

Multi-Hazard Vulnerability Assessment

Charleston County, South Carolina

2024



Disclaimer

This analysis is a working document and should not be considered final; all information contained herein is subject to change. The analysis is based on the best available information for specific threats and assets at the time the analysis was conducted. Quantitative results presented herein are preliminary and are based on data with inherent uncertainties and generalized assumptions; site-specific evaluations of vulnerability and risk are beyond the scope of this assessment and should be reserved for a detailed evaluation of specific adaptation measures.

Acknowledgements

This work was undertaken with support from two Federal Emergency Management Agency grant programs that aim to support local resilience and adaptation work: the Building Resilience In Communities (BRIC) and Hazard Mitigation Grant Program (HMGP) funding are critical to improving community resilience projects like this one. This assessment would not have been possible without the active support from Charleston County staff as well as County Council, who demonstrated a strong commitment to this vital work. We also acknowledge the elected leadership for their dedication to advancing these initiatives, as well as the Resiliency and Sustainability Advisory Committee for their contributions.

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Introduction

What is Resilience?

Resilience is defined as the capacity of a community, business, or natural system to prevent, withstand, respond to, and recover from a disruption. Across the southeastern United States and nationwide, local governments are increasingly recognizing the need to create adaptive policies, robust planning processes, and proactive response protocols to build resilience against more frequent and severe extreme weather events, largely driven by a changing climate (Adger et al., 2007 & Burton, 1997).

Charleston County, like other southeastern counties, faces increasing impacts from hazards that are expected to become more frequent and severe in the future. The County's primary challenge stems from a variety of flood hazards due to its proximity to water, including nearly 100 miles of Atlantic Ocean shoreline, in addition to numerous marshes, rivers and wetlands. The County also has the distinction of being one of the few East Coast counties located in an area at risk for seismic activity.

The County has taken a proactive approach to building resilience by leveraging this document to incorporate additional science based insights on future impacts of key hazards and climate stressors. The County's existing portfolio of related work provides a strong foundation for planners and policymakers. Combined with the information from the Vulnerability and Risk Assessment, it supports more informed decision making to prepare the county for both current and future hazards and risks.

This Vulnerability and Risk Assessment is designed to support and inform the work identified in the County's Comprehensive Plan, Hazard Mitigation Plan, Emergency Operations Plan, the Resilience and Sustainability Advisory Committee. In addition, it will serve as a key resource for the County's Resilience Manager. The assessment provides County focused information on community vulnerability and risk, supplementing the information provided in the South Carolina Strategic Statewide Resilience and Risk Reduction Plan. It also aligns with and supports the greater objectives outlined in the South Carolina Disaster Relief and Resilience Act.

Performing a Vulnerability Assessment

Efforts to increase resilience to climate and non-climate impacts are built on the foundation of understanding—and reducing—vulnerability. Vulnerability is a term often used to describe susceptibility to harm. In the context of building resilience, a vulnerability assessment is a structured process that identifies how an organization, community, or city is susceptible to harm from existing or potential hazards.

Vulnerability assessments evaluate three main components: 1) exposure; 2) potential impact; and 3) adaptive capacity, where both physical and socioeconomic dimensions are considered. Another key concept used in a resilience assessment is the understanding of risk. Risk involves the likelihood and consequence of a hazard.

Together, the concepts of vulnerability and risk within a resilience framework can serve to inform the development of strategies to reduce vulnerability or risk. By taking an integrated viewpoint of these concepts, efforts can focus on building resilience for the assets that are most susceptible and most likely to be impacted. This approach also complements risk-hazard mitigation activities and management practices.

Another important aspect of a resilience assessment is to recognize the iterative nature of the process. Once strategies are implemented, it is necessary to monitor their effectiveness and update the plan.

Our Approach

This assessment was conducted using the U.S. Climate Resilience Toolkit's "Steps to Resilience" Framework. We started the project by collaborating closely with County staff to gain a clear understanding of their priorities and specific needs. With our decision support software, AccelAdapt, we gathered and analyzed data on various assets, focusing on how climate and non-climate stressors affected their vulnerability. To ensure a thorough and inclusive process, we held workshops with County staff and a focus group of community leaders, gathering input and sharing findings throughout the project. This approach allowed us to identify the most significant risks and vulnerable assets, aligning our assessment with existing hazard mitigation and resilience plans. Our goal was to provide clear, actionable recommendations to strengthen the County's resilience to future climate challenges, by building upon the progress the County had already achieved.

The following sections detail the full "Steps to Resilience" framework as well as our methodology, outlining each step of our process for this comprehensive assessment.

Steps to Resilience

The U.S. Climate Resilience Toolkit provides an iterative, six-step process for communities to follow when planning for climate resilience. This framework—known as the Steps to Resilience—is used as the foundation of this all-hazards vulnerability and risk assessment. The framework integrates the components of resilience that can be used in existing planning processes at the local level, and can be used to understand the characteristics of vulnerability and risk in a community, inform policy, and evaluate the effectiveness of strategies that are implemented.

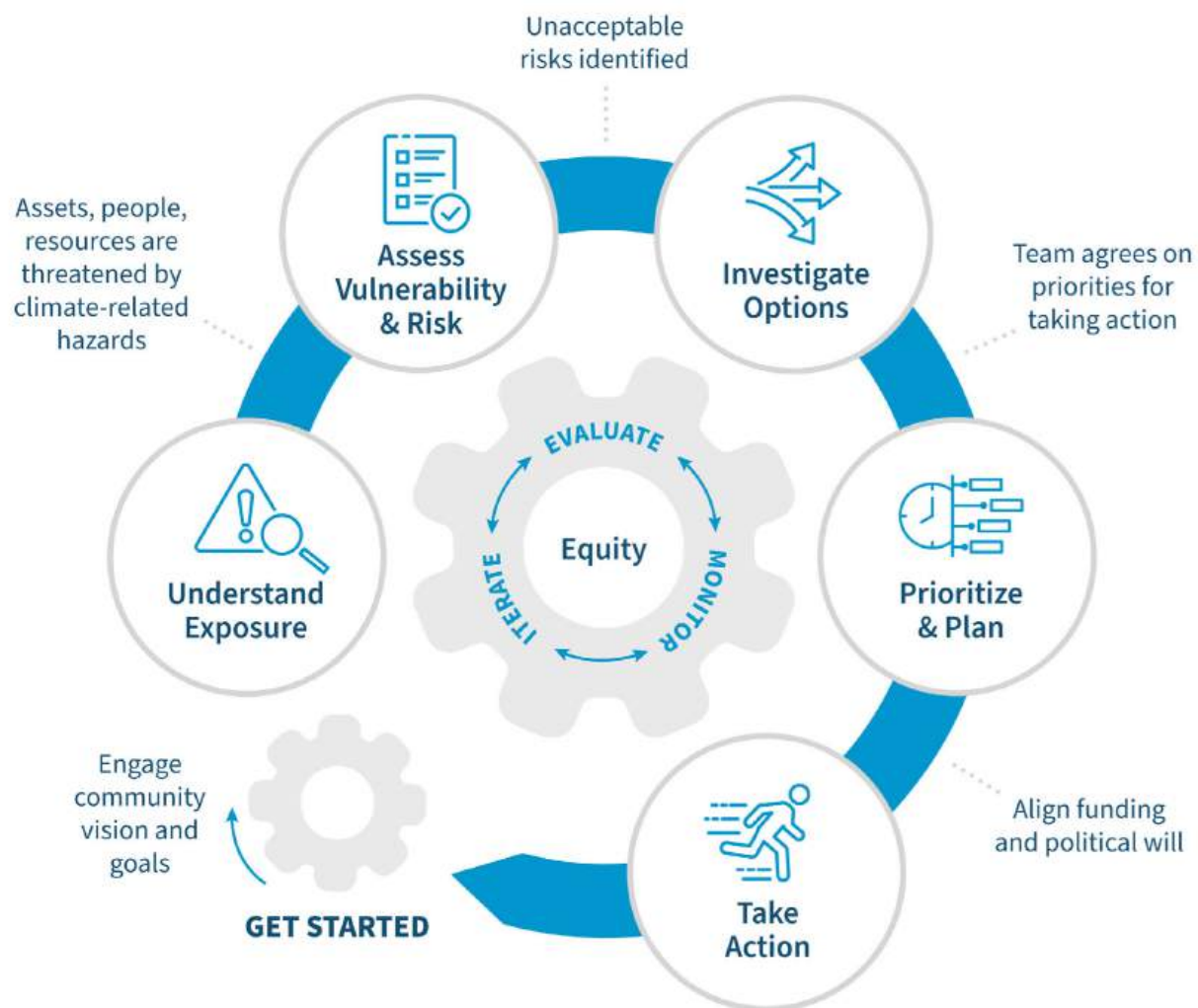


Figure 1. U.S. Climate Resilience Toolkit's Step to Resilience Framework



GETTING STARTED

A community begins by researching its past experiences with climate and weather events to identify the climate hazards and stressors, both climate-related and non-climate-related, that affect them. The community then forms a team of key government experts and community members, reviews existing plans, and develops a shared vision of a more resilient community based on its values. Finally, they set goals to achieve that vision.



Understand Exposure

A community begins by exploring regional climate trends and projections to understand its current and future exposure to climate hazards. The community then takes an inventory of the hazards it faces and examines how community assets-people, infrastructure, services, and resources- have been affected by these hazards in the past and how they might be threatened in the future.



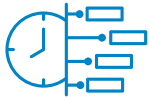
Assess Vulnerability and Risk

The goal is to identify which assets are vulnerable to specific hazards and to further examine the characteristics that make them more or less at risk of harm or destruction. It is important to assess the impact of losing these assets and the services they provide, and most importantly, to determine who will be affected by that disruption. This provides the foundation for addressing the vulnerabilities and reducing risk.



Investigate Options

There may be different strategies or actions to reduce vulnerability and risk from a particular hazard. The critical next step is to identify options that are both effective and feasible. This requires the involvement of key government experts and community members, whose experience and expertise is essential to creating a list of effective options for further consideration.



Prioritize and Plan

This step involves evaluating numerous options and prioritizing those that will have the greatest impact, while also considering the resources and expertise required for implementation. Input from key government and industry experts is essential. It's also important to consider the community values identified in the 'Get Started' phase and to include key community members in the evaluation process. Ultimately, the selected options need to be implementable, fundable, and aligned with community values. These options can inform other county plans will likely need to be implemented by existing county departments through policies, projects, or regulations.



Take Action

This step can be viewed as the most important, as it is by taking action that a community truly begins to build resilience. This process can take years and may never be fully complete. Communities will need to continuously adapt to build and maintain their resilience. By making resilience part of everyday business, the most consistent results can be achieved over time. Monitoring efforts, making necessary adjustments, and updating the information in this assessment will support those responsible for the ongoing process.

Assessment Methodology

A spatial assessment framework is applied to understand the challenges that a hazard poses to the community assets and government services of Charleston County.

The vulnerability assessment framework used in this project includes three key elements:

1. Publicly and privately owned community assets are categorized into six themes. Each combination of asset category and hazard condition is evaluated separately.
2. A set of rules, based on the attributes of asset and hazard data, is used to classify community assets as having “high”, “medium”, or “low” characteristics of vulnerability and risk.
3. Asset-level results are summarized or aggregated at planning scales.

COMMUNITY ASSET CATEGORIES

The assessment evaluates critical infrastructure and services, natural, cultural, and historic resources, homes, and businesses. These are grouped into the six asset categories shown below in Table 1. Together they represent most of the built environment and land-based natural areas in the county.

Table 1. Asset Categories and Community Asset Types Within Those Categories

Asset Category	Asset Types
<i>Critical and Government Owned</i>	Government owned assets including fire stations, schools, county owned facilities, and public works, as well as assets that are critical to community function during (and beyond) emergency scenarios, such as hospitals, points of distribution, and solid waste operations.
<i>Cultural & Community</i>	Services and facilities that are important for community wellbeing and relations, such as cemeteries, churches, historic monuments, and libraries.
<i>Residential</i>	All residential properties (homes) and long term care facilities (such as nursing homes or other residential care services). Includes specific housing types, such as public/assisted housing, manufactured homes, and multifamily properties.
<i>Industrial</i>	All industrial property, including warehouses, manufacturing sites, or ports.
<i>Commercial</i>	Any property that is primarily commercial (offices, supermarkets, retail, etc.).
<i>Open Space</i>	Land that is either vacant or some form of green space, such as vacant residential properties, working lands (agriculture, timber, etc.), and parks/recreation.

The property parcel dataset for Charleston County forms the basis for identifying and categorizing the asset types in Table 1. Additionally, point data from local and federal sources are used to provide supplemental parcel-based attributes across all asset categories.

Analysis Rulesets

Vulnerability is defined as the combination of an exposed asset's sensitivity and adaptive capacity (Figure 6). Risk considers the probability and magnitude of impact of the hazard (Figure 8). Rulesets are used to classify each exposed community asset as having "high," "medium," or "low" characteristics of each component of vulnerability and risk. The following describes these rulesets and Table 2 summarizes them.

EXPOSURE

For this assessment, **exposure** specifically means that an asset is within an area that the model predicts to be impacted by the hazard. Assets that are not exposed are not vulnerable or at risk from that hazard.

The assessment assumes that vacant or undeveloped properties (identified by the parcel use type) do not contain built structures and are only evaluated for exposure.

VULNERABILITY

To assess levels of **sensitivity**, the location of the asset's structure and its criticality are considered together. This is based on building footprints and the type of use or nature of service provided. Properties with structures that sit spatially within the hazard extent have higher sensitivity compared to those properties with structures outside of the hazard extent. Criticality is then considered in a binary manner, where some asset types have a higher sensitivity based on the magnitude or criticality of impact from the hazard. For example, a school or an EMS facility that provides direct services to residents is considered to be more critical than a commercial warehouse. Assets categorized as having a "high" level of sensitivity are those with both a building footprint within the hazard extent and a use that is considered critical.

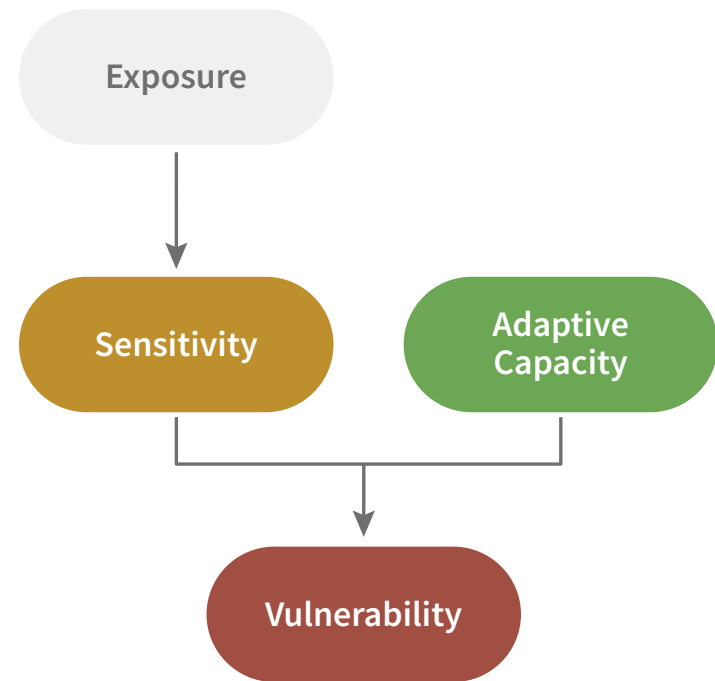


Figure 2. Flooding Assessment Components

Adaptive capacity is the ability of an asset to adjust to or cope with the impacts of hazard and is classified as high, medium, or low. This ruleset considers the characteristics of the asset that help it to remain intact following a climate-related hazard. For example, a newer building may have a higher adaptive capacity than an older building because it is constructed to the most current building codes.

Levels of sensitivity and adaptive capacity are then combined to determine vulnerability, as shown in Figure 3. Assets with low sensitivity and high adaptive capacity are the least vulnerable. Assets with high sensitivity and low adaptive capacity are the most vulnerable.

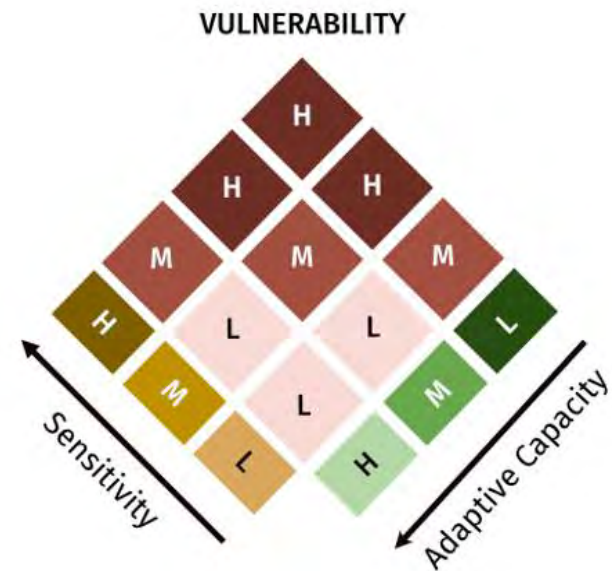


Figure 3. Vulnerability Matrix

RISK

Risk is the combination of probability or relative likelihood of a hazard occurring and the magnitude of its impact.

Probability is often determined using annualized likelihood to estimate the expected frequency of a certain hazard, such as the recurrence interval of a storm event.

Magnitude is the level or intensity of the hazard when it occurs. This could be measured with metrics such as wind speeds or number of extreme heat days. Both probability and magnitude are defined in these rulesets as low, medium, or high to produce an overall measure of risk.

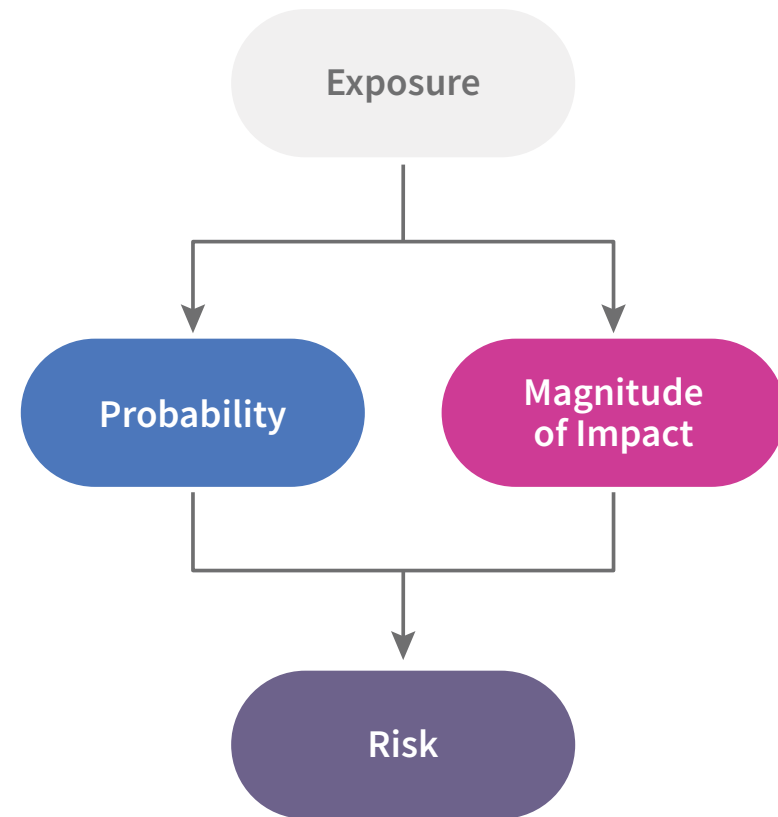


Figure 4. Components of Risk

COMBINED VULNERABILITY AND RISK

Once vulnerability and risk are determined, they are combined into one overall metric, as shown in Figure 5. Vulnerability considers how an asset, infrastructure, or service might be impacted and its ability to cope if a given hazard were to occur. Risk considers the probability and the general consequence of the hazard. Combining these concepts in a matrix comparing low, medium, and high vulnerability and risk allows decision makers to understand which assets are most susceptible and most likely to be impacted.

To better understand these rulesets in a practical application, coastal flooding can be used as a typical hazard for Charleston County. In this case, **exposure** is determined using a flooding dataset such as the FEMA 1% annual chance Special Flood Hazard Area to determine if an asset is inside or outside the extent of inundation. If an asset is not within the flood extent then it is not considered to be exposed.

COMBINED VULNERABILITY & RISK

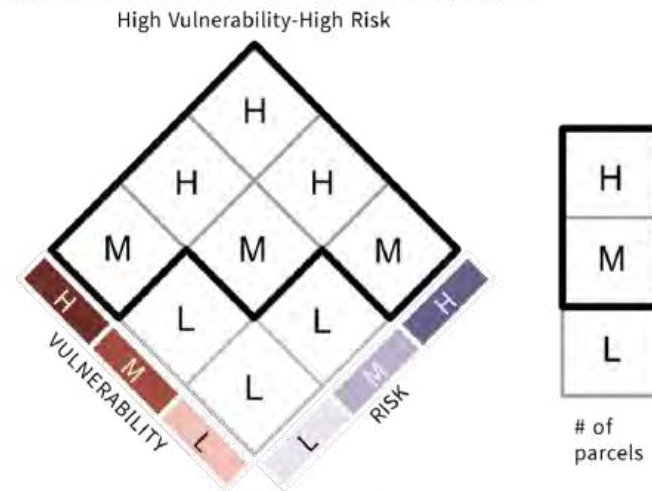


Figure 5. Combined Vulnerability & Risk

Sensitivity is the combination of the spatial location of a building and the criticality of its use. If the building is located inside the flood extent and it is a critical use or service, the property has a high sensitivity. If the building is located outside of the flood extent and does not have a critical use, the property has a low sensitivity. If one of these conditions exists, the property has a medium sensitivity. The asset's adaptive capacity is determined by the year the building was constructed. A building that conforms to the most current elevation requirements of the Base Flood Elevation plus freeboard has a high adaptive capacity. A building that was constructed outside of the regulatory floodplain or before Base Flood Elevation requirements were adopted has a low adaptive capacity. A building that was constructed to an older, lower Base Flood Elevation or without a freeboard has a medium adaptive capacity. Together, high, medium, or low sensitivity and adaptive capacity determine the vulnerability of the asset.

Considering coastal flooding, Federally modeled floodplain boundaries are used to determine probability. Assets in the 25% annual chance floodplain experience a high probability. Assets in the .2% annual chance floodplain experience a low probability. Magnitude is measured by the depth of flooding. Assets exposed to

flood depths greater than three feet experience a high magnitude. Assets exposed to flood depths less than one foot experience a low magnitude. Like the determination of vulnerability, risk is then assessed using the combination of low, medium, and high probability and magnitude.

Planning-Scale Aggregations

To facilitate the interpretation of and decision making related to parcel-based analyses and comparisons with census-based indicators of social stressors and social vulnerability, the assessment results are aggregated at the municipalities scale (including the unincorporated land), the planning area scale, and the census block group scale.

Aggregation of parcel-level assessment results to planning scales involves calculating the sum or proportion of assets with a medium or high classification for vulnerability and risk for each aggregation area (Figure 5). These are referred to as “highly vulnerable” assets.

Social Stressors and Disproportionate Impacts

Some existing environmental conditions, such as air and water quality or access to basic services, can particularly impact certain neighborhoods by being exacerbated by climate change. Disproportionate exposure to these conditions, as well as an unequal distribution of services and resources, can lead to increased sensitivity to the hazards assessed in this project, ultimately reducing adaptive capacity of affected areas. Social vulnerability is used in the assessment to help identify communities that are disproportionately vulnerable to climate hazards because of socioeconomic factors. These communities often reside in areas prone to multiple threats and may lack the resources needed to prepare for and recover from such hazards.



Figure 6. CDC Social Vulnerability Index Variables

Some existing environmental conditions, such as air and water quality or access to basic services, can particularly impact certain neighborhoods by being exacerbated by climate change. Disproportionate exposure to these conditions, as well as an unequal distribution of services and resources, can lead to increased sensitivity to the hazards assessed in this project, ultimately reducing adaptive capacity of affected areas. Social vulnerability is used in the assessment to help identify communities that are disproportionately vulnerable to climate hazards because of socioeconomic factors. These communities often reside in areas prone to multiple threats and may lack the resources needed to prepare for and recover from such hazards.

To assess social vulnerability, the assessment utilizes social and economic metrics at the block group levels from the 2021 American Community Survey (5-year estimates) and through the Centers for Disease Control and Prevention (CDC) Social Vulnerability Index (SVI), which measures social vulnerability through four themes at the census tract level: household composition and disability; socioeconomic status; minority status and language; and housing type and transportation (CDC, 2024).

To gain further insights, we also gathered data from the Climate and Economic Justice Screening Tool (CEJST), a national geospatial tool developed by the Environmental Protection Agency. This tool offers an overview of the socioeconomic and environmental challenges faced by the communities within Charleston County. This geospatial tool identifies 'disadvantaged areas' at the census tract scale that are overburdened and underserved across eight categories: energy, health, housing, legacy pollution, transportation, water and wastewater, climate change, and workforce development. Each theme includes multiple indicator datasets, ranking tracts by percentiles to assess the burden experienced by each census tract. This ranking determines the relative burden each census tract experiences compared to others.

In addition to the limitations that come with census tracts or block groups as a unit of analysis, these analysis tools cannot capture cases where impacts from multiple social stressors interact and lead to larger cumulative burdens (National Academies of Sciences, Engineering, and Medicine, 2023). This highlights the need for a deeper understanding of the nature of disproportionate and compounding impacts, which is crucial for designing solutions that are effective in the long term. Therefore, it is essential to seek and amplify community voices and incorporate the knowledge based on their lived experiences in resilience planning and implementation efforts.

Community Engagement

In December 2023, Fernleaf, with support from Adaapta, incorporated a community-informed approach to the assessment to gain a more holistic understanding of the county's climate vulnerabilities and to build a foundational understanding of the resilience planning process with the community. The objectives of this initial stage of community engagement were:

Create a broader understanding of vulnerabilities in Charleston County

- Obtain early feedback on the vulnerability assessment from community members who represent some of the most vulnerable to the effects of climate change.
- Use collected community input to guide the interpretation of the quantitative assessment
- Align the vulnerability assessment with lived experiences of the community

Lay the foundation for long-term community engagement

- Build trust by developing meaningful dialogues among focus group participants
- Grow the community's capacity to participate in future resilience-building efforts through hands-on discussions, shared conceptual understanding, and an active role in shaping the current effort
- Identify some shared priorities for actions to reduce everyday stresses as well as to make the community more resilient to extreme climate events
- Garner support for resilience initiatives by the County. Conversely, identify ways for the County to support any existing initiatives by the community
- Increase County staff readiness for broader community involvement following this phase of work

The project team included Chief Resilience Officer Karen Green, consultants from Fernleaf and Adaapta, as well as a focus group of four community stakeholders. The focus group participants were selected based on their ability to represent the perspectives and experiences of frontline and historically marginalized communities in Charleston County. To meet the project's objectives, each participant is a current community resident, deeply embedded within their community—such as staff members of community-based organizations or trusted community leaders—and willing to provide insights into the social stressors and challenges their communities face in accessing basic needs, resources, and opportunities.

Based on these criteria, the focus group consisted of one individual from the African American Settlement Community of Red Top, a Reverend from Edisto Island, a staff member from the Low Country Alliance for

Model Communities, and a staff member from the Center for Heirs Property Preservation. Over the course of nine months, the project team held four workshops, three in person and one virtual. Each workshop was designed to build upon the content and discussions of the previous. Facilitators led intentional discussions to identify important community assets and introduce key terms and concepts integral to the vulnerability assessment or to community climate resilience. Time was split between individual and group discussions to get a mix of specific details and broader consensus. Focused time was also spent on data literacy to ensure participants not only understood the vulnerability assessment but were also able to teach other members of their community about it. The materials and notes from each workshop, as well as lessons learned and recommendations, can be found in the full Community Engagement report.



Figure 7. Starting at the left: Matt Hutchins, Fernleaf; Aashka Patel, Fernleaf; Karen Green, Charleston County; Whitney Hansen, Fernleaf; Inka Bogdanski, Lowcountry Alliance for Model Communities; Dr. Melody Dover, Red Top Improvement Association; Rev. Charles Heyward, Edisto Presbyterian Church; Danielle Getsinger, Adaapta; Krisandra Provencher, Adaapta

Hazards Evaluated

Five hazards were assessed for Charleston County including, flooding, extreme heat, wildfire, high winds, and earthquake. Each one is multi-faceted and may include multiple risk sources and scenarios, including current and projected risk levels. Most of these are either climate driven or will continue to have increasing frequencies/intensities/impacts with climate change. Some of these hazards may also produce related impacts. For example, extreme heat increases the likelihood of drought, which increases the likelihood of wildfires. Each hazard is introduced generally here, more detailed information about the impacts of the hazard in Charleston County and the assessment findings are presented in the following sections.

FLOODING AND SEA LEVEL RISE

Flooding hazards are the most frequently impactful of the primary hazards facing Charleston County. This is due in large part to the fact that multiple types of flood hazards exist in this single geographic area, which is surrounded by water. Individual flooding hazards, which are described in more detail below, may occasionally occur at the same time as part of a single or multiple concurrent events, creating a complex compound flooding event that is difficult to predict and mitigate. An example of compound flooding is when a coastal storm impacts the area during an unusually high tide cycle, resulting in elevated coastal storm surge levels as well as stormwater runoff flooding due to coastal drainage outfalls being submerged by the high tide.

Coastal Flooding

Coastal flooding occurs due to inundation from the ocean. There are two types of coastal flood risks in Charleston County: coastal storm flooding and high tide flooding. Coastal storm flooding is driven by coastal storms like hurricanes and includes the effects of both storm surge and waves. High tide flooding, also referred to as "sunny day" or "nuisance" flooding, involves inundation of low-lying coastal areas by high tides, which can occur during normal high tides or extreme high tide events like king tides. Tidal flooding may be experienced in both areas that are adjacent to tidally-influenced water bodies as well as in more inland areas where tidal water will push through stormwater infrastructure in reverse and flow out through drains.

Rainfall Flooding

Rain-induced flooding occurs as a result of heavy precipitation events. The types of rain-induced flooding that can occur in Charleston County are overbank riverine flooding and stormwater runoff flooding. Riverine flooding, also known as fluvial flooding, occurs when water in rivers, creeks, canals, or swales overtops the banks and inundates the adjacent floodplain. This can happen due to locally heavy rainfall or from rainfall in upstream areas that moves downstream, even when it has not rained where the flooding occurs. Stormwater flooding, also known as pluvial flooding, is the accumulation of rainwater in areas with inadequate or dysfunctional drainage. This often happens during heavy rainfall events when drains and pipes cannot keep up with the amount of falling rain or when drainage outfalls are blocked by water or debris. In the southeast and across the United States, an increasing trend in the frequency and intensity of these types of heavy rain events due to more atmospheric water vapor being held in warmer air is already being observed (USGCRP, 2017).

CLIMATE CHANGE IMPACTS

All of these flooding hazards are anticipated to become increasingly frequent and impactful. Warming temperatures worldwide are causing land and glacial ice to melt and ocean water to expand, and rising ocean and atmospheric temperatures also allow both major and minor storms to carry and deposit more precipitation. And Charleston County, like most coastal areas, will see all of its flooding hazards amplified by this ongoing sea level rise and precipitation intensification.

Globally, the average sea level has risen about 8–9 inches since 1880, with about 35% of that rise occurring since 1990 (Carter et al., 2018). Higher sea levels due to climate change will raise the elevation of storm surge and waves and cause them to travel farther inland than in the past, impacting more coastal properties (USGCRP, 2017). Not only will more sea water push onshore during coastal and tidal events, but rainfall induced floodwaters will also drain less freely to natural and constructed outfalls. In Charleston County, mean sea levels are expected to increase by about another foot by 2050 relative to conditions today, as shown in Figure 8.

