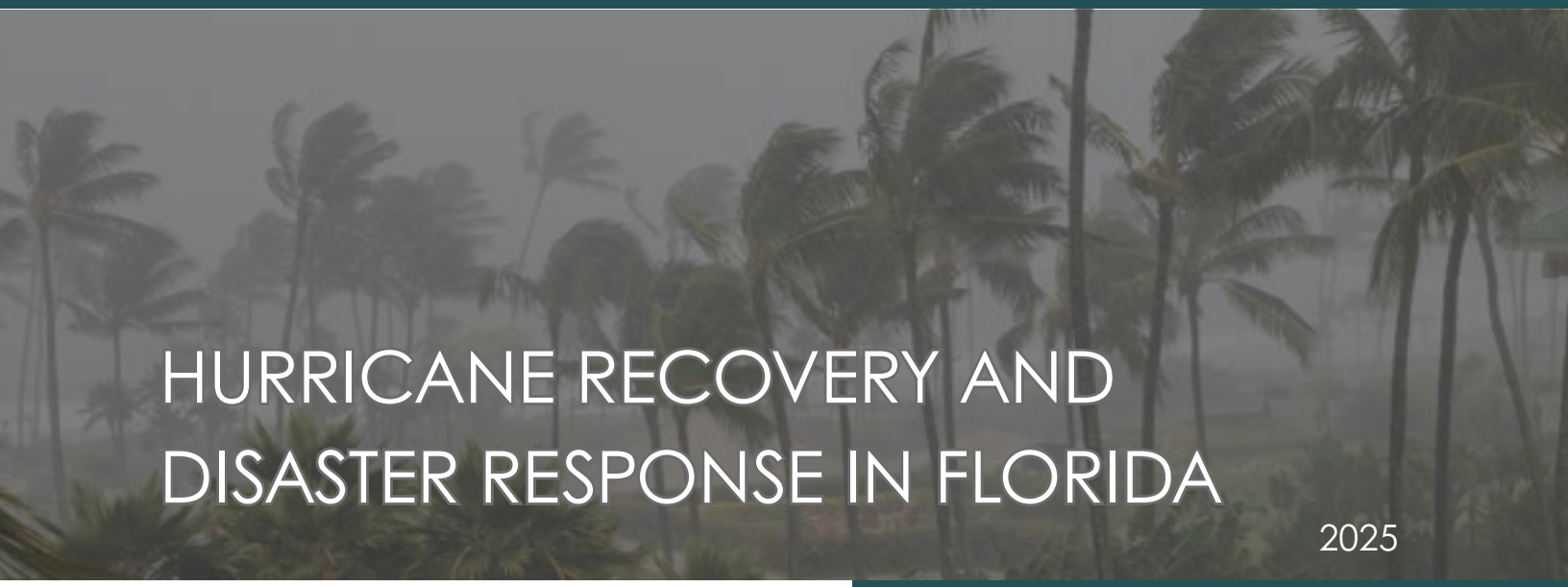
FORWARD PINELLAS
Integrating Land Use & Transportation

The Knowledge Exchange Series



HURRICANE RECOVERY AND DISASTER RESPONSE IN FLORIDA

2025

KNOWLEDGE EXCHANGE SERIES

Forward Pinellas provides a countywide forum for land use and transportation planning, where representatives of all 25 local governments in Pinellas County, as well as partners from the Tampa Bay region, come together to address common issues. Together we are able to learn from the experiences and practices of many different jurisdictions, helping to shape the way Pinellas County redevelops.

Through the Knowledge Exchange Series, we focus these efforts on exploring emerging planning topics, highlighting best practices. For each topic, we provide research, case studies, example regulations, presentations, and video interviews with planning staff and stakeholders, as resources for use by any interested local government or agency.

TABLE OF CONTENTS

INTRODUCTION

Florida is famous for its beautiful beaches and major theme parks but is also infamous for its annual hurricane season. Hurricanes are an ever-present threat to the state of Florida with their rise in frequency being acutely felt throughout recent years. A "major" hurricane is defined by the National Hurricane Center as a Category 3 storm or higher. According to NOAA (2023), the number of major hurricane landfalls in the U.S. has increased by 30% over the past two decades, with Florida experiencing a disproportionate share. Florida's precarious position between the Atlantic Ocean and Gulf of America cause the state to be extremely susceptible to many tropical storms which often escalate into hurricanes. These hurricanes are often the largest cause of damage to infrastructure, residences, businesses, and the environment that the state experiences in a single year. Planners, in collaboration with local governments, must address the challenges of disaster response, recovery, and resilience, as shifting weather patterns contribute to more frequent and intense storms (National Hurricane Center, 2020).

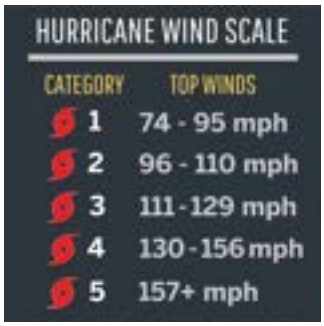


Image Source: National Hurricane Center

Major hurricanes are now a core theme to Florida. These destructive forces create important opportunities for communities and governments to unite to recover and rebuild. Hurricane recovery and disaster response is important because these efforts can reduce suffering, economic loss and ecological damage. Planners face the important job of creating systems, policies and strategies that address hurricane damage and aid communities in fully recovering from subsequent storms.


Treasure Island, Florida (Source: Pinellas County Government Communication)s

HURRICANE IMPACTS IN FLORIDA

Over the past decade, Florida has faced the devastating impacts of several major hurricanes. These storms caused widespread destruction, leading to severe economic losses, displacement of communities, and long-term environmental damage. Below is a summary of some of the key hurricanes, their categories, affected areas, and the destruction they caused over the last five to ten years.

Fort De Soto Park, Pinellas County, FL
(Source: Pinellas County Government)

Hurricane Irma (2017)

- **Category:** 4
- **Date:** September 10–19, 2017
- **Areas Affected:** Affected the entire state, with the hardest-hit areas being the Florida Keys, South Florida, and the southwest coast.
- **Economic Impact:** Estimated at $50 billion. The storm caused widespread power outages, flooded streets, and significant damage to homes and businesses (Federal Emergency Management Agency [FEMA], 2017).
- **Human Impact:** At least 134 fatalities in Florida, with over 6 million residents losing power.
- **Environmental Impact:** The storm severely damaged ecosystems, causing saltwater intrusion into freshwater systems and the destruction of wetlands and mangroves.

Hurricane Michael (2018)

- **Category:** 5
- **Date:** October 7–19, 2018
- **Areas Affected:** Primarily the Florida Panhandle, especially Bay County (Panama City) and surrounding areas.
- **Economic Impact:** Estimated at $25 billion. Michael was the strongest hurricane to hit the Florida Panhandle in recorded history, causing catastrophic infrastructure damage (FEMA, 2018).
- **Human Impact:** 16 fatalities in Florida, with widespread destruction of homes and businesses, displacing thousands.
- **Environmental Impact:** Coastal erosion, destruction of forests, and significant flooding that displaced wildlife.

Hurricane Dorian (2019)

- **Category:** 5 (but impacted Florida as a Category 2)
- **Date:** August 28–September 4, 2019
- **Areas Affected:** Primarily the eastern coast of Florida (e.g., Miami, Fort Lauderdale, Palm Beach), though the Bahamas were hit especially hard.
- **Economic Impact:** Estimated at $10 billion, primarily from flooding, storm surge, and wind damage (National Oceanic and Atmospheric Administration [NOAA], 2019).
- **Human Impact:** No direct fatalities in Florida, but the storm caused widespread evacuations and displacement, particularly in coastal areas.
- **Environmental Impact**: Damage to coral reefs, beaches, and coastal infrastructure.

Hurricane Elsa (2021)

- **Category:** 1
- **Date:** July 6–9, 2021
- **Areas Affected:** Primarily Florida's west coast, including Tampa Bay, St. Petersburg, and Clearwater.
- **Economic Impact:** Estimated at $1.2 billion, mainly due to flooding and wind damage to infrastructure and homes (NOAA, 2021).
- **Human Impact:** Several injuries were reported, but no fatalities in Florida.
- **Environmental Impact:** Minimal environmental damage, with some localized flooding.

Hurricane Ian (2022)

- **Category:** 4
- **Date:** September 26–October 5, 2022
- **Areas Affected:** Southwest Florida (Fort Myers, Naples, Cape Coral) and parts of central Florida.
- **Economic Impact:** Estimated at $112 billion, making it one of the costliest hurricanes in U.S. history. Extensive damage to homes, businesses, and infrastructure, particularly in coastal communities (FEMA, 2022).
- **Human Impact:** At least 127 fatalities in Florida, with thousands displaced due to flooding and wind damage.
- **Environmental Impact:** Severe destruction of wetlands, mangroves, and coastal habitats. The storm surge caused significant erosion of beaches and coastal barriers.

Damage to causeway after Hurricane Ian, in Naples, FL (Source: ABC Action News)

Hurricane Helene (2024)

- **Category:** 4
- **Date:** September 24–29, 2024
- **Areas Affected:** Made landfall in Florida's Big Bend region, impacting areas including Tampa Bay, Sarasota, and the Florida Panhandle.
- **Economic Impact:** Estimated damages exceeded $1.1 billion in Sarasota and Manatee counties alone, with over 3,100 buildings damaged or destroyed (King, 2024).
- **Human Impact:** At least 17 fatalities in the Tampa Bay area, including 12 in Pinellas County due to storm surge. Over 1,000 rescues were conducted in the region (Erdman & Dolce, 2024).
- **Environmental Impact:** Catastrophic storm surge caused significant coastal flooding and erosion. The storm also led to widespread power outages and infrastructure damage (National Hurricane Center [NHC], 2024).

Hurricane Helene damage in Pinellas County.

Hurricane Helene damage to Crystal Beach Pier in Palm Harbor, Pinellas County.

(Images Source: Pinellas County Government Communications)

Hurricane Milton (2024)

- **Category:** 3 (landfall; peaked at Category 5)
- **Date:** October 5–10, 2024
- **Areas Affected:** Made landfall near Siesta Key on Florida's Gulf Coast and exited on the Atlantic side, impacting areas from Sarasota to St. Augustine.
- **Economic Impact:** Estimated insured losses between $30 billion and $50 billion. Agricultural losses exceeded $190 million, with total damages potentially surpassing $642 million (Associated Press [AP], 2025).
- **Human Impact:** At least 10 fatalities in Florida, including four in Port St. Lucie due to tornadoes spawned by the storm. Over 3.5 million residents experienced power outages (The Times, 2024).
- **Environmental Impact:** Record rainfall and a sea surge up to 13 feet caused extensive flash flooding. The storm also spawned nearly 20 tornadoes, leading to widespread structural damage (The Times, 2024).

Hurricane Milton flood damage in Pinellas County.

Hurricane Milton tornado damage in Palm Harbor.

