MOBILE
ALABAMA

CITY-WIDE RESILIENCE ASSESSMENT

December 2023

SUGGESTED CITATION

The City of Mobile. (2023). City-Wide Resilience Assessment: An Assessment of Mobile's Resilience. Produced by The Water Institute in partnership with Sea Grant, Mississippi State University, Volkert, Ephriam and Associates LLC, Waggonner & Ball, and Moffatt & Nichol. Prepared for and funded by the City of Mobile, AL

OFFICE OF THE MAYOR

November 22, 2023

Dear Mobile,

In 2021, the City of Mobile created an Office of Resilience to look toward the future, define the challenges our community will face and create a plan to address them.

For the city, resilience is the capacity of individuals, communities, institutions, businesses, and systems to survive, adapt, and thrive no matter what comes their way. Resilience is also defined as the ability to withstand acute shocks like a hurricane or a global pandemic and chronic stressors like sea level rise, aging infrastructure, and social unrest.

To be the safest, most business and family friendly city in America, we need to think outside the box – and outside of city hall – to prepare for and be responsive to anything the future may hold. In 2022, we brought on The Water Institute of the Gulf, Waggoner & Ball, Mississippi Alabama Sea Grant, and local partners like Volkert, Ephriam Environmental, and Moffett & Nichol to help us understand where we are and develop a plan to build resilience into all our city departments and governmental functions.

This Resilience Assessment is the result of nearly two years of analysis, and it shows that Mobile still has work to do to get all our citizens prepared for a changing future. However, improvement always begins with identifying what you could be doing better. This assessment and the forthcoming Resilience Plan will help Mobile do just that.

This document is a look into our history. It explores things that have been neglected over time and the ways we are trying to address those challenges today. Using extensive data, it also projects some of the changes that could impact the people, businesses and organizations that call Mobile home. Throughout this effort, we defined a Resilient Mobile as one that can ensure ALL Mobilians are poised to thrive in the face of increasing changes in the environment, climate, and economy.

Our consultants have worked with city staff members as well as community leaders and experts on our local economy, environment, and infrastructure. Together, they have analyzed the tools we have to make Mobile more resilient while identifying which sectors need to be strengthened and what processes need to be developed.

With every project the city undertakes, we are working to build a stronger, more resilient city that is prepared for whatever the future holds. To ensure resilience is woven into the fabric of our community, we need you to get involved. We hope you learn something from this document and stay engaged as we develop a plan to build a truly resilient community for ourselves and future generations of Mobilians.

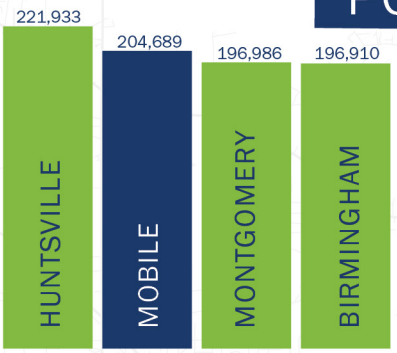
Sincerely,

William S. Stimpson
Mayor

TABLE OF CONTENTS

MOBILE AT A GLANCE

POPULATION



MOBILE IS THE SECOND LARGEST CITY IN ALABAMA

TOTAL POPULATION
204,689

Mobile population reflects post-annexation estimates as of July, 2023 based on AL.com data. Huntsville, Montgomery, and Birmingham estimates are based on U.S. Census QuickFacts population estimates as of July 1, 2022.

EMPLOYEES PER INDUSTRY

WHOLESALE & RETAIL SALES	28,588
HEALTHCARE	27,265
ENTERTAINMENT & TOURISM	19,026
MANUFACTURING	18,873
ADMINISTRATIVE SUPPORT, WASTE MANAGEMENT, & UTILITIES	15,549
PROFESSIONAL	14,282
EDUCATION	13,073
CONSTRUCTION	12,411
SERVICES	11,143
TRANSPORTATION & WAREHOUSING	9,192
FINANCE & IT	7,890
PUBLIC ADMINISTRATION	7,280
AGRICULTURE & NATURAL RESOURCES	1,445

(Mobile Area Chamber of Commerce 2019)

PORT OF MOBILE

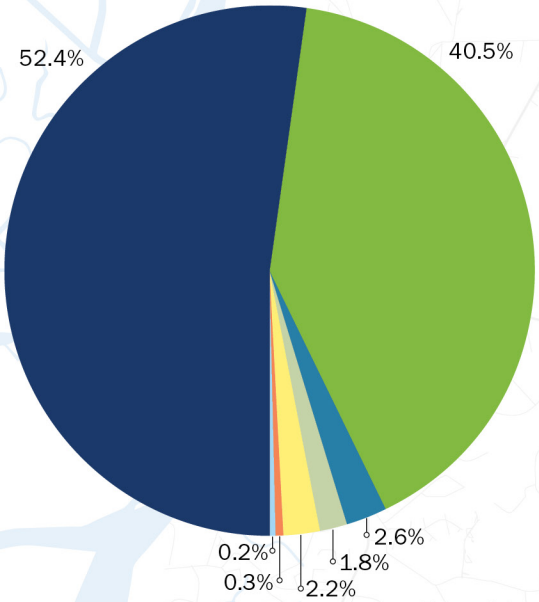
IN 2021, THE PORT OF MOBILE CREATED

$85 BILLION
IN ECONOMIC VALUE TO THE STATE OF ALABAMA

312,000 JOBS

(Alabama Port Authority, Port of Mobile, 2022)

RACIAL AND ETHNIC DIVERSITY



- BLACK, NON-HISPANIC
- WHITE, NON-HISPANIC
- HISPANIC
- ASIAN, NON-HISPANIC
- TWO OR MORE RACES, NON-HISPANIC
- NATIVE AMERICAN, NON-HISPANIC
- OTHER, NON-HISPANIC

The racial and ethnic diversity graphic below is derived from data provided by the 2021 American Community Survey 5-year Estimates and is not reflective of the 2023, post-annexation.

BIODIVERSITY

- 300+ SPECIES OF BIRDS
- 68 SPECIES OF REPTILES
- 310+ SPECIES OF FISH
- 40 SPECIES OF AMPHIBIANS
- 57 SPECIES OF MAMMALS
- 15 SPECIES OF SHRIMP

(ADCNR, 2015)

HOUSING COST IN MOBILE

52.7% THE NATIONAL AVERAGE

MOBILE
$176,020

U.S.
$334,269

(Zillow, 2023)

1 WORKING TOWARD A MORE RESILIENT MOBILE

Throughout Mobile's 300+ year history, Mobilians have experienced how unanticipated disruptions can change the trajectory of the city's future—from flooding, storms, and other extreme weather events; to economic booms and busts; to infrastructural innovations and failures.

Mobile has often weathered these challenges by adapting its infrastructure, economy, and society. Examples of Mobile's resilience date back to the city's earliest days and continue today. Following a devastating flood in 1711, Mobile was relocated from its original location upriver to its current location where the Mobile River meets Mobile Bay—a site that provides easy access to the Gulf of Mexico and to 1,500 miles of inland and intracoastal waterways, shaping Mobile's development as Alabama's port city. In response to a series of heavy rainfall events in the 1980s that caused Three Mile Creek to rise quickly and flood nearby homes and cars, Mobile worked with the U.S. Army Corps of Engineers to widen the creek and make other improvements to minimize future flood risk. Mobile was able to maintain greater economic stability through the COVID-19 pandemic than most U.S. cities in part thanks to ongoing efforts to strengthen and expand the number and types of industries doing business in Mobile. These are just a few examples of how resilience is woven into Mobile's DNA.

To thrive for the next 30 to 300 years, Mobile must adapt to new and even greater challenges. Like other coastal cities, Mobile is facing a future of unprecedented change from sea-level rise, more frequent and more extreme weather events, and other impacts from a changing climate. At the same time, the city's aging infrastructure struggles to keep up with the increasing demands on it.

Beyond fortifying infrastructure, resilience requires ensuring that all Mobilians have the resources and capacity to survive and thrive, day-to-day and in times of crisis. Focusing on the fundamentals of safe and affordable housing, clean and healthy environments, safe communities, quality education, good jobs, stable incomes, and accessible healthcare will support the entire community's resilience.

CITY RESILIENCE *is the capacity of individuals, communities, institutions, businesses, and systems within a city to* ***survive, adapt,*** *and* ***thrive*** *no matter what kinds of acute shocks or chronic stressors they experience.*

The following timeline (Figure 1 and Table 1) highlights key events that have shaped Mobile throughout its history, including over 40 shocks and stressors that the city has weathered. In addition to the key events noted here, Mobile has faced ongoing stressors such as income inequality, environmental degradation, aging infrastructure, crime, and climate change that can exacerbate the impact of disruptive events on communities.

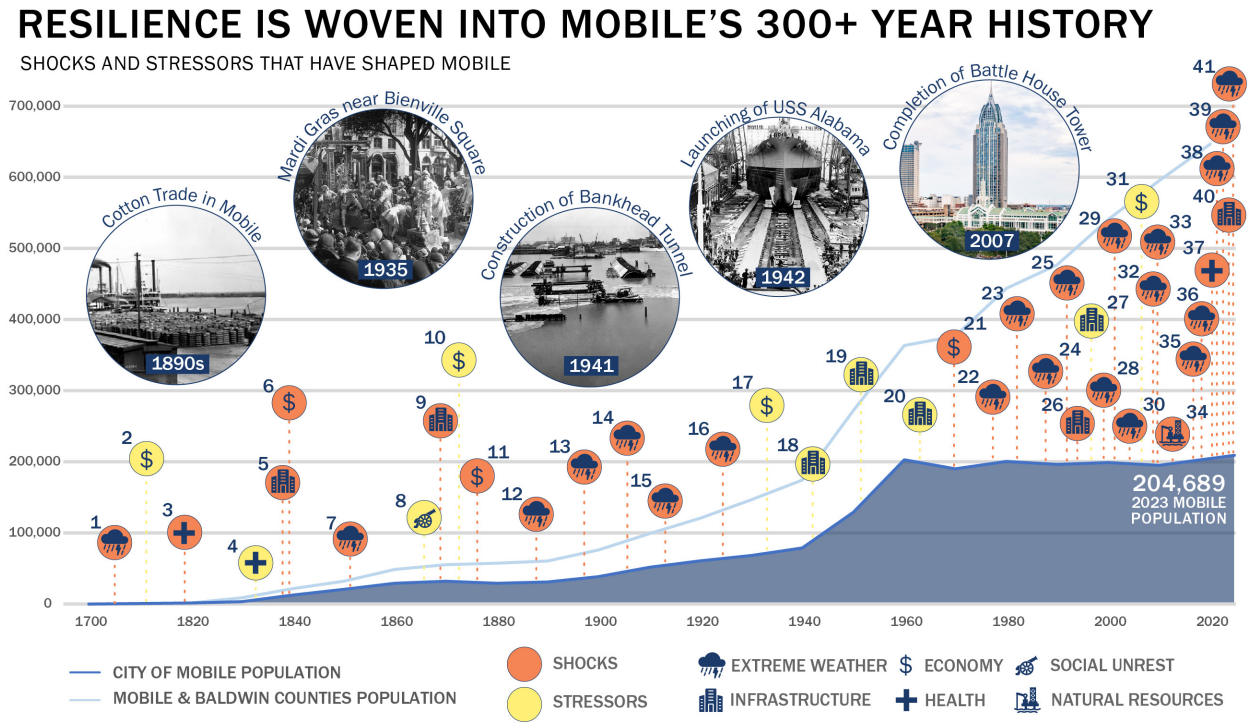


Figure 1. Timeline of recent and historic shocks and stressors affecting the City of Mobile. Details for each event are provided in Table 1.

Table 1. Details of shocks, stressors, and key events that have shaped Mobile's history.

Year	Event Description	Shock/ Stressor	Category	#
1500	Mobile Bay appears on Spanish maps as early as 1500, named as Bahia del Espiritu Santo, though many Indigenous tribes—Cherokee, Chickasaw, Choctaw, Creek, and others—had inhabited the area for more than 10,000 years.			
1702	The French establish Mobile as the oldest permanent settlement and first capitol of the Colony of French Louisiana.			
1703	Mardi Gras celebrated for the first time in Mobile.			
1712	French colonists relocate Mobile from 27-mile bluff to its current location, in part because of a 1711 flood that submerged the colony.	Shock	Extreme Weather	1
1722	After years of disease outbreaks, floods, and finally, the death of King Louis XIV, the Capitol of French Louisiana is moved to New Orleans.	Stressor	Economy	2
1763	France loses the French and Indian War; Mobile is ceded to England and spends 13 years under British Authority. Major commodities from Mobile—naval supplies, hides, pecans, timber, indigo, and cattle—are shipped abroad.			
1776	Mobile is taken by Spain during the American Revolutionary War and remains under Spanish control until 1813.			
1819	Alabama becomes the 25th state in the U.S.			
1819	Yellow Fever epidemic causes the death of 43% of the population (430 deaths out of a population of 1,000). City establishes Church Street Graveyard to inter the victims.	Shock	Health	3
1826	Mobile County establishes the state's first public school system.			
1827 &1839	Repeated fires destroy large portions of the city.	Shock	Infrastructure	5
1830s	Massive growth of Mobile's economy due to its international seaport and harvest and transportation of cotton.			
1830s	Recurring outbreaks of Yellow Fever.	Stressor	Health	4
1837	Financial Panic of 1837; City of Mobile fails to pay its debts (defaults).	Shock	Economy	6
1800–1850	Massive growth of Mobile's economy due to its international seaport and cotton trade.			
1852	Great Mobile Hurricane of 1852 (Category 3)	Shock	Extreme Weather	7
1859–1860	The *Clotilda*, the last known slave ship to the U.S., arrives in Mobile Bay in July 1860.			
1861–1865	**Civil War.**	Stressor	Social	8
1865	An explosion at an ordinance depot and magazine housing 200 tons of confiscated Confederate ammunition kills roughly 300 people and causes fires that burned much of the northern part of Mobile.	Shock	Infrastructure	9
1866	Africatown settlement is established by 32 of the formerly enslaved West Africans who arrived on the *Clotilda*.			
1870	Post-war economic downturn due to collapse of cotton industry, leading to economic depression and municipal insolvency for the remainder of the 19th century.	Stressor	Economy	10
It 1874	Financial Panic of 1874; City of Mobile defaults again.	Shock	Economy	11
1879	With Mobile's economy near collapse, the State of Alabama repeals the city charter to protect the state's only port. The Governor appoints three city commissioners to govern and reduce the city's debt.			
1895	Mobile's greatest snowfall on record: 6.0" between February 14–15.	Shock	Extreme Weather	12
1899	Coldest temperature on record for Mobile, AL: -1°F on February 13.	Shock	Extreme Weather	13

Year	Event Description	Shock/ Stressor	Category	#
1906	Mississippi Hurricane (Category 3) makes landfall near Pascagoula, MS, and causes more than $15 million in damages and drowns an estimated 150 people in southern Mobile County.	Shock	Extreme Weather	14
~ 1910	Heavy investments in the port and deepening ship channel.			
1916	Gulf Coast Hurricane (Category 3) strikes near Pascagoula, MS, causing massive flooding in downtown and record high storm surge in Mobile.	Shock	Extreme Weather	15
1926	Great Miami Hurricane (Category 3) impacts Mobile with 24 hours of rain, extreme winds, and flooding.	Shock	Extreme Weather	16
1928	Authorized for construction by the Alabama State Legislature in 1922, the Alabama State Docks officially open in 1928 on 500 acres north of Mobile's waterfront, serving to increase the shipping capacity.			
1929–1939	Great Depression: Many businesses, shipyards, and industrial plants close.	Stressor	Economy	17
1937	Housing Act of 1937 enacted by the U.S. Congress, ushering in the creation of the Mobile Housing Authority.			
1940	Brookley Air Force Base built.			
1940–1943	89K people come to Mobile to work in shipyards and other World War II industries. Mobile becomes one of the most congested cities in the U.S. as population doubles.	Stressor	Infrastructure	18
1941	Bankhead Tunnel completed.			
1941	Mobile Regional Airport completed.			
1942	Thomas James Place was constructed to provide homes for defense workers at Brookley Airfield. Property was acquired by the Mobile Housing Board in 1948 to provide 796 housing units for low-income residents.			
1950s	Mobile's Wragg Swamp wetland drained, in part through Eslava Creek, to facilitate development of the Springdale Shopping Center and Bel Air Mall in the 1960s.	Stressor	Natural Resources	19
1963	Building of the Interstate 65 (I-65) highway draws dividing lines between races and socio-economic statuses.	Stressor	Infrastructure	20
1964	Civil Rights Act ends segregation; University of South Alabama holds first classes.			
1964	Battleship USS Alabama, built for the U.S. Navy in the 1930s and operated during WWII, arrives in Mobile and is preserved as a museum ship in Battleship Memorial Park.			
1969	Brookley Airforce Base closes, producing economic downturn with the loss of over 14K jobs (nearly 10% of the area's workforce) and $95M in payroll (about 20% of local economy).	Shock	Economy	21
1971	Birdie Mae Davis vs. Mobile County School Commissioners case challenging the school desegregation plan for Mobile County as inadequate; the U.S. Supreme Court rules in favor of plaintiff in 1971—active until 1997.			
1973	Construction completed on the Wallace Tunnel.			
1979	Hurricane Frederic (Category 4) impacts Mobile, resulting in weeks of widespread power and water outages.	Shock	Extreme Weather	22
1980s	Economic growth from post-Frederic Federal relief funds.			
1980	April floods lead to dam failure at Municipal Park.	Shock	Extreme Weather	23
1981	April and May floods—latter prompting disaster declaration after 1,300 homes flooded.	Shock	Extreme Weather	24
1984	Tennessee-Tombigbee Waterway "Tenn-Tom" completed.			
1985	Hurricane Elena (Category 3) impacts Mobile with winds over 75 mph. Hurricane Juan (Category 1) creates severe flooding with over 5 in of rain in Mobile County.	Shock	Extreme Weather	25
1985	Mobile moves from 3-person at-large commission to a more diverse Mayor-Council government.			
Late 1980s	String of Pearls Initiative launched, restoring hundreds of historic downtown buildings and homes, and initiating construction of new facilities and projects across the city.			

Year	Event Description	Shock/ Stressor	Category	#
1993	Mobile's waterfront convention center, later named for former mayor Arthur Outlaw, is constructed—the first pearl in the String of Pearls approach to a downtown renaissance.			
1993	Amtrak train derails on Big Bayou Canot Bridge killing 47 people and injuring 103 more, making it the worst U.S. rail disaster in 35 years.	Shock	Infrastructure	26
1993	Construction completed on the downtown Tax Increment Financing (TIF) plan allowing local governments to invest in public infrastructure and other improvements up-front.			
1994	Building of the I-165 highway draws more dividing lines between races and socio-economic statuses.	Stressor	Infrastructure	27
1995	Hurricane Erin (Category 2) impacts Mobile.	Shock	Extreme Weather	28
1997	Hurricane Danny (Category 1) impacts Mobile.	Shock	Extreme Weather	29
1998	Hurricane Georges (Category 2 and weakening to a tropical storm as it crossed northeast of Mobile, AL) produced 7–12 ft storm surge in Mobile and Baldwin Counties.	Shock	Extreme Weather	30
1999	Austal USA established, reviving Mobile's shipbuilding industry.			
1999–2011	Slimming down of the paper mills.	Stressor	Economy	31
2004	Hurricane Ivan (Category 3) becomes the strongest hurricane to hit Mobile in more than 100 years and the most damaging storm to strike the central Gulf Coast in 25 years.	Shock	Extreme Weather	32
2005	Hurricane Katrina (Category 5) impacts Mobile indirectly but causes substantial damage to homes and businesses as well as key transportation infrastructure, including the causeway and passenger rail service from New Orleans to Mobile. The Mobile State Docks measured the highest storm surge of 11.45 ft.	Shock	Extreme Weather	33
2007	Battle House Tower completed; highest building in Alabama.			
2008	Alabama State Port Authority and private partners open a $300 million Mobile Container Terminal at Choctaw Point.			
2010	ThyssenKrupp Steel USA, a new steel-processing plant, relocated to Mobile, AL (2007) and officially opened in 2010. Constitutes a significant source of tax revenue for the Mobile County school system and a significant source of funding for port infrastructural developments. Currently operated as AM/NS Calvert.			
2010	Oil drilling rig Deepwater Horizon explodes in the Gulf of Mexico resulting in the death of 11 workers and the largest oil spill in the history of marine oil drilling operations. In 2015 the State of Alabama announces that it will receive more than $2 billion in total for settlement against BP for damages to economies, natural resources, and additional fines from the Clean Water Act.	Shock	Natural Resources	34
2012	Christmas Day tornado outbreak which included a long-track EF-2 tornado through Midtown following a similar track as an EF-1 tornado that developed only five days earlier on December 20.	Shock	Extreme Weather	35
2014	Historic ice and sleet storm impacts cities across the deep south (January 27-29), resulting in 1.3 inches of sleet accumulation in West Mobile on January 28.	Shock	Extreme Weather	36
2014–present	Airbus, USA announced its plan to expand in the City of Mobile. Over the 8-year period, three major aircraft final assembly lines have been announced at the Brookley Aeroplex; more than 350 aircraft have been delivered from the Mobile facility. Airbus has also opened an exhibition and education training center – Flight Works Alabama and announced a partnership with Lockheed Martin to compete in the US Air Force's upcoming tanker competition with the promise that the aircraft would be made "by Americans, for Americans."			
2015–2017	City wins the Bloomberg Innovation grant to focus on blight, creates a Blight Survey, and passes the public nuisance ordinance specifically focusing on restoring and/or removing blighted properties.			
2016	The Innovation Portal was founded as a program of the Mobile Chamber partnering with the City of Mobile as an intentional way to grow entrepreneurship across Coastal Alabama.			
2018–2019	The *Clotilda* wreckage is discovered in 2018 and its identity confirmed by the Alabama Historical Commission in 2019.			

Year	Event Description	Shock/ Stressor	Category	#
2020	The University of South Alabama opens the Fanny Meisler Trauma Center, the region's only Level 1 trauma center.			
2020	The City of Mobile purchases Brookley by the Bay – more than 100 acres of waterfront property acquired to provide Mobilians access to Mobile Bay.			
2020	The Mobile County Health Department reports 1,770 deaths related to the global COVID-19 pandemic between March 2020 and December 2022 (MCHD 2023).	Shock	Health	37
2020	Hurricane Sally (Category 2) makes landfall in Gulf Shores, Alabama and impacts Mobile directly.	Shock	Extreme Weather	38
2020	Hurricane Zeta (Category 3) makes landfall near New Orleans, LA, causing wind gusts of 91 mph, widespread damage to buildings, and power outages for residents and businesses in Mobile.	Shock	Extreme Weather	39
2021	Ground broken for $775 million expansion to AM/NS steel mill to support jobs, state revenue, and provide significant portion of the Port's business.			
2021	Mobile County cyberattack shuts systems down for three days.	Shock	Infrastructure	40
2022	Mobile receives more than $700 million from Senator Richard Shelby to support the Alabama Port Authority through expanding the container port, deepening and widening the Mobile Ship Channel, and another $100 million from Senator Shelby for the buildout of the new terminal for Mobile's International Airport at Brookley Aeroplex.			
2022	Canfor announces a new $210 million investment in a new sawmill complex, providing 130 jobs in Mobile.			
2022	The City of Mobile adopts the Unified Development Code (UDC) which updates the City's zoning ordinance to create a modern and user-friendly approach to regulating development.			
2023	The Mobile Historic Development Commission and the Mobile Architectural Review Board is reconstituted—in terms of composition and makeup—which stipulates the overall appointment process and professional makeup of both bodies.			
2023	The Historic Preservation Ordinance is updated and amended in an effort to comply with State Law provisions that afford the City with the legal power to protect Mobile's unique community heritage.			
2023	Mobile Alabama Area sets new record high temperature of 106°F on August 26, 2023, replacing the prior record of 105°F set on August 29, 2000.	Shock	Extreme Weather	41
2023	The Medical Association of the State of Alabama, during its Annual Session, recognizes Mayor Stimpson and the City of Mobile for its COVID-19 Response Model which led pandemic-related response efforts throughout the state.			
2023	The City of Mobile creates the Homeownership Provides Equity (HoPE) Program to create affordable infill housing and promote homeownership for financially disadvantaged individuals in Mobile.			
2023	Mobile votes to annex additional territory. The city population expands from 184,952 to 204,689 residents. Prior failed efforts to annex additional land occurred in July 1992, November 1993, December 2002, September 2007, and December 2019.			

LOOKING TO THE FUTURE: MOBILE'S VISION FOR RESILIENCE

*A **Resilient Mobile** will ensure **all** Mobilians are poised to thrive in the face of increasing challenges and changes in the environment, climate, and economy.*

Strengthening the Resilience of Mobile is a multifaceted challenge with actions required by four key constituents—government, businesses, non-profits, and residents. With an eye to future acute shocks and chronic stressors, the City of Mobile must continue to proactively address and improve upon its delivery of services and aging infrastructure which support the basic quality of life for all Mobilians. Secondly, businesses and non-profits play a tremendous role in the functionality of society and must realize their role in building a resilient Mobile. And lastly, residents must accept their responsibility for their roles within our community and take advantage of increasing opportunities and available resources.

ACHIEVING THE VISION

A resilience approach plans holistically for a safe and thriving future for the city's people, infrastructure, environment, and economy. The practice of improving Mobile's resilience will require new approaches to problem solving and decision making. Business-as-usual approaches that are reactionary and siloed are not sufficient in preparing to meet the diversity of infrastructural, societal, environmental, and economic challenges Mobile may face in the future. Mobile will incorporate resilience into its ongoing plans, policies, practices, and procedures by applying approaches to decision making that are:

- **Risk-Aware:** understands the multiple threats Mobile may face and incorporates the best-available data on risk into planning and decision making.
- **Forward-Looking:** plans for an uncertain future over the next 10–30 years—understanding how environmental, climate, and economic changes may shift risk over time while also setting an aspirational vision for Mobile's future.
- **Holistic:** breaks down silos to build connections across issues and sectors to address challenges in an integrated way.
- **Inclusive:** includes all community perspectives in planning and decision making, particularly those historically underserved and most vulnerable to hazards.
- **Place-Based:** tailors solutions to the unique conditions on-the-ground in specific communities in Mobile.

2 DEVELOPING A RESILIENCE ASSESSMENT AND PLAN FOR MOBILE

To ensure the community is prepared to meet any of the future challenges that may impact Mobile, the City of Mobile developed this *Resilience Assessment* that will serve as the foundation for developing an actionable *Resilience Plan*.

The ongoing process is led by Mobile's Chief Resilience Officer in consultation and collaboration with a Steering Committee of City leaders, an Internal Planning Team of subject matter experts across selected City departments, four external Advisory Groups of technical experts and community stakeholders (Infrastructure & the Built Environment, Economy, Community, Health & Quality of Life, and Environment), and the public to ensure that the *Resilience Assessment* and *Resilience Plan* reflect the priorities and perspectives of Mobile's diverse people and institutions.

The goal of this Resilience Assessment is to determine where we are.
It sets a baseline understanding of the resilience of Mobile's systems, institutions, cultural and historic resources, and businesses to chronic stressors and acute shocks today and into the future.

This Assessment was developed by:

- **Establishing a Vision for a Resilient Mobile:** summarizing the collective values and goals shared during multiple meetings and discussions with City leadership, staff, and Advisory Group members.
- **Synthesizing Data on Changing Conditions:** reviewing and summarizing localized projections on changing climate, sea-level rise, economic, and social factors.
- **Defining Priority Chronic Stressors and Acute Shocks:** assessing public perceptions of the most important threats facing Mobile and the City's capacity to address them through a public survey and direct community outreach.
- **Reviewing Assets:** summarizing the holistic set of systems (Infrastructure, Economy, Health and Wellbeing, Community, and Natural Resources) critical to Mobile's resilience, assessing the potential vulnerabilities and risks to each posed by the exposure of key assets to shocks and stressors, and opportunities to build on existing efforts to strengthen those systems.
- **Researching Existing Plans:** identifying opportunities to incorporate resilience goals into existing plans, policies, and programs.

This Assessment is the first phase in this process and serves as the foundation for the development of an implementable Resilience Plan.

Mobile's Resilience Plan will define where we want to go.
It will investigate options and identify actionable steps the City can take to withstand, adapt, and thrive in the face of future challenges so that Mobile remains a great place to live, work, and raise a family for generations to come.

The final Resilience Plan will serve as the roadmap with which to build the city's resilience and will include details about timelines, partners, funding, and other mechanisms to support implementation. Actions will be woven into the existing long-range plans and day-to-day work of the City and its partners so that resilience is built into everything that Mobile does.

The process to develop Mobile's *Resilience Assessment* and *Resilience Plan* draws closely from federal guidance on the "Steps to Resilience" (Figure 2). This framework serves as a tool to help guide communities through iterative steps to identify and address their most pressing vulnerabilities and risks. The Steps to Resilience begin with defining what a community cares about and wants for its future and progresses through the phases of understanding what threats communities face, identifying how assets important to the community may be vulnerable and at risk, investigating possible solutions, prioritizing actions to address their greatest concerns, and aligning funding and political will to support implementation.

The work does not stop at a completed plan. The City of Mobile and its partners will use the *Resilience Plan* as a roadmap to implement actions that increase city resilience in the near-term while looking toward a long-term vision of a thriving Mobile. The *Resilience Assessment* and *Resilience Plan* will also serve as important tools to help educate residents of Mobile about their city's valued assets, their associated vulnerabilities, and how the city can work to improve outcomes for all residents equitably and transparently. Resilience is an ongoing practice and will require continued collaboration among city departments, agencies, civic organizations, and residents to achieve measurable results.

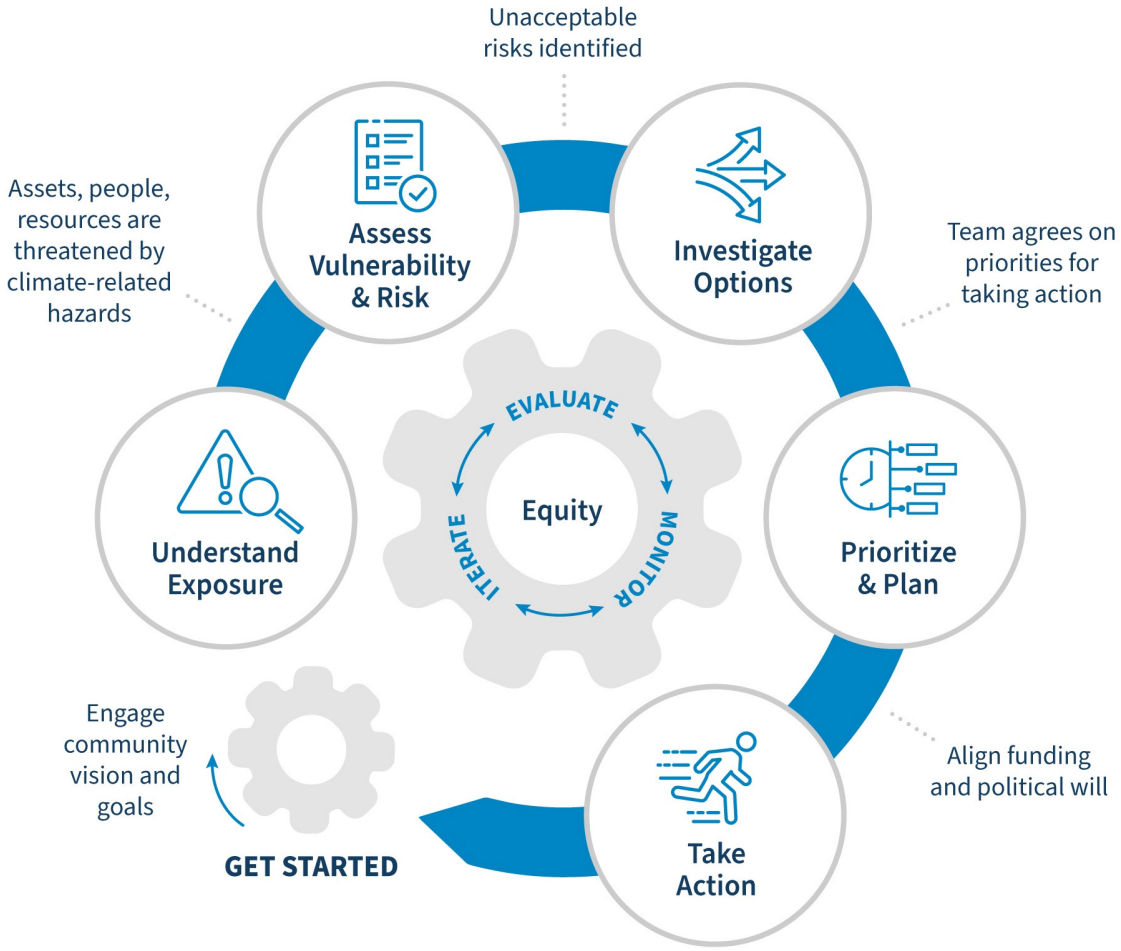


Figure 2. The Steps to Resilience are iterative in nature—planners and communities may need to return to previous steps over time to consider changing vulnerabilities and risks while continuing to plan and take action toward reducing those risks. Ongoing engagement with a wide range of stakeholders (represented by the gear in the center of the circle) is important throughout every step (U.S. Climate Resilience Toolkit 2023).

BUILDING ON EXISTING PLANS

Mobile's vision for resilience is not a stand-alone endeavor that can be achieved in a silo—it will require coordinated action across City departments and with partner agencies and organizations for Mobile to be successful. The *Resilience Assessment* and *Resilience Plan* must work alongside and be woven into the suite of other plans that guide investments in infrastructure, the economy, public services, communities, and the natural environment. As Mobile continues to devote resources to making the city a great place to live, work, and raise a family, the *Resilience Assessment* and *Resilience Plan* will help ensure that these investments withstand and adapt to the challenges of the future.

Mobile has a strong foundation of existing plans upon which to build. In recent years, the City of Mobile has embarked on extensive planning efforts, beginning with the adoption of Map for Mobile in 2015 and gradually building on this foundation (Figure 3). The *Map for Mobile* is a comprehensive plan that established a citywide vision, framework, and policy guide for long-term, future-focused planning and decision making. Several components have been added since, including the *Future Land Use Plan* in 2017 and the *Map for Mobile Action Plan*, which identifies projects, programs, and initiatives with responsibilities and timing and is reviewed annually.

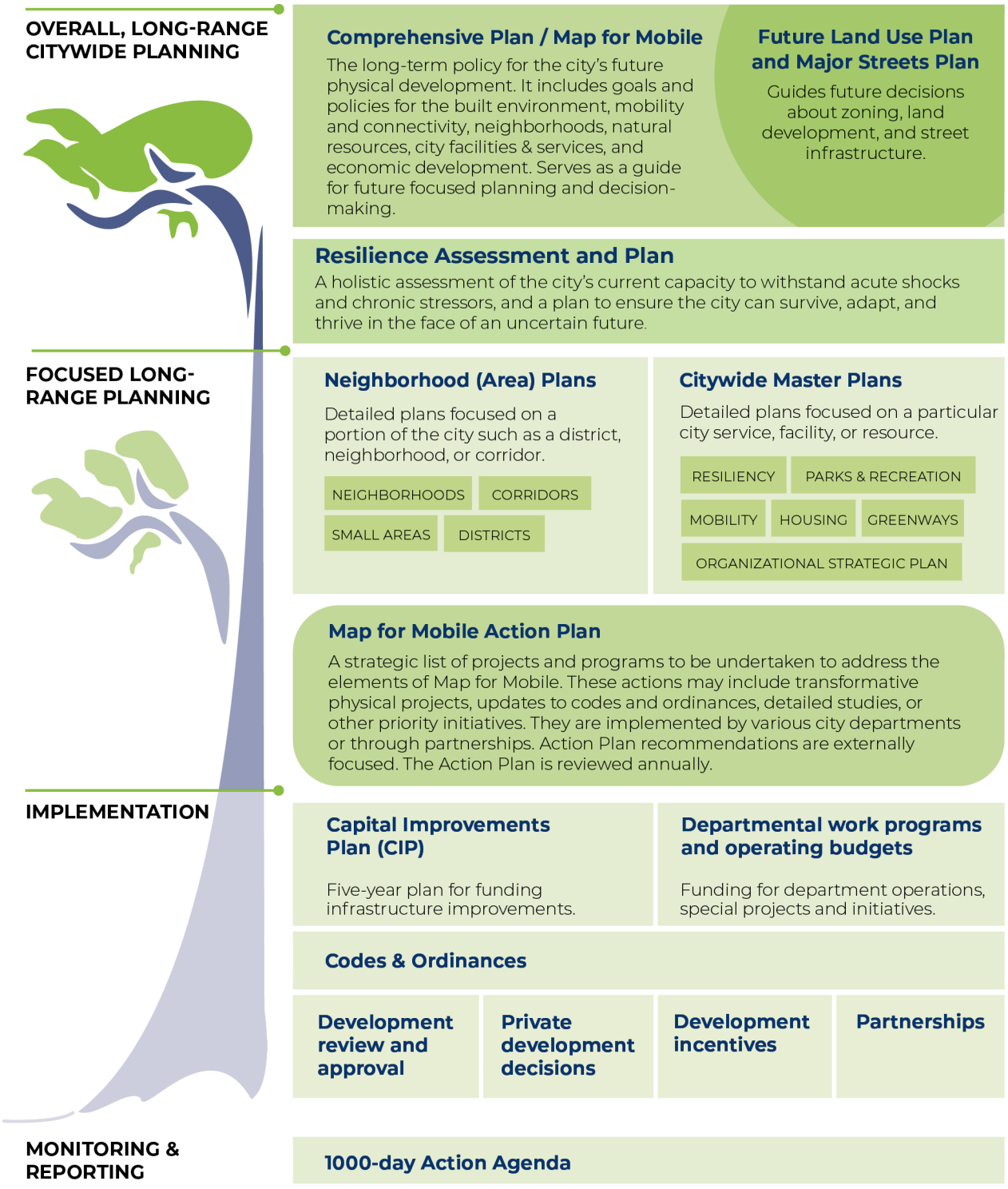


Figure 3. Existing planning efforts conducted by the City of Mobile. Figure modified from original graphic produced for the Map for Mobile.

This *Resilience Assessment* supports several goals in the *Map for Mobile*, most notably its vision of being a resilient coastal community that is prepared for natural and man-made disasters now and into the future. To support this goal, the *Resilience Assessment* and *Resilience Plan* are intended to help refine and update long-range goals and objectives, as well as departmental work, the *Capital Improvement Plan*, and the *Action Plan*.

For a holistic review of the city's potential vulnerabilities, this assessment was informed not only by existing plans driven by the City of Mobile, but also by other local and regional plans and studies, such as hazard mitigation plans, housing studies, economic reports, watershed management plans, and others. The table below (Table 2) offers an overview of each plan that was referenced in the process of developing this Assessment and suggests additional efforts to fill any identified gaps. Also included are opportunities for incorporating resilience into future iterations of the existing plans.

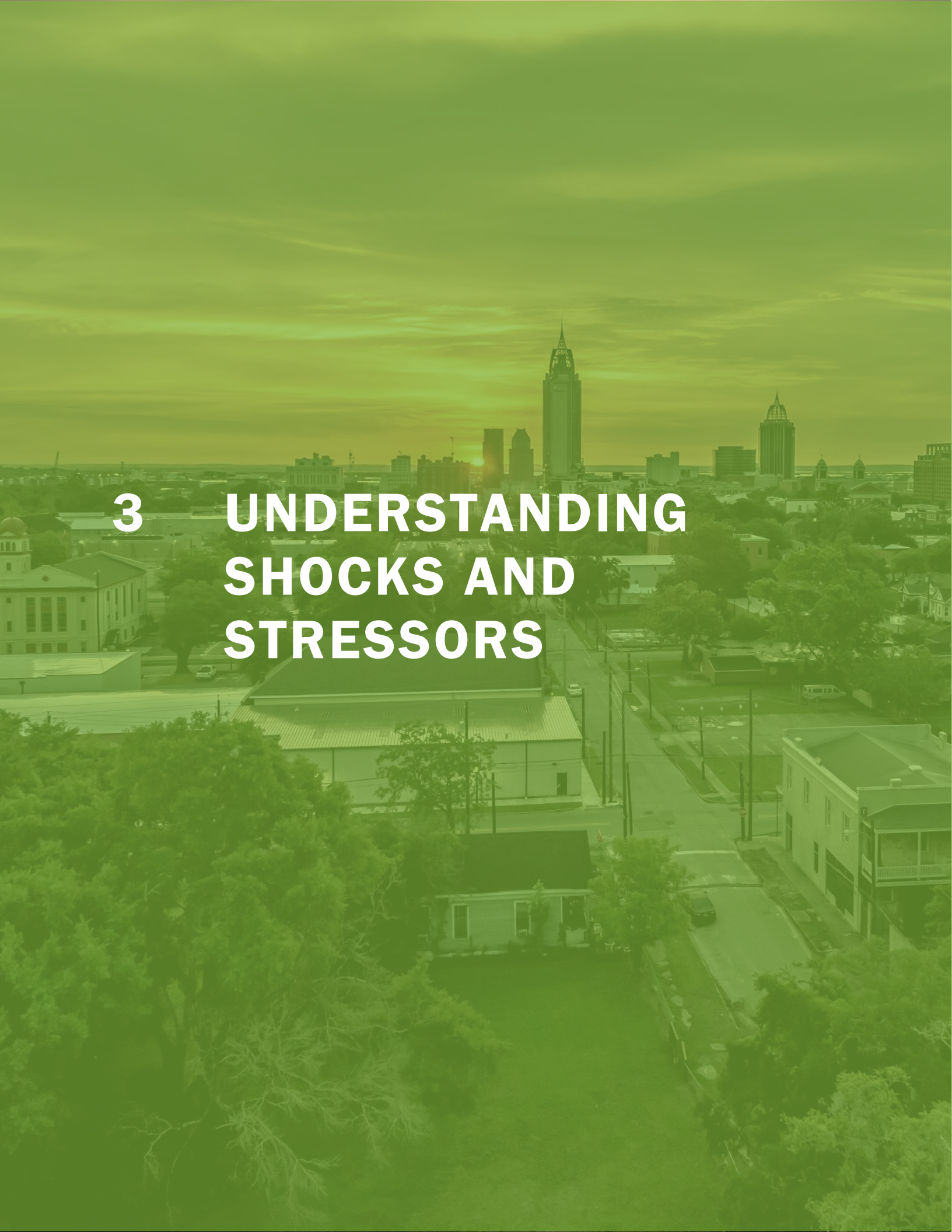
Table 2. Existing plans and documents with opportunities identified for aligning them with the Resilience Plan. Plans and documents listed by year of most recent update in descending order.