Local sea-level rise scenarios : Charleston County, SC

Source: 2022 U.S. Interagency Taskforce (ITF) Report

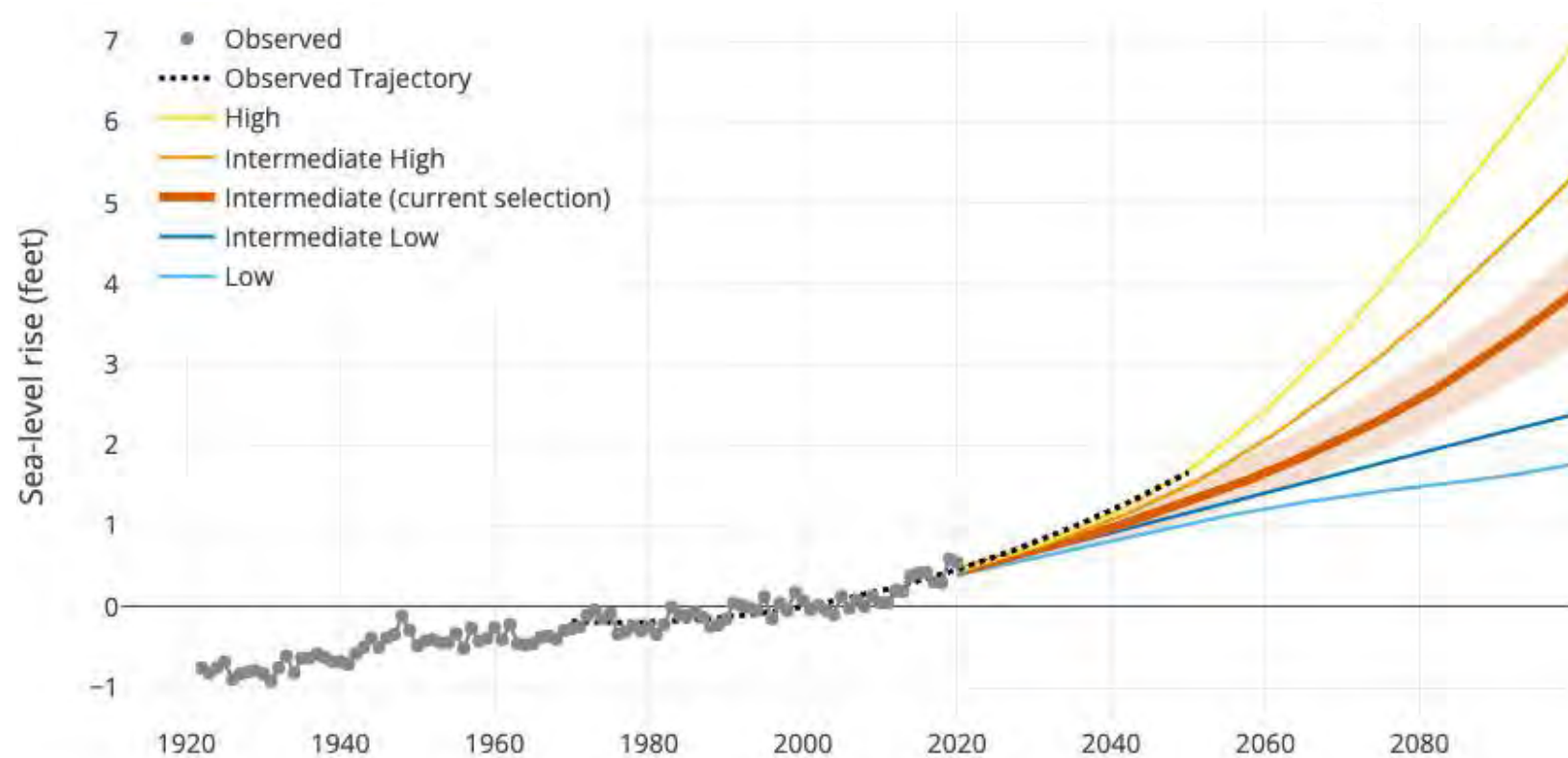


Figure 8. Sea Level Rise Scenarios for Charleston County, NASA Sea Level Change Team Flooding Analysis Tool, 2024

As sea levels rise, the time periods when tidal flooding occurs will increase in frequency and duration. Over time, this may be exacerbated by losses of natural barriers (Sweet et al., 2018). During the period of May 2023 to April 2024, Charleston County experienced 17 high tide flooding days. As Figure 9 shows, by 2050, this number is anticipated to increase to 60-100 high tide flooding days (NOAA, 2022).

Projected Flooding Days : Charleston County, SC

SLR scenario: **Intermediate High** Flooding threshold: **NOAA Minor**

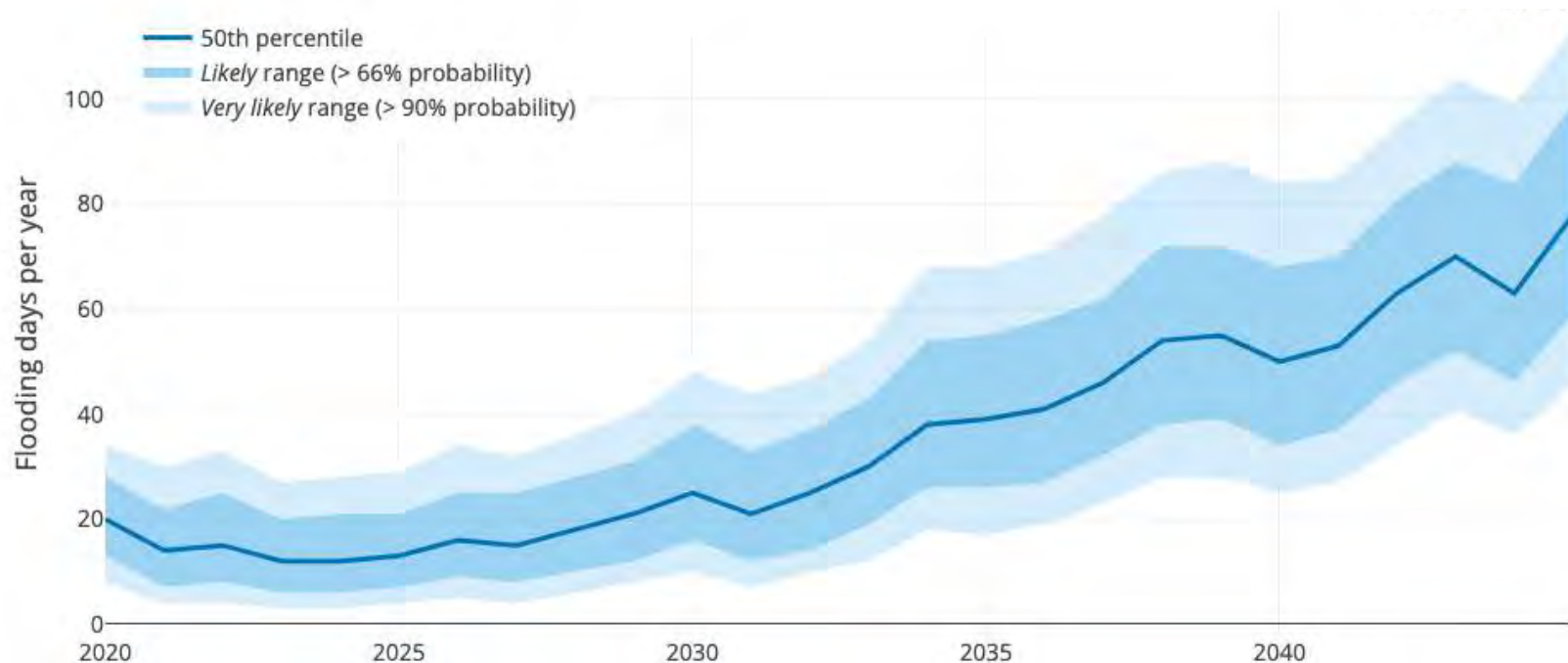


Figure 9. Projected Flooding Days for Charleston County, SC, NASA Sea Level Change Team Flooding Analysis Tool, 2024

EXTREME HEAT

Extreme heat is when summertime conditions combine hotter than normal temperatures with high humidity. Exposure to extreme heat can cause heat exhaustion, heat cramps, heat stroke and even death. Extreme heat is, indeed, the number one weather-related killer in the U.S. (National Weather Service, 2018).

While hot days and heat waves are natural weather patterns in the Lowcountry, a warming climate is increasing the risk of extreme heat. In the southeast, the most significant trend observed is of increasing hot summer nights, defined as nighttime low temperatures at or above 70 °F. Over the past two decades, the southeastern United States has experienced the most significant increase in warm nights nationwide. The region is projected to experience about 35 additional 'warm nights' (over 70 °F) per year by mid-century with the current trajectory of greenhouse gas emissions (Union of Concerned Scientists, 2017).

This pattern aligns with the broader trend of increasing heat waves across the United States, which have become more frequent, intense, and longer-lasting (National Academies of Sciences, Engineering, and Medicine, 2023). Since the 1980's, heatwaves have doubled in number and duration, with the heatwave season extending by about 30 days (US Global Change Research Program, 2023). This increase in extreme heat events poses significant health risks, including heat-related illnesses and deaths, impacts to agriculture and the natural environment, and interruptions in operations and services.

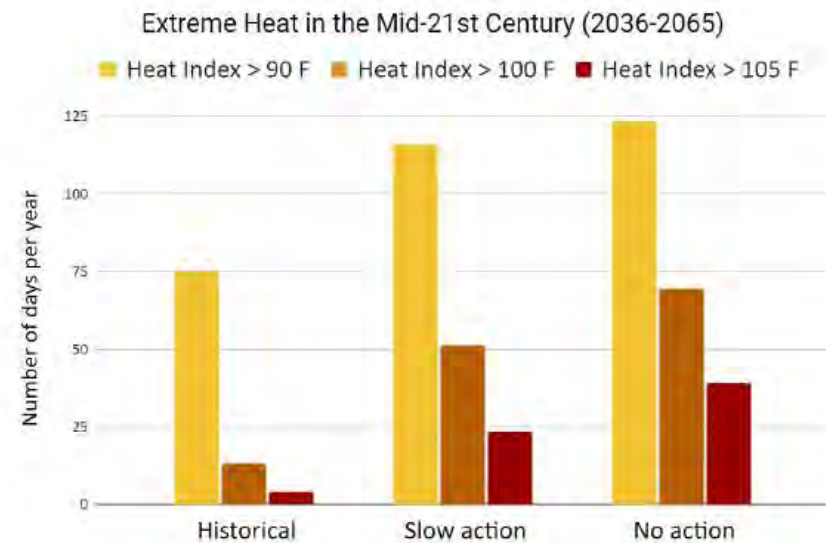


Figure 10. Observed Changes in Warm Nights, Fifth National Climate Assessment, 2023

WILDFIRE

A wildfire is an unplanned fire that originates in natural or wildland areas. Wildfires can cause damage to important natural resources as well as surrounding communities located in the wildland urban interface (National Wildfire Coordinating Group, 2012). As the climate warms, it is anticipated that wildfires will increase in frequency and expanse, which is expected to drive up the costs associated with health effects, fire suppression, and loss of homes and infrastructure (USGCRP, 2017). Reports published by the IPCC support these projections, explaining that rising temperatures and increases in the duration and intensity of drought are expected to increase wildfire occurrence and reduce the effectiveness of prescribed fire.

Although the western United States experiences the greatest total area burned by wildfire, the southeast experiences the highest number of wildfires. Furthermore, rapid urban expansion taking place near managed forests leads to reduced opportunities to use prescribed fire, which has the potential to increase wildfire occurrence and its impacts to the economy and public health (USGCRP, 2017).

EARTHQUAKE

An earthquake is a sudden, rapid shaking of the earth due to seismic activity. In addition to ground shaking, earthquakes can cause liquefaction, which has the potential to damage or destroy buildings and infrastructure, trigger fires, and cause loss of life.

Softer soils amplify ground motion and are more susceptible to seismic activity. Softer soils typically occur near water, of which there is a lot in Charleston County. Even in areas with stiffer soils that amplify seismic motion less, significant damage can occur to buildings and infrastructure that were constructed prior to the adoption of building codes and seismic construction guidelines.

NEHRP Soil Site Classes for Earthquake Risk Determination

Soft Soils

Stiff Soils

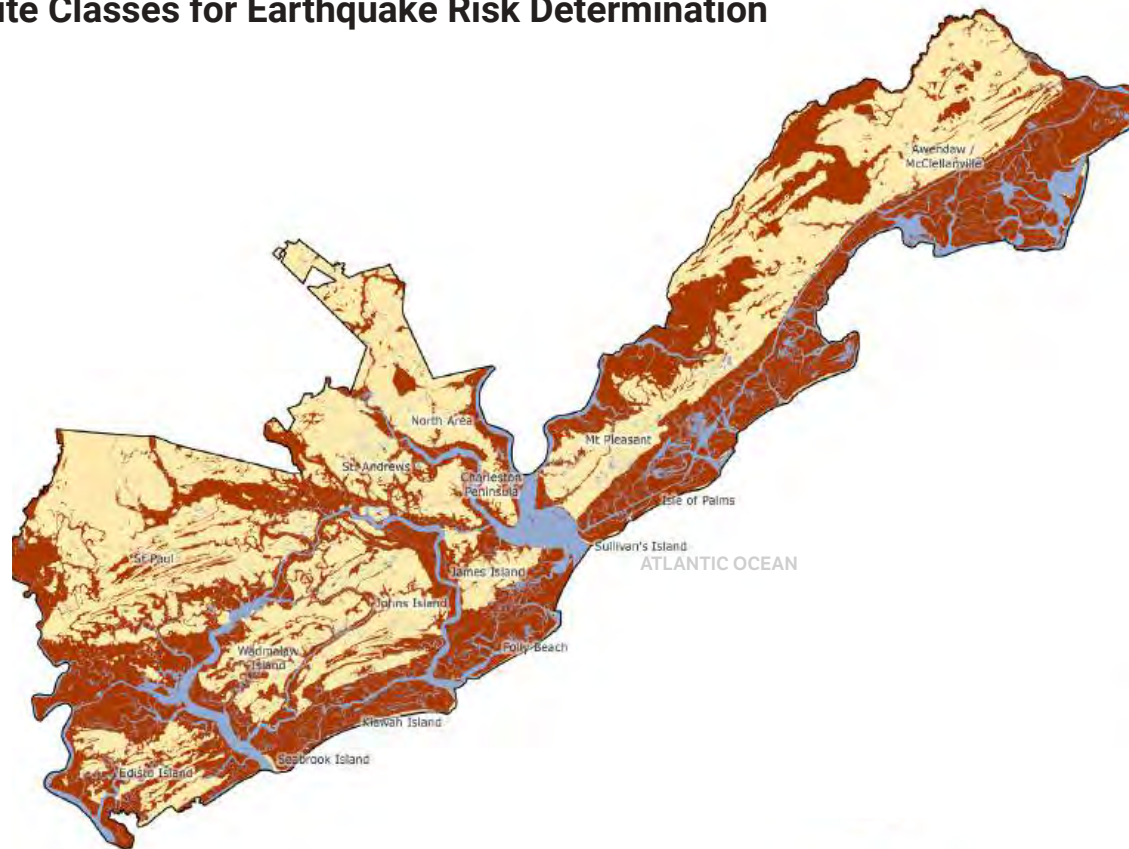


Figure 11. National Earthquake Hazards Reduction Program, 2024

HIGH WINDS

High winds are defined as sustained, strong winds most often associated with tropical storm systems. High winds can damage or destroy property, cause extensive power outages or other utility disruptions, and threaten health and safety due to windblown debris. Jacksonville experienced the damage high winds can cause when Hurricane Irma's 85 (+) mph wind gusts damaged trees, roofs, and powerlines (Cangialosi et al., 2021).

The high wind threat from storms like Irma is likely to increase in the next century as most forecasting models show that climate change may increase hurricane wind intensity. This change is likely due to warmer ocean temperatures and more moisture in the air, which can fuel hurricanes (Colbert, 2024).



Vulnerability to Flood Hazards

As an area with urbanized communities in which many rivers, creeks, and tidal marshes meet the ocean, Charleston County experiences flood hazards from nearly every source of flooding possible. Storm surge, high tide, riverine, and stormwater flooding all impact parts of the county regularly, sometimes concurrently in compound flooding events, and the impacts of each will continue to be intensified by sea level rise and heavier rainfall. And while this assessment examines snapshots of current risk conditions as well as some future projections, it is important to keep in mind that these likelihoods will change over time; that is, a 1% annual chance today will be greater in the years to come.

Flood Hazard Assessment Methodology

Multiple flood datasets are available for Charleston County that show different types of flood risk. To assess the impact of a range of flooding hazards as well as climate-driven changes in the future, eight different flood scenarios from four datasets were selected in consultation with the staff work group.

Flood Hazard Data Sources

These data are from publicly available datasets developed by the Federal Emergency Management Agency (FEMA), the National Oceanic and Atmospheric Administration (NOAA), and the United States Geological Survey (USGS), and are supplemented by climate modeling performed by the Woodwell Climate Research Center.

NATIONAL FLOOD HAZARD LAYER, FEMA

The National Flood Hazard Layer (NFHL) is the flood dataset developed by FEMA to support the National Flood Insurance Program (NFIP) by defining flood zones that correspond to a range of modeled risk to flood hazards. In coastal areas like Charleston County, FEMA flood zones represent a combination of riverine floodways, rainfall-induced riverine flooding, and storm surge with or without wave action, and are shown on the Flood Insurance Rate Map (FIRM) that is published for each county.

FEMA flood zones are defined by how likely a level of flooding can recur or be exceeded over a period of time. For example, the terms “1% annual chance flood”, “100-year flood”, or “1% annual exceedance probability flood” are used to refer to the level of inundation that has a 1% chance of occurring or being exceeded in any given year. A 1% annual chance flood event also has about a 26% chance of occurring over 30 years or about a 40% chance over 50 years. The 1% annual chance and 0.2% annual chance (500-year) floods are the two most common risk likelihoods shown on a FIRM. In Charleston County, as is common elsewhere, the 1% annual chance flood zones along with the floodway form the regulatory floodplain, which is collectively referred to as the Special Flood Hazard Area (SFHA).

The FEMA data is used in the assessment in two ways: the full FEMA National Flood Hazard Layer (NFHL) which includes wave action and the 1% and 0.2% annual chance floodplains, as well as the FEMA Special Flood Hazard Area (SFHA), which includes just the higher risk zones of floodway and the 1% annual chance floodplain.

The data produced by FEMA are the official standard used to inform flood risk reduction policy as well as flood insurance risk ratings nationwide. For this reason, the FEMA datasets are particularly useful in aligning local regulations, providing consistent flood risk advice, and developing proposals for Federal funding. The range of risk shown in the different flood zones can also be a planning tool to project the extent to which the higher flood risk zones may expand over time.

One limitation of the FEMA flood hazard data is that the modeling approach does not include pluvial flooding, or flooding from rainfall runoff, which is a major contributor to flooding experienced in both urban and suburban areas. FEMA modeling also does not incorporate instances of compound flood risks from multiple concurrent flooding sources. Coastal and riverine hydrology are modeled independently and to simplify their primary regulatory and insurance rating purposes, the FIRM often shows only the flood hazard with the greatest likelihood for a given area.

In addition, despite the fact that many Federal funding programs require consideration of future hazard projections, information on increases in flood risk specifically related to sea level rise and climate-driven storm intensification is currently not available from FEMA.

FEMA National Flood Hazard Layer (NFHL)

-  Floodway or Wave Action Area
-  1% Annual Chance Floodplain
-  0.2% Annual Chance Floodplain

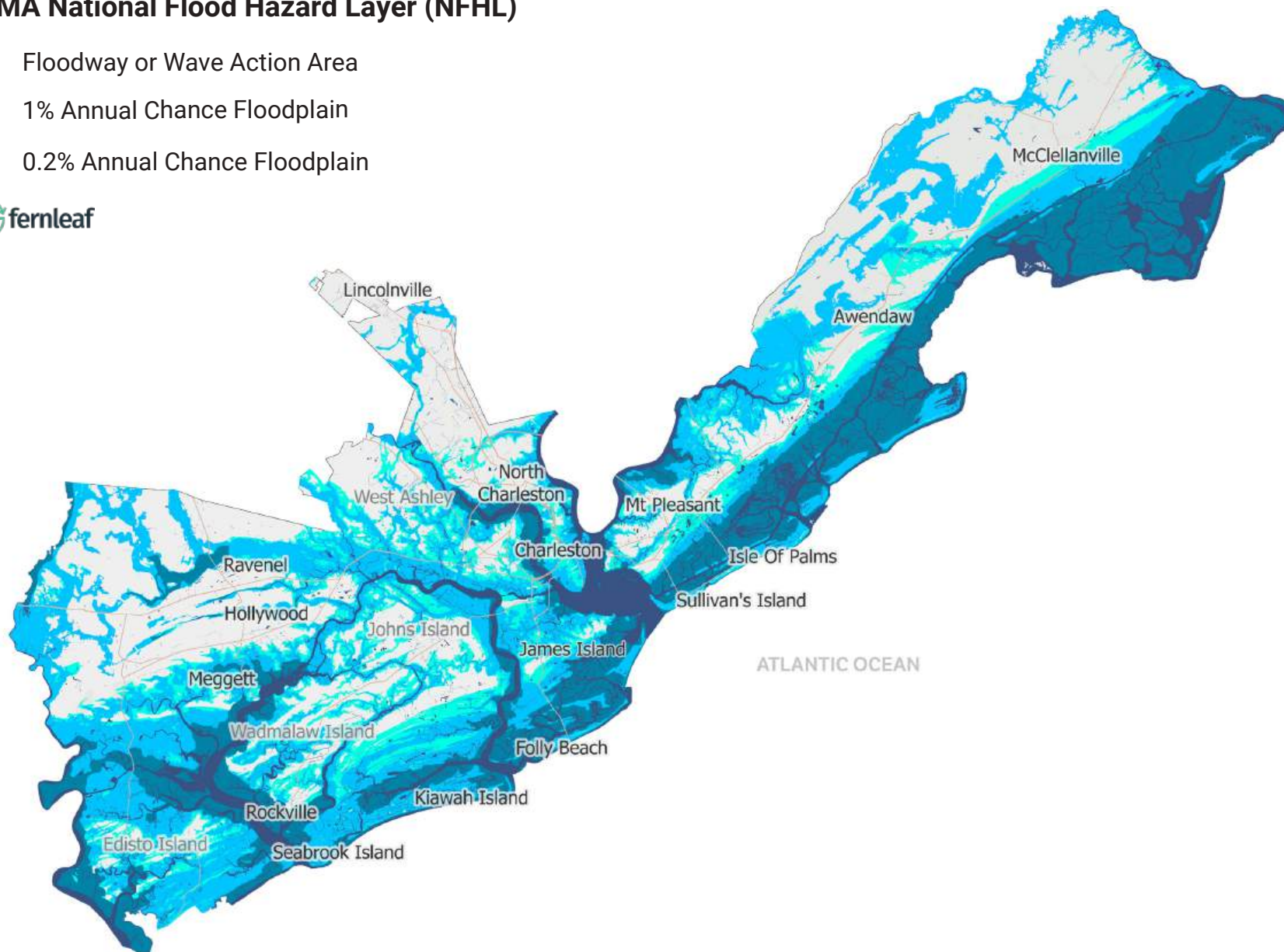


Figure 12. The extent of the FEMA National Flood Hazard Layer

HIGH TIDE FLOODING, NOAA OFFICE OF COASTAL MANAGEMENT

High tide flooding occurs when the low-lying lands along the coastline and tidally-influenced rivers and creeks become inundated during an astronomical high tide that is not associated with a tropical storm. Tidal flooding is also referred to as “sunny day,” “nuisance,” or “king tide” flooding. The height of a daily tide varies seasonally and from year to year, depending on the relative positions of the earth, the sun, and the moon, ocean and wind currents, and changes in ocean circulation (such as El Niño and La Niña cycles). In addition to the height of the high tide, the degree of tidal flooding at a location is dependent upon the coastal landscape, topography, and coastal infrastructure (such as seawalls, storm drains, and roadways).

The NOAA High Tide Flooding layer is available through the Sea Level Rise Viewer and is used to assess the current vulnerability of community assets to ‘minor’ high tide flooding. At the Charleston Harbor gauge (ID: 866530) the ‘minor’ flooding threshold established by NOAA is 1.87 feet above Mean Higher High Water (MHHW), which is the average highest tide in the daily tidal cycle.

NOAA High Tide Flooding Extent

■ High Tide Flooding

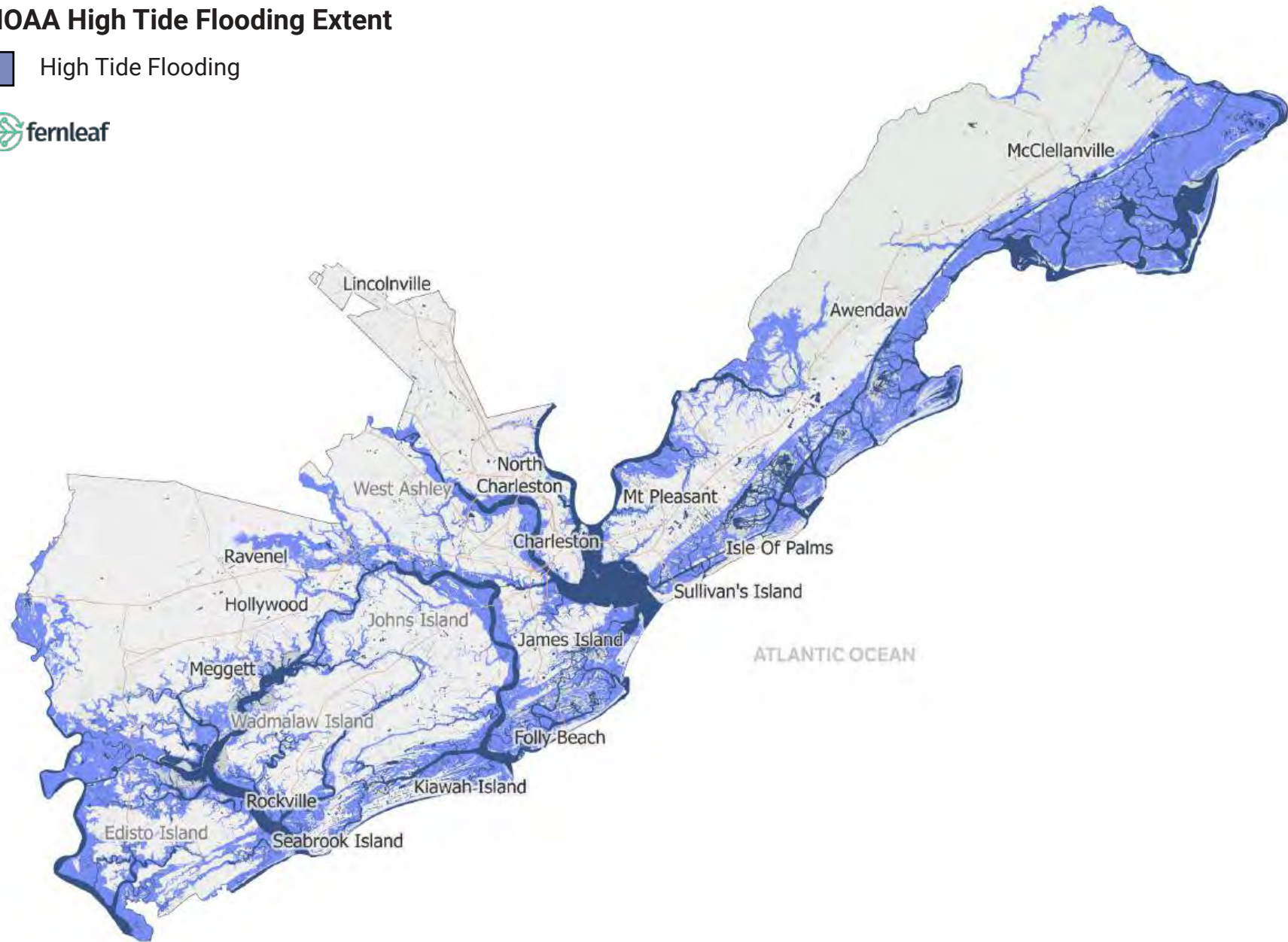


Figure 13. Extent of surface flooding caused by a tidal level of 1.87 ft above MHHW, which is the NOAA threshold for 'minor' high tide flooding

COASTAL STORM MODELING SYSTEM, USGS

In January 2023, USGS released a new coastal flooding dataset for the Carolinas based on their Coastal Storm Modeling System (CoSMoS). The CoSMoS approach used for the southeast Atlantic includes all coastal factors that contribute to flood water levels such as tides, storm surge, and waves, as well as inland processes of river discharge and overland or pluvial flooding. A nested, dynamic modeling approach is used to estimate compound flooding caused by the interaction of these factors.

For future projections of storm-induced coastal flooding, CoSMoS incorporates estimates for sea level rise, wind, and pressure from global climate models to project coastal storms under changing climate conditions rather than relying on change factors applied to historic storm records (Barnard et al. 2023). In addition to a range of sea level rise scenarios, the Carolinas CoSMoS dataset includes flood extents and depths for a range of recurrence intervals.

The vulnerability assessment examines four flooding scenarios: a 5% annual chance (20-year) flood and a 1% annual chance (100-year) flood for both current conditions and for 1.6 feet of relative sea level rise. This amount of sea level rise could occur in the region as early as the 2040s in the Intermediate-High Scenario and by the 2060's in the Intermediate-Low Scenario (Sweet et al. 2022).

