

Effects of the 2024 Hurricane Season on
Coastal Cities' Infrastructure and Recovery
Efforts:

A Report on Gulfport's Resiliency

IDH4950 – Honors Capstone
Maria Jose Ruiz and Ava Selvig

Abstract

Long-term green-gray mitigation projects such as watershed and in land shores, natural or artificial, have the potential to mitigate storm hazards. These strategies are said to be cost-effective and built for the long term. Because of this, the EPA highly encourages small local governments to fund and maintain green and green-gray structures. We investigated two such projects, the Tangerine Greenway, and the retention ponds at Clam Bayou. Through interviews with local staff and businesses, media, and public records, we present a perspective on the resiliency of the city of Gulfport under tropical storms.

Introduction

Florida suffered three major storms during the 2024 hurricane season. Hurricane Debbie from August 3rd to the eighth, Hurricane Helene from September 24th to the 27th, and Hurricane Milton from October 5th to the 10th (Grow Cei E, 20). These sequential storms severely impacted Florida's coastal cities, dramatically changing their demographic and political landscape. Among the most notable physical consequences of the storm were the high storm surge and loss of power and running water to the Tampa Bay area. The city of Gulfport is the focus of this report. Located at the southern tip of Pinellas County, it is one of the most densely populated cities in the most populated county in the state (Pinellas County Government, 2023).

Hurricane Effects on Gulfport's Public Infrastructure

During Hurricane Helene, Gulfport suffered a 6ft storm surge (Healy, 2024). Mapped with NOAA's Sea Level Rise Viewer, Figure 1 gives us a satellite-view of the extent of the flooding.

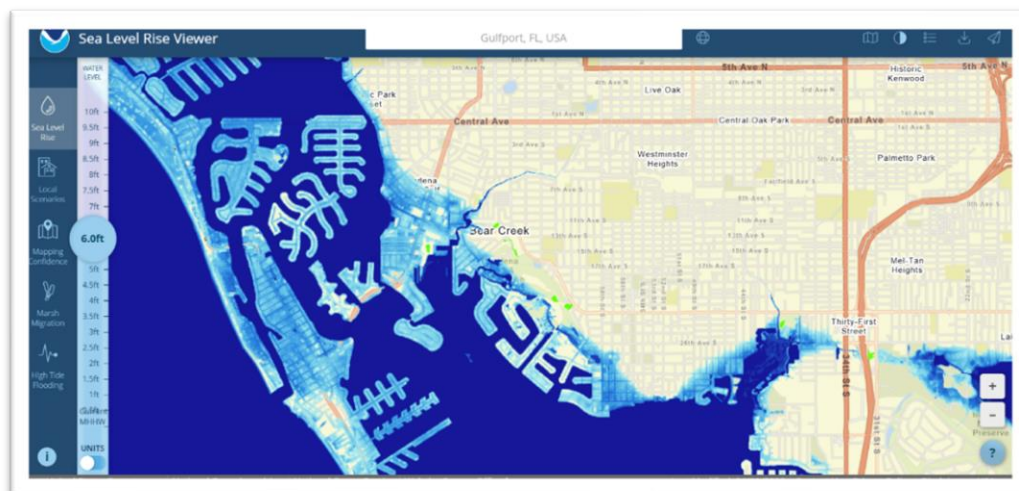


Figure 1. Gulfport at 6ft of water level increase (MHW). NOAA Sea Level Rise Viewer.

We interviewed the Parks & Facilities Superintendent, Tim Connor, about the effects of the storms on Gulfport's public infrastructure. About Hurricane Helene, he told us that the places in the city of Gulfport that were severely affected were the volleyball courts, the casino, the rec center, and the pier, all located in the beach area in the south. The beach volleyball courts were washed away by the storms. Hurricane Helene pushed a lot of the sand inland, and Hurricane Michael pulled it back, cutting a deep path in the area. The volleyball courts require complete reconstruction. As of April 2024, the casino is still closed. Apart from awaiting an inspection from FEMA, this historical building also requires an inspection by the federal Historical Preservation Society. The rec center is partially open; while events and meetings are held on the second floor, the first floor is undergoing repairs. Lastly, the pier suffered significant structural damage.