Document	Last Updated	What the Plan/Document Informs	Opportunities for Alignment with Resilience Plan
City of Mobile Capital Improvement Plan: 2023–2027	**2023**	Tool to implement the Map for Mobile. Identifies and prioritizes infrastructure projects for FY2023–2027.	The 2023–2027 CIP has already begun laying the foundation to include resilience tactics in future plan updates.
Analysis of Impediments to Fair Housing Choice: Mobile, AL	**2023**	This update to the 2017 plan, which is required every 5 years for communities that receive federal housing funds, analyzes demographic, socioeconomic and housing trends to identify factors impacting access to opportunity, including education, transportation, jobs, and environmental issues.	This plan establishes goals and priorities to further fair housing and provide guidance for the Community and Housing Development Department over the next 5 years. Although it is a near- to mid-term plan by design and provides a holistic review of housing issues (including environmental health), any future updates should also include how these existing inequities will be exacerbated by climate impacts such as increased flooding, storm surge, and heat.
100-Day and 1,000-Day Action Agendas	**2023**	Mayor's initiative for implementing city-wide improvements to address immediate, short-term needs over 100 days.	Resilience strategies can be incorporated in the 100-Day and 1,000-Day Agendas to ensure that short-term planning and projects are developed and constructed to higher standards and incorporate future conditions.
Transportation Improvement Program (TIP), Fiscal Years 2024-2027	**2023**	The TIP informs the transportation planning process through its selection of projects based on priorities established by Metropolitan Planning Organization (MPO) member governments and availability of funds.	Opportunities for alignment with the Resilience Plan include coordinating drainage upgrades at the time of road improvements/construction, as well as designing and constructing infrastructure and transportation improvements that account for future conditions.

Document	Last Updated	What the Plan/Document Informs	Opportunities for Alignment with Resilience Plan
2022 Comprehensive Economic Development Strategy (CEDS)	**2022**	The CEDS is a regional economic strategy that provides information to guide the future economic direction of the South Alabama Region (i.e., Mobile, Escambia, and Baldwin counties), and fulfill its mission of utilizing each county's unique assets to attract targeted development, recruit growth, and build a skilled workforce.	Many of the features included in the CEDS (e.g., natural resource assets, brownfield site locations, storm surge level maps based on hurricane category, FEMA Flood Risk maps) for their potential economic impacts also have the capacity to impact Mobile's and the surrounding region's overall resilience. As the CEDS vision promotes long-term economic resilience through growth and diversification, future iterations may also consider future rainfall, storm surge, and extreme heat projections when developing regional economic strategies.
Division A Multi-Jurisdictional Hazard Mitigation Plan (HMP)	**2022**	All state and local governments must develop an HMP as a condition of receiving non-emergency federal disaster assistance, including hazard mitigation grant program (HMGP), pre-disaster mitigation (PDM), and flood mitigation assistance (FMA) program funds.	Although the HMP identifies current hazards, it does not assess climate change and how this exacerbates hazardous impacts. Though both the Resilience Plan and the Hazard Mitigation Plan promote development away from areas most at risk to current and future hazards and emphasize mitigation for homes, businesses and infrastructure, future updates to the HMP would benefit from incorporating future conditions (e.g., temperature, extreme weather, increased flooding, etc.) into the plan.
City of Mobile Capital Improvement Plan: 2022–2026	**2022**	Tool to implement the Map for Mobile. Identifies and prioritizes infrastructure projects for FY2022–2026.	Future updates to the CIP can incorporate strategies identified by the Resilience Plan, such as: • infrastructure and transportation improvements that are designed and constructed to account for future conditions; • improving and maintaining green/open space and parks as community amenities/facilities and for flood/risk reduction.
Economic Relief & Resiliency Plan and Regional Workforce Plan	**2022**	This plan explores strategies for post-pandemic economic recovery and mitigating future economic disruptions in the South Alabama Region with the goals of maintaining resilience and sustainability.	This plan provides valuable site, labor force, and industry sector data used to develop economic resilience strategies for the Region. Opportunities to further increase resilience and align with Mobile's Resilience Plan include factoring for future conditions (e.g., sea-level rise, extreme heat) when developing commercial or industrial sites and/or targeting certain industry sectors and/or businesses.
Annual Comprehensive Financial Report (ACFR)	**2022**	The ACFR is an independent audit of the City's financial statements required by the State of Alabama. The 2022 ACFR provides an annual update on the City's financial information, as well as useful economic data.	Future financial audits may be useful for measuring resilience by tracking the costs and benefits of specific activities, programs, and projects implemented.
Unified Development Code (UDC)	**2021/ 2022**	Laws that implement the policies in Map for Mobile and the FLUP.	The UDC introduces new provisions that are closely aligned with resilience, including: • open space and green infrastructure (practices that use or mimic natural systems) requirements • various types of development (e.g., mixed-use, conservation subdivision, and low impact development).
MAWSS Vision 2026: Our Strategic Plan	**2021**	The MAWSS strategic plan provides information on its facilities and assets and provides goals and tactics for operational efficiency and sustainability.	The MAWSS Strategic Plan provides an overview of its critical water and wastewater systems, as well as its goals for operational efficiency and sustainability, but does not include information on how its systems may be impacted by more frequent and extreme storms and weather events.

Document	Last Updated	What the Plan/Document Informs	Opportunities for Alignment with Resilience Plan
Map for Mobile Action Plan	**2021**	Provides a strategic list of projects and programs to address priorities identified in the Map for Mobile.	The Action Plan outlines multiple city-wide priorities that, if implemented, will improve Mobile's resilience, such as: • reconcile existing and future plans and policies with a focus on resilience • conduct regular infrastructure conditions assessments • evaluate, design, and develop safe, affordable housing in areas at low risk from current and future flooding.
Habitat Conservation and Restoration Plan for Coastal Alabama	**2019**	The plan provides priority conservation and restoration actions at the watershed scale for implementation along the Alabama coast.	Opportunities to increase the resilience of natural ecosystems – within which Mobile is embedded—through conservation and restoration actions, which may provide multiple co-benefits to Mobile's critical systems.
Comprehensive Conservation & Management Plan (CCMP) for Alabama's Estuaries & Coast 2019–2023	**2019**	This 5-year update of the CCMP details the value of ecosystem services, stressors impacting coastal Alabama habitats, major accomplishments since the 2013–2018 plan (i.e., projects implemented), and provides watershed management strategies.	The 2019–2023 CCMP provides a climate vulnerability assessment matrix that evaluates vulnerabilities of its strategies/objectives to climate impacts into the next decade and beyond, which can be used in alignment with the Resilience Plan to prioritize projects for implementation.
Parks and Recreation System Improvements Plan	**2019**	Plan provides an analysis of current business practices, assesses existing infrastructure and programing, engages the public to understand their need, and identifies trends and best practices from peer cities with similar parks systems.	Aligns with the Resilience Plan by systematically outlining infrastructure maintenance and upgrade needs, community engagement, and opportunities to promote health and wellbeing.
City of Mobile Facility Condition Assessment	**2019**	Provides a review of every city owned and operated building and defines the life expectancy, maintenance needs, and a plan for how to get the most out of City facilities.	Aligns with the Resilience Plan by enabling the city to think through and budget for infrastructure maintenance and upgrade needs.
City of Mobile Housing Study	**2018**	The Housing Study provides recommendations for Mobile's neighborhoods and builds on the work of Build Mobile, the Mayor's Innovation Team, and CIP projects.	The Housing Study analyzes overall demographic, income, housing, and transportation data, and identifies areas most at-risk of flooding and storm surge based on FEMA Flood Hazard Zones. To improve resilience, updates to this plan should include future flood and storm surge projections to better predict actual, rather than historical, risk.
Future Land Use Plan (FLUP) and Major Streets Plan (MSP)	**2017**	The FLUP and MSP implement the Map for Mobile vision and provide more specific guidance on the character of and coordination with future land use and transportation throughout the city.	Opportunities to align resilience with the FLUP and MSP include: • promoting development away from areas most at risk to future sea-level rise and flooding; • incorporating future conditions into transportation planning.

Document	Last Updated	What the Plan/Document Informs	Opportunities for Alignment with Resilience Plan
Africatown Neighborhood Plan	**2016**	An overall strategy for improving the Africatown community to encourage reinvestment, enhance economic opportunity and improve the quality of life for residents.	Plan evaluates existing land uses, identifies areas for protection and growth, defines blight and methods to reduce or eliminate it.
Map for Mobile: Framework for Growth	**2015**	Map for Mobile establishes a framework and vision that provide guidance and policy recommendations for future planning in the City.	Mobile's Resilience Plan aligns with many of the key priorities identified in the Map for Mobile, and guidance and policy recommendations for future updates of the plan should incorporate the best available data and science, particularly in decisions regarding: • replacing aging infrastructure; • promoting denser/infill development to address regional suburban sprawl and lack of quality affordable housing; • increasing amount of protected green/open space and natural areas.
Alabama Coastal Comprehensive Plan (ACCP)	**2015**	The ACCP is a geo-spatial mapping tool used to visualize vulnerability of coastal infrastructure to various storm surge scenarios. The tool also directs users to resources such as existing plans, methodologies, and potential funding sources for resilience projects.	The plans included in the ACCP tool provide an abundance of opportunities to increase resilience to reduce flooding, improve water and environmental quality, offer public access to recreation, and more. Opportunities for alignment with the resilience plan include utilizing the ACCP tool's plans to identify preferred projects that may not have been implemented yet and prioritize these for funding and implementation.
Assessing Transportation System Vulnerabilities to Climate Change: Synthesis of Lessons Learned and Methods Applied	**2014**	This comprehensive, multi-phase USDOT study of the Central Gulf Coast region assesses climate change impacts on transportation infrastructure and identifies potential adaptation strategies.	The study's vulnerability assessment found that sea-level rise and storm surge are the most significant climate stressors for Mobile's transportation system, with highway assets vulnerable to these as well as extreme heat and wind. To increase transportation infrastructure resilience, the study recommends incorporating future risk and adaptation considerations into existing asset management systems and regulatory processes to reduce overall cost and increase asset lifespan.
Continuity of Operations Plan	**TBD**	Semi completed.	A Continuity of Operations Plan has been recommended for each City department. The Resilience Plan, which identifies areas of the city most at-risk, including the infrastructure, facilities, and critical assets located within them, will be a useful and reliable framework for updating existing Continuity of Operations Plan and developing them for departments that have not yet written theirs.
Energy Efficiency and Conservation Plan	**TBD**	Future plan—does not yet exist.	The current Resilience Plan lays the groundwork for a future Energy Efficiency and Conservation Plan through recommendations for investing in a more healthy, inclusive, and sustainable city.



3 UNDERSTANDING SHOCKS AND STRESSORS

Acute shocks and chronic stressors are challenges that test a city's resilience. **Shocks** are sudden, extreme events that threaten a community. Shocks are acute, meaning that the event may take place over a short period of time, but its impacts can be severe and long-lasting. **Stressors** are long-term pressures that weaken the fabric of a community over time. Stressors are chronic, meaning they persist over a long period of time or recur regularly.

Individual shocks and stressors rarely operate independently. Long-term stressors, like aging infrastructure and social and wealth inequality, may make a community more vulnerable to the impacts of a shock like an extreme weather event. And two shocks happening simultaneously can compound their effects—as other communities along the Gulf Coast experienced with hurricanes occurring during the global COVID-19 pandemic.

Shocks and stressors can:

- Directly harm individuals and the community.
- Disrupt access to and availability of critical services.
- Interrupt economies and impact financial livelihoods resulting in multi-generational wealth impacts.
- Exacerbate existing societal and economic inequities.

HOW SHOCKS AND STRESSORS CAN IMPACT COMMUNITIES DIFFERENTLY

Resilience is often framed as the capacity to "bounce back" after the experience of a disruption. Figure 4 below shows a common trajectory a community may experience after an acute shock like a hurricane. A community's functional capacity may significantly decrease in the immediate aftermath and slowly recover over time. During that response and recovery phase, a community may experience significant social and economic losses. However, not all communities or residents within a city or region have the same capacity to weather a shock. Some communities within a city or region may have the resources and support systems to better withstand a shock, recover more quickly, and possibly even transform and grow (see Line A in Figure 4). Other communities, especially those that are under-resourced and most vulnerable, may experience a greater initial shock, take longer to recover, and never get back to the same level of function as before (see Line C in Figure 4). A resilient city works to ensure that all communities, neighborhoods, and residents have the capacity to return to the same or a greater functional capacity following an acute shock.

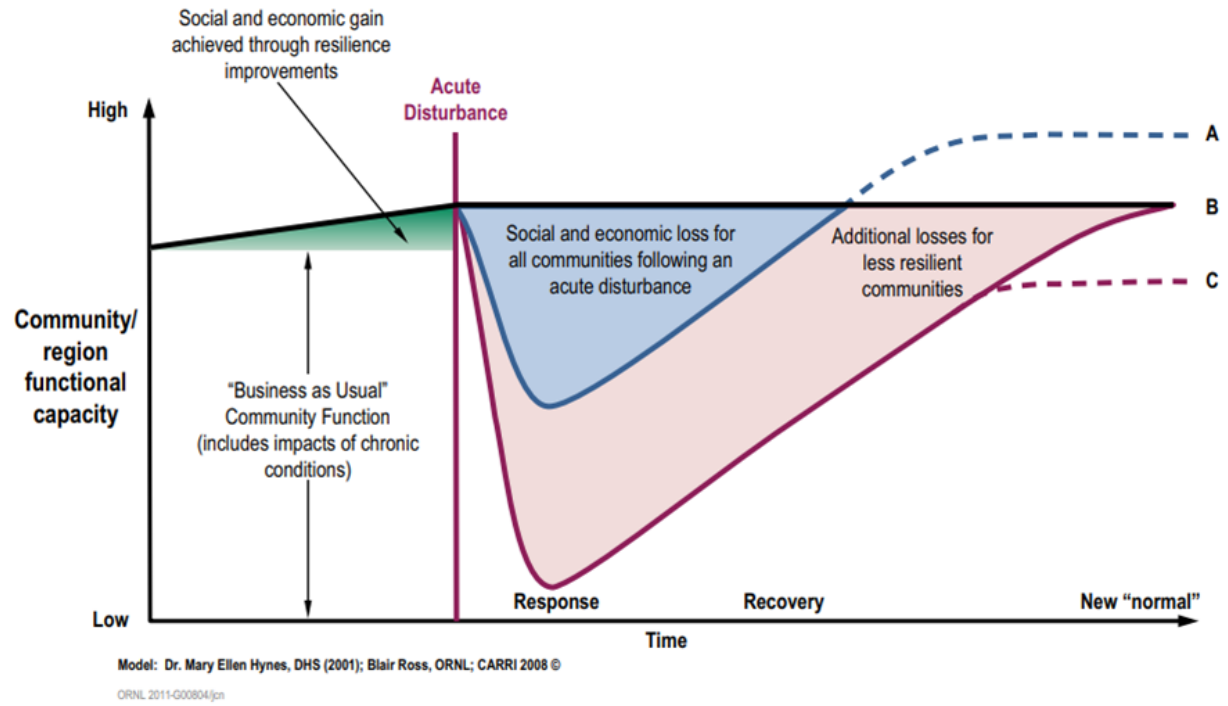


Figure 4. Resilience loss recovery curve. Source: White et al., (2015), p. 203. Adapted from model developed by M.E. Hynes, B. Ross, and CARRI (2008), presented at the DHS University Summit, Washington, DC.

COMMUNITY PERCEPTIONS ON SHOCKS AND STRESSORS IN MOBILE

Public and stakeholder perceptions on the most concerning threats facing Mobile and the City's capacity to address them were assessed via a digital survey (akin to a public poll) which received 458 responses from the public, 32 responses from Advisory Group members, and 24 responses from City staff (see Appendix A). Priority shocks and stressors were further discussed in stakeholder meetings and one-on-one conversations with City staff, City leadership, and four external Advisory Groups. It is important to note that these efforts were intended to serve as a snapshot of current concerns and perceptions today and that additional data and information were collected to ensure a robust understanding of shocks and stressors in Mobile.

Survey respondents were asked to select what they see as the top three greatest sources of acute shock and the top three greatest sources of chronic stress for Mobile. Results are summarized in Figure 5 and Figure 6.

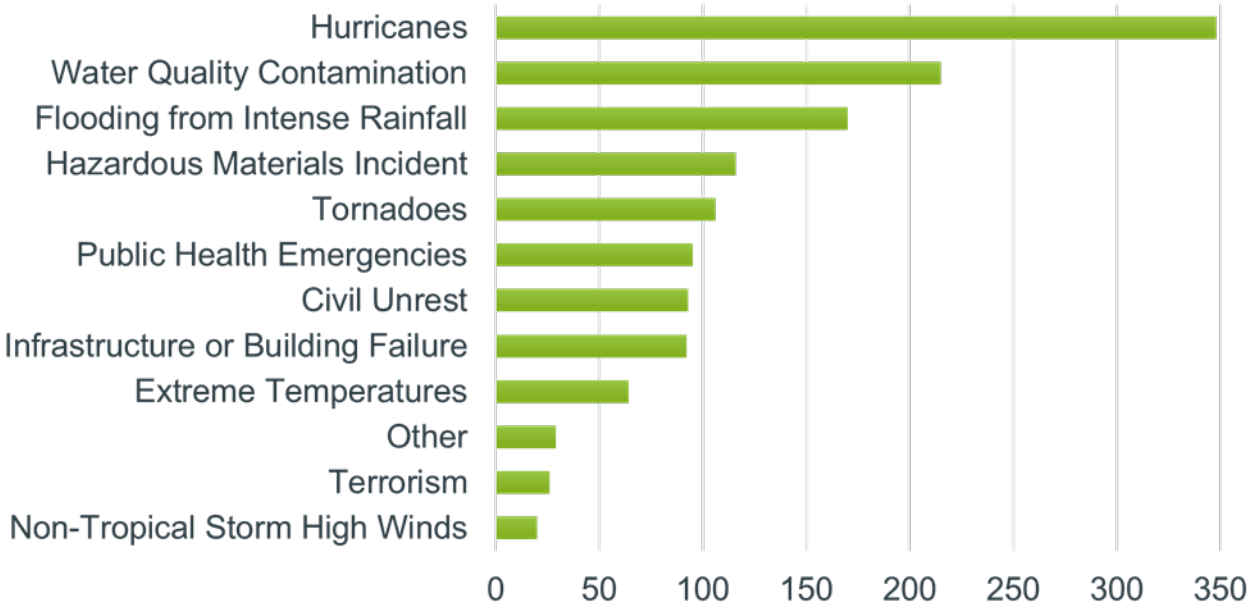


Figure 5. Summary of community perceptions on greatest sources of acute shock.

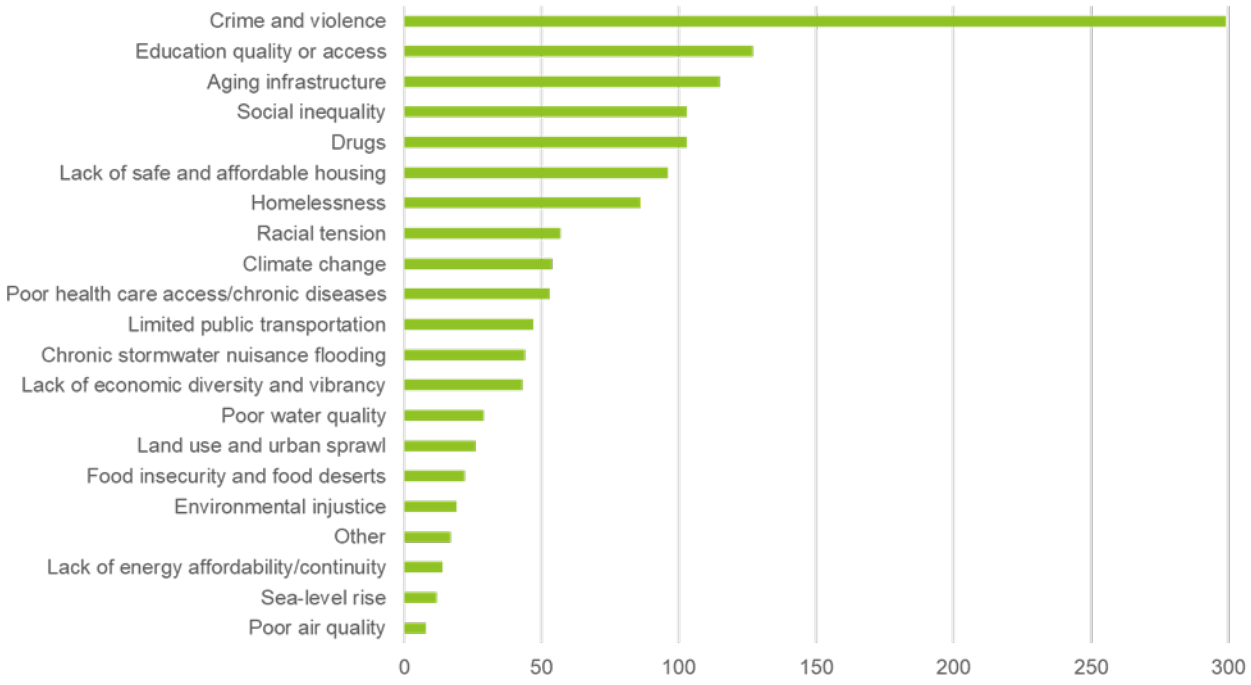


Figure 6. Summary of community perceptions on greatest sources of chronic stress.

A COMPREHENSIVE APPROACH TO PLANNING FOR SHOCKS AND STRESSORS

Community priorities on shocks and stressors are an important lens when planning for resilience. These priorities provide insight into what members of the community are most concerned about today and worried about for the future. But just because a specific shock or stressor is lower on the list of top community priorities does not necessarily mean that it presents a lower potential threat to Mobile. For example, had this survey been conducted prior to the global COVID-19 pandemic, "public health emergencies" may have ranked much lower as a community concern. Now Mobile knows from experience the impacts a public health emergency can have on its community and economy. Similarly, extreme temperatures did not rank as a top priority shock among public survey responses. However, this does not mean that an extreme cold event or an extreme heat event cannot have devastating impacts on infrastructure, utilities, and community health. For instance, the 2021 Texas winter storms resulted in road closures, extreme power outages, burst water pipes, and at least 200 lost lives.

What is top of mind today may not be what comes tomorrow. A resilience approach plans comprehensively for shocks and stressors, strengthening the systems that help Mobile survive and thrive no matter what the future may bring.

4 LOOKING TO AN UNCERTAIN FUTURE

There is no universal approach when planning for the future. Planners and decision makers must rely on the best available information that anticipates a range of potential impacts and the specific needs of their community. It is important to consider what the world might look like in terms of issues such as economic opportunities, environmental conditions, population needs, and potential hazards.

When exploring how today's decisions will impact Mobile's future, there are several different points in time to consider based on what types of actions are being taken. For example, infrastructure lasts for decades, sometimes centuries. Decisions made about infrastructure when Mobile was founded have lasting impacts today. Similarly, it is important to consider the infrastructure needs of the future when making new investments today.

For this Resilience Assessment, ***future conditions in 2030 and 2050*** *are the primary focus and a* ***moderate to moderate-low risk tolerance*** *was applied.*

These points in time were selected because they are relevant to different resident and City official timelines across a variety of sectors and planning needs. Implementation of actions which are expected to provide benefits to Mobile beyond 2050 and that are difficult or expensive to adapt over time, may consider conditions further into the future (e.g., specific types of infrastructure, land use and development patterns).

It is also necessary to consider what Mobile's potential environmental and social circumstances may be for the selected future planning horizons. However, exactly how or to what extent these conditions will continue to change by 2050 are not fully understood, and there is even greater uncertainty when looking further ahead. Scientists and researchers have a good understanding of the range of possible (scientifically plausible) outcomes for some of these elements and, by considering the range of potential scenarios, Mobile can make informed decisions to help prepare the city for the future. Because it is not always possible or practical to consider every potential future condition, this *Resilience Assessment* selected a risk tolerance range based on what makes sense for the place, the people, and the specific planning objective at hand. City staff described wanting to be ahead of most impacts while still striking a practical position of not trying to plan for the very worst case. That helped define the City's risk tolerance as avoiding impact from what has a high and moderate chance of occurring and would be a fiscally sound planning pathway.

CHANGING CLIMATE

Decades of observations tell us that the climate is changing locally and globally, and that these changes are not the same across all parts of the world. In Coastal Alabama, the changes locally translate into **rising seas, warmer temperatures, and more extreme weather** including colder cold snaps, hotter heatwaves, and more intense storms. Coastal Alabamians are accustomed to dealing with hazards, but a changing climate is expected to worsen those hazards. Understanding how climate-related shocks and stressors may change over time is a critical aspect of being more resilient.

Sea-Level Rise

As a coastal city, Mobile will be impacted by sea-level rise and its associated hazards in the future. Sea level is measured over long periods of time using tide stations and satellites that continuously monitor changes. This includes changes in sea level and movement in the land such as uplift and subsidence, or land sinking, to describe what is known as relative sea-level rise. Observations of sea level show that sea levels are rising, they are rising faster now than they have in the past, and seas are rising faster in the northern Gulf of Mexico than other places. When planning for the future along the northern Gulf it is important to consider relative sea-level rise as it will impact current and future infrastructure, homes, and businesses in Mobile.

For the time points relevant to this assessment, 2030 and 2050, we can look at historically observed relative sea-level rise and extend the trend into the future to provide a general idea of continued relative sea-level rise. According to the National Oceanic and Atmospheric Administration's (NOAA) sea level gauge located on Dauphin Island, over a 30-year period from 1990–2020, the sea level has risen around 8 inches in Coastal Alabama. Extending that trend into the future another 30 years, it is likely there will be an additional 18 inches of relative sea-level rise by 2050 (Figure 7).

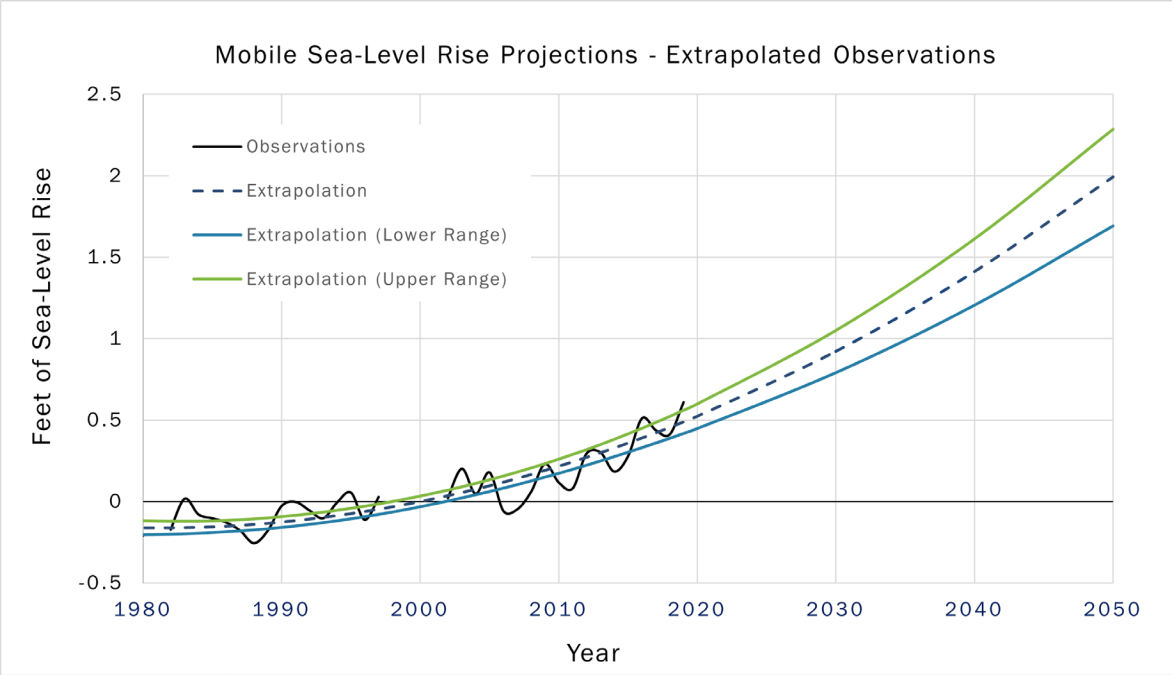


Figure 7. Sea-level rise projects and extrapolated observations for Mobile, AL. Data from Sweet et al., (2022).

In some specific cases, planning for conditions beyond a 30-year time horizon may help Mobile ensure that certain investments made today—such as upgrades, repairs, and newly installed critical infrastructure and land use planning—are long-lasting. For example, there are currently operating storm drains in Mobile that were constructed more than 100 years ago. In such instances where valuable investments are expected to last 50 years or more and are expensive or difficult to adapt after installation, considering 2070 conditions may save the City resources in the long run. In Mobile, the range of potential sea-level rise in 2070 is 1.7–3.75 feet. For long-range investments, planning for **3 feet** of sea-level rise would provide Mobile with an extra level of protection and reduce the likelihood of critical and expensive infrastructure failures in the future.

Temperature

Current trends show us that the world is warming, and recent years have produced record setting temperatures across the U.S.. Average surface air temperatures (meaning the temperatures on land) in Mobile have increased a total of 2.2°F since 1950 (Vose et al. 2021). This trend is projected to continue into the future. Not only will we see an increase in the average temperature, but we are also projected to see an increase in the number of days in a year in which temperatures reach 95 °F or higher—rising from around 26 days per year in 2020 to around 47 days per year by 2050 (Vose et al. 2021).

Extreme heat is a serious public health concern that will only get worse due to climate change. Extreme heat is one of the leading causes of weather-related deaths in the United States with more than 600 deaths per year recorded in the United States on average (Taylor et al. 2018). Extreme heat is also associated with prolonged health risks including increases in cardiovascular, respiratory, and kidney-related illnesses (U.S. EPA 2015).

Increases in temperature may also result in impacts to Mobile's economy in the future. Extreme heat is a serious concern for outdoor workers and is known to reduce productivity for agriculture, industry, and construction sectors. Work hours lost from extreme heat for outdoor workers are projected to increase to more than 20% in the United States by 2030, nearly double the loss of work hours in 1995 (11%; ILO 2019). Warmer temperatures also increase demands on energy, particularly during the summer months. In Mobile, energy expenditure is projected to continue increasing (Hsiang et al. 2017).

On August 26, 2023, Mobile set a record high temperature of 106°F, a temperature that is 16°F above the normal monthly temperature. Mobile also experienced 11 days of temperatures that exceeded 100°F, surpassing the previous record of 8 days set in 2000 (Maniscalco 2023).

Precipitation

The Alabama Gulf Coast is one of the rainiest regions of the United States both in terms of average annual rainfall and extreme rainfall events. Mobile experiences a yearly average of 66 inches of rain through a combination of non-tropical storm events as well as hurricanes. This means Mobile sees a lot of rain, but it also comes in intense bursts of rainfall.

Annual rainfall shifts with natural year-over-year and decade-over-decade variability. However, since 1950, the annual rate of rainfall for Mobile has steadily increased; today, it rains roughly 5 inches more on average per year than it did in 1960.

Extreme rainfall events are times when 4 or more inches of rain fall over a 24-hour period. Extreme rainfall is problematic because stormwater infrastructure has difficulty effectively and efficiently draining large amounts of rainfall over a short period of time. Furthermore, significant rainfall events also influence river discharge and exacerbate associated stressors (e.g., runoff contamination, harmful algal blooms [HABs], sedimentation) that can impact fisheries and recreation (see the later subsection related to Water Quality as well as Section 5: Natural Resources for additional information). Extreme rainfall events have become more frequent over time and are projected to continue becoming more frequent. In the southeastern U.S., extreme rainfall events have increased 27% since 1958 and are projected to continue increasing in frequency in the future (Hayhoe et al. 2018).

POPULATION UNCERTAINTIES

Despite a few downward trends in population through the years, Mobile's population has remained relatively steady since 1960, hovering at or slightly below 200,000 residents. Additionally, unlike other cities across the nation, Mobile has avoided significant population decline from recent events, such as the COVID-19 pandemic, attributed in part to the city's strong economy. The city has also been fortunate to have been spared the worst impacts of recent hurricanes, and as a result, has not experienced the same levels of people moving away as those seen in other Gulf Coast cities. In fact, in 2023 the total number of residents in Mobile, AL, jumped from 184,952 to 204,689 as a result of annexation, making Mobile the second largest city in the state. It remains to be seen how the city's population would be impacted if it is tested by more extreme storms and weather events, as well as future national or global events.

ECONOMIC UNCERTAINTIES

Mobile is familiar with how unanticipated changes in the local and global economy can significantly change the city's trajectory. For example, Mobile's economy boomed and population more than doubled between 1940 and 1960 following the opening of the Brookley Air Force Base and the growth of the shipbuilding industry and other World War II production efforts. The closing of Brookley in 1969 resulted in the loss of 14,000 jobs and reverberating impacts to Mobile's economy and population.

Current and future economic trends may again test Mobile's capacity for resilience and drive increases or decreases in population. Despite the recent period of economic growth, inflation and mortgage rates remain high nationwide, thereby causing volatility in the housing market. Further, continued recovery from the COVID-19 pandemic has brought an end to related federal financial assistance, increasing financial insecurity for low-income households. Insurers are also changing how rates are calculated for homeowners based on changing frequencies of hazards, and the cost of flood insurance will continue to increase over time for many of Mobile's residents.

Mobile's successful efforts in recent decades to diversify its economic base may help the city weather economic downturns. Just as the war production effort in the 1940s shaped new industries in Mobile's economy, emerging sectors such as clean and renewable energy production have the potential to reshape Mobile's and the Gulf Coast's economy for the future. The recent vote to annex portions of West Mobile has pushed the total number of residents above 200,000, thereby opening new avenues for federal funds and ensuring extra revenue for the city. Further, recent efforts by Congress to redraw district boundaries is expected to shift the political and legislative landscape for Mobile. However, the potential implications of redistricting on Mobile's economic forecast are unknown.

CHANGES IN SHOCKS AND STRESSORS

Flood Hazards

Sea-level rise will exacerbate existing flood hazards including rainfall and coastal flooding (Figure 8). Even small amounts of sea-level rise can reshape the coast, exacerbating erosion and exposing new areas to flood risk and magnifying the risk in areas it is known to flood.

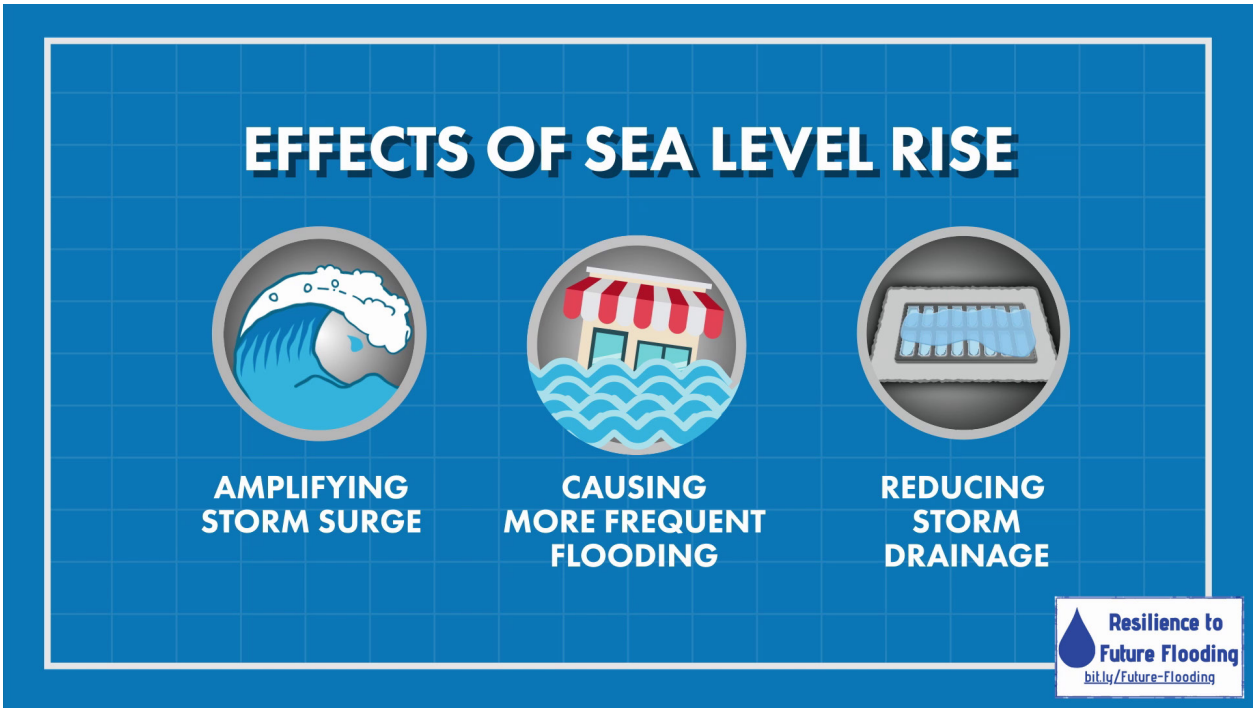


Figure 8. Infographic highlighting some of the main impacts of sea-level rise from PLACE:SLR extension.

STORM SURGE

The Alabama Coast is very flat and low-lying, meaning there is little barrier to prevent water from traveling deeper and further inland when water levels are elevated. This is important because as sea level increases, storm surge will also increase, flooding areas that have never flooded before, while in areas already expected to flood, it will be deeper than it was before (Figure 9). Additionally, lower intensity storms such as tropical storms are already having larger flood impacts.

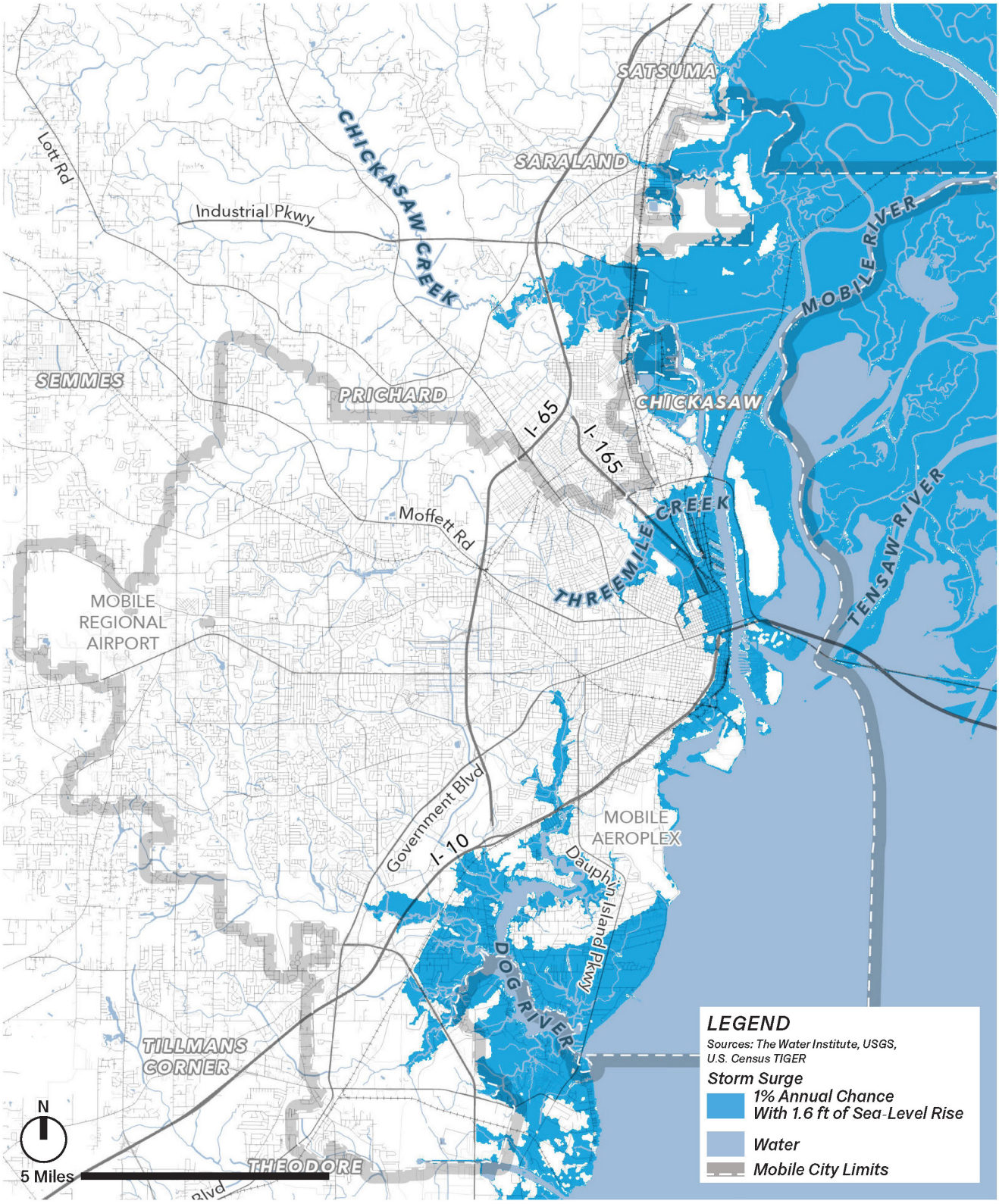


Figure 9. Future storm surge projections for Mobile, AL with 1.6 ft of sea-level rise, based on Bilskie et al. (2017).