USGS CoSMoS 5% Annual Chance Flood Extend

Current

Future (1.6 ft SLR)

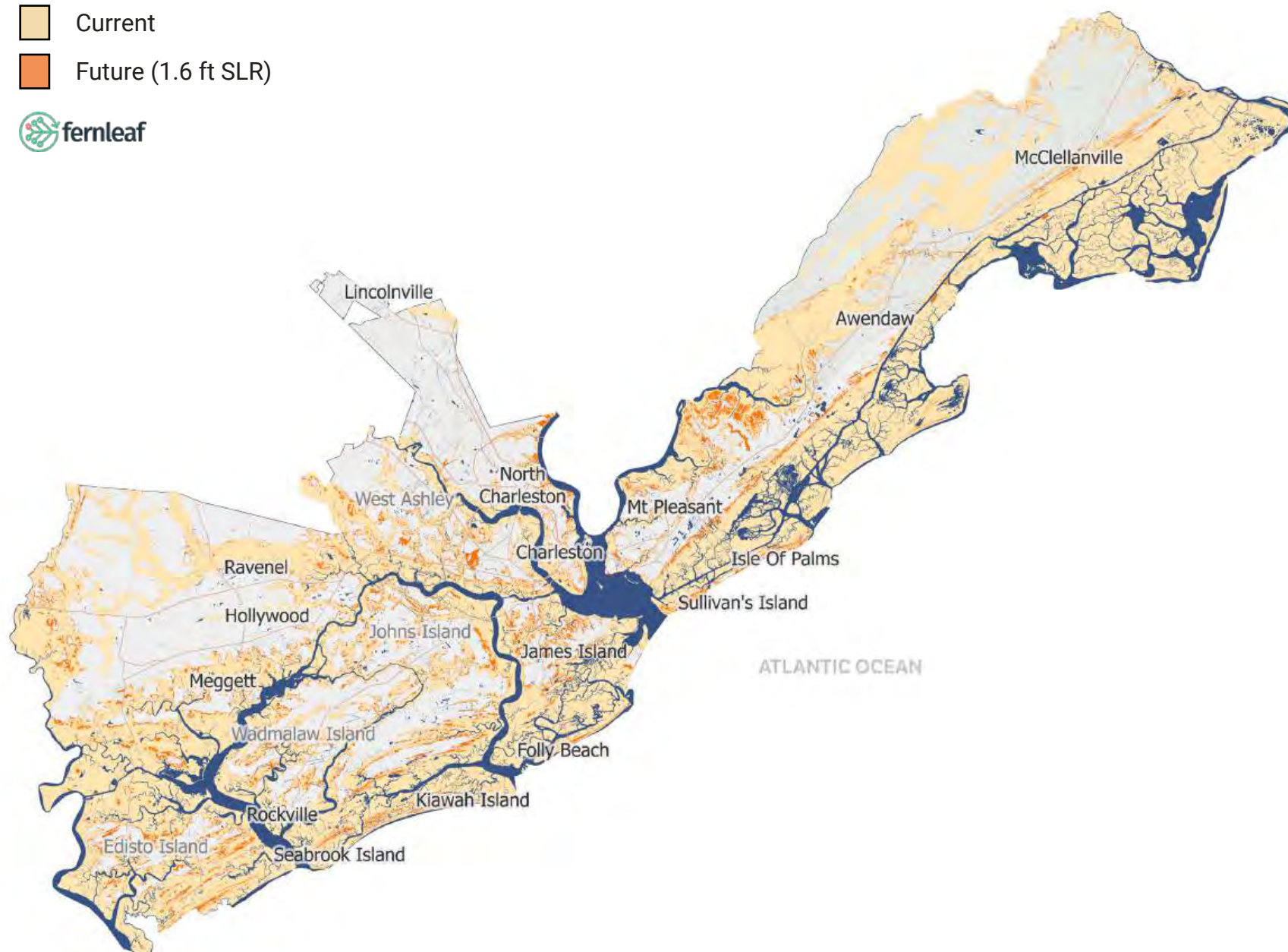


Figure 14. Extent of 5% annual flooding per CoSMoS dataset developed by USGS

USGS CoSMoS 1% Annual Chance Flood Extent

Current

Future (1.6 ft SLR)

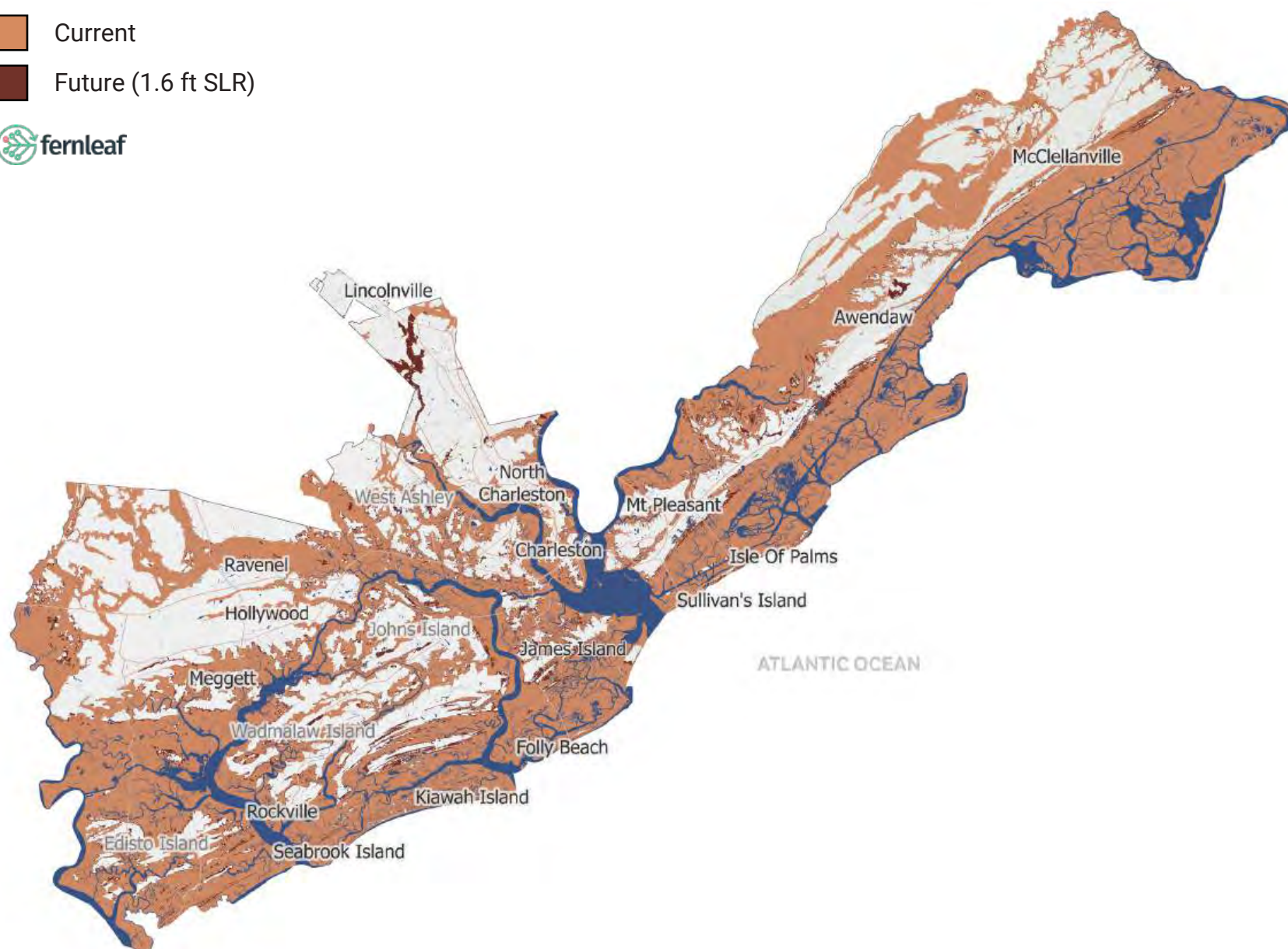


Figure 15. Current & Future USGS CoSMoS 1% Annual Chance Flood Extent

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1% ANNUAL CHANCE FLOODPLAIN, WOODWELL

In the summer of 2023, the Woodwell Climate Research Center provided a flood risk assessment and associated datasets to the Tri-County Taskforce comprising Charleston County, the Cities of North Charleston and Charleston, and the Town of Mount Pleasant. For this study, Woodwell mapped current and future 1% annual chance flood extents and depths for the entire Charleston County region using the LISFLOOD-FP model. This is a relatively simplified flood modeling approach that uses riverine boundaries and storm surge water levels as determined by the FEMA Flood Insurance Study, which employs relatively intensive hydrologic and hydraulic modeling. Results from separate riverine and coastal flooding models are combined and the highest flood depth is selected for mapping where they overlap.

Notably, the riverine model component includes a pluvial flood component. As is highlighted in Woodwell's report, areas with significant pluvial flooding include North Charleston, especially around the airport and surrounding commercial areas, West Ashley, and Mount Pleasant town center. In addition, the region between Savannah Highway and Highway 162 in the western portion of the County also shows significant pluvial flooding.

This assessment used the 1% annual chance flood extent under current conditions and in a future condition with 2.5 feet of Sea Level Rise. A relative sea level rise of 2.5 feet could occur in this region as early as the 2060s in the Intermediate-High scenario, which assumes high greenhouse gas emissions (Sweet et. al 2022).

Woodwell Current & Future 1% Annual Chance Relative to FEMA 1 % Annual Chance

- Woodwell Current 1% Annual Chance
- Woodwell Future 1% Annual Chance (2.5 ft. SLR)
- FEMA 1% Annual Chance (SFHA)

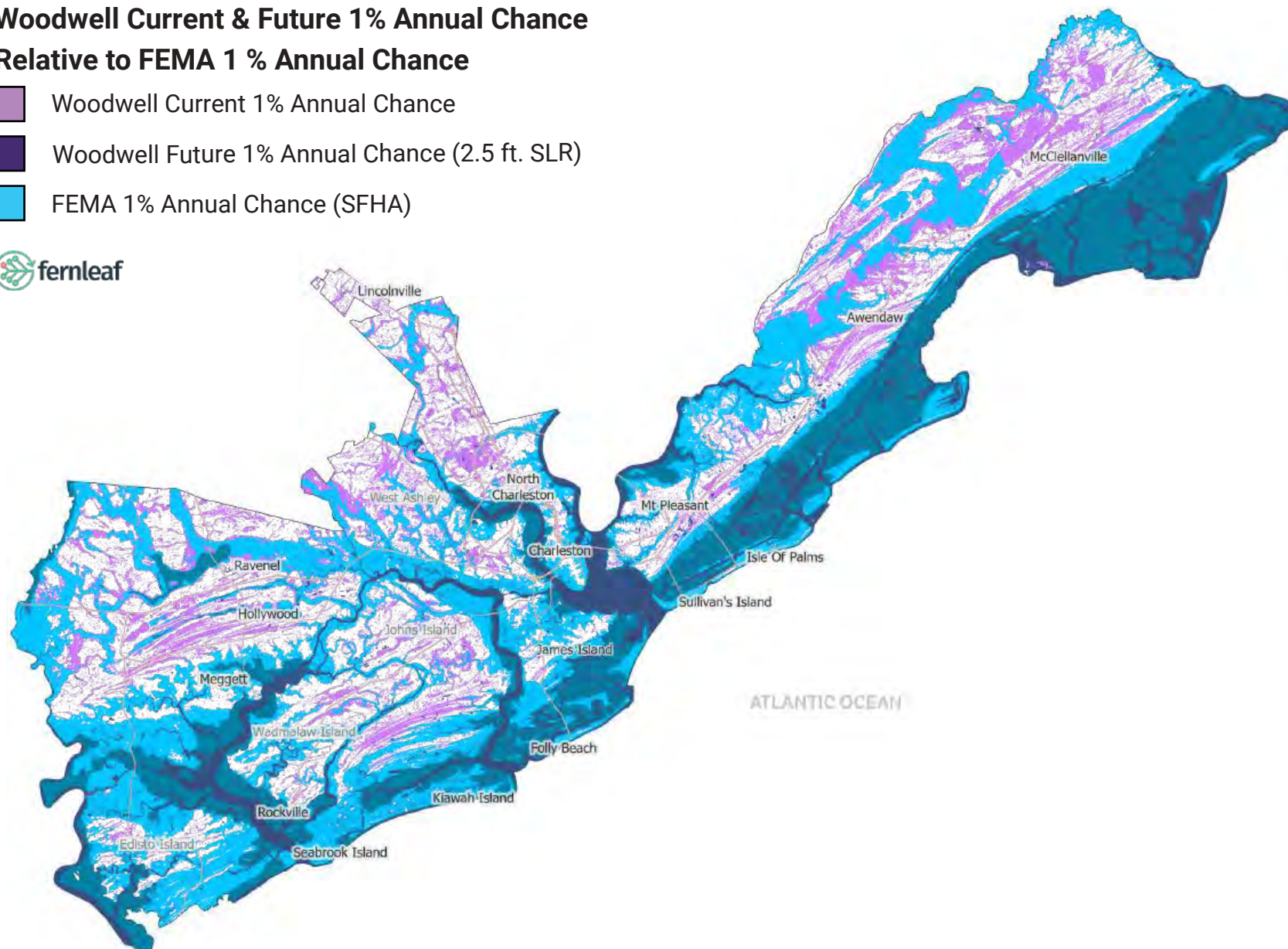


Figure 16. Woodwell 1% annual chance flood extent with the Special Flood Hazard Areas defined within the FEMA NFHL. Areas where the Woodwell flood extent reaches beyond the FEMA floodplain are indicated in purple

Flood Hazard Rulesets

In examining flooding vulnerability, rulesets were established for each of the flood hazard datasets to provide a view of a variety of modeled scenarios for both current conditions and future projections. These rulesets are summarized below to show the risk related to each flood hazard dataset.

Table 2. Summary of rulesets used for flooding vulnerability assessment

Threat	Exposure	Sensitivity	Adaptive Capacity	Risk Probability	Risk Consequence
<u>FEMA SFHA</u> (floodway, 1% and 0.2% annual chance)	Parcels exposed to the flood extent	<i>Criticality of assets within threat extent:</i> <u>HIGH:</u> Structure in inundation extent & High Sensitivity tag <u>MEDIUM:</u> Structure in inundation extent <u>LOW:</u> No structure in inundation extent (land only)	<i>Floodplain development requirements during year of construction:</i> <u>HIGH:</u> Structure outside the flood extent or built after BFE requirements were raised to 1ft <u>MEDIUM:</u> Structure in flood extent built after BFE requirements were put in place <u>LOW:</u> Structure in flood extent built before BFE requirements were in place or structure outside regulatory floodplain	Flood Zone: <u>HIGH:</u> Structure or parcel in floodway OR 1% annual chance extent <u>MEDIUM:</u> Structure or parcel in 0.2% annual chance extent <u>LOW:</u> N/A	N/A
<u>FEMA NFHL</u> (floodway, 1% and 0.2% annual chance)				N/A	N/A
<u>NOAA</u> Current High Tide Flooding				N/A	<i>Depth of flood exposure:</i> <u>HIGH:</u> Structure exposed to potential flood depth of 3ft+ <u>MEDIUM:</u> Structure exposed to potential depth between 1 and 3ft <u>LOW:</u> Structure exposed to flood depth less than 1 ft OR no structure exposed (land only)
<u>Woodwell</u> Current and Future (+2.5 ft SLR) 1% annual chance					
<u>USGS CoSMoS</u> Current & Future (+1.6ft SLR) 1% and 5% annual chance					

Flood Hazard Assessment Findings

Charleston County's assets face varying degrees of flood risk, as shown in the assessment of nine distinct flood conditions. Each of these conditions and their related vulnerabilities are examined in detail in Appendix A.

RESIDENTIAL PROPERTIES

Less Frequent, Extreme Flooding

Figures 17 and 18 show the spatial distribution of highly vulnerable homes across the County for the USGS and Woodwell current 1% annual chance flood assessments, respectively. Even as residential vulnerability to this extreme flood conditions is widespread, the results summarized for each census block group provide an understanding of relative severity of this issue across different areas of the County. Highlighted in darkest red are block groups where at least 1 in 4 residential properties within its boundaries that are highly vulnerable (i.e., have moderate or high combined vulnerability and risk).

Both the USGS and Woodwell assessments show that the highest proportion of vulnerable homes (50% or higher symbolized in red and dark red) are located in the coastal towns and communities (Edisto Island, Seabrook Island, Kiawah Island, Folly Beach, Isle of Palms and Sullivan's Island), outermost areas of the Peninsula, and pockets of James Island and West Ashley. The Woodwell assessment also indicates highest vulnerability block groups in much of West Ashley, more areas of James Island, and several block groups each in Mount Pleasant and North Charleston. Notably, According to the Woodwell assessment, nearly all block groups in the County have at least 1 in ten homes (10%) vulnerable (shaded orange or darker). This is a significantly higher estimate than USGS in Hollywood and some surrounding block groups, much of North Charleston outside the neck area, portions of Johns Island, and much of Mount Pleasant. At least some of this difference is attributable to the strong representation of the pluvial (or surface) flooding mechanism in the Woodwell model as well as the 1% annual chance event (Woodwell Climate Research Center, 2023).

Residential Assets | USGS CoSMoS Current 1% Annual Chance

Properties with Med/High Combined Vulnerability and Risk

-  No Vulnerability
-  < 27% Vulnerable
-  27%-54% Vulnerable
-  54%-99% Vulnerable
-  Median Income <\$48k

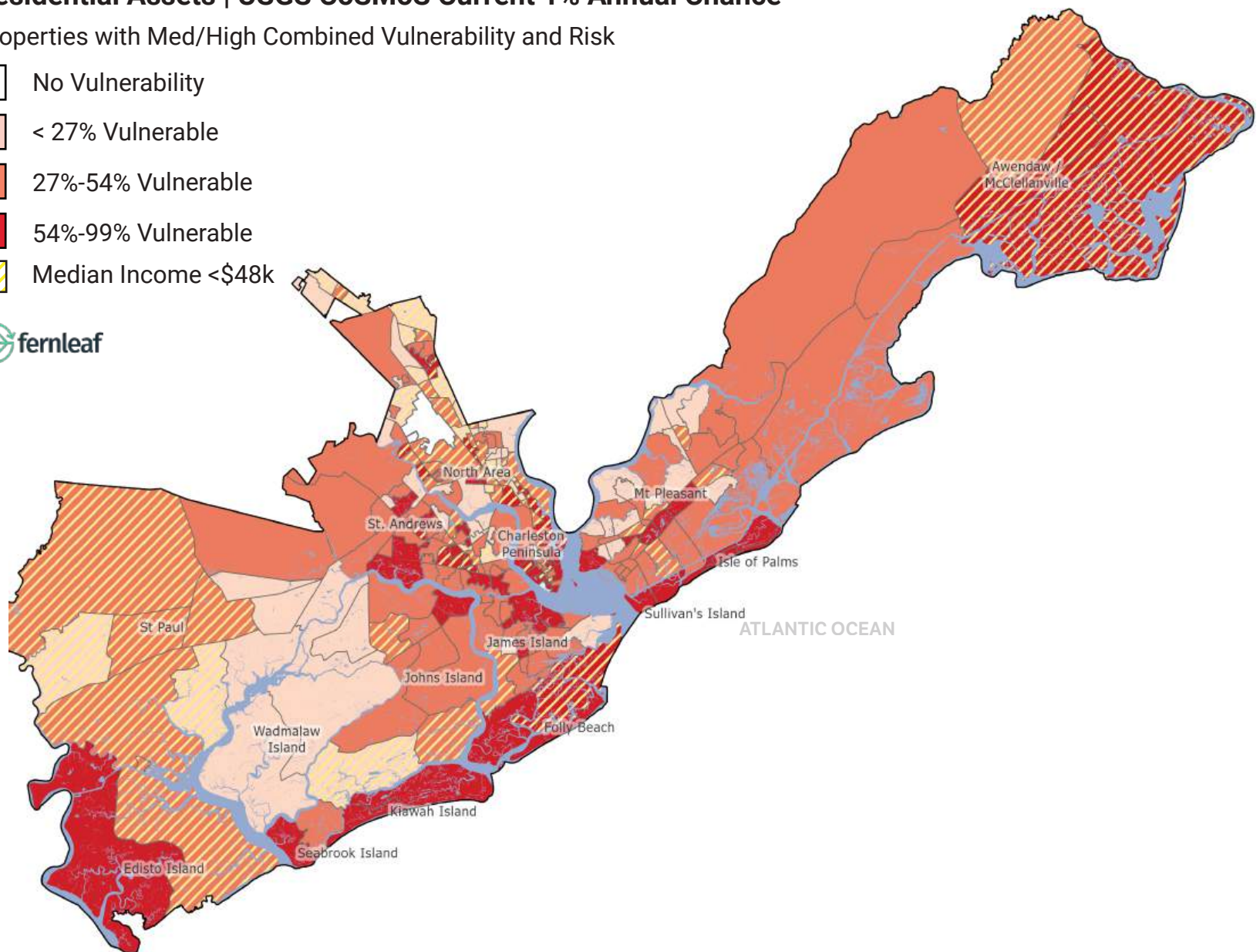


Figure 17. Percent of Residential Properties that are highly vulnerable to 1% annual chance flooding (USGS CoSMoS) aggregated at the census block group scale.

Residential Assets | Woodwell Current 1% Annual Chance

Properties with Med/High Combined Vulnerability and Risk

-  No Vulnerability
-  1% - 9% Vulnerable
-  10% - 42% Vulnerable
-  43%-99% Vulnerable
-  Median Income <\$48k

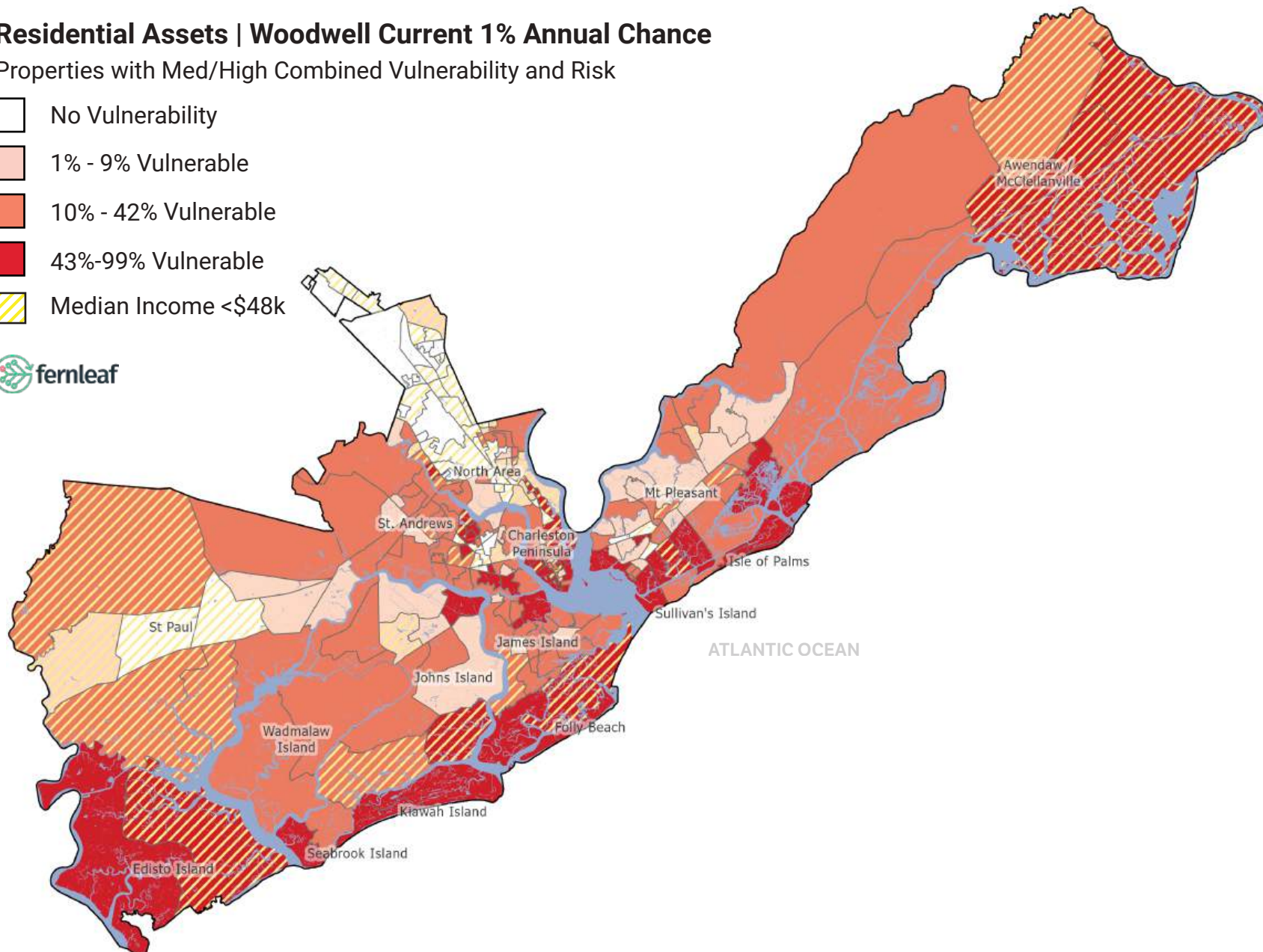


Figure 18. Percent of Residential Properties that are highly vulnerable to 1% annual chance flooding (Woodwell) aggregated at the census block group scale.

Residential Assets | NOAA Current High Tide Flooding (1.87 ft MHHW)

Percentage of Properties with Med/High Vulnerability

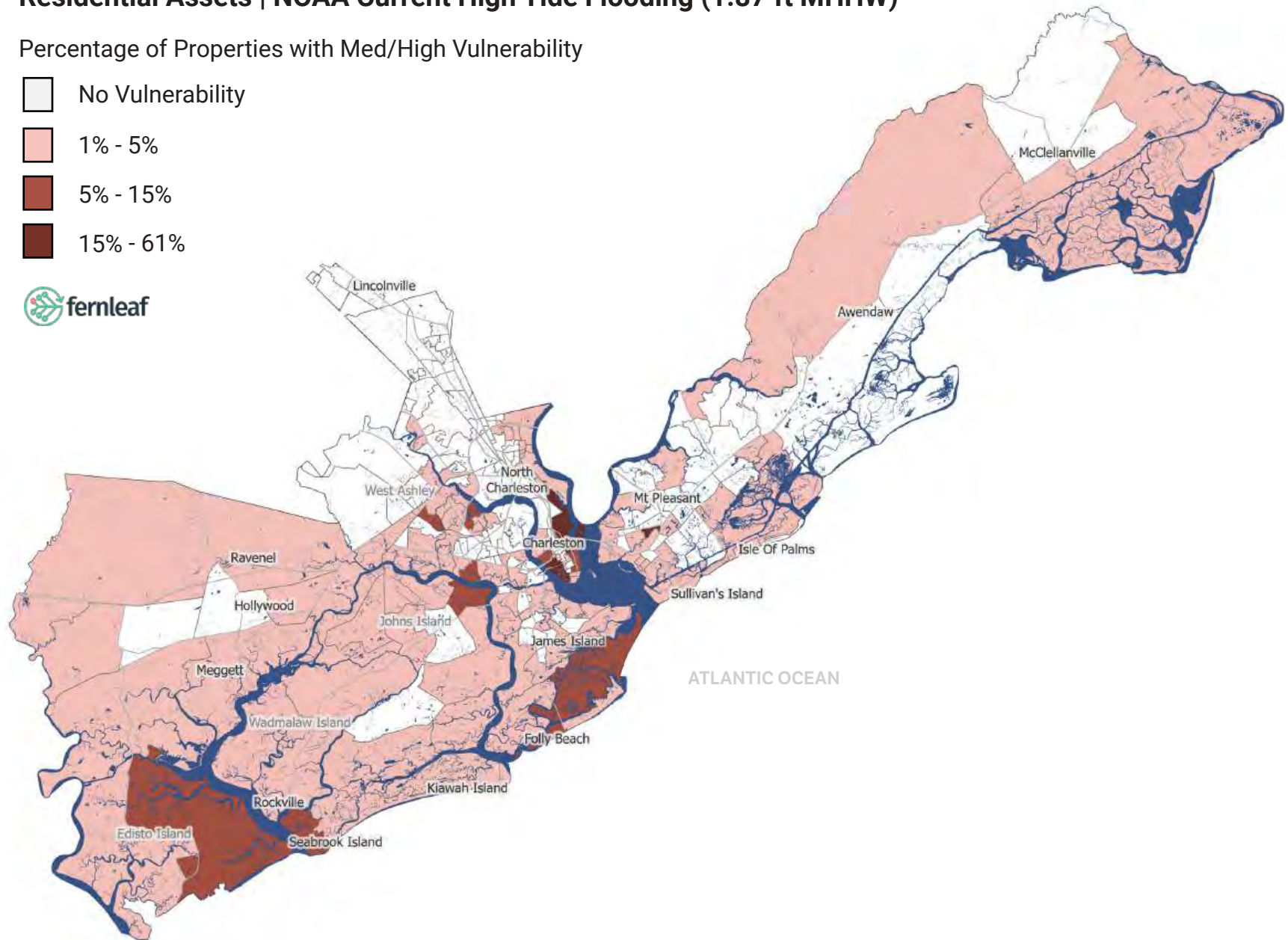
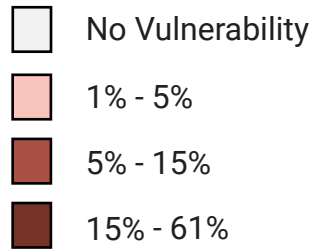


Figure 19. Percent of Residential Properties that are highly vulnerable to high tide flooding aggregated at the census block group scale.

Higher Frequency, Minor to Moderate Flooding

The Current High Tide Flooding assessment shows the vulnerability of homes to a tidal level of 1.87 feet Mean Higher High Water. The Peninsula of Charleston is by far the area with the highest proportion of homes vulnerable to high tide flooding. Several block groups on the tip of the Peninsula have >50% of homes currently vulnerable to high tide flooding. A moderate proportion (about 6-10%) of vulnerable homes are located in both coastal areas of Folly Beach and southern sea islands as well as areas further inland around Long Branch Creek in West Ashley and on Johns Island along the Stono River, Penny's Creek and Capri Isles Channel. Within the unincorporated County, Edisto Island has the highest proportion of properties vulnerable to high tide flooding.

Future Flooding

The largest increase in residential vulnerability is seen for the 5% annual chance flood which nearly doubles the percentage of vulnerable properties at 23% with a 1.6 feet SLR. In terms of raw numbers, the total residential vulnerability to 5% annual chance flooding in the future is closely comparable to that for 1% annual chance flooding (USGS and FEMA SFHA) today.

AFFORDABLE HOUSING STOCK

Understanding the vulnerability of affordable housing to flooding is crucial for planning and preserving this essential resource, especially given the dire shortage of affordable housing in Charleston County. For this assessment, both dedicated affordable housing properties and "naturally occurring" affordable housing, which includes multifamily properties and manufactured housing parks, are considered to form a portion of the overall affordable housing stock.

Over 40% of dedicated affordable housing (also referred to as assisted or subsidized housing) in Charleston County is highly vulnerable to flooding with a 1% annual chance of occurring, equating to about a 1 in 4 chance within a 30-year period (Woodwell). This includes 23 properties owned by Charleston County Housing Authority.

A disproportionate number of multifamily properties from the affordable housing stock are highly vulnerable to all types of flooding conditions. For instance, while 12% of all residential properties in the County are vulnerable to 5% annual chance (USGS CoSMoS), the vulnerability rate for non-subsidized multifamily is significantly higher at 22% (as shown in the data table in the appendix). Given the lack of adequate affordable housing in the County, proactive efforts to preserve the existing affordable housing stock are extremely important not only to ensure the safety and stability of current residents but also to help maintain the availability of affordable housing in the face of increasing growth.

RESIDENTIAL CARE FACILITIES

Within the Residential Properties category, the assessment specifically identifies residential facilities that provide different types of long-term care or assistance. These include assisted living facilities, senior group care homes, and multi-residence retirement communities. About half (35) of the 67 residential care facilities identified in the assessment are highly vulnerable to flooding with 1% annual chance of occurring (Woodwell). Most of these are located in the Central region of the County, southern Mount Pleasant and West Ashley. The high vulnerability of these residential care facilities points to a significant risk to health, safety and well-being of medically vulnerable residents emphasizing the need for targeted emergency preparedness and planning.

CRITICAL INFRASTRUCTURE AND GOVERNMENT-OWNED ASSETS

This category encompasses a range of assets, including County-owned and other critical infrastructure, facilities, and services, as well as non-critical County-owned facilities and properties and private or state-government owned properties. The results presented here should be considered as screening information. It is designed to selectively point to assets that need further review of considerations such as elevation of critical components, redundancy and back-up availability, and recent improvements or upgrades to enhance flood resilience. This can enable building a prioritized list of assets and systems for protection and adaptation actions.

Table 5 provides a breakdown of these different asset types within this category to help understand how flooding can lead to the loss or disruption of emergency and essential services, compromise public safety, and cause significant economic impacts. Vulnerability to current High Tide flooding in this category is largely seen for properties owned by municipal, state and federal entities. In addition, the John's Island Fire Station 2, the Main public library and Ashley Hall High School are other public properties that are highly vulnerable to recurrent minor high tide flooding. Vulnerability to 5% annual chance flood (USGS CoSMoS) is significant at 14% percent of properties in this category.

Forty-four of these properties can experience greater than 3 feet of flood depth and may be subject to significant flooding impacts even during relatively moderate flooding events. Most of these properties are located in North Charleston, on the peninsula, or in Mount Pleasant.

EMERGENCY RESPONSE SERVICES

Figure 20 shows Charleston County facilities that are critical for emergency response in the immediate aftermath of an extreme events. It includes fire stations, points of distribution, shelters, EMS stations, and evacuation pick up points. The locations outlined with a red or dark red circle indicates that they have a high vulnerability to 1% annual chance flooding (Woodwell). Of the 179 properties identified by the assessment, roughly half (n=92) are highly vulnerable in current conditions (red circle) and an additional 17 become vulnerable with a 2.6 ft of SLR projected to occur by 2060s/2070s (dark red circle). Most of the latter are located West of the Ashley River, whereas three of them are located on the peninsula and in the North Charleston area.