(Images Source: Pinellas County Government Communications)

KEY STATISTICS FROM THE LAST 10 YEARS

Hurricane Frequency

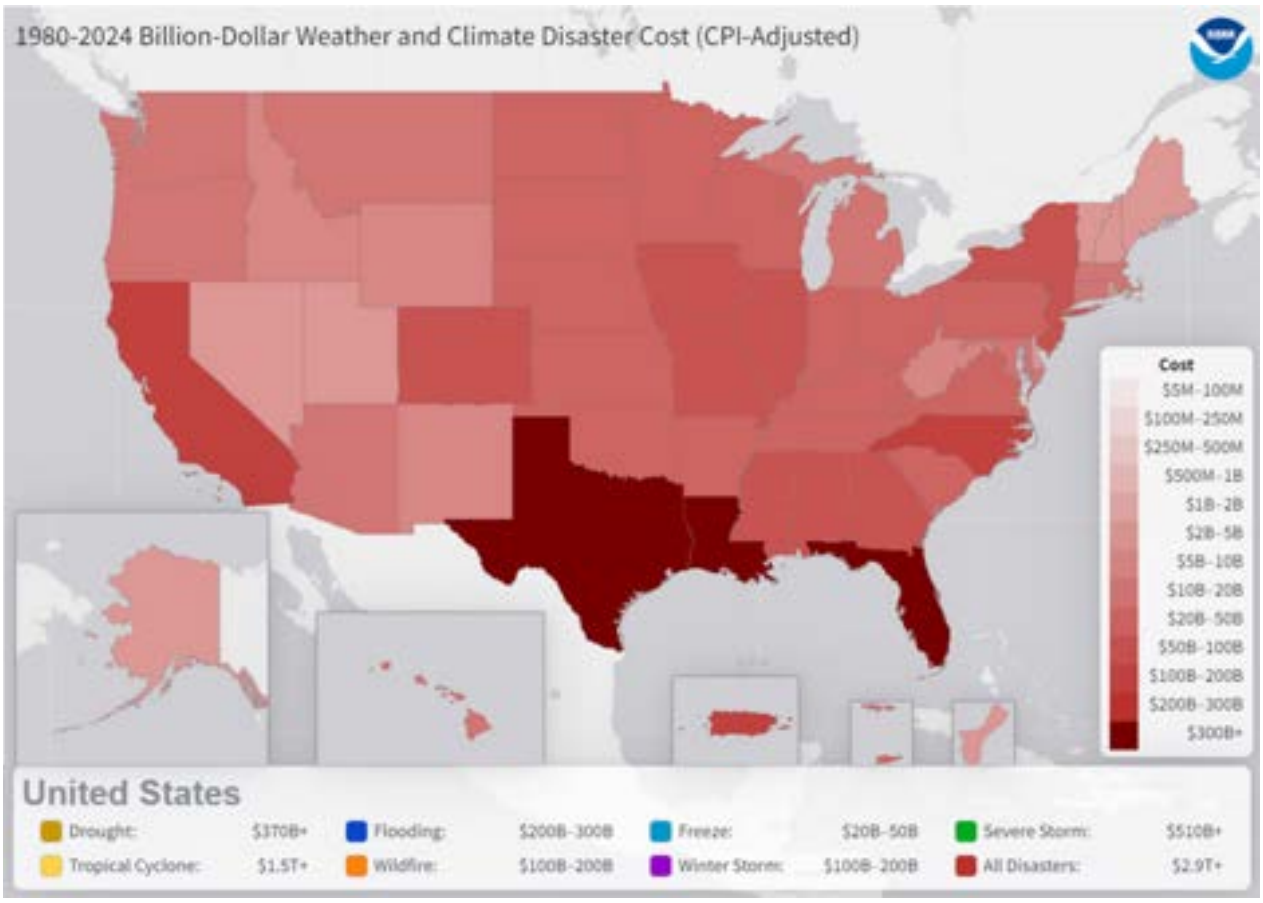
Over the past decades, the number of hurricanes in the Atlantic basin has increased, likely due to shifts in environmental patterns. For instance, the 2020 Atlantic Hurricane Season saw a record 30 named storms, surpassing the previous record set in 2005. This trend is expected to continue as ocean temperatures rise (National Hurricane Center).

Hurricane Intensity

has also increased, with more hurricanes reaching Category 4 and 5. Both Hurricane Michael (2018) and Hurricane Ian (2022) were extremely powerful storms, highlighting a trend linked to rising ocean temperatures (NOAA).

Economic Losses

Since 2000, the U.S. has seen over $300 billion in hurricane-related damages. This rise is exacerbated by increased urbanization along coastal areas, which not only heightens exposure to hurricanes but also increases recovery costs (NOAA).



The financial burden of recovery has risen sharply. For instance, Florida has allocated billions of dollars for disaster recovery following major storms like Irma and Ian (FEMA)

OTHER KEY STATISTICS

Average Annual Hurricane Activity: Between 2010 and 2020, Florida experienced an average of **1.3 hurricanes per year** (NOAA).

Economic Damage: Over the past decade, hurricanes caused over **$150 billion** in damages in Florida alone (FEMA, 2022).

Evacuations: Major hurricanes have led to an average of **6 million people being evacuated annually** in Florida, underscoring the importance of effective evacuation planning (FEMA).

Insurance Losses: Florida's insurance market has faced significant losses, exceeding **$50 billion in claims** following major hurricanes (Florida Office of Insurance Regulation).

Florida's vulnerability to hurricanes is underscored by the catastrophic damages caused by storms such as Irma, Michael, Ian, Dorian, Milton, and Helene. These storms have highlighted critical challenges for local governments and the need for more robust disaster planning and response strategies. The state's recovery from these hurricanes has involved not only rebuilding infrastructure but also addressing long-term issues such as resilience building and the management of limited recovery funds.

As Florida continues to face the growing threat of more frequent and severe hurricanes, the development of comprehensive recovery frameworks is essential. These frameworks must integrate environmental sustainability, infrastructure resilience, community engagement, and effective collaboration with federal agencies like FEMA.

WHY HURRICANE RECOVERY & DISASTER RESPONSE ARE CRITICAL FOR PLANNERS

It is known that first responders and emergency management professionals are the first people on the scene after a hurricane. Yet what about the long-term community effects after the disaster? This is where urban planners thrive. A key position in performing hurricane disaster response and recovery are urban planners due to their ability to create a sustainable and resilient community before, during and after major storms. All planners play a role in the complete long-term recovery and reconstruction of the effected communities. With the help of urban planners, communities emerge stronger, communities emerge prepared, communities emerge safer.

Planner's Core Responsibilities During Hurricane Recovery

Infrastructure Resilience: Planners are tasked with assessing and guiding the restoration of critical infrastructure, such as roads, bridges, and utilities, that are often damaged or destroyed by hurricanes. In addition to simply repairing these systems, planners must advocate for the incorporation of measures that will help these structures withstand future storms, such as flood-resistant designs, elevated buildings, and strengthened stormwater systems.

Flooded roadway in Pinellas County, FL
(Images Source: Pinellas County Government Communications)

Damaged trailer home
(Images Source: Pinellas County Government Communications)

Housing and Community Development: Hurricanes often leave large portions of the population displaced. Planners must work to establish policies that streamline the process to rebuild housing in ways that provide for displaced residents while also addressing issues such as affordable housing, zoning changes, and long-term community development. This includes ensuring that rebuilt neighborhoods are not only functional but resilient to future storms.

Land Use and Zoning: One of the primary tools planners have is land-use regulation, including zoning ordinances. After a hurricane, planners are responsible for reviewing and adjusting land-use plans to ensure that new development is located in areas that are less prone to flooding and other storm-related damage. Planners also have the opportunity to advocate for more sustainable and disaster-resilient development practices.

Countywide Plan Map

(Source: Pinellas County Government)

Environmental Restoration: A significant challenge after a hurricane is the environmental damage that often accompanies storms. Planners must work to restore natural habitats, such as wetlands and coastal ecosystems, which provide critical services like storm surge protection and water filtration. Moreover, planners must integrate nature-based solutions into rebuilding efforts to reduce future vulnerabilities.

Community Engagement: Successful recovery efforts rely on the active involvement of communities. Planners facilitate public meetings, engage with residents, and advocate for inclusive strategies that address the unique needs of diverse populations. Communities also play a critical role in shaping how disaster recovery funds are prioritized and spent, often through participatory budgeting processes, citizen advisory boards, and public hearings tied to federal and state funding programs.

Pinellas County Emergency Operations Center,
(Source: Pinellas County Government)

Given the complexity of these tasks, the role of urban planners is crucial in hurricane recovery. The aftermath of a hurricane presents an opportunity to reimagine cities and counties in ways that are more sustainable, equitable, and resilient to impacts. An urban planner's goal is to make our state come out of a disaster stronger and improved. However, the road to recovery is long, and the challenges are significant.

OVERIVEW OF LOCAL VULNERABILITY ASSESSMENTS IN PINELLAS COUNTY

Municipalities in Pinellas County have made significant efforts to evaluate their vulnerability to various environmental and disaster-related risks through vulnerability assessments. These assessments are essential for understanding potential threats to both natural and built environments, serving as a guide for planning a resilient future. They take into account factors such as flood risks, infrastructure weaknesses, and socio-economic elements that impact community resilience. An increasing number of local governments are also incorporating adaptation strategies into their sustainability initiatives, encouraging a proactive approach to disaster preparedness and long-term resilience.

Importance of Vulnerability Assessments in Disaster Recovery Planning

Vulnerability assessments are essential tools for disaster recovery and long-term resilience planning. They help municipalities:

- Identify vulnerable critical infrastructure that may be at risk during extreme weather events.
- Develop targeted mitigation and adaptation strategies to address specific threats to the community.
- Enhance emergency preparedness and improve the response to potential disasters.
- Secure funding for resilience projects that can reduce future risk and improve community sustainability.
- Foster collaboration among various jurisdictions, ensuring a coordinated approach to resilience and recovery.

By incorporating vulnerability assessments into local planning processes, municipalities can create more resilient and adaptable frameworks that will improve their ability to recover from future hurricanes and other disasters.

City of Largo: Sustainability and Resilience Action Plan (SRAP)

Largo's Sustainability and Resilience Action Plan (SRAP) focuses on addressing environmental challenges such as hurricanes, sea level rise, and extreme heat. The city's SRAP identifies several key risks.

- **Sea Level Rise & Flooding:** Largo's infrastructure, particularly its stormwater systems and roadways, are increasingly at risk of flooding. The city's older neighborhoods need upgrades to stormwater management systems to handle these threats more effectively.
- **Extreme Heat:** Urban heat islands disproportionately affect vulnerable populations, such as the elderly and low-income residents. Areas lacking green space are prioritized for urban greening projects to provide relief.
- **Hurricane Vulnerability:** Older buildings, which do not meet modern wind-load standards, are more vulnerable to hurricanes. The city is working to bolster the resilience of its power grid and improve emergency response systems.
- **Social Vulnerability:** Disadvantaged communities face unique challenges when it comes to disaster preparedness and recovery, so there is a focus on providing support to these groups.