Permitting has been the biggest challenge to get these places back into action. By law, local governments must receive permits from federal and state governments before a building can be reopened to the public. These permits are issued after an inspection, which is another issue. Gulfport is not the only

affected coastal city, so FEMA inspectors have their hands full with checking buildings across the Gulf coast. Similarly, 50% damage to a building requires complete reconstruction and lifting, which due to Florida's increasing housing costs, such upfront bill is a struggle for these small governments to pay which also puts pressure into FEMA's insurance sector because of the high demand. Six months after the storms, recovery is still underway.

A Look at Gulfport’s Risk

The National Risk Index (NRI) is a country-wide effort to assess the potential negative consequences to communities from the most common natural hazards in the U.S. Risk level is defined as a composite value made of expected annual loss, social vulnerability, and community resilience relative to other communities for all recorded hazards. (Zuzak et al., 2023) Higher social vulnerability and/or expected annual loss increases risk level while high community resilience lowers it.

Gulfport is made up of seven census tracts with their respective Risk Index percentile (Table 1.). Of the eighteen hazards FEMA tracks, Gulfport is at considerable risk of hurricanes, lightning, and tornadoes (Zuzak et al., 2023). Due to the scope of this report, only the hazard type Hurricane Risk Index Score has been included. In addition to hazards, each census tract also has a respective Expected Annual Loss, Social Vulnerability, and Community Resiliency percentile.

Census Tract	Risk Index	Hurricane Risk	Expected Annual Loss	Social Vulnerability	Community Resilience
28102	78.61	90.16	78.91	47.7	6.8
28300	77.27	89.67	71.81	70.9	6.8
28103	73.79	88.55	64.5	80.4	6.8
22301	71.44	87.91	69.71	53.5	6.8
28403	68.01	86.74	68.96	42.7	6.8
28200	58.78	84.89	63.92	25.6	6.8
28500	52.34	83.07	54.4	34.7	6.8

Table 1. Gulfport Risk Indices by Census Tract. Composite Risk, Hurricane Risk, Composite Expected Annual Loss, Social Vulnerability, and Community Resilience.

Risk Index

Thanks to GIS, the information in this table can be visualized geographically. Figure 2 displays Risk Index for all census tracts. Note that five out of seven tracts are at moderate risk (above the 60th percentile) compared to the national average. Census track 028102, corresponding to Bear Creek, has the highest percentile (78.21). This means that this area is at higher risk than about 80% of *all* census tracks in the country.

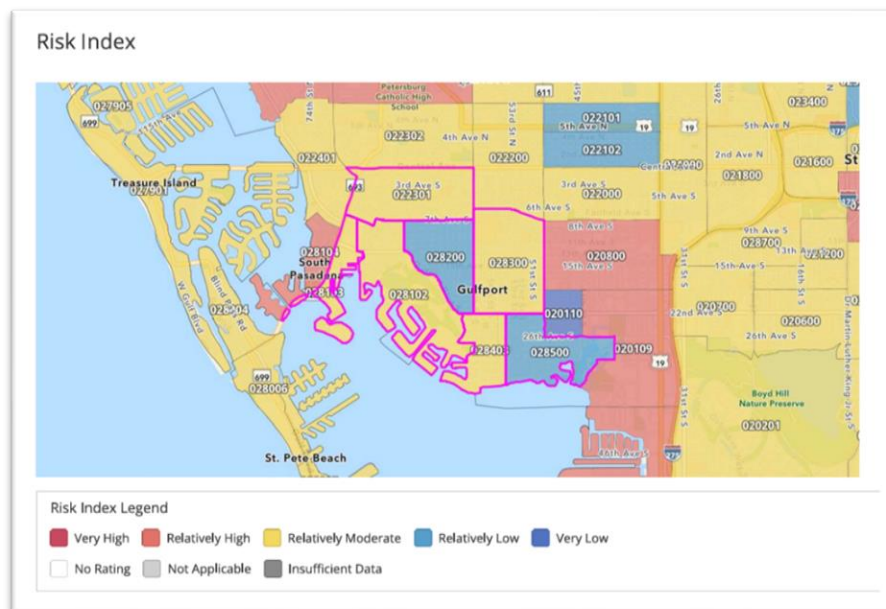


Figure 2. Gulfport's Risk Index Map.