The assessment finds that four emergency shelters in Charleston County are highly vulnerable, two of which could experience a potential flood depth of over 3 feet (Charleston School of the Arts, Charleston Military Magnet Academy, Matilda Dunston Elementary School and Jerry Zucker Middle School).

There are 41 highly vulnerable Points of Distribution sites, many of which are located in socially vulnerable areas. For example, one highly vulnerable POD in the heart of James Island at the intersection of Folly Road and Fort Johnson Road is in a block group with low median income (\$45,000) and high percentage of older individuals. In West Ashley, a highly vulnerable POD is located in a block group with very low median income (\$38,906) and high rate of households experiencing poverty (nearly 40%). Any disruption in distribution of essential supplies as a result of impacts to POD sites, particularly those serving disadvantaged communities, can result in outsized impacts.

While locations of critical infrastructure and government-owned assets within the Special Flood Hazard Area (FEMA floodway and 1% annual-chance floodplain) are usually known, it is important to note the additional vulnerability for the same risk likelihood as indicated by Woodwell and USGS CoSMoS assessments. Of the services / facilities shown on the map, 3 EMS locations, 7 evacuation pickup points, 17 fire stations, 28 points of distribution, and 3 shelters are not in the FEMA SFHA, but are highly vulnerable when evaluated using the two non-FEMA data sources. This makes the case for prioritizing further evaluation of this subset of facilities as they may reveal previously unrecognized needs for flood risk reduction for critical facilities.

Emergency Response Facilities | Woodwell Current and Future 1% Annual Chance

- EMS ● Shelter
- Fire Station ● Point of Distribution
- Highly Vulnerable to Current 1% Annual Chance Flooding
- Highly Vulnerable to Future 1% Annual Chance Flooding

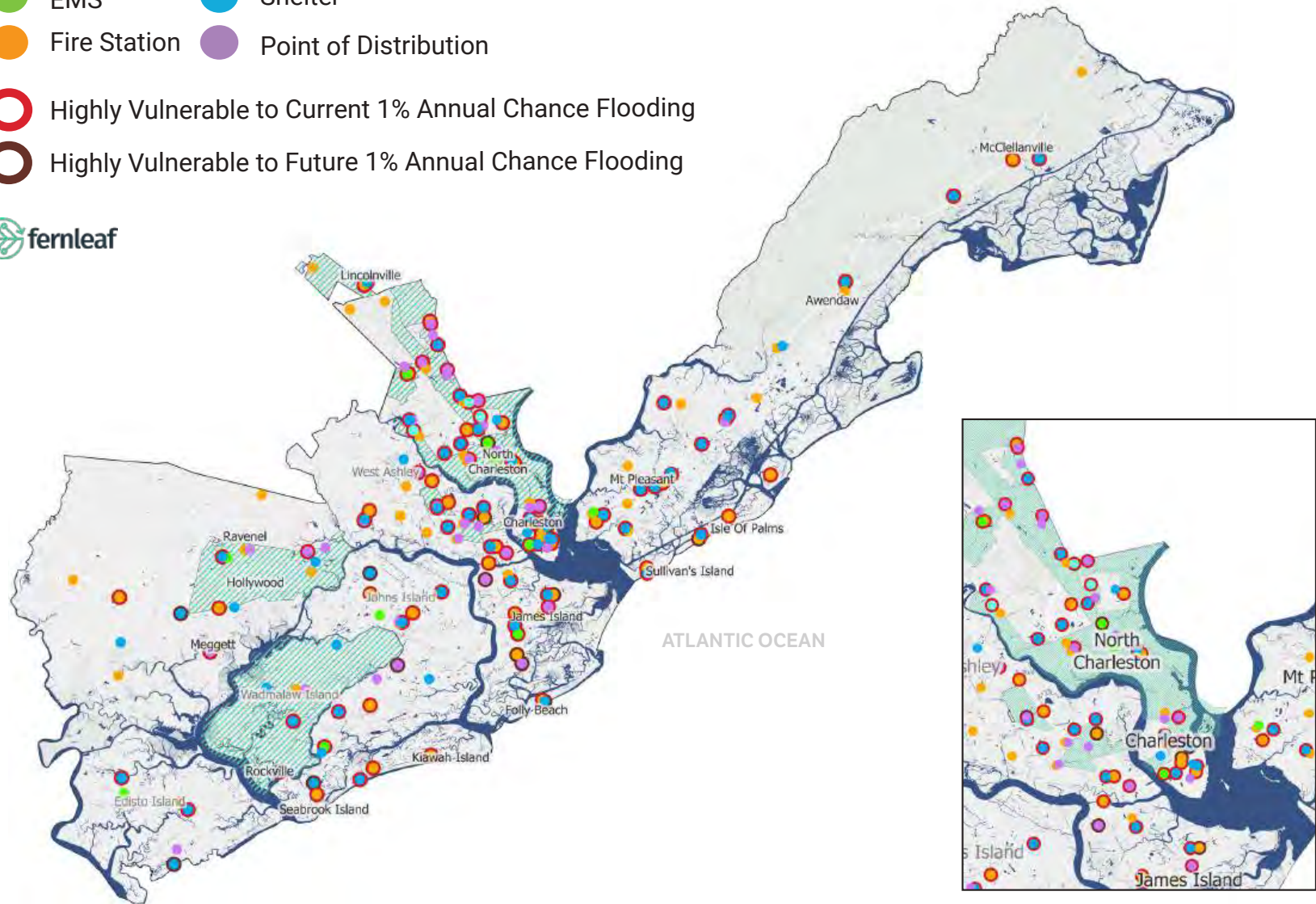


Figure 20. Emergency response facilities highly vulnerable to Current or Future Woodwell 1% Annual Chance of Flooding. Assets symbolized with a red or brown boundary are highly vulnerable. Tracts highlighted in hatched green symbology have the highest social vulnerability within the County per the CDC Social Vulnerability Index (SVI).

SCHOOLS LIBRARIES AND PARKS

Public schools, libraries, and parks in Charleston County not only provide essential services for education, learning, and recreation, but they are also a critical component of social infrastructure that enhances well-being and quality of life for residents. Primary and secondary schools are a resource for healthy food to children and youth and often provide other formal and informal support services for under-resourced families. Beyond learning opportunities, libraries provide safe and well-maintained social spaces for gathering, can serve as a hub for resources (internet, ESL, adult literacy), and services for under-resourced residents. Charleston County Parks similarly offer a diverse set of programs and services in addition to access to outdoor public amenities.

6 (32%) libraries are highly vulnerable to a 5% annual chance event (USGS CoSMoS). Eight additional properties are susceptible to a 1% annual chance flood event. In recent years, Building Services staff have had to address stormwater pooling multiple times in at least one library location.

Of the 136 school properties identified in the assessment, about 30% (n=40) are highly vulnerable to the regulatory floodplain (FEMA SFHA). Almost all the highly vulnerable school properties are located in the central part of the county, between North Charleston/West Ashley and James Island/Sullivan's Island. Two school properties in McClellanville area are highly vulnerable (Cape Romain Environmental Ed. Charter School, and Lincoln High School). This area has a relatively high percentage of African American residents (87% in the block group), and 43% of households in the block group have income below the poverty level. The number of highly vulnerable school properties nearly doubles (88 properties) in the Woodwell assessment which shows the same level of risk likelihood as the FEMA SFHA (1% annual chance). Twenty-one of these 88 properties could experience significant flooding (over 3 feet of depth) with 1% annual chance of occurring.

Of the 69 total county parks, 6 parks are currently highly vulnerable to 5% annual chance flood event and 10 are vulnerable to a current 1% annual chance flood event (USGS CoSMoS). All of these properties have at least one building and some are home to a multitude of physical infrastructure including splash pads, waterparks, campgrounds, fishing piers, public bathrooms, and other recreational facilities. Although it is important to note that Parks may be located within the natural floodplain or be designed to temporarily store floodwaters. In addition, park infrastructure may be designed to withstand some flooding. As a result, site-based assessments of the properties highlighted here is needed for a more refined view of flood vulnerability of County Park facilities.

COMMERCIAL PROPERTIES

The highest concentrations of commercial properties in Charleston County are primarily centered in three areas: the Town of Mount Pleasant along Highway 17 and Coleman Boulevard, the City of North Charleston along U.S. Route 52, and the City of Charleston's peninsula region, which features a particularly dense grouping of commercial properties throughout the historic downtown area.

Within these areas, current high tide flooding vulnerability is highest on the west side of the peninsula, between Cannon Street and Calhoun Street, which includes the medical complex.

During more extreme large-scale flooding events that include coastal and inland flooding (as indicated by Woodwell 1% annual chance condition), commercial vulnerability is most concentrated in census block groups within North Charleston, Charleston's peninsula, Folly Beach, West Ashley, and north Mount Pleasant. While commercial activities such as retail stores, recreational facilities, and services businesses are fewer in number and more spread out in rural unincorporated areas and smaller towns, they may be highly valued by the surrounding residents especially those facing transportation limitations. Vulnerable properties in such areas include commercial properties along North Highway 17 as well as Pinckney St in McClellanville, along Savannah Highway on Johns Island, and along Highway 78 and Benchmark Drive in Ladson.

Commercial Assets | Woodwell Future 1% Annual Chance (2.5 ft SLR)

Percent with Med/High Combined Vulnerability and Risk

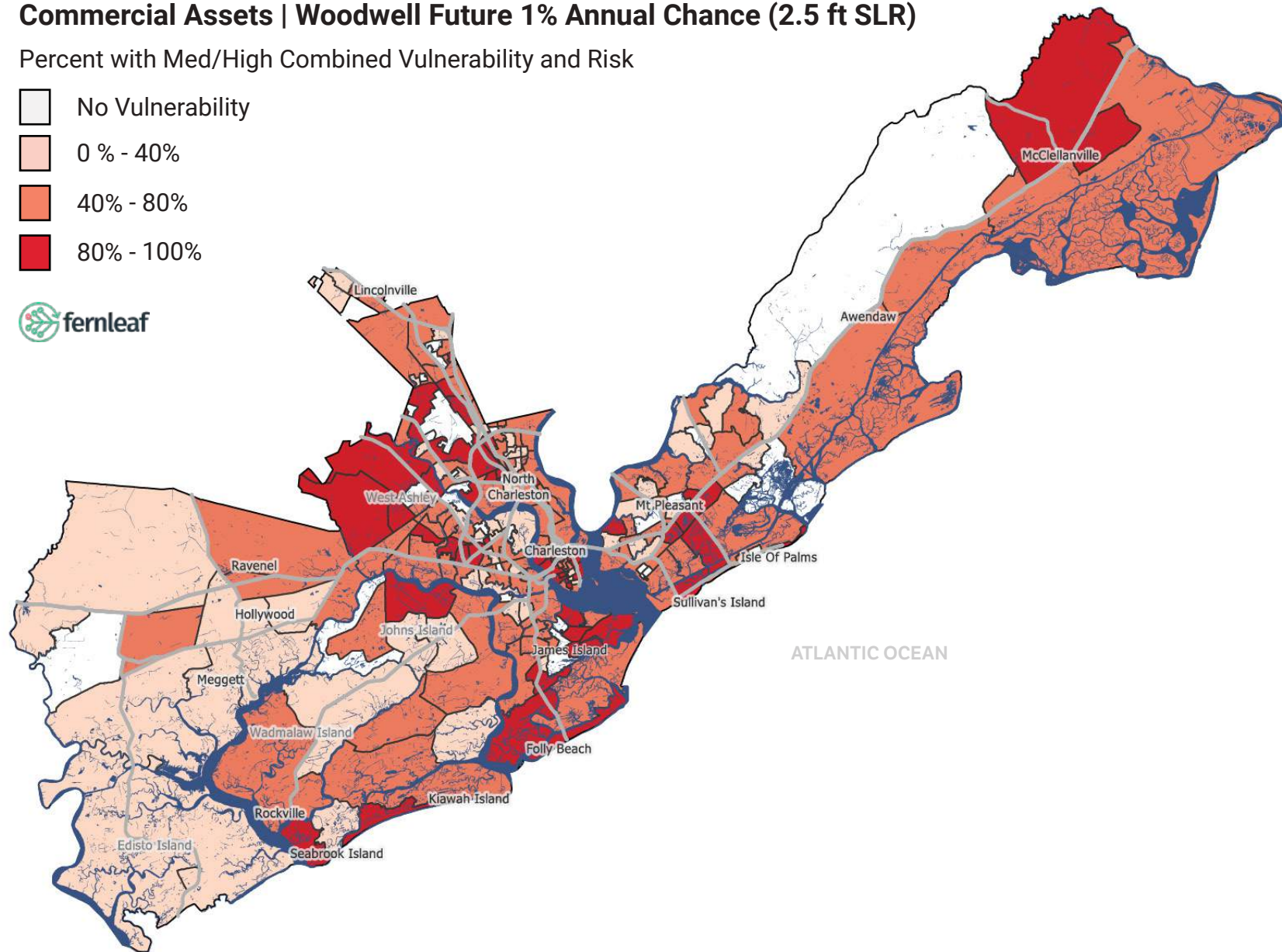
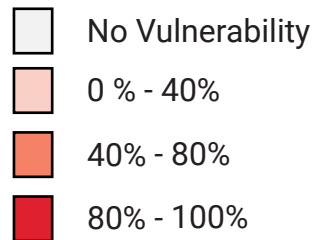


Figure 21. Percent of Commercial Properties that are highly vulnerable to Woodwell Current 100-yr Flooding threat aggregated at the census block group scale.

INDUSTRIAL PROPERTIES

The industrial properties category includes manufacturing facilities, warehouses and port facilities. Industrial activity in Charleston County is concentrated in the entire Neck area down to the Eastside neighborhood and much of southern North Charleston.

The 1% annual chance flood extent modeled by Woodwell shows significant flooding in this industrial corridor, extending further beyond from the FEMA designated 1% annual chance floodplain. Accordingly, the vulnerability assessment shows that 65% of industrial properties in the North Charleston region and 75% of industrial properties on the Charleston peninsula are highly vulnerable to flooding. Figure 22 provides a more detailed view of spatial concentration by providing the number of highly vulnerable industrial properties at the census block group scale. Beyond this corridor, the rest of the county has limited industrial development and hence a lower number of vulnerable industrial properties or none at all.

The small number of industrial properties with high vulnerability to high tide flooding are concentrated along the Cooper River in North Charleston and along both Cooper and Ashley River in Charleston. In addition, a few industrial properties on Bees Ferry Road are also currently vulnerable to high tide flooding.

The concentrated industrial activity in the region has a long history and the resulting negative consequences make it an environmental justice issue. This is highlighted by the Climate and Economic Justice Screen tool. As discussed in the Social Stressors and Disproportionate Impacts section, census block groups in Charleston County that face exposure to legacy land-based pollution, chronic exposure to air pollution, waste and wastewater burdens, and poor health outcomes are primarily located in southern North Charleston and Charleston's peninsula. High rates of poor health outcomes in this area are a consequence of this disproportionate environmental burden. Increasing flood risks to current and former industrial activity thus intensify the cumulative health and economic burdens already borne by residents in the region.

Industrial Assets | Woodwell Current 1% Annual Chance

Properties with Med/High Combined Vulnerability and Risk

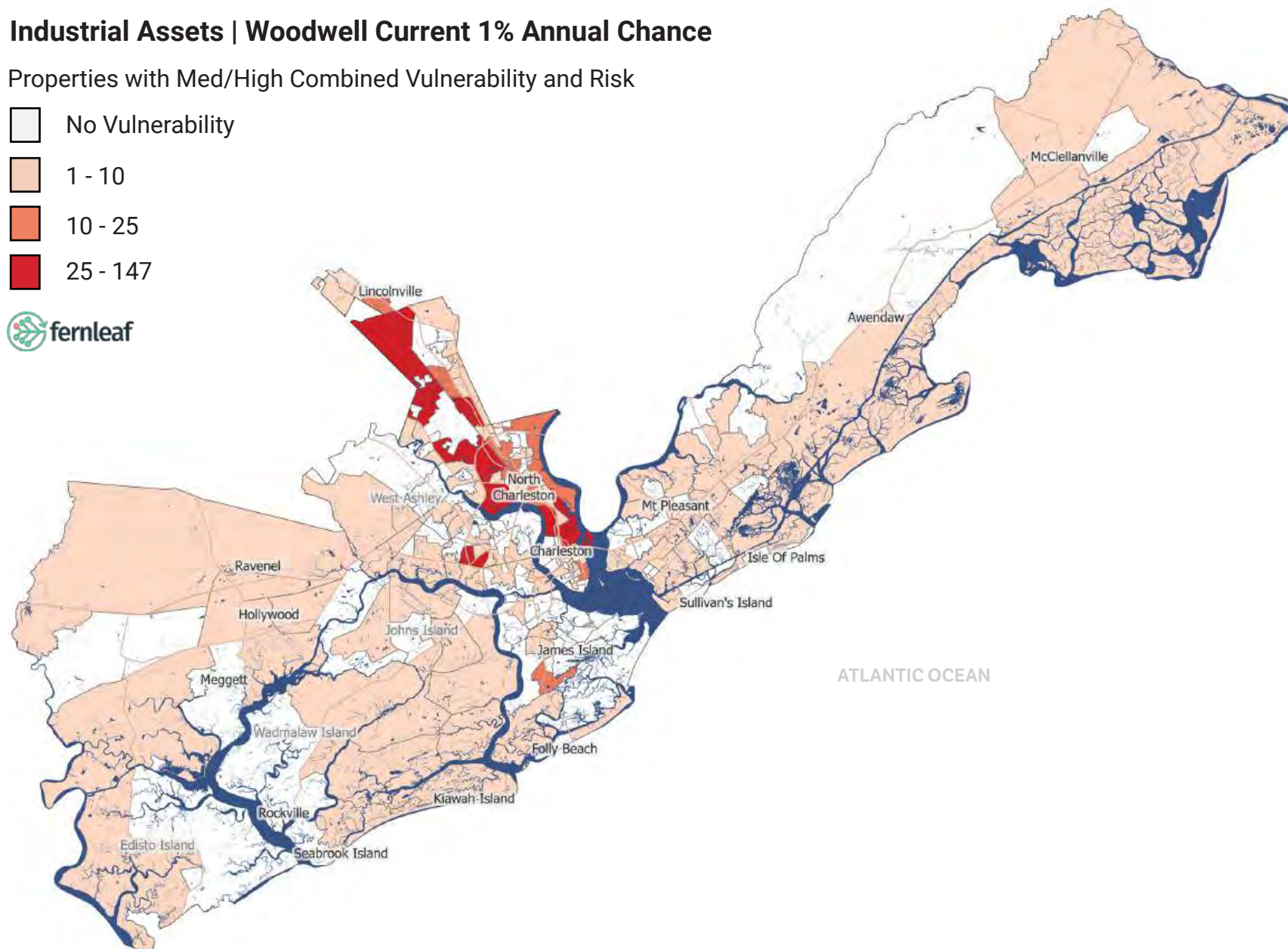
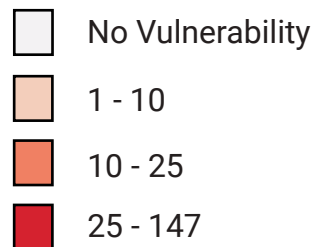


Figure 22. Number of Industrial Properties that are highly vulnerable to Woodwell Current 100-yr Flood threat aggregated at the census block group scale

OPEN SPACE

The Open Space category includes parcels identified as vacant by the Property Assessor's office, agricultural and timber properties (i.e. working lands), and properties under conservation or managed by government and non-government entities. Vacant and working lands are identified using the parcel use type information. Conserved and managed natural areas are identified using the USGS Protected Areas Database of the United States (PAD-US), and additional data from The Nature Conservancy. In addition, this category also includes properties protected using funding from the Greenbelt Program. It is important to note that due to multiple data sources, there is some overlap between the Open Space property types listed below. As a result, the total number of unique properties in this category is smaller than the sum of each individual type.

This assessment assumes that vacant properties and those included in the managed and working lands asset categories do not contain built structures and thus are only evaluated for flood exposure. In total, the assessment identified 25,914 unique properties in this category of which 26% - 83% have at least some exposure to flood waters depending on the current conditions evaluated and 48% - 86% in the future (as stated in data table in appendix).

The exposure of vacant properties is particularly important to note. The assessment evaluated three types of vacant properties identified by the County Assessor's Department – zoned residential or commercial and county-owned vacant land (as shown in the data table in the appendix). Close to a quarter of vacant properties are exposed to recurrent flooding from 'minor' high tide and 38% of all vacant properties are exposed to flooding with about a 3 in 4 chance of occurring over the next thirty years (i.e., 5% annual chance or a 20-year flood). When considering more extreme events with 1% annual chance (100-year flood) up to 80% of properties are exposed to coastal, riverine, or pluvial flooding as modeled by Woodwell. Thus, most of the remaining undeveloped land in Charleston County is flood prone.

The results for exposure of vacant lands underscores the urgent need for a strategic approach to ensure that future growth in the County is climate resilient. Vacant properties facing the most severe flood risk could be considered for implementing green stormwater infrastructure, restoring natural floodplain function and other similar actions that reduce flood risk of surrounding areas. Zoning and land use strategies can ensure that development on properties with moderate risk is flood adaptive. Further property-level evaluation of intensity of flooding in terms of percent of land flooded and potential depth of flooding can provide a thorough understanding of the challenges and opportunities with vacant lands.

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Vulnerability to Extreme Heat

Even though the Lowcountry is no stranger to hot weather, extreme heat beyond what has been normal in the past is becoming a pressing concern with rising global temperatures and more frequent heat waves.

The degree to which extreme heat poses health risks to individuals and communities depends on two key sets of factors that result in differing vulnerability of people, communities, and neighborhoods.

First, the urban heat island effect, where densely populated urban areas with extensive heat-absorbing paved surfaces and limited tree canopy and green space experience temperatures significantly higher than surrounding rural or more adaptive urban areas. A recent heat study conducted through public participatory methods found that the temperature differential between the hottest and coolest areas in the daytime can be as much as 10°F in the Cities of Charleston and North Charleston. (CAPA Strategies, 2021).

Second, several individual and social factors play a major role in determining sensitivity to heat stress and capacity to adapt or manage its impacts. Research shows some individuals have a higher sensitivity to extreme heat conditions. These include children under 5 years of age and adults over 65 years of age, women who are pregnant, and people who have chronic lung, heart, and kidney conditions. In addition, outdoor workers or indoor workers in certain settings, those living in mobile homes, individuals who are unhoused, renters in substandard housing, energy-burdened households, and student athletes are also likely to have increased exposure or decreased adaptive capacity to extreme heat. Together, these groups are also often referred to as “high-risk” groups in the context of public health impacts of extreme heat.

In urban areas, the urban heat island effect and these individual/social factors overlap, exacerbating individual heat vulnerability and creating neighborhood-level hotspots. Despite the relatively lower temperatures, heat vulnerability does exist in rural areas. Rather than environmental factors of urban heat island, it is likely to be shaped by factors such as occupational exposure, limited access to health care, energy inefficient housing, and health outcomes.

Extreme Heat Assessment Methodology

This spatial assessment focuses on public health impacts and is conducted at the census block group scale. For this urban heat island assessment, only census block groups identified as urban by this dataset were included. Urban and rural designations are sourced from 2020 Census Urban Areas dataset which identifies densely developed urban areas and distinguishes them from rural areas based on criteria such as population density, housing unit density, and land use patterns. To qualify as an urban area, the territory identified must encompass at least 2,000 housing units or have a population of at least 5,000. All block groups in the county were overlaid with the Census Urban Areas dataset and selected out where they overlapped. These selected block groups shape the study area for the Urban Heat Island Vulnerability Assessment.

To assess vulnerability to extreme heat in urban areas, the proportion of developed land cover is used as an environmental indicator of exposure to higher temperatures. The proportion of tree canopy coverage, recognizing its cooling effect, is used as an indicator of environmental adaptive capacity. The median household income is used as a social and economic indicator of adaptive capacity to extreme heat, such as access to adequate residential cooling, being able to afford and access medical care, have an efficient means of transportation, etc. It is important to note that in this approach, the exposure and adaptive capacity indicators are combined to assign a relative vulnerability classification for each census block group (Table 9), whereas high-risk groups can be considered post-classification using census-based data and other information as shown through the examples below.

Table 3. Summary of Approach for Extreme Heat Vulnerability Assessment

Exposure	Sensitivity	Adaptive Capacity
High: > 75th percentile Developed Land Cover Medium: > 50th percentile Developed Land Cover Low: < 50th percentile Developed Land Cover	-- (Heat-sensitive and at-risk groups are considered post-classification where information is available)	Low: < 25th percentile tree canopy coverage AND/OR < 25th percentile median income Medium: 25th to 75th percentile tree canopy coverage AND/OR 25th to 75th percentile Median Income High: > 75th percentile tree canopy coverage AND/OR > 75th percentile Median Income

Extreme Heat Assessment Findings

URBAN AREAS

At the census block group scale, nearly the entire peninsula and most of North Charleston have high heat vulnerability to the urban heat island effect. In addition, a cluster of 10 block groups in southern West Ashley and 2 block groups in Mount Pleasant have relatively high vulnerability.

Furthermore, eleven census block groups in Charleston County fit the most extreme criteria for all three indicators of heat vulnerability used in the assessment: they have more than 78% developed land cover, less than 10% tree canopy cover, and a median income of less than \$48,668. These block groups are highlighted in the inset map in Figure 24 and are all located east of I-26 in southern North Charleston and on the peninsula of Charleston.

Urban Heat Island Vulnerability

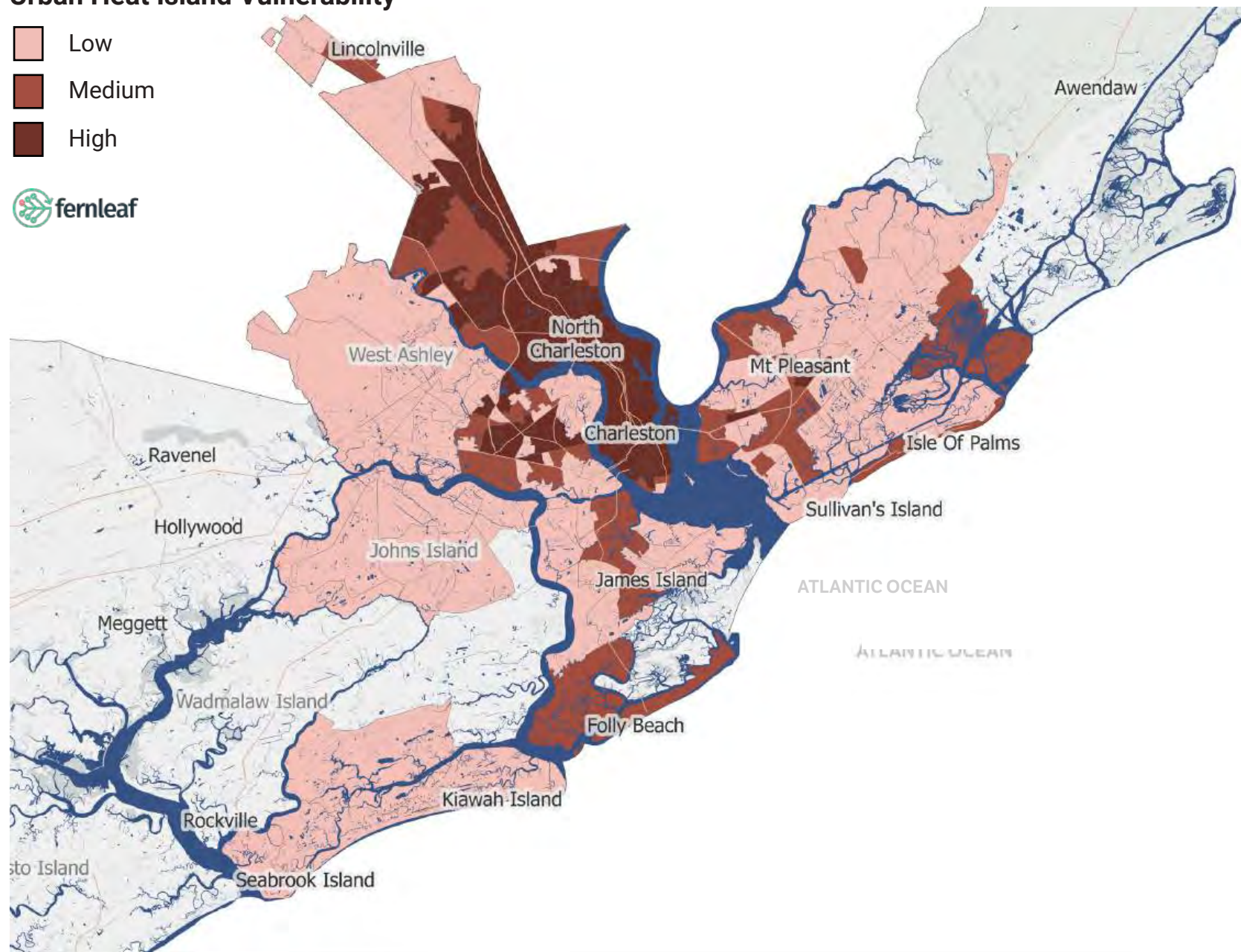
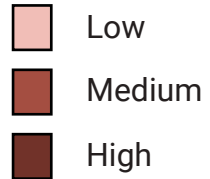


Figure 23. Urban heat island vulnerability assessment results. Areas in grey are rural and not included in the assessment.

As mentioned earlier, a number of factors give some individuals and households a much greater risk of heat stress impacts. Identifying where the spatial concentration of different high-risk groups within the County through census-based data provides another broad lens with which to spatially differentiate heat vulnerability. The 'Community Resilience Estimates for Heat' dataset (CRE-H) developed by US Census includes ten risk factors to evaluate social vulnerability in the context of extreme heat exposure at the census tract scale: financial hardship, single or zero caregiver households, housing quality, communication barriers, employment, disabilities, health insurance, age (specifically individuals age 65 or older), transportation access, and broadband internet access. Figure 24 shows in yellow census tracts where a third of the residents face a combination of 3 or more of the ten risk factors. Thus, overlapping areas of high heat vulnerability with high rates of at-risk residents provides one view of where highest needs are for urban heat resilience efforts.

Individual census-based indicators may provide a more specific view of where individual high-risk populations are most concentrated. For example, older mobile homes are often energy inefficient and have substandard cooling, increasing the intensity of heat exposure for residents. Figure 25 shows block groups with highest percentage of mobile homes (in yellow hatching) overlaid on the urban heat island assessment. Using the threshold of more than 1 in 4 occupied housing units being mobile homes, the visualization highlights that within urban parts of Charleston County, mobile-home related heat vulnerability is most concentrated in east-central North Charleston (cluster of seven block groups) along I-26 and Rivers Avenue and block groups to the west of the Air Force Base and one in West Ashley located between Ashley River Road and Old Towne Road. Individuals with asthma are another high-risk group when it comes to extreme heat. Several predominantly black neighborhoods in southern North Charleston have very high rates of asthma (per CEJST) from long-term exposure to air pollution are also some of the most densely-developed and/or with very low tree canopy. This is another example of climate threats further exacerbating impacts of disproportionate environmental burdens.

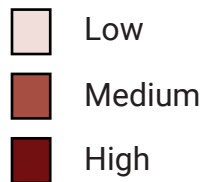
RURAL AREAS

While rural areas tend to experience comparatively lower temperatures than surrounding urban areas, other factors affecting individual and population-level heat risks may be more severe in rural areas. For example, a study in North Carolina, found that emergency department visits for heat related illnesses were higher in rural locations than urban locations (at the zip code-level). The most significant risk factors for rural locations included elderly individuals, mobile homes, labor-intensive agriculture and non-citizens (Kovach et al., 2015).