As surge becomes deeper and travels farther inland, it exposes more homes, people, and essential facilities to flood risk. To prepare for the risks from storm surge, current building codes require building to the standards of a flood level that has a 1% chance of occurring each year—sometimes called the 100-year flood. In the next 20 years, by 2040, the number of people that would be displaced and needing shelter due to the 1% annual chance flood is expected to double (Table 3).

Table 3. Summary of potential risks to buildings and people based on two scenarios of sea-level rise. Data from Del Angel et al., 2021.

Building Stock Impacted by Future Storm Surge		
	Residential Buildings	**Total Buildings**
Surge with **0.7 ft** of sea-level rise	225	734
Surge with **1.6 ft** of sea-level rise	555	1647
People Impacted by Future Storm Surge		
	Displaced	**Needing Shelter**
Surge with **0.7** ft of sea-level rise	2477	114
Surge with **1.6** ft of sea-level rise	5001	291

STORMWATER DRAINAGE

As sea level rises, it will combine with other stressors to reduce the capacity of existing storm drainage and stormwater management systems, creating flooding issues inland (Figure 10). Higher seas reduce the speed at which stormwater can drain, causing systems to back up. This is compounded by increased occurrences of extreme rainfall events because it adds to the total amount of water in the storm drainage system. Storm drainage is further reduced by other factors including development which increases impervious surfaces and funnels more water into the stormwater system. Accumulation of trash, waste, and yard debris in storm drainage ways further reduces the capacity of storm drainage systems to drain effectively.

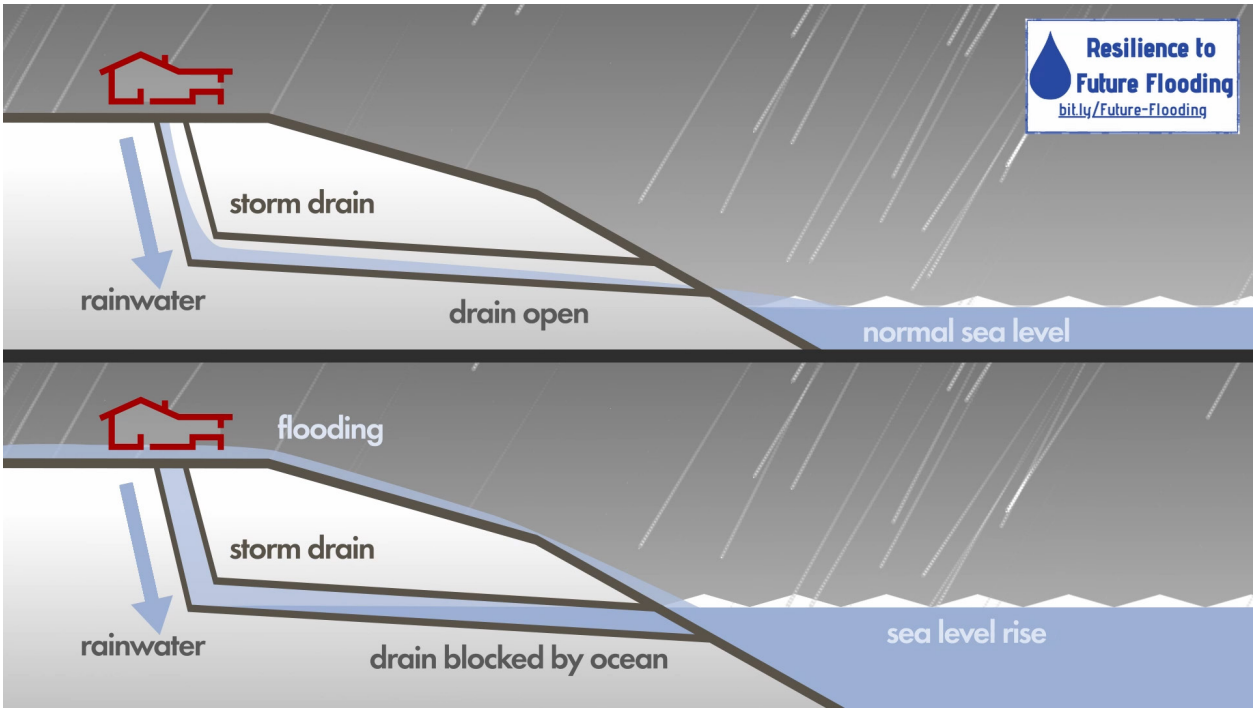


Figure 10. Schematic illustration highlighting the impacts of sea-level rise on storm drainage systems. From PLACE:SLR extension.

Finally, in Mobile stormwater drainage challenges are further exacerbated by the age of the infrastructure. Much of the stormwater system, especially east of Interstate 65 (I-65) is undersized and deteriorating. Because the infrastructure is undersized, the increasing frequency of extreme rainfall events coupled with rising seas, development, and accumulation of debris can lead to even greater stormwater challenges. There are already examples of flash flooding and frequent stormwater flooding in localized areas around Mobile (Figure 11). These are expected to become more frequent with time. Current efforts (e.g., the complete street initiative) by the City are underway to address these issues (see Section 5: Infrastructure).

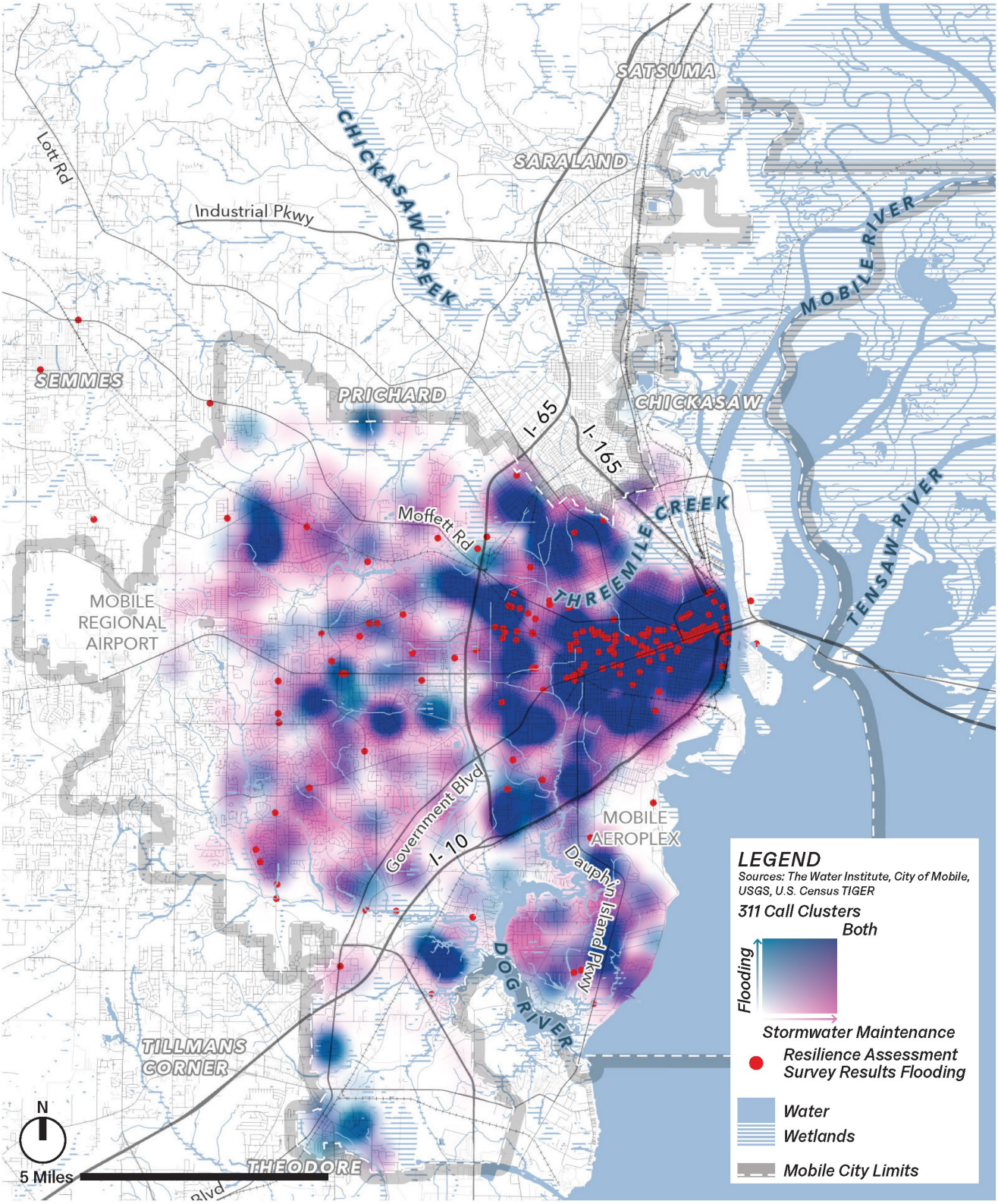


Figure 11. Map of 311 call data collected between January 2018 and March 2023. Shades of blue indicate the frequency of reports received related to flooding and stormwater maintenance. Orange dots are locations where the public observed flooding as collected by the Resilience Assessment *public survey.*

HIGH TIDE FLOODING

High tide flooding, sometimes known as nuisance or sunny-day flooding, occurs without a tropical system or rainfall. Areas are flooded by coastal water, usually due to a higher-than-average tide. In Mobile and Coastal Alabama, we have begun to see this on the lowest lying roadways (e.g., causeways, waterfront areas; Table 4). In the coming years we expect to see more areas flooded more often by high tide which will interrupt commerce, emergency services, stormwater drainage, and other activities (Figure 12).

Table 4. Days of projected high tide flooding in Coastal Alabama based on observed rates of sea-level rise. Asterisk (*) indicates data from May 2022 through April 2023 (NASA SLCT and University of Hawai'i Sea Level Center 2023).

Date	Days
2000	1 day
2022*	6-11 days
2030	18-68 days
2050	192-331 days

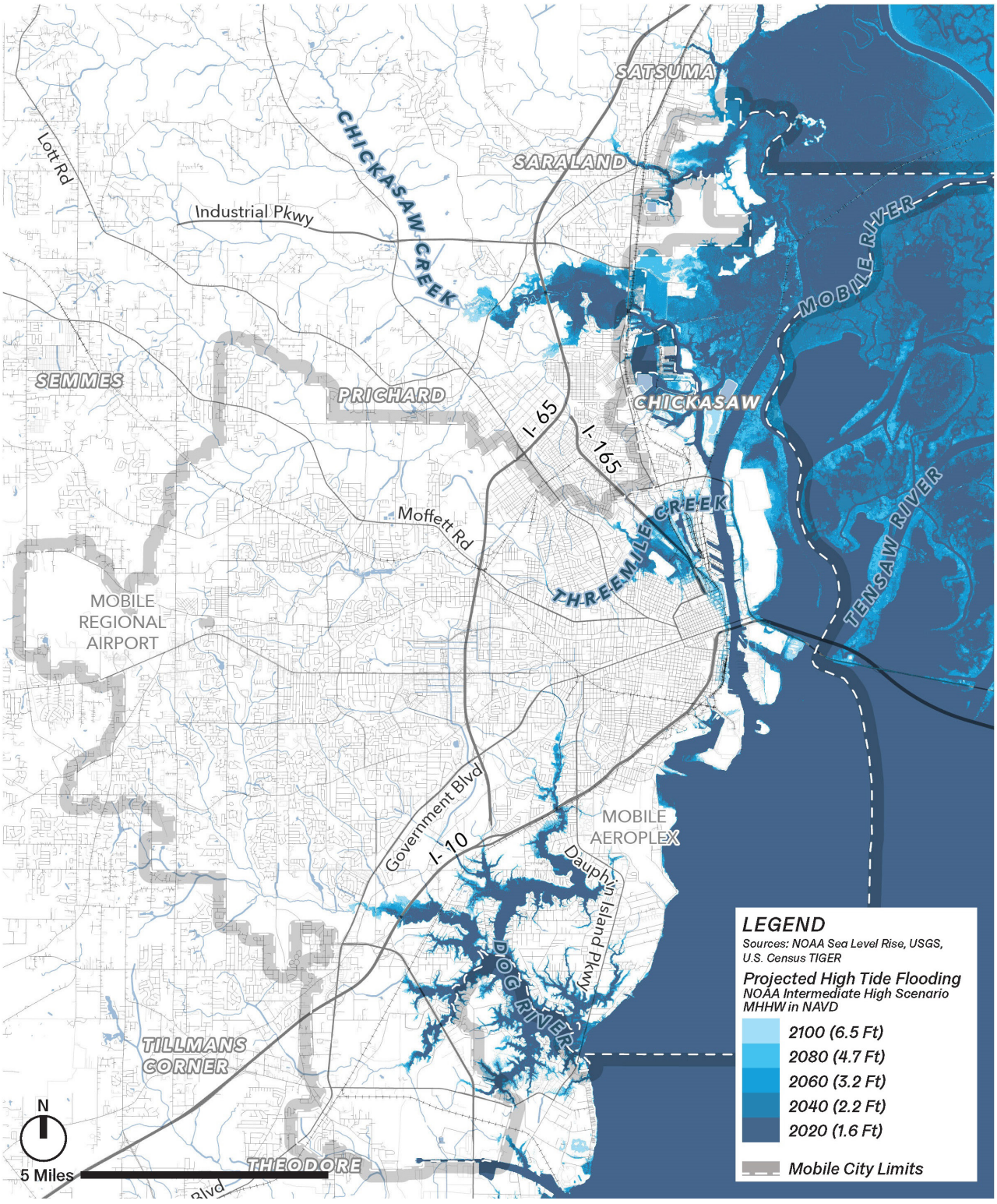


Figure 12. Anticipated changes in high tide flooding based on NOAA sea-level rise projections expressed as mean higher high water (MHHW) in NAVD: 2020-2100. Data from (NOAA n.d.).

Water Quality

Increases in sea level and extreme rainfall events can also negatively impact water quality. More frequent rainfall coupled with aging infrastructure and other stressors on wastewater treatment systems may lead to more frequent events that put untreated sewage into natural water ways—corridors which are critical for the local economy and culture (see more on these systems in Section 5). In addition to sewage spills, increasing high tide flooding and stormwater flooding both lead to water quality degradation. In other areas of the country where high tide flooding was tested for water quality, there were extremely high levels of multiple pollutants (Morrison 2019). This is because stormwater is more than just rain: items such as animal waste, contents of trash bins that are knocked over (e.g., diapers, chemicals, litter), oil from roadways, and other pollutants get mixed in with the rainwater as it rises and then gets washed into creeks, streams, bayous, and the Bay.

Increases in temperature are also a concern for water quality. Water stores less dissolved oxygen as temperatures increase which creates greater opportunities for hypoxic (low oxygen) events that can be harmful to local fish and shellfish populations—causing them to relocate, become stressed, or die. Warmer temperatures also can create more favorable conditions for pathogens such as bacteria (e.g., vibrio and *E. coli*), invasive species, and HABs, sometimes known as red tides. See Section 5: Natural Resources for additional information about these associated stressors.

Disparate Impacts

Climate impacts are not felt equally across Mobile residents. There are higher frequencies of hazards among low-income neighborhoods and communities of color, including higher flood exposure (see Section 5: Communities). This has been exacerbated among rural and low-income areas through reinforcing investment systems, where large-scale hazard protection projects are directed to areas where they will protect the greatest economic value. This means areas that are sparsely populated and/or have low home values are significantly less likely to be awarded protection dollars. There is also greater exposure for people who are unhoused or underhoused, without appropriate protection from the elements. As more intense and more frequent heatwaves, rainfall events, and other hazards increase, these residents will face greater effects from changing conditions.

Additionally, the ability to prepare for and respond after acute and chronic stressors ranges among residents. For example, low- and moderate-income families are less able to retrofit their homes to avoid damage, prepare or evacuate ahead of hurricanes, or address damage post-disaster. They are also less likely to have hazard or flood insurance given the increasing costs of both, placing greater burden on these residents when disasters occur. Residents who are elderly or disabled may also face challenges including differing mobility and medical needs that can

complicate their disaster preparedness as well as the ease with which they can receive disaster recovery support.

Increased exposure combined with lower capacity means that acute shocks and chronic stressors have very different impacts on residents. This can include mental and physical health impacts, food and housing insecurity, and financial strife (see Figure 13 for examples). By considering these differences in needs and exposure, Mobile can pursue just and equitable resilience.

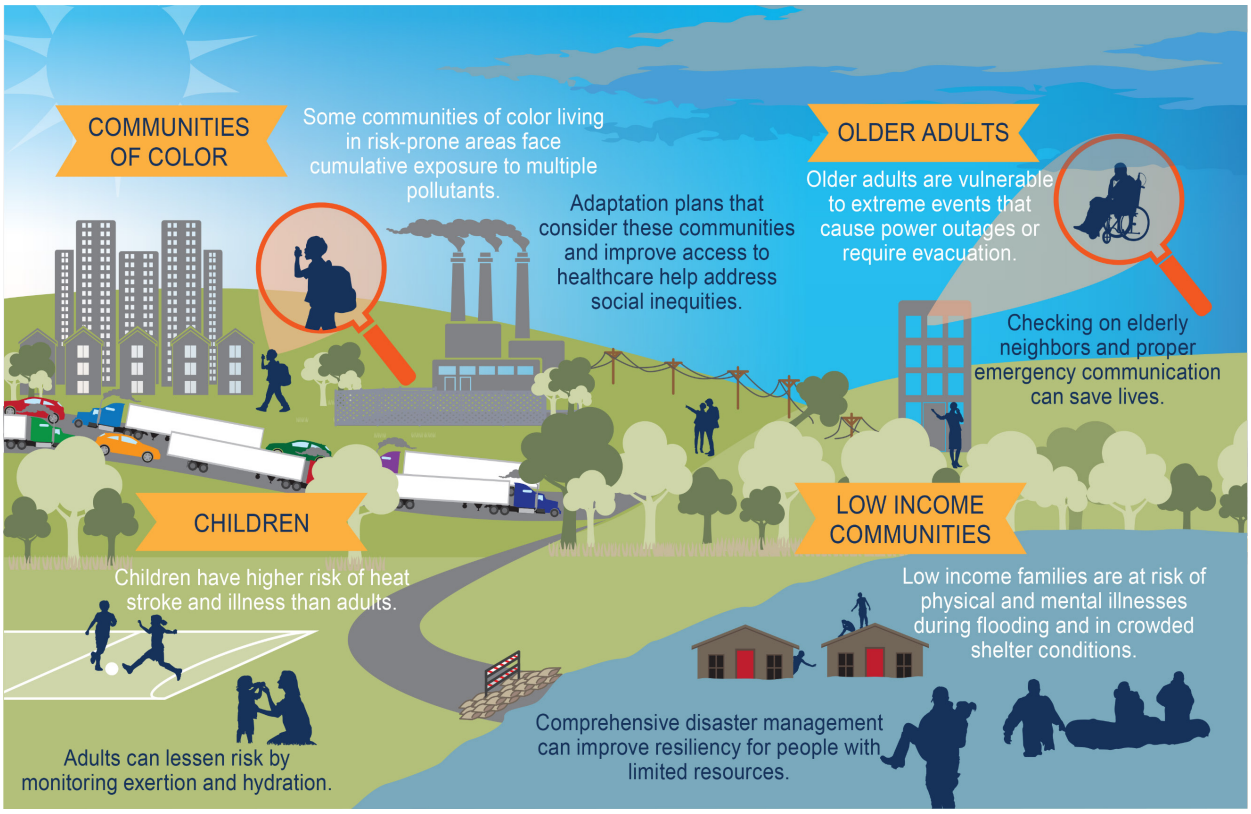


Figure 13. This illustration developed by the U.S. EPA for the Fourth National Climate Assessment (USGCRP 2018) serves as an example of how different socioeconomic stressors can combine to cause unequal health impacts from climate change and what actions can be employed to address them.

5 SYSTEMS CRITICAL TO MOBILE'S RESILIENCE

This *Resilience Assessment* focuses on the underlying systems and assets that are foundational to a resilient and thriving Mobile: infrastructure, economy, health and wellbeing, communities, and natural resources. These categories emerged from discussions with and input from City staff and leadership, Advisory Group members, and residents on what resilience means for Mobile.

Each system is connected to multiple others, meaning efforts to enhance resilience in one may benefit the others, while shocks and stressors that reveal vulnerabilities can create cascading challenges for the city. A holistic approach is required.

A Resilient Mobile is One Mobile: *focused on strengthening the links in the chain that connect and coordinate across all of these systems (Figure 14).*

Figure 14. Schematic of the systems critical to Mobile's resilience.

Each of the five systems are explored in depth below to provide an overview of existing assets and challenges that influence Mobile's current capacity for city resilience. Important and valuable existing efforts identified during development of this *Resilience Assessment* that are currently increasing resilience are highlighted to showcase Mobile's commitment to improving resilience. Each introduction includes key takeaways that provide a concise summary of findings.

INFRASTRUCTURE

Reliable infrastructure is the connective tissue of a thriving city—supporting commerce, enabling access to essential services and resources, protecting from and aiding recovery after catastrophic events, and sustaining healthy communities. Infrastructure that protects residents and connects the city raises quality of life and has the potential to attract new businesses, workers, and residents. Aging and outdated infrastructure is a widespread issue across the nation, but in older cities like Mobile, it is particularly important to address. Upgrading and maintaining infrastructure is the foundation for improving Mobile's resilience, allowing it to thrive now and into the future.

Key Takeaways

- *As an historic city, much of Mobile's infrastructure has been serving residents for many years—in some cases for over a century. Mobile faces increasing demands on the city's aging infrastructure from climate change, development, and other pressures.*
- *As Mobile continues to implement long range planning and proactively increases investments in upgrading and maintaining infrastructure systems, there will be fewer reactionary responses to the acute shocks and chronic stressors.*
- *There are many ongoing efforts across infrastructure categories to improve service, reliability, and resilience. Mobile has an opportunity to continue and expand these efforts and share transferrable lessons from one type of infrastructure to another.*

Mobile's critical infrastructure includes the assets and systems that are vital to the city's ability to function and operate. These assets include physical facilities such as hospitals, schools, government buildings, and water and wastewater treatment plants, as well as the city's vast network of pipes, drainage ways, roads, fiber-optic cables, along with other infrastructure that often go unnoticed but are integral to residents' daily lives. Some of these systems are managed directly by the City of Mobile while others are managed by external agencies and organizations.

The City of Mobile's comprehensive Capital Improvement Plan (CIP), most recently updated in 2023, outlines City-led projects beginning construction in the next 5 years that will address critical infrastructure needs and support community priorities (City of Mobile 2023b). CIP projects aim to improve streets, sidewalks, lighting, parks, public buildings, stormwater systems, and other critical infrastructure to protect public health and safety, as well as promote growth opportunities to make Mobile a more desirable place to live, work, and invest. Recent capital improvement investments are highlighted in Figure 15.

Figure 15. Highlights of past capital improvement accomplishments to fund maintenance and transformative projects completed by the City leveraging State and Federal grant funds. Values provided reflect only capital improvement funds from 2016–2020 (City of Mobile 2022).

For the purposes of this *Resilience Assessment*, infrastructure assets, challenges, and opportunities were assessed under the following categories:

- **Water**
- **Transportation**
- **Power**
- **Communications**
- **Critical Facilities**

Water

Water infrastructure in Mobile considered for this assessment are specifically drinking water, wastewater, and stormwater systems that support the provision of clean drinking water, removal of wastewater, and effective and efficient drainage of stormwater to prevent flooding. Water is primarily managed by two entities in Mobile. Mobile Area Water and Sewer System (MAWSS) is responsible for drinking water and wastewater, and the City of Mobile oversees stormwater.

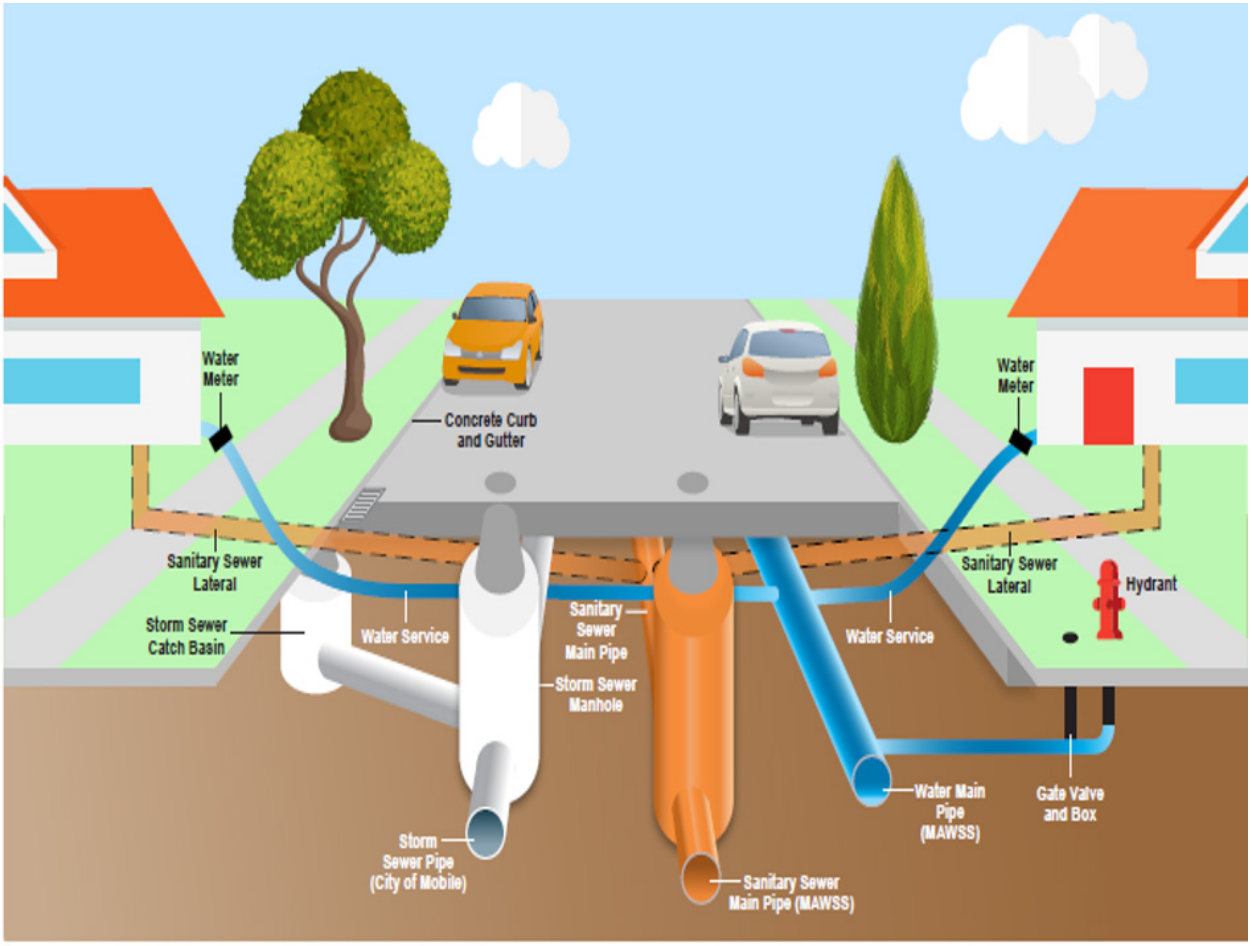


Figure 16. MAWSS system graphic.

DRINKING WATER

Assets

MAWSS delivers roughly 41 million gallons of freshwater daily to residents through a combination of reservoirs, tanks, pumps, and more than 1,550 miles of water main pipes (MAWSS 2019). MAWSS uses surface water rather than groundwater as its raw water source. The raw water source is managed with a dam and spillway to always maintain an ample volume of raw water to treat for customers' use. The water is then pumped to one of two water treatment

plants. The E.M. Stickney Water Treatment Plant was built in 1943 and updated in 1955 and 1976. The H.E. Myers Water Treatment Plant was built in 1990. After treatment, the water is pumped to storage tanks and/or individual homes and businesses.

Challenges

One of the largest challenges that MAWSS faces regarding potable drinking water is the age of its distribution lines. Across the MAWSS service area, 15% of the water lines are between 50 and 70 years old, 39% are an unknown age but are thought to be more than 70 years old, and approximately 3% (42 miles) are more than 100 years old. Over the course of Mobile's history, distribution lines have been constructed of different materials, sizes, and qualities. The aging of infrastructure and mismatches in connections can cause leakage or strain on the system.

Building on Existing Efforts

There are many efforts underway at MAWSS to address the challenges of aging infrastructure and to ensure that future issues are avoided. Some of these programs include:

- New infrastructure is planned according to anticipated future growth, allowing MAWSS to accommodate residential, commercial, and industrial expansion in the Mobile area.
- There are many measures in place to ensure the safety of the water quality including security at the reservoirs as well as at the water treatment plants.
- When roads are replaced/repaved, MAWSS often upgrades all of its infrastructure below such roads to proactively prevent future road degradation resulting from failed under-road pipelines.

WASTEWATER

Assets

The C.C. Williams Wastewater Treatment Plant was initially constructed in 1957 and upgraded in 1977 and 1996. The Wright Smith Jr. Wastewater Treatment Plant was built in 1947 and upgraded in 1963 and 1987. MAWSS collects and treats wastewater for Mobile residents through a combination of pumps, tanks, and treatment facilities that include almost 1,500 miles of sewer main pipe. Unlike drinking water, which is pressurized, roughly 84% of the wastewater lines are gravity fed, meaning they rely on gravity to flow from one point to another. Wastewater is transported to the two wastewater treatment plants mentioned above, where it is then treated and released into the Mobile River.

Challenges

There are several current and future challenges MAWSS faces with some of the most impactful being aging infrastructure, old materials of construction not used anymore, customers flushing grease, wipes, and other non-suitable materials down the drain, defective private laterals, and

increasing extreme rainfall events. These challenges create a situation where the flow of wastewater in the sewers is either blocked by the accumulation of unsuitable materials or by the sewer capacity being exceeded by extraneous stormwater entering defects in the sewer. Both circumstances can cause wastewater to exit manholes and is commonly termed a sewage spill (also known as a sanitary sewer overflow or SSO), which compromises surface water quality and is a public health concern.

Approximately 13% of the wastewater treatment lines are more than 50 years old and 41% of the lines are of an unknown age. As with drinking water lines, older wastewater lines were made of different material, size, and quality over time. As these lines degrade in quality, it not only allows seepage of sewage out but can also allow water to seep in and overwhelm the sewer system, generating a sewage spill.

Two major sources of stormwater entering the sanitary sewer-system are on private property. One is property owners leaving their sewer cleanouts without caps or damaged caps go unrepaired or replaced. These pipes, typically installed in yards, exist to allow plumbers easy access to wastewater pipes to treat common issues such as clogs. However, when cleanouts are not properly capped, this is a direct route for rainwater to enter the sewer system. With the occurrence of more frequent extreme rainfall events, it is crucial that property owners properly maintain their cleanouts. By simply ensuring these are capped, homeowners can considerably cut down on their contribution to sewage spills. The other private property source of stormwater entering the sanitary sewer system is defective wastewater plumbing that extends from the property line to the floor of the house. These lines are called private laterals and are the responsibility of the property owner to keep in a state of good repair to prevent groundwater from entering the lateral. Property owners need to realize that the wastewater plumbing in their yard is likely as old as the building and is defective if it has never been replaced with PVC.

Another related challenge is funding. Because MAWSS operates independently from both Mobile County and the City of Mobile, some federal funds designed to support infrastructure upgrades are not directly available to MAWSS. Furthermore, MAWSS does not receive tax revenue. Therefore, MAWSS relies almost exclusively on water rates to cover the expense of

What can you do to help with wastewater problems?

A major source of water that leads to sanitary sewer overflows during rainfall events are individual homeowners and businesses not keeping their cleanouts covered. Make sure yours is capped.

infrastructure renewal. Addressing this funding challenge is particularly urgent as all types of infrastructure, not just water, are rapidly aging and in need of upgrades.

Building on Existing Efforts

Aware of these challenges, MAWSS has already taken many steps to reduce the frequency of sewage spills through the addition of increased storage capacity during severe weather events and implementing infrastructure upgrades. These programs include:

- Completion of a needs assessment and Master Plan (MAWSS 2019) which identifies near-, mid-, and long-term actions to be implemented that would provide immediate and then sustained results including, among others, a reduction in sewage spills.
- Installation of Severe Weather Attenuation Tanks (SWATs) and Severe Weather Attenuation Basins (SWABs) which act as additional storage for wastewater that needs to be treated when the system is overwhelmed by groundwater and stormwater entering the system (MAWSS 2023b). Through these efforts there has been a significant decrease in sewage spills.
- MAWSS has been upgrading the infrastructure systematically at the direction of the Master Plan, leveraging funding opportunities, acquiring additional in-house funding, and opportunistically upgrading infrastructure when roads are replaced.
- MAWSS – Citizens Water Academy (MAWSS 2023a) educates the public about their water source and how the delivery system operates, fostering good stewardship of wastewater and drinking water assets.

STORMWATER

Assets

The City of Mobile manages the stormwater system across the city and uses a combination of pipes and natural drainage ways to drain stormwater away from homes and businesses into the Mobile Bay. The system is drained by gravity and therefore there are no pumps used to move stormwater in Mobile.

Challenges

There are many challenges to the stormwater system in Mobile, the most critical of which are the age of the infrastructure, increasing extreme rainfall events, maintenance of drainage ways, rising sea levels, and urban development. Each of these stressors individually reduce the capacity of the stormwater system to drain stormwater effectively and efficiently, together causing more frequent flash flooding and street flooding (Figure 17). Another challenge is that

there is not currently a comprehensive map of the built and natural stormwater conveyances in the city.

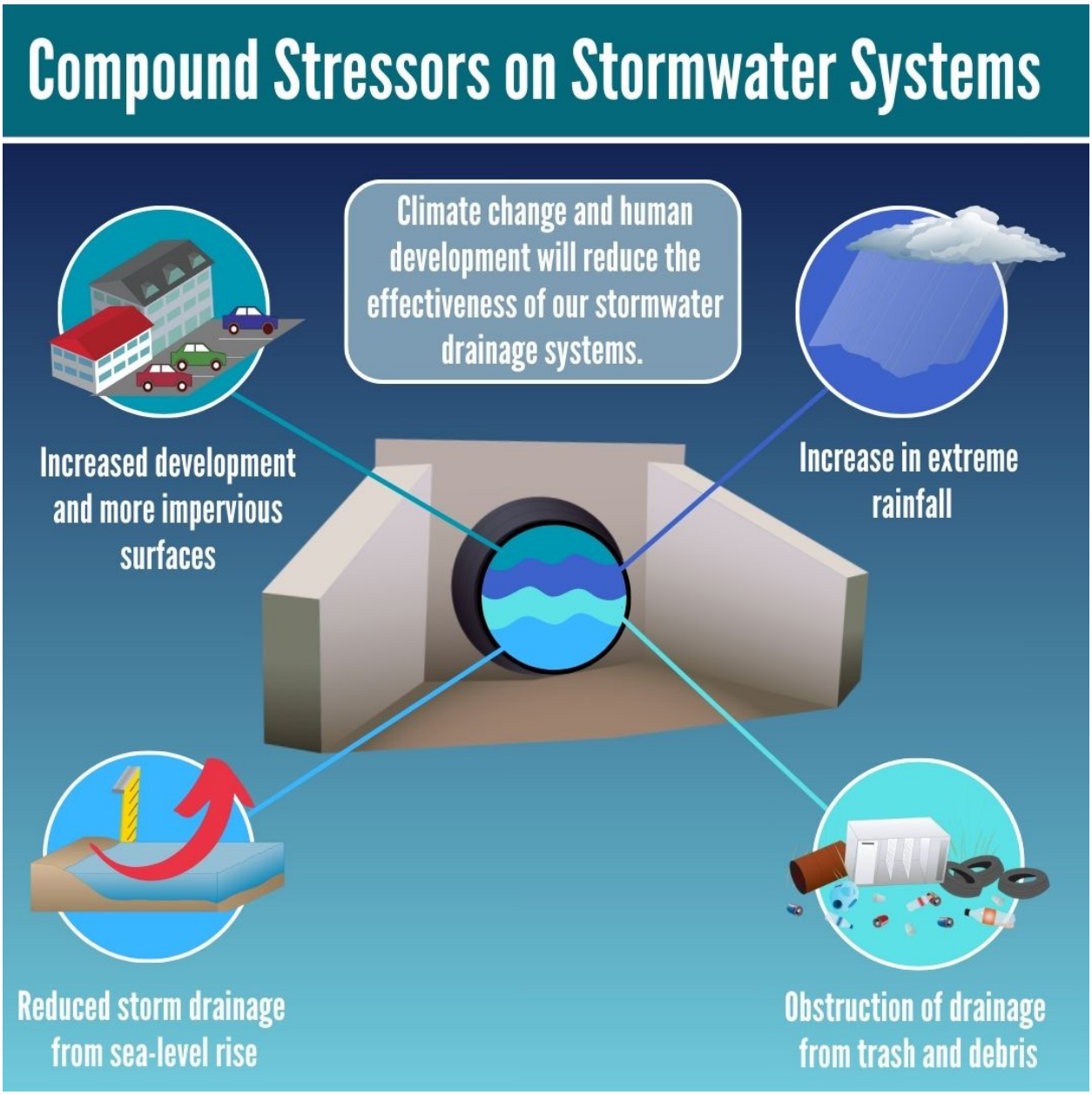


Figure 17. Schematic illustration highlighting the compounding stressors impacting stormwater systems in Mobile. Stressors include development, increasing rainfall, water system blockages, and reduced storm drainage capacity resulting from sea-level rise. Graphic from PLACE:SLR extension publication MASGP-23-061.

The age of the stormwater infrastructure is one of the largest and most significant challenges facing Mobile's water system, particularly in the areas east of I-65 where the existing infrastructure is significantly undersized, it was made of material that is now compromised, and

the overall age is causing it to deteriorate. The infrastructure being undersized means that even if the system worked perfectly, it would still not be able to successfully convey all the rainwater that it is currently expected to intake. Further, the system is not working at full capacity. The Mobile Tree Ordinance established in the 1960's was meant to ensure a healthy canopy of trees, but it also resulted in trees being planted too close to stormwater and sewer lines compromising pipes with an extensive growth of tree roots. In open drainage ways and at sewer openings, overgrowth, household detritus (e.g., yard clippings), and other types of litter, trash, and debris clog and reduce the effectiveness of the drainage systems.

One consequence of rising sea levels is that stormwater becomes more difficult to manage. Storm drains that once emptied with the help of gravity to waterways below are now faced with a water level that has risen to meet them, rendering their design less effective. This combines with more frequent and more extreme rainfall events to strain systems and prevent them from functioning as intended. Further, urban expansion of Mobile resulting in replacement of open or green space (parks, playgrounds, and recreational fields) with impervious surface will also worsen existing runoff problems by preventing water from naturally being absorbed by the soil.

Funding to maintain the existing assets and to upgrade those that need upgrading are another constant challenge. Sustained funding to support maintenance of the existing infrastructure along with funds to upgrade undersized and aging infrastructure in areas that are the most compromised are needed.

Finally, there is not currently a department, separate from the engineering department, focused on floodplain management—floodplain management falls under the duties of the engineering department. In a city with flooding from rivers, stormwater, and coastal flooding, the lack of a department or individual whose sole focus is the broader flood prevention and management needs of the city is a challenge.

Building on Existing Efforts

Proactive action to improve Mobile's resilience relative to stormwater management is already underway by the City, its local partners, and the local citizens. Such actions are aimed at providing direct improvements to existing infrastructure as well as at increasing the capacity of the City to manage its stormwater through advances in research and education/training initiatives.

- As with drinking and wastewater, each time a road is replaced or undergoes major repair, the infrastructure underneath is upgraded and/or undergoes needed maintenance.

- Building codes for new or significant improvements on properties located in areas with older stormwater infrastructure require stricter stormwater management on property to accommodate for it being undersized.
- In-house training and mentoring of engineering department staff on resilience and floodplain management.
- A stormwater fee is collected annually for the purpose of supporting stormwater infrastructure upgrades and maintenance.
- An ongoing effort to map and model all of the stormwater drainage ways and conveyances to enable comprehensive planning and prioritization.
- Cleanouts of known trouble spots ahead of expected major rainfall events.
- Collaborations with partners to restore and enhance natural drainage ways throughout the city are also underway. For example, the Three Mile Creek Watershed Restoration, the Twelve Mile Creek, and the Langan Lake Dredging which will stabilize banks and streambed to reduce downstream sedimentation, restore riparian buffers which will act as floodplains to absorb the creeks as they swell during rain events, and dredge the lake of the sediments that have already traveled downstream to also support flood control.
- Mobile maintains an online litter dashboard (City of Mobile 2023d) to support ongoing litter collection efforts within the city that reduce blockages of stormwater systems. More detail on ongoing efforts for litter collection is provided in Section 5: Natural Resources.
- Anticipated completion and initial implementation of a City of Mobile Stormwater Manual.
- The City of Mobile revised the Tree Ordinance at the end of 2020 to include a "right tree in the right place" effort. This begins to ensure a more responsible and resilient way to maintain the tree canopy.