Hurricane Risk

Digging deeper into the NRI report shows that hurricane risk is the highest hazard type risk for Gulfport. Back in Table 1, all tracts have a Hurricane Risk higher than the 80th percentile and up to 90th. This means that 80% to 90% of all census tracts in the country are less at risk from hurricanes. Once again, Bear Creek is the most at risk with a percentile of 90.16. This matches results from the flood map (Fig. 1) where most of this area is expected to flood with a 6ft storm surge.

Expected Annual Loss (EAL)

Expected Annual Loss (EAL) is the yearly monetary impact of natural hazards, encompassing loss of property, people, and agriculture. It is divided into all eighteen measured natural hazards, giving a thorough view of the potential highest economic risks of the common natural hazards in a specific area. (Zuzak et al, 2023) Figure 3 shows the composite Expected Annual Loss (EAL) of each census tract compared to the national average. Once again, most (6 out of 7) tracts are in the moderate category. Table 1 shows a range of 55th to 80th percentile with Bear Creek once again at the lead. This means that out of all the tracts, in addition to being at the highest risk of natural hazards (Fig.2) and flooding (Fig.1) Bear Creek is also expected to have 80% more losses due to natural hazards compared to the national average.

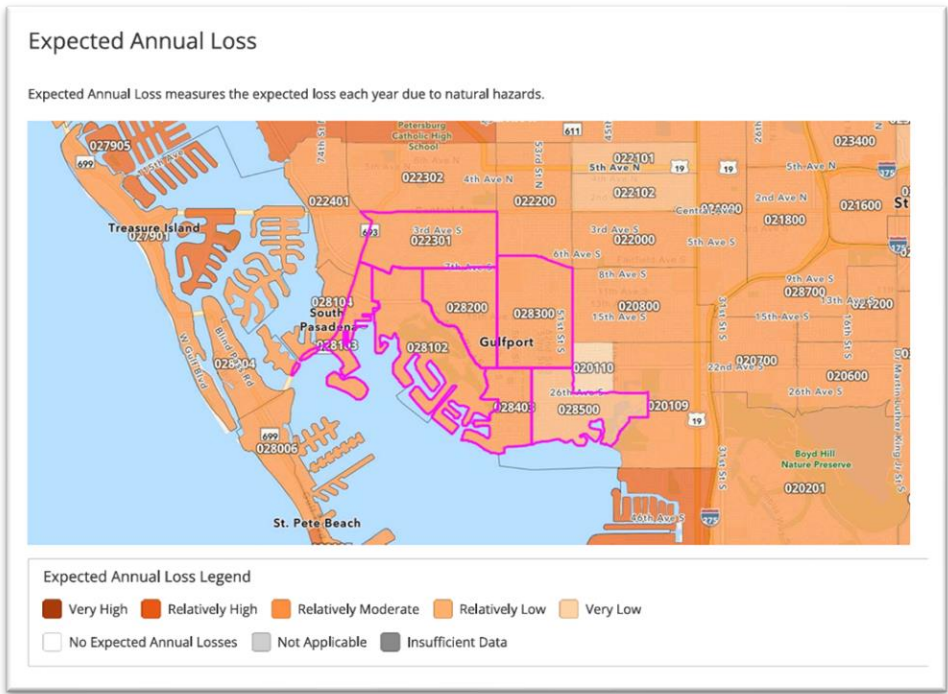


Figure 3. Gulfport's Expected Annual Loss (EAL) Map.

Table 2 displays the EAL from hurricanes for each tract and their equivalence in U.S dollars using 2022 inflation values. Bear Creek's hurricane EAL peaked at a million U.S dollars with a percentile of 89.7. This means that this area is expected to lose almost 90% of property, people, and agriculture than the rest of the country due to hurricanes.