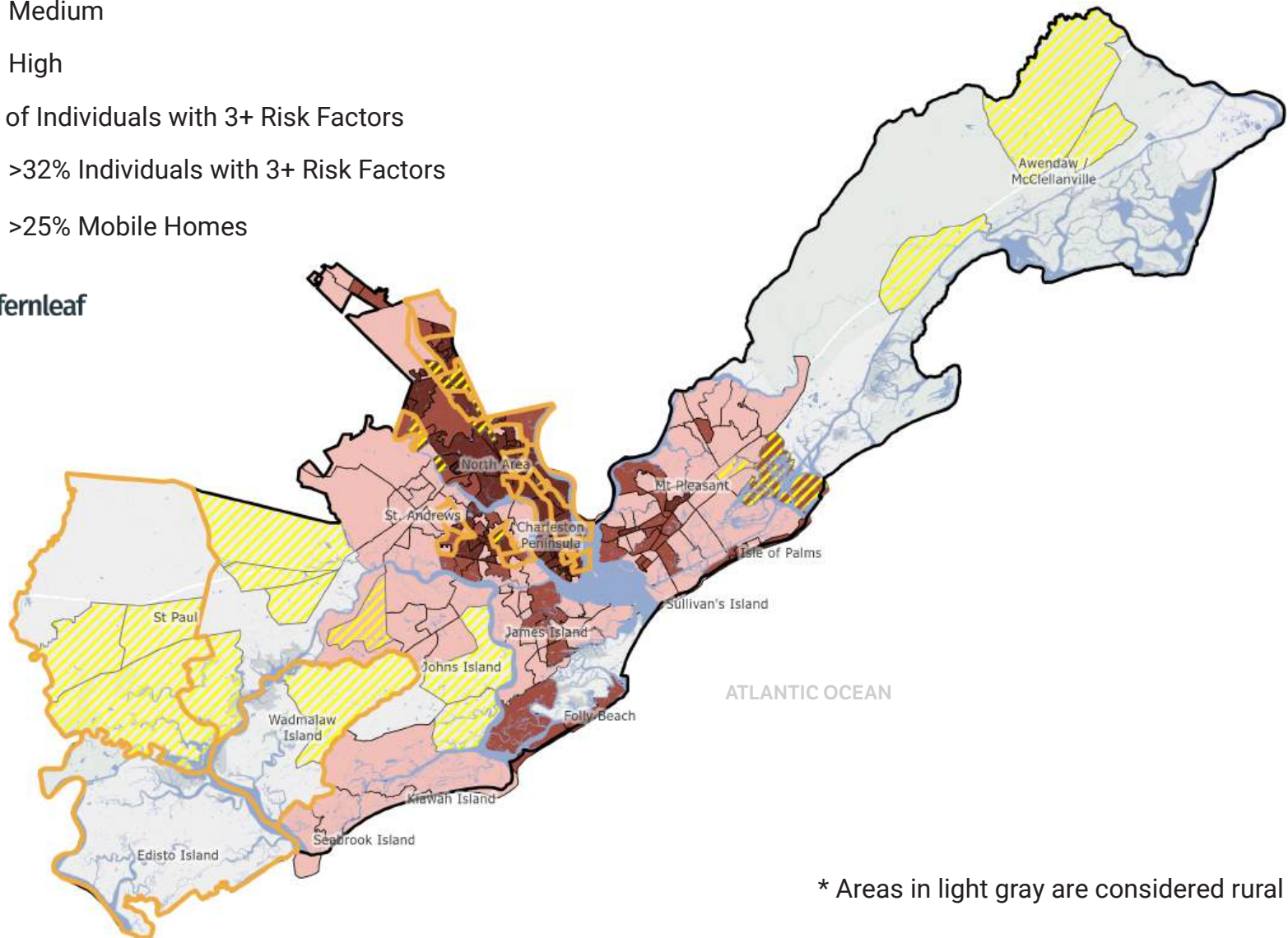
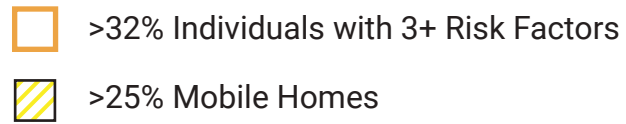
Focusing on the areas characterized as rural (no UHI assessment) by the Census in the two maps referenced on the next two pages (Figures 24 and 25), many of these include high concentration of at-risk populations. Per CRE-H, tracts covering the southwestern corner of the County, Edisto Island and Wadmalaw Island have among the highest rates of at-risk individuals (1 in 3 residents). Looking at a housing-specific exposure separately, mobile homes are highly concentrated in many rural areas of the County (Figure 25). Although these areas may be a few degrees cooler on very hot days, indoor temperatures experienced by mobile home residents can still be high if homes are poorly insulated or if residents struggle to afford utility bills.

Other significant 'at-risk' groups that face higher vulnerability to heat in rural areas of the Charleston County include higher rates of individuals with diabetes (CEJST) and migrant farmworkers (in John's Island). Data sources and analysis used in these discussions are merely the first step in understanding heat vulnerabilities. Ultimately, for government-led heat mitigation and management to be effective, they need to be place-specific requiring more in-depth understanding of the combination of factors driving heat vulnerability at the neighborhood level.

Urban Heat Island Vulnerability and Urban Heat Factors



Rate of Individuals with 3+ Risk Factors



* Areas in light gray are considered rural

Figure 24. Community Resilience Estimates for Heat (CRE-H) and Urban Heat Island Vulnerability Assessment

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Vulnerability to Wildfire

Wildfire is a natural disturbance that provides benefits to ecosystems and natural systems, but it can become a hazard when it negatively impacts communities and the services people value. Drought conditions can lead to a greater chance of wildfire. However, one of the primary contributing factors to the hazard of wildfire is the management of fuels and vegetation. Lack of active fuel management can contribute to a decline in fire-resilient ecosystems, an increase in wildfire burn severity, and an increased risk of destructive wildfires that damage landscapes and threaten people and communities.

This assessment of wildfire examines the hazard of wildfire in the Wildland Urban Interface (WUI). The WUI includes areas where homes and assets are within or adjacent to vegetation and fuels for wildfire. A WUI-based wildfire vulnerability assessment can help to understand potentially vulnerable geographic areas, plan for emergency services, and prioritize areas for active fuel management, especially in areas where fire response may be more challenging.

Wildfire Assessment Methodology

Data from the USDA's Wildfire Risk to Communities dataset forms the basis for vulnerability and risk to wildfire. In particular, the Risk to Potential Structures product from this dataset is used to examine the potential likelihood (or risk probability) and consequence at the property level within the City. High levels of risk were attributed to properties in areas within the highest 25th percentile of risk compared to the entire State of South Carolina.

Similar to the flood assessment methodology, the criticality of the asset is determined based on the type of asset use or the nature of the service provided. Drive time to the properties from the nearest fire station is calculated as an indicator of adaptive capacity. The criticality and types of properties (for sensitivity) and drive-time to the properties from the nearest fire stations (for adaptive capacity) were also examined for vulnerability. Property-level vulnerability and risk information are combined to inform "high, medium, low" classifications of vulnerability and risk for properties across the County.

For this assessment, we focus on Residential and Critical and Government-Owned asset categories. *Landscape treatments for wildfire reduction or site-specific conditions were not considered as part of this assessment.*

Wildfire Assessment Findings

RESIDENTIAL PROPERTIES

About 13% of residential property in the county have moderate to high vulnerability and risk to wildfire. Of these, about 6,000 properties (5%) are located in the highest category of wildfire risk. As shown in Figure 28, two areas of the county have the highest percentages of properties with high vulnerability and risk: the Awendaw-McClellanville region of the County and parts of James Island just north of Folly Beach, both of which have 83% to 98% of homes highly vulnerable and at risk.

One factor of residential vulnerability to wildfire is the emergency response drive time from the nearest fire stations. County-wide, more than 40,000 residential properties are outside an 8-minute response time (Table 4). However, within the highest wildfire risk areas, about 14,000 of homes (47%) are outside of an 8-minute response time (Table 4), indicating how the response times are potentially slower for the areas of greatest wildfire risk as compared to the county as a whole.

Table 4. Summary of Approach for Wildfire Vulnerability Assessment

Adaptive Capacity	Sensitivity	Risk
Low: Property within 5-min drive time from fire station Medium: Property in 5-min to 8-min drive time from fire station Low: Property outside 8-min drive time from fire station	Low: Not exposed Medium: Property in wildfire risk area Low: Property in wildfire risk area and identified as high criticality asset	Low: Low risk (probability and consequence) to structures Medium: Moderate risk (probability and consequence) to structures High: High risk (probability and consequence) to structures *Risk determined by USDA's Wildfire Risk to Communities classification.

Wildfire Risk to Homes | U.S. Forest Service

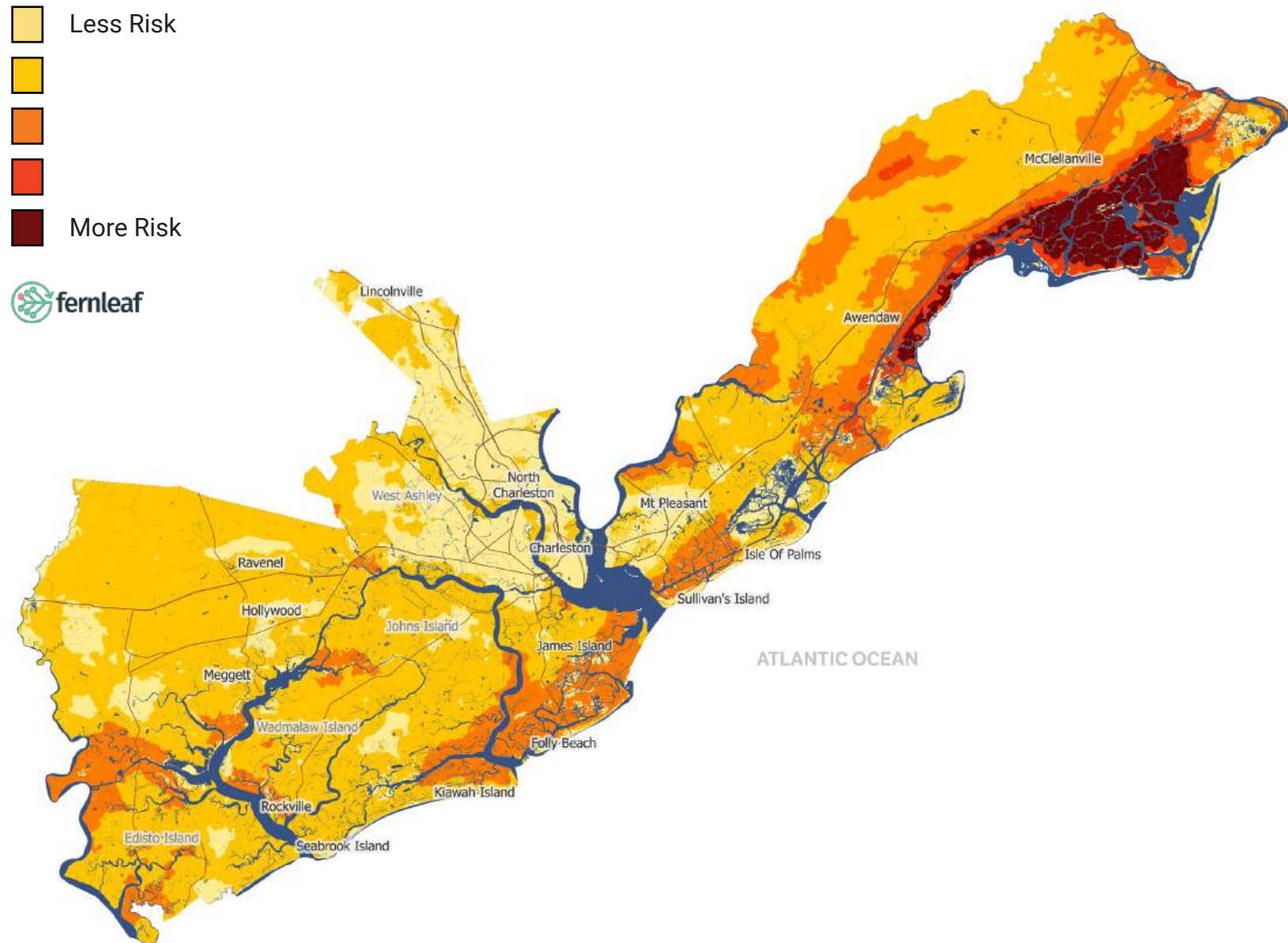


Figure 25. Homes at risk to wildfire as determined by the U.S. Forest Service.

Residential Assets | USDA Wildfire Risk

Percent of Vulnerable Assets

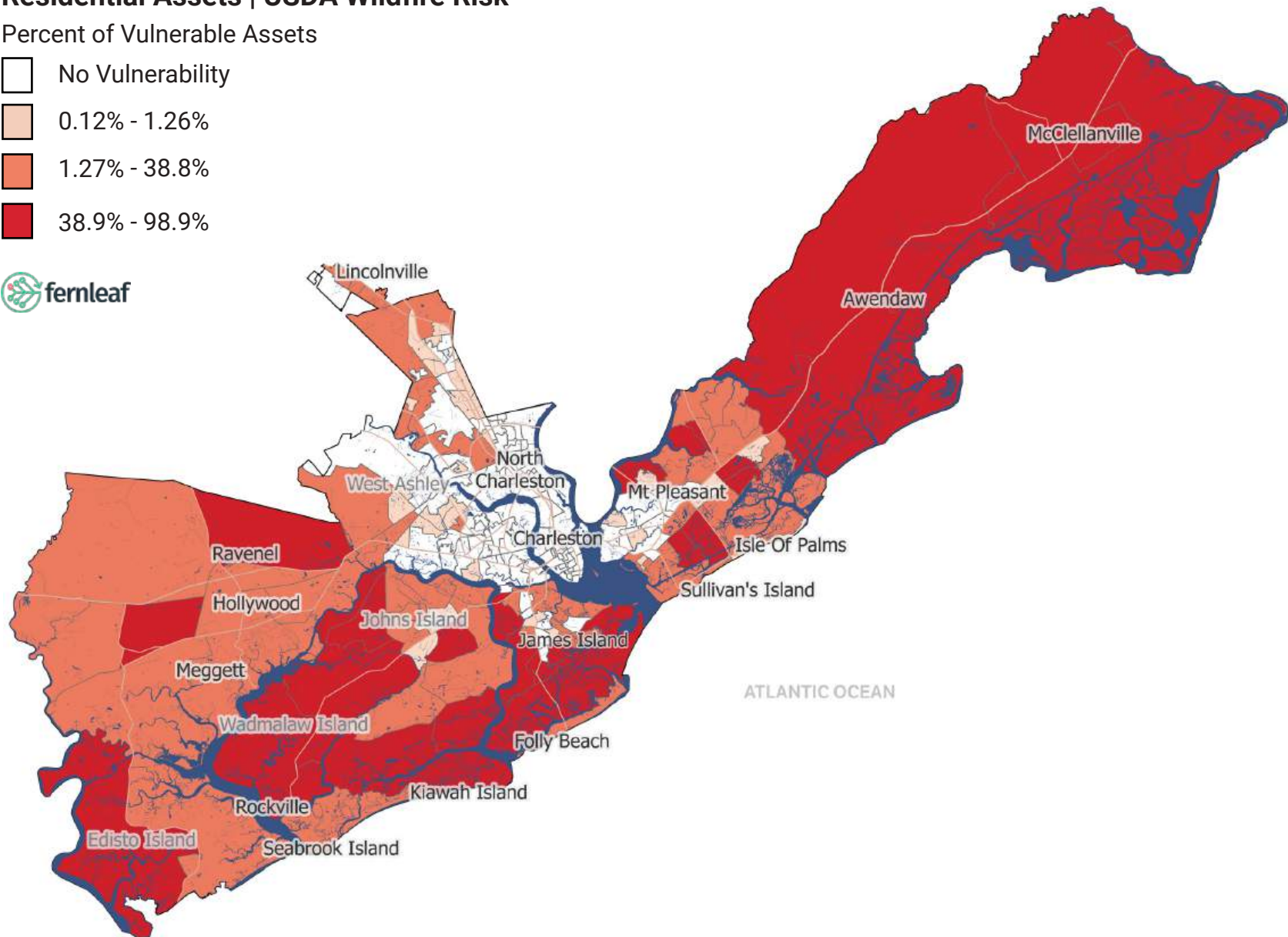
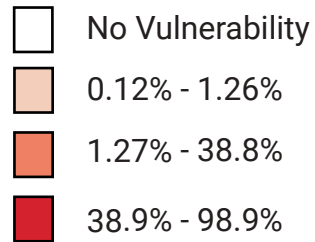


Figure 26. Residential properties vulnerable to wildfire in Charleston County.

CRITICAL INFRASTRUCTURE AND GOVERNMENT-OWNED ASSETS

About 39% of County-owned properties and nearly a quarter (24%) of all government-owned properties in the county are highly vulnerable to wildfire. Spread throughout the county, these properties include schools, hospitals, shelters, and other critical infrastructure. Table A-4 in the appendix shows government-owned and critical infrastructure by type that have a relatively high number of properties with high vulnerability and risk to wildfire.

County parks and points of evacuation/distribution have among the highest percentages of properties that have a lower emergency response time and are in high wildfire-risk areas. The Greenbelt program has the highest number of properties that are highly vulnerable and at risk.

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Vulnerability to High Winds

Sustained high winds are typically associated with tropical storms in South Carolina, with the Atlantic hurricane season extending from June 1 through November 30. Sustained high winds can destroy infrastructure and assets. Also, due to its position on the Eastern Seaboard, South Carolina is especially susceptible to tropical storm systems.

Based on an understanding of climate trends, it is anticipated that while overall frequency of hurricanes may not change, the storms that do form will have greater wind intensity.

High Winds Assessment Methodology

For this study, a screening-level assessment was developed for all properties in the study area in order to estimate vulnerability to high winds. This assessment shows properties that may be more vulnerable to high winds based on use type and relevant wind-related building design regulations at the time the primary structure on a property was built. It is important to note that this assessment should not replace site-specific assessments of wind vulnerability and is not intended to be used for insurance purposes.

BUILDING DESIGN REQUIREMENTS AND STANDARDS

The year of construction for structures is particularly important for estimating vulnerability to high winds, in particular the wind-load and wind-pressure design requirements in place at the time of construction. The section below describes how particular years were used for determining levels of adaptive capacity in the vulnerability assessment.

- Buildings constructed before 1976 in Charleston County were built before the inception of the Building, Fire, Residential Codes which was adopted by the South Carolina State Legislature for enforcement throughout South Carolina.

- Between 1976 and 2001 general structural design requirements were in place through the adoption of standard building code. No jurisdiction-specific amendments within the County are documented to have been made during this time (personal communication, August 2024). These standards included minimum wind-load design criteria. Properties with buildings constructed during this period are considered to have medium/moderate adaptive capacity for the purposes of this assessment.
- In 2001, the County adopted the International Building Code and the design standards from the American Society of Civil Engineers (ASCE) 7-95. This adoption included significant changes in the wind-load criteria for building construction, with the most significant change being the wind-speed reference that changed from fastest-mile to the 3-second gust (Mehta 2010). Additional changes to wind design criteria at this time include:
 - o A topographic factor to consider wind speed-up over certain terrains.
 - o Wind-load parameters to account for torsional effects.
 - o A separate procedure for determining wind-loads on main wind-force resisting systems (MWFRS) of buildings with roof heights less than 60 feet.
 - o Internal pressure coefficients in hurricane-prone regions to reflect debris impact.
 - o Pressure coefficients for Components and Cladding (C&C) for multiple roof types.
 - o The Gust Effect Factor (GEF) for structures in a unified equation form.
- Since 2001 additional changes in wind-borne debris region maps and building design requirements have taken place. Changes in wind-load design criteria also continue to be made across newer ASCE codes and standards, such as in how pressure coefficients are applied. However, for the purposes of this screening-level assessment, this ASCE 7-95 (after 1995) is the most significant in terms of considering property-level adaptive capacity (Mehta 2010).

WIND-BORNE DEBRIS REGIONS

ASCE wind-borne debris regions and related risk categories were considered within the region. While different risk categories apply to different types of assets (e.g., residential vs. medical facilities) all of the study area is within the same debris region and mean recurrence interval (MRI) zones. Therefore, all of the study area was considered exposed to the threat of high winds.

PARCEL AND STRUCTURAL DATA

Property parcel and building-level year-built information from the Charleston County Tax Appraiser's Office was used for parcel boundaries and year-built information.

High Winds Findings

There are 35,580 parcels in Charleston County that contain a structure built before 1976, when building regulations accounted for high winds protection. The majority of these are residential homes (26,466 properties). Additionally, 1,164 commercial properties and 605 critical or government owned properties are susceptible to damage from high winds.

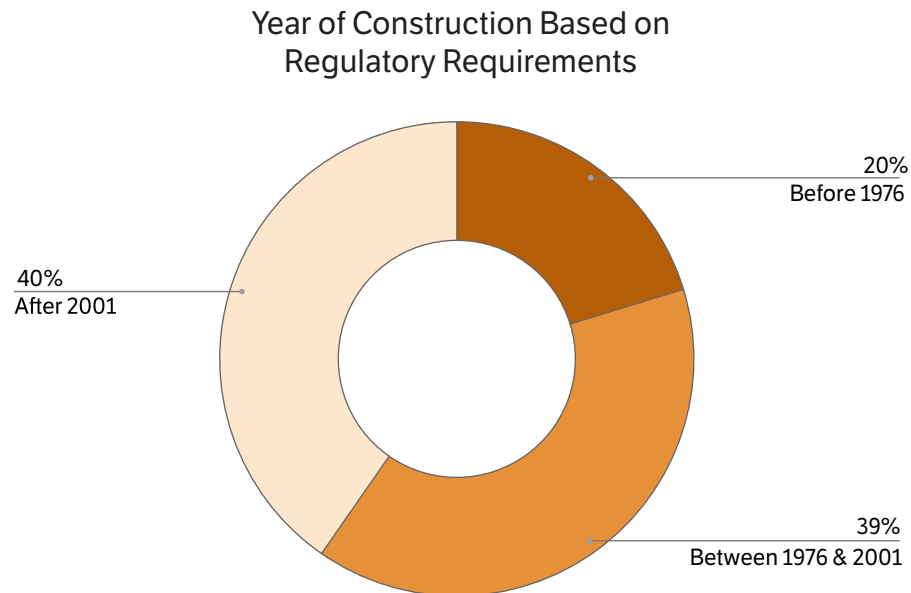


Figure 27. Percentage of properties constructed by year and organized by when regulations were added or updated for High Wind scenarios.



Vulnerability to Earthquake

In addition to ground shaking, earthquakes can cause liquefaction, which has the potential to damage or destroy buildings and infrastructure, trigger fires, and cause loss of life.

Earthquake Assessment Methodology

The National Earthquake Hazard Reduction Plan (NEHRP) site class map (part of the FEMA HAZUS 4.1 data suite) was used to assess earthquake hazard. The NEHRP site class map is based on 1997 NEHRP provisions. Site classes provide a simplified measure of the potential for strong shaking in a particular area based on soil conditions (softer soils amplify the ground motion). Two site classes are present in the Charleston region: Class D (stiff soils) and Class E (soft soils). Class E areas are considered to be the high hazard areas, with less geologic stability and more susceptibility to ground shaking and seismic activity. In addition to ground shaking, earthquakes can cause liquefaction, which has the potential to damage or destroy buildings and infrastructure, trigger fires, and cause loss of life.

Assessment Factors

- Criticality of buildings
- Soil site classes (soft vs. stiff soils)
- Seismic building code and design standards

The assessment of property assets consider building code standards and seismic design guidelines. Key dates and considerations in the assessment include:

- 1968 as the first year that building codes were established for Charleston
- 2002 as the first year when building codes for seismic guidelines were updated and building requirements were increased

Bridges were also evaluated based on a review of bridge design guidance. The review found that first performance based seismic design procedures for bridges were implemented in South Carolina in 2001 and were updated in 2008. The review also found that bridges designed in the 1990's likely had some consideration for seismic forces, but industry standards were limited. Bridges designed prior to the 1990's likely did not have consideration for seismic forces.

Note that this screening-level vulnerability assessment does not examine specific earthquake scenarios or consider other seismic risk factors such as liquefaction potential, depth to the marl, or probabilities.

Earthquake Assessment Findings

Based on the NEHRP map of susceptibility and parcel-level information, about 5,059 parcels are vulnerable to earthquake. This includes 2,823 residential, 181 commercial, and 206 critical/government-owned properties. Additionally, properties that experienced damage from the 1886 earthquake in Charleston are particularly susceptible to future damages. There are 2,495 properties with structures built before 1886, 366 of which are residential, 191 of which are critical or government owned properties, and 142 of which are commercial properties.

Overlapping hazards can exacerbate and worsen existing stressors, and many properties in the area face vulnerability to both earthquakes and flooding. For example, 4,426 of the properties that are built before earthquake building regulations were put in place are also exposed to the FEMA floodplain. 2,712 of those properties are residential, 170 are commercial, and 191 are critical or government owned.

Next Steps

Before considering the implementation of specific resilience and adaptation strategies, it is crucial to take a step back and assess the broader context in which these strategies were developed and will be realized. Factors such as staff capacity, funding scenarios, political and public support, and stakeholder expectations must be carefully evaluated. Thoughtfully aligning resilience efforts with the County's and community's long-term goals is also important in ensuring effectiveness by being adaptable to future changes. In accounting for these elements, not only do strategies become more actionable but implementation also becomes more sustainable.

Of particular importance is ongoing relationships and coordination with those who offered their time, knowledge, and support through this assessment effort. Each of these stakeholders and the organizations they represent have a keen interest in Charleston County evolving to be more climate-smart and better able to recover to conditions even stronger and safer than those that existed before a hazard impacted them. The members of this assessment's focus group and other similar community leaders are invaluable not only as conduits of lived experiences but also as voices to disseminate information to their audiences; they should remain key players in efforts to address vulnerabilities uniquely and equitably in communities across the County.

Specifically, these are some initial and ongoing considerations to best situate the County to move consistently forward with strategies to improve resilience and adaptive capacity:

Move to Implement

Position the County so that it can pursue specific resilience and adaptation strategies efficiently and effectively.

- Coordinate actively among community, staff, and elected leadership to identify and prioritize projects and initiatives
- Develop internal procedures that align departments in achieving specific goals and objectives both individually and collaboratively
- Foster partnerships with other agencies and community-based organizations with shared missions to find opportunities for shared effort.

Incorporate into Planning Resources

Maintain the data and findings of this assessment as living resources. They could be incorporated into future planning documents, such as updates to the Resilience Element of the Comprehensive Plan or a specific set of strategies related to flooding and sea level rise, or as the basis for specific amendments to regulatory frameworks like zoning or flood prevention ordinances. It may also be useful to periodically review and update this assessment to leverage the most current data and produce the most actionable findings.

Identify Funding Opportunities

While a great deal of financial support for resilience and adaptation planning and projects exist, many funding programs are tailored to certain hazards or challenges and to specific outcome objectives. A thoughtful approach to how the County's resilience goals align with particular funding sources will result in higher rates of success in securing funding as well as in more streamlined project design and implementation.

Preliminary Strategies and Actions

Strategies List

- S01 Programmatic Approach to Flood Mitigation
- S02 Collaborative Easement Acquisition Process
- S03 Drainage System Maintenance
- S04 Emergency Services Planning
- S05 Extreme Heat Planning
- S06 Resilience of County-Owned or Managed Properties
- S07 Climate Resilient Brownfields Redevelopment
- S08 Local Resilience Fund
- S09 Structured Resilience Governance
- S10 Resilience in Codes and Guidance
- S11 Stormwater Special Protection Areas

S01

Develop a programmatic approach to flood mitigation to increase efficiency and effectiveness of flood risk reduction initiatives and ultimately expand investments in flood mitigation.

Leader: Floodplain Management

Flood mitigation can include a wide variety of projects, processes, and policies, all aimed at reducing flood risk. When this work is undertaken by multiple entities it can result in disjointed efforts. A centralized County flood mitigation program led by County Floodplain Management staff can improve the efficiency and effectiveness of flood risk reduction initiatives. Ultimately, a programmatic approach to flood mitigation can make the case for the creation of a dedicated local resilience fund by articulating a long-term implementation pathway that is feasible, equitable, and matches the growing countywide need for flood adaptation.

Opportunities for Action:

- Establish short, medium, and long-term goals related to reducing flood insurance gaps, site-scale and neighborhood-scale mitigation projects, complementary flood prevention policies, and addressing repetitive loss areas
- Utilize multiple data sources to inform both internal decision making as well as external programming and to leverage the best available funding sources for projects
- Design prioritization, funding, and project management structures that overcome barriers in the existing federal funding process for flood mitigation (long project timelines, unrealistic cost-effectiveness thresholds, limited eligibility)
- Enable staff and organizational capacity so that program implementation is manageable and sustainable
- Broaden involvement from currently underrepresented areas in the mitigation planning process

In July 2024, Charleston County was awarded a planning grant by the NOAA Climate Smart Communities Initiative to further develop this particular strategy in partnership with Fernleaf and the Lowcountry Alliance for Model Communities, based in North Charleston. The project is aimed at building the framework for countywide flood mitigation that programmatically identifies and prioritizes needs in a way that will reduce procedural barriers and emphasize equitable mitigation benefits. This foundation for ongoing mitigation efforts will also seek to build capacity and sustained funding for a pipeline of flood mitigation work that could also be expanded into broader countywide resilience programming.

S02

Develop a strategic and collaborative process for acquisition of stormwater easements to support long-term sustainability of stormwater management infrastructure.

Leader: Stormwater Management

County easements are the foundation for stormwater management infrastructure throughout the unincorporated areas of the County. Easements can also be utilized as a floodplain preservation tool to guide floodwaters and minimize damage, either in addition to or in conjunction with existing stormwater infrastructure. The effectiveness of an easement system is maximized when there is a connected and multi-functional network of conveyances and basins with which to move and store floodwater away from buildings and neighborhoods and towards natural floodplains. This system is disrupted when easement networks are disconnected or are not able to adequately carry typical floodwater volumes. An ongoing internal process for easement acquisition and expansion with clearly defined partnerships and roles will support county-wide functional stormwater management and flood prevention and may also be eligible for Community Rating System credit.

Opportunities for Action:

- Pinpoint and highlight gaps in the easement network, needs for easement expansion, and opportunities for easement connections in the GIS inventory of stormwater infrastructure
- Identify and pursue funding sources that best support the existing criteria for prioritization of easement and infrastructure needs
- Establish a streamlined process for easement design and acquisition that emphasizes an equitable distribution of easement benefits and encourages property owners to grant easements
- Create a proactive outreach program to discuss property- and neighborhood-scale benefits of stormwater easements, promote transparency, and understand community needs and concerns

S03

Develop a systematic approach to drainage system maintenance.

Leader: Stormwater Management

The drainage system managed by the County comprises natural water courses as well as constructed inlets, conveyances, and basins, all with limited carrying capacities. As storm events become more frequent and intense, the drainage system's limits are more frequently exceeded, causing flooding as well as potentially damaging components of the system itself. This pattern can be exacerbated by the accumulation of debris, sedimentation, and the growth of unwanted vegetation. A data-driven community program to routinely keep streams, channels, and storage basins clear of debris will help to maintain maximum flood carrying and storage capacity.

Opportunities for action:

- Engage both County staff and community members to gather institutional and experiential knowledge of locations of inadequate or dysfunctional stormwater infrastructure
- Include an inventory of known problem sites with attribute details in the GIS inventory of stormwater infrastructure and use this inventory to identify and prioritize needs for updated, expanded, and additional infrastructure based on which problem sites require the most regular maintenance or cause the greatest disruption to the drainage system
- Collaborate with agencies that maintain adjacent or connected infrastructure, including the South Carolina Department of Transportation and neighboring jurisdictions, to communicate the areas of greatest need and address shared choke points
- Continue coordination with Floodplain Management to annually update the documentation for Community Rating System credit for Channel Debris Removal (CDR) and Problem Site Maintenance (PSM) (Elements 5423.a. & 542.b.)