There are opportunities to increase quality and frequency of community education around stormwater in a variety of languages to reach renters and homeowners. Actions individuals can take to reduce stormwater impacts include investing in high up-take, individual actions (e.g., rain gardens, pervious concrete) to support reduced stress on the stormwater system. Finally, there are opportunities to continue restoring natural drainageways and change policies so that sizing of pipes during repairs is reflective of future water flow conditions.

Transportation

ASSETS

Transportation systems in this assessment include roads, bridges, railways, waterways, public transit, and sidewalks. The Port of Mobile and associated waterways are also recognized as key

transportation conduits for Mobile; the Port is discussed in detail in the "Economy" subsection below. The installation, operation, and maintenance of transportation systems in Mobile are the work of a combination of different government and private entities. These systems intertwine to provide connectivity within the city as well as connect the city to the surrounding areas. This transportation network is critical for commerce and the delivery of essential services. Major assets include the Interstate 10 (I-10) and I-65 corridors, Mobile International Airport, Mobile Regional Airport, and the extensive railway system. Other key assets are the roadways within the city and county together with sidewalks and bike lanes, all of which connect larger transportation hubs and provide for multiple modes of transportation.

CHALLENGES

Resilience transportation challenges within Mobile fall into **two general categories**:

1. Direct exposure to hazards that might render them temporarily out of service or in need of repairs.
2. The influence of the current transportation on other systems such as Health and Wellbeing and Community.

Direct Exposure

Currently, there are 44 miles of road exposed to major coastal storms and many more segments of road exposed to rainfall flooding. Additionally, the roads themselves are aging and are exposed to additional degradation from compromised and leaking water infrastructure underneath them. These issues manifest as potholes, cracks, and other road hazards which can lead to damage to vehicles. Such challenges can even cause drivers to deviate from their regular commute routes causing congestion, altering commerce patterns, and creating ripple effects that impact other areas of resilience such as access to essential services.

As sea levels rise and extreme rainfall events continue to increase, this will further compromise the integrity and reliability of the transportation systems in Mobile resulting from direct damages and temporary flooding. Estimates show that with the anticipated sea-level rise in the next 20 years (by 2043) the amount of roadways exposed to coastal flooding could increase by 63% with an additional almost 30 miles at risk of damage (Del Angel et al. 2019). Additionally, sections of the Mobile Causeway, which already threaten to flood with the right combination of high tide and winds, are expected to be regularly inundated by high tide as early as 2050 (within the next 30 years; Del Angel et al., 2019).

Additionally, there are many bridges within Mobile that serve as critical access points into and out of the city, in particular the I-10 bridge span that connects Mobile and Baldwin Counties, known as the Bayway. The vulnerability of bridges to damage from flooding increases as flood risk overall increases, which can cause severe interruptions in daily lives and in emergency response and recovery during disasters. The Bayway is an essential artery for commerce and

commuting on a daily basis in addition to being key for evacuations—if the Bayway and other routes across the Bay cannot handle daily traffic, this is an indication that it is woefully inadequate for evacuations. Beyond the capacity issues, the Bayway is also not tall enough to withstand a 100-year storm surge—the minimum standard for building codes.

Transportation & Resident Resilience

In development of this assessment, there are specific needs that residents have expressed to enhance their mobility for access to employment and healthcare opportunities. This includes enhanced public transportation options, such as efficient and extended bus transportation services (particularly for elderly and disabled residents) and expanded bus fixed-rate routes and services. Members of the community also identified challenges with efficient flow of traffic (e.g., one-way streets, light coordination) through the city that restrict movement and negatively impacts access to services and commerce. Additionally, pedestrian-/bike-safe systems to support foot traffic and other means of moving between spaces that are safe for those not in vehicles has been identified as another opportunity to enhance mobility and access to services.

BUILDING ON EXISTING EFFORTS

Addressing these transportation challenges has the potential to not only improve evacuation speed and emergency response during natural disasters, but also to boost the quality of life for residents of Mobile on a daily basis. Many of the agencies, departments, and organizations dedicated to transportation in Mobile have already undertaken efforts to improve the resilience of transportation infrastructure:

- The CIP has identified funding for ongoing repairs of streets, sidewalks, and right-of-way infrastructure, as well as funding for roadway striping maintenance, ongoing resurfacing of streets throughout the city, Americans with Disabilities Act (ADA)-accessible sidewalk modification, and repairing broken signal detection infrastructure at various intersections across the city (City of Mobile 2023b). Highlights include:
    - Redeveloping Broad Street – a "complete streets" initiative that includes safe pedestrian and bike-friendly access, handicap-accessible sidewalks, upgraded stormwater drainage, gas, water, and sewer lines, modernized street surfaces, and reconnects severed neighborhoods.
    - St. Louis Street – will redesign and rebuild roadbed and infrastructure for a 17-block area downtown on St. Louis Street
    - Additional Full Rebuilds – completed redesign and rebuild roadbed and infrastructure on Ann, Baltimore, and Texas streets.
- The Downtown Street Optimization project focuses on the streets within the Hank Aaron Loop in accordance with many of the recommendations of the Optimizing Downtown Streets Report. The project will include converting many of the one-way streets to two-

ways, removing unnecessary traffic signals, and adding bike lanes and additional on-street parking.

- Alabama Department of Transportation (ALDOT), in partnership with the Mobile and Baldwin County Metropolitan Planning Organizations, in the design phase of the Mobile River Bridge intended to increase capacity for daily transit along with evacuations and enhance the resilience through higher elevations and building design. Assuming funding is secured, construction could begin in September 2024.

Mobile has an opportunity to continue optimizing traffic flows, repairing roads and the related infrastructure underneath, investing in a more diverse and accessible public transit system, and exploring the expansion of non-motorized transportation infrastructure.

Power

ASSETS

Alabama Power, an investor-owned utility regulated by the Alabama Public Service Commission, provides the majority of electric power to Mobile's residents and city buildings. With nearly 75,000 miles of distribution lines across the state, Alabama Power maintains the system following weather events and other events that can cause interruptions in service. Essential services like healthcare, wastewater management, and traffic management all depend on the reliability of the power supply, even more so during and after an acute shock.

Over the last two decades, the Southern Company has coordinated its subsidiary companies—Alabama Power, Georgia Power, and Mississippi Power, along with private contractors—to address storm damages and power outages. Today, due to their investment in technology combined with the coordinated emergency response has reduced the time citizens are without power. Service can be interrupted, but an additional asset is that seldom, if ever, is power interruption caused by the generation system, or more specifically the power plant shutting down. According to the Mobile County EMA, Mobile has adequate shelters for individuals who have concerns about their ability to withstand the disruptions caused by storms. These shelters have the capability to house citizens for short periods of time. While staffing can be a problem, the EMA, in partnership with SARPC, has executed a county-wide agreement with the school board giving the employees with the school system an opportunity to work at these facilities during emergency situations.

CHALLENGES

Hurricanes, tropical storms, and other significant weather events serve as major interrupters of power. In certain circumstances, residents may experience multiple days without power depending on the extent of the damages. The wind related to tropical storms causing damage to the power distribution system comes primarily from the damage caused to trees that are near powerlines. Challenges related to power disruptions are exacerbated by specific policies in place

that reduce the fiscal attractiveness of solar panels or other parallel systems (e.g., monthly fee charged to residents with solar systems). These fees also reduce Mobile's economic and community competitiveness when other states do not make renewable energy cost prohibitive.

While utility providers across the city are leading to ensure against extreme events, the current resilience capacity of Mobile's power grid to stressors other than wind and flood is currently unknown. Recent shocks and stressors have tested systems in other regions and have provided opportunities for those locations to increase their resilience. Many southern cities across the U.S. have experienced rolling brownouts and blackouts due to high temperatures, which cause more households to rely on air conditioning during summer months. Alabama Power has not been tested by such temperature extremes, but with shifting climate patterns and rapid urban growth in the region these strains are likely to become more common.

There are residents in the city who live in flood prone areas or homes that are not storm resistant. While the city has adequate shelters for severe storms, plans and procedures are needed for periods of extreme heat and cold. The majority of back-up or redundant systems in Mobile's shelters are fossil fuel-powered generators, which can create noise and pollution problems in addition to the potential for shutdown with reduced fuel availability. Finding the personnel to staff the facilities can also be a burden.

BUILDING ON EXISTING EFFORTS

Addressing power delivery and reliability in Mobile is a well understood issue. Ongoing activities by Alabama Power and others to support increased resilience include:

- Continued installation of protective features on critical instrumentation and hardened design elements that provide protection from severe weather at power generation facilities. Such features act to minimize planned maintenance outages prior to storm season as well as during peak season.
- Provision of a free outage alert program that allows customers to receive personalized notifications about their power on a phone or computer.
- Alabama Power is consistently working across the region to put more overhead lines underground to reduce impacts during weather events.
- Investment by Alabama Power in smart grid technology has resulted in outage times that are 55% shorter than the national average.
- Partnerships between telecommunications companies and Alabama Power expand fiber cable networks which makes the electric grid more resilient. Since 2017, more than 1,200 miles of fiber cable have been added. Investment in fiber by Alabama Power will be essential to sustaining Mobile's electric system into the future.

- Investments by hospitals and other essential service providers in having and maintaining redundant power systems.
- Continued planning and logistics efforts by Alabama Power, both internally as well as with community partners, to support storm response by assisting with staging areas and other resources.
- Investments in automated applications that identify the locations of power transmission faults and reduce the distance utility crews need to patrol for routine maintenance and emergency response.

Moving forward, the City could consider programs to: increase access to community or resilience hubs that can provide power after a significant weather event; support Alabama Power's plan to bury overhead lines and make infrastructure upgrades when feasible; and educate residents and businesses on the benefits of having a redundant power system located in safe locations (e.g., not located on lower floors that are at risk to flooding). The City can also work on policy changes to foster renewable primary and secondary energy infrastructure in addition to adding renewable energy systems. Policy changes on where trees can be planted for the future would also reduce impacts to power and other utility concerns. These updates could simultaneously improve public health, reduce electricity costs, and appeal to the next generation of workers.

Communications

ASSETS

The ability to connect via high-speed internet and cell phone services is a critical underpinning of daily life, commerce, and provision of city services. An array of private entities (e.g., AT&T, Xfinity) are responsible for the infrastructure that supports these methods of communications, ranging from physical towers to underground cables. The City of Mobile has significantly prospered from its status as the birthplace of Southern Light, which is now integrated into Uniti Group, a top-10 provider of mission critical fiber optic networks across the United States. This association has enabled Mobile to boast one of the most extensive fiber networks in the Southeast, encompassing approximately 600 miles of fiber within the city limits alone. This network provides cutting-edge fiber optic infrastructure and comprehensive internet services, further elevating Mobile's position as a pivotal hub in the telecommunications landscape.

In addition to physical access to internet and phone services, the City is responsible for ensuring continuous functioning of the internal communication systems that allow City operations to function for residents. Further, the City must also safeguard the availability and maintenance of other elements of communication infrastructure, including websites, cell phone apps, and other types of communication that are essential for City operations.

CHALLENGES

Many residents and businesses of Mobile do not have access to high-speed internet, either because the infrastructure is not available, or residents cannot afford the prices (Figure 18). This lack of access negatively impacts commerce and education and can further widen inequities.

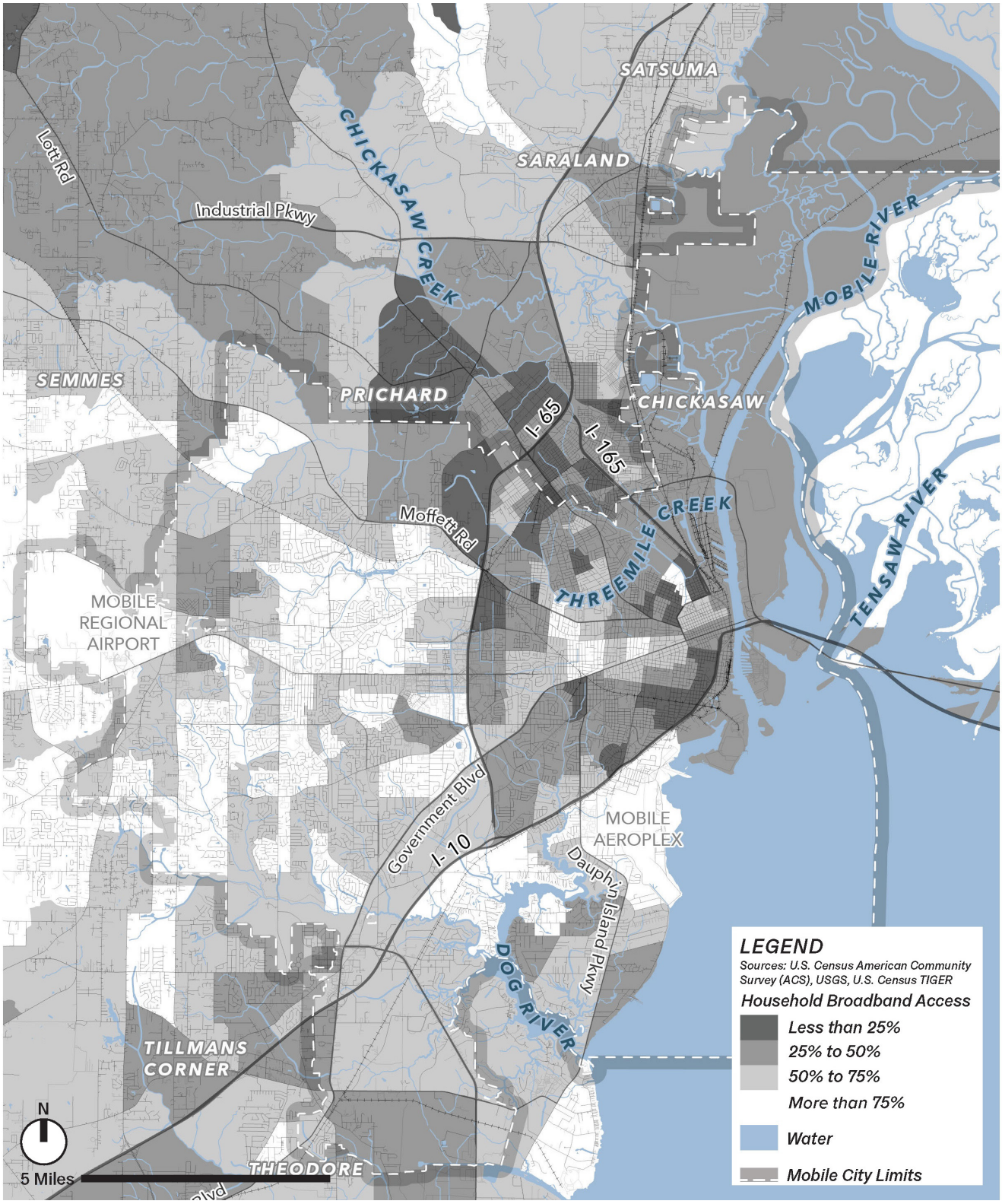


Figure 18. Proportion of households with broadband internet access in Mobile, AL, mapped by Census block group.

Maintaining safe and secure functionality of communications infrastructure in the current technological age is increasingly more challenging—cyber security threats can result in physical damage, data mining, or preventing the City from accessing its critical servers and systems. Insurance premiums for cyber security have doubled each year since 2020 (post-COVID-19) adding a significant fiscal strain. Additionally, physical infrastructure for communications is at risk of damage associated with severe storms and corrosion of infrastructure due to saltwater intrusion (the movement of seawater into freshwater aquifers), among other threats.

BUILDING ON EXISTING EFFORTS

- The City of Mobile has been extremely proactive in their cyber security work, taking many measures to ensure that their hardware and software are up to date. This enables their ability to maintain provision of city services consistently.
- Mobile County maintains an emergency alert notification application that provides information about weather updates.
- The City of Mobile has been adding additional locations for free wi-fi around the city.
- Education of residents about federal programs that provide internet access for eligible customers (e.g., the Affordable Connectivity Program).

There are opportunities for Mobile to increase its resilience by considering programming that provides access to high-speed internet in public places, supporting partnerships with the private sector to increase infrastructure for high-speed internet, and considering additional means of communicating with residents.

Critical Facilities

ASSETS

Critical facilities in Mobile range across public and privately managed assets. Critical government facilities include the schools, police stations, emergency shelters, fire stations, and animal shelters distributed throughout the city, as well as centrally located buildings such as Government Plaza, which contains county and city governments, as well as the court system in one facility. Non-government facilities such as churches, hospitals, and others are also facilities deemed critical to Mobile's resilience. Additionally, the people who staff both public and private critical facilities are also an essential aspect of these facilities' capacity to function. Figure 19 maps critical facilities across the categories of emergency response, health and medical, schools, landmarks, and government in relation to the 1% annual chance floodplain.

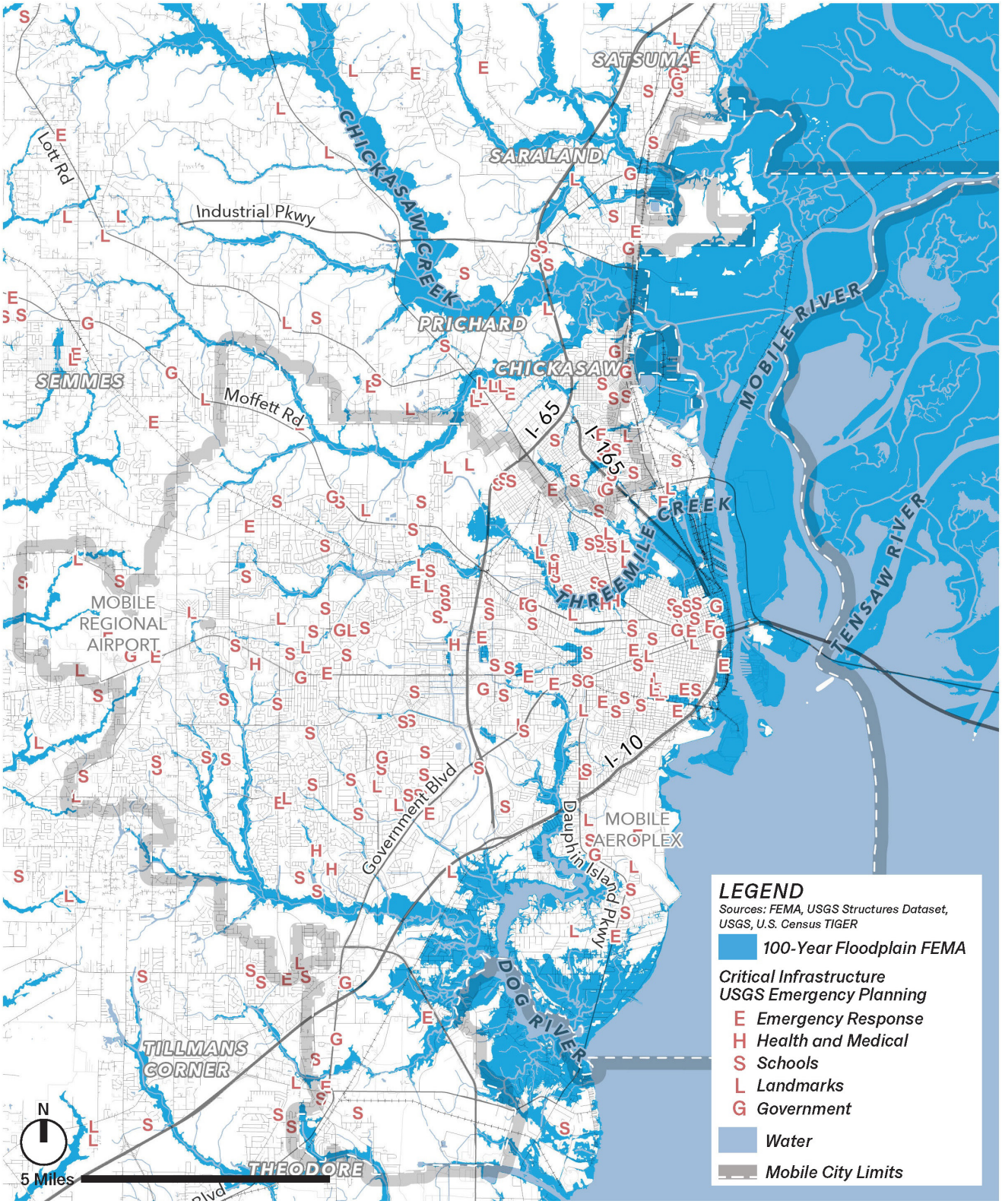


Figure 19. Locations of critical facilities in Mobile, AL, overlayed on 100-year floodplain.

CHALLENGES

Critical facilities face challenges because they, like other types of infrastructure, are suffering from age, worsening hazards, and being under-designed for the demands of today. This trickles down to the ability of the staff of critical facilities to be able to perform their duties. As an illustrative example, Mobile's current animal shelter is aging, and a lack of funding is preventing necessary maintenance. This has caused parts of the building to fall into disrepair, which now prevents the integration and use of new technologies and reduces its capacity to house the volume of animals that need shelter. Already struggling with these chronic issues and located in a floodplain, the shelter and the staff that support animal services for the city would be unable to meet the needs of its two- and four-legged residents.

Worsening hazards in Mobile are putting additional stress on critical facilities, in particular flooding and heat. More individuals will need help and support as heat worsens (see Section 4), which will put additional demand on the services required and on the performance of the buildings directly. There will also be increased severity of flooding of critical facilities, and performing critical services will become more difficult as roads are inundated more frequently which may prevent staff from getting to the facility to do their work.

BUILDING ON EXISTING EFFORTS

There are efforts underway to increase the resilience of critical facilities.

- Emergency planning by departments to consider how essential staff can still respond to their jobs and other aspects of continuity through Continuity of Operations Plans and Emergency Action Plans by Department.
- Planning for a new animal shelter.
- Several critical public works and public safety facilities are being moved out of the floodplain.

The City and local partners can continue this good work by ensuring future hazard conditions are included in future plans for critical facilities, such as the current animal shelter efforts, and that all departments are generating and staying up to date with emergency and hazard mitigation plans that are updated as shocks and stressors continue to evolve.

Common Challenges and Opportunities Across All Infrastructure Categories

As with all municipalities, funding has limits; therefore, there will always be a balancing act of meeting needs, proactively addressing problems, and ensuring fiscal responsibility. This can generate challenges for developing and maintaining resilient infrastructure, regardless of the specific system; these challenges are presented in specific ways as described below.

MAINTENANCE

Maintenance is a continual challenge across all infrastructure types. It requires funding and proactively spending resources before there are problems. However, if something else in the system is broken or failing, then that will have to be addressed first. Across all interviews during development of this *Resilience Assessment*, there seemed to be a theme of being more reactive than proactive in some of these processes by necessity. In the older systems (e.g., stormwater) this is becoming an increasingly greater problem.

There are several opportunities the City could explore to address this, including dedicated maintenance funding that is separate from other repair or expansion funds, as well as careful consideration of any increased demand on operations and maintenance budgets when implementing any new physical assets (roadways, for example).

JOBS RECRUITMENT AND TRAINING

Another common theme across all infrastructure systems is the difficulty in hiring and retaining skilled and qualified employees. City leaders report difficulty in retaining talent due to competition faced with rising wages, more flexible work formats in the private sector, and the changing desires of a younger workforce (e.g., different amenities, sociocultural priorities). Additionally, there is a need for more workforce training within City government so that employees are able to keep up with the changing infrastructure systems and needs of the future. This covers everything from climate change to electric vehicles.

The City already has strong workforce professional development in some departments (e.g., Information Technology) which could be models for how to structure workforce training and professional development opportunities across all departments, fostering a culture of continual learning and evolution.

COLLABORATION AND COMMUNICATION

Mobile has already proven successful in developing strategic plans through collaboration and partnership across city departments (e.g., the *Capital Improvement Plan*, Figure 20). Furthermore, local researchers at the University of South Alabama are working directly with state and federal agencies to improve existing guidance for coastal highways in an effort to increase resilience of key transportation conduits across the northern Gulf states (Darestani et al. 2021; Douglass, Krolak, and Webb 2023). Utilities such as Alabama Power continue to test

and implement new technologies to advance system resilience. Due to the interconnected nature of the infrastructure systems discussed in this *Resilience Assessment*, continued emphasis on collaboration and communication are vital for meeting shared goals that advance citywide resilience.

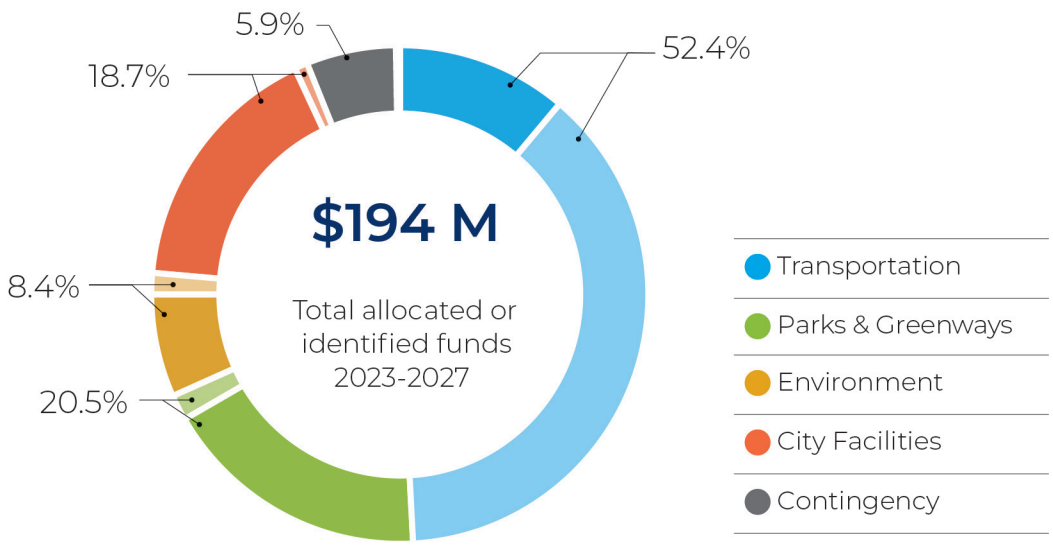


Figure 20. CIP Program Summary and 5-year Currently Identified Funding (City of Mobile 2023b).

ECONOMY

Mobile has a strong and growing economy that has weathered several booms and busts over the city's long history. Mobile continues to leverage its vital role in global commerce as a major port city, while also attracting new industries, expanding into emerging sectors, and cultivating local small businesses. A resilient economy is one that fosters prosperity for all, therefore improving jobs and providing wealth-building opportunities for all residents will ensure that the benefits of Mobile's growing economy reach the entire community.

Key Takeaways

- *Mobile has made great strides in diversifying its economy in recent years. Continuing to maintain and expand the wide range of sectors and industries doing business in Mobile can help to sustain the city's economy through unexpected downturns and support local jobs at all skill levels.*
- *Workforce shortages have been noted as a challenge across industry sectors in Mobile. Expanding jobs and recruiting, training, and retaining workers skilled in filling those positions will drive a resilient economy.*
- *While recent efforts to support small and minority-owned business development have expanded local entrepreneurship, economic security and prosperity remain challenging to access for some Mobilians.*

Assets

Mobile continues to make significant strides toward increasing its already diverse economy. As a result of local economic growth campaigns, more than 2,000 jobs were created and more than $2 billion in capital investments were made in the city in 2021 (Mobile Area Chamber of Commerce 2022). These jobs span a variety of industries, including aviation and aerospace, chemical manufacturing, logistics and distribution, healthcare, oil and gas, information technology, maritime operations, and steel manufacturing (Mobile Area Chamber of Commerce 2019). Despite lingering impacts from the COVID-19 pandemic, travel-related employment in Mobile County grew significantly between 2020 and 2021 (Alabama Tourism Department 2022) and was one of the top five counties visited in the state during that time.

The Port of Mobile is an essential economic engine for the entire State of Alabama with a container terminal that has been growing rapidly over the past few years (Mobile Area Chamber of Commerce, 2019; Alabama Port Authority, Port of Mobile, 2022). In 2021, the Port of Mobile contributed an estimated $85 billion in total economic value and generated 313,000 jobs in the State of Alabama (Alabama Port Authority, Port of Mobile 2022). Continued investments in the Port's infrastructure and expansion are anticipated to further increase its importance to Alabama and the nation. For example, a multi-phase dredging project aimed to allow passage of larger, deeper draft ships to the Port of Mobile is currently underway with expected completion in March 2025 (Adams and Collins 2021).

The Port's position as a cornerstone in manufacturing and logistics positions it advantageously to potentially leverage opportunities provided by recent federal legislation, such as the Bipartisan Infrastructure Law (BIL), which offers new and expanded competitive grant programs for transportation infrastructure. Such opportunities include $2.25 billion towards the nation's Port Infrastructure Development Program to improve supply chains, reduce pollution, and enhance resilience in the shipping industry (U.S. Department of Transportation Office of Public Affairs 2022).

The City of Mobile is also focusing on training and developing disadvantaged business enterprises in order to move those businesses from subcontractors to prime contractors. Training and certification opportunities, as well as small business and low-to no-interest loan funding programs, are providing the tools and resources for an improved and growing workforce.

Challenges

Mobile's continued success in attracting business and meeting its targets for economic opportunities and investments will have positive, far-reaching impacts on the city. However,

Mobile also faces challenges that must be overcome for its economy to remain resilient both today and into the future.

Like much of the nation, workforce shortages are impeding economic growth. Workforce shortages are due in part to stagnant population growth—limited by the lack of available and affordable housing within the city—and a lack of local, workforce-ready talent. The constraints posed by housing and stagnant population growth especially contribute to difficulty in recruiting knowledgeable and capable talent from both local universities and outside of the region to fill positions in the professional services sector (e.g., legal, medical, engineering, architectural, accounting, and others) that serve the community and support continued economic growth. Further, the COVID-19 pandemic revealed the fragility of supply chains that drive sectors of Mobile's economy, causing disruptions and delays to work across multiple sectors.

Economic resilience is not only tied to general employment rates but is also dependent on economic prosperity for all of Mobile's residents. Members of the community identified social inequality and poor education quality or access as among the top stressors facing the city today. As Mobile's economy diversifies, education and training for members of the entire community will become even more important to sustain a thriving and ready workforce.

Building on Existing Efforts

Continuing to advance an already strong economy is a well understood priority for Mobile. Mobile seeks to capitalize on its success through continued diversification and expansion through multiple programs and initiatives:

- Exploring the possibility of manufacturing components for electric vehicles locally to both ease the transition to electric and capitalize on this expanding market in the automotive industry.
- Local universities are investing in and implementing workforce training programs which develop local talent for employment in disadvantaged business enterprises. These businesses range in focus from life science, contracting, and governmental contract bid processes to other small business development training.
- The Small Business Development Center Network supports and works with many small businesses in Mobile to ensure the city is both family- and business-friendly. The Innovation Portal, a local business incubator, is also supporting and growing local small businesses in Mobile and provides support during disasters (e.g., the COVID-19 pandemic).

- Implementing CIPs that will further boost a growing tourism sector (e.g., the Africatown Welcome Center, Three Mile Creek Greenway Trail, Brookley by the Bay, Downtown Waterfront development, and others).
- Private investment projects are providing additional opportunities for economic expansion, including Airbus expansion, Austal and other ship building, and TopGolf construction.
- State and federal investments will fund a new Mobile River Bridge, and funding from the City of Mobile, Mobile County, the State of Alabama and the federal government will support building the new Mobile International Airport at the Brookley Aeroplex.

Mobile's economy has already proved to be resilient, particularly after weathering the impacts of the COVID-19 pandemic. Positioning itself as an attractive city for industry and tourism, Mobile can continue its efforts to recruit and retain diverse talents that fuel economic sectors beyond healthcare and train the local workforce to support its growing and diverse economy. These efforts can further ensure that economic prosperity is realized for all members of the community. Mobile can also seek to leverage federal investment opportunities that may provide additional resilience to its economy now and into the future.

HEALTH AND WELLBEING

Planning for the future is nearly impossible if you are struggling to reach a baseline today. Improving the health and wellbeing of all residents is essential to Mobile's resilience and requires focusing on the fundamentals—safe and affordable housing, clean and healthy environments, safe communities, food access, quality education, a stable income, and accessible physical and mental health resources. Ensuring that all Mobilians can meet their basic needs day-to-day strengthens the entire community's ability to survive and thrive when Mobile next experiences an acute shock.

Key Takeaways

- *Mobile County currently ranks low in overall health outcomes and increases in extreme heat events and flooding will exacerbate public health impacts.*
- *Safe, resilient, and affordable housing is essential to health and wellbeing, but like many cities, there is not enough to meet resident needs. Mobile is turning to focus on opportunities to expand existing housing-related policies and programs to increase resilient and affordable housing.*
- *Healthy environments support healthy communities. Expanding programs to clean up and redevelop brownfield sites and vacant properties can improve neighborhood quality of life and support other resilience goals.*
- *Access to quality education and jobs training were identified as critically important for long-term individual and community resilience. Addressing external factors such as poverty, health, and housing that interfere with education will allow Mobile to enhance education and workforce development.*
- *Continuing to support opportunities for generational wealth-building for marginalized residents can increase Mobile's resilience to both acute shocks and chronic stressors.*

Assets

In the way that nutrition, exercise, and sleep are necessary for maintaining personal health, the health and wellbeing of a community hinge on equitable access to safe and affordable housing, quality education, food, healthcare, clean and healthy environments, and economic opportunities. As it relates to city resilience, assets for health and wellbeing include the services, facilities, and structures that support the essentials of housing, education, mental and physical healthcare, safety, and wealth building. In Mobile, this includes the public and private primary and secondary schools along with the University of South Alabama, Bishop State Community College, Coastal Alabama Community College, and Spring Hill College. It also includes affordable housing, access to green and natural spaces, and programming designed to reduce crime.

Mobile's ongoing efforts to diversify economic opportunities can positively impact the health and wellbeing of its residents. Local educational initiatives such as the University of South Alabama's push toward becoming nationally recognized in biomedical education and research offers the potential to prepare graduates for successful careers in healthcare, as well as increase access to quality healthcare locally. Bishop State and the City of Mobile are partnering on a Contractor's College, workforce training programs, and small business development training. The City of Mobile is also providing microenterprise loan programs to small and disadvantaged business enterprises to build equity into businesses across the City of Mobile.

Expanding access to the city's parks and green spaces through projects such as Brookley by the Bay and the Mobile Greenway Initiative will also increase exercise and recreational opportunities for Mobilians. The Greenway Initiative connects trails and parks throughout the city (including the Three Mile Creek Greenway Trail, bike lanes down Broad Street, and connections with Langan, Brookley, and Perch Creek parks). Efforts are also underway to develop marked routes on navigable waterways (e.g., rivers, lakes, canals, and coastlines) for recreational use—termed blueways (Mobile County 2022). One example of an existing blueway is the Dog River Blueway that is accessible from five launch sites throughout the river system. Integrating into this growing web of nature-based trail systems, Africatown community members, in partnership with the National Park Service and other organizations, have created an Africatown Connections Blueway planning team that is working to create a trail plan to make the water accessible to Africatown residents. This planning team is working to link the historical neighborhoods of Africatown USA State Park via a water trail following Three Mile Creek, Mobile River, and Chickasaw Creek.

Recent housing-related programs and policies also contribute to increased quality of life. In 2015, the City won a Bloomberg Innovation Grant to address blight as a major challenge to property value, pride in community, and the well-being of Mobilians. Mobile was the first city in the nation to digitally catalog and map blight, creating a blight index. Using that tool, the City of

Mobile coordinates several home repair and blight remediation programs which provide grants to aid minority contractors with up to $20,000 per unit to rehabilitate blighted properties in lower-income neighborhoods, as well as grants to needs-based homeowners for major repairs, and down payment and closing cost assistance to qualified homebuyers (City of Mobile 2023a). Mobile has funded more than 200 roof replacements in the last year with more planned moving forward. Additionally, the City of Mobile has worked with the federal Housing and Urban Development (HUD) agency to ensure Mobile's investments stay in lower income areas, so they are not abandoned to become blighted.

These programs not only encourage neighborhood revitalization but increase opportunities for building generational wealth through property ownership. In January 2023, the City also adopted the 2021 International Residential Code Coastal Construction Code Supplement for more resilient roof construction, which will increase building safety and reduce property damage during tropical storms and other high wind events. The new ordinance applies city-wide. By meeting these standards, residents and businesses can also pursue FORTIFIED designations which provide additional tax and insurance benefits. These programs and policies contribute to residents' health and wellbeing by reducing the risk of future property damage, improving building and personal safety, and thereby, increasing resilience.

Challenges

Based on a recent 2023 assessment by the University of Wisconsin Population Health Institute, Mobile County suffers from poor health, ranking 28 out of the 67 counties in Alabama for overall health outcomes (CHR&R 2023). That assessment identified that only 64% of the population has access to exercise opportunities (compared to the national average of 84%) and 39% of adults are obese (compared to the national average of 32%). In terms of access to mental health providers, the ratio of population to available professionals is 880:1 for Mobile compared to 340:1 nationwide. During development of this *Resilience Assessment*, many members of the community expressed concern over the lack of reliable public transportation options that may limit access to critical services including hospitals and grocery stores and confirmed a lack of available and accessible mental health providers.

While Mobilians are acclimated to warm weather, extreme heat events like the 2023 summer heatwaves are anticipated to be more frequent and intense in future decades, increasing the potential for heat-related health impacts. Rising global temperatures are compounded by the urban heat island effect—a phenomenon where urbanized areas with high concentrations of paved surfaces and limited green spaces experience higher temperatures than natural landscapes. Older adults, young children, outdoor workers, athletes, people with chronic health conditions, and low-income households are disproportionately affected by extreme heat. A recent study conducted by NASA in partnership with Groundwork USA and Groundwork Mobile County evaluated locations in Mobile County, AL that are vulnerable to the urban heat island

effect and flood impacts (Figure 21; Stanley et al., 2019). This data can be used to inform where investments in cooling strategies can be prioritized, particularly in communities with a higher percentage of vulnerable populations.

Figure 21. Land surface temperatures show where highly-paved and urbanized areas of Mobile experience hotter temperatures (in darker red) than outlying undeveloped areas and areas with greater green spaces and tree canopy (Stanley et al. 2019).

Despite the cost of living in Alabama being nearly the lowest of any state in the nation (Lloyd 2023), many residents of Mobile still struggle to afford housing and other necessities like food and health care. Several factors contribute to this issue, but low wages and a current lack of safe and affordable homes for all residents particularly impact Mobile's capacity to ensure city resilience.

In May 2023, the City of Mobile completed its 5-year update of the *Analysis of Impediments to Fair Housing Choice* report. This report identified major impediments to accessing fair housing in Mobile, including lack of affordable housing, aging and deteriorating housing stock, geographic segregation/unequal admittance to opportunities, home lending disparities that reduce availability of capital, restrictive or limited local land use regulations and policies, and exposure to and remediation of environmental hazards (City of Mobile 2023a).

Roughly 65% of Mobile's housing stock was built before 1980, with about 43% built before 1970 (City of Mobile 2023a), meaning that approximately two-thirds of the city's housing stock is more than 40 years old and over two-fifths more than 50 years old. While some of the older housing stock is well-kept historic homes, aging housing stock bring potential issues such as the need for lead remediation, energy efficiency upgrades, flood mitigation and/or repairs, new roofing, and other improvements, and it can be difficult to find financing or afford improvements and repairs. Lack of funding to make needed repairs or mitigation improvements can also equate to higher insurance costs, which are already rising along coastal regions throughout the nation.

Furthermore, existing policies such as FEMA's 50% rule, which requires homes to be brought up to current building standards if the cost of improvements or the cost to repair damages exceeds 50% of the market value of a structure (Federal Emergency Management Agency n.d.), also present challenges to updating current affordable housing. For example, despite some federal funding for home rehabilitation assistance for eligible low-income households available through programs such as HUD's HOME program, the market value of homes located in a floodplain tend to be lower, and the cost to replace a roof can quickly exceed 50% of a home's market value when factoring for labor and materials costs, thereby triggering FEMA's 50% rule which requires additional improvements to bring the structure up to current building standards. This indicates that homeowners who need the most financial assistance to make needed repairs or improvements are not able to access existing federal funding streams to do so. Therefore, this presents Mobile with an opportunity to devise local policies and programs that rely less on federal hazard mitigation and disaster recovery funding to assist those who need it most.

Resident Perspective:

"Although all [city systems] are important, the one that is most severely lacking in Mobile is affordable housing. We cannot pay working people $8/hour and only have places for them to rent or own that take half or more of their income." – As of April 2022, the City of Mobile minimum wage for city employees increased to $15.22.

The Mobile Housing Authority (MHA), established in 1937, is the second largest public housing authority in Alabama with more than 85 employees; MHA owns and manages 2,665 public housing units in 11 developments (MHA 2021). Exacerbating the lack of affordable housing, MHA—the public housing administrator governing public housing opportunities across the city of Mobile—has plans to remove multiple public housing developments in Mobile (Roger Williams, Happy Hills, R.V. Taylor Plaza, and Thomas James Place) by 2026 due to the poor conditions of these buildings, which will reduce the number of public housing units by 50% (City

of Mobile 2023a). Closures of these public housing developments have caused ripple effects in the surrounding community, including the closure of schools, health centers, and other essential neighborhood-based facilities. As a result, historic neighborhoods of color are experiencing significant decline in population which has a direct impact on school enrollment and declines in other key services, resulting in higher levels of vulnerability to stressors and shocks. There are currently thousands of households on the waitlist for public housing and vouchers. However, many rental property owners do not accept these vouchers so the current supply of available affordable housing is not able to meet demand. MHA also has numerous unused and unassigned vouchers leaving many in need without access to housing. MHA is a City Council-authorized board under state law, but the City has little authority over its efforts, nor does the City have access to the millions of federal dollars that fund its efforts. To begin combatting the lack of accessible housing, Mobile's Neighborhood Development department has hired an inspector to ensure existing low-income, vouchered housing is meeting the minimum standards of safety.

