictive models for future forecasting of pervasive flooding, utilizing crowd-sourced information in an attempt to map inundation.

➢ Policies and Initiatives Addressing Flooding in Virginia

A. Virginia Coastal Resilience Master Plan

In 2018, Governor Northam signed Executive Order 24 calling for the development of a Virginia Coastal Resilience Master Plan. In 2020, the Governor issued the framework for the Plan, a roadmap for the Commonwealth to become more prepared to mitigate future coastal flooding. The Master Plan is under development and scheduled to be released in November 2021.

B. Regional Greenhouse Gas Initiative (RGGI)

In 2020, the General Assembly authorized Virginia to join this multi-state initiative establishing a regional carbon dioxide electric power sector cap-and-trade program. Forty-five percent of all revenue derived from RGGI auctions selling carbon dioxide emissions allowances will be apportioned to the Virginia Community Flood Preparedness Fund.

C. The Virginia Community Flood Preparedness Fund

This fund was created in conjunction with the legislature's authorization for the Commonwealth to join RGGI during the General Assembly's 2020 session. The fund will issue grants and low-interest loans to help coastal communities reduce flooding damage and become more resilient.

D. The Virginia Coastal Zone Management (CZM) Program

This program, authorized by the federal Coastal Zone Management Act of 1972, is designed to protect Virginia's coastal resources, such as wetlands and beaches. Every coastal state with a CZM Program has its own policies, depending on its unique geography, that it must enforce in order to comply with the Coastal Zone Management Act.

E. **Chesapeake Bay Program Climate Resiliency Workgroup**

The Chesapeake Bay Program, consisting of Virginia, the five other states in the Bay watershed, and the District of Columbia, works to restore and protect the Chesapeake Bay in order to comply with the 2014 Chesapeake Bay Watershed Agreement. A variety of committees and work groups were created to accomplish the restoration and protection goals outlined in the agreement, including the Climate Resiliency Workgroup which coordinates with partners on implementing climate-related resiliency projects.

F. **Living Shoreline Mandate**

In 2020, the General Assembly adopted legislation requiring local wetlands boards to approve living shorelines for shoreline stabilization unless the "best available science" indicates that a living shoreline is not "feasible" in a given location. Living shorelines provide erosion control and water quality benefits, protect, restore, or enhance natural shoreline habitat, and maintain coastal processes through the strategic placement of plants, stone, sand fill, and other structural and organic materials. The updated Wetlands Guidelines from the Virginia Marine Resources Commission (VMRC) state that the "best available science" and the suitability of a site for a living shoreline are best relayed by Habitat Engineers within VMRC's Habitat Management division. In addition, the VMRC names VIMS as the Commonwealth's science advisor on coastal and marine natural resource-related issues, designating them as the arbiter in situations where the "best available science" is in question.

G. **Chesapeake Bay Preservation Act (CBPA)**

Originally adopted by the General Assembly in 1988, the CBPA seeks to protect and improve the water quality of the Chesapeake Bay by requiring the implementation of effective land use management practices that incorporate measures to protect the quality of state waters. A 2020 amendment to the CBPA (§ 62.1-44.15:72) requires the State Water Control Board to expand the regulatory criteria used by local governments in granting, denying, or modifying requests to rezone, subdivide, or use and develop land in Chesapeake Bay Preservation Areas. The criteria now must also encourage and promote coastal resilience and adaptation to sea-level rise and climate change.

➢ Strategies to Mitigate and Adapt to Flooding

Localities can implement strategies to *mitigate* the effects of flooding, such as preserving natural areas to act as flood buffers, or to *adapt* to the effects of flooding, such as by elevating houses or incentivizing movement away from flood prone areas. Examples of each of these strategies are included below.

A. **Comprehensive Planning**

I. A comprehensive plan provides a policy framework for regulatory tools, while promoting a community's visions and goals, and addressing both current and long-

term needs. Virginia Code requires localities included in the Hampton Roads Planning District Commission (HRPDC) to incorporate strategies to combat projected sea-level rise and recurrent flooding into their comprehensive plan strategies. The list below provides examples of HRPDC localities in coastal Virginia that have incorporated resiliency and the impacts of sea-level rise into their Comprehensive Plans:

Complete Chart (Coastal Virginia Localities)

a. City of Norfolk
b. City of Portsmouth
c. City of Hampton

B. **Zoning**

I. Adoption of Resilience-Oriented Zoning Ordinances – Localities can create zoning ordinances to direct new development out of flood zones and incentivize the use of resiliency measures in development.