Census Tract	Expected Annual Loss (EAL) Score (All Hazards)	Expected Annual Loss (EAL) Score (Hurricanes)	Expected Annual Loss (EAL) From Hurricanes (\$)
28102	78.91	89.7	\$1,024,251
28300	71.81	87.4	\$795,149
28103	64.5	86.9	\$749, 979

22301	69.71	86.4	\$712,374
28403	68.96	85.3	\$635,792
28200	63.92	85.3	\$634,227
28500	54.4	82.6	\$469,361

Table 2. Breakdown of Gulfport's Expected Annual Loss (EAL)

Social Vulnerability

Social Vulnerability (SV) is the susceptibility of certain populations to adverse effects from natural hazards such as disruption of their livelihood, injury, or death (Zuzak, 2023). This risk-enhancing component is part of the Social Vulnerability Index (SVI), a similar effort to map characteristics from vulnerable populations such as transportation, socioeconomic status, racial minority status, and age (CDC/ATSDR, 2025). In Gulfport, the census tracts fall on a wide spectrum with a tendency towards moderate to very high vulnerability (Fig.4). While the NRI provides no more information, the SVI mapping tool would have more in-depth information.

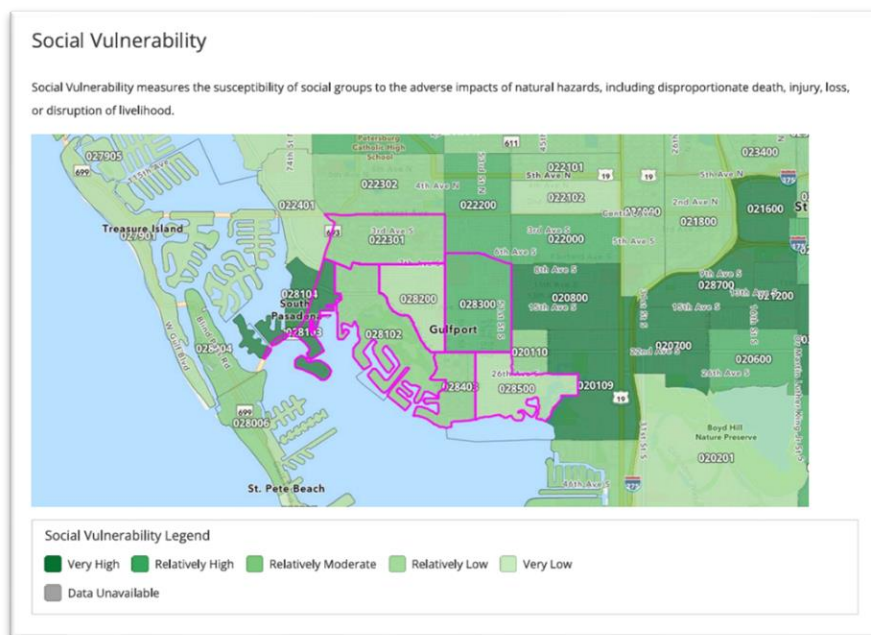


Figure 3. Gulfport's Social Vulnerability (SV) Map.

Community Resilience

Likewise, the Baseline Resilience Indicators for Communities (BRIC), denoted in the NRI as the Community Resilience component, measures a group's capacity to return to the state before a disturbance (Zuzak, 2023). Here, the data is uniform. All census tracts have a very low score of 6.8. This means that about 93% of the rest of the country is more resilient to natural hazards than this area which extends to all of Pinellas's County. Like SVI, a look at the BRIC data from this area would yield some enlightening information behind this score.