Housing insecurity in all its forms has been shown to negatively affect health (HUD 2022). Hazardous spaces within Mobile can also negatively impact the health and wellbeing of local residents, particularly when housing is located near industrial or contaminated sites, which are often sited near low-income neighborhoods and communities of color. Mobile also has several brownfield sites, areas impacted by the presence of real (or perceived) pollution or contamination that hinders or fully prevents use or redevelopment of the site. These sites can include abandoned motor vehicle repair shops, tire shops, gas stations, former dry-cleaning sites, vacant historic buildings and warehouses, and abandoned industrial factories or other commercial buildings. The majority of Mobile's brownfields (Figure 22) are located in or near low-income neighborhoods, where residents experience lower average health outcomes compared to other parts of the city. Mobile has many brownfields that are in various stages of assessment and redevelopment; the City has received grants from the U.S. Environmental Protection Agency (EPA) Brownfield Program to assess these sites, but additional funds are often required to act.

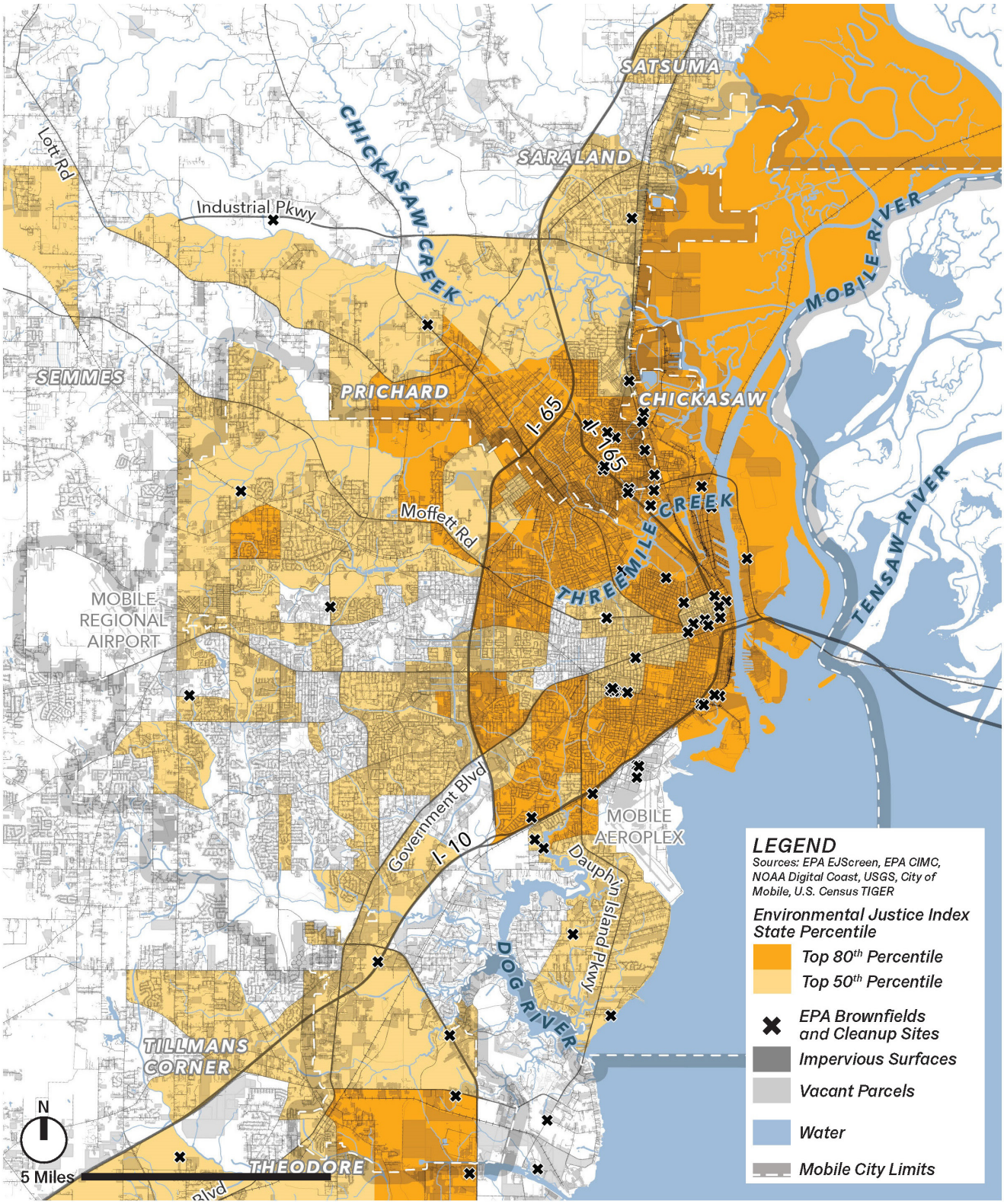


Figure 22. Brownfield sites, vacant parcels, impervious surfaces, and the U.S. EPA Environmental Justice state percentile index values for communities in Mobile. The U.S. EPA values can be interpreted as greater vulnerability (higher percentile) displayed in darker shades of orange.

Access to quality education is also essential to health and wellbeing. Public survey respondents ranked education as one of the highest stressors to Mobilians' ability to survive, adapt, and thrive. Research has shown a correlation between higher educational attainment and better health outcomes, including higher life expectancy (Zajacova and Lawrence 2018). Education can function as a driver of economic opportunity but can also reproduce disparities and widen pre-existing gaps in income, health, and generational wealth if access to quality education is lacking.

Six Mobile County Public School System (MCPSS) schools within the city of Mobile made the Alabama State Department of Education's 2022 list of the lowest 6% of schools identified for the Alabama Accountability Act of 2015 (Alabama State Department of Education 2022). While MCPSS has a higher college and career readiness rate than the rest of the state, there is room for improvement for these and all public schools in Mobile. With many of Mobile's students experiencing external issues such as poverty, hunger, learning delays exacerbated by the COVID-19 pandemic, mental health needs, and other factors not directly related to academics, learning outcomes are impacted. Meeting academic standards is very difficult when students' fundamental needs are not met.

Poverty is a critical issue that directly impacts youth access to quality education and mental health services, and stakeholders and community members identified a significant need to prioritize high-quality and accessible youth programs and education in Mobile. In Mobile County, 2023 data shows that 25% of children live in poverty compared to 23% of children in Alabama and 17% of children nationwide (CHR&R 2023). Moreover, 35% of children in Mobile County live in single-parent households (31% in Alabama, 25% nationwide). This represents a critical challenge to Mobile's long-term resilience. Youth represent the foundation and future of a community; a resilient community requires an environment sufficient to raise the next generation safely and effectively.

Breaking the cycle of poverty is difficult when many of the root causes stem from actions made decades and even centuries ago. It is therefore critical to address these gaps by promoting generational wealth-building opportunities through policies and programs to increase resilience for Mobile's most vulnerable residents.

Some of the consequences of poverty are increased crime and neighborhood disinvestment, which create a reinforcing cycle where these stressors continue to influence and exacerbate each other. Public survey respondents indicated that crime and violence was the number one source of chronic stress in Mobile. However, total crime in Mobile decreased by nearly 5% and total violent crimes (i.e., homicide, rape, robbery, and aggravated assault) declined more than 10% between 2021 and 2022 (City of Mobile Police Department 2022). Total crime has trended downward since its peak in 2017, but the number of total crimes in 2022 (9,387) was lower than each of the past 10 years, including in 2012 when the total number of crimes was 13,414. This does not mean that crime is not an issue (e.g., aggravated assault has steadily increased each

year since 2012); simply that the Mobile Police Department is continuing efforts to build on recent successes and partnering with the community to make the city of Mobile a safer place to live.

Resilience encourages a holistic focus on the root causes of health and public safety and how investments in health services, safe and affordable housing, quality education, jobs training, and generational wealth building can improve overall health outcomes and reduce crime.

Building on Existing Efforts

Health and wellbeing are rooted in quality of opportunities. Mobile is already working to provide more services to all members of the community to support priorities of health and wellbeing, including:

- Creating more new and affordable housing units. Single and multi-family housing developments are prioritized for development to support a range of living options across the community, not only in high-poverty areas.
- Continued collaboration between the City and local non-profit and religious organizations to fill existing gaps in community health needs, particularly to provide expanded options for mental health services and resources for women recovering from drug addiction and domestic abuse. Increasing public access to and awareness of these services is a priority.
- Continued development of greenways and blueways that foster improved health outcomes for all residents across Mobile as a result of greater connectivity between people and the natural environment.
- Providing expedient and equitable access to transportation, food, shelter, and other resources during emergency situations through partnerships and coalitions between the city and non-profit organizations.
- Many efforts are ongoing to reduce poverty, blight, and provide educational opportunities to support the development of generational wealth for Mobilians.
- Through a grant from the Bloomberg Foundation, the Innovation Team was created to address blighted homes and develop a process to restore and/or remove unsafe housing, therefore upgrading neighborhoods through direct investments.

Mobile can continue to provide essential services to residents and expand on existing programs. Mobile can strategically prioritize continuity of access and care in locations most at risk for shocks and stressors. Additional educational opportunities to spread awareness of existing services is one way to ensure resilience into the future.

COMMUNITIES

Mobile is a racially and culturally diverse city with a rich and unique heritage. The traditions and community events Mobilians celebrate together are what make Mobile such a great place to live. Mobile still has much work ahead to ensure community cohesion and equity for all residents, and it is committed to both strengthening existing programs as well as creating new ones. Strong, healthy communities are vital to the city's resilience.

Key Takeaways

- *An accessible, connected, vibrant, and active city promotes community cohesion, enhances resilience, and ensures longevity of a family-friendly city.*
- *Policies and programs created since 2013 to address historical inequalities must continue as the first step toward ensuring more focused resilience efforts in the areas that need it most, which will in turn fortify citywide resilience.*
- *Fiscal transparency and responsibility build trust between residents and City government.*
- *An informed and engaged community is a resilient community—community input to citywide planning ensures a mechanism for making all voices heard.*

Assets

Communities are comprised of people interconnected through shared experiences, spaces, histories, and cultures. The importance of interconnected, strong community can be seen in disasters, such as during and after hurricanes. People rely on those around them and the networks in which they are embedded. Founded more than 300 years ago, the community of Mobilians today is built on a long and storied history. Aptly described as the "largest small town you'll ever visit," there is a deep connection to the area and often people from Mobile stay in Mobile. When thinking of the assets of a community, the most critical assets are the people and their bonds to each other and to the place. This includes everything from knowing neighbors to participating in recreational and celebratory events to partaking in civic activities. This is important because strong ties to community and between residents generate greater community resilience in times of personal and community need. An accessible, connected, and vibrant city builds that cohesion and trust buoys residents individually and as a whole.

In addition to the people, other assets that make up community include: the places people gather, connect, and interact with each other; cultural celebrations and historic resources; and inclusive, transparent government processes. Important community places include Mobile's vibrant places of religious worship, including churches, synagogues, and temples. Local non-profits, businesses (large and small), and restaurants serve as the lifeblood of Mobile's economic community culture, serving both residents and visitors alike. The Mobile Museum of Art, the History Museum of Mobile, and the Mobile Saenger Theater—among many others—bring cultural experiences from outside of Alabama to the community of Mobile while ensuring the city's own history is remembered. Cultural organizations that promote these and other institutions include the Mobile Arts Council, Mobile Opera, Mobile Symphony, Mobile Ballet, and Playhouse in the Park. Furthermore, Mobile's community centers provide classes and activities, including seasonal sports leagues; there are nine large centers and six small centers located in neighborhood parks across the city (City of Mobile 2023c).

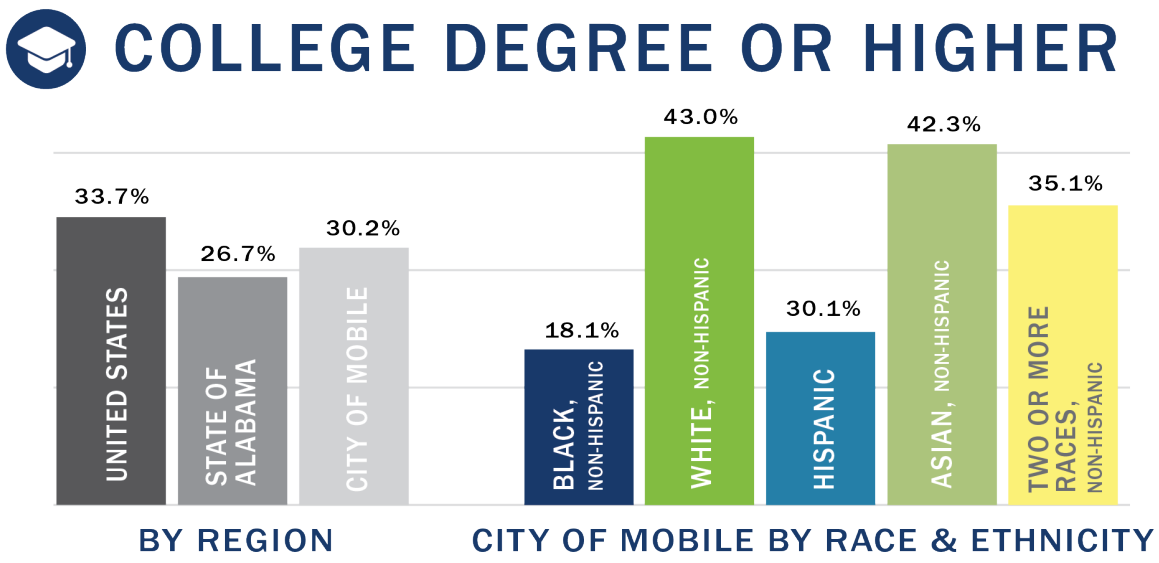
Many of the above-mentioned cultural resources intersect with a mosaic of historic neighborhoods included in the National Register of Historic Districts located in downtown Mobile. Many other parts of Mobile, including Africatown and Midtown, also have rich cultural histories that have helped shape the unique essence of each community, even if these places are not yet officially designated in the national register. The diversity of Mobile's culture today is a reflection of its long and complex history of diverse land uses, including cemeteries, burial grounds, historic landscapes, historic buildings, and natural spaces which are all sensitive to shocks and stressors. Other critical assets are the cultural anchors such as the working waterfront and the cultures that were brought here because of it.

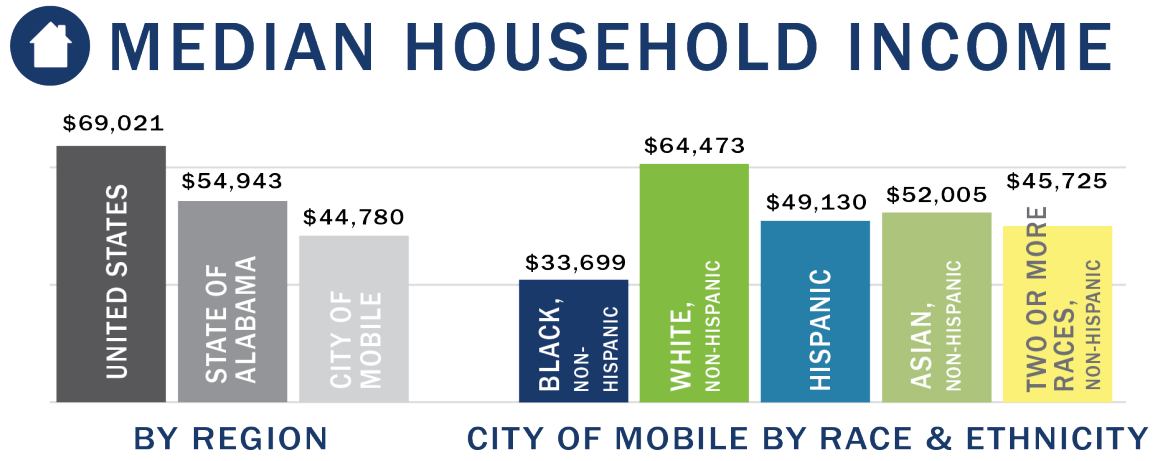
Cultural activities and celebrations are wide ranging and include events such as Mardi Gras, Art Walk, Greek Fest, Latin Fest, Juneteenth, the Africatown/Clotilda Remembrance Ceremonies, and many more. Cultural activities enhance the sense of community in Mobile and can provide direct avenues for funding valued programs and entities that support community improvements. Such events also bring people together to learn more about local cultural history and community needs.

Underpinning and connecting the multifaceted events and locations that support and celebrate our history and heritage is the City government. An important aspect of a cohesive and inclusive community is trust in the government to be good stewards of the physical, cultural, and fiscal resources of the community. A key component to this is transparent and effective processes from budget to prioritization to communication.

Challenges

As Mobile works to strengthen its resilience for the future, it is important to acknowledge the city's past—the good and the bad. This includes understanding how the racial and geographic disparities in resources, life outcomes, and hazard risk seen today stem from policies and practices in generations past (Figure 23). Acknowledging this past brings an opportunity for Mobile to grow. Focusing resilience-building efforts in communities that historically have been left behind will strengthen resilience for all Mobilians.





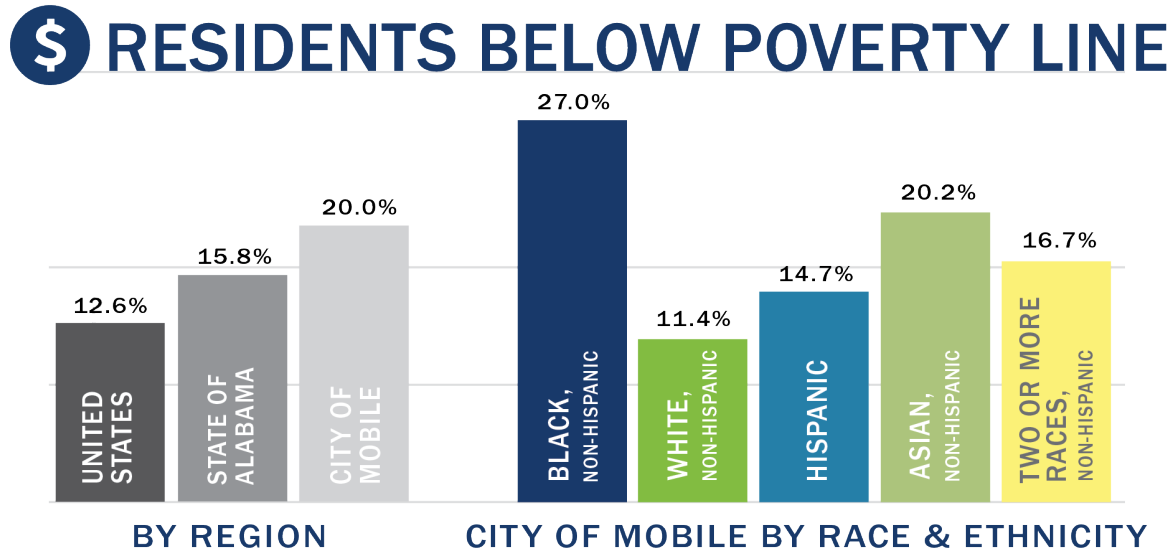


Figure 23. Summary of household income, educational attainment, and poverty data derived from the 2021 American Community Survey 5-year Estimates (U.S. Census Bureau 2021a); information collected prior to annexation in 2023. Only racial and ethnic groups that comprise 1% or more of total population are represented.

Challenges to the community come in the form of chronic stressors and acute shocks that strain and reduce the connections and trust between residents and with City government. In Mobile, one of the greatest stressors that strain community is historic, structural racism that has perpetuated multigenerational inequities. The past cannot be changed, but its role in shaping the city must be acknowledged and addressed in order to plan for a more resilient future.

Resident Perspective:

"After an acute shock event that tests the ability of a community to recover, trust is one of the most important currencies. Incoming leaders should tackle uncomfortable conversations head on to get around this well before a disaster."

Lingering gaps between Mobile neighborhoods in health, wealth, education, life expectancy, and other factors that affect quality and longevity of life (Figure 24) stem in part from discriminatory policies decades in the past that limited opportunities and resources for certain people and communities based on race and other positions. Today, spatial patterns of life expectancy mirror spatial patterns of race and ethnicity (Figure 25), with predominantly communities of color experiencing shorter average life expectancy.

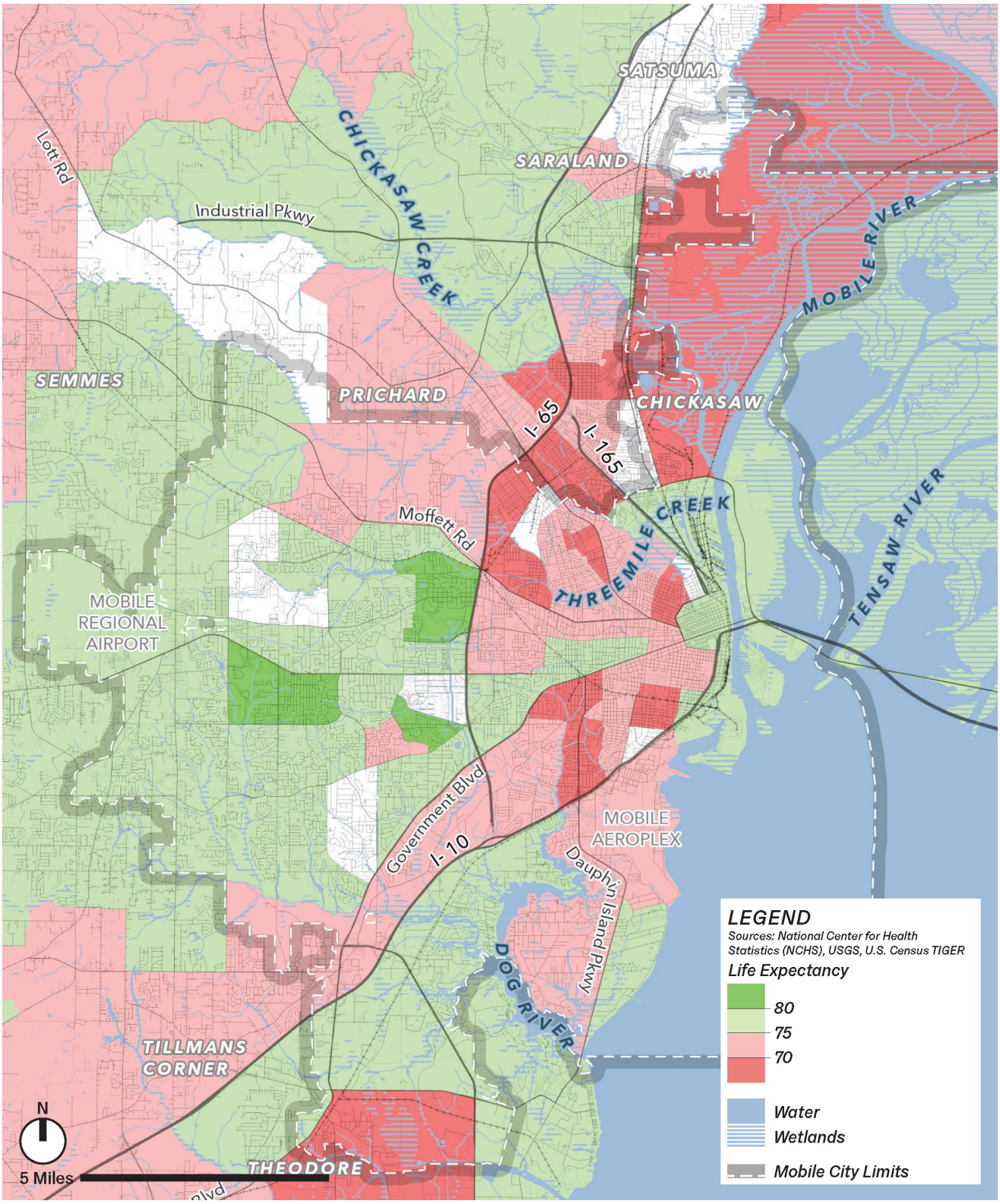


Figure 24. 2010–2015 life expectancy estimates at birth by census tract, National Center for Health Statistics. Life expectancy in the State of Alabama is 75.5, the third lowest in the nation after Mississippi and West Virginia. The red tracts in Mobile represent areas of even lower life expectancy (less than 75 years). These differences in life expectancy correlate with race and poverty.

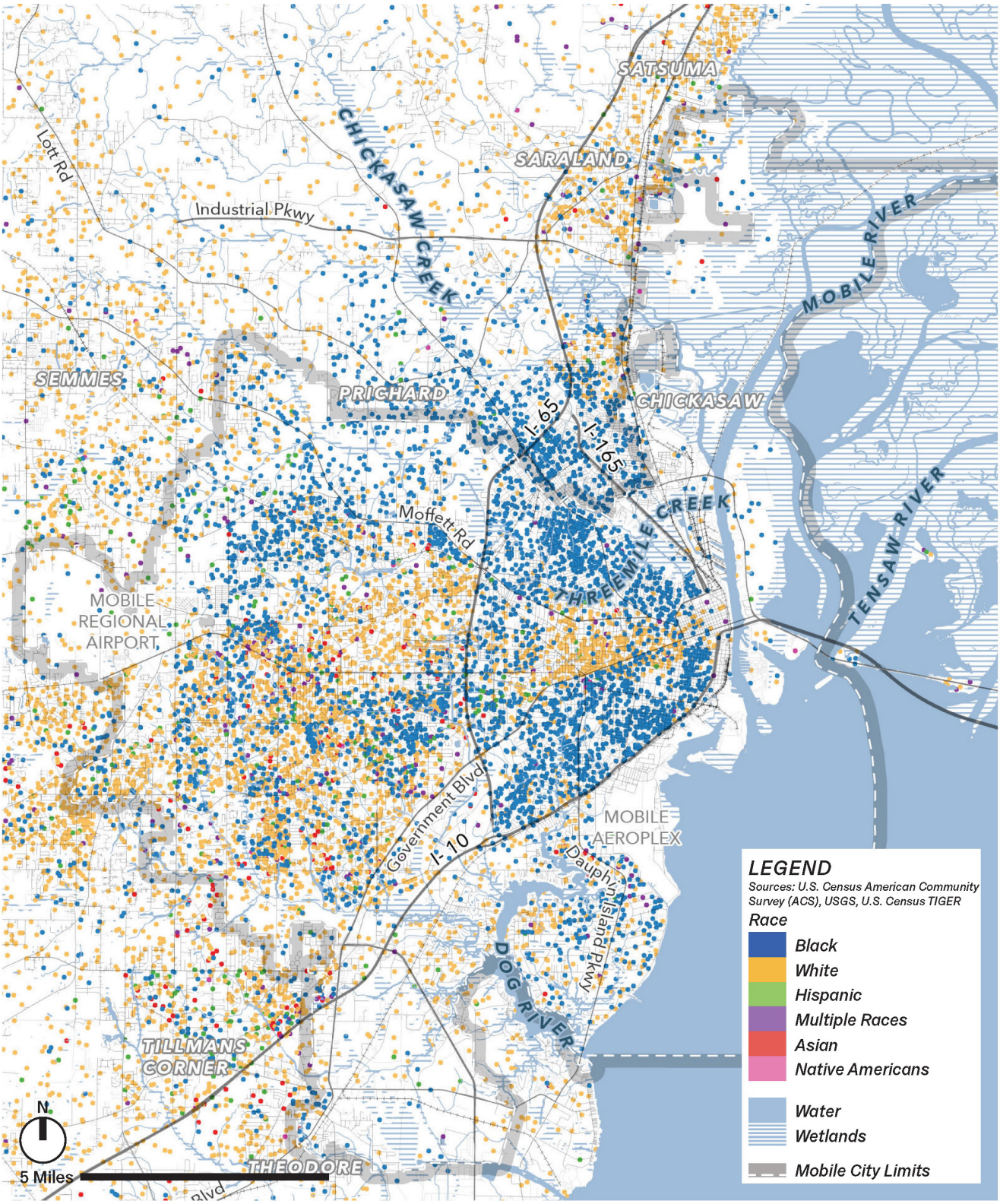


Figure 25. 2022 population by race, American Community Survey.

The City of Mobile has created multiple programs to combat the effects of past discriminatory policies like redlining, the federal practice started in the 1930s that facilitated racially segregated housing through policies such as refusing to lend mortgages or insure homes in predominantly African American neighborhoods (marked in red as "hazardous" in the 1937 Home Owners' Loan Corporation map in Figure 26). The acknowledgement and acceptance of these historic inequities and their present-day impacts is a necessary, critical step toward a truly resilient Mobile.

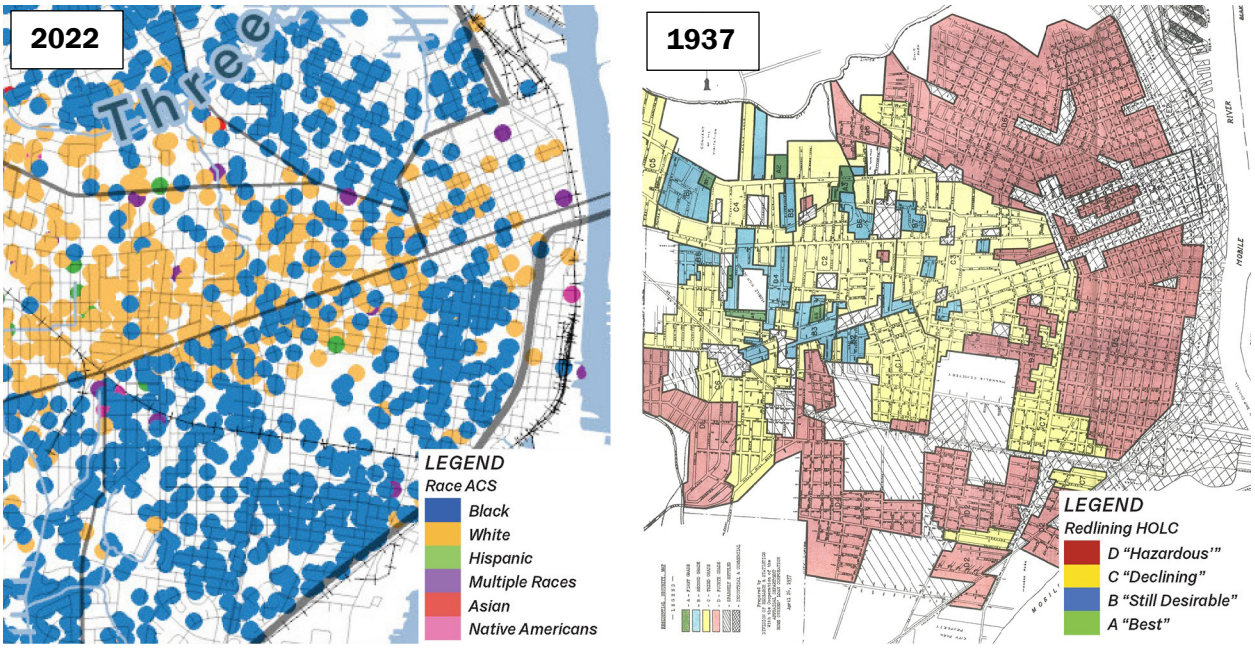


Figure 26. Left panel: 2022 population by race in Downtown Mobile, American Community Survey. Right panel: Historic redlining in Mobile in the 1930s conducted by the federal government. The different colors represent areas designated as least to most risky. Red areas were those designated as "hazardous," and were excluded from homeownership and lending programs. Most of the red, or "D – Hazardous," areas were neighborhoods inhabited by Black residents. The ramifications were that Black homeowners could not get home loans backed by government programs or mainstream banks.

REINFORCING SYSTEMS

Allocation of resources has a direct impact on community resilience when considering how dollars are invested. Often, investment decisions include a cost-benefit analysis to support sound stewardship of public money. They rely on comparing the dollar value of projects and investing in areas where there would be greater return on investment. Unfortunately, cost-benefit analyses often do not consider the past or the cultural, individual, or community value of projects or efforts which can lead to investment patterns that reinforce and widen inequities. Being aware of this challenge helps avoid concentrating dollars spent on infrastructure improvements, flood protection, and other aspects of health, economy, and natural systems resilience in wealthier areas.

Hurricanes were identified by residents and municipal staff as the greatest acute shock in Mobile. While natural disasters strike without prejudice, the experience of withstanding them can be less equitable. Some parts of the city are more equipped than others to weather and recover from storms, from the ability to evacuate (e.g., access to transportation out of town or to shelters, passable roads) to the capacity to recover (e.g., fewer financial resources for recovery, both at the individual and systemic level). Individuals take pride in themselves and their communities for successfully weathering disasters and other challenges; however, residents who live in neighborhoods that do not recover at the same rate as the city overall can feel they are being asked to be "resilient" individuals rather than seeing meaningful action taken to address issues. This can lead to the erosion of trust in the government and strain the critical sense of community leaving residents feeling isolated or forgotten. The same is true of chronic stressors and investment. Investment in programs, dollars, and City staff time directly impacts resident quality of life. The distribution of resources is directly related to other aspects of community well-being, health, economic opportunities, and educational opportunities.

GREATER HAZARD EXPOSURE

Another present-day effect of historically inequitable housing policies is the increased exposure of impacted communities to hazards, particularly flooding. Minority residents of the past were often only able to secure housing in undesirable areas which were in low-lying, flood prone areas. The majority minority communities that exist in these areas today have deep roots and a legacy of endurance that create an understandable reluctance to relocate as well as persistent fiscal barriers, regardless of the possibility of increased exposure to hazards. Challenges with stormwater management east of I-65 also serve to compound the effects of flooding in these low-lying neighborhoods. The combination of these factors means that people of color are more likely to experience flooding in Mobile (Figure 27).

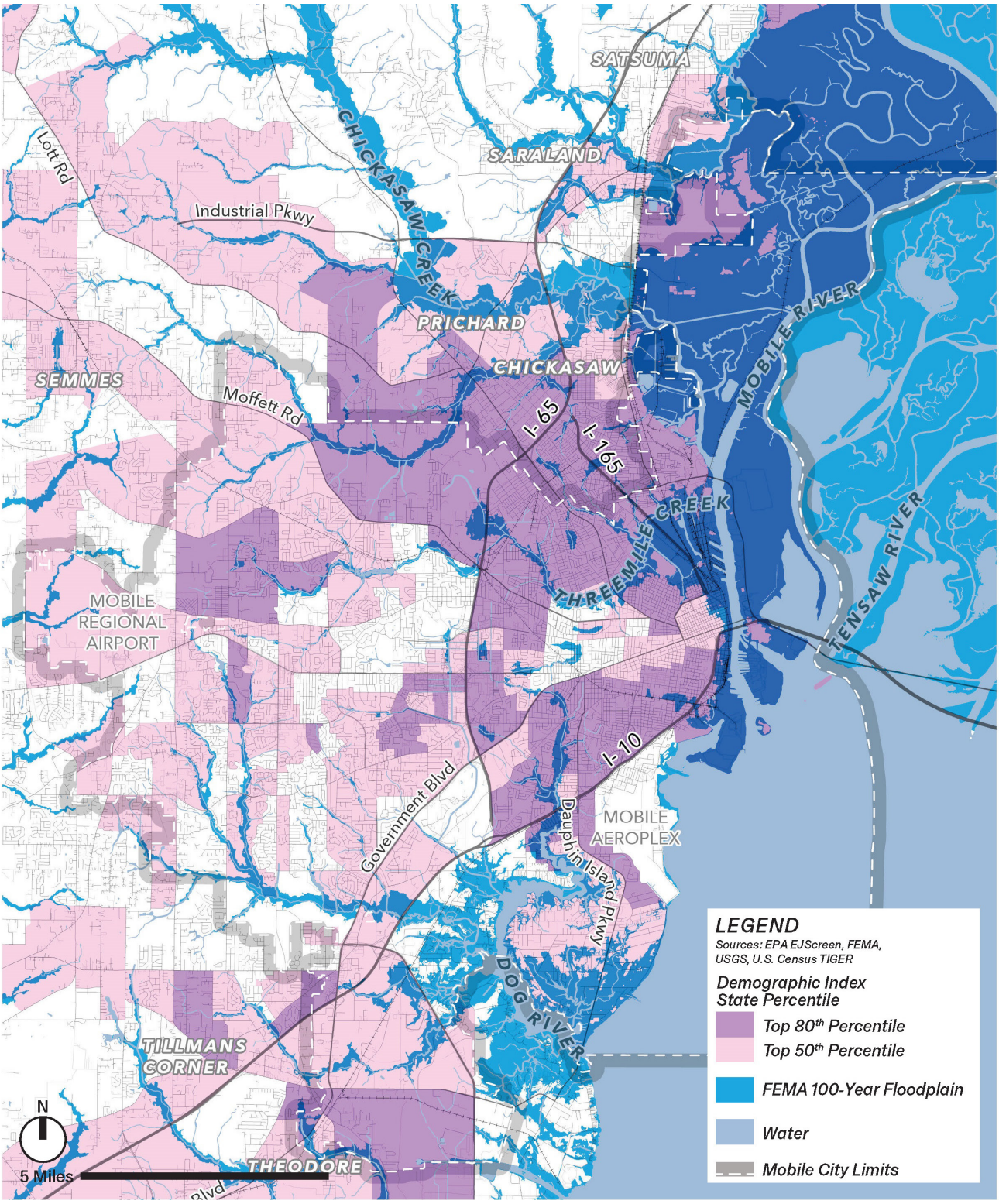


Figure 27. Map showing the intersection of race and poverty with flood risk. The color blocks are census tracts color coded to reflect percentile in the national demographic index. The demographic index is a combination of income and race, with higher percentiles indicating higher proportions of residents that are persons of color or low income. In Mobile, there is a greater chance of living in a floodplain if you are low income or a person of color. This does not include flood risk from factors such as rainfall or compromised/overwhelmed flood infrastructure.

INCLUSIVE PLANNING AND PROCESSES

Another barrier to building strong communities is when processes or decisions do not feel inclusive or transparent to residents. There are several ways this can ripple through the trust and cohesion of a community. Large efforts, such as Map for Mobile, have been inclusive of residents with major endeavors put forth to incorporate a range of perspectives. Mobile can continue to build on these efforts by taking into consideration underlying systems and challenges that make it difficult for some residents to meaningfully participate in public processes. For example, the location and timing of public meetings or community engagement activities impact who is able to show up—residents whose work or childcare duties conflict with a meeting time, residents reliant on public transportation, or mobility-challenged residents may have a more difficult time attending a specific meeting. A variety of meeting times, venues, and formats can ensure a broader range of participants. Beyond community engagement in the planning process, an ongoing dialogue with residents throughout the implementation of a project provides an opportunity to build confidence and trust, particularly if concerns are clearly heard and addressed.

Building on Existing Efforts

Good work is already happening to strengthen the connections between residents and to invest in the people of Mobile. Since the implementation of the CIP in 2016, every City Council district has an equal amount of funding which assures every community is being improved: $3 million/district through FY2023 and $4 million/district beginning in FY2024. Examples include:

- Revitalization of Downtown, which is now a vibrant and thriving area.
- Capital Improvement Projects are explicitly designed to acknowledge and honor history.
- Africatown Welcome Center–$3.2 million funded (in 2021) from RESTORE Act–target date for project completion is 2024.
- Clotilda Museum and Tours, Africatown Heritage House.
- Citizens Academy helps build transparency and understanding of how city processes work and how to engage.
- Fiscal management and sharing of City spending. Many residents reported that they found those communications to be valuable.
- Family-friendly, vibrant Mardi Gras celebrations as well as other, diverse cultural celebrations inclusive to all residents of Mobile.
- Recent addition of the Community Affairs Department.

- Parks and Recreation activities such as Art Walk that focus on every cultural and social aspect of people living within the City of Mobile to ensure One Mobile.

Moving forward, the City can consider prioritizing resource investments in programs that address systemic inequities to enhance resilience. The City could also foster more public participation in educational, informational, and participatory efforts by ensuring that timing and location of events align with resident availability (e.g., after work, within walking/biking distance).

NATURAL RESOURCES

Mobilians engage with the natural world in many ways, all of which rely on the availability and quality of natural resources including air, water, and green and blue spaces. Maintaining and improving the health of the city's natural resources is central to Mobile's identity as a coastal city and necessary to sustain the region's bustling economy. Access to Mobile's natural spaces, parks, and waterways is highly valued for recreation and is essential for the health and wellbeing of Mobilians.

Key Takeaways

- *Maintaining and enhancing Mobile's rich natural resources is essential to Mobile's culture, economy, community health, and resilience.*
- *While Mobile's natural resources are threatened by future climate and development trends, green and blue spaces in the city can also serve to buffer communities from the harshest impacts of extreme heat and flooding.*
- *Survey respondents identified parks and recreation as one of the most valued assets contributing to Mobile's resilience, but less than 40% of Mobilians live within a 10-minute walk of a park. Expanding access to high-quality green spaces for all Mobilians can improve community health and resilience.*
- *Mobile is a Water City and a Port City with a working waterfront. Finding a balance between supporting economic production and maintaining the health of waterways and other natural resources is a critical consideration for Mobile's long-term resilience.*

Assets

Mobile's natural resources and ecosystems are not only valuable to the local community, but to the State of Alabama and the northern Gulf of Mexico as a whole. Located at the mouth of the Mobile-Tensaw River Delta (or Mobile River Basin—nicknamed North America's Amazon by native son E.O. Wilson), Mobile thrives alongside biodiverse habitats, including 200,000 acres of natural estuary that also brings significant value to local communities and economies (Figure 28). The Mobile Bay is 1,070 km^2 (413 $miles^2$) in area and 51 km (32 miles) in length, making it the sixth largest estuary in the nation (ADCNR 2015; MBNEP 2008). This region is home to many types of natural habitats, including wetlands, barrier islands, seagrass beds, and oyster reefs (Auburn University 2004; Valentine et al. 2013), which support more than 300 species of birds, 310 species of fish, 68 species of reptiles, 57 species of mammals, 40 species of amphibians, and 15 species of shrimp (ADCNR 2015). Mobile intersects the Mississippi and Atlantic Flyways which are important corridors for migrating birds and emphasizes the value of birding as recreation. The diversity of flora and fauna of Mobile Bay contributes significantly to the State's overall biodiversity, making it the state with the largest number of different plant and animal species east of the Mississippi River (Stein 2002).