- City of Norfolk: Building a Better Norfolk – The City of Norfolk adopted a zoning ordinance in 2018 to enhance flood resilience and direct new, more intense development to higher ground. A Coastal Resilience Overlay (CRO) zone requires new development and redevelopment to comply with new flood resilience requirements. A companion Upland Resilience Overlay (URO) zone will encourage new development in areas with lower risk of flooding. The ordinance also contains a Resilience Quotient framework in which developers earn points for adopting different measures promoting flood risk reduction, stormwater management, and energy resilience, among other practices.

C. **Floodplain Management**

I. Floodplain Buyouts - Floodplain buyouts, or the voluntary acquisition of flood-damaged property, are intended to mitigate flood damage by moving people and structures out of harm's way. Buyouts can be completed under federal, state, and sometimes local programs, but the largest source of funding is FEMA's Hazard Mitigation Grant Program (HMGP).

- New Jersey: Blue Acres Floodplain Acquisitions -The Green Acres, Farmland, Blue Acres, and Historic Preservation Bond Act of 2007 authorized $12 million for acquisition of lands in the floodways of the Delaware River, Passaic River or Raritan River (and their respective tributaries) for recreation and conservation purposes.

II. Conversion to Open Space – When structures are removed, properties can be repurposed as "open space." Local governments typically use this land for projects like parks, floodplain storage, or dedicated wildlife habitat.

- City of Virginia Beach: Open Space Program - Funded through the Department of Parks and Recreation's Capital Improvement Program, the

Open Space Program researches and evaluates undeveloped properties for possible open space acquisition and preservation.

D. Gray Infrastructure

Green infrastructure is generally preferred or required, but in some circumstances, such as when protecting valuable public infrastructure, gray infrastructure may be necessary. Some types of gray infrastructure manage water directly, such as levees; while others do so indirectly, such as by providing erosion control to prevent the loss of natural shorelines that can act as flood buffers, like marshes and wetlands. The section below introduces various types of gray infrastructure, explaining their uses, and providing reasoning as to why green infrastructure is preferred.

Seawall

A seawall is a large concrete structure built parallel to shore to resist flooding and defend shorelines from wave-attack. Seawalls can be vertical, sloped, curved or stepped in order to better absorb wave energy. By creating a fixed point along naturally dynamic shorelines, seawalls can increase erosional stress on adjacent beaches by blocking cross-shore and longshore sediment transport.

Levee

A levee is a man-made structure designed to contain, control, or divert the flow of water, typically built as a concrete floodwall or an earthen embankment around a vulnerable area. Disadvantages of levees include increased water speed (runoff) which can cause erosion and reduce beneficial in-stream vegetation, while also increasing potential flooding downstream.

Riprap Revetment

Large rocks known as riprap can be placed on a coastline to prevent erosion of the beach underneath. Although a riprap revetment can provide shoreline stabilization for many years, the benefits of fringe marsh ecology are lost. Species that depend on cooler shallow-water temperatures, migration from shore to inland habitats (i.e., turtles), and the shelter of marsh plants are disrupted by imposing an exposed rocky environment.

Bulkhead

A bulkhead is essentially a mini-seawall strategically placed on coastlines to prevent or reduce flooding. Like seawalls, the wave energy generated from water crashing into the bulkhead will eventually erode the base, requiring maintenance to remain effective. Bulkheads create a hard barrier between the upland and the water, resulting in erosion that often causes the intertidal zone to disappear and displacing species dependent on those habitats.

Groins and Jetties

Groins and jetties are wall-like structures placed perpendicular to a shoreline, designed to prevent beach erosion by reorienting natural sand transportation. Groins work by trapping enough waterborne sand to create beach behind them. Artificially capturing sand changes near-shore currents, disrupting natural shoreline migration and beach replenishment.

Breakwater

A breakwater is an offshore structure usually constructed of stone or baskets filled with stones installed parallel to a coastline. The structure interrupts the force of incoming waves to protect harbors, anchorages, beaches, or shore areas. Breakwaters can have similar effects on local ecosystems as other types of gray infrastructure, interrupting natural currents and sediment transportation, blocking animal movement, and causing erosion outside the hardscaping.

E. Green Infrastructure - Natural and Nature-Based Features (NNBF)

The following table sets forth sample types of green infrastructure, or natural and nature-based features, and the benefits they provide. Below it are definitions for each term.