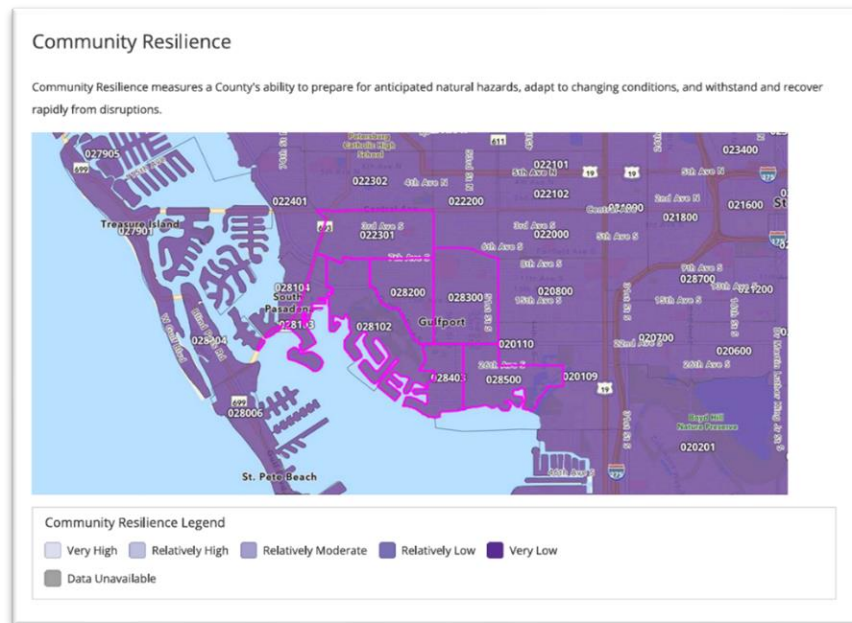


Figure 4. Gulfport's Community Resilience Map.

With such elevated risk, social vulnerability, and low community resilience, what can the local governments such as Gulfport do to reduce their risk from natural hazards whose strength may increase due to climate change? The Federal Emergency Management Agency has developed a flexible guide to help local government address natural hazard risk by working together with established natural landscapes.

Storm Risk Mitigation Practices: Nature-based Solutions

According to FEMA, nature-based solutions for mitigation and management of flood-associated risks are sustainable planning, design, and environmental practices that add natural features or processes into a community's environment to increase its resiliency. Nature-based solutions are based on scale and location. They are watershed/landscape scale, neighborhood/site scale, and coastal areas. Watershed or landscape practices encompass natural areas and open spaces, including engineered and retrofitted ones. They include but not limited to wetlands, greenways, and parks. These types of projects require the most planning and coordination. Neighborhood or site scale projects focus on on-site precipitation. Instead of opening a new space like in the landscape category, these projects can be added to existing infrastructure such as roads, buildings, and sidewalks. Lastly, coastal areas are projects that aim to enhance or regenerate the coastline. They include waterfront parks, living shorelines, and oyster reefs.

A great deal of the potential benefits of nature-based solutions are related to flood mitigation. Because we are focusing on a coastal city, storm-related hazards are an increasing concern. Nature-based solutions, particularly watershed practices, help mitigate flooding. Benefits include but are not limited to the storage, reduction, and slowing of floodwaters including any pollutants found therein to waterways. This therefore can reduce the cost of storm water management and drinking water treatment. With this information, let us look at the current efforts in Gulfport to address and manage hurricane-related hazards:

Current Efforts to Reduce Risk

Floodwater is a storm-related hazard with the potential to cause short and long-term impacts on property and people, and thus it is important for local governments to understand the movement of surface waters. Surface waterflow across Gulfport is divided by a horizontal limestone formation about 22ft high called the Distant Ridge. Its highest point is around 53rd Street and goes about fifty yards, ending at Pinellas Park. This geological feature keeps many households in the middle of the city outside of the flood zone and is one of the reasons behind the V-shape flooding (Fig. 1).

One of the city's ongoing projects to reduce floodwater in undesirable places involves connecting the several existing waterbodies in the city to the bay with pipes and pumps. As of 2025, on the west side, three water bodies (Boca Ciega HS, Tomlinson Park, and Wood Ibis Park) running from north to south have been connected and on the east side, two (Marina Ponds and Clam Bayou).