Due to these drivers, the Mobile Bay watershed is a hotspot for scientific research and conservation efforts. Watershed management plans (approximately 19 at the smallest drainage area scale at the time of writing) and larger regional watershed plans, such as the 2019 Habitat Conservation and Restoration Plan for Coastal Alabama and the Comprehensive Conservation and Management Plan for Alabama's Estuaries and Coast, are unconstrained by the geopolitical borders that typically define traditional city plans (MBNEP & TNC 2019; MBNEP 2019). The two most relevant watershed plans for Mobile include the Dog River Watershed Management Plan (MBNEP 2017) and the Three Mile Creek Watershed Management plan (MBNEP 2014). Localized plans and regional plans serve important roles in guiding ecosystem restoration and conservation efforts that sustain and improve natural resources balanced against the perspectives and values of local stakeholders. Please refer to those documents, including the Alabama Coastal Comprehensive Plan (USACE 2015) for additional information and a complete list of watershed management plans for coastal Alabama.

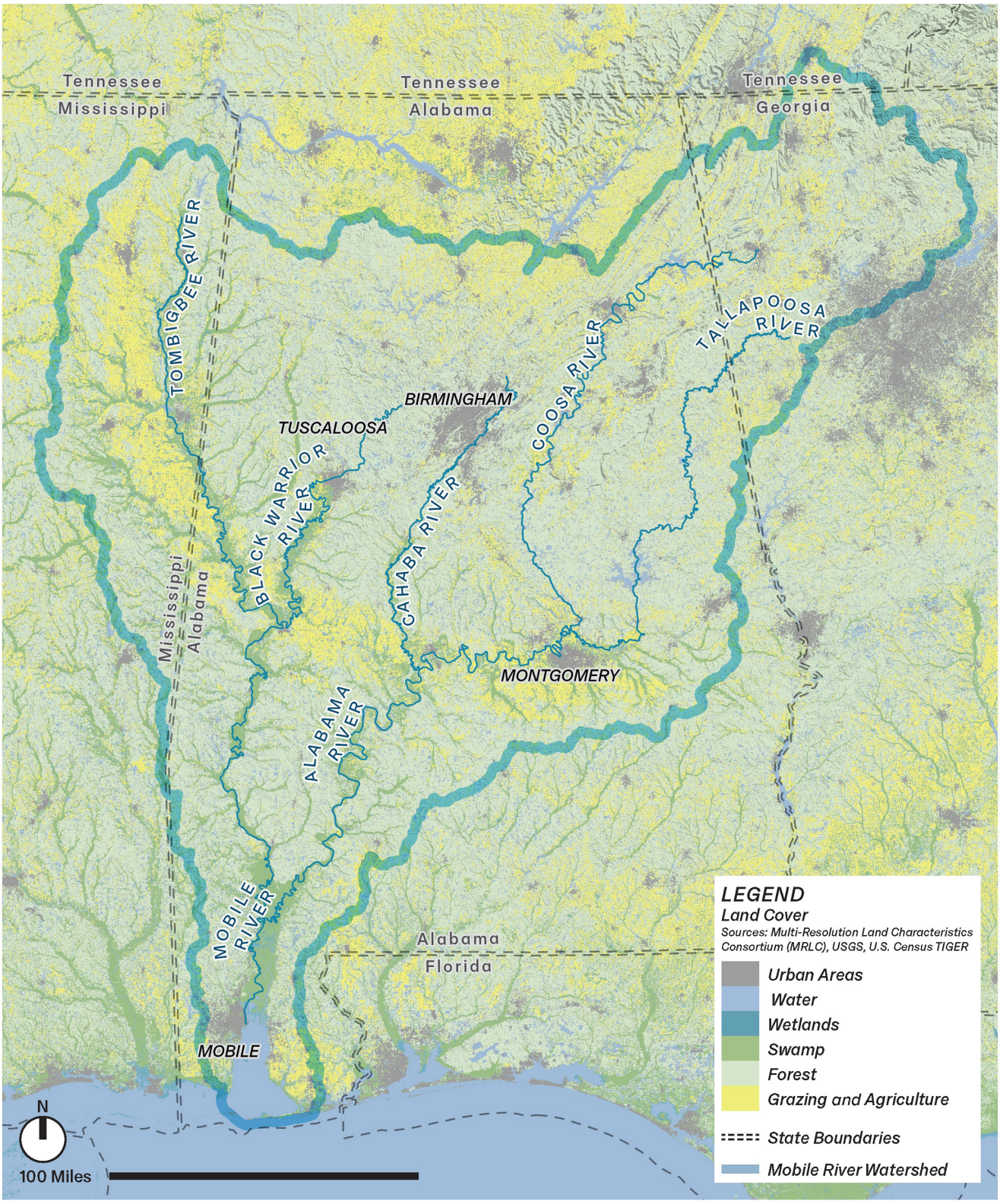


Figure 28. The Mobile Bay Watershed and associated land cover types.

Healthy and productive ecosystems also drive elements of Mobile's economic engine. Mobile's growing ecotourism industry connects visitors with nature and relies upon accessible, biologically diverse, and abundant natural spaces. Alabama's seafood industry relies on landings of shrimp, blue crabs, striped mullet, oysters, and ladyfish. The commercial marine seafood industry in Coastal Alabama provides more than 12,000 jobs, $555 million in sales, $219 million in income, and $287 million in general profits each year (National Marine Fisheries Service 2018). Saltwater recreational fishing has also provided 16,100 jobs in Alabama, second only to West Florida (60,200 jobs). The success of these fisheries is dependent on environmental factors including nutrients and water quality. Recent research has shown that high sources of nutrients derived from anthropogenic and natural sources contribute to fluctuations in dissolved oxygen concentrations within the Bay waters, driving seasonal occurrences of "Jubilee" events (Montiel et al. 2019).

Jubilees are valued by local communities because they result in easy-to-catch seafood as bottom-dwelling fish, crabs, and shrimp move to surface waters, buoyed up from the depths by low oxygen conditions. Jubilee events have been reported by residents within the Mobile Bay estuary since at least the early 1800s (Valentine et al. 2013) and represent an important cultural connection between local residents and the natural environment. Unfortunately, depending on the severity of the low oxygen event, Jubilees can result in large-scale fish, crab, and shrimp kills which can result in significant economic impacts (see Montiel et al. 2019 and references therein). Despite seasonal occurrences of low oxygen, Mobile Bay has been characterized by relatively low nutrient concentrations compared to other similar estuaries within the United States (Pennock et al. 1999; Valentine et al. 2013). Considerable investments have already been made by organizations such as the Dauphin Island Sea Lab, the University of South Alabama, and the Mobile Bay National Estuarine Program (NEP) in monitoring and researching long-term water quality patterns of Mobile Bay, a location that serves as a critical bottleneck between the Mobile Bay Watershed and the Gulf of Mexico.

Flourishing natural environments are an important part of balanced human environments. Natural environments within urban areas are often termed "blue" or "green" spaces based on whether they intersect with water or are located on land. Green spaces include parks, playgrounds, and recreational fields, whereas blue spaces are ponds, lakes, rivers, canals, and wetlands (van den Berg et al. 2015; Völker and Kistemann 2011). These spaces provide opportunities for outdoor physical activities, social interaction, and relaxation—often seen as determinants of the health of urban residents (van den Berg et al. 2015). Mobile has a total of 72 parks including Bienville Square, Cathedral Square, Washington Square, Langan Park, Medal of Honor Park, and Cooper Riverside Park. Mobile has also set aside 1,709 acres of land to conserve natural green spaces, hosts nearly 16 miles of trails, and provides 7 canoe, kayak, and boat launches. Although only 39% of residents live within a 10-minute walk of a park (compared to the national average of 55%), the parks are relatively evenly distributed across the community

in terms of categories such as age, income, and race/ethnicity (TPL 2023). Further, the public identified Mobile's Parks and Recreation Department—which provides community programs and dynamic green spaces to all members of the community—as one of the most valued assets contributing to the city's resilience.

Mobile Bay is also the center point for many ongoing conservation initiatives and ecosystem restoration projects that benefit both the people and natural resources while providing long-term resilience. Such efforts are possible due to the many organizations and cross-agency partnerships committed to preserving Mobile Bay.

Challenges

Mobile, like other coastal cities, is facing urban and economic expansion which often comes at the price of robust and resilient natural spaces. The climate and geography of the Mobile Bay area are responsible for the rich plant and animal diversity found in its ecosystems, yet these factors also result in the extensive rainfall and subsequent runoff that threatens those ecosystems with fertilizers, chemicals, sediment, oil, trash, and sewage (MBNEP 2008). A recent assessment finds that the Mobile Bay Watershed has experienced an increase of woody wetlands and a reduction in herbaceous (grassy) wetlands between 1984 and 2019, with a total of 106 mi^2 of wetlands observed within the area in 2019 (Muñoz et al. 2021). Urban development, sea-level rise, and storm impacts are attributed to observed wetland area gains and losses. Loss of habitat can adversely affect native plants and animals by removing key refuges, resources, and by allowing for more opportunistic invasive species to dominate.

Invasive species create significant problems for the city's ecosystems, particularly its waterways and greenspaces. Island apple snails, Chinese tallow, wild taro, hydrilla, privet are just a few species that have entered the area. Mobile County has been reported to have over 360 different non-native species making it the most of any County in Alabama (MBNEP 2017).

Finding a balance between meeting the needs of industry and maintaining the health of natural resources is a critical consideration for long-term city resilience. Industrial production of chemicals, pulp, and paper products, significant industries in Mobile and the surrounding areas, produce effluent that in turn can cause environmental stress. Portions of six waterways that intersect with the City of Mobile are currently on the Alabama Department of Environmental Monitoring 303-D list of impaired waters, meaning the State is required to established maximum allowable limits on certain contaminants to comply with federal water quality standards. These include: Toulmin's Spring Branch, 3 Mile Creek, Dog River, Halls Mill Creek, Rabbit Creek, and parts of the Mobile River (ADEM 2022). One notable potential source of contamination to the Mobile River noted by the public is the coal ash pond at Plant Barry which is currently being evaluated.

Elements of a changing climate, including temperature changes, sea-level rise, and shifting rain patterns may also impact the long-term health and resilience of Mobile's valued plants and animals. Vulnerable species, particularly those that rely on a narrow range of ideal environmental conditions and those already facing declining populations, are most at risk of negative outcomes because of rising temperatures or shifting temperature extremes. Rising temperatures also mean warmer water that encourages the growth of oxygen-depleting algae and harmful bacteria like vibrio, both of which negatively affect aquatic life. Unpredictable and shifting rain patterns can also create droughts and floods which disrupt natural life-cycles of species (such as frogs and salamanders) that rely on the regular ebb and flow of consistent water sources (ADCNR 2015). Some characteristics of coastal habitats can enhance their ability to adapt to rising water levels and remain productive over time. For wetlands, this includes the availability of natural space adjacent to existing habitat into which plants and animals can migrate as seas rise and habitats are lost (Figure 29). Ecological resilience of coastal habitats along Mobile's coastline is estimated to be average/low along the downtown waterfront and Port, indicating a lack of opportunity for wetlands to adapt to rising waters (Figure 30); more resilient habitats are identified north of Mobile (within the delta) and to the south (Dog River) (Anderson and Barnett 2019).

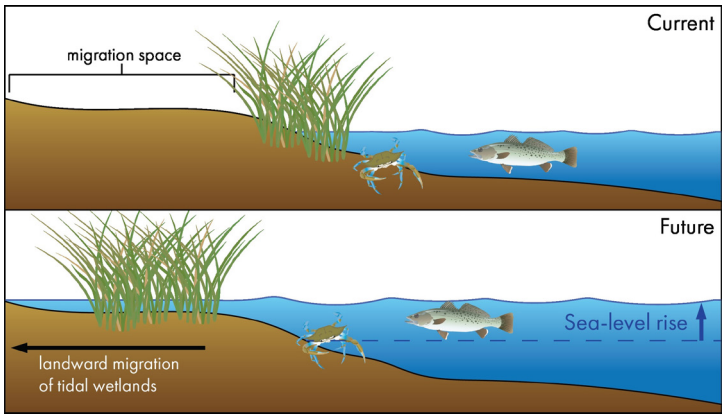


Figure 29. A conceptual diagram of wetland migration space (The Nature Conservancy n.d.-b).

Conserving and restoring coastal habitats are of significant focus for many states across the northern Gulf of Mexico, particularly those impacted by the 2010 Deepwater Horizon oil spill and subsequent economic settlement. In Alabama, this source of funds as well as many other funding streams from private and federal sources fuel scientific research across the Mobile River Basin. For example, researchers from the University of South Alabama in collaboration with other experts across the Gulf have investigated the capacity of oyster reef living shorelines to increase shoreline resilience through reduction of wave energy (Morris et al. 2021) and have developed guidelines for implementing nature-based solutions for coastal highway resilience (Webb et al. 2019).

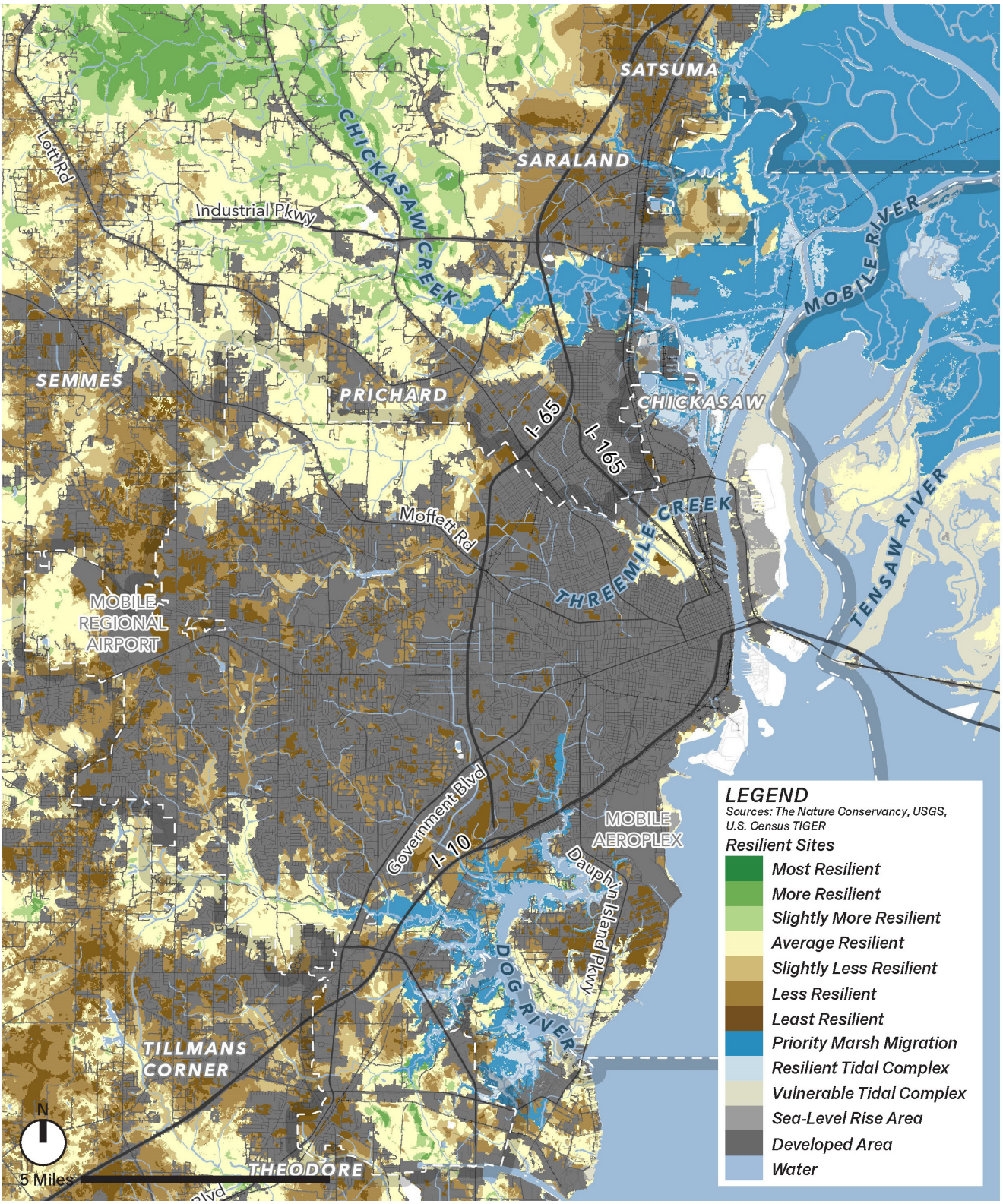


Figure 30. A mapped assessment of the ecological resilience of open spaces in the Mobile area. A site's resilience score is an estimate of its capacity to maintain species diversity and ecological function as the climate changes (The Nature Conservancy n.d.-b).

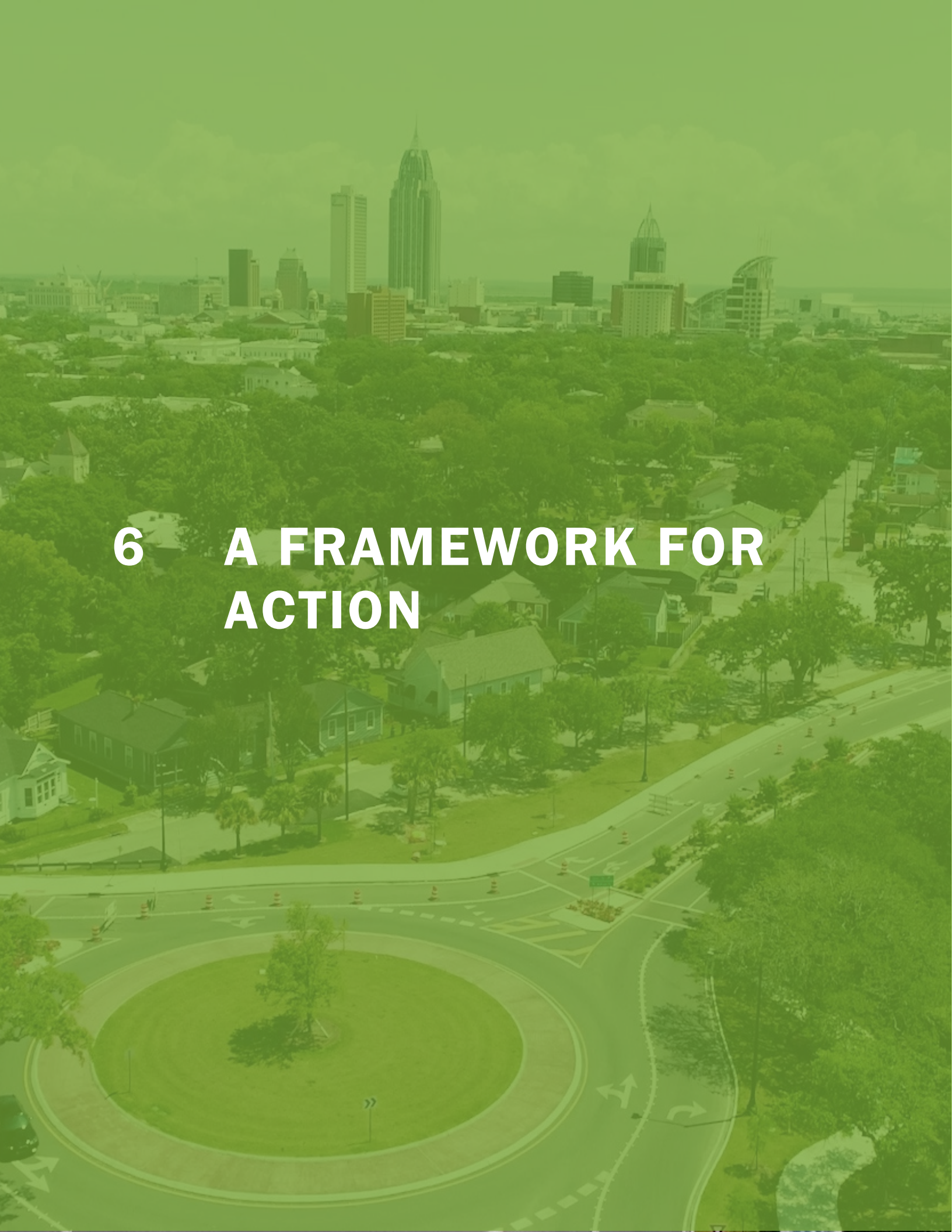
Building on Existing Efforts

Mobile's continued investments in preserving and improving access to—and quality of—blue and green spaces will provide benefits to both humans and nature while maintaining the strong identity of Mobile as a water city. Mobile is already advancing this priority through multiple programs and initiatives:

- Completing Brookley by the Bay, a new park under along Mobile Bay adjacent to Brookley Airfield, will provide new opportunities for the community to access ecosystems by the water's edge, including tidal flats, marshes, forested wetlands, and shallow lagoons (SCAPE 2023).
- Continuing efforts to manage urban tree canopies strategically and proactively to ensure urban heat reduction and habitat provisioning while preventing stress to water systems caused by roots (e.g., the proposal to inventory City-maintained trees; City of Mobile 2023b). Similarly, tree planting initiatives should ensure the right species of tree are planted in appropriate areas to reduce the burden of long-term tree canopy maintenance while ensuring long-lasting access to green space for all residents.
- Implementing wetland habitat protection and restoration efforts aimed to restore for injuries incurred to natural resources impacted by the 2010 Deepwater Horizon oil spill and other hazardous events—including deployment of living shorelines at the Alabama Port, Brookley by the Bay, and many other locations along Mobile Bay's western shore (The Nature Conservancy n.d.-a). This includes implementation of shoreline restoration projects adjacent to the city (e.g., Dauphin Island Causeway Shoreline Restoration Project). Advancing ecosystem conservation and restoration efforts that seek to prioritize efforts at regional watershed scales (e.g., the 2019 Habitat Conservation and Restoration Plan for Coastal Alabama, Dog River Watershed Management Plan, and the Three Mile Creek Watershed Management plan) remain critical for ensuring funds are used efficiently to maximize co-benefits to people and local ecosystems.
- Public-private partnerships encouraged the development of the Marine Debris Interceptor and the Litter Gitter deployment programs. These devices revolutionized the City's ability to collect trash debris from mid-stream waterways before they reach natural waterways. These were developed through partnership among the City of Mobile, Mobile Baykeeper, Outfall Protection, Alabama Pipe and Supply, Osprey Initiative and others (City of Mobile 2014). In 2022, these devices and other collaborative litter collection initiatives removed 257,000 pounds of litter (Greenberg 2023).

Green space is important for the long-term mitigation of chronic stressors on the community and environment. Green space can act as a natural buffer, enhance commerce (e.g., tourism and commercial fisheries), improve the health of residents, and support the durability of ecosystems. Continuation and expansion of programs that bring residents closer to nature can enhance the

Mobile's resilience. Mobile can also continue to prioritize maintenance of existing parks and development of new ones to ensure the positive connection between people and ecosystems. Supporting partnerships between Federal, state, public and private entities is critical for advancing planning and implementation of habitat protection and restoration projects which are essential for ensuring the continuity of ecosystem services to all communities that rely on Mobile Bay.



6 A FRAMEWORK FOR ACTION

Over the last 10 years, great strides have been made in becoming a more resilient City. Nevertheless, resilience requires a **long-term vision** for Mobile's future in the face of increasing and uncertain challenges combined with **actionable steps that can start today** to make the community safer, stronger, and more adaptable. This approach will ensure that Mobile remains a family-friendly and business-friendly city for years to come.

The development of actions for the Resilience Plan will be guided by the following seven pillars that organize the City's strategic initiatives, including the 1,000-Day Agenda and the Map for Mobile Action Plan. This consistent framing will ensure that opportunities identified through Mobile's resilience planning process are embedded in the day-to-day work and existing plans of the City and its partners so that Mobile is building resilience in everything it does.

APPENDIX A: PUBLIC SURVEY AND OUTREACH FOR ASSESSMENT DEVELOPMENT

Surveys were used in this planning process to elicit feedback from stakeholder groups and the public to capture residents' perspectives on resilience in Mobile. The information was used to provide an understanding of how Mobilians perceive resilience in their day-to-day lives.

An initial survey was circulated to Advisory Groups 3/24/2023 and 4/14/2023 to gather initial feedback. This survey was then modified slightly to reach a more general public audience and circulated to the broader community 3/27/2023 and 4/24/23 2023. The public survey consisted of 19 questions that prompted community members to reflect on the meaning of resilience for their community. A copy of the public survey is provided at the end of this appendix.

- **April 8th- Spring Fling at Dotch Community Center**
- **April 13th-23rd Thrillville at Ladd-Peebles (carnival)**
- **April 14th- LoDa ArtWalk (Lower Dauphin Arts District)**
- **April 15th- Saturdays at the Coop- Cooper Riverside Park**
- **Mar 31 – Sun, Apr 2- South Sounds Music & Arts Festival**
- **92 ZEW and Affiliated Stations – Kelli Finley radio interview 4/13/23 Segment Aired 4/19/23**
- **Lagniappe Publication Ad 4/19 - 4/25/23**
- **April 23rd -MudBottom Revival Music Festival 7-11pm**
- **Steppin' Out News Magazine Publication 4/21/23 -4/28/23**

Copy of the Public Survey:

1. CITY RESILIENCE is the capacity of individuals, communities, institutions, businesses, and systems within a city to **survive**, **adapt**, and **thrive** no matter what kinds of acute shocks or chronic stressors they experience. Often, the impact of an **acute shock** (a sudden, extreme event that threatens a community, like a hurricane) is made worse by **chronic stressors** (long-term pressures that weaken the fabric of a community over time, like aging infrastructure and social inequality). A resilience approach plans holistically for a safe and thriving future for the city's people, economy, and physical environment. *Please consider this definition of CITY RESILIENCE when thinking about what resilience means to you as a resident of Mobile.*

1. For each of the following systems or assets, rate on a scale of 1 (not very important) to 5 (very important) **how essential they are to Mobile's ability to survive, adapt, and thrive. Use the comment box to describe why you provided that rating.**

- **Infrastructure** (including water, transportation, power, and communications)
  - 1 Not very important
  - 2 Somewhat not important
  - 3 Neutral
  - 4 Somewhat important
  - 5 Very important

- **Health & Wellbeing** (including housing, physical and mental health access, education, food supply, and city services)
  - 1 Not very important
  - 2 Somewhat not important
  - 3 Neutral
  - 4 Somewhat important
  - 5 Very important

- **Economy** (including jobs, small businesses, major industries, and opportunities for wealth building)
    - 1 Not very important
    - 2 Somewhat not important
    - 3 Neutral
    - 4 Somewhat important
    - 5 Very important

- **Communities** (including community connectedness, racial justice, informed and engaged citizens, and cultural heritage)
    - 1 Not very important
    - 2 Somewhat not important
    - 3 Neutral
    - 4 Somewhat important
    - 5 Very important

- **Natural Resources** (including access to water and green space, working waterfront, air and water quality, and natural habitats)
    - 1 Not very important
    - 2 Somewhat not important
    - 3 Neutral
    - 4 Somewhat important
    - 5 Very important

2. What do you see as the top three greatest sources of **acute shocks** (sudden, extreme events that threaten a community) for Mobile? **(Select top three)**

- Flooding from intense rainfall
- Hurricanes
- Extreme temperature
- Non-tropical storm high winds
- Tornadoes
- Terrorism
- Public health emergencies
- Hazardous materials incident
- Infrastructure or building failure
- Water quality contamination event
- Civil unrest
- Other

3. What do you see as the top three greatest sources of **chronic stress** (long-term pressures that weaken the fabric of a community over time) for Mobile? **(Select top three)**

- Chronic stormwater nuisance flooding
- Climate change
- Sea-level rise
- Crime and violence

- Aging infrastructure
- Social inequality
- Drugs
- Homelessness
- Lack of safe and affordable housing
- Limited public transportation
- Education quality or access
- Land use and urban sprawl
- Poor air quality
- Poor water quality
- Environmental injustice
- Lack of economic diversity and vibrancy
- Lack of energy affordability/continuity
- Food insecurity and food deserts
- Poor health care access / chronic diseases
- Racial tension
- Other

4. Among the following qualities that make a community more resilient, **select the top 3** that Mobile ***does well*** today.

- Fosters economic prosperity
- Meets basic needs
- Ensures social stability and justice
- Ensures continuity of critical services
- Supports livelihoods and employment
- Promotes cohesive and engaged communities
- Promotes leadership and effective management
- Ensures public health services
- Provides reliable communication and mobility
- Enhances and provides nature-based and man-made assets
- Fosters long-term and integrated planning
- Other

5. What do you see as Mobile's most important ***existing*** efforts (plans, projects, programs, policies, etc.) that strengthen the resilience of the city? **(Please list as many as you would like).**

6. Select the **top three** areas where resilience ***could be improved*** in Mobile?

- Fosters economic prosperity
- Meets basic needs
- Ensures social stability, security, and justice
- Ensures continuity of critical services
- Supports livelihoods and employment
- Promotes cohesive and engaged communities

- Promotes leadership and effective management
- Ensures public health services
- Empowers a broad range of stakeholders
- Provides reliable communication and mobility
- Enhances and provides natural and man-made assets
- Fosters long-term and integrated planning

7. Describe what/how resilience could be improved and/or any additional rationale:

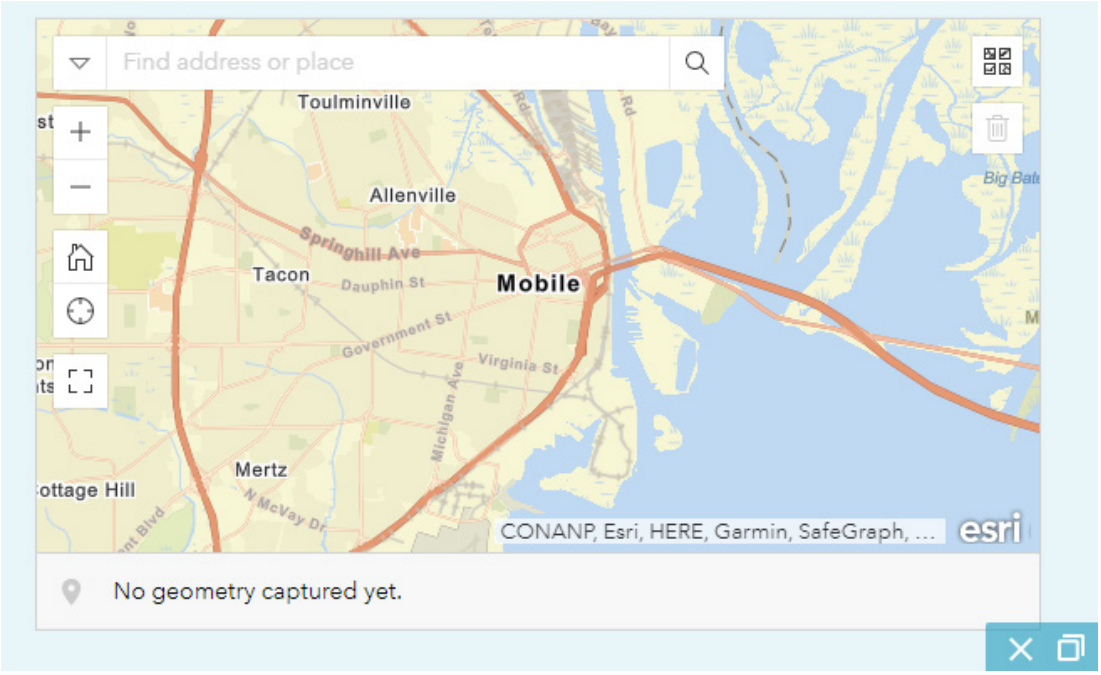
_____

8. In your opinion, what role does race play in a resilient community? Please explain.

9. Have you experienced flooding due to rainfall, sometimes known as street flooding or stormwater flooding, in the City of Mobile?

- Never
- Rarely
- Sometimes
- Often
- Every time it rains

10. If you have experienced rainfall flooding, please select a location on the map below where you have observed it. In the next question, please describe what you experience at this location. *To select a specific location, you may enter a place or an address in the "Find address or place" box,* ***or*** *you may interact with the map by zooming in or out, scrolling around until you find the location you want to select, and clicking on it. If taking this survey on a phone, you may need to click "OK" at the top right corner of the screen to return to the survey.*



11. Please describe any specific types of conditions that seem to cause the flooding (e.g., very hard rainfall) at the location(s) you selected above, and how intense the flooding is (e.g., ankle deep, damaging cars, inside of building).

12. If you have experienced rainfall flooding in multiple locations, please enter any additional addresses below and describe the specific types of conditions that seem to cause the flooding (e.g., very hard rainfall) at this/these location(s), as well as how intense the flooding is (e.g., ankle deep, damaging cars, inside of building).

The purpose of the following questions is to gather information about people who participate in this survey. These are voluntary questions. You are not required to give this information, but doing so will help to ensure that we cover all backgrounds for this survey. Your information will be kept private to the extent permitted by law. Thank you for your response.

13. What is your highest level of education?
    - Elementary School
    - Some High School
    - High School Graduate
    - Some College
    - College Graduate
    - Post Graduate Degree

14. How long have you lived in Mobile?

- Less than 5 years
- 5 years but less than 15 years
- 15 years but less than 25 years
- 25 years but less than 35 years
- 35 years but less than 45 years
- 45 years or more

15. What is your age range?
    - 18-24 years old
    - 25-34 years old
    - 35-44 years old
    - 45-54 years old
    - 55-64 years old
    - 65-74 years old
    - 75 years +

16. Are you of Hispanic, Latino, or Spanish origin?
- Yes
- No

17. Which race best describes you? (Please choose only one.)
    - American Indian or Alaskan Native
    - Asian / Pacific Islander
    - Black or African American
    - White / Caucasian
    - Multiple races
    - Prefer not to answer
    - Other

18. Please list your ZIP code:
    _____
19. Do you rent or own your home, own your home, or something else?
    _____

APPENDIX B: SURVEY RESULTS AND SUMMARY OF STAKEHOLDER MEETINGS

Summary of survey results:

The goal of the Resilience Assessment surveys was to gain an understanding of current perceptions of city resilience in Mobile from the perspective of local residents.

A total of 32 responses were gained through the stakeholder survey, and 458 total responses were received from the public survey. Responses from stakeholders and the public are summarized in Figure 31 through Figure 53 below.

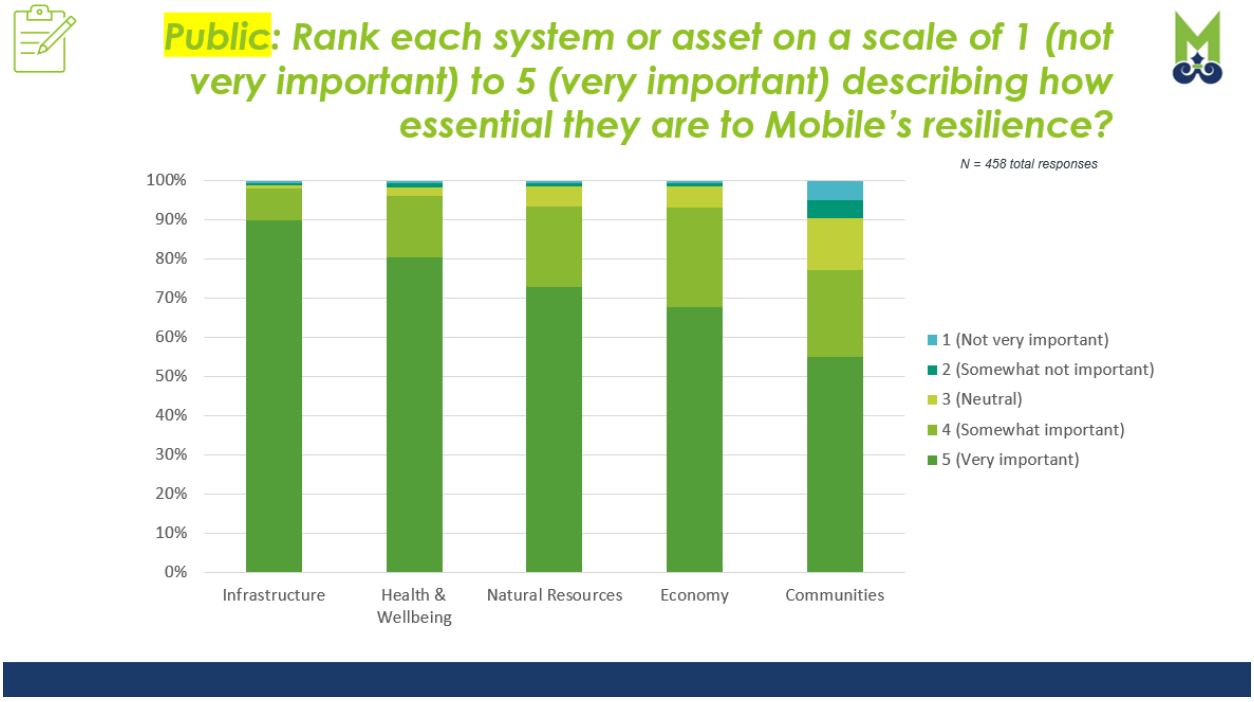


Figure 31. Summary of public responses received from the survey related to essential systems or assets.

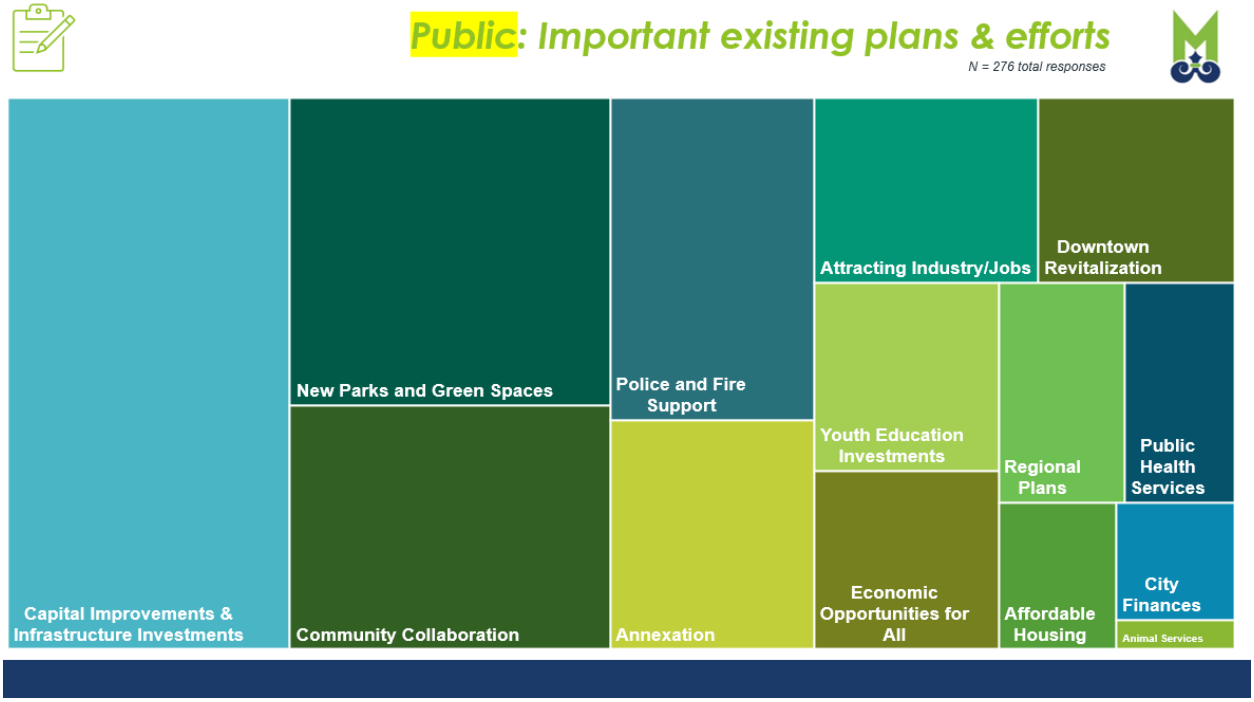


Figure 32. Summary of public responses received from the survey related to important existing plans and efforts.