Type of Green Infrastructure /NNBF: **----------** **Benefits:**	Constructed Wetlands	Swales and Bioswales	Living Shore-lines	Marsh Toe Revet-ments	Rain Gardens	Oyster Reefs	Beach Nourish-ment	Rain Barrels	Permeable Pavement	Marsh Sills	Artificial Reefs
Shoreline stabilization	**X**		**X**	**X**		**X**	**X**			**X**	
Water quality benefits	**X**	**X**	**X**		**X**	**X**		**X**	**X**		
Flood buffer/ storm protection	**X**	**X**	**X**			**X**	**X**			**X**	**X**
Runoff reduction	**X**	**X**	**X**		**X**			**X**	**X**		
Habitat	**X**	**X**	**X**		**X**	**X**	**X**				**X**

Definitions:

Constructed Wetlands

These artificial wetlands are designed to absorb stormwater and filter pollutants, imitating natural wetlands functions such as improving water quality and providing habitat.

Swales

Swales and Bioswales are depressions that collect stormwater runoff from roads and other impervious surfaces. Bioswales contain organic matter and vegetation that act to slow down water speed and filter pollutants.

Living Shorelines

Living shorelines are constructed of natural materials like vegetation, sand, or rock to stabilize tidal shorelines, as well as shorelines of freshwater ponds and lakes. They reduce erosion, improve marine habitat, improve water quality, and filter stormwater runoff and groundwater.

Marsh Toe Revetments

Marsh toe revetments are trapezoidal structures that can be used where existing marshes are eroding due to wave action. The revetments add structure that can help redirect water currents.

Rain Gardens

These small-scale bioretention areas can be located on roofs, around driveways, and in yards to collect, slow, and absorb rainwater, reducing flood risk for residential developments.

Oyster Reefs

Oyster reefs, which can be created by using recycled oyster shells, can be used for shoreline stabilization efforts and serve as habitats for keystone species that improve water quality.

Beach Nourishment

Beach nourishment improves storm protection by increasing the distance between the upland bank and waves. The nourishment process involves placing sand, usually dredged from offshore, onto an existing beach to replace sand lost to erosion.

Rain Barrels

Rain barrels are used to collect rainwater and store it for future use, reducing flood risk and pollutants.

Permeable Pavement

Permeable pavement, made of alternative materials like pervious asphalt or open pavers, allows rain and snowmelt to seep into the underlying soil, reducing runoff and filtering out pollutants.

Marsh Sills

Marsh sills are low-profile structures designed to help increase the size of existing marsh areas.

Artificial Reefs

Artificial reefs are primarily constructed out of materials that replicate wild oyster reefs, providing shelter and habitat, as well as wave interruption in the same ways as a natural reef.

➢ Paying for Resilience Measures

A. Bonds

Catastrophe Bonds

Catastrophe (Cat) bonds function like insurance in which insurers transfer risk to investors. After a disaster, the principal originally invested is forgiven and used by the insurer to reimburse claims to the policyholders.

Municipal Bonds

These debt securities are fully backed by a governmental entity and issued to fund capital projects. Municipal bonds usually take two specific forms:

1. General Obligation Bonds

General obligation bonds, secured by the debtor based on projected tax revenues, are primarily issued to fund capital improvement projects that do not generate money for the issuer such as schools. The Virginia Constitution permits issuance (with exceptions) subject to majority referendum approval and General Assembly authorization.

2. Revenue Bonds

Revenue bonds are issued to subsidize capital infrastructure projects like airports and sewage systems that are backed by revenues from non-tax sources like fees.

Pay-for-Success Program, or Environmental Impact Bonds

In this approach, private investment is directly tied to the delivery of certain project outcomes. Investors lend funds, then are paid based on a locality's savings as a result of the new infrastructure. The City of Hampton is the first locality in Virginia to use environmental impact bonds for three public projects: City of Hampton.

Resilience Bonds

Resilience bonds link insurance coverage that localities already purchase (such as catastrophe bonds) with capital investments in resilient infrastructure systems (such as flood barriers and green infrastructure) that reduce expected losses from disasters.

B. Other Funding Mechanisms

Public-Private Partnerships

Public-Private Partnerships are long-term contracts between individuals or businesses and a government entity to provide a public asset or service. In Massachusetts, multiple private partners have worked with the state to successfully fund and develop resiliency projects.

Parametric Insurance

This type of insurance is based on the likelihood of a predetermined event occurring, triggering payment when an objective measurement such as wind speed is reached or surpassed.

Green Bank

Virginia Va. Code 15.2-958.3:1 authorizes localities to enter into contracts with property owners to provide loans for the initial acquisition and installation of clean energy, resiliency, or stormwater management improvements, similar to efforts by the Connecticut Green Bank.

Service Districts

Localities in Virginia are authorized by Va. Code § 15.2-2400 to create larger 'service districts' to provide additional, more complete, or more timely services of government. For example, Virginia Beach created a Special Service District for Sandbridge Beach to stabilize, maintain, and restore the beach, helping to provide funding for a 2019 renourishment project.