S04

Ensure that County emergency services are prepared for increasing impacts from extreme flooding events by operationalizing flooding vulnerability assessments and other relevant information for planning, siting, and external coordination.

Leader: Emergency Management, Emergency Medical Services

Emergency management and response services are critical to efficient and effective preparedness and recovery. While emergency planning efforts clearly identify hazards and risks that may generate an emergency response, there must also be ongoing updates to incorporate vulnerability information to allow emergency services to provide programming that is specific and tailored to areas with unique assets, hazards, and recovery capacity.

Opportunities for Action:

- Align plans for emergency preparedness, warning, response, and recovery with the findings of the vulnerability assessment to support emergency management decision making that considers flood hazard impacts
- Inform decisions around siting, design, and upgrades of new and existing emergency facilities by incorporating both current flood hazard conditions and future flooding projections
- Consider the establishment of EMS operations areas with vehicles and assets designed and outfitted for the hazards that most impact the area in which they operate
- Share the vulnerability assessment information with local first and second responders, fire districts, and neighboring emergency management leaders to collaboratively identify needs for enhanced planning and coordination

S05

Develop a collaborative and comprehensive heat education, warning, and response program with local agencies, community-based organizations, medical institutions, and state agencies.

Leader: Emergency Management, Emergency Medical Services

In places like the Lowcountry, where people are accustomed to hot weather, the health-related impacts of unusually hot and humid days tend to be invisible or minimized. The County should elevate the dangers of extreme heat as a key climate hazard in its emergency planning and preparation.

Opportunities for Action:

- Expand the use of existing tools and processes for flooding emergencies to also effectively manage heat-related emergencies, including heat alerts and advisories or tabletop exercises simulating heat wave scenarios
- Develop heat-specific protocols for all first responders to effectively identify, assess, and assist at-risk populations during extreme heat events, including for County personnel
- Develop and distribute materials that effectively communicate heat risks and safety measures through a variety of official and unofficial channels
- Focus on collaborating with community partners to engage and assist at-risk and less connected individuals like migrant farmworkers, the unhoused, and elderly residents living alone

S06

Enhance resilience of and through County-owned facilities and infrastructure.

Leader: Facilities

Properties, buildings, and infrastructure owned and maintained by the County are opportunities for the most direct application of adaptive practices to improve resilience at site and neighborhood scales. Projects to design new or retrofit existing facilities that emphasize community resilience can also act as a model to practitioners considering climate adaptations in their own design, development, and operations programming.

Opportunities for Action:

- Conduct site-scale assessments for the subset of County-owned assets that are screened as highly vulnerable in this study, prioritizing those that serve vulnerable populations, and develop an inventory of appropriate interventions for priority assets
- Operationalize resilience considerations for Capital Improvement Planning by requiring all new capital projects or major renovations to be evaluated for climate risk as well as the potential to incorporate co-benefits such as heat mitigation, enhanced ecosystem services, multi-functional infrastructure, or added amenities in underserved areas
- Continue to update and enhance Public Works and Planning design standards to incorporate evolving hazard risks to ensure that new infrastructure can withstand climate impacts throughout its lifecycle

S07

Reactivate the County's Brownfields Redevelopment Program to pursue climate-resilient community revitalization in neighborhoods facing disproportionate environmental burdens.

Leader: Community Development and Revitalization

Many predominantly African American neighborhoods in North Charleston have borne a disproportionate burden of the long history of intense industrial and transportation expansion, resulting in poor health outcomes and hindering community development. The increasing severity and frequency of flooding exacerbates the risks associated with polluted sites, including contaminated floodwaters and ground water, on already overburdened communities. The unprecedented federal funding now available through the US Environmental Protection Agency's (EPA) Brownfields Grant Program offers the County a timely opportunity to revive its dormant brownfields program. By implementing a climate-resilient approach to brownfields redevelopment, the County can address environmental contamination, reduce flood and extreme heat vulnerability, enhance community resilience, and promote economic development in areas that need it most.

A planning grant awarded by the NOAA Climate Smart Communities Initiative in July 2024 will support a collaborative brownfields pilot project between Charleston County and the Lowcountry Alliance for Model Communities with the consultant team from Fernleaf and Adaapta. Focusing on neighborhoods in North Charleston, the project will involve creating a brownfields inventory and a strategic plan to guide their redevelopment in alignment with local priorities and economic initiatives. This pilot effort aims to build the knowledge and relationships necessary for community-driven and climate-smart brownfields redevelopment. It will also provide the essential background data and capacity for competitive EPA Brownfields Community-wide Assessment grant applications and for the reactivation of the County's Brownfields Redevelopment Program.

S08

Explore and leverage diverse public and private funding, and finance sources to develop a robust local resilience fund capable of sustaining resilience investments at the pace and scale necessary to address escalating climate risks.

Leader: Resilience and Sustainability

Studies estimate that every \$1 invested in resilience in the public sector returns \$6 worth of societal benefits, including from reduced future disaster losses, and another \$7 in economic savings through reduced costs to the local economy (National Institute of Building Sciences, 2019 & U.S. Chamber of Commerce, 2024). Despite the clear benefits of proactive resilience investments, the significant upfront costs are a major barrier for communities nationwide. Indeed, many of the strategies and actions discussed in this report require substantial financial resources that may not be easily accessible or available in a timely manner.

While federal funding for hazard mitigation and climate resilience has increased sharply in recent years, most grant programs are highly competitive and come with their own set of challenges. Grant writing and administration require institutional knowledge and consistent management capacity while also only funding individual projects included in each application. Hence, a locally managed resilience fund leveraging a variety of public and private financing and funding mechanisms, as well as the staff capacity and expertise to support it, is crucial for timely and sustained investments in climate resilience. It can ease administrative burdens and limitations of grant-funded projects, while also better leveraging inter-agency support to manage countywide mitigation projects efficiently and effectively.

S09

Establish structures and processes for collaborative resilience governance and decision making.

Leader: Administration

Resilience efforts can span a wide range of programs, projects, regulations, and community engagement initiatives, which makes tracking progress and efficiently leveraging capacity and resources difficult. A centralized internal framework for defining goals and milestones will afford greater success in focusing efforts and achieving desired outcomes. Most importantly, the objectives, metrics, and leaders must be clear and specific.

Opportunities for Action:

- Create a cross-departmental structure led by a facilitator and a technical expert for collaboration on resilience objectives
- Establish specific key performance indicators and metrics for each that are assigned to individual departments for ongoing leadership and management
- Regularly report out progress on metrics to highlight any needs for additional resources or inter-departmental shared effort
- Leverage the strong capabilities of the GIS Department to create a central map-based hub for resilience data to, for example, centralize flooding reports and translate them to data points or generate progress dashboards for internal or external efforts

S10

Support resilience in ordinances to ensure that future growth and development is climate-smart.

Leader: Zoning and Planning

Many resilience and adaptation practices are successful because they are supported by informed regulations and guidelines. One area in which regulation is impactful is in guiding growth and development in a way that is community-focused, climate-smart, and equitable. The new Resilience Element of the County's Comprehensive Plan notes ideas for incorporating resilience-driven guidance into County land use and site design ordinances, which are included and expanded upon below, as opportunities to explore further.

Opportunities for Consideration:

- Compensatory storage to offset losses of natural flood storage
- Tree canopy preservation to increase water absorption and mitigate heat impacts
- Incentives for green infrastructure on private properties
- Site design guidelines that consider climate hazards
- Consistent plans and codes
 - Incorporate components of the Resilient Element into all Comprehensive Plan to ensure a thread of resilience throughout
 - Reconcile new codes across departments in central regulatory resilience framework
 - Align regulations and guidance with neighboring jurisdictions
- Reassessment of the highest and best use of vacant and public lands
 - Leverage the foundation of Greenbelt and Parks systems to expand conserved lands that provide both recreational and climate resilience benefits
 - Use multiple hazard datasets to inform highest risk areas
 - Prioritize conservation of existing vacant land that also falls into highest risk / mitigation priority areas
 - Partner with local land trusts for coordination and management of shared resources
 - Rethink two-dimensional urban growth boundary by considering three-dimensional flood hazards in preserving rural land and guiding development
- Adoption of South Carolina Low Impact Development Manual guidance into code
- Guidelines for the use of fill to minimize impact to neighbors
 - Limit fill to use for roads, utilities, etc.
 - Prohibit slab-on-grade foundations
 - Define acceptable fill soil characteristics

S11

Reassess the approach to stormwater Special Protection Areas to refine objectives and leverage them as a tool to guide development intensity.

Leader: Stormwater Management

Special Protection Areas have been successful in reducing off-site stormwater runoff on newly developed and redeveloped properties in areas of particular flood risk. Incomplete flood hazard data and limitations of staff capacity have led the County to approach the SPAs broadly in order to capture as many high hazard locations with these higher standards. Additional available flood hazard data and refinement of metrics for success could drive SPAs that are more impactful as levers of development regulation and result in areas that are more resilient to increasing flood hazards.

Opportunities for Action:

- Clearly define both short- and long-term objectives for SPA standards and the metrics of success for their application
- Use best available data identify and map areas of high risk for individual or multiple flood hazards for the application of SPA standards
- Align the higher standards of SPAs with other development intensity regulations to collaboratively and collectively guide climate-smart development from multiple planning and development disciplines

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Appendices

Appendix A: Complete Flood Hazard Assessment Findings

SOCIAL STRESSORS AND DISPROPORTIONATE IMPACTS

In Charleston County, the CEJST identifies 22 disadvantaged census tracts (Figure A-1). The central region, stretching from Lincolnville down the neck of the Peninsula, shows a concentration of disadvantaged communities, with over half of the tracts in this section of the county facing significant burdens in one or more categories. Nearly all tracts in this area experience four or more of the eight burdens. One census block, just north of Union Heights, stands out as facing all eight burdens, highlighting the severely compounding social stressors in this area. Health disparities in this tract include high rates of asthma (97th percentile), diabetes (98th percentile), and heart disease (96th percentile), and low life expectancy (99th percentile). Environmental concerns are also prominent, with proximity to superfund sites (97th percentile) and exposure to toxic wastewater discharge (95th percentile).

Four tracts in the western part of the County, covering Edisto Island, Wadmalaw Island, Adams Run, Hollywood, Meggett, Ravenel, and Rockville are identified as disadvantaged for transportation based on the average relative cost and time spent commuting for work or essential services (94th percentile). Two of these tracts also have a high rate of diabetes (91st percentile). In the eastern part of the county, the census tract that includes the Towns of Awendaw and McClellanville faces a combination of legacy pollution from a former military training site, transportation barriers (98th percentile), and high exposure to wastewater discharge (91st percentile).

Food insecurity was identified as a significant stressor in the conversations with community partners. The Food Access Research Atlas (FARA) developed by the US Department of Agriculture provides information about food insecurity by identifying 'low income and low food-access' tracts. Tracts highlighted in Figure 27 are those with a high rate of households experiencing poverty or living with low incomes and at least a third of the population living more than 1 mile from the nearest supermarket or large grocery store in urban areas, or more than 10 miles in rural areas.

While CEJST and similar national tools provide valuable insight into the distribution of disadvantaged communities and the types of social stressors they face, it is important to note that these tools have limitations. African American settlement communities, often small and dispersed throughout the County, face many of the burdens listed on the CEJST. However, their size and locations, often surrounded by suburban or more affluent development, frequently lead to them being overlooked by the CEJST tool. Many of these historically self-sufficient communities do not currently have adequate infrastructure, are situated in low-lying areas, and deal with distinct pressures that arise from heirs' property issues (Fleming et al., 2016). The small African American settlement community of Red Top, for example, is about 2-3 miles wide and is split between two census block groups that cover parts of the larger areas of Ravenel and Johns Island. Due to the smaller size of the Red Top community in comparison to its neighboring towns, social and economic disadvantages faced by members of this community are not reflected in census-based data.

CEJST Analysis of Disadvantaged Communities in Charleston County

■ Identified as Disadvantaged

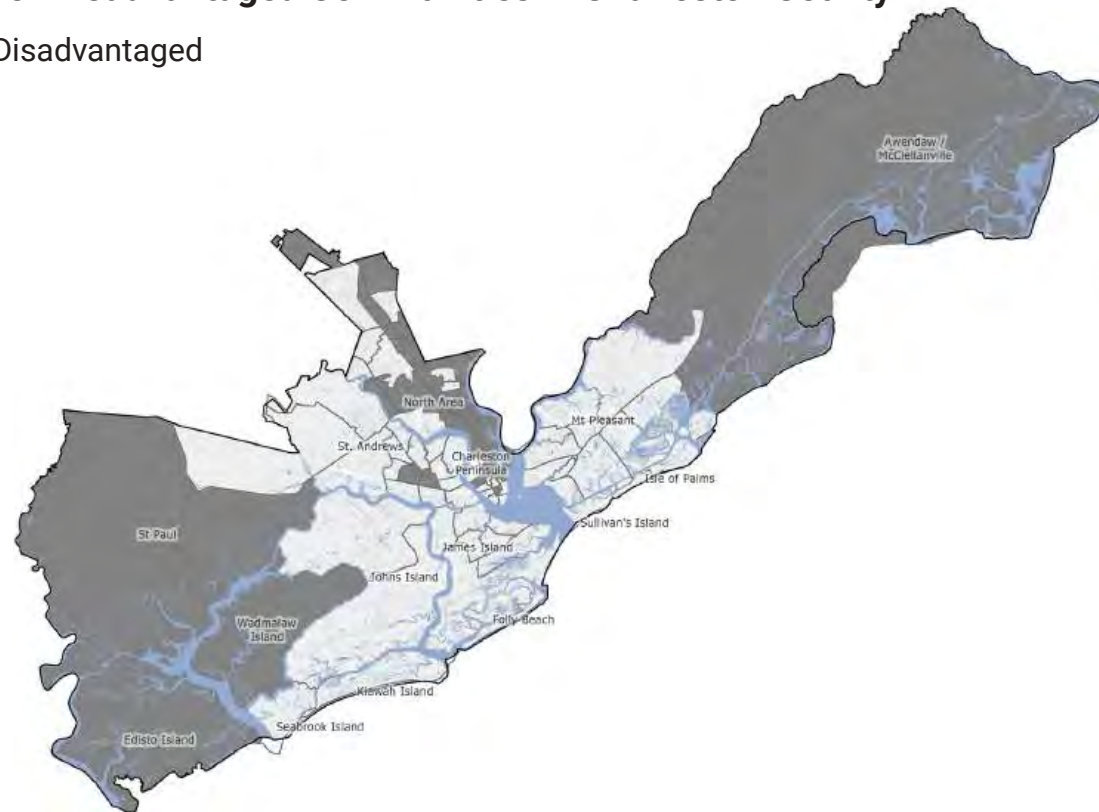


Figure A-1. Climate and Economic Justice Screening Tool, 2022

VULNERABILITY TO FLOOD HAZARDS

Table A-1 shows the total number of assets organized by asset category as well as the number and percentage of those assets facing a medium or high flood vulnerability and risk under the nine flood conditions assessed. The Open Space category is an exception, where properties are only evaluated for exposure and the numbers in Table 3 represent exposed assets.

It should be noted that while the flood vulnerability assessment results across the eight conditions are presented together, modeling approaches and assumptions vary between different data sources for these conditions. Direct comparisons across flood conditions should be limited to scenarios from the same datasets (for example, comparing flood vulnerability from USGS CoSMoS for 5% and 1% annual chance extents).

Table A-1. Summary of vulnerability assessment results by asset category and flood conditions

Asset Category	Total Assets	Current						Future		
		NOAA OCM High Tide Flooding	USGS CoSMos 5% annual chance	FEMA SFHA 1% annual chance	USGS CoSMos 1% annual chance	Woodwell 1% annual chance	FEMA NFHL 1% and 0.2% annual chance	USGS CoSMos 5% annual chance with 1.6ft SLR	USGS CoSMoS 1% annual chance with 1.6ft SLR	Woodwell 1% annual chance with 2.5 ft SLR
Residential	133,045	1,613 1%	15,402 12%	28,303 21%	30,147 23%	54,889 41%	79,071 59%	30,873 23%	50,066 38%	79,085 59%
Critical and Government Owned	1,344	42 3%	182 14%	287 21%	275 20%	497 37%	821 61%	274 20%	355 26%	586 44%
Cultural and Community	810	17 2%	113 14%	183 23%	164 20%	310 38%	416 51%	162 20%	228 28%	380 47%
Commercial	6,733	147 2%	614 9%	1251 18%	1,145 17%	3,184 47%	3,352 49%	1,108 16%	1,723 25%	3,904 58%
Industrial	1,445	39 3%	132 9%	258 18%	231 16%	934 65%	593 41%	212 15%	354 24%	998 69%
Open Space	25,914	6,664 26%	10,937 42%	16,628 64%	12,835 50%	21,383 83%	16,874 65%	12,480 48%	14,483 56%	22,257 86%

Results for individual asset categories are discussed in more detail in sections that follow, though several general observations can be drawn from Table 3. The three 1% annual chance flood assessments for current conditions – using the FEMA, USGS and Woodwell datasets – together provide a more expansive picture of vulnerability to **low frequency extreme flood events** compared to the FEMA regulatory floodplain model alone. In general, the significant difference in the scope of vulnerability and risk indicated by the Woodwell data compared to the FEMA and USGS data can be largely (but not completely) attributed to the pluvial flooding component included in the Woodwell dataset.

The **moderate frequency and intensity** flood condition with a 5% annual chance modeled by USGS can result from rainfall-induced and/or coastal flooding events and in some areas result in flood heights over three feet. Over 10% of the developed properties countywide are highly vulnerable to 5% annual chance flooding in current conditions (USGS CoSMoS).

Developed properties that are currently highly vulnerable to **‘minor’ tidal flooding** are lower in number (about 1% of properties countywide) but can experience disruptive impacts multiple times a year. While the intensity of flooding from a high tide of this level may not be as severe today, with the one foot of sea level rise that is expected by about 2050, these vulnerable properties are almost certain to feel moderate impacts many times per year. In other words, the properties that are vulnerable to minor high tide flooding today will see increases in both the frequency of flooding and intensity of impacts with rising sea levels.

Deconstructing these results based on subcomponents of vulnerability and risk reveal the drivers of negative impacts. **Adaptive Capacity** of properties, determined by building requirements at the time of construction, indicates how well buildings can cope when impacted by flooding. Figure 10 shows that about 13% of properties in the regulatory floodplain were built after mapping but before the adoption of the one-foot freeboard requirement (different years for different jurisdictions), giving them a relatively moderate coping capacity. About 4% of properties in the County were built in the regulatory floodplain before it was first mapped and hence are likely built below the Base Flood Elevation, providing them the least coping capacity.

The USGS and Woodwell datasets, however, add a key insight about the much larger number of properties with low adaptive capacity. This is because floodplain management regulations only apply to properties within the FEMA Special Flood Hazard Area, leaving properties with the same level of risk (1% annual chance) outside the regulatory floodplain with low adaptive capacity as they are likely to be built on grade regardless of construction date. These additional properties with low adaptive capacity constitute 3% of all developed properties in the USGS 1% annual chance flood assessment and 16% of developed properties in the Woodwell 1% annual chance flood assessment.

The **Risk Consequence subcomponent** is based on depth of flooding, where a 'high' classification indicates properties that can experience inundation of 3 feet or more. The 5% annual chance flood assessments show that with just 1.6 feet of sea level rise, projected to occur as early as the 2040s, 10% of properties could experience high-depth flooding over 3 feet (Figure 15), which is 4.5 times more properties than face the same risk today (Figure 14). Thus, even a moderate frequency flooding event can result in significant flood impacts in the County. Similarly, a relative sea level rise of 2.5 feet doubles the number of existing homes that could face greater than 3 feet of inundation in a 1% annual chance flood event.

The flood vulnerability and risk predicted in assets in Charleston County varies based on the specific flood scenario assessed. Table A-2 shows the total number of assets in each category, as well as the number and percentages of those assets predicted to have a medium to high flood vulnerability and risk under each of the eight flood scenarios assessed.

Table A-2. Summary of Vulnerability Assessment Results in Unincorporated Areas by Asset Category

Asset Category	Total Assets	Current						Future		
		NOAA OCM High Tide Flooding	USGS CoSMos 5% annual chance	FEMA SFHA 1% annual chance	USGS CoSMos 1% annual chance	Woodwell 1% annual chance	FEMA NFHL 1% and 0.2% annual chance	USGS CoSMos 5% annual chance with 1.6ft SLR	USGS CoSMos 1% annual chance with 1.6ft SLR	Woodwell 1% annual chance with 2.5 ft SLR
Residential	21,514	234 1%	2,872 13%	3,590 17%	4,829 22%	7,895 37%	13,101 61%	5,165 24%	7,650 36%	11,883 55%
Commercial	875	9 1%	60 7%	132 15%	147 17%	362 41%	395 45%	139 16%	224 26%	480 55%
Industrial	250	8 3%	28 11%	49 20%	51 20%	146 58%	102 41%	47 19%	70 28%	170 68%
Critical and Government Owned	401	7 2%	52 13%	70 17%	72 18%	112 28%	249 62%	72 18%	95 24%	152 38%
Cultural and Community	194	3 2%	25 13%	28 14%	35 18%	59 30%	86 44%	38 20%	46 24%	74 38%
Open Space (exposure only)	12,046	3503 29%	5,751 48%	8,669 72%	6,645 55%	10,518 87%	8,436 70%	6,486 54%	7,442 62%	10,878 90%

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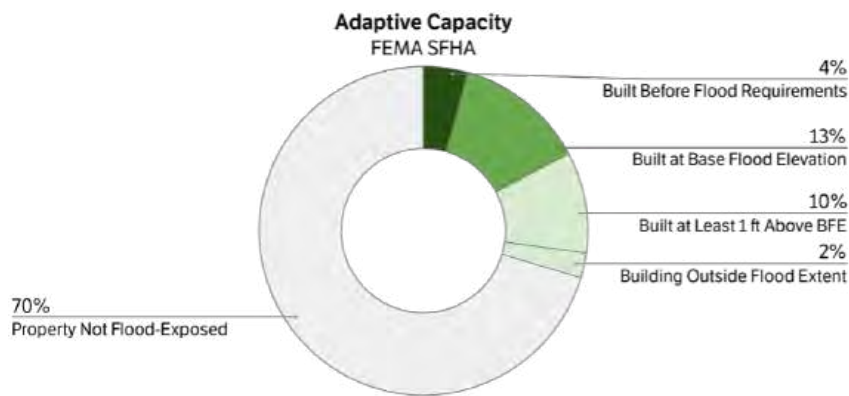


Figure A-2. Adaptive Capacity of properties to FEMA Special Flood Hazard Area (i.e., the regulatory floodplain)

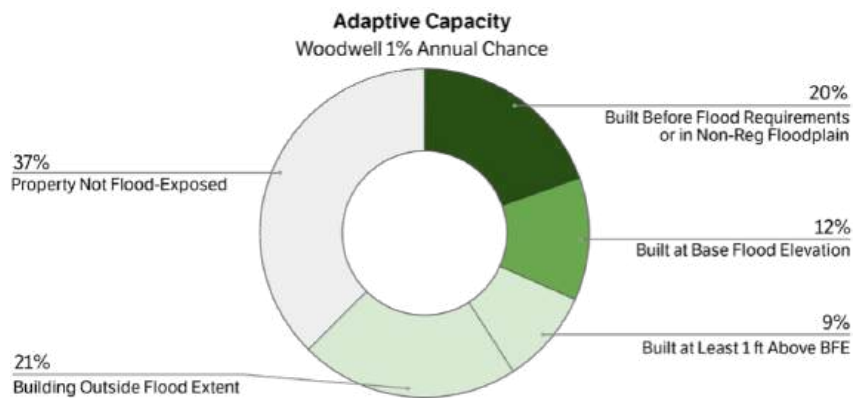


Figure A-3. Adaptive Capacity of properties to 1% annual chance flooding based on Woodwell dataset

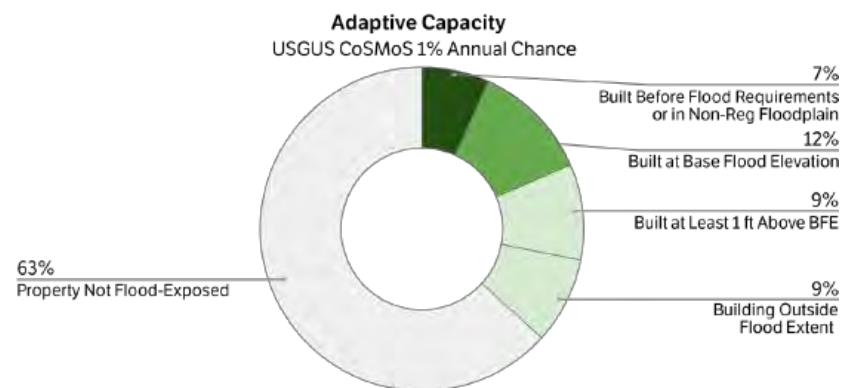


Figure A-4. Adaptive Capacity of properties to 1% annual chance flooding based on USGS CoSMoS dataset

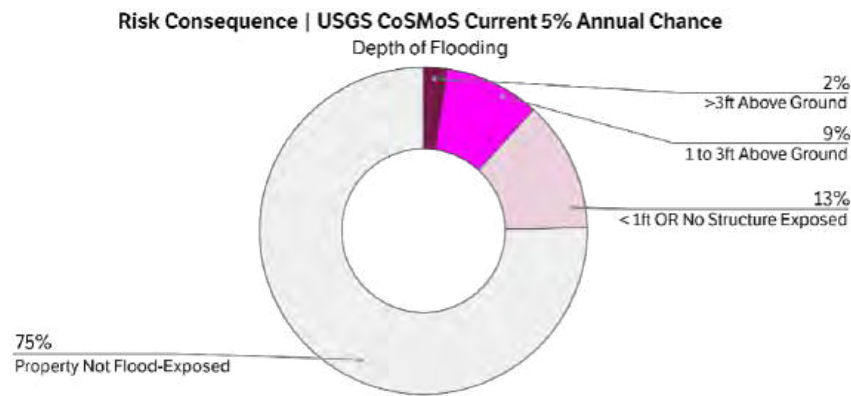


Figure A-5. Magnitude of impact of 5% annual chance flooding (USGS) under current conditions

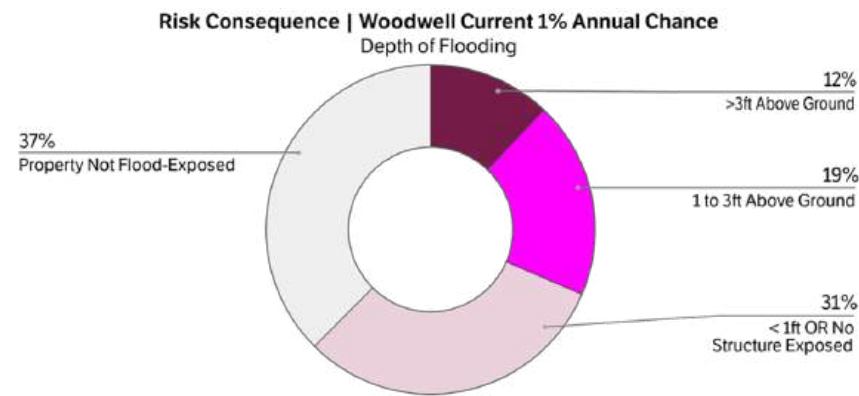


Figure 30. Magnitude of impact of 1% annual chance flooding (Woodwell)

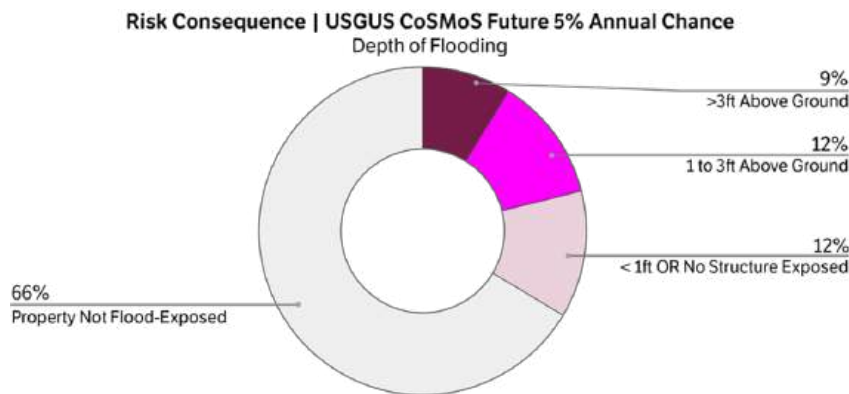


Figure A-6. Magnitude of impact of 5% annual chance flooding with 1.6 ft SLR (USGS)

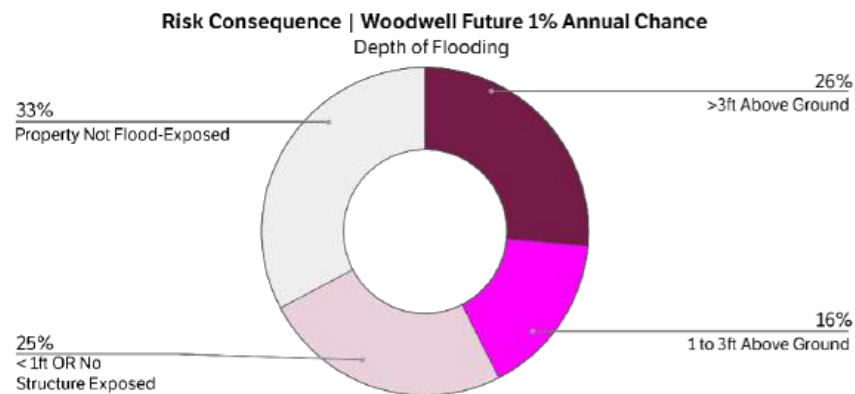


Figure 32. Magnitude of impact of 1% annual chance flooding with 2.5 ft SLR (Woodwell)

Table A-3. Vulnerability of dedicated (i.e., subsidized) and 'naturally-occurring' affordable housing in Charleston County

Asset Category	Total Assets	Current						Future		
		NOAA OCM High Tide Flooding	USGS CoSMos 5% annual chance	FEMA SFHA 1% annual chance	USGS CoSMos 1% annual chance	Woodwell 1% annual chance	FEMA NFHL 1% and 0.2% annual chance	USGS CoSMos 5% annual chance with 1.6ft SLR	USGS CoSMos 1% annual chance with 1.6ft SLR	Woodwell 1% annual chance with 2.5 ft SLR
Manufactured and Mobile Homes	1,766	12 1%	167 9%	222 13%	272 15%	610 35%	637 36%	263 15%	375 21%	750 42%
Manufactured Home Parks	180	3 2%	8 4%	14 8%	11 6%	80 44%	29 16%	9 5%	17 9%	84 47%
Multi-family	374	18 5%	83 22%	133 41%	123 41%	278 74%	210 56%	119 32%	160 43%	295 79%
Dedicated Affordable Housing	315	9 3%	47 15%	91 29%	83 26%	139 44%	166 53%	77 24%	111 35%	177 56%
Total	2,635	281 11%	281 11%	429 24%	459 18%	1065 41%	1003 39%	440 17%	630 24%	1262 49%

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Table A-4. Summary of assessment results by asset type within Critical Infrastructure and Government Owned Assets category