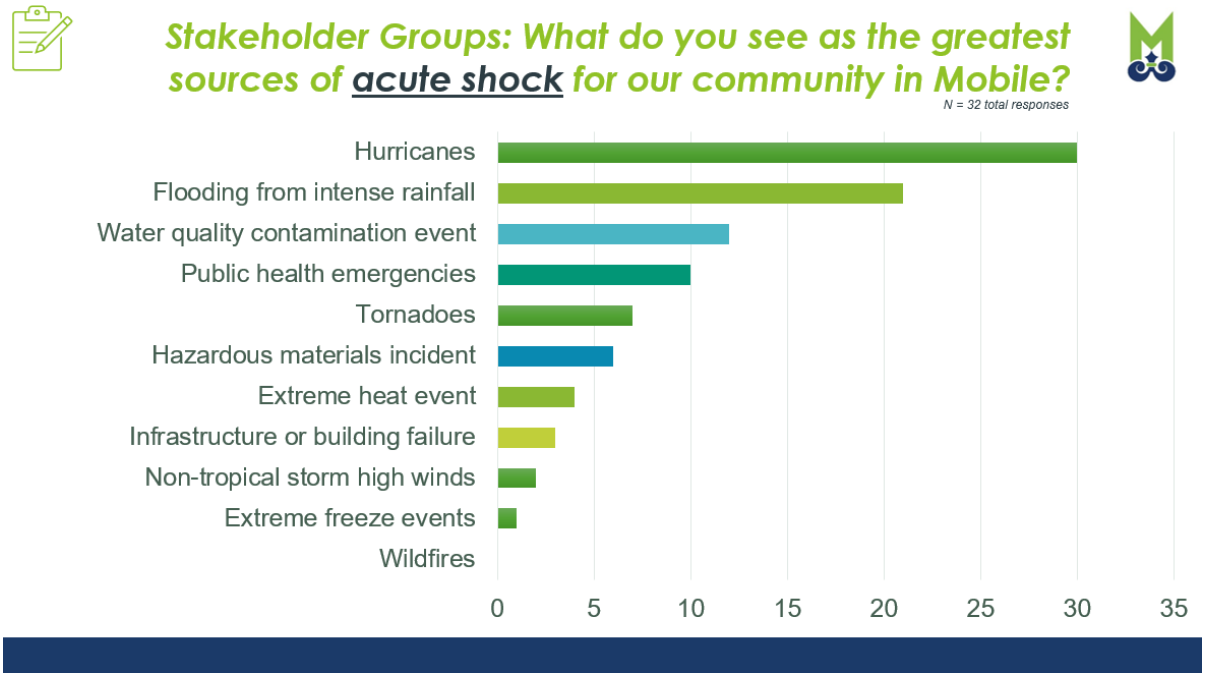


Figure 33. Summary of stakeholder responses received from the survey related to greatest sources of acute shocks.

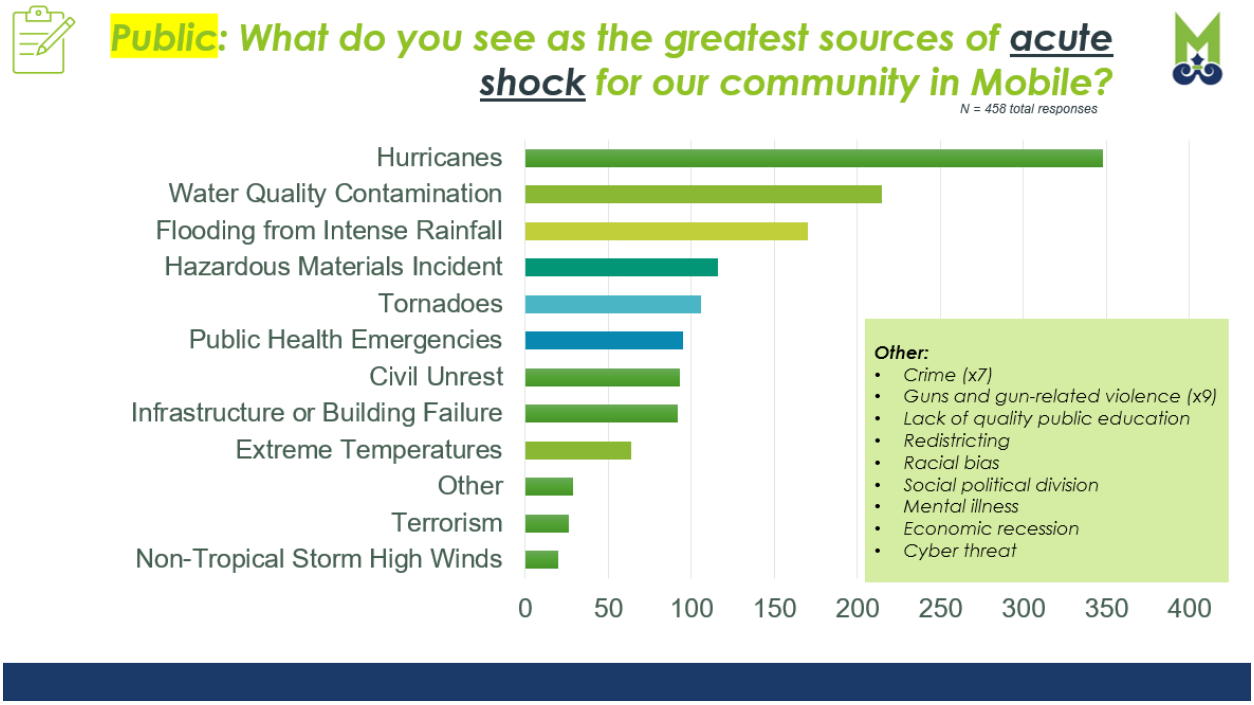


Figure 34. Summary of public responses received from the survey related to acute shocks.

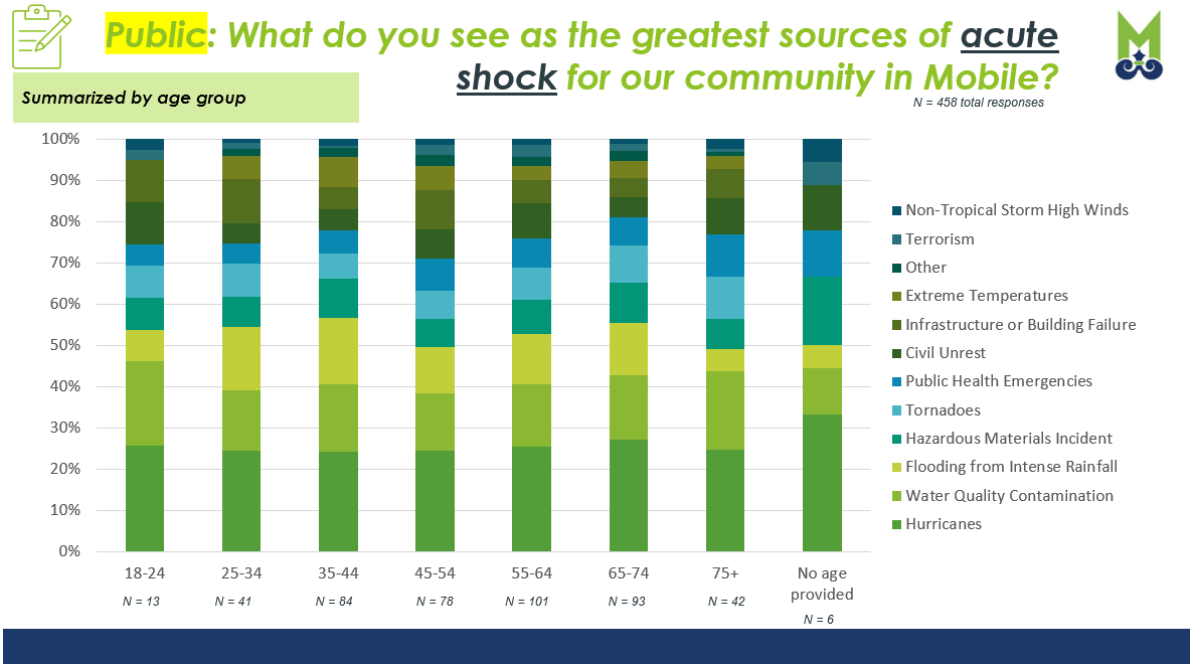


Figure 35. Summary of public responses received from the survey related to acute shocks, summarized by age group.

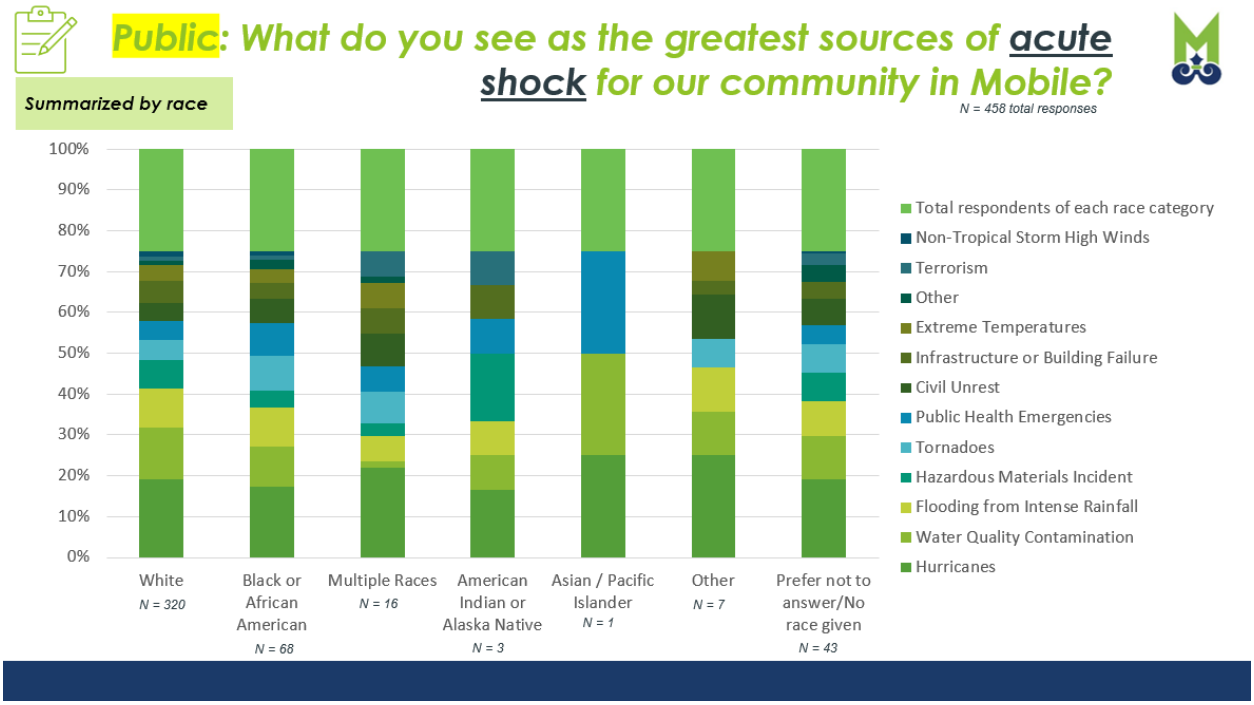


Figure 36. Summary of public responses received from the survey related to acute shocks, summarized by race.

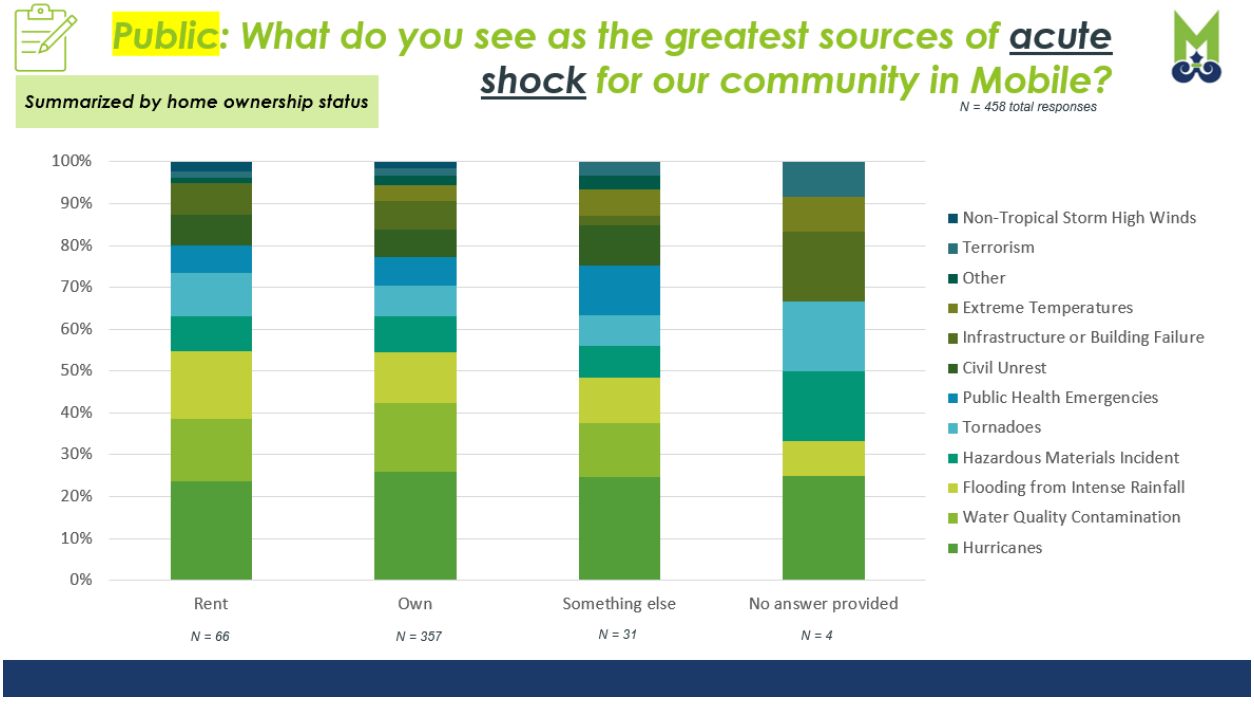


Figure 37. Summary of public responses received from the survey related to acute shocks, summarized by homeownership status.

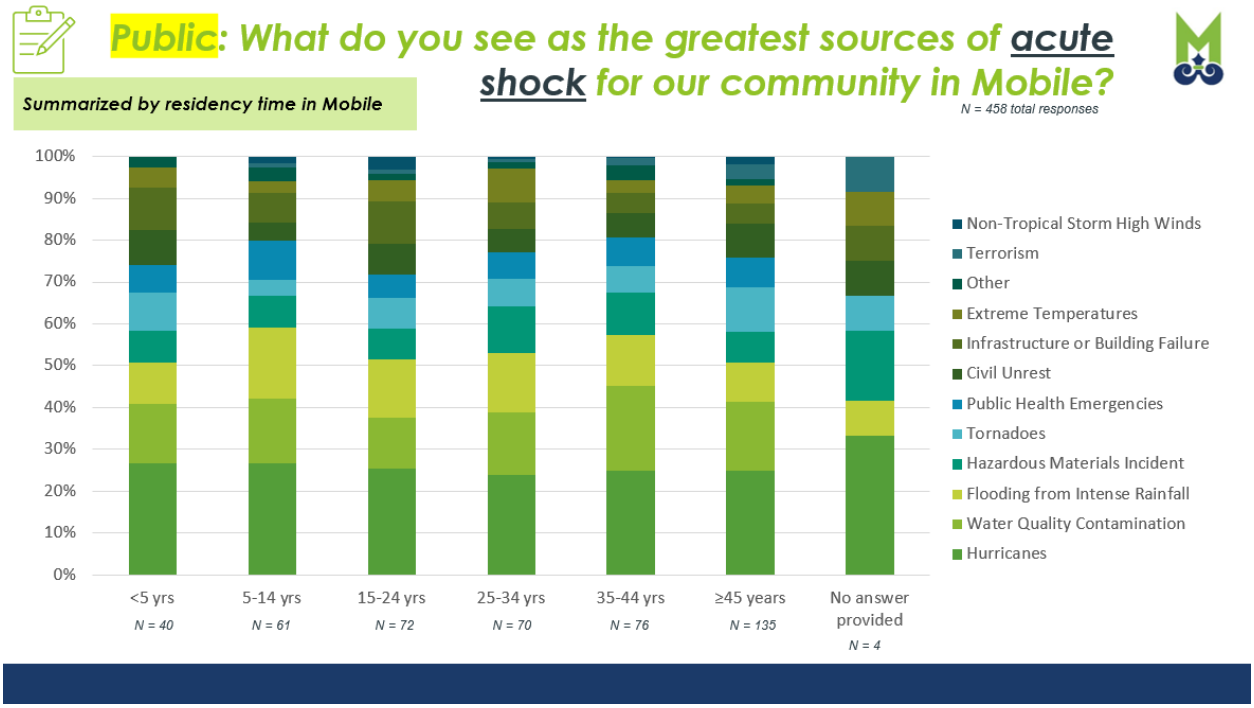


Figure 38. Summary of public responses received from the survey related to acute shocks, summarized by residency time in Mobile.

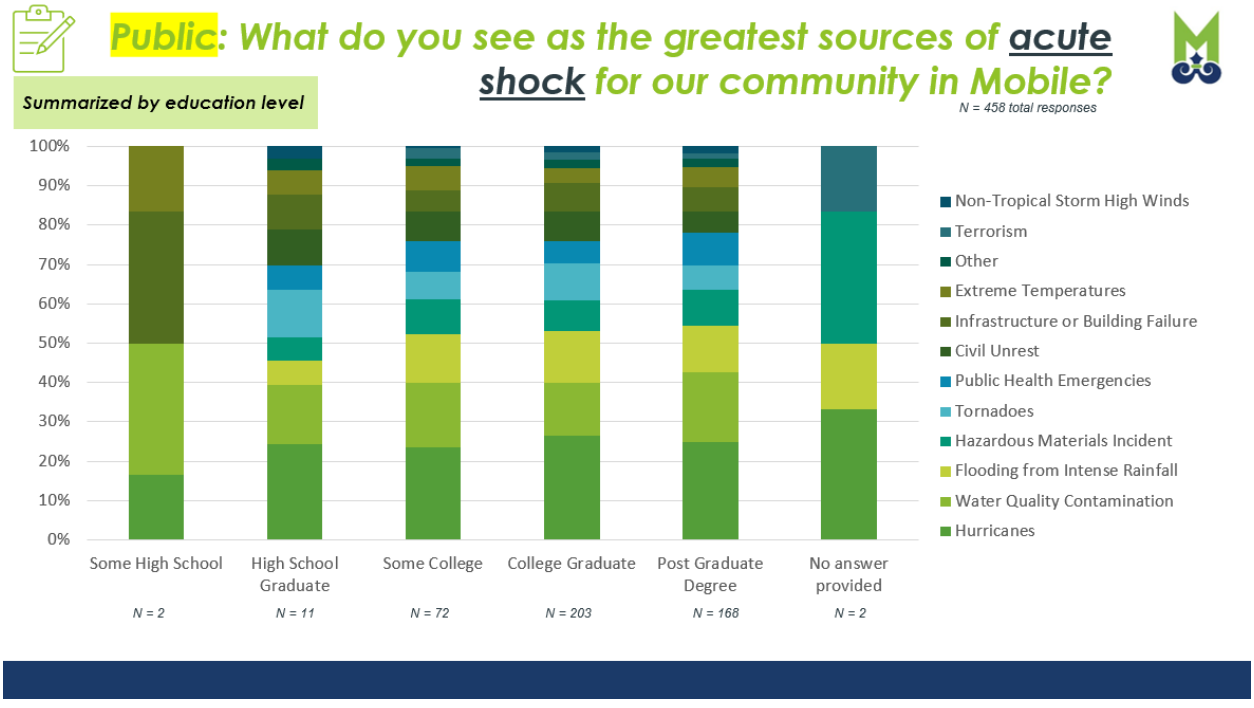


Figure 39. Summary of public responses received from the survey related to acute shocks, summarized by education level.

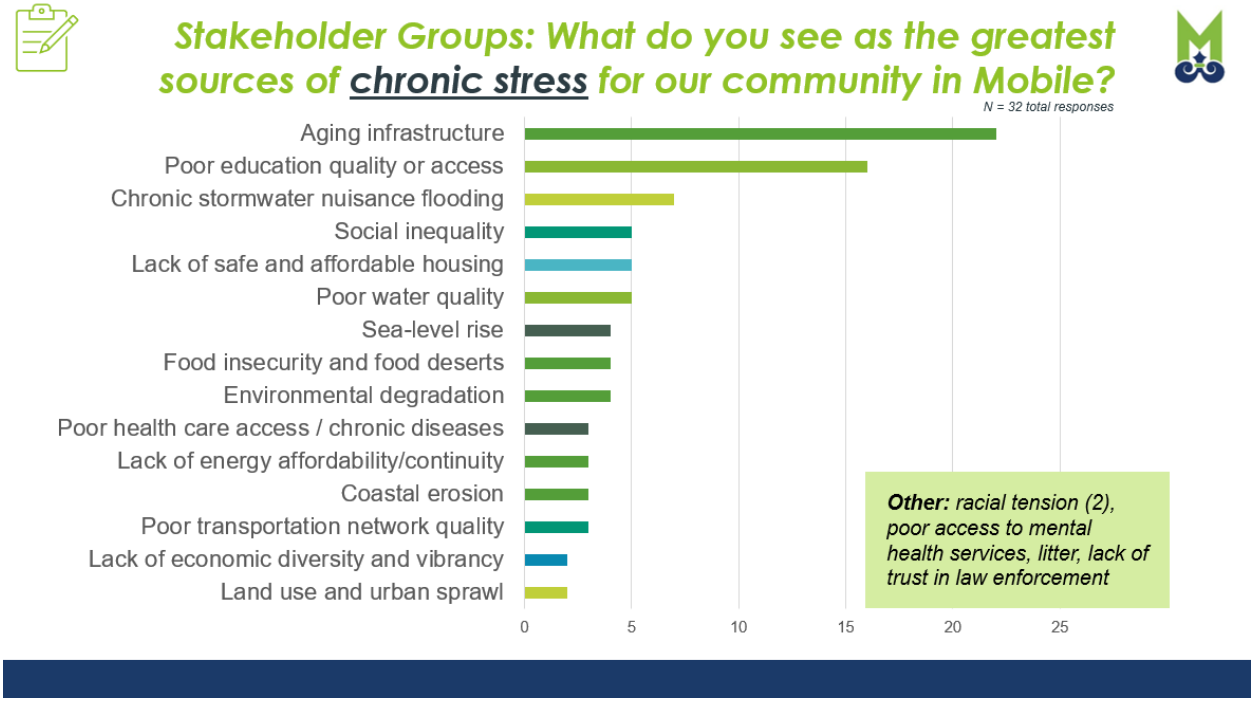


Figure 40. Summary of stakeholder responses received from the survey related to sources of chronic stress.

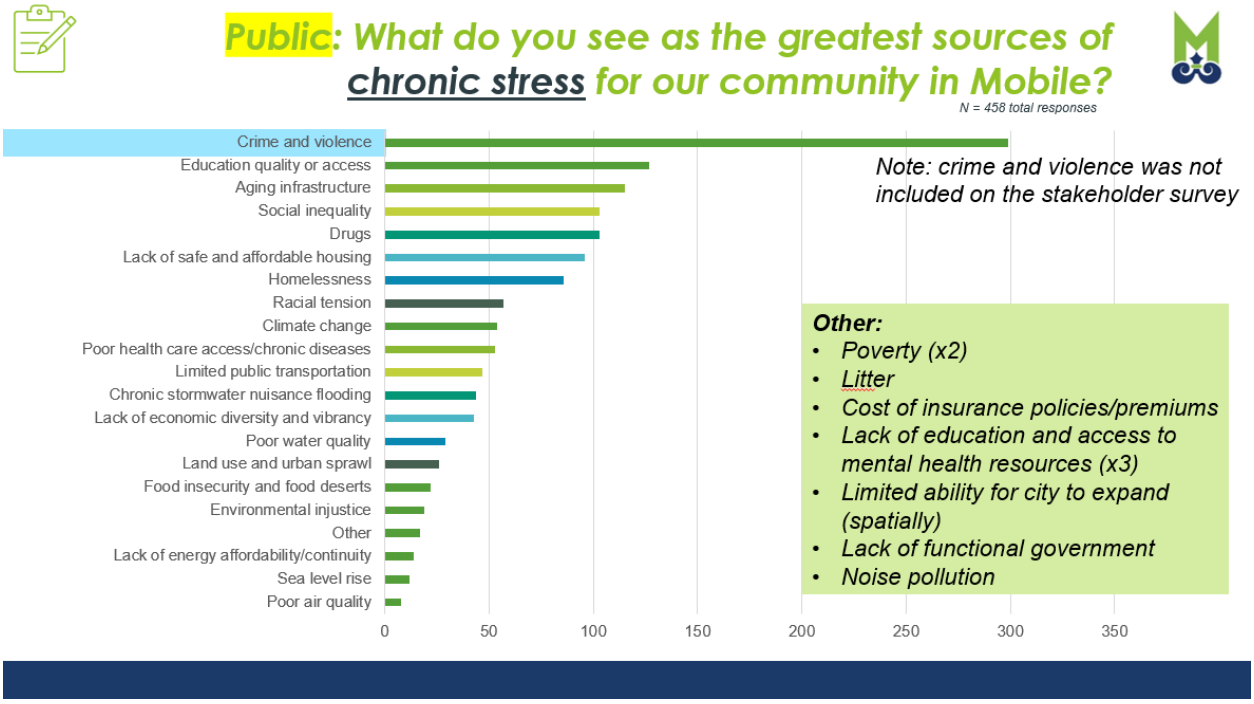


Figure 41. Summary of public responses received from the survey related to sources of chronic stress.

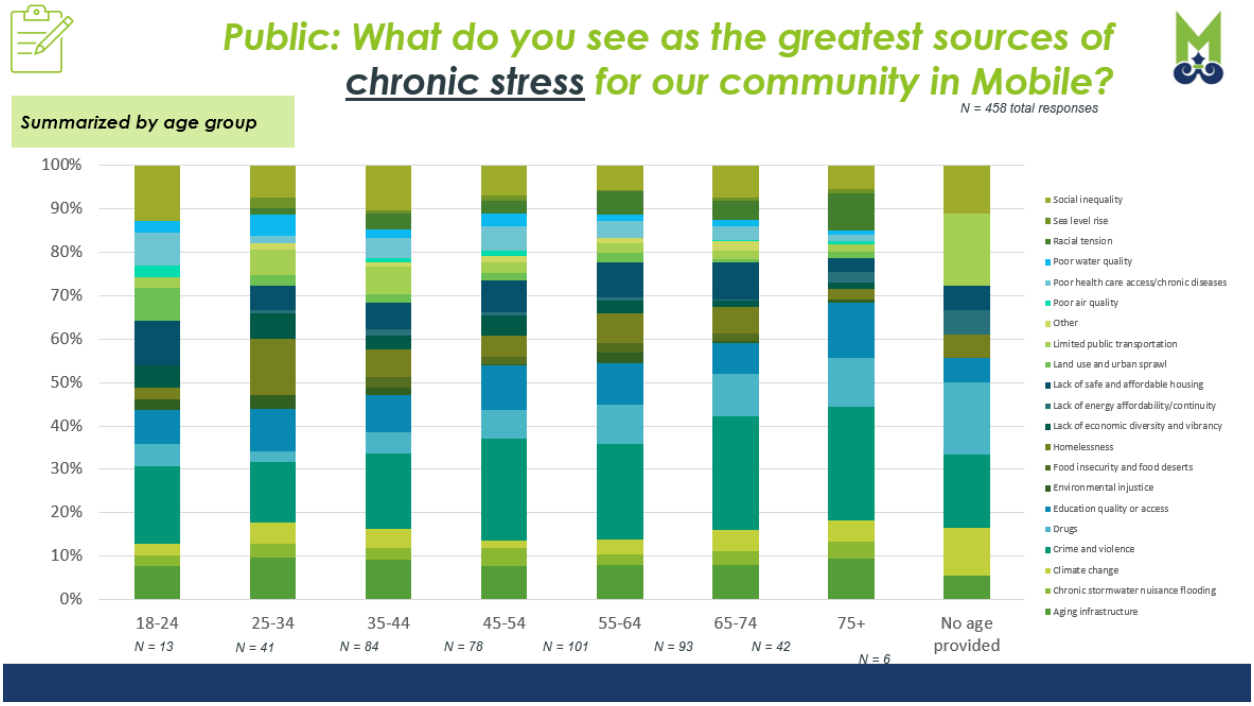


Figure 42. Summary of public responses received from the survey related to sources of chronic stress, summarized by age group.

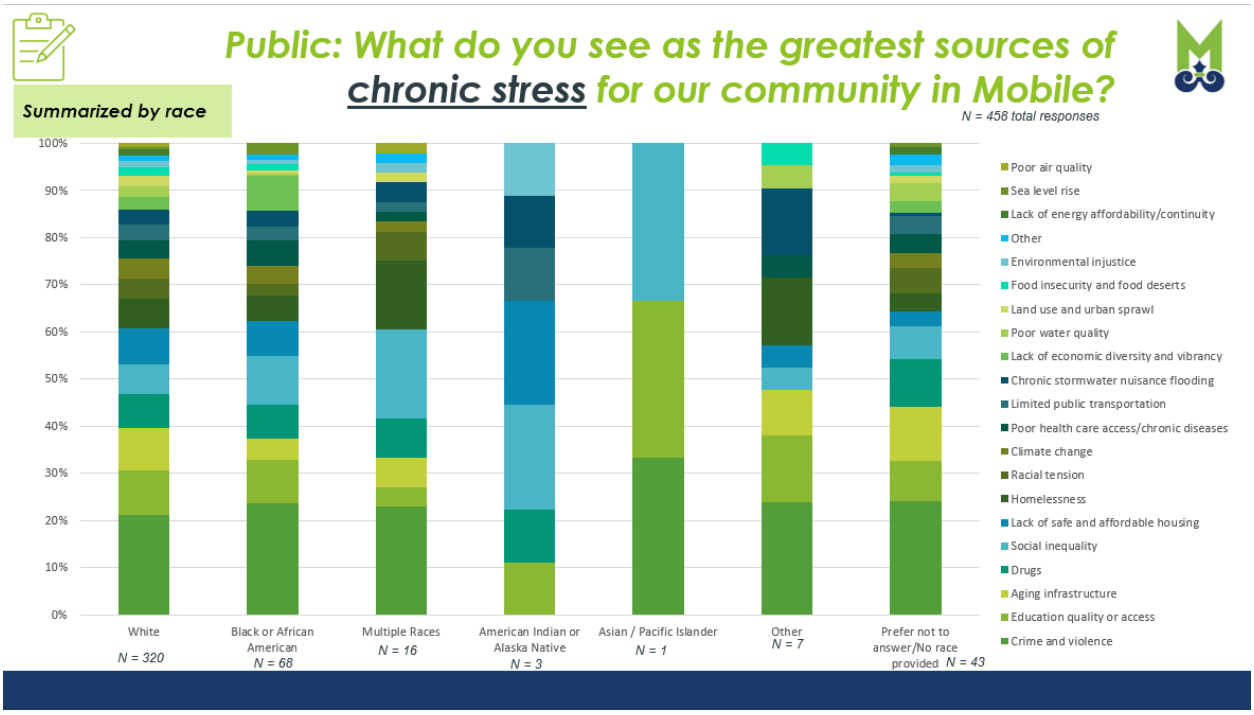


Figure 43. Summary of public responses received from the survey related to sources of chronic stress, summarized by race.

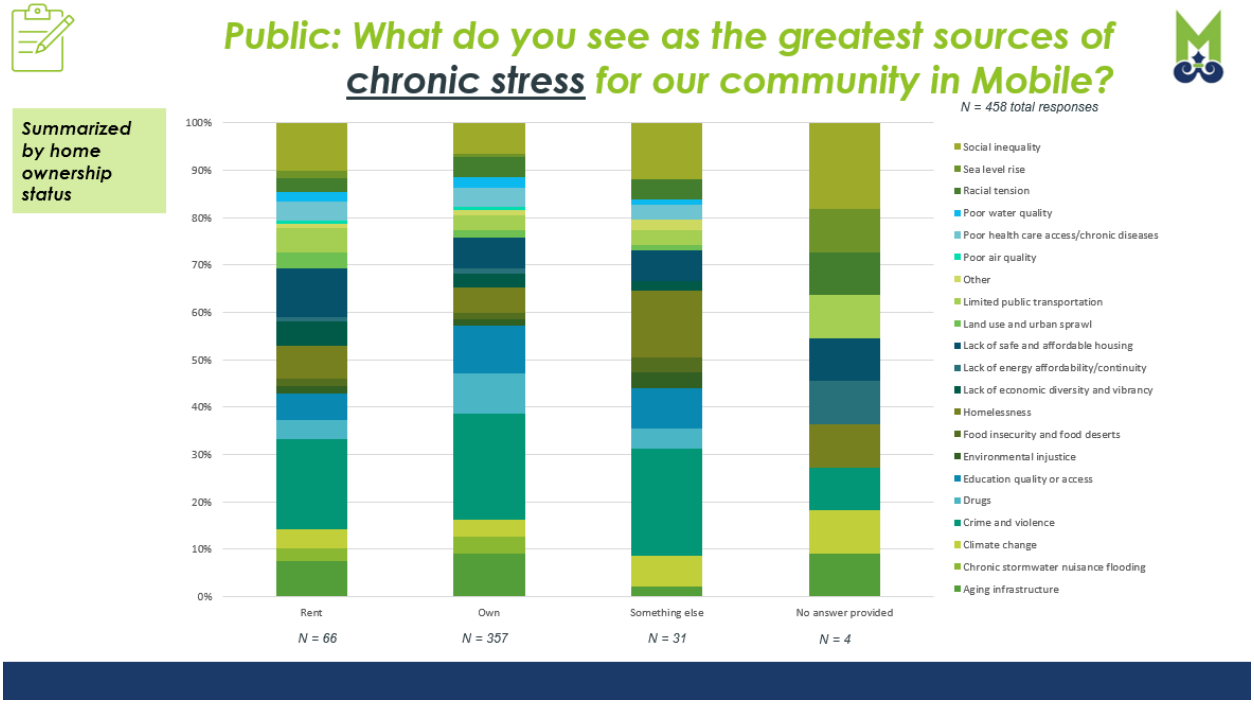


Figure 44. Summary of public responses received from the survey related to sources of chronic stress, summarized by home ownership status.

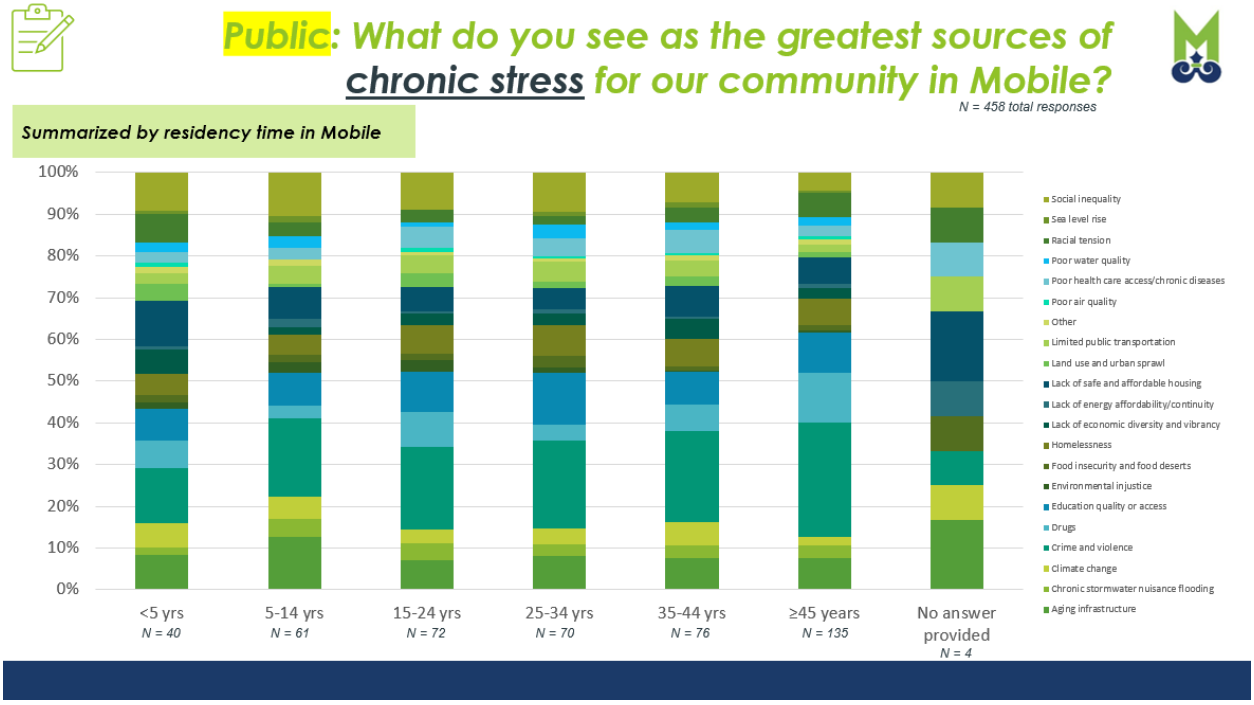


Figure 45. Summary of public responses received from the survey related to sources of chronic stress, summarized by residency time.

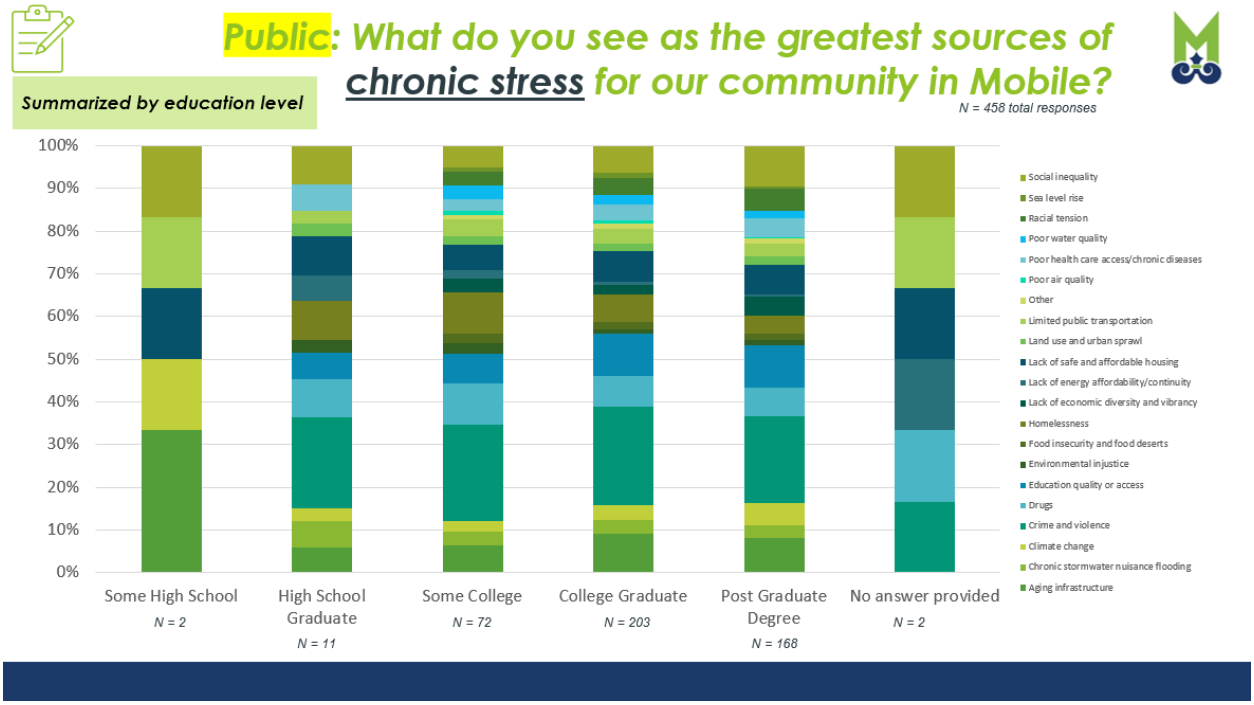


Figure 46. Summary of public responses received from the survey related to sources of chronic stress, summarized by education level.

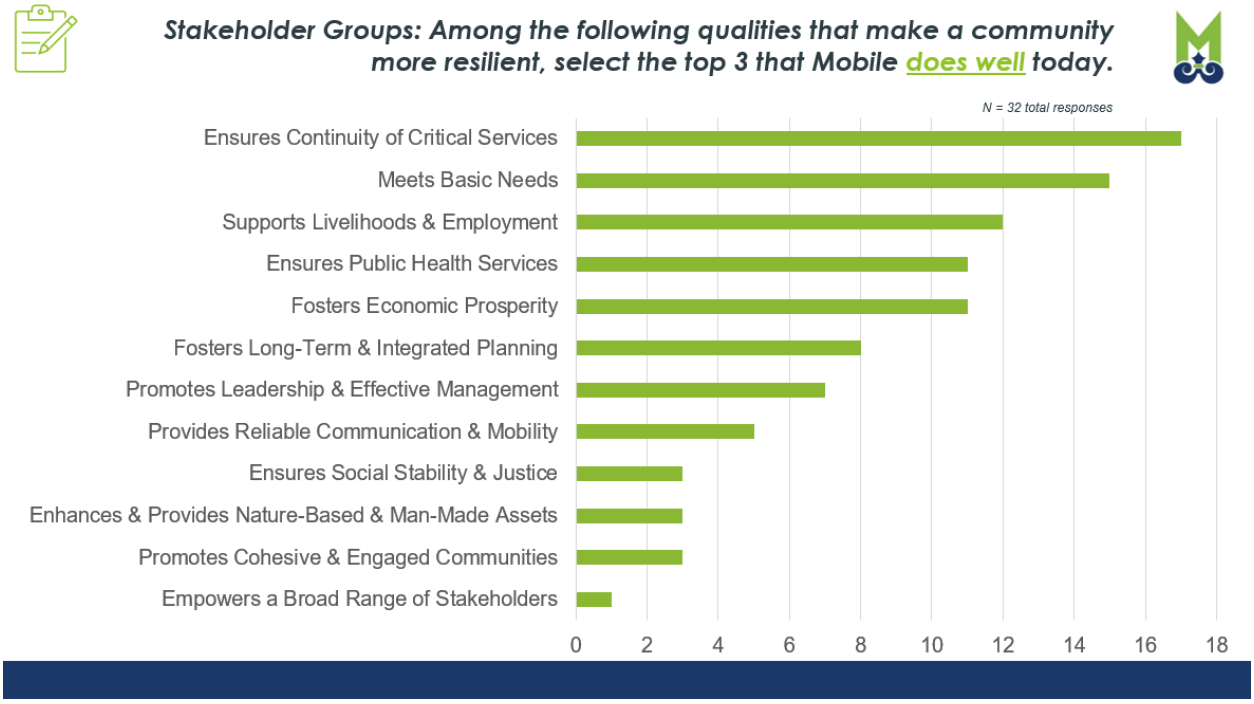


Figure 47. Summary of stakeholder responses received from the survey related to qualities that currently contribute to Mobile's resilience.