Stormwater Utility Fee

Localities in Virginia are authorized by Va. Code § 15.2-2114 to impose a stormwater utility fee funding stormwater management and flood control measures, based on the rational relationship between the fee and stormwater management services provided by the locality. Arlington County provides a comprehensive description of how a stormwater utility fee is calculated and utilized.

C. Virginia-Specific Funding

Virginia Dam Safety, Flood Prevention and Protection Assistance Fund

This fund was created by the General Assembly pursuant to Va. Code § 38.2-401.1 to provide grants or loans to a local government that owns a dam, to a local government for a dam located within the locality, or to a private entity that owns a dam for design, repair, and safety modifications to a dam in order to mitigate both flood damage and public safety risk.

Stormwater Local Assistance Fund (SLAF)

This fund provides matching grants for locality stormwater and water quality improvement projects, which can be include resilience and flood mitigation as co-benefits.

Commercial Property Assessed Clean Energy (C-PACE) Program

This program provides financing to commercial property owners for resiliency and clean energy projects, with a lien placed on the property tax assessment and no down payment necessary. This program is authorized by Va. Code § 15.2-958.3(a), and the Virginia Coastal Policy Center outlines the use of C-PACE in financing the resiliency improvements of commercial buildings in this report.

Virginia Conservation Assistance Program (VCAP) Funding through Soil and Water Conservation Districts

VCAP provides funds through some Soil and Water Conservation Districts to implement living shoreline projects, which can be reimbursed by up to 75% of total cost up to $15 million.

D. **Federal Funding**

Military Installation Sustainability Studies (formerly JLUS)

The Department of Defense's Office of Local Defense Community Cooperation provides funding and technical assistance to communities to help address issues and conditions that impede the operational readiness, resilience, and mission of military installations. This program funds community-driven, cooperative planning efforts that can address issues such as incompatible development, access, flooding, and others. Two types of projects are funded by this program: Compatible Use Studies (formerly known as Joint Land Use Studies) and Military Installation Resilience Reviews. A model example of a successful Joint Land Use Study between Joint Base Langley-Eustis and the City of Hampton can be found here.

U.S. Department of Housing and Urban Development (HUD) Grants

The HUD Community Development Block Grant (CDBG) Program offers Disaster Recovery grants to states and local governments to rebuild areas affected by natural disasters.

FEMA's Building Resilient Infrastructure and Communities (BRIC) Grants

States, local communities, tribes, and territories can access funding to build capacity and for projects to increase resilience. Projects must be cost-effective and reduce or eliminate risk and damage from future disasters and natural hazards.

United States Army Corps of Engineers (USACE) Funding

A wide range of projects are funded by the USACE, primarily those related to the building and maintenance of flood-prevention infrastructure. Sample programs funded in Virginia include:

1. Alternative or Beneficially Modified Habitats for Fish and Wildlife

In the Chesapeake Bay Oyster Recovery Program, USACE is working with the Virginia Marine Resources Commission to restore oyster reef habitats in the Chesapeake Bay, which would improve water quality and increase keystone species' habitat in the watershed.

2. Beach Renourishment

In the Beach Erosion Control and Hurricane Protection Project partnership between the City of Virginia Beach and the USACE for Sandbridge Beach, four renourishment efforts since 1998 have been conducted with a 65%-35% cost share between USACE and the City. A later 2019 project used a different model incorporating Sandbridge Special Service District funds (see previous section: Special Service Districts).

3. Aquatic Ecosystem Restoration

Under Section 206 of the Water Resources Development Act of 1996, USACE may perform aquatic ecosystem restoration and protection projects if the project is cost-effective, in the public interest, and will improve environmental quality. An example is the Belle Isle State Park Ecosystem Feasibility Study evaluating measures to mitigate erosion and improve habitat.

➢ Addressing the Resilience Needs of Socially & Physically Vulnerable Populations

Social vulnerability refers to the characteristics of an individual or group that influence their capacity to anticipate, cope with, resist, and recover from a physical hazard. Since socially vulnerable groups are less resilient to physical hazards, they may face disproportionate losses from either a natural or man-made disaster. Communities need to take socially and physically vulnerable populations into account and plan for their needs in designing resilience measures.

Typical information used to understand social vulnerability includes demographic, economic and employment, household, transportation, and health infrastructure data. The maps below illustrate different proxies that can also inform planning efforts, including race, income, and language:

Social Vulnerability Maps

1. Social Vulnerability Viewer - ADAPTVA
2. Social Vulnerability Index (SoVI)
3. National Risk Index - FEMA
4. Environmental Justice Screening and Mapping Tool – EPA
5. Surging Seas Risk Zone Map – Climate Central