Asset Type	Total # of Properties	Current						Future		
		NOAA OCM High Tide Flooding	USGS CoSMos 5% annual chance	FEMA SFHA 1% annual chance	USGS CoSMos 1% annual chance	Woodwell 1% annual chance	FEMA NFHL 1% and 0.2% annual chance	USGS CoSMos 5% annual chance with 1.6ft SLR	USGS CoSMoS 1% annual chance with 1.6ft SLR	Woodwell 1% annual chance with 2.5 ft SLR
INFRASTRUCTURE AND UTILITY										
Electric	3	2 67%	2 67%	2 67%	2 67%	2 67%	2 67%	2 67%	2 67%	2 67%
Communication	30	0	2 7%	3 10%	4 13%	9 30%	12 40%	4 13%	5 17%	10 33%
Utility	154	2 1%	10 6%	15 10%	15 10%	31 20%	88 57%	14 9%	20 13%	36 23%
Pump Station	29	0	1 3%	1 3%	1 3%	1 3%	18 62%	1 3%	1 3%	1 3%
Lift Station	2	0	0	0	0	0	2 100%	0	0	0
Solid Waste	8	0	0	0	0	1 13%	3 38%	0	1 13%	2 25%

CONTINUED - Table A-4. Summary of assessment results by asset type within Critical Infrastructure and Government Owned Assets category

Asset Type	Total # of Properties	Current						Future		
		NOAA OCM High Tide Flooding	USGS CoSMos 5% annual chance	FEMA SFHA 1% annual chance	USGS CoSMos 1% annual chance	Woodwell 1% annual chance	FEMA NFHL 1% and 0.2% annual chance	USGS CoSMos 5% annual chance with 1.6ft SLR	USGS CoSMoS 1% annual chance with 1.6ft SLR	Woodwell 1% annual chance with 2.5 ft SLR
EMERGENCY RESPONSE SERVICES										
EMS	14	1 7%	4 29%	3 21%	4 29%	6 43%	7 50%	4 29%	5 36%	8 67%
Fire	71	1 1%	13 18%	17 24%	15 21%	32 45%	31 44%	16 23%	20 28%	37 52%
Point of Distribution	60	0	9 15%	15 25%	14 23%	41 68%	33 55%	15 25%	19 32%	47 78%
Shelter	5	0	0	1 20%	1 20%	4 80%	2 40%	1 20%	1 20%	4 80%
Evacuation Pickup Points	42	0	4 10%	7 17%	8 19%	17 40%	18 43%	8 19	1 24%	23 55%
Fuel Storage	6	0	1 17%	1 17%	1 17%	4 67%	4 67%	1 17%	1 17%	5 83%

CONTINUED - Table A-4. Summary of assessment results by asset type within Critical Infrastructure and Government Owned Assets category

Asset Type	Total # of Properties	Current						Future		
		NOAA OCM High Tide Flooding	USGS CoSMos 5% annual chance	FEMA SFHA 1% annual chance	USGS CoSMos 1% annual chance	Woodwell 1% annual chance	FEMA NFHL 1% and 0.2% annual chance	USGS CoSMos 5% annual chance with 1.6ft SLR	USGS CoSMoS 1% annual chance with 1.6ft SLR	Woodwell 1% annual chance with 2.5 ft SLR
ESSENTIAL SERVICES AND AMENITIES										
Library	22	1 5%	6 27%	7 32%	7 32%	15 68%	10 45%	7 32%	9 41%	15 68%
County Park	69	1 1%	6 9%	11 16%	10 14%	14 20%	59 86%	9 13%	13 19%	20 29%
School	136	3 2%	25 18%	40 29%	38 28%	88 65%	70 51%	38 28%	49 36%	94 69%
Greenbelt	69	9 3%	38 12%	40 13%	46 14%	51 16%	256 80%	46 14%	57 18%	68 21%
COUNTY-OWNED FACILITIES										
Judicial	14	0	4 29%	4 29%	5 36%	10 71%	9 64%	5 36%	5 36%	12 86%
County Fa- cilities and Operations	34	0	3 9%	9 25%	6 18%	17 50%	22 65%	6 18%	12 35%	20 59%
Police	9	0	2 22%	3 33%	3 33%	4 44%	6 67%	3 33%	4 44%	5 56%

CONTINUED - Table A-4. Summary of assessment results by asset type within Critical Infrastructure and Government Owned Assets category

Asset Type	Total # of Properties	Current						Future		
		NOAA OCM High Tide Flooding	USGS CoSMos 5% annual chance	FEMA SFHA 1% annual chance	USGS CoSMos 1% annual chance	Woodwell 1% annual chance	FEMA NFHL 1% and 0.2% annual chance	USGS CoSMos 5% annual chance with 1.6ft SLR	USGS CoSMoS 1% annual chance with 1.6ft SLR	Woodwell 1% annual chance with 2.5 ft SLR
OTHER FACILITIES AND GOV-OWNED PROPERTIES										
Government-Owned (State and Municipal)	188	19 10%	44 23%	88 47%	76 40%	117 62%	141 75%	77 41%	95 51%	129 69%
State-Owned Facilities	8	0	0	2 25%	1 13%	5 63%	5 63%	1 13%	2 25%	5 63%
Hospital	5	0	0	0	1 20%	4 80%	2 40%	1 20%	1 20%	4 80%
Government Health Facility	2	0	0	0	0	1 50%	0	0	0	1 50%

Table A-5. Summary of flood exposure of properties in the Open Space category

Asset Type	Total Assets	Current						Future		
		NOAA OCM High Tide Flooding	USGS CoSMos 5% annual chance	FEMA SFHA 1% annual chance	USGS CoSMos 1% annual chance	Woodwell 1% annual chance	FEMA NFHL 1% and 0.2% annual chance	USGS CoSMos 5% annual chance with 1.6ft SLR	USGS CoSMoS 1% annual chance with 1.6ft SLR	Woodwell 1% annual chance with 2.5 ft SLR
Vacant Residential	19,744	4,559 23%	7,925 40%	12,523 63%	9,376 47%	15,820 80%	12,255 64%	9,124 46%	10,663 54%	16,565 84%
Vacant Commercial	2,426	286 12%	555 23%	1,278 53%	738 30%	1,920 79%	1,303 54%	708 29%	930 38%	2011 83%
Vacant County Land	25	10 40%	14 56%	12 48%	14 56%	22 88%	15 60%	14 56%	16 64%	22 88%
Agriculture	2,717	1,120 41%	1,680 62%	2,064 76%	1,856 68%	2,668 98%	2,089 77%	1,797 66%	1,933 71%	2,683 99%
Working Lands	89	22 25%	52 58%	51 57%	64 72%	85 96%	61 69%	53 60%	67 75%	87 98%
Managed Lands	138	92 67%	120 87%	116 84%	122 88%	136 99%	126 91%	123 89%	126 91%	136 99%
Parks & Recreation	478	179 37%	267 56%	316 66%	335 70%	439 92%	405 85%	329 69%	366 77%	456 95%
Protected Lands	1,812	1,043 58%	1,439 79%	1,501 83%	1,566 86%	1,744 96%	1,652 91%	1,534 85%	1,609 89%	1,775 98%

Table A-6. The total number and the vulnerability and risk of critical infrastructure properties by type

Asset Type	Total Number	Moderate or High Vulnerability and Risk
County Parks	69	20 29%
Greenbelt Properties	320	65 20%
Points of Evacuation and Distribution	102	31 30%
Fire/Police/EMS Stations	94	19 20%
Schools	136	30 22%
Utilities and Pump/Lift Stations	188	40 21%

Flood Appendix B: Planning Area Summaries of Flood Hazards

Charleston County's 16 planning areas reflect a unique mix of urban centers, rural landscapes, unincorporated zones, coastal regions, and marshlands. Planning areas were previously designed by the County in order to recognize the diverse needs of its community, taking into account environmental factors, historical significance, and local growth trends.

Information about the vulnerability and risks for each planning area is summarized in the following pages and can be used as a reference for planners and stakeholders, helping them make informed decisions that honor the unique characteristics of each area.

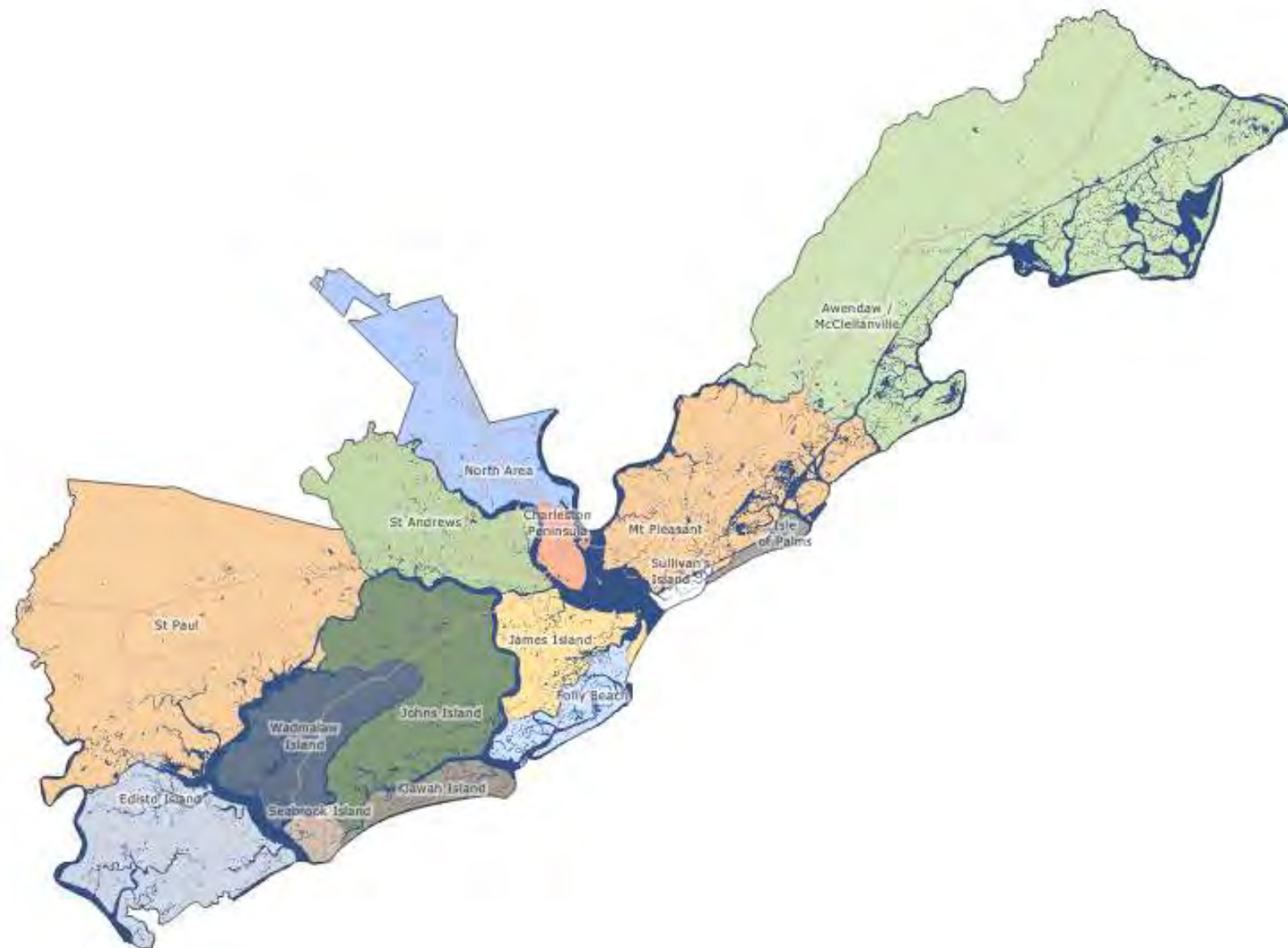


Figure A-7. Planning Areas in Charleston County

Awendaw/McClennanville Planning Area



Figure A-8. Awendaw/McClennanville Planning Area

Table A-7. Vulnerability Assessment Summary Table for Awendaw/McClennanville Planning Area

Asset Category	Total Assets	Current					Future		
		NOAA OCM High Tide Flooding	USGS CoSMos 5% annual chance	USGS CoSMos 1% annual chance	Woodwell 1% annual chance	FEMA NFHL 1% and 0.2% annual chance	USGS CoSMos 5% annual chance +1.6ft SLR	USGS CoSMos 1% annual chance with 1.6ft SLR	Woodwell 1% annual chance +2.5 ft SLR
Residential	2,075	18 1%	445 21%	763 37%	957 46%	1,384 67%	683 33%	967 47%	1,279 62%
Critical and Government Owned	77	0 0%	10 13%	15 19%	24 31%	41 53%	14 18%	17 22%	25 32%
Cultural and Community	43	0 0%	13 30%	14 33%	19 44%	24 56%	14 33%	16 37%	20 47%
Commercial	78	2 11%	22 28%	36 46%	41 53%	48 62%	31 40%	40 51%	49 63%
Industrial	19	3 16%	8 42%	11 58%	15 79%	14 74%	8 42%	12 63%	17 89%
Open Space (exposure only)	2,464	593 24%	1,404 57%	1,596 65%	2,334 95%	1,830 74%	1,468 60%	1,697 69%	2,366 96%

FEMA NFHL 1% AND .2% ANNUAL CHANCE FLOODING SCENARIO

- Of the 187 identified manufactured homes in the area, 93 are highly vulnerable.
- 3 communication facilities are vulnerable, as well as 3 of the 6 identified utility properties (which include properties owned by Public Works, Dominion Energy, Berkeley Electric parcels, McClellanville Telephone Company).
- Charleston County EMS Medic #6 as well as 1 fire station are vulnerable.
- 4 parcels are identified as cemeteries, 2 of which are vulnerable.
- 3 properties are identified as vacant county owned land, 2 of which are exposed.
- 1,350 vacant residential properties (about 73%) are exposed to the FEMA floodplain, and approximately 81% of protected land is exposed.

USGS COSMOS CURRENT 1% ANNUAL CHANCE FLOODING SCENARIO

- 3 of the 5 school properties in the area are vulnerable.
- Charleston County EMS Medic #6, as well as one fire station is vulnerable.
- One utility property, which is owned by McClellanville Telephone Company, is vulnerable.
- 1 vacant county owned property and 61% of vacant residential properties are exposed.
- Of the 198 parcels identified as protected land, 165 (about 83%) are exposed.

WOODWELL CURRENT 1% ANNUAL CHANCE FLOODING SCENARIO

- There are 100 manufactured homes in the area that are vulnerable (about 54%).
- 50% of identified communications facilities are vulnerable.
- 4 of 5 school properties, as well as Charleston County EMS Medic #6 and 1 fire station are vulnerable.
- 2 utility properties are vulnerable.
- All 3 vacant county owned properties are exposed to Woodwell flooding, as well as 94% of vacant residential properties.
- All but 3 parcels identified as protected land are exposed (99%).

ADDITIONAL FINDINGS

- Two school properties in McClellanville area are highly vulnerable to the regulatory floodplain (FEMA) - Cape Romain Environmental Ed. Charter School, and Lincoln High School. This area has a relatively high percentage of African American residents (87% in the block group), and 43% of households in the block group have income below the poverty level.
- Commercial properties in the area vulnerable to large-scale flooding events, including coastal and inland flooding (as indicated by Woodwell 1% annual chance condition), are found along North Highway 17 as well as Pinckney St in McClellanville, along Savannah Highway in Johns Island, and along Highway 78 and Benchmark Drive in Ladson.
- Awendaw-McClellanville and the Long Island area (just north of Folly Beach) have the highest percentages of properties with high vulnerability and risk to wildfire in the County, both of which have 83% to 98% of homes highly vulnerable and at risk.
- In Charleston County, the CEJST reveals 22 disadvantaged census tracts. In the western part of the county, the census tract that include the Towns of Awendaw and McClellanville face a combination of legacy pollution from formerly used defense site, transportation barriers (98th percentile), and high exposure to wastewater discharge (91st percentile).

Edisto Island Planning Area



Figure A-9. Edisto Island Planning Area

Table A-8. Vulnerability Assessment Summary Table for Edisto Island Planning Area

Asset Category	Total Assets	Current					Future		
		NOAA OCM High Tide Flooding	USGS CoSMos 5% annual chance	USGS CoSMos 1% annual chance	Woodwell 1% annual chance	FEMA NFHL 1% and 0.2% annual chance	USGS CoSMos 5% annual chance +1.6ft SLR	USGS CoSMos 1% annual chance with 1.6ft SLR	Woodwell 1% annual chance +2.5 ft SLR
Residential	1,070	56 5%	516 48%	608 57%	552 52%	969 91%	684 64%	736 69%	798 75%
Critical and Government Owned	75	4 5%	22 29%	25 33%	24 33%	69 92%	25 33%	28 37%	29 39%
Cultural and Community	17	1 6%	6 35%	8 47%	7 41%	14 82%	9 53%	10 59%	10 59%
Commercial	25	0 0%	7 28%	12 48%	6 24%	23 92%	12 48%	12 48%	14 56%
Industrial	2	0 0%	2 100%	2 100%	2 100%	2 100%	2 100%	2 100%	2 100%
Open Space (exposure only)	1,447	742 51%	1,107 77%	1,192 82%	1,358 94%	1,360 94%	1,220 84%	1,272 88%	1,407 97%

FEMA NFHL 1% AND .2% ANNUAL CHANCE FLOODING SCENARIO

- There are 80 manufactured housing properties in Edisto Island, 55 of which (69%) are highly vulnerable.
- 1 major supermarket is highly vulnerable.
- Both warehouse properties in the area are highly vulnerable.
- Critical and government owned properties have relatively high vulnerability in the area. This includes one communication facility, one evacuation pick up point, St. Paul's Fire Department, and Edisto Library.

USGS COSMOS CURRENT 1% ANNUAL CHANCE FLOODING SCENARIO

- 44% of manufactured housing in Edisto Island are vulnerable (35 properties).
- The major supermarket in Edisto Island is also vulnerable.
- 1 cultural property is vulnerable.
- A vacant county-owned property near the McKinley Washington Jr. Bridge is vulnerable across all threats.
- 840 vacant residential properties (81%) are exposed.
- The large majority of protected land in Edisto Island are exposed - 168 properties, which is about 94% of all vacant residential land in the area.

WOODWELL CURRENT 1% ANNUAL CHANCE FLOODING SCENARIO

- Edisto Library is highly vulnerable.
- 3 cultural properties are exposed.
- 958 vacant residential properties are exposed (93%).
- All but 2 properties considered to be protected land are exposed.

ADDITIONAL FINDINGS

- Within the unincorporated areas of the County, Edisto Island has the highest proportion of properties vulnerable to current high tide flooding. This data aligns with a concern voiced by one focus group participant, who indicated that they observed an increase of water along highways on Edisto Island, John's Island, and Wadmalaw Island during high tide conditions. This participant reported that the water recedes slowly, especially after rain events.
- Per CRE-H, tracts covering the south western corner of the County, Edisto Island and Wadmalaw Island have among the highest rates of at-risk individuals (1 in 3 residents).
- In Charleston County, the CEJST reveals 22 disadvantaged census tracts. Four tracts in the eastern part of the County covering Edisto Island, Wadmalaw Island, Adams Run, Hollywood, Ravenel, and Rockville are identified as disadvantaged for transportation based on the average relative cost and time spent (94th percentile). Two of these tracts also have high rates of diabetes (91st percentile). This data aligns with the concerns voiced by a focus group participant. They highlighted the lack of grocery stores offering healthy and affordable options on Edisto Island, forcing residents to travel upwards of 20 minutes to Hollywood or Edisto Beach to fulfill their basic needs.
- 1 school (Jane Edwards Elementary School) is moderately vulnerable to wildfire.

Folly Beach Planning Area



Figure A-10. Folly Beach Planning Area

Table A-9. Vulnerability Assessment Summary Table for Folly Beach Planning Area

Asset Category	Total Assets	Current					Future		
		NOAA OCM High Tide Flooding	USGS CoSMos 5% annual chance	USGS CoSMos 1% annual chance	Woodwell 1% annual chance	FEMA NFHL 1% and 0.2% annual chance	USGS CoSMos 5% annual chance +1.6ft SLR	USGS CoSMos 1% annual chance with 1.6ft SLR	Woodwell 1% annual chance +2.5 ft SLR
Residential	1,612	109 7%	736 46%	1,083 67%	1,343 83%	1,612 100%	1,293 80%	1,430 89%	1,549 96%
Critical and Government Owned	18	0 0%	5 28%	7 39%	7 39%	17 94%	7 39%	7 39%	9 50%
Cultural and Community	8	1 13%	6 75%	6 75%	6 75%	8 100%	6 75%	6 75%	7 88%
Commercial	58	2 3%	19 33%	32 55%	49 84%	58 100%	46 79%	50 86%	52 90%
Industrial	1	0 0%	1 100%	1 100%	1 100%	1 100%	1 100%	1 100%	1 100%
Open Space (exposure only)	253	170 67%	218 86%	240 95%	250 99%	253 100%	246 97%	249 98%	253 100%

Some assets are vulnerable across all flooding scenarios (excluding High Tide Flooding), including 1 warehouse, the Folly Beach Fire Department, Folly Beach Library, and the National Exchange Club (identified as a cultural property).

FEMA NFHL 1% AND .2% ANNUAL CHANCE FLOODING SCENARIO

- All 6 lodging facilities (hotels, motels, etc.) are vulnerable.
- 1 of the 2 communications properties and 1 of the 2 utility property are vulnerable.
- All vacant residential properties in Folly Beach are exposed, as well as all parcels identified as protected land.

USGS COSMOS CURRENT 1% ANNUAL CHANCE FLOODING SCENARIO

- 3 of the 6 lodging properties identified in Folly Beach are vulnerable to this threat.
- 1 communication property (owned by AT&T) and 1 utility property are vulnerable.
- 160 vacant residential properties (94%) and all but 4 (93%) of protected land is exposed.

WOODWELL CURRENT 1% ANNUAL CHANCE FLOODING SCENARIO

- All but 1 lodging facility are vulnerable.
- 1 communication facility and 1 utility parcel are vulnerable.
- All but 2 vacant residential properties (170 total) are exposed and all but 1 parcel is identified as protected land.

ADDITIONAL FINDINGS

- About 6-10% of residential homes vulnerable to current high tide flooding are located in Folly Beach and the southern sea islands, as well as areas further inland such as around Long Branch Creek in St. Andrews and in John's Island along Stono River, Penny's Creek and Capri Isles Channel.
- Commercial properties near Fort Johnson and those located north of Folly Beach along Folly Road face significant vulnerability to High Tide Flooding.
- During more extreme large-scale flooding events that include coastal and inland flooding (as indicated by Woodwell 1% annual chance condition), commercial vulnerability is most concentrated in census block groups within North Charleston, Charleston's peninsula, Folly Beach, West Ashley, and north Mount Pleasant.
- Awendaw-McClennanville and the Long Island area (just north of Folly Beach) have the highest percentages of properties with high vulnerability and risk to wildfire in the County, both of which have 83% to 98% of homes highly vulnerable and at risk.

Isle of Palms Planning Area



Figure A-11. Island of Palms Planning Area

Table A-10. Vulnerability Assessment Summary Table for Isle of Palms Planning Area

Asset Category	Total Assets	Current					Future		
		NOAA OCM High Tide Flooding	USGS CoSMos 5% annual chance	USGS CoSMos 1% annual chance	Woodwell 1% annual chance	FEMA NFHL 1% and 0.2% annual chance	USGS CoSMos 5% annual chance +1.6ft SLR	USGS CoSMos 1% annual chance with 1.6ft SLR	Woodwell 1% annual chance +2.5 ft SLR
Residential	3,500	39 1%	805 23%	2,015 58%	2,596 74%	3,465 99%	2,156 62%	2,921 83%	3,242 93%
Critical and Government Owned	13	0 0%	2 15%	6 46%	6 46%	12 92%	6 46%	6 46%	7 54%
Cultural and Community	3	0 0%	2 67%	3 100%	3 100%	3 100%	3 100%	3 100%	3 100%
Commercial	61	1 2%	10 16%	21 34%	27 44%	59 97%	22 36%	31 51%	37 61%
Industrial	7	0 0%	3 43%	5 71%	6 86%	7 100%	5 71%	7 100%	7 100%
Open Space (exposure only)	160	43 27%	83 52%	123 77%	141 88%	160 100%	131 82%	149 93%	154 96%

FEMA NFHL 1% AND .2% ANNUAL CHANCE FLOODING SCENARIO

- Both of the identified lodging facilities (hotels, motels, etc.) are vulnerable.
- 1 supermarket (the Harris Teeter on Palm Boulevard) is highly vulnerable.
- 2 utility properties are vulnerable, however the 1 identified communications facility is not vulnerable.
- 2 fires stations were identified in this area, 1 is vulnerable (Isle of Palms Fire Station #2).
- All 7 warehouses identified in Isle of Palms are vulnerable.
- All vacant residential properties are exposed (139 total), as well as all protected lands parcels (6 total).

USGS COSMOS CURRENT 1% ANNUAL CHANCE FLOODING SCENARIO

- Both of the identified lodging facilities (hotels, motels, etc.) are vulnerable.
- 1 supermarket (the Harris Teeter on Palm Boulevard) is highly vulnerable.
- 5 of 7 identified warehouses in the area are highly vulnerable.
- 112 vacant residential properties are exposed (81%), as well as 5 of 6 identified protected lands parcels.

WOODWELL CURRENT 1% ANNUAL CHANCE FLOODING SCENARIO

- Both of the identified lodging facilities (hotels, motels, etc.) are vulnerable.
- 1 supermarket (the Harris Teeter on Palm Boulevard) is highly vulnerable.
- All but one identified warehouses are vulnerable.
- 126 of 139 vacant residential properties (91%), as well as all identified protected land is exposed.

James Island Planning Area



Figure A-12. James Island Planning Area

Table A-11. Vulnerability Assessment Summary Table for James Island Planning Area

Asset Category	Total Assets	Current					Future		
		NOAA OCM High Tide Flooding	USGS CoSMos 5% annual chance	USGS CoSMos 1% annual chance	Woodwell 1% annual chance	FEMA NFHL 1% and 0.2% annual chance	USGS CoSMos 5% annual chance +1.6ft SLR	USGS CoSMos 1% annual chance with 1.6ft SLR	Woodwell 1% annual chance +2.5 ft SLR
Residential	14,068	71 1%	1,739 12%	4,107 29%	6,232 44%	12,146 86%	3,931 28%	7,217 51%	10,050 71%
Critical and Government Owned	90	2 2%	12 13%	26 29%	40 44%	79 88%	27 30%	40 44%	51 57%
Cultural and Community	42	1 2%	8 19%	11 26%	19 45%	36 86%	12 29%	18 43%	21 50%
Commercial	309	8 3%	32 10%	66 21%	129 42%	251 81%	58 19%	121 39%	199 64%
Industrial	38	1 3%	1 3%	4 11%	25 66%	32 84%	3 8%	22 58%	28 74%
Open Space (exposure only)	1,403	490 35%	694 49%	862 61%	1,190 85%	1,337 95%	841 60%	1,106 79%	1,303 94%

FEMA NFHL 1% AND .2% ANNUAL CHANCE FLOODING SCENARIO

- 89% of manufactured housing in the area is vulnerable, as well as 1 mobile home park.
- All but 1 of the 14 multifamily housing parcels are vulnerable, and 82% of assisted housing is vulnerable (34 properties total).
- All 4 daycares in the area as well as 5 of the 7 identified supermarkets are vulnerable.
- 1 manufacturing site and 32 warehouses are high vulnerability.
- All 3 evacuation pickup points and all 6 fire stations are vulnerable.
- Community services also face moderate vulnerability, with the 1 library (Baxter-Patrick James Island Library), 4 of 6 utility properties, and 9 schools all identified as highly vulnerable.
- All 5 identified cultural properties are vulnerable.
- 94% of vacant residential properties and 93% of protected land are exposed.

USGS COSMOS CURRENT 1% ANNUAL CHANCE FLOODING SCENARIO

- There are 13 vulnerable manufactured homes, as well as 8 vulnerable multifamily homes and 13 vulnerable assisted housing properties.
- All 4 daycares and 2 major supermarkets are vulnerable.
- 4 of 38 warehouses are vulnerable.
- The County of Charleston EMS Station #4 is not vulnerable in the current CoSMoS 100-yr flooding scenario, however it does become vulnerable in the future scenario.
- 4 schools are considered vulnerable to this threat (~36).
- 4 utility properties as well as James Island Fire Station #3 are vulnerable in this area, contributing to an interrupted emergency response in a disaster scenario.
- 62% of vacant residential land and 70% of protected land is exposed to this threat.

WOODWELL CURRENT 1% ANNUAL CHANCE FLOODING SCENARIO

- Nearly 50% of manufactured homes in the area are vulnerable.
- All multifamily properties are vulnerable, and 58% of assisted housing is vulnerable.
- All 4 daycares and 5 of 7 major supermarkets are vulnerable.
- One manufacturing site and 25 warehouses have high vulnerability.
- Critical and government owned assets are most impacted by this flood threat in the area. This includes the County of Charleston EMS Station #4, 1 evacuation pickup point, 9 schools, 2 fire stations (James Island Fire Station #1 and #3), and Baxter-Patrick James Island Library.
- 2 parcels cultural assets are vulnerable.
- 85% of vacant residential land and 93% of protected land is exposed to Woodwell flooding.

ADDITIONAL FINDINGS

- There are 41 highly vulnerable Points of Distribution sites in the County, many of which are located in socially vulnerable areas. For example, one highly vulnerable POD in the heart of James Island at the intersection of Folly Road and Fort Johnson Road is in a block group with low median income (\$45,000) and high percentage of older individuals. (Woodwell 1%).
- Of the 136 school properties in the County, about 30% are (n=40) are highly vulnerable to the regulatory floodplain (FEMA). Almost all the highly vulnerable school properties are located in the central part of the county, between North Charleston/St. Andrews and James Island/Sullivan's Island.
- One highly vulnerable POD in the heart of James Island at the intersection of Folly Road and Fort Johnson Road is in a block group with low median income (\$45,000) and high percentage of older individuals.

Johns Island Planning Area



Figure A-13. Johns Island Planning Area

Table A-12. Vulnerability Assessment Summary Table for Johns Island Planning Area

Asset Category	Total Assets	Current					Future		
		NOAA OCM High Tide Flooding	USGS CoSMos 5% annual chance	USGS CoSMos 1% annual chance	Woodwell 1% annual chance	FEMA NFHL 1% and 0.2% annual chance	USGS CoSMos 5% annual chance +1.6ft SLR	USGS CoSMos 1% annual chance with 1.6ft SLR	Woodwell 1% annual chance +2.5 ft SLR
Residential	9,959	73 1%	884 9%	1,443 14%	3,567 36%	4,009 40%	1,632 16%	2,390 24%	4,905 49%
Critical and Government Owned	106	1 1%	7 7%	9 8%	29 27%	52 49%	8 8%	12 11%	37 35%
Cultural and Community	46	0 0%	3 7%	4 9%	13 28%	13 28%	4 9%	5 11%	16 35%
Commercial	216	1 0%	5 2%	14 6%	57 26%	63 29%	18 8%	26 12%	77 36%
Industrial	55	0 0%	2 4%	5 9%	26 47%	23 42%	7 13%	8 15%	34 62%
Open Space (exposure only)	3,620	946 26%	1,595 44%	1,862 51%	3,088 85%	2,503 69%	1,860 51%	2,152 59%	3,178 88%

FEMA NFHL 1% AND .2% ANNUAL CHANCE FLOODING SCENARIO

- John's Island is home to a relatively high number of manufactured housing units. Of the 269 manufactured homes in the area, 109 of them (about 41%) are vulnerable.
- 24 warehouses and 1 manufacturing site are vulnerable.
- 1 communication facility (which is owned by Charleston County) is vulnerable, as well as 11 utility parcels.
- Many emergency response facilities are impacted by this threat, including Charleston County EMS Station #10, 2 evacuation pickup points, and 1 fire station.
- Of the 7 school properties in the area, 3 are vulnerable.
- 1 cemetery is vulnerable.
- 2 vacant county owned properties and 68% of vacant residential properties are exposed.
- 85% of protected land is exposed.

USGS COSMOS CURRENT 1% ANNUAL CHANCE FLOODING SCENARIO

- 15% of manufactured homes are vulnerable.
- 7 industrial properties (all warehouses) are vulnerable.
- Critical and government owned property is moderately affected by this flood hazard. 1 evacuation pick up point, 1 utility parcel, and 2 schools are potentially inundated.
- 1 cemetery is vulnerable.
- 2 vacant county owned properties, 50% of vacant residential property, and 79% of protected land is exposed.