Flooded community in Pinellas County, FL
(Source: Pinellas County Government)

Collapsed two-story house,
(Source: Pinellas County Government)

Largo's SRAP includes stormwater and flood mitigation initiatives, upgrades to building codes, expanding the tree canopy, and enhancing emergency preparedness to tackle these risks (City of Largo, 2023).

City of Clearwater: Adaptation Plan

Clearwater's Adaptation Plan, developed under the Florida Community Resiliency Initiative, incorporates vulnerability findings into the city's long-term infrastructure planning. Following NOAA's five-step framework, Clearwater's Coastal Vulnerability Assessment highlights:

- **Flooding & Sea Level Rise:** Coastal areas face increasing risks from storm surges and erosion, and these are expected to intensify over time.
- **Stormwater & Wastewater Infrastructure Strain:** The city's aging systems are under pressure due to heavier rainfall and rising groundwater levels.
- **Coastal Development:** Clearwater is updating its seawall infrastructure and strengthening regulations to prevent flood-prone development. They're also implementing freeboard requirements, which elevate structures above predicted flood levels.
- **Public Awareness & Policy Implementation:** The city has prioritized educating residents about flood insurance and the importance of preparing for environmental changes, ensuring the community is better equipped for future events.

Clearwater has designated Adaptation Action Areas (AAAs), which help prioritize investments and integrate resilience considerations into zoning and land use planning (City of Clearwater, 2023).

Clearwater, FL, Pinellas County

City of Tarpon Springs: Vulnerability Assessment and Action Plan (VAAP)

Tarpon Springs has developed a comprehensive Vulnerability Assessment and Action Plan (VAAP) to address coastal flooding, erosion, and sea level rise. Supported by the Florida Resilient Coastlines Program, the VAAP helps the city identify vulnerable assets, update coastal management policies, prioritize adaptation efforts, and create a roadmap for mitigation. The plan also positions the city to secure future funding for resilience projects, which will be crucial in adapting to the environmental challenges ahead (City of Tarpon Springs, 2024).

Pinellas County: Resilient Pinellas Action Plan

Pinellas County is actively advancing its Resilient Pinellas Action Plan, a forward-thinking roadmap designed to strengthen the community's ability to prepare for and respond to climate-related threats like hurricanes, flooding, and sea level rise.

With 56 initiatives spanning infrastructure resilience, environmental health, and community engagement, the plan emphasizes proactive, long-term strategies that protect both people and natural systems. It reflects the County's commitment to building a safer, more sustainable future in the face of increasing environmental risks.

A major component of this effort is the County's ongoing Vulnerability Assessment, supported by the Florida Department of Environmental Protection (FDEP). This work is currently moving through key phases, including finalizing data on critical assets, running exposure models, and preparing for the sensitivity analysis. The project team has already completed initial tasks like establishing data standards and submitting technical materials to FDEP, and is now fine-tuning the analysis with input from subject matter experts. The groundwork being laid today; through mapping, modeling, and collaboration, will guide Pinellas County's strategy to recover more effectively from future disasters and build lasting resilience. (Pinellas County, 2023).

(Background Image source: Pinellas County Government)

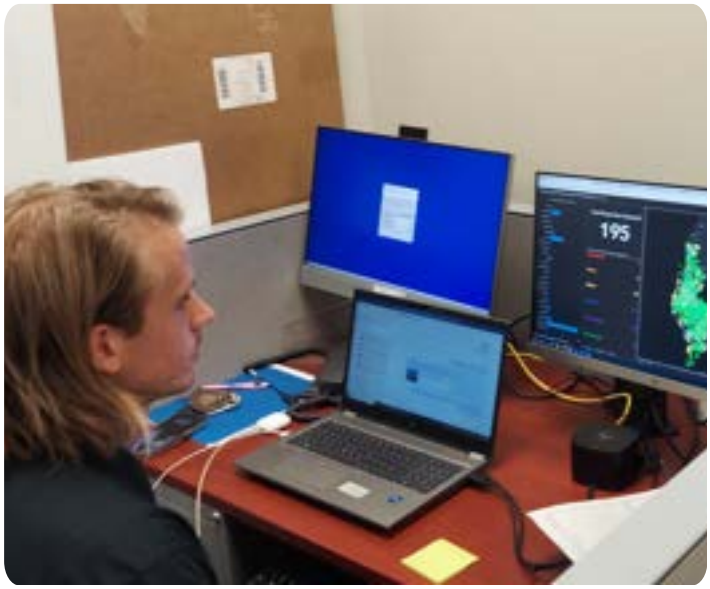
EMERGENCY MANAGEMENT PROTOCOLS IN PINELLAS COUNTY

Pinellas County has developed a comprehensive emergency management framework that could serve as a model for other municipalities. These strategies ensure seamless coordination before, during, and after a hurricane, and can be adapted for use in other areas facing similar challenges. Key protocols include:

Emergency Operations Center (EOC)

Activated before disasters, the EOC acts as the central coordination hub, managing multi-agency responses according to the Federal Emergency Management Agency (FEMA)'s Incident Command System (ICS) structure (Pinellas County, 2024).

Pinellas County EOC full activation during Hurricane Milton (Image source: Pinellas County Government)



Forward Pinellas staff performing damage assessments at the EOC.

Comprehensive Emergency Management Plan (CEMP)

The CEMP outlines a holistic approach to all-hazards preparedness, addressing evacuation, sheltering, recovery, and public communication responsibilities (Pinellas County, 2023).

Evacuation Planning

Up-to-date evacuation zone maps are shared with residents through extensive outreach campaigns to ensure efficient and timely evacuations (Pinellas County, 2023).

Emergency Alert System (EAS)

This system delivers real-time updates via TV, radio, and mobile devices, keeping residents informed about evolving situations (Pinellas County, 2024).

ALERTPinellas
Emergency Notification Service

Shelter Operations

Designated local schools, community centers, and faith-based organizations are used as shelters to accommodate displaced residents (Pinellas County, 2024).

Displaced residents resting on cots in a shelter during Hurricane Helene
(Image source: Pinellas County Government)

Displaced residents receiving food at a shelter during Hurricane Helene
(Image source: Pinellas County Government)

Post-Disaster Recovery Task force

Activated to assess damage, coordinate financial aid, and plan for long-term recovery, this task force includes specialized recovery teams focused on housing and infrastructure (Pinellas County, 2024).

(Image source: Pinellas County Government)
Post-Disaster Recovery Task force providing water

Utilities department assessing and repairing damage
(Image source: Pinellas County Government)

Municipal Coordination Protocols

Pinellas County conducts joint preparedness drills and maintains mutual aid agreements with municipalities, fostering enhanced coordination during recovery efforts (Forward Pinellas, 2023).

Vulnerability Assessment Integration

Efforts are underway to incorporate vulnerability data into emergency planning, aligning with statewide resilience initiatives and making the county more prepared for future events (FDEM, 2023).

These strategies are supported by partnerships with the Tampa Bay Regional Planning Council (TBRPC) and the Economic Development Administration (EDA), which help strengthen regional resilience. Other counties and municipalities could potentially adapt and implement similar approaches to bolster their own preparedness and recovery frameworks.

CASE STUDIES

(Image Source: ABC Action News)

Fort Myers Case Study: Hurricane Ian Recovery and Rebuilding

Background: Before Hurricane Ian, Fort Myers was a growing city with a mix of aging homes, high-value coastal properties, and areas like Midtown which was ripe for redevelopment. Sitting along the Caloosahatchee River and close to barrier islands like Sanibel and Pine Island, the city was highly exposed to both storm surge and inland flooding. While officials had been working on flood management and downtown revitalization, Fort Myers' comprehensive plan hadn't fully caught up with modern climate risks or resiliency needs (Palermo, personal interview, 2025; Lee County Recovery Plan, 2023).

Hurricane Ian hit on September 28, 2022, as a Category 4 storm, bringing 150+ mph winds, heavy rain, and a massive storm surge that devastated much of Lee County. Fort Myers saw widespread damage—flooded neighborhoods, destroyed infrastructure, and mountains of debris. The downtown Yacht Basin was wiped out. The city's Emergency Operations Center stayed active for over a month, starting with downtown recovery and then expanding citywide (Palermo, personal interview, 2025). With its diverse economy and mix of income levels, the recovery process was complex, requiring coordination across all levels of government (Fort Myers Recovery Task Force, 2023; Lee County Recovery Plan, 2023).

Rebuilding Process

Planning & Policy Changes: Fort Myers adopted several key policies and planning amendments after Hurricane Ian to rebuild and ensure future resilience. Important changes included:

- The creation of the Fort Myers Comprehensive Recovery Plan, which included specific guidelines for rebuilding damaged neighborhoods with an emphasis on resilience and sustainable design.
- Zoning and code amendments focused on increasing the resilience of buildings, including strengthening wind and flood regulations.
- Development of community-driven planning initiatives that involved stakeholders from across the city to prioritize rebuilding in the most affected areas, with special focus on low-lying neighborhoods.
- Implementation of stormwater management solutions, including the use of permeable pavement and improved drainage infrastructure to prevent future flood risks (Fort Myers Recovery Task Force, 2023).

The Rebuild Florida Program and the newly launched Elevate Florida initiative have played an important role in supporting infrastructure upgrades in Fort Myers. Elevate Florida, rolled out by the Florida Division of Emergency Management, is now active in Fort Myers Beach and is helping homeowners elevate and strengthen their homes to better withstand future storms (Gulf Coast News Now, 2025). At the same time, Lee County is utilizing Community Development Block Grant–Disaster Recovery (CDBG-DR) funds to assist with critical recovery needs—including home repairs, neighborhood revitalization, and infrastructure improvements following recent hurricanes like Helene and Milton (Lee County Government, 2025).

Infrastructure Rebuilding: Fort Myers' recovery strategy emphasized rebuilding smarter and stronger. Major infrastructure actions included:

- Utility restoration and upgrades, including the hardening of electrical infrastructure and prioritization of underground utilities where feasible.
- Stormwater infrastructure enhancements to reduce future flood risks, with particular attention to neighborhoods previously reliant on outdated drainage systems.
- Temporary debris management zones and emergency access corridors were rapidly established post-storm to streamline recovery logistics (Palermo, 2025).

Environmental Considerations:
Environmental resilience was a focus during the rebuilding process. Fort Myers made strides in protecting natural resources, such as preserving coastal wetlands to buffer against future storm surges. Additionally, new building codes were adopted to promote flood-resistant construction and to integrate natural stormwater management features (Fort Myers Recovery Task Force, 2023).