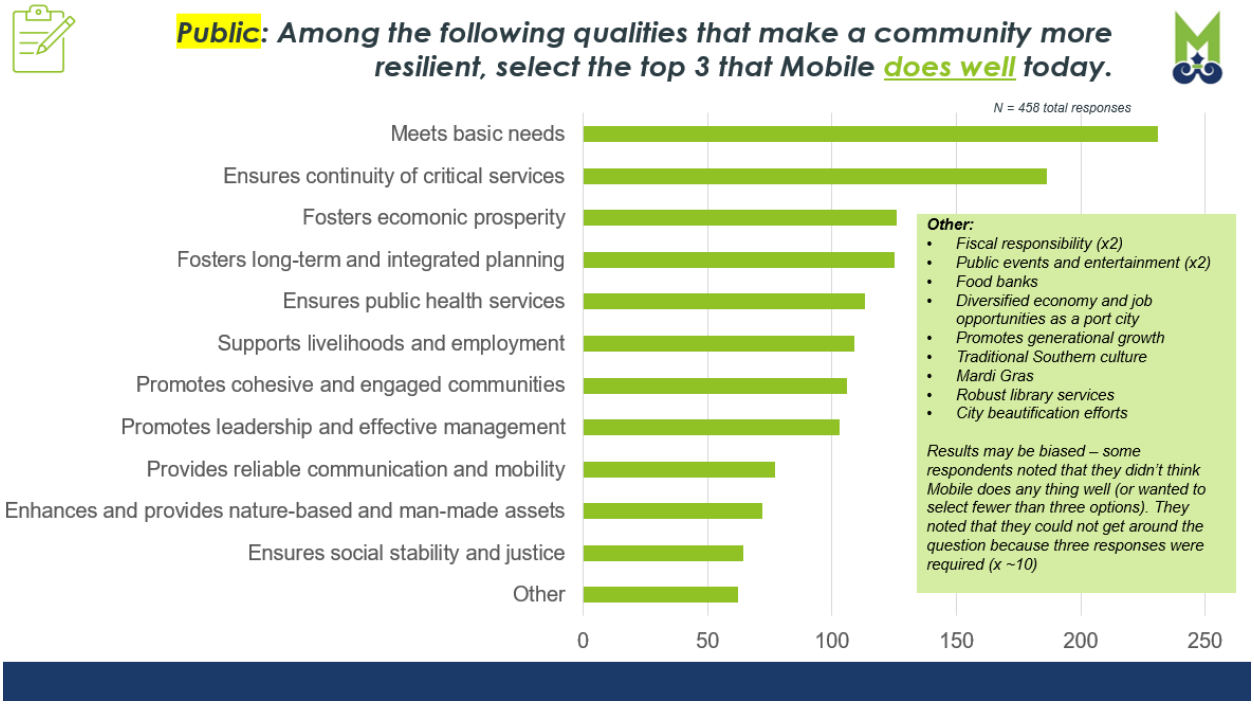


Figure 48. Summary of public responses received from the survey related to qualities that currently contribute to Mobile's resilience

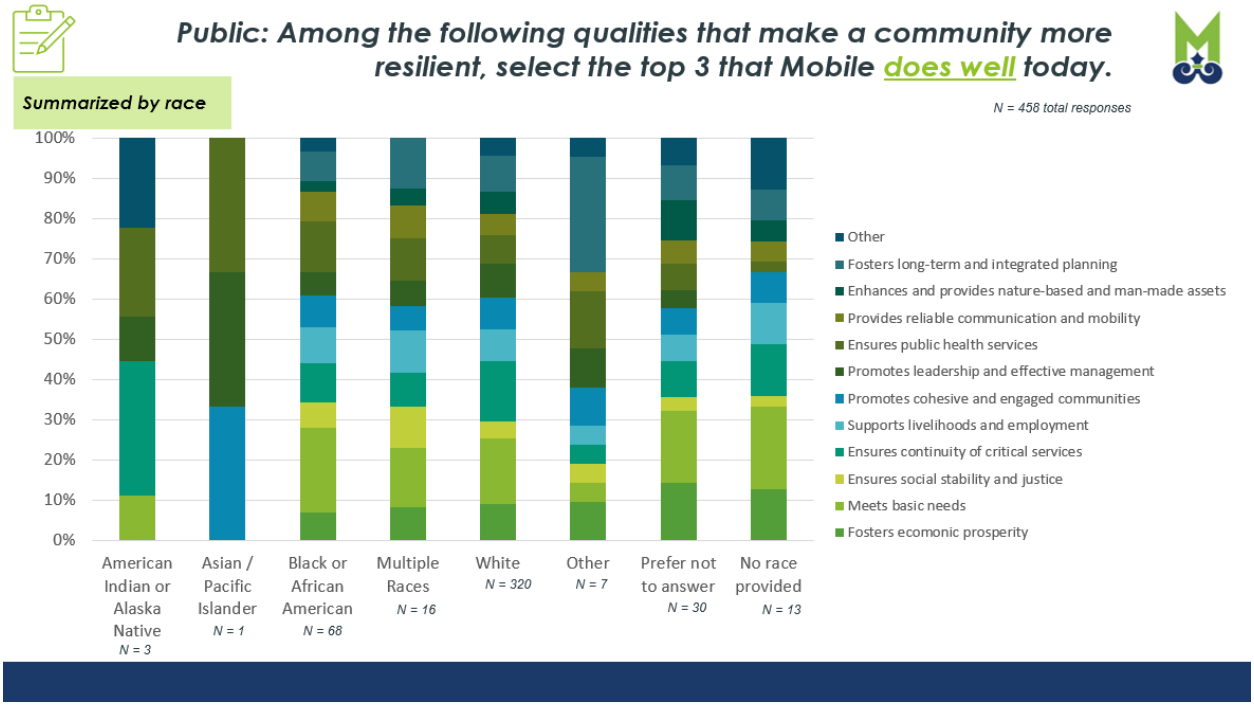


Figure 49. Summary of public responses received from the survey related to qualities that currently contribute to Mobile's resilience, summarized by race.

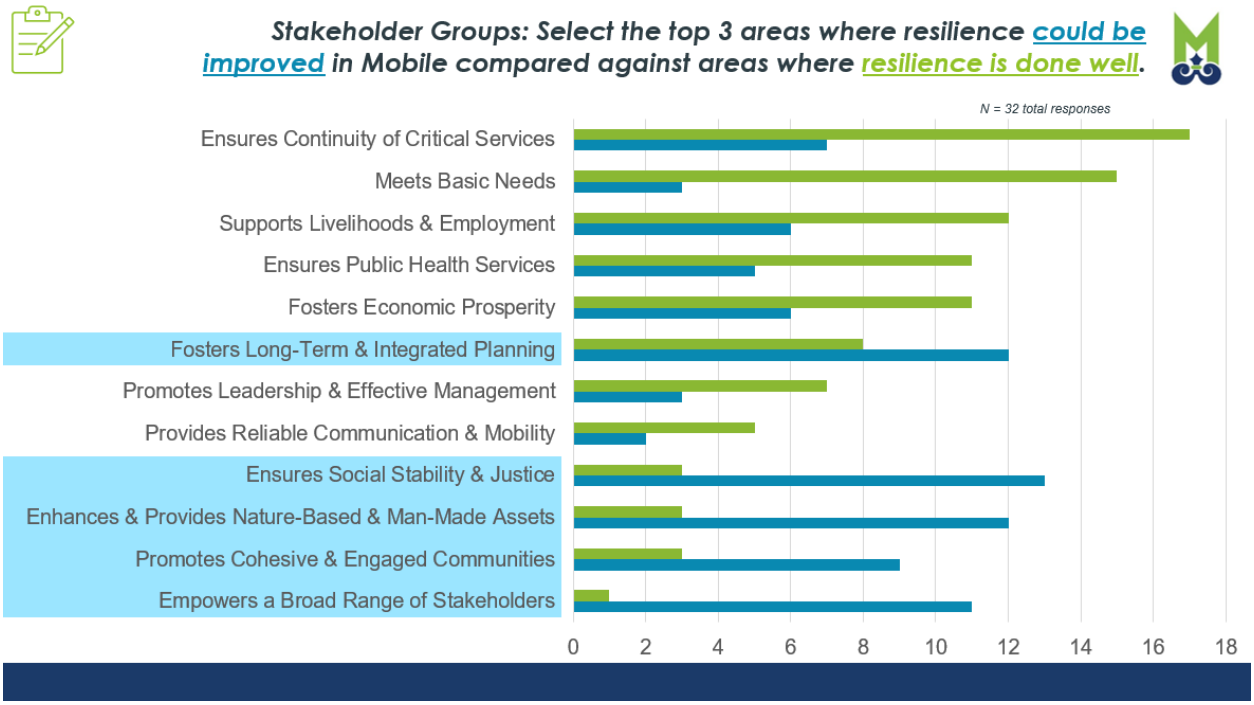


Figure 50. Summary comparing stakeholder responses received from the survey related to qualities of Mobile's resilience that are done well versus what could be improved.

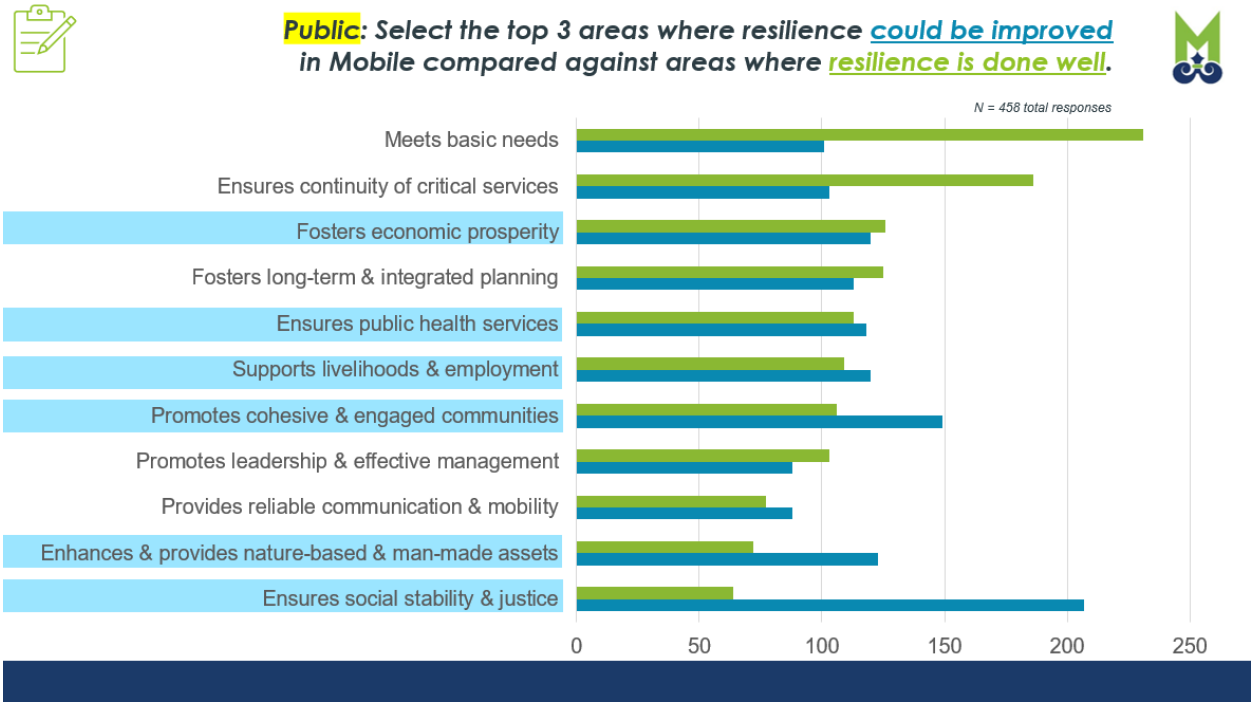


Figure 51. Summary comparing public responses received from the survey related to qualities of Mobile's resilience that are done well versus what could be improved.

Public: Have you experienced flooding due to rainfall in the City of Mobile? If so, where?

N = 193 total responses

Zip code	Number of Respondents
36608	75
36604	56
36695	48
36606	41
36609	38
36693	27
36607	24
36602	18
36605	17
36618	15
36619	12
36617	11
36603	6
36575	5
36582	5
36526	3
36541	2
36572	2

...continued:

Zip code	Number of Respondents
36505	1
36528	1
36532	1
36555	1
36584	1
36593	1
36611	1
36612	1
36613	1
36615	1
36633	1
36640	1
36644	1
36527	1

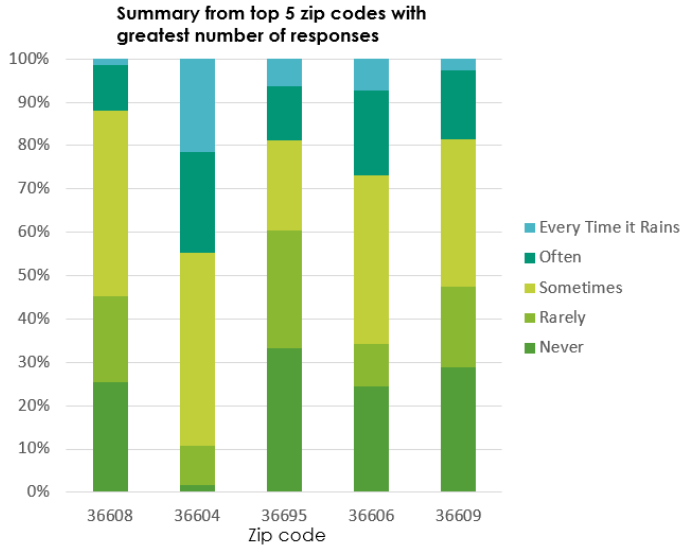
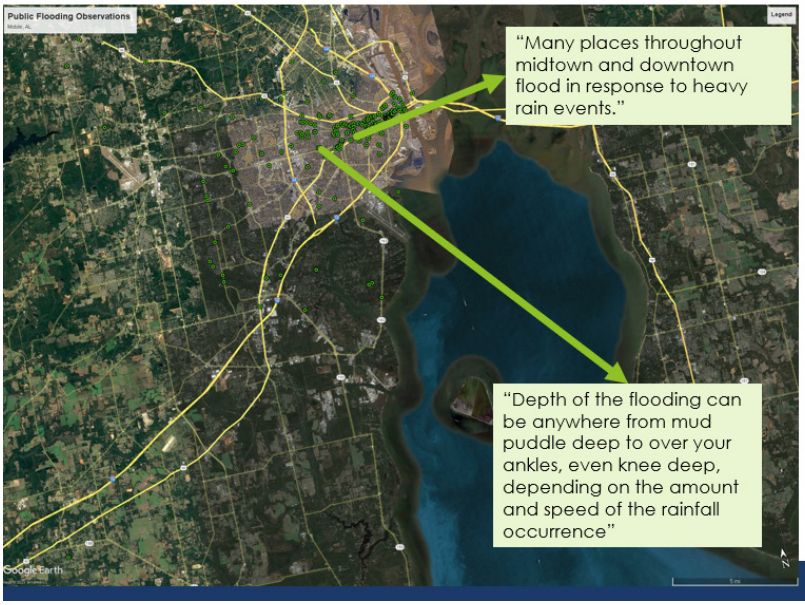


Figure 52. Summary of public feedback received from the survey related to locations in Mobile that experience flooding due to rainfall, summarized by zip code.

Public: Have you experienced flooding due to rainfall in the City of Mobile? If so, where?



N = 193 total responses

- Excerpt of notable streets & intersections:
  - Government St. & Catherine St. and Etheridge St.
  - University St. at Old Shell and Grelot
  - Old Shell under railroad track
  - Etheridge St.
  - Water St.
  - N. Scott St.
  - Washington St.
  - Ziegler just East of Cody
  - Cottage Hill from Schillinger to Hillcrest
  - Dauphin St.
  - Springhill Ave.
  - Butler St. and Esau Ave.
  - Virginia St.
  - Ann St.
  - Airport Blvd. and Dauphin St. service road at Montlimar Creek
  - Others...

Figure 53. Summary of public feedback received from the survey related to locations in Mobile that experience flooding due to rainfall.

Summary of stakeholder meetings:

These meetings served to kick-off engagement Advisory Group (AG) stakeholders for the Resilience Assessment and Plan initiative. Attendees were first introduced to the project with a high-level overview of AG engagement, encompassing anticipated planning processes and outcomes, roles and expectations, and vision and opportunities. The following sections summarize topics and discussions covered during the meeting.

<u>Infrastructure Advisory Group Meeting – November 16 2022</u>

- The first facilitated discussion of the meeting prompted AG members to describe their perspectives on what best describes a Resilient Mobile, and what a successful outcome of resilience planning might look like for Mobile.
    - AG members indicated that a resilient Mobile is one with open communication and cooperation that enables the city to be proactive and well-prepared for unexpected shocks.
    - Preparedness is also manifested through strategic land use planning that considers the city's current vulnerabilities to sea level rise, thereby bringing resilience support to areas that are most threatened.
    - Prior resilience and vulnerability assessments (e.g., for transportation systems) have directly resulted in project implementation, and attendees noted that a Resilient Mobile would continue that practice as well as expanding more resilience metrics into design.
- The meeting facilitators then walked AG members through two key terms of resilience planning: acute shocks and chronic stressors. Facilitators summarized feedback received from an initial resilience survey circulated to meeting participants ahead of the meeting describing the range of shocks and stressors relevant to Mobile.
    - Attendees highlighted wildfires and terrorism as significant acute shocks to Mobile.
    - Participants urged caution around detail within the resilience assessment, noting that it may reveal vulnerabilities for bad actors to exploit.
    - AG members identified aging infrastructure as a significant chronic stressor, emphasizing that poor public communication/education about infrastructure vulnerabilities has resulted in unwillingness to raise rates necessary to implement resiliency efforts.
    - In general, AG members noted that poor public perception is a chronic stressor for those involved in Mobile's infrastructure.
    - Further, limited workforce development (lack of internships and apprenticeships) was noted as a chronic stressor, highlighting that most funding goes towards raising wages and increased materials costs rather than on training and work skill improvements.
- The second facilitated discussion of the meeting prompted AG members to identify existing/planned efforts or data that may build and strengthen resilience of Mobile.
    - Attendees identified the climate change study conducted by the South Alabama Regional Planning Commission as a valuable resource for identifying vulnerable transportation systems in Mobile and Gulf wide.

- Participants also noted the 2021 COM building codes, the Port's Emergency Operations Plan, and the MAWWS 15-year master plan for infrastructure needs (under development).

Environment Advisory Group Meeting – November 16 2022

- The first facilitated discussion of the meeting prompted AG members to describe their perspectives on what best describes a Resilient Mobile.
    - AG members highlighted that a resilient Mobile would provide protection to city spaces where it is needed, calling for strategic land-use planning that locates new infrastructure, industry, and people away from current and future flood-prone areas.
    - Participants reflected on the impacts realized by flooding versus storm intensity, particularly in relation to aging infrastructure.
    - Discussion expanded beyond water-related hazards as attendees discussed the importance of connecting all citizens with green space as a means to enhance quality of life of all residents equitably (e.g., protecting existing parts, implementing nature-based and green infrastructure solutions, increase walkability and safe access to public facilities).
    - Next, AG members were asked to reflect on what a successful outcome of resilience planning might look like for Mobile. Attendees noted that a successful resilience plan would contribute to shifting existing mindsets of communities by providing accessible information to educate residence about resilience planning as a means to improve adaptability of the city to shocks and stressors and improve overall quality of life.
    - Furthermore, a successful plan would contextualize Mobile's importance and vulnerabilities within the mosaic of neighboring counties and the rest of Alabama (e.g., Baldwin County), many of which are contributing to trends seen in Mobile today (e.g., population growth).
    - Participants discussed that a successful plan would assess all types of risks and threats facing Mobile, not only those related to climate change, and would engage many different sectors and local perspectives to ensure long-term buy-in and support.
- The meeting facilitators then walked AG members through two key terms of resilience planning: acute shocks and chronic stressors. Facilitators summarized feedback received from an initial resilience survey circulated to meeting participants ahead of the meeting describing the range of shocks and stressors relevant to Mobile.
    - Attendees discussed current building codes and permitting requirements that require riparian buffer zones on rivers as well as the exemptions made for industry. Other physical security plans were noted, including the Marine Security Act, and AG members discussed whether current permitting (ADEM) considers future planning.
    - Water quality issues were raised related to channelization established 70 years ago which now creates turbulent conditions and impacts oysters, noting that similar design standards should not be used today.
    - Attendees did not identify any additional acute shocks, but expressed surprise that racial tension was at the bottom of the list and noted that chronic chemical exposure is a threat (exposure to lead in water and paint).

- The second facilitated discussion of the meeting prompted AG members to identify existing/planned efforts or data that may build and strengthen resilience of Mobile.
    - AG members noted that an awareness of resiliency has been increasing in recent Mobile County projects.
    - Potential data sources related to flood management, ecosystem restoration, and 40 years of prior projects by Mobile County were identified.
    - Attendees then discussed how a resilience plan could support ongoing work. Examples included: the Dauphin Island Causeway resilience research effort, stormwater planning by Mobile County, Africatown connections blueway community engagement plan.
    - Participants discussed the importance of equitable implementation of resilience across all neighborhoods, particularly poorer and underserved communities that have been historically neglected and co-located near hazardous industrial facilities.

<u>Economy Advisory Group Meeting – November 17 2022</u>

- The first facilitated discussion of the meeting prompted AG members to describe their perspectives on what best describes a Resilient Mobile (what a successful outcome of resilience planning might look like).
    - Attendees highlighted that a resilient city is one with a resilience plan in place – noting that some communities of Florida could withstand the impact of Hurricane Ian due to having a plan in place.
    - AG members discussed that a successful outcome of this effort may provide a mechanism to communicate and educate the critical importance of Mobile's economic engine to Alabama's State Legislature, providing an avenue for increased infrastructure funding opportunities.
    - A Resilient Mobile would also include resilient businesses and a diversified economy driven by a strong education system that provides a skilled labor force to fill local needs.
- The meeting facilitators then walked AG members through two key terms of resilience planning: acute shocks and chronic stressors. Facilitators summarized feedback received from an initial resilience survey circulated to meeting participants ahead of the meeting describing the range of shocks and stressors relevant to Mobile. Attendees noted that pandemics (i.e., COVID19) should be highlighted as an important acute shock for Mobile's economy.
- The second facilitated discussion of the meeting prompted AG members to identify existing/planned efforts or data that may build and strengthen resilience of Mobile.
    - Attendees noted the value of the Port Authority Economic Impact Study, small business data available through the Mobile Chamber, the 2022 Tourism/Ecotourism study, and the community health assessment as potential information sources that may strengthen the resilience assessment and plan.
    - Next, AG members were prompted to identify how a resilience plan could support ongoing work. Attendees highlighted that a plan could provide a road-map of smaller, more attainable actions that support ongoing efforts to build toward larger-scale change.
    - This plan would validate current actions that move toward increased resiliency and increase public support for important activities.

- Further, AG members noted the long-term value of a plan that transcends any single term of an elected official, thus providing long-term support to activities that may strengthen the city adaptively over time.

Community Advisory Group Meeting – December 8 2022

- The first facilitated discussion of the meeting prompted AG members to describe their perspectives on what best describes a Resilient Mobile. AG members highlighted the value of engaged citizens invested in the long-term viability of Mobile both economically as well as emotionally, mentally, and physically.
  - Participants reflected on vulnerabilities of critical infrastructure highlighted in recent media reports (e.g., drinking water issues in Flint and Jackson), noting Mobile is only as strong as its weakest link.
  - Discussion revolved around moving citizens out of crisis mode by elevating the current baseline.
  - Strategies may include increasing and ensuring access to preventative and affordable healthcare and medications to reduce strain on medical infrastructure, increasing access to mental health services, and reducing intergenerational translation (perpetuation of crisis and poverty across generations).
  - Next, AG members were asked to reflect on what a successful outcome of resilience planning might look like for Mobile. Attendees noted the importance of utilizing a wholistic planning approach to ensure citizens are secured on multiple fronts (housing, income, health, etc.), and that a singular vision is carried forward spanning key themes: (i) youth are prepared for life, (ii) families are engaged and connected, and (iii) culturally and racially aware community that can thrive.
- The meeting facilitators then walked AG members through two key terms of resilience planning: acute shocks and chronic stressors. Facilitators summarized feedback received from an initial resilience survey circulated to meeting participants ahead of the meeting describing the range of shocks and stressors relevant to Mobile.
- Attendees noted that the following should be added as relevant to Mobile: racial tension, domestic terrorism (school shootings, direct damage to the power grid, cyber security, and poverty (beyond economics).
- The second facilitated discussion of the meeting prompted AG members to identify existing/planned efforts or data that may build and strengthen resilience of Mobile.
  - Street debris clean-up efforts, collaboration with law enforcement ("see something, say something"), and education programs aimed to increase flow of information to citizens related to crisis prevention resources were noted as important existing efforts for long-term city resilience.
  - Additional data resources were identified: census block hunger data, 211 national call data for social service needs, 311 for litter, homelessness data, assessments conducted by hospitals (poverty, street medicine, healthcare for the homeless), and homeless management information system data.
  - Attendees then discussed how a resilience plan could support ongoing work. Examples included: increasing positive perceptions and pride of various neighborhoods; increasing affordable housing; building support and understanding of social services as distinct from charity; and providing a means for the city and its citizens to acknowledge and take actions to address racial inequities and tensions.
  - The discussion concluded with a collective brainstorm of who might be missing from the conversation. Attendees noted youth representatives from different zip codes,

MAIC, neighborhood center, housing authority representative, career development agencies that work with schools (Goodwill easter seal, southwest Alabama partnership for training), school counselors, area agency on aging (SARPC), and other faith-based leaders.

REFERENCES

Adams, Judith, and Sheri Collins. 2021. "Press Release: Port of Mobile Harbor Construction Underway Deepening and Widening to Be Completed by 2025." *Port of Mobile: Alabama Port Authority*. Retrieved October 11, 2023 (https://www.alports.com/mobile-harbor-construction-begins/).

ADCNR. 2015. "Alabama's Wildlife Action Plan: 2015-2025."

ADEM. 2022. "Final 2022 303(d) List."

Alabama Port Authority, Port of Mobile. 2022. "Alabama Port Authority Economic Impacts 2021, Executive Summary." Retrieved May 9, 2023 (https://www.alports.com/wp-content/uploads/2022/10/Alabama_Port_Authority_Economic_Impact_2021_Executive_Summary.pdf).

Alabama State Department of Education. 2022. *Lowest 6% of Schools Identified for the Alabama Accountability Act of 2015; November 2022*.

Alabama Tourism Department. 2022. *Alabama Tourism Industry Economic Impact Report, 2021*.

Anderson, Mark G., and Analie Barnett. 2019. *Resilient Coastal Sites for Conservation in the Gulf of Mexico US*. The Nature Conservancy, Eastern Conservation Science.

Auburn University. 2004. "Citizen Guide to Alabama Rivers. Volume 5: Escatawpa, Mobile, and Tombigbee." *Alabama Water Watch Program*. Auburn, Alabama: Auburn University.

van den Berg, Magdalena, Wanda Wendel-Vos, Mireille van Poppel, Han Kemper, Willem van Mechelen, and Jolanda Maas. 2015. "Health Benefits of Green Spaces in the Living Environment: A Systematic Review of Epidemiological Studies." *Urban Forestry & Urban Greening* 14(4):806–16. doi: 10.1016/j.ufug.2015.07.008.

Cardoza, JE, CJ Gronlund, J. Schott, T. Ziegler, B. Stone, and MS O'Neill. 2020. "Heat-Related Illness Is Associated with Lack of Air Conditioning and Pre-Existing Health Problems in Detroit, Michigan, USA: A Community-Based Participatory Co-Analysis of Survey Data." *International Journal of Environmental Research and Public Health* 17(16):5704. doi: 10.3390/ijerph17165704.

CHR&R. 2023. "Building a Culture of Health, Mobile AL County Ranking." *County Health Rankings & Roadmaps*. Retrieved May 11, 2023 (https://www.countyhealthrankings.org/explore-health-rankings/alabama/mobile).

City of Mobile. 2014. “Mayor Declares War on Blight and Litter - FACT SHEET.” Retrieved May 12, 2023 (https://www.cityofmobile.org/news/mayor-declares-war-on-blight-and-litter-fact-sheet/).

City of Mobile. 2022. *Capital Improvement Plan, 2022-2026*.

City of Mobile. 2023a. *Analysis of Impediments to Fair Housing Choice, Mobile, AL*.

City of Mobile. 2023b. *Capital Improvement Plan, 2023-2027*.

City of Mobile. 2023c. “Community Centers.” *Mobile Alabama*. Retrieved October 12, 2023 (https://www.cityofmobile.org/parks-rec/community-centers/).

City of Mobile. 2023d. “Litter Dashboard.” *One Mobile Litter Free!* Retrieved May 12, 2023 (https://www.arcgis.com/apps/dashboards/db6dfe4076384d259bb00f55f5c3de0a).

City of Mobile Police Department. 2022. *City of Mobile Police Department Annual Report 2022*.

Darestani, YM, B. Webb, JE Padgett, G. Pennison, and E. Fereshtehnejad. 2021. “Fragility Analysis of Coastal Roadways and Performance Assessment of Coastal Transportation Systems Subjected to Storm Hazards.” *Journal of Performance of Constructed Facilities* 35.

Del Angel, D. C., D. Yoskowitz, M. Bilskie, S. Hagen, and K. Wowk. 2019.“Understanding the Increased Cost of Storm Surge Flooding under Sea Level Rise.” Presented at the Coastal and Estuarine Research Federation Conference, Mobile, Alabama.

Douglass, Scott, Joseph Krolak, and Bret Webb. 2023. “Highways in the Coastal Environment: New USA Guidance.” *Coastal Engineering Proceedings* (37):36. doi: 10.9753/icce.v37.management.36.

Federal Emergency Management Agency. n.d. *Unit 8: Substantial Improvement and Substantial Damage*.

Greenberg, Brett. 2023. “City of Mobile Reports 257K Pounds of Litter Collected in 2022.” *WKRG.Com*. Retrieved May 12, 2023 (https://www.wkrg.com/mobile-county/city-of-mobile-reports-257k-pounds-of-litter-collected-in-2022/).

Hayhoe, K., DJ Wuebbles, DR Easterling, DW Fahey, S. Doherty, J. Kossin, W. Sweet, R. Vose, and M. Mehner. 2018. “Our Changing Climate.” Pp. 72–144 in *Impacts, Risks, and*

Adaptation in the United States: Fourth National Climate Assessment, Volume II. Washington, DC, USA: U.S. Global Change Research Program.

Hsiang, Solomon, Robert Kopp, Amir Jina, James Rising, Michael Delgado, Shashank Mohan, D. J. Rasmussen, Robert Muir-Wood, Paul Wilson, Michael Oppenheimer, Kate Larsen, and Trevor Houser. 2017. "Estimating Economic Damage from Climate Change in the United States." *Science* 356(6345):1362–69. doi: 10.1126/science.aal4369.

HUD. 2022. "Promoting Mental Health Through Housing Stability | HUD USER." Retrieved June 7, 2023 (https://www.huduser.gov/portal/pdredge/pdr-edge-trending-053122.html).

ILO. 2019. *Working on a Warmer Planet: The Impact of Heat Stress on Labour Productivity and Decent Work*. Geneva: International Labour Organization.

Jisung, PR, J. Goodman, M. Hurwitz, and J. Smith. 2020. "Heat and Learning." *American Economic Journal: Economic Policy* 12(2):306–39. doi: 10.1257/pol.20180612.

Lloyd, Lauren. 2023. "10 Cheapest States To Live In For 2023." *Forbes Home*. Retrieved June 6, 2023 (https://www.forbes.com/home-improvement/moving-services/cheapest-states-to-live-in/).

Maniscalco, Joe. 2023. "August 2023 Climate Summaries: Mobile Alabama and Pensacola Florida Area." *National Weather Service*. Retrieved October 11, 2023 (https://www.weather.gov/mob/August2023climatesummaries#:~:text=August%20top%20records%20for%20the,occurred%20on%20the%2025th%2F1891.).

MAWSS. 2019. *Vision 2026: Our Strategic Plan*. Mobile, AL: Mobile Area Water and Sewer System.

MAWSS. 2023a. "Mobile Area Water and Sewer System | Citizens Water Academy." Retrieved June 5, 2023 (https://www.mawss.com/education-and-outreach/citizens-water-academy/).

MAWSS. 2023b. "Mobile Area Water and Sewer System | Our Wastewater System." Retrieved June 5, 2023 (https://www.mawss.com/our-wastewater-system/).

MBNEP. 2008. *State of Mobile Bay. Status Report*. Mobile, AL: Mobile Bay National Estuary Program.

MBNEP. 2014. "Three Mile Creek Watershed Management Plan."

MBNEP. 2017. “Dog River Watershed Management Plan.”

MBNEP. 2019. “Comprehensive Conservation & Management Plan for Alabama’s Estuaries & Coast 2019-2023.”

MBNEP & TNC. 2019. “2019 Habitat Conservation and Restoration Plan for Coastal Alabama.”

MCHD. 2023. *Weekly Report on Characteristics of COVID-19 Patients - Mobile County, Alabama, 2020-2022*. Mobile, AL: Mobile County Health Department.

MHA. 2021. “History.” *Mobile Housing Authority*. Retrieved October 11, 2023 (https://www.mobilehousing.org/aboutus/history).

Mobile Area Chamber of Commerce. 2019. “Mobile’s on the Grow.” Retrieved May 9, 2023 (https://mobilechamber.com/wp-content/uploads/2022/07/MOTG_06042019-3-low.pdf).

Mobile Area Chamber of Commerce. 2022. *2021 Annual Report*.

Mobile County. 2022. “Mobile County Blueways.” Retrieved October 16, 2023 (https://www.mobilecountyblueway.com/).

Montiel, Daniel, Alexander F. Lamore, Jackson Stewart, W. Joe Lambert, Jacob Honeck, Yuehan Lu, Olivia Warren, Dini Adyasari, Nils Moosdorf, and Natasha Dimova. 2019. “Natural Groundwater Nutrient Fluxes Exceed Anthropogenic Inputs in an Ecologically Impacted Estuary: Lessons Learned from Mobile Bay, Alabama.” *Biogeochemistry* 145(1–2):1–33. doi: 10.1007/s10533-019-00587-0.

Morris, Rebecca L., Megan K. La Peyre, Bret M. Webb, Danielle A. Marshall, Donna M. Bilkovic, Just Cebrian, Giovanna McClenachan, Kelly M. Kibler, Linda J. Walters, David Bushek, Eric L. Sparks, Nigel A. Temple, Joshua Moody, Kory Angstadt, Joshua Goff, Maura Boswell, Paul Sacks, and Stephen E. Swearer. 2021. “Large-scale Variation in Wave Attenuation of Oyster Reef Living Shorelines and the Influence of Inundation Duration.” *Ecological Applications* 31(6):e02382. doi: 10.1002/eap.2382.

Morrison, Jim. 2019. “As High-Tide Flooding Worsens, More Pollution Is Washing to the Sea.” *Yale Environment 360*.

Muñoz, David F., Paul Muñoz, Atieh Alipour, Hamed Moftakhari, Hamid Moradkhani, and Behzad Mortazavi. 2021. “Fusing Multisource Data to Estimate the Effects of Urbanization, Sea Level Rise, and Hurricane Impacts on Long-Term Wetland Change

Dynamics." *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing* 14:1768–82. doi: 10.1109/JSTARS.2020.3048724.

NASA SLCT, and University of Hawai'i Sea Level Center. 2023. "Dauphin Island, AL." *NASA Sea Level Change Team Flooding Analysis Tool*. Retrieved June 6, 2023 (https://sealevel.nasa.gov/flooding-analysis-tool/projected-flooding?station-id=8735180&scenario=traj).

National Marine Fisheries Service. 2018. *Fisheries Economics of the United States, 2016. Tech. Memo*. NMFS-F/SPO-187. U.S. Dept. of Commerce, NOAA.

NOAA. n.d. "Sea Level Rise Viewer." *Sea Level Rise Viewer*. Retrieved (https://coast.noaa.gov/slr/#/layer/slr).

Pennock, JR, T. Whitledge, J. Boyer, J. Herrera Silveira, and R. Iverson. 1999. "Patterns of Phytoplankton Production and Nutrient Uptake in Estuaries of the Gulf of Mexico." Pp. 109–62 in *Biogeochemical dynamics of estuarine ecosystems in the Gulf of Mexico*. New York, NY: John Wiley and Sons.

Save on Energy Team. 2023. "Electricity Bill Report: Who Paid the Most, Least?" *SaveOnEnergy*. Retrieved (https://www.saveonenergy.com/resources/electricity-bills-by-state/).

SCAPE. 2023. "Brookley by the Bay: A Collective Vision for the City of Mobile's Largest Waterfront Park."

Stanley, Lydia, Arman Bajracharya, Filoteo Gomez-Martinez, and Kelly Dunn. 2019."Mobile Urban Development: Evaluating Urban Heat Islands and Flooding to Enhance Green Infrastructure Initiatives in Coastal Communities in Mobile, AL," Mobile, AL.

Stein, BA. 2002. *States of the Union: Ranking America's Biodiversity*. Arlington, Virginia: NatureServe.

Sweet, William V., Benjamin D. Hamlington, Robert E. Kopp, Christopher P. Weaver, Patrick L. Barnard, David Bekaert, William Brooks, Michael Craghan, Gregory Dusek, Thomas Frederikse, Gregory Garner, Ayesha S. Genz, John P. Krasting, Eric Larour, Doug Marcy, John J. Marra, Jayantha Obeysekera, Mark S. Osler, Matthew Pendleton, Daniel Roman, Lauren Schmeid, Will Viatch, Kathleen D. White, and Casey Zuzak. 2022. *Global and Regional Sea Level Rise Scenarios for the United States: Updated Mean Projections and Extreme Water Level Probabilities along U.S. Coastlines. NOAA Technical Report NOS*

01. Silver Spring, MD: National Oceanic and Atmospheric Administration, National Ocean Service.

Taylor, Ethel V., Ambarish Vaidyanathan, W. Dana Flanders, Matthew Murphy, Merianne Spencer, and Rebecca S. Noe. 2018. "Differences in Heat-Related Mortality by Citizenship Status: United States, 2005–2014." *American Journal of Public Health* 108(S2):S131–36. doi: 10.2105/AJPH.2017.304006.

The Nature Conservancy. n.d.-a. *Our Living Shorelines*. The Nature Conservancy.

The Nature Conservancy. n.d.-b. "Resilient Land Mapping Tool." Retrieved May 6, 2023 (https://maps.tnc.org/resilientland/).

TPL. 2023. "ParkServe® for Mobile, AL - TPL." *Trust for Public Land*. Retrieved May 10, 2023 (https://www.tpl.org/city/mobile-alabama).

U.S. Climate Resilience Toolkit. 2023. "Steps to Resilience Overview." Retrieved May 30, 2023 (https://toolkit.climate.gov/steps-to-resilience/steps-resilience-overview).

U.S. Department of Transportation Office of Public Affairs. 2022. "The Bipartisan Infrastructure Law Will Deliver for Alabama."

US EPA, OAR. 2015. "Health Effects of Ozone Pollution." Retrieved June 7, 2023 (https://www.epa.gov/ground-level-ozone-pollution/health-effects-ozone-pollution).

USACE. 2015. "Alabama Coastal Comprehensive Plan." *Alabama Coastal Comprehensive Plan*. Retrieved October 12, 2023 (https://experience.arcgis.com/experience/f7abf24ab7e7483b8a754017f135c1d6/page/Home).

USGCRP. 2018. *Impacts, Risks, and Adaptation in the United States: The Fourth National Climate Assessment, Volume II*. U.S. Global Change Research Program. doi: 10.7930/NCA4.2018.RiB.

Valentine, JF, KL Heck, MR Dardeau, and H. Burch. 2013. "Ecosystem-Based Management of Mobile Bay, Alabama." P. 21 in *Gulf of Mexico Origin, Waters, and Biota. Volume 4, Ecosystem-Based Management*. College Station: Texas A&M University Press.

Völker, Sebastian, and Thomas Kistemann. 2011. "The Impact of Blue Space on Human Health and Well-Being – Salutogenetic Health Effects of Inland Surface Waters: A Review." *International Journal of Hygiene and Environmental Health* 214(6):449–60. doi: 10.1016/j.ijheh.2011.05.001.

Vose, R. S., B. Huang, X. Yin, D. Arndt, D. R. Easterling, J. H. Lawrimore, M. J. Menne, A. Sanchez-Lugo, and H. M. Zhang. 2021. "Implementing Full Spatial Coverage in NOAA's Global Temperature Analysis." *Geophysical Research Letters* 48(4):e2020GL090873. doi: 10.1029/2020GL090873.

Webb, BM, B. Dix, SL Douglas, S. Asam, C. Cherry, and B. Buhring. 2019. "Nature-Based Solutions for Coastal Highway Resilience: An Implementation Guide."

White, Robin K., Warren C. Edwards, Ann Farrar, and M. John Plodinec. 2015. "A Practical Approach to Building Resilience in America's Communities." *American Behavioral Scientist* 59(2):200–219. doi: 10.1177/0002764214550296.

World Population Review. 2023. "Average Income by State." *World Population Review*. Retrieved (https://worldpopulationreview.com/state-rankings/average-income-by-state).

Zajacova, Anna, and Elizabeth M. Lawrence. 2018. "The Relationship Between Education and Health: Reducing Disparities Through a Contextual Approach." *Annual Review of Public Health* 39(1):273–89. doi: 10.1146/annurev-publhealth-031816-044628.