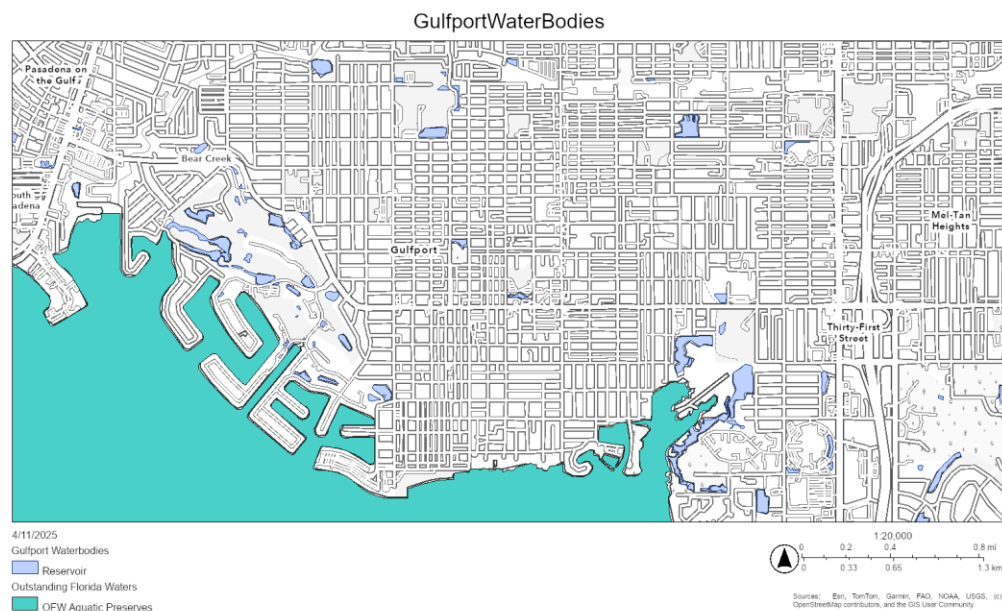


Figure 6. Gulfport Flood Water Bodies

From the northwest, floodwaters are captured at the Boca Ciega high school pond (11th Ave S and 55th St. S). It was built in the fifties and remains fenced off and surrounded by trees and other vegetation. The pond connects to another at Tomlinson Park, seven streets down (18th Ave S). This pond is home to and a recreational space for birds such as ibis, gray blue heron, and grackles. It also serves as a water basin for the adjacent linear park, Tangerine Greenway. Tangerine Greenway is a fascinating piece of engineering and community effort. It underwent two public feedback events, not to mention the initial planning and funding efforts. From east to west, at the end of each basin there is a storm drain conduct that transfers rainwater to the following basin until it reaches the pond at Tomlinson Park. This design allows a certain volume of water to percolate to the aquifers, and any excess water is shared between different water basins. The project takes advantage of the natural landscape and vegetation and works together with nature by connecting to the water cycle and recharging the natural aquifer, protecting the

city's drinking water supply. In addition, the greenway serves as a habitat for wildlife with only two bridges connecting the parallel sidewalks across the greenway.

The water captured at Tomlinson Park's Pond is connected to Wood Ibis Park (58th St and 28th Ave). Most of the area is covered by two ponds, a large pond and a smaller one. The former can be circled around, separating itself from the smaller one on the surface. These ponds also serve as a wildlife habitat. Lastly, water then moves to Boca Ciega Bay which is next to the ponds.

Information on the east side water is frankly severely lacking in this report. Our research identified two important basins right next to the bay, two ponds at the Marina (between 29th Ave S and Del Rio Way S), and the retention ponds at Clam Bayou. The Marina ponds are connected vertically to other water bodies in the northeast of the city. Like the pond at Boca Ciega HS, they are fenced off and surrounded by several feet of vegetation. The southernmost Marina Pond is connected to the Marina itself which leads to the east side of Boca Ciega Bay. Unfortunately, these water bodies are not visible in the map above and could only be visualized with satellite-imagery. On another topic, Clam Bayou Nature Preserve is right next to this marina, with the retention ponds located diagonally to it and visible on-ground across the Skyway Trail. The retention ponds were a joint effort between the city of Gulfport, the city of St. Pete, and the South Water Management District to manage floodwaters, solid waste, and runoff.

Code Woes

Gulfport's building codes are borrowed from national fire code and Florida's building codes, with no modifications to that code within the city itself. Having consistent building codes across the state aids in enforcing them, but it also means that areas that could potentially benefit from stricter codes due to greater risk of damage like Gulfport have the same standards as elsewhere in the state that do not face the same dangers. The greatest obstacle to keeping buildings up to a particular code is standards changing over time, as buildings built before FEMA standards for building in a flood zone existed to not have to adhere to said standards. This can be beneficial to homeowners who can't pay the potentially expensive price to build their homes up to the new standard, but it also means they wouldn't be prepared to deal with the flooding that comes from a hurricane or other disasters. In the case of Gulfport, the majority of commercial and residential structures were constructed before those FEMA standards existed, and so most of the city was unprepared for the flooding that resulted from Helene and Milton.