Property Values and Housing

Post-Hurricane Property Trends: Despite the initial devastation, Fort Myers saw a gradual increase in property values in the years following Hurricane Ian. Factors contributing to this increase included:

- The demand for new construction driven by government incentives and private investment.
- Development of previously underused or vacant properties in the downtown area.
- The influx of tourists and seasonal residents, which helped revitalize the local economy (Lee County Recovery Plan, 2023).

Housing Recovery and Assistance Programs: The recovery of Fort Myers' housing stock involved both short-term and long-term initiatives. Key housing recovery programs included:

- Temporary housing options, including mobile homes and FEMA housing, that helped displaced residents while long-term solutions were being developed.
- A voluntary home buyout program for residents in high-risk flood zones.
- The Fort Myers Housing Rehabilitation Program, which offered financial assistance for homeowners to repair or elevate their properties to meet new flood standards (Fort Myers Recovery Task Force, 2023).
- Blue tarp programs and rapid repair grants, which were deployed to stabilize structures before permanent repairs could begin (Palermo, 2025).

Successes and Challenges

Successes in Recovery

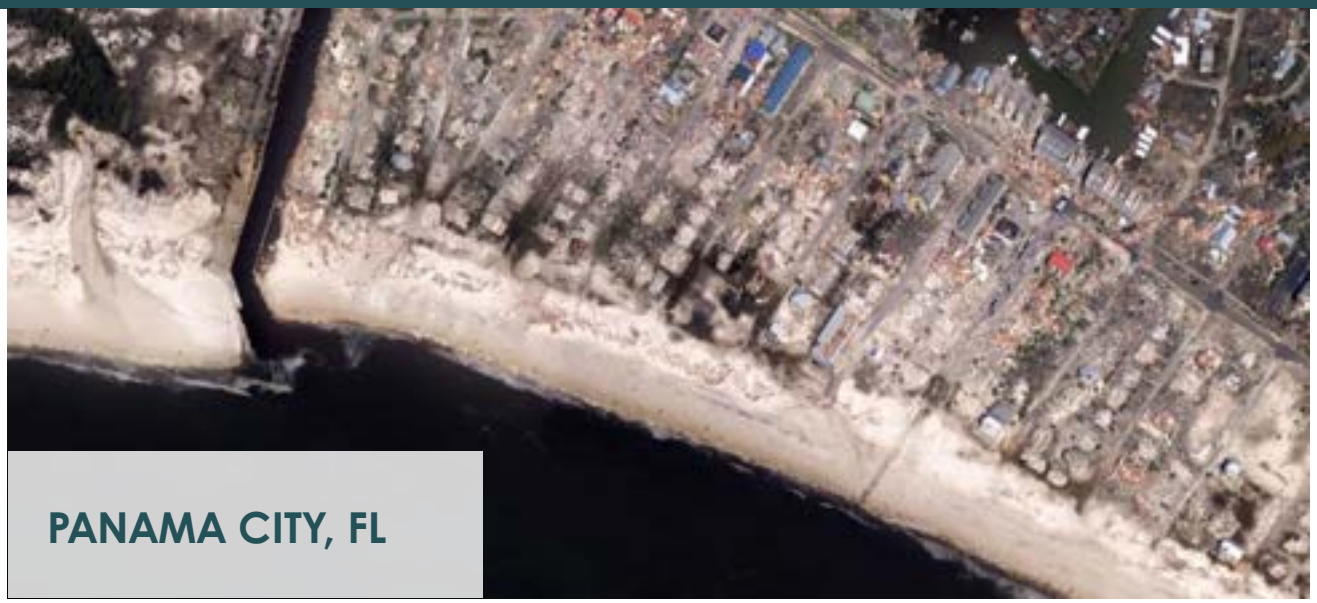
- Proactive Use of Data: Fort Myers embraced vulnerability assessments and hazard mapping to guide decision-making.
- Stronger Building Standards: Reconstruction is meeting or exceeding modern wind and flood resilience standards.
- Federal and State Partnerships: Coordination with FEMA and the Florida Division of Emergency Management has enabled progress, particularly on infrastructure repairs.
- Momentum for Resilient Growth: The city is rethinking how and where to grow, with resilience now a core planning principle (Palermo, 2025).

Ongoing Challenges

- Financing and delays: Although federal funding helped, Fort Myers faced delays in FEMA reimbursements and resource shortages, which slowed down recovery projects.
- Permitting and regulatory hurdles: The permitting process for rebuilding homes and businesses was slow and cumbersome, which further delayed the recovery timeline.
- Staffing and Administrative Burden: The scale of recovery overwhelmed city departments, requiring temporary staffing increases and consultant support.
- Environmental impact: While efforts were made to address environmental concerns, significant flooding in some neighborhoods highlighted the need for continued focus on stormwater management and flood mitigation (Lee County Recovery Plan, 2023).

Key Takeaways for Pinellas County

1. **Integrated Recovery Plans**: Having a comprehensive recovery plan that includes long-term resilience goals can help streamline rebuilding efforts.
2. **Flood Mitigation Strategies**: Enhancing stormwater systems and implementing green infrastructure techniques can reduce future risks.
3. **Community Involvement:** Engaging the community in rebuilding decisions helps ensure that recovery is inclusive and meets local needs.
4. **Resilient Building Codes:** Strengthening building codes to incorporate resilience measures will help mitigate future storm damage.
5. **Financial Flexibility:** Securing diverse sources of funding and accelerating the use of federal grants can aid in faster recovery.



(Image Source: BBC)

Panama City Case Study: Hurricane Michael Recovery and Rebuilding

Background: Hurricane Michael made landfall as a Category 5 storm on October 10, 2018, bringing catastrophic winds and storm surge to Panama City, Florida. The city, located in Bay County, had a pre-hurricane landscape characterized by a mix of residential, commercial, and industrial areas, with a strong tourism-based economy. Before the hurricane, Panama City's median household income was relatively high, but the city also had aging infrastructure and areas of concentrated low- to moderate-income populations (Rebuild PC, 2021).

The impact of Hurricane Michael was severe, causing widespread destruction to homes, businesses, and public infrastructure. Wind speeds exceeding 160 mph led to structural failures, while storm surge and flooding further exacerbated damages. Recovery efforts required extensive coordination between local, state, and federal agencies (Haley & Aldridge, personal communication, February 6, 2025).

Rebuilding Process

Planning & Policy Changes: Following Hurricane Michael, Panama City adopted multiple policy and zoning amendments to facilitate reconstruction while ensuring future resilience. Key initiatives included:

- The adoption of neighborhood zoning districts, particularly in three historic Community Redevelopment Agency (CRA) districts.

- Implementation of a neighborhood district future land use category and amendments to zoning maps to align with long-term recovery goals.
- A series of community planning charettes (2020-2021) that informed zoning code amendments, including regulations for mixed-use development and the incorporation of corner stores to encourage walkability (Haley & Aldridge, 2025)
- Increased freeboard requirements, raising elevation standards to 2 feet above the base flood elevation to mitigate flood risks (Rebuild PC, 2021).

The Rebuild Florida Program and Elevate Florida provided funding to support these policy shifts and infrastructure upgrades. Additionally, Community Development Block Grant-Disaster Recovery (CDBG-DR) funds played a vital role in financing neighborhood revitalization and voluntary home buyouts.

Infrastructure Rebuilding: The city faced significant challenges in rebuilding its roads, utilities, and public facilities. Infrastructure reconstruction was prioritized based on storm impact assessments, with funding coming from FEMA reimbursements, CDBG-DR grants, and a $150 million loan from the state revolving loan fund (Rebuild PC, 2021). Key efforts included:

- Undergrounding utilities to improve storm resilience.
- Restoring roadways and drainage systems, with approximately $330 million in estimated infrastructure needs.
- Enhancing stormwater management through land buyouts in frequently flooded areas to develop stormwater facilities (Haley & Aldridge, 2025).

Environmental Considerations: Environmental resilience was a core focus of Panama City's rebuilding efforts. The city implemented stricter building codes to promote flood-resistant structures and invested in land acquisition programs to mitigate flood risks in vulnerable areas. However, rebuilding efforts remained slow, with many vacant lots persisting in areas of severe storm impact (Rebuild PC, 2021).

Before and after satellite images of Panama City, FL (Image source: DigitalGlobe, 2018)

Property Values and Housing

Post-Hurricane Property Trends: Despite initial devastation, property values in Panama City experienced a growth boom in the years following Hurricane Michael. Factors contributing to this increase included:

- Drop in interest rates, incentivizing rebuilding and home purchases.
- High demand for new construction, attracting developers and investors.
- Government funding and incentives, such as CDBG-DR grants for infrastructure improvements and home buyouts (Haley & Aldridge, 2025).

Housing Recovery and Assistance Programs: Several housing assistance initiatives were implemented, including:

- The voluntary home buyout program, helping residents relocate from high-risk flood zones.
- The hometown revitalization program, which provided grants to improve downtown historical businesses.
- FEMA-supported temporary housing, which was phased out within two years post-hurricane. Many displaced residents relocated temporarily to nearby areas such as Destin (Haley & Aldridge, 2025).

Successes and Challenges

Successes in Recovery

- **Growing recognition of urban planning's role in resilience:** The storm underscored the importance of long-term planning, leading to a more proactive approach to zoning and land use.
- **Continued economic growth:** Despite setbacks, Panama City remained an attractive destination for new development.
- **Strong community engagement:** Local residents played a key role in shaping recovery policies and supporting revitalization projects (Rebuild PC, 2021).

Planners deliberating over the countywide plan map.

Ongoing Challenges

- **Financial constraints:** Despite receiving federal aid, Panama City faced continuous funding shortages. The city estimated $330 million in infrastructure needs but struggled with FEMA reimbursement delays (Haley & Aldridge, 2025).
- **Infrastructure bottlenecks:** Rebuilding roads, utilities, and stormwater systems took longer than anticipated due to resource limitations.
- **Permitting and administrative hurdles:** The permitting process was described as chaotic, adding delays to reconstruction projects. The city ultimately brought its building department in-house to streamline the process (Rebuild PC, 2021).

Key Takeaways for Pinellas County

1. **Proactive Neighborhood Planning:** Pre-established neighborhood plans can expedite rebuilding and enhance resilience.
2. **Elevation and Flood Mitigation:** Increased freeboard requirements help prevent future flood damage.
3. **Diverse Funding Strategies:** Combining federal, state, and private funding can accelerate recovery efforts.
4. **Resilient Infrastructure Investments:** Undergrounding utilities and upgrading stormwater systems improve long-term sustainability.
5. **Community Involvement:** Engaging residents in planning efforts fosters stronger recovery outcomes.
6. **Flexible Zoning Policies:** Mixed-use zoning and walkability-focused land use policies can support long-term growth and resilience.

Lifted house in Tampa Bay, FL (Image source: Fox 13 News)

HARRISON COUNTY, MS

Photo of damaged shipping containers at the Port of Gulfport after Hurricane Katrina. From Gulfport, MS: The Port of Gulfport by Esri StoryMaps, 2018

Harrison County Case Study: Hurricane Katrina Recovery and Rebuilding

Background: Hurricane Katrina made landfall on the Mississippi Gulf Coast in August 2005, bringing catastrophic destruction to communities across Harrison County. The storm produced a storm surge of up to 22 feet, flooding coastal areas and causing widespread wind damage to homes, businesses, and public infrastructure. The county's economic foundation, tourism, gaming, and seafood industries suffered massive losses, with entire neighborhoods left uninhabitable for months (Harrison County Community Plans, 2011).

Unlike New Orleans, where flooding persisted for weeks, Harrison County experienced immediate structural devastation due to storm surge and wind rather than prolonged inundation. The impact was particularly severe for low-income residents, many of whom lacked mortgages or insurance, leaving them with limited options for recovery (Bonck, personal communication, 2024).

Rebuilding Process

Planning & Policy Changes: Harrison County's rebuilding process required extensive planning and zoning policy updates to manage temporary housing, guide redevelopment, and prevent long-term non-conforming land uses.

- **Temporary Use Permits:** To regulate temporary housing, the county introduced a structured temporary use permit process. This system ensured that FEMA trailers

and Katrina Cottages were not used as permanent residences, requiring residents to obtain approvals that expired after six months, with possible extensions up to one year (Bonck, personal communication, 2024).

- **Zoning Text Amendments:** Several zoning ordinances were updated to accommodate disaster recovery needs while preventing uncontrolled development. These amendments were published online to maintain transparency and accessibility (Harrison County Zoning Ordinance, 2011).
- **Avoidance of Permanent Trailer Parks**: Having learned from Hurricane Camille, where emergency trailer parks persisted for decades, Harrison County prohibited FEMA trailer parks on private properties, instead allowing them only on government land to ensure temporary usage (Bonck, personal communication, 2024).

Environmental Considerations: The recovery process also involved substantial environmental planning, particularly in the areas of floodplain management and wetland protection. To support essential rebuilding projects while minimizing environmental impacts, Harrison County implemented expedited permitting for core property development, taking care to ensure that wetlands were not unduly affected (Harrison County Community Plans, 2011). Additionally, the county updated its building codes in the aftermath of Hurricane Katrina to enhance flood resilience. These revisions required all new construction to be elevated at least two feet above the Base Flood Elevation (BFE), a measure designed to reduce vulnerability to future flood events (Mississippi Floodplain Management Report, 2018).

Property Values and Housing

Post-Katrina Property Trends: Despite the destruction, property values in Harrison County surged in the years following Katrina:

- **Beachfront Property Boom**: The demand for coastal redevelopment led to skyrocketing property values. Developers rushed to rebuild, often constructing larger, more expensive homes along the waterfront. This surge in high-end development priced out many low-income residents, pushing them inland (Bonck, personal communication, 2024).
- **Wetlands and Unbuildable Land:** Approximately 20% of available land remained undeveloped post-Katrina due to wetland restrictions, which limited expansion opportunities and contributed to rising property costs (Harrison County Zoning Ordinance, 2011).

Historic and Affordable Housing Efforts: While some historic buildings in Gulfport and Biloxi were restored, others remained unused due to challenges in repurposing older structures for modern needs (Bonck, personal communication, 2024). Additionally, lower-income communities struggled with rebuilding due to insurance costs and lack of financial assistance, exacerbating socioeconomic disparities in recovery (Mississippi Gulf Coast Recovery Report, 2012).

Successes and Challenges

Successes in Recovery

- **Resilient Building Practices:** Strengthened building codes requiring elevated structures and storm-resistant materials significantly improved the durability of new developments (Mississippi Floodplain Management Report, 2018).
- **Economic Revitalization:** Despite initial setbacks, the Mississippi Gulf Coast ultimately experienced economic growth through reinvestment in tourism and infrastructure (Harrison County Community Plans, 2011).
- **Proactive Planning for Temporary Housing:** The county's structured approach to temporary housing helped prevent long-term non-conforming developments while facilitating disaster relief (Bonck, personal communication, 2024).

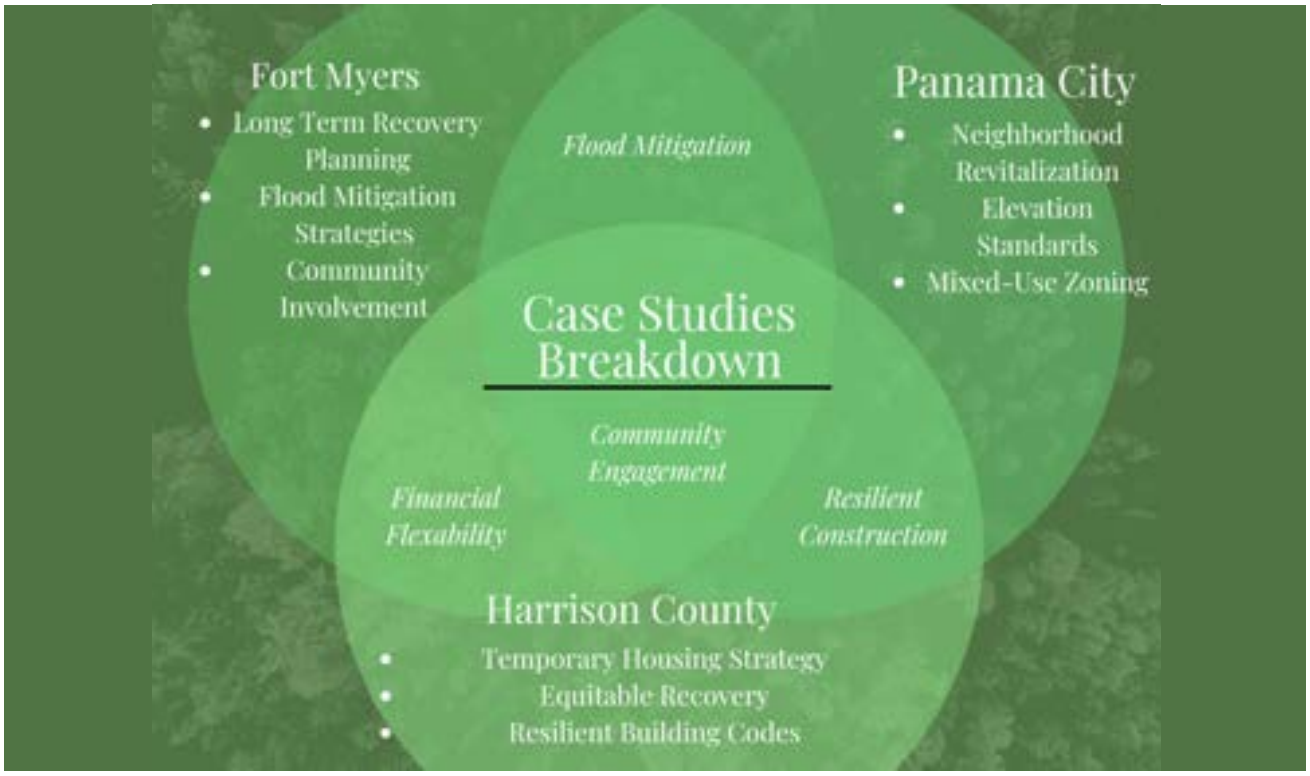
Challenges and Ongoing Issues

- **Disparities in Recovery:** Low-income residents faced the greatest difficulties, often unable to afford rebuilding costs, forcing many to relocate inland (Mississippi Gulf Coast Recovery Report, 2012).
- **Insurance and Financing Issues:** Property insurance rates skyrocketed post-Katrina, making homeownership difficult for many residents. Increased flood insurance requirements further complicated the rebuilding process (Bonck, personal communication, 2024).
- **Environmental Concerns:** Efforts to balance rapid development with sustainable practices remained a challenge, particularly in managing stormwater runoff and preserving natural coastal defenses (Mississippi Floodplain Management Report, 2018).

Key Takeaways for Pinellas County

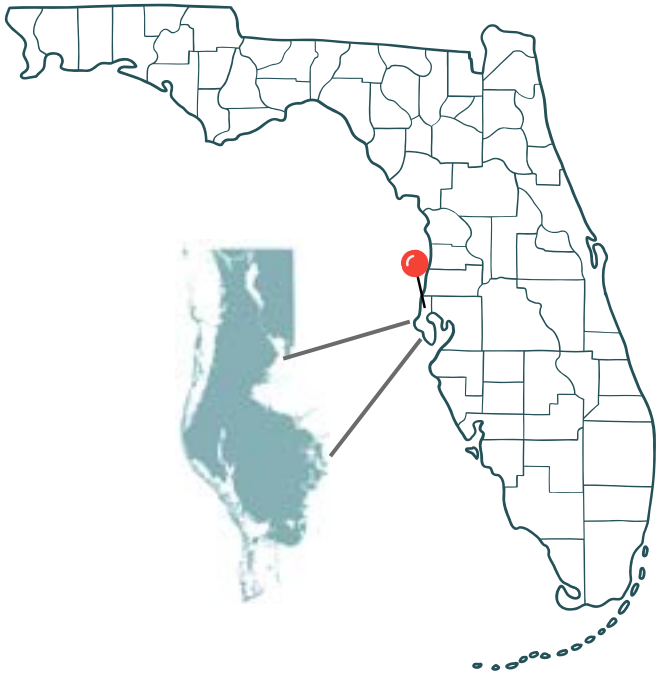
1. **Establish a Clear Temporary Housing Strategy:** Implementing structured temporary housing permits can prevent long-term zoning conflicts while providing essential shelter for displaced residents.
2. **Enhance Resilience in Building Codes:** Requiring elevated structures above BFE and incorporating storm-resistant designs can significantly reduce future hurricane damage.
3. **Prioritize Equitable Recovery:** Developing financial assistance programs for low-income homeowners can prevent displacement and ensure a more balanced recovery.
4. **Integrate Environmental Protections into Development:** Preserving wetlands and implementing stronger floodplain regulations can mitigate storm surge impacts and support long-term resilience.
5. **Encourage Community Participation in Recovery Planning:** Engaging residents in rebuilding discussions fosters collaboration and ensures redevelopment efforts align with local needs.

Case Study Comparison Graphic



CHALLENGES AND OPPORTUNITIES IN PINELLAS COUNTY

Pinellas County, located on Florida's west coast, is particularly vulnerable to hurricanes due to its low-lying geography, proximity to the Gulf of America, and extensive coastline. With a population of approximately 959,000 (U.S. Census Bureau, 2023), a large portion of residents live in coastal areas, making the county particularly susceptible to storm surge, flooding, and wind damage. Given these risks, the county's planning and disaster recovery efforts must focus on minimizing the impacts of storms and preparing for future disasters.



Challenges in Pinellas County

Vulnerability to Storm Surge and Flooding: Pinellas County's coastal communities are particularly vulnerable to storm surge and flooding. The county has a high percentage of waterfront properties, and past hurricanes like Ian and Irma have caused widespread damage. Planners face the challenge of balancing development pressures with flood risk mitigation to ensure new construction is more resilient to future storms.