Gulfport had over 600 buildings damaged by flooding, and each of these buildings had to be inspected independently to assess the degree of damage that had occurred. This was an arduous task due not just to a shortage of those available to do the work in the area, but also because the contractor assigned by the state to help, Tidal Basin, proved to be inconsistent at best and incompetent at worst. Over 100 errors were found in their assessments in Gulfport alone, leaving residents waiting months to learn the fate of their homes. If it is found that over 50% of a building's value is required to repair it, then it will have to build up to the newer FEMA standards as well, a process which can be prohibitively expensive. Due to the size of the city of Gulfport's government, preparing for a disaster like this is impossible using its own resources, and it has to rely on the federal and state governments for assistance. However, both have shown themselves to either be unable or unwilling to provide the aid needed to help citizens recover from these disasters. Hope remains that improving and/or reforming these systems could help aid citizens when future disasters strike, but currently there is very little incentive to make these changes.

Resiliency in Gulfport

The definition of resiliency in regards to a city varies depending on who you ask. It could mean how quickly the city bounces back to relative normalcy after a disaster, or how cooperation between its citizens lessens the damage. Gulfport's response to the hurricanes was initially a patient one, with neighbors happy to help one another when able. But as time passed and it was clear the extent of the damage would cause repair efforts to take months, citizens became less patient, and those who stood to benefit from raising tensions and pointing fingers did so eagerly. The former mayor, Sam Henderson, seems to have been blamed by many citizens for the overall inadequacy of the disaster response, and as a result has recently been voted out as mayor in favor of Karen Love. The citizens of Gulfport don't know who to direct their anger at and so settled on local government despite their inability to help in such a dire situation. Gulfport's resiliency has been tested by the storms, and I'm unsure if it can be said that it passed. If nothing else, Gulfport's citizens are likely now more prepared to flee from a storm like this in the future, whereas before they had become complacent. There isn't really a happy end to this story yet, nor should there be expected to be one. It will take time for damage to be repaired and for tensions to fall once again, and the city might never be the same after this. Gulfport's citizens will have to keep up hope and take care of one another during this tumultuous time in order to ensure the city returns to its previous state, or at least something resembling it. If enough effort is put in, the city may even be able to build back stronger than it was before.

References

1. Grow Cei, E. (2024). Atlantic hurricane season races to finish within range of predicted number of named storms | National Oceanic and Atmospheric Administration. (2024, November 25). <https://www.noaa.gov/news-release/atlantic-hurricane-season-races-to-finish-within-range-of-predicted-number-of-named-storms>
2. Pinellas County Government. (2023, June 1). *Fast facts about Pinellas County - Pinellas County*. Pinellas County. Retrieved from <https://pinellas.gov/about-pinellas-facts/>.
3. Healy, C. (2024, October 3). Aftermath of Hurricane Helene in Gulfport. *The Gabber Newspaper*. Retrieved from <https://thegabber.com/aftermath-of-hurricane-helene-in-gulfport/>
4. Zuzak, C., E. Goodenough, C. Stanton, M. Mowrer, A. Sheehan, B. Roberts, P. McGuire, and J. Rozelle. 2023. National Risk Index Technical Documentation. Federal Emergency Management Agency, Washington, DC.
5. Federal Emergency Management Agency (FEMA) (2021). *Nature-based solutions for storm hazards community resiliency guide*. Retrieved from https://www.fema.gov/sites/default/files/documents/fema_riskmap-nature-based-solutions-guide_2021.pdf.
6. Centers for Disease Control and Prevention/Agency for Toxic Substances and Disease Registry/Geospatial Research, Analysis, and Services Program. CDC/ATSDR Social Vulnerability Index Interactive Map. Accessed on April 22nd, 2025.
7. “Gulfport Reuse Planning” document from September 30th, 2016.
8. National Oceanic and Atmospheric Administration (NOAA). (n.d.). *Sea Level Rise Viewer*. NOAA Office for Coastal Management. <https://coast.noaa.gov/slr/>
9. Streicher, C. (2024). FLOOD DAMAGE PERMITTING PROCESS. In City of Gulfport, Florida. Retrieved May 2, 2025, from <https://mygulfport.us/wp-content/uploads/2024/11/Flood-Damage-Permitting-Process.pdf>
10. Simonton, T., Mahoney, E. L., & Liebson, R. (2025, May 1). Pinellas post-hurricane home assessments rife with flaws. *Tampa Bay Times*. <https://www.tampabay.com/news/business/2025/04/26/tidal-basin-florida-pinellas-hurricane-milton-helene/>