Aging Infrastructure: Like many parts of Florida, Pinellas County's infrastructure is aging and was not originally designed to withstand the intensity and frequency of modern hurricanes. Roadways, bridges, and utilities require significant upgrades to meet current and future storm demands. The challenge lies in securing funding for these large-scale infrastructure upgrades while also addressing other municipal needs (Florida Department of Transportation, 2022).

Damaged boat ramp in Safety Harbor, FL
(Image source: Pinellas County Government)

Population Density and Housing Affordability: Pinellas County is one of the most densely populated counties in Florida, with a population density of approximately 3,500 people per square mile (Pinellas County, 2022).and the high demand for housing exacerbates its vulnerability to storm surge. After hurricanes, planners must deal with the dual challenge of rebuilding damaged homes and addressing ongoing affordable housing needs in high-risk areas (Pinellas County, 2022).

Environmental Protection and Restoration: Pinellas County boasts a rich diversity of natural ecosystems, including mangroves, salt marshes, and coastal wetlands. These ecosystems are crucial in mitigating the impacts of storms by absorbing storm surge and providing habitats for wildlife. However, these areas have been degraded by development and environmental stress. Rebuilding efforts must prioritize restoring these natural systems while ensuring that new development does not worsen future vulnerabilities.

Flooding and beach erosion at Madeira Beach (Image source: Pinellas County Government)

Insurance Pressures and Recovery Delays: Homeowners across Florida are facing increasing insurance premiums, coverage gaps, and delays in claims processing. In storm-prone areas like Pinellas County, these challenges can slow the pace of recovery and make it more difficult for residents to repair or rebuild after a disaster. Planners must account for these financial barriers when supporting long-term recovery efforts and community resilience.

Opportunities in Pinellas County

Green Infrastructure and Nature-Based Solutions: Pinellas County has the opportunity to incorporate green infrastructure and nature-based solutions into its recovery strategies. These approaches can help manage stormwater, reduce flooding, and restore natural habitats. For example, planting mangroves along the coast can mitigate storm surge and improve water quality. Coastal restoration projects can also aid in shoreline stabilization and protect vital ecosystems.

Resilient Housing Development: The recovery process provides an opportunity to rebuild housing in more resilient ways. By incorporating elevated homes, flood-resistant materials, and energy-efficient systems, planners can create housing that is

better equipped to withstand future storms. Sustainable zoning policies and mixed-use developments can also help reduce urban sprawl and promote resilience.

Collaboration and Funding Opportunities: After major hurricanes, Pinellas County can leverage state and federal funding, including grants from the Federal Emergency Management Agency (FEMA) and the Department of Housing and Urban Development (HUD), to support recovery and resilience planning. Collaborative efforts with local organizations, universities, and community groups can also enhance recovery efforts and ensure the needs of all residents, particularly vulnerable populations, are addressed (FEMA, 2021).

Beach Renourishment and Coastal Resilience: Recent hurricanes have caused serious erosion along Pinellas County's coastline, putting infrastructure and natural habitats at risk. In response, the County is restoring dunes, replacing lost sand, and reinforcing shoreline defenses through beach renourishment projects. These efforts not only reduce storm surge risk but also support tourism and protect wildlife habitats like those of sea turtles and shorebirds. Continued investment and strong partnerships with state and federal agencies will help strengthen the county's natural coastal defenses over time (Pinellas County Government, 2024).

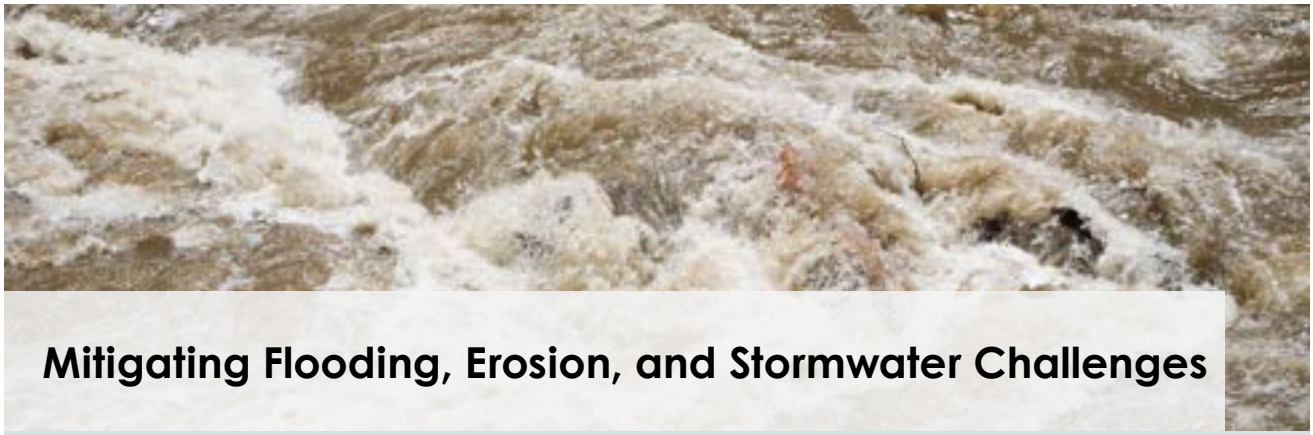
Sand distribution on beach
(Image source: Pinellas County Government)

Comprehensive Vulnerability Assessments: Pinellas County is currently undertaking a comprehensive vulnerability assessment to identify areas at greatest risk from future storms. Through tools like GIS mapping and climate modeling, this effort will support more informed land use decisions, zoning updates, and infrastructure investments that aim to protect residents, critical services, and natural ecosystems.

The importance of effective hurricane recovery and disaster response cannot be overstated. As environmental conditions continue to influence the frequency and intensity of storms, urban planners must remain vigilant and adapt their strategies to mitigate the impacts of future storms. In Pinellas County, the combination of significant challenges and unique opportunities underscores the need for proactive disaster recovery planning and resilient community development. By embracing innovative solutions and prioritizing sustainability, planners can help ensure that Pinellas County recovers from future hurricanes and emerges stronger, more resilient, and better prepared for future challenges.

ENVIRONMENTAL CONSIDERATIONS OF REBUILDING

When a hurricane strikes, the environmental impact can be devastating, but it's also a chance to reconstruct in a way that prioritizes sustainability and resilience. For Pinellas County, a coastal area with dense urban development, it's essential that rebuilding efforts focus on addressing flooding, stormwater runoff, erosion, and the protection of vital ecosystems like wetlands and coastal barriers. This section outlines strategies to tackle these challenges and make sure the county comes back stronger while preserving its natural resources.



Mitigating Flooding, Erosion, and Stormwater Challenges

Flood Mitigation

Flooding, particularly from storm surges and overwhelmed stormwater systems, is one of the biggest concerns after a hurricane. Pinellas County's stormwater infrastructure should be updated to handle the increased intensity of storms. One way to do this is through green stormwater infrastructure, such as bioswales and rain gardens, which can absorb excess water and reduce runoff.

Recommendation: Pinellas should prioritize floodplain management and integrate green infrastructure into new and redevelopment projects. Stricter floodplain regulations could also help limit development in high-risk flood zones.

Green Infrastructure and Nature-Based Solutions

Living Shorelines

Living shorelines, which use plants, oysters, and natural materials to stabilize coastlines, offer a more sustainable alternative to traditional hard infrastructure. These projects reduce wave energy and improve water quality.

Recommendation: Pinellas County should invest in living shoreline projects to enhance coastal resilience and biodiversity.

Erosion Control: Coastal erosion, made worse by hurricanes, threatens Pinellas's beaches and shorelines. Solutions like beach nourishment, dune restoration, and living shorelines can help protect the coastline and restore marine habitats.

Recommendation: Expand dune restoration efforts and prioritize the use of living shorelines to safeguard shorelines and improve water quality (NOAA, 2021).

Stormwater Management

With rising sea levels and heavier rainfall expected, Pinellas County needs to adopt green infrastructure techniques like permeable pavements and rainwater harvesting systems. These can reduce stormwater runoff and help recharge groundwater supplies.

Recommendation: Encourage low-impact development practices and integrate comprehensive water management systems that manage stormwater, wastewater, and drinking water.

Ecosystem and Coastal Barrier Preservation

Wetland Restoration

Wetlands play a vital role in reducing flood risks by absorbing excess water and filtering pollutants. Pinellas County should focus on restoring damaged wetlands and create wetland mitigation banks to offset development in more vulnerable areas.

Recommendation: Invest in wetland restoration and tighten zoning regulations to protect wetland areas from being encroached upon.

Coastal Barrier Protection

Mangroves, seagrass beds, and coral reefs act as natural barriers against storm surges. While these ecosystems are fragile, they are essential to keeping our coastline protected and resilient.

Recommendation: Increase investments in restoring mangrove forests and seagrass meadows, with the support of mitigation funding and conservation partnerships (NOAA, 2021).

Dune Restoration and Coastal Defense

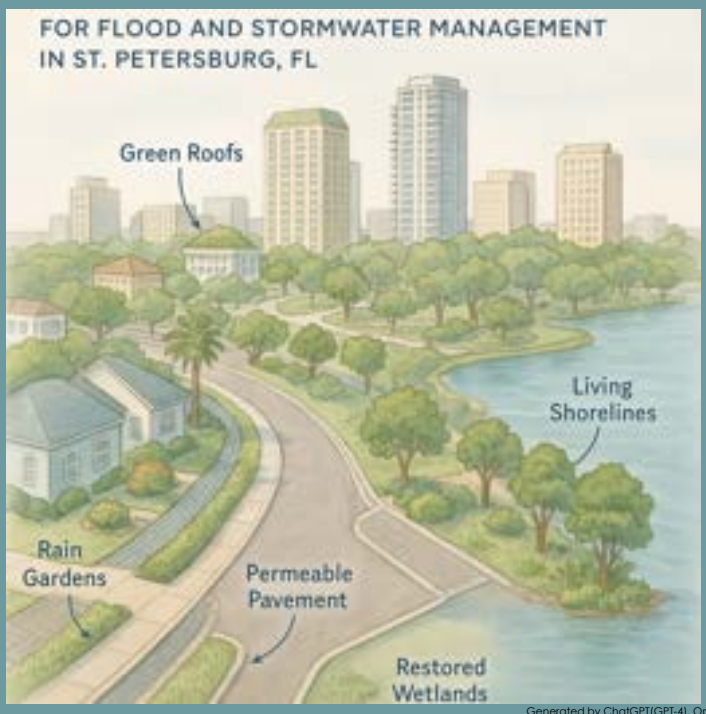
Dunes act as natural buffers, absorbing wave energy and providing protection from storm surge. Restoring dunes with native plants like sea oats helps stabilize the shoreline, reduce erosion, and provide habitat for wildlife such as nesting sea turtles and shorebirds. These soft-engineering approaches also enhance the recreational and aesthetic value of the coastline (Pinellas County Government, 2024)

Recommendation: Expand dune restoration programs along vulnerable beach segments and integrate living shoreline principles into beach design where appropriate. Prioritize continuity in dune systems to prevent weak points along the coast.

Urban Greening and Permeable Surfaces

In more urbanized areas, incorporating green infrastructure such as permeable pavements, green roofs, and vegetated swales can help reduce flooding and improve air quality.

Recommendation: Implement green infrastructure in both new developments and retrofits of existing areas to help manage stormwater and increase urban resilience (EPA, 2020).



Generated by ChatGPT(GPT-4), OpenAI

By focusing on flood mitigation, ecosystem restoration, and green infrastructure, Pinellas County can rebuild in a way that strengthens its resilience and helps preserve its natural beauty. Investing in nature-based solutions will not only protect the community from future storms but also safeguard our ecosystems for generations to come.

WHAT PLANNERS SHOULD KNOW

Urban planners are essential for both disaster recovery and the long-term resilience of communities. Their expertise in areas like land use, infrastructure, and community engagement is crucial for shaping disaster recovery strategies that can help communities bounce back stronger. Below is what planners should keep in mind when involved in disaster response and recovery.

Image source: Pinellas County Government Communications

Generated by ChatGPT(GPT-4), OpenAI

Understanding Vulnerability and Risk

- **Comprehensive Risk Assessment:** It's important to regularly update vulnerability assessments to include current hazards like inland flooding and storm surge, especially in areas that aren't part of the Special Flood Hazard Area (SFHA) but could still be at risk (FEMA, 2023).
- **Mapping and Data Analysis:** Tools like GIS and FEMA Flood Maps, along with data from NOAA and the National Hurricane Center, help identify areas at risk. It's also crucial to educate the public on how to read these maps, so communities can understand their own vulnerabilities (FEMA, 2022).
- **Scenario Planning:** By developing hazard mitigation plans that anticipate different disaster scenarios, planners can design proactive strategies to make recovery easier and more effective (FEMA, 2023).

Community Engagement and Communication

- **Consistent Messaging:** Collaborating with local governments, emergency management agencies, and community groups ensures that disaster-related information gets out quickly and accurately (FEMA, 2022).
- **Education Programs:** Offering workshops that teach residents about evacuation routes, storm surge risks, and flood zones ensures that communities are prepared before disaster strikes (FEMA, 2022).
- **Cultural and Language Accessibility: Make** sure disaster-related information is accessible to everyone by offering it in multiple languages and making it culturally relevant for all community members (FEMA, 2023).

Infrastructure and Land Use Planning

- **Resilient Design Standards:** Encourage using water-resistant materials, elevating structures, and adopting advanced stormwater management systems to reduce the impacts of flooding and high winds, especially in vulnerable areas (American Planning Association, 2020).
- **Green Infrastructure:** Incorporate natural solutions like wetlands, mangroves, and permeable surfaces to manage flood risks and improve the resilience of the built environment (American Planning Association, 2020).

- **Zoning Adjustments:** Adjust zoning and land use regulations to limit development in high-risk areas, and encourage resilient construction practices in safer zones. It's also helpful to promote mixed-use and sustainable development inland to reduce pressure on coastal infrastructure (FEMA, 2023).

Expedited Permitting and Regulatory Stability (SB 180)

- **Faster Permits After a Storm:** SB 180 (2024) requires local governments to issue permits within 5 days for minor repairs and 30 days for major rebuilds after a declared disaster. Planners should help set up post-storm permitting plans in advance, including staffing needs, pre-approved criteria, and digital processing (Florida Legislature, 2024).
- **Clear Public Guidance:** By May 1 each year, local governments must post a hurricane recovery permitting guide online. It should outline what needs a permit, what doesn't, applicable fees, and any local rules like elevation requirements. Planners can ensure it's clear and easy to access (Florida Legislature, 2024).
- **No New Red Tape During Recovery**: To keep things consistent, SB 180 blocks new construction bans or stricter land use rules for one year after a storm. This helps residents rebuild without sudden regulatory changes. Planners can use this time to support smooth, stable recovery efforts (Florida Legislature, 2024).

FEMA Trailers for Temporary Housing

- **Temporary Housing Programs:** FEMA's Direct Housing and Direct Lease programs help provide temporary housing for those displaced by disasters. These programs require close coordination with local emergency management and building services to deploy the trailers quickly and efficiently (FEMA, 2023).
- **Permitting and Site Suitability:** FEMA trailers need to comply with local zoning and building codes. Pinellas County has set up an expedited permitting process for these trailers, prioritizing areas with access to utilities and avoiding wetlands and Coastal High Hazard Areas (CHHAs) (FEMA, 2023).
- **Planning Ahead:** Planners should work proactively with FEMA and county staff to identify pre-approved staging sites and create zoning overlays that can quickly accommodate mobile homes, making post-disaster housing deployment smoother (FEMA, 2023).

RECOMMENDED CODE UPDATES

Rebuilding after a disaster isn't just about fixing what's broken—it's about ensuring that the next storm doesn't cause the same damage. Updating building codes and land development regulations provides the perfect opportunity to make communities more resilient. Here are some ways to build back stronger:

1. Structural Resilience

- **Elevated Construction:** Homes and buildings in flood-prone areas should be elevated above the Base Flood Elevation (BFE) to reduce the risk of flooding. A small freeboard—around 2–3 feet above the BFE for residential areas—can make a big difference in minimizing flood damage and lowering future insurance costs (Florida Building Commission, 2022).
- **Wind-Load Provisions:** To prevent structural damage from hurricane-force winds, we recommend strengthening wind-resistance standards. Buildings should be designed to withstand winds of 140–160 mph, particularly in coastal areas (International Code Council [ICC], 2021).
- **Floodproofing and Breakaway Walls:** Using floodproofing materials and breakaway walls in flood-prone areas can enhance resilience by allowing water to flow freely without causing structural damage (ICC, 2021).

2. Zoning and Land Use

- **Coastal High Hazard Areas (CHHA):** It's essential to enforce CHHA overlays, limiting development in areas most vulnerable to storm surge. This ensures that new developments are built in safer, less risky locations (Florida Department of Economic Opportunity, 2013).

Tampa Bay Regional Planning Council. (n.d.). 3D storm surge and sea level rise visualization of Tampa Bay

A modeled projection of flooding potential within a coastal high hazard area in St. Petersburg, FL.

- **Buffer Zones:** Natural barriers like wetlands and mangroves should be required as buffer zones. These not only protect coastal infrastructure but also help manage stormwater runoff (American Planning Association [APA], 2020).
- **Inland Mixed-Use Development:** Encouraging mixed-use development in inland areas can help reduce the strain on coastal infrastructure, making the entire community more resilient (APA, 2020).

3. Infrastructure Resilience

- **Green Infrastructure:** Stormwater management systems should go beyond the minimum standards. By integrating green infrastructure like bioswales and pervious surfaces, communities can better handle stormwater impacts and reduce flooding risks (APA, 2020).
- **Backup Power for Essential Facilities:** Regulations should require backup power systems for critical infrastructure—such as hospitals, shelters, and emergency services—ensuring these facilities remain operational during and after a disaster (Florida Department of Economic Opportunity [DEO], 2013).
- **Evacuation Routes and Signage:** Clear, well-designed evacuation routes and signage are crucial for efficient evacuations during emergencies. Planning for heavy traffic flow and accessibility will make evacuations smoother when every minute counts (Pinellas County, 2024).

4. Post-Disaster Redevelopment Ordinances

Local governments should consider adopting ordinances that streamline the permitting and zoning processes after a disaster. These ordinances can balance resilience goals with community needs, helping to ensure that the recovery process strengthens the community long-term (DEO, 2013).

FEMA ABOUT

The Federal Emergency Management Agency (FEMA) is the key federal agency that handles disaster response and recovery in the U.S. For local governments like Pinellas County, getting familiar with FEMA's resources and how they work can make all the difference when it comes to responding effectively after a disaster. Here are some essential FEMA programs and elements that are important for local disaster planning:

FEMA

1. **Hazard Mitigation Assistance (HMA):** FEMA's Hazard Mitigation Assistance programs, including the Hazard Mitigation Grant Program (HMGP) and Building Resilient Infrastructure and Communities (BRIC), provide funding for long-term projects that aim to reduce disaster risks. These programs fund efforts like elevating properties, retrofitting infrastructure, and other initiatives that reduce vulnerability to future disasters (FEMA, 2022).

2. **Public Assistance (PA) Program:** The PA program helps state, local, tribal, and territorial governments by covering costs for debris removal, protective measures, and repairing public infrastructure. This program is crucial for getting public services and facilities back up and running after a disaster (FEMA, 2023).

3. **Community Development Block Grant-Disaster Recovery (CDBG-DR):** Administered by the U.S. Department of Housing and Urban Development (HUD), CDBG-DR grants are focused on addressing unmet needs like housing, infrastructure, and economic recovery in areas hit by disasters (FEMA, 2023).

4. **National Flood Insurance Program (NFIP):** The NFIP is designed to help communities manage flood risks and promote good floodplain management practices. It's a vital resource for ensuring that communities have the financial tools to recover after flooding (FEMA, 2023).

5. Technical Assistance: Community Engagement and Risk Communication (CERC): FEMA's CERC initiative provides tailored advice on how to engage with communities and communicate risk. This helps local governments create clear, actionable plans for disaster preparedness and response (FEMA, 2022).

6. FEMA Trailers for Temporary Housing: In the aftermath of a disaster, temporary housing is often an immediate need. FEMA offers programs like Direct Housing and Direct Lease to help provide trailers for those affected. Coordination with local emergency management and building departments is key to getting these housing solutions deployed smoothly (FEMA, 2023).

FEMA trailers (Image source: FEMA)

7. Individual Assistance (IA): The IA program offers direct support to individuals and households in the wake of a disaster, including help with housing, unemployment assistance, and crisis counseling (FEMA, 2023).

8. National Disaster Recovery Framework (NDRF): The NDRF is a comprehensive guide that supports collaboration among local, state, federal, tribal, and private-sector partners in disaster recovery. It includes Recovery Support Functions (RSFs) like Housing and Infrastructure, which provide coordinated strategies to restore communities (FEMA, 2016).

POTENTIAL FUNDING OPTIONS

Pinellas County's recovery and resilience strategy hinges on securing the right funding sources to support rebuilding efforts. Below are some key programs that can help.

- **Elevate Florida (Priority Funding Source)**: This new initiative from the Florida Division of Emergency Management (FDEM) offers direct financial assistance to homeowners for elevation, mitigation reconstruction, and voluntary property acquisition. It's especially useful for flood-prone areas, and local governments can play a key role in guiding residents through the application process (Florida Division of Emergency Management [FDEM], 2024).

- **Community Development Block Grant – Disaster Recovery (CDBG-DR):** Administered by the U.S. Department of Housing and Urban Development (HUD), CDBG-DR funds support recovery efforts, including housing, infrastructure repair, and economic revitalization. These funds are particularly beneficial for low- to moderate-income communities (U.S. Department of Housing and Urban Development [HUD], 2023).

- **Hazard Mitigation Grant Program (HMGP):** Available after federally declared disasters, HMGP funds long-term mitigation projects—like stormwater improvements and flood reduction strategies—that help communities reduce future disaster risk (Federal Emergency Management Agency [FEMA], 2023a).

- **Building Resilient Infrastructure and Communities (BRIC):** This competitive FEMA grant program provides funding for pre-disaster mitigation projects. While the competition is tough, it offers Pinellas County a chance to secure funding for critical infrastructure upgrades and risk reduction efforts (FEMA, 2023b).

- **Florida Resilient Coastlines Program (FRCP):** Managed by the Florida Department of Environmental Protection (FDEP), this state program offers grants for projects focused on sea level rise adaptation, vulnerability assessments, and nature-based shoreline stabilization (Florida Department of Environmental Protection [FDEP], 2023).

- **State Emergency Response and Recovery Fund (SERRF)**: SERRF provides cost-share support to local governments to meet FEMA's match requirements or fund disaster response and recovery efforts not covered by federal assistance (Florida Division of Emergency Management [FDEM], 2023).

- **FEMA Public Assistance (PA) Grants:** While more focused on immediate disaster response, PA grants are vital for debris removal, emergency protective measures, and repairing public infrastructure (FEMA, 2023c).

- **Infrastructure Investment and Jobs Act (IIJA) – PROTECT Program:** Through the PROTECT program, local governments can access funding for transportation infrastructure upgrades that increase resilience to future disasters (U.S. Department of Transportation, 2023).

Storm debris pick-up after Hurricane Helene
(Image source: Pinellas County Government)

By aligning recovery projects with the priorities of these funding programs and collaborating with regional and state partners, Pinellas County can maximize its resources and build a more resilient community in the face of future disasters.

CONCLUSION

As the frequency and intensity of hurricanes continue to increase, Pinellas County stands at a critical juncture in its journey toward a resilient future. The lessons learned from past storm events and the recovery efforts in communities like Fort Myers, Panama City, and Harrison County underscore the importance of a coordinated, multi-faceted approach to disaster recovery. This is not just about rebuilding physical structures; it's about creating a community that can bounce back stronger, smarter, and more united.

Recovery and resilience go hand-in-hand. Pinellas County has a unique opportunity to lead the way by proactively leveraging proven strategies, such as updating building codes, enhancing stormwater management, and focusing on environmental restoration. These actions, alongside targeted funding options like FEMA's Hazard Mitigation Grant Program and programs such as Elevate Florida,

provide essential resources for strengthening the county's disaster response capabilities.

However, the true key to success lies in collaboration across jurisdictions, between local stakeholders, and through innovative partnerships. Effective disaster recovery is not a one-size-fits-all solution but a shared effort that requires continuous learning, flexibility, and an unwavering commitment to long-term resilience. By engaging communities, particularly vulnerable populations, in the planning and recovery process, Pinellas County can ensure that its strategies reflect the needs of all residents, cultivating a safer, more sustainable, and more equitable future for everyone.

As Pinellas County prepares for future storms, it is crucial not only to build on past lessons but to take adaptive action now. By incorporating these best practices, strengthening collaborations, and continuously evolving its strategies, the county can become a model of how proactive, thoughtful planning drives resilience. In doing so, Pinellas County can ensure its communities are better prepared for whatever comes next, setting an example for others in Florida and beyond.

The Knowledge Exchange Series
Research and technical assistance on topics that shape the way Pinellas County redevelops.

REFERENCES CITED

- American Planning Association. (2020). Planning for disaster resilience: A guide for local governments. https://www.planning.org.
- Associated Press. (2025, January 15). Florida agriculture hit with $190M losses from Hurricane Milton. https://apnews.com/article/f2e49fa9f6df2bb8a170cadb160c1295
- Bonck, P. (2024, March 30). Personal communication.
- City of Clearwater. (2023). Clearwater Adaptation Plan. https://www.clearwater-fl.com.
- City of Largo. (2023). Sustainability and Resilience Action Plan (SRAP). https://www.largo.com/document_center/SRAP/Largo%20SRAP%202023.pdf
- City of Tarpon Springs. (2024). Vulnerability Assessment. https://connecttarponsprings.com/vulnerability.
- Erdman, J., & Dolce, C. (2024, September 26). Hurricane Helene nears Category 4 Florida landfall. The Weather Channel. https://weather.com/storms/hurricane/news/2024-09-26-hurricane-helene-florida-landfall.
- Federal Emergency Management Agency. (2016). National Disaster Recovery Framework (NDRF). https://www.fema.gov/sites/default/files/2020-09/national_disaster_recovery_framework_2nd-edition.pdf.
- Federal Emergency Management Agency. (2017). Hurricane Irma recovery. https://www.fema.gov/disaster/4337.
- Federal Emergency Management Agency. (2018). Hurricane Michael recovery. https://www.fema.gov/disaster/4399.
- Federal Emergency Management Agency. (2021). Hurricane recovery and resilience in communities. https://www.fema.gov/emergency-managers/practitioners/recovery-resilience-resource-library.
- Federal Emergency Management Agency. (2022). Hazard Mitigation Assistance and BRIC Program Guide. https://www.fema.gov/hazard-mitigation-assistance
- Federal Emergency Management Agency. (2022). Hurricane Ian recovery. https://www.fema.gov/disaster/4673.
- Federal Emergency Management Agency. (2023a). Hazard Mitigation Grant Program (HMGP). https://www.fema.gov/grants/mitigation/hazard-mitigation.
- Federal Emergency Management Agency. (2023b). Building Resilient Infrastructure and Communities (BRIC). https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities.

- Federal Emergency Management Agency. (2023c). Public Assistance Program Overview. https://www.fema.gov/assistance/public.
- Federal Emergency Management Agency. (2023d). FEMA trailers and temporary housing programs. https://www.fema.gov/fema-trailers.
- Federal Emergency Management Agency. (2023e). National Flood Insurance Program (NFIP) Overview. https://www.fema.gov/nfip.
- Florida Building Commission. (2022). Building code amendments for resilience. https://www.floridabuilding.org.
- Florida Department of Economic Opportunity. (2013). Post-disaster redevelopment planning and ordinances. https://www.floridajobs.org.
- Florida Department of Environmental Protection. (2022). Living shorelines and habitat restoration. https://www.floridadep.gov.
- Florida Division of Emergency Management. (2023). State Emergency Response and Recovery Fund (SERRF). https://www.floridadisaster.org.
- Florida Division of Emergency Management. (2024). Elevate Florida program overview. https://www.floridadisaster.org/dem/mitigation/elevate-florida.
- Forward Pinellas. (2023). Municipal coordination protocols and regional resilience. https://www.forwardpinellas.org.
- Fort Myers Recovery Task Force. (2023). Fort Myers Recovery Plan: Strategic Rebuilding Efforts Post-Hurricane Ian. https://www.fortmyersbeachfl.gov/1251/Hurricane-Ian-Recovery-Resources.
- Gulf Coast News Now. (2025, March). Elevate Florida helps residents dealing with rising threat of flood. https://www.gulfcoastnewsnow.com/article/elevate-florida-residents-dealing-rising-threat-flood/64223171.
- Haley, J., & Aldridge, J. (2025, February 6). Personal communication.
- Harrison County Community Plans. (2011). Post-Katrina recovery and zoning updates in Harrison County, Mississippi. https://www.harrisoncountyms.gov/planning/community-plans
- Harrison County Zoning Ordinance. (2011). Zoning text amendments for disaster recovery. https://www.harrisoncountyms.gov/planning/zoning-ordinance.
- International Code Council. (2021). Wind load and floodproofing standards for coastal construction. https://www.iccsafe.org.
- King, E. (2024, October 5). Helene damage estimates in Sarasota, Manatee surpass $1 billion. Sarasota Herald-Tribune. https://www.heraldtribune.com/story/news/2024/10/05/helene-damage-estimates-in-sarasota-manatee-surpass-1-billion/71000000007/.
- Lee County Government. (2025, February 18). Lee County CDBG-DR Action Plan. https://www.leegov.com/recovery/cdbg-dr/2024ActionPlan/LeeCoDraftAction%20Plan_2-18-2025.pdf.

- Lee County Recovery Plan. (2023). Rebuilding Lee County: Lessons Learned from Hurricane Ian. https://ianprogress.leegov.com.
- Mississippi Floodplain Management Report. (2018). Storm surge mitigation strategies. https://www.msema.org/floodplain-management-report.
- Mississippi Gulf Coast Recovery Report. (2012). Economic and housing recovery post-Katrina. https://www.msgulfcoastrecovery.org/report.
- National Hurricane Center. (2024, October). Hurricane Helene. https://www.nhc.noaa.gov/data/tcr/AL092024_Helene.pdf
- National Hurricane Center. (n.d.). Hurricane frequency and intensity trends. https://www.nhc.noaa.gov.
- National Oceanic and Atmospheric Administration. (2019). Hurricane Dorian report. https://www.noaa.gov.
- National Oceanic and Atmospheric Administration. (2019). Hurricane Dorian. https://www.nhc.noaa.gov/data/tcr/AL052019_Dorian.pdf.
- National Oceanic and Atmospheric Administration. (2021). Hurricane Elsa. https://www.nhc.noaa.gov/data/tcr/AL052021_Elsa.pdf.
- National Oceanic and Atmospheric Administration. (2021). Living shorelines and storm surge protection. https://www.noaa.gov.
- Pinellas County. (2022). Housing affordability and recovery post-hurricanes. https://www.pinellas.gov.
- Pinellas County. (2023). Comprehensive Emergency Management Plan (CEMP). https://www.pinellascounty.org/emergency
- Pinellas County. (2024). Evacuation planning and emergency protocols. https://www.pinellascounty.org/emergency
- Rebuild Panama City. (2021). Panama City Neighborhood Plans. https://www.rebuildpc.org/wp-content/uploads/2021/05/Panama-City-Neighborhood-Plans_042121_FOR-WEB.pdf.
- The Times. (2024, October 10). Hurricane Milton unleashes 'extreme impacts' in Florida. https://www.thetimes.co.uk/article/aftermath-of-hurricane-helene-damage-pictures-jbjpfwpwp.
- U.S. Department of Housing and Urban Development. (2023). CDBG-Disaster Recovery Program. Https://www.hud.gov/program_offices/comm_planning/communitydevelopment/programs/drsi.
- U.S. Department of Transportation. (2023). PROTECT Program Overview. https://www.transportation.govRevize+5Largo+5Largo+5FEMAFEMA+2FEMA+2FEMA+2.