WOODWELL CURRENT 1% ANNUAL CHANCE FLOODING SCENARIO

- 36% of residential property is vulnerable, including 91 manufactured homes, 2 mobile home parks (Willow Wood and Readan Mobile Home Park), all identified multi family homes (6 in total), and 43% of assisted housing properties.
- Many commercial and industrial properties are highly vulnerable including 1 daycare and 1 supermarket (the Food Lion on Maybank Highway), as well as 27 warehouses and 1 manufacturing site.
- Charleston County EMS Station #10, 1 evacuation pickup point, 3 utility parcels, and 3 fire stations are vulnerable.
- 5 of the 7 identified schools are vulnerable.

ADDITIONAL FINDINGS

- Commercial properties in the county vulnerable to large-scale flooding events, including coastal and inland flooding (as indicated by Woodwell 1% annual chance condition), are found along North Highway 17 as well as Pinckney St in McClellanville, along Savannah Highway in Johns Island, and along Highway 78 and Benchmark Drive in Ladson.

Kiawah Island Planning Area



Figure A-14. Kiawah Island Planning Area

Table A-13. Vulnerability Assessment Summary Table for Kiawah Island Planning Area

Asset Category	Total Assets	Current					Future		
		NOAA OCM High Tide Flooding	USGS CoSMos 5% annual chance	USGS CoSMos 1% annual chance	Woodwell 1% annual chance	FEMA NFHL 1% and 0.2% annual chance	USGS CoSMos 5% annual chance +1.6ft SLR	USGS CoSMos 1% annual chance with 1.6ft SLR	Woodwell 1% annual chance +2.5 ft SLR
Residential	2,802	64 2%	1,456 52%	2,165 77%	2,384 85%	2,802 100%	2,433 86%	2,627 94%	2,711 97%
Critical and Government Owned	13	0 0%	6 46%	6 46%	6 46%	13 100%	6 46%	6 46%	6 46%
Cultural and Community	1	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
Commercial	34	2 6%	14 41%	18 53%	21 62%	34 100%	20 59%	21 62%	23 68%
Industrial	7	0 0%	5 71%	6 86%	6 86%	7 100%	6 86%	6 86%	6 86%
Open Space (exposure only)	647	409 63%	638 99%	645 100%	647 100%	647 100%	647 100%	647 100%	647 100%

FEMA NFHL 1% AND .2% ANNUAL CHANCE FLOODING SCENARIO

- All 7 of the identified warehouses are vulnerable.
- Every utility parcel found in this assessment is vulnerable (9 in total).
- St. John's Fire District Station #4 and Station #6 are both vulnerable.
- All vacant residential land and all protected land are exposed.

USGS COSMOS CURRENT 1% ANNUAL CHANCE FLOODING SCENARIO

- There are 6 vulnerable warehouses in the area, as well as 3 vulnerable utility properties.
- St. John's Fire District Station #4 and Station #6 are both vulnerable.
- All but 2 vacant residential properties are exposed in this flood scenario, and all protected land parcels are exposed.

WOODWELL CURRENT 1% ANNUAL CHANCE FLOODING SCENARIO

- Similar to the USGS flood scenario above, 6 warehouses and 3 utility properties are vulnerable.
- St. John's Fire District Station #4 and Station #6 are both vulnerable.
- All vacant residential property and all protected land is exposed.

Mt. Pleasant Planning Area

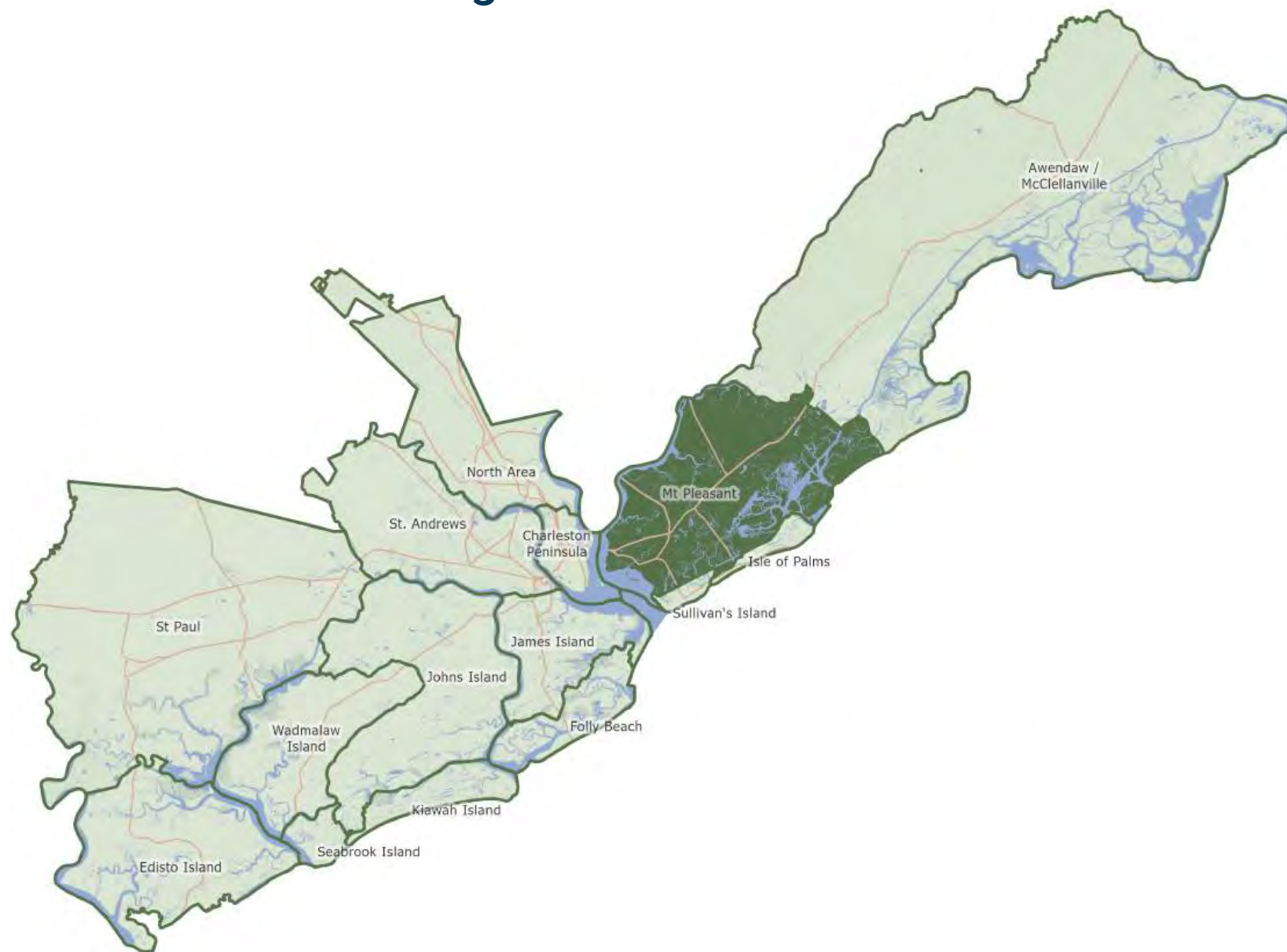


Figure A-15. Mt. Pleasant Planning Area

Table A-14. Vulnerability Assessment Summary Table for Mount Pleasant Planning Area

Asset Category	Total Assets	Current					Future		
		NOAA OCM High Tide Flooding	USGS CoSMos 5% annual chance	USGS CoSMos 1% annual chance	Woodwell 1% annual chance	FEMA NFHL 1% and 0.2% annual chance	USGS CoSMos 5% annual chance +1.6ft SLR	USGS CoSMos 1% annual chance with 1.6ft SLR	Woodwell 1% annual chance +2.5 ft SLR
Residential	32,028	70 0%	1,416 4%	5,139 16%	10,635 33%	19,667 61%	4,693 15%	11,299 35%	19,805 62%
Critical and Government Owned	119	3 3%	11 9%	17 14%	47 39%	63 53%	15 13%	24 20%	50 42%
Cultural and Community	63	1 2%	7 11%	9 14%	22 35%	21 33%	9 14%	13 21%	23 37%
Commercial	928	10 1%	46 5%	94 10%	412 44%	383 41%	87 9%	125 13%	475 51%
Industrial	84	0 0%	9 11%	16 19%	58 69%	36 43%	14 17%	19 23%	62 74%
Open Space (exposure only)	2,874	805 28%	1,300 45%	1,712 60%	2,493 87%	2,171 76%	1,553 54%	1,874 65%	2,576 90%

FEMA NFHL 1% AND .2% ANNUAL CHANCE FLOODING SCENARIO

- Residential property is heavily impacted by FEMA flooding. About 67% of manufactured homes, 2 mobile home parks, 28 multifamily homes, and 2 assisted housing properties are vulnerable.
- 7 daycares, 5 supermarkets, and 28 lodging facilities (hotels, motels, etc.) are vulnerable.
- The Port of Charleston, as well as other industrial properties (including 35 warehouses), are highly vulnerable.
- Emergency response assets are also heavily impacted 2 communication facilities, 1 evacuation pickup point (located at Wando High School), Vibra Hospital of Charleston, 12 utility parcels, and 3 fire stations (Dewees Island Fire Station, County of Charleston Service Center - East's Cooper Branch, and Mount Pleasant Fire Dept. Station #4) are vulnerable.
- 5 schools in Mt. Pleasant are highly vulnerable.
- 2 cemeteries and all three cultural properties identified in the area are vulnerable.
- 76% of vacant residential property 97% of protected land is exposed.

USGS COSMOS CURRENT 1% ANNUAL CHANCE FLOODING SCENARIO

- 40% of manufactured homes and 16 multifamily properties in Mt. Pleasant are vulnerable.
- Commercial and industrial property (including 2 daycares, 2 supermarkets, 16 warehouses, and 5 lodging facilities) has moderate vulnerability in the area.
- 2 schools, 1 utility property, and Dewee's Island Fire Station are vulnerable, potentially impacting emergency response processes.
- Vulnerability for cultural and community resources is moderate in the area, and includes 1 cemetery and 2 cultural sites.
- 59% of residential land and 97% of protected land is exposed.

WOODWELL CURRENT 1% ANNUAL CHANCE FLOODING SCENARIO

- 58% of manufactured homes, as well as 4 of 7 mobile home parks and 90% of multifamily properties are vulnerable to Woodwell flooding.
- The Port of Charleston is highly vulnerable.
- Emergency response in the area is potentially heavily interrupted by this threat, as evidenced by high vulnerability for 2 communication facilities, 1 EMS facility, 1 evacuation pickup point, both hospitals (Vibra Hospital of Charleston and East Cooper Medical Center), and 4 fire stations.
- Both libraries (Mt. Pleasant Library and Wando Library) are highly vulnerable to this hazard, as well as 10 of 16 identified school properties in the area.
- 85% of vacant residential land and 96% of protected land is exposed.

ADDITIONAL FINDINGS

- About half of all 67 residential care facilities in the County are highly vulnerable to flooding with 1% annual chance of occurring (Woodwell). Most of these are located in the Central region of the County, southern Mount Pleasant and St. Andrews.
- 14% of critical infrastructure and government-owned properties are vulnerable to 5% annual chance flood (USGS CoSMoS). Among these, 44 properties could experience flooding depths exceeding 3 feet, leading to notable impacts even during relatively moderate flooding events. Most of these properties are located in North Charleston, Charleston's peninsula, and Mount Pleasant.
- During more extreme large-scale flooding events that include coastal and inland flooding (as indicated by Woodwell 1% annual chance condition), commercial vulnerability is most concentrated in census block groups within North Charleston, Charleston's peninsula, Folly Beach, West Ashley, and north Mount Pleasant.
- 2 block groups in Mount Pleasant are relatively highly vulnerable to the urban heat effect.

North Planning Area

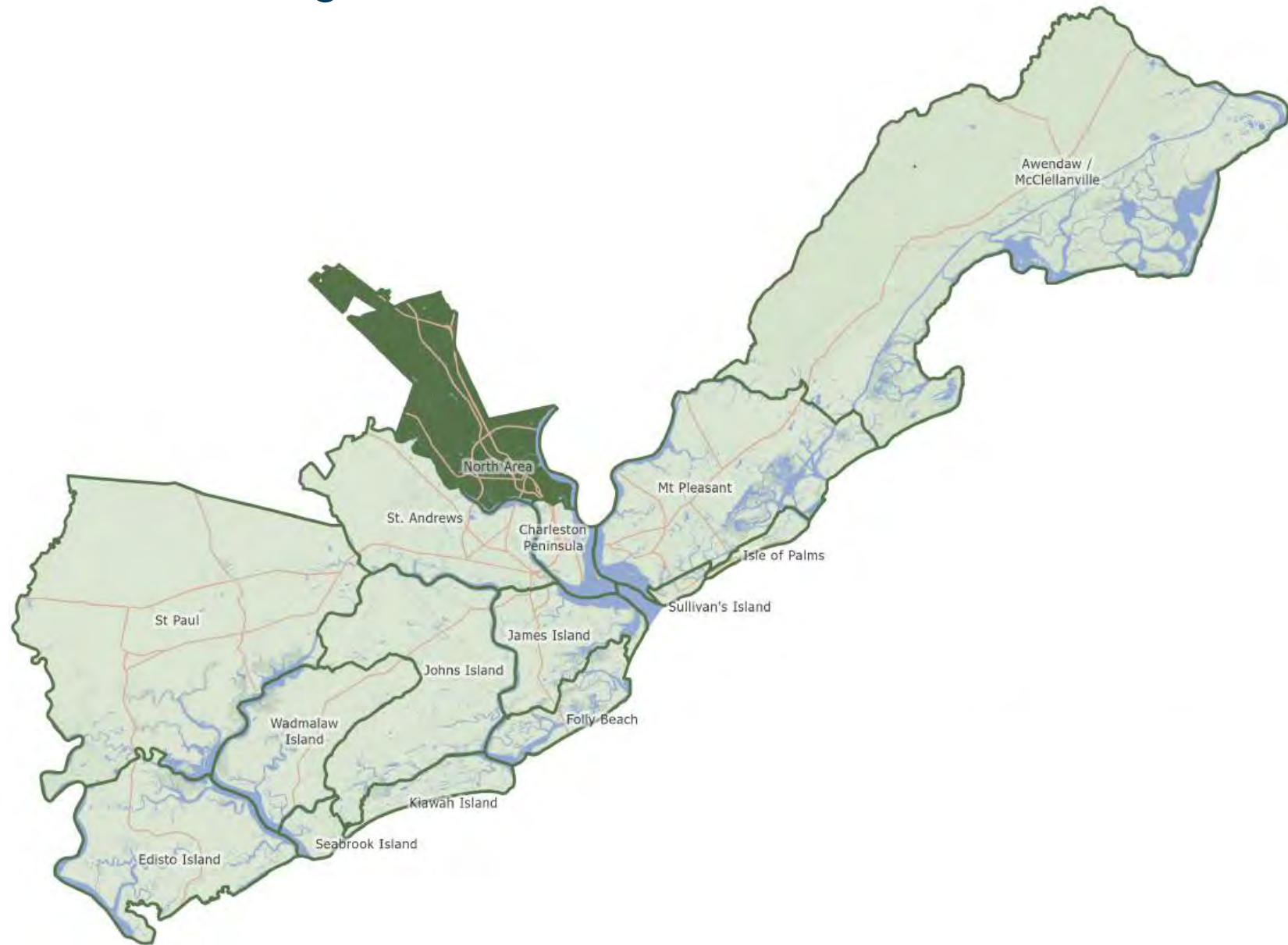


Figure A-16. North Planning Area

Table A-15. Vulnerability Assessment Summary Table for the North Planning Area

Asset Category	Total Assets	Current					Future		
		NOAA OCM High Tide Flooding	USGS CoSMos 5% annual chance	USGS CoSMos 1% annual chance	Woodwell 1% annual chance	FEMA NFHL 1% and 0.2% annual chance	USGS CoSMos 5% annual chance +1.6ft SLR	USGS CoSMos 1% annual chance with 1.6ft SLR	Woodwell 1% annual chance +2.5 ft SLR
Residential	24,336	50 0%	632 3%	1,553 6%	7,849 32%	4,190 17%	1,208 5%	2,402 10%	8,720 36%
Critical and Government Owned	398	3 1%	17 4%	28 7%	131 33%	147 37%	27 7%	37 9%	140 35%
Cultural and Community	212	0 0%	5 2%	8 4%	65 31%	33 16%	7 3%	13 6%	66 31%
Commercial	2,244	10 0%	51 2%	131 6%	1068 48%	432 19%	110 5%	253 11%	1145 51%
Industrial	848	12 1%	34 4%	61 7%	555 65%	216 25%	58 7%	127 15%	571 67%
Open Space (exposure only)	4,516	288 6%	390 9%	564 12%	2,771 61%	1,303 29%	523 12%	813 18%	2,900 64%

FEMA NFHL 1% AND .2% ANNUAL CHANCE FLOODING SCENARIO

- 16 of the 250 manufactured homes in the area are vulnerable, as well as 22 mobile home parks.
- 33 multi-family properties are vulnerable (~21%). Additionally 25 assisted housing properties are vulnerable (~21%).
- Commercial properties are moderately impacted by this threat. 4 daycares, 6 lodging properties (hotels, motels, etc.), and 2 supermarkets are vulnerable.
- Industrial activity is highest in this area compared to the rest of the county. 22 manufacturing sites, 3 ports (which is all in the area), and 197 warehouses are highly vulnerable.
- 2 communication properties, 19 utility parcels, and 1 library (Charleston County Public Library - Support Services) are all vulnerable.
- Emergency response facilities face high vulnerability in the area as well. 1 EMS facility, 1 evacuation pickup point (located at the Dorchester Square Business Center), Trident Medical Center and Shoultz Conny Hospital, 2 of the 5 emergency shelters, and 1 fire station are vulnerable.
- 2 cemeteries are vulnerable.
- Open Space properties face moderate exposure in the North Area, with 6 vacant county owned properties, 30% of vacant residential land, and 63% of protected land being exposed.

USGS COSMOS CURRENT 1% ANNUAL CHANCE FLOODING SCENARIO

- Residential vulnerability is slightly lower in this scenario compared to the FEMA floodplain. Still, 4 manufactured housing properties, 9 multifamily homes, 9 mobile home parks, and 9 assisted housing properties are vulnerable to this threat.
- Commercial vulnerability in the area is moderate in this flood scenario, and includes 2 daycares, 2 lodging facilities, and 1 supermarket.
- Of the critical and government owned properties, 7% are vulnerable in this scenario. This includes a communication facility, 3 schools, 4 utility parcels, and 1 library (Charleston County Public Library - Support Services).
- Emergency response services face moderate vulnerability to CoSMoS Current 100-yr flooding. The County of Charleston EMS Station #2, the Dorchester Square Business Center evacuation pickup point, and 1 emergency shelter are vulnerable.
- 5 vacant county owned parcels are exposed to this threat, as well as 382 vacant residential properties (12%) and 61 protected lands parcels (49%).

WOODWELL CURRENT 1% ANNUAL CHANCE FLOODING SCENARIO

- This flood scenario impacts significantly more properties than either of the 2 previously listed threats.
- In the residential category, 74 manufactured homes (30%), 86 multifamily properties (55%), 60 mobile home parks (41%), and 36 assisted housing properties (30%) are highly vulnerable.
- 7 daycares are vulnerable, as well as 51 lodging properties (hotels, motels, etc.), and all 7 identified supermarkets.
- 26 manufacturing facilities (more than half in the area), all 3 ports, and 537 warehouses (about 66%) are vulnerable.
- 1 communication facility, 25 school properties, 14 utility parcels, and all 4 identified libraries in the area are vulnerable.
- Emergency services have a high potential of being disrupted in this scenario. 2 EMS Stations (County of Charleston EMS Station #2 and Charleston County Medic Station #9), 7 of the 13 evacuation pickup points in the area, Trident Medical Center & Shoults Conny Hospital, 4 of the 5 emergency shelters, and 6 fire stations are all vulnerable.
- 1 cemetery and Exchange Park (identified as a cultural asset) are vulnerable.
- 8 vacant county owned properties, 62% of vacant residential land, and 84% of protected land are exposed.

ADDITIONAL FINDINGS

- 30% of school properties are highly vulnerable to the regulatory floodplain (FEMA). The majority of them are located in the central part of the county, between North Charleston/St. Andrews and James Island/Sullivan's Island.
- During more extreme large-scale flooding events that include coastal and inland flooding (as indicated by Woodwell 1% annual chance condition), commercial vulnerability is most concentrated in census block groups within North Charleston, Charleston's peninsula, Folly Beach, West Ashley, and north Mount Pleasant.
- The small number of industrial properties with high vulnerability to high tide flooding are concentrated along the Cooper River in North Charleston and along both Cooper and Ashley River in Charleston.
- In Charleston County, the CEJST reveals 22 disadvantaged census tracts. The central region, stretching from Lincolnville down to the Peninsula, shows a concentration of disadvantaged communities, with over half of the tracts facing significant burdens in one or more categories.
- 11 census block groups in Charleston County fit the most extreme criteria for all three indicators of heat vulnerability used in the assessment: they have more than 78% developed land cover, less than 10% tree canopy cover, and a median income of less than \$48,668. These block groups are highlighted in the inset map in Figure 24 and are all located east of I-26 in southern North Charleston and on the Peninsula of Charleston.
- Mobile-home related heat vulnerability is most concentrated in east-central North Charleston (cluster of seven block groups) along I-26 and Rivers Avenue and block groups to the west of the Air Force Base.

Charleston Peninsula Planning Area



Figure A-17. Charleston Peninsula Planning Area

Table A-16. Vulnerability Assessment Summary Table for Charleston Peninsula Planning Area

Asset Category	Total Assets	Current					Future		
		NOAA OCM High Tide Flooding	USGS CoSMos 5% annual chance	USGS CoSMos 1% annual chance	Woodwell 1% annual chance	FEMA NFHL 1% and 0.2% annual chance	USGS CoSMos 5% annual chance +1.6ft SLR	USGS CoSMos 1% annual chance with 1.6ft SLR	Woodwell 1% annual chance +2.5 ft SLR
Residential	7,931	671 8%	2,400 30%	3,484 44%	4,673 59%	7,817 99%	3,555 45%	5,112 64%	6,780 85%
Critical and Government Owned	148	25 17%	51 34%	78 53%	100 68%	143 97%	76 51%	96 65%	115 78%
Cultural and Community	187	9 5%	37 20%	61 33%	89 48%	169 90%	56 30%	92 49%	129 69%
Commercial	1,499	89 6%	313 21%	475 32%	759 51%	1,343 90%	465 31%	668 45%	1,049 70%
Industrial	179	14 8%	40 22%	61 34%	117 65%	164 92%	57 32%	74 41%	134 75%
Open Space (exposure only)	972	241 25%	462 48%	579 60%	749 77%	952 98%	577 59%	681 70%	872 90%

FEMA NFHL 1% AND .2% ANNUAL CHANCE FLOODING SCENARIO

- All but one of the multifamily properties in the Peninsula area are vulnerable (67 out of 68 multifamily homes).
- 81 of the 91 assisted housing parcels are vulnerable (89%).
- This area has a relatively high number of commercial properties. Of the 84 lodging facilities (hotels, motels, etc.), about 42% are vulnerable in this flood scenario. Additionally, all 8 major supermarkets identified in the assessment are vulnerable.
- The Peninsula is part of an industrial hotspot that exists throughout central Charleston County. 92% of warehouses are vulnerable, 9 out of 10 manufacturing sites are vulnerable, and all 3 ports are vulnerable in this flood scenario.
- Emergency response facilities and services have the potential to be highly interrupted in this flood scenario. The one EMS facility in the area, 3 out of the 4 evacuation pick up points, and all 5 fire stations are vulnerable.
- There are 20 parcels identified as school properties in the Peninsula, all of which are vulnerable in this flood scenario.
- Charleston County Main Library and the John L. Dart Library are both vulnerable.
- All utility properties identified in the area (8 in total) are vulnerable.
- 6 cemeteries are vulnerable, as well as all 20 of the identified cultural properties in the Peninsula.
- Open Space includes vacant land and natural areas. In the Peninsula, all but one vacant residential property is exposed to the FEMA floodplain (530 in total). Additionally, all 80 parcels identified as protected lands (conservation easements, wildlife reserves, national parks, etc.), are exposed in this flood scenario.

USGS COSMOS CURRENT 1% ANNUAL CHANCE FLOODING SCENARIO

- The majority of multifamily housing is vulnerable in this flood scenario (~80%).
- About half of the assisted housing in the area is vulnerable (44 properties).
- 34 lodging facilities are vulnerable (42%), similar to the FEMA flooding scenario.
- One supermarket is highly vulnerable to this flood threat.
- There are 56 vulnerable warehouses (33%), 4 vulnerable manufacturing sites (40%), and 3 vulnerable ports (all ports in the area) in this flood scenario.
- Emergency response facilities and services have the potential to be highly interrupted in this flood scenario. The one EMS facility in the area, 2 out of the 4 evacuation pick up points, and 2 of the 5 fire stations are vulnerable.
- Critical services in the area are highly impacted by this threat. 12 schools, half of the utility parcels (4 of 8 properties), and Charleston County Main Library are vulnerable.

- 2 cemeteries and 4 cultural properties are highly vulnerable.
- 63% of vacant residential property are exposed, as well as 90% of protected land

WOODWELL CURRENT 1% ANNUAL CHANCE FLOODING SCENARIO

- 52 multifamily properties are vulnerable (about 78%), and 56 assisted housing parcels are vulnerable (about 62%)
- Commercial property in the area is highly impacted by Woodwell flooding. 49 lodging facilities are vulnerable (over half of the lodging properties in the area), as well as 2 of the 8 supermarkets.
- 65% of warehouses and 70% of manufacturing sites are vulnerable to this threat. Additionally, all 3 port facilities are vulnerable.
- Emergency response services are also heavily impacted by Woodwell flooding. The one EMS facility in the area, 2 of the 4 evacuation pickup points, and 3 of the 5 fire stations are vulnerable.
- Critical community services have the potential to be greatly affected by this threat. 16/20 schools, half of utility properties in the Peninsula, and the Charleston County Main Library are vulnerable.
- 2 cemetery parcels and 12 cultural properties are vulnerable in this flood scenario
- 75% of vacant residential properties are exposed to this threat, as well as 95% of protected land

ADDITIONAL FINDINGS

- Charleston's peninsula has the highest proportion of homes vulnerable to high tide flooding, particularly in several block groups at its southern tip, where more than 50% of residences are currently vulnerable.
- For commercial properties, current high tide flood vulnerability is highest on the west side of the peninsula, between Cannon Street and Calhoun Street, which includes the medical complex.
- According to the 1% annual chance flood extent modeled by Woodwell, 75% of industrial properties on Charleston Peninsula are vulnerable.
- At the census block group scale, nearly the entire Peninsula has high heat vulnerability to the urban heat island effect.
- Eleven census block groups in Charleston County fit the most extreme criteria for all three indicators of heat vulnerability used in the assessment: they have more than 78% developed land cover, less than 10% tree canopy cover, and a median income of less than \$48,668. These block groups are all located east of I-26 in southern North Charleston and on the Peninsula of Charleston.
- Focus group participants expressed concerns that heat is exacerbated by factors such as lack of shade, insufficient AC, poor insulation/weatherization, the urban heat island effect, and the removal of trees for development.

Seabrook Island Planning Area



Figure A-18. Seabrooke Island Planning Area

Table A-17. Vulnerability Assessment Summary Table for Seabrook Island Planning Area

Asset Category	Total Assets	Current					Future		
		NOAA OCM High Tide Flooding	USGS CoSMos 5% annual chance	USGS CoSMos 1% annual chance	Woodwell 1% annual chance	FEMA NFHL 1% and 0.2% annual chance	USGS CoSMos 5% annual chance +1.6ft SLR	USGS CoSMos 1% annual chance with 1.6ft SLR	Woodwell 1% annual chance +2.5 ft SLR
Residential	1,979	99 5%	673 34%	956 48%	1,152 58%	1,977 100%	1,233 62%	1,517 77%	1,806 91%
Critical and Government Owned	7	1 14%	2 29%	3 43%	3 43%	7 100%	3 43%	4 57%	4 57%
Cultural and Community	1	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
Commercial	18	3 17%	9 50%	11 61%	12 67%	18 100%	13 72%	14 78%	16 89%
Industrial	2	0 0%	2 100%	2 100%	2 100%	2 100%	2 100%	2 100%	2 100%
Open Space (exposure only)	342	152 44%	328 96%	342 100%	342 100%	342 100%	342 100%	342 100%	342 100%

GENERAL FINDINGS

- Both warehouses identified in the area are vulnerable across all threat scenarios (excluding High Tide Flooding).
- All 4 utility parcels are vulnerable to the FEMA NFHL 1% and .2% Annual Chance flooding scenario. Only 1 utility property is vulnerable to Woodwell Current 1% Annual Chance flooding and USGS CoSMoS Current 1% Annual Chance flooding.
- St. Johns Fire Department facility (the only fire station identified in the area) is vulnerable across all flooding scenarios.
- All vacant residential property and all parcels identified as protected land are exposed across all flooding scenarios.

St. Andrews Planning Area



Figure A-19. St. Andrews Planning Area

Table A-18. Vulnerability Assessment Summary Table for St. Andrews Planning Area

Asset Category	Total Assets	Current					Future		
		NOAA OCM High Tide Flooding	USGS CoSMos 5% annual chance	USGS CoSMos 1% annual chance	Woodwell 1% annual chance	FEMA NFHL 1% and 0.2% annual chance	USGS CoSMos 5% annual chance +1.6ft SLR	USGS CoSMoS 1% annual chance with 1.6ft SLR	Woodwell 1% annual chance +2.5 ft SLR
Residential	24,674	224 1%	3,019 12%	5,516 22%	10,751 44%	15,487 63%	5,899 24%	9,350 38%	14,797 60%
Critical and Government Owned	145	1 1%	27 19%	36 25%	52 36%	96 66%	38 26%	52 36%	74 51%
Cultural and Community	93	2 2%	13 14%	19 20%	37 40%	54 58%	18 19%	27 29%	49 53%
Commercial	1,063	16 2%	72 7%	207 19%	534 50%	579 54%	197 19%	329 31%	686 65%
Industrial	135	7 5%	19 14%	46 34%	96 71%	70 52%	37 27%	62 46%	107 79%
Open Space (exposure only)	1,697	508 30%	763 45%	902 53%	1,318 78%	1,336 79%	892 53%	1,077 63%	1,435 85%

FEMA NFHL 1% AND .2% ANNUAL CHANCE FLOODING SCENARIO

- Approximately 63% of residential property in the area is vulnerable. This includes 70% of manufactured housing, 7% of multifamily homes, 31 assisted housing properties, and 4 mobile home parks.
- Commercial property is also highly affected by flooding. 10 daycares, 18 lodging facilities (hotels, motels, etc.), and 5 supermarkets are vulnerable.
- FEMA flooding significantly impacts emergency response facilities, including 4 evacuation pickup points, 12 utility properties, 1 EMS station, and half of identified fire stations in the area.
- Of the 30 schools identified in the area, 12 are vulnerable. Additionally, the West Ashley Branch Library is vulnerable.
- 3 cemeteries and 4 cultural properties face high vulnerability to this hazard.
- Overall, 79% of open space is exposed to FEMA flooding, including 78% of vacant residential land, 85% of protected land, and both county owned properties in the area.

USGS COSMOS CURRENT 1% ANNUAL CHANCE FLOODING SCENARIO

- Residential vulnerability is also fairly high in this scenario - 8 manufactured homes, 2 mobile home parks, 55% of multifamily homes, and 33% of assisted housing is vulnerable.
- 4 of the 23 identified daycares are vulnerable, as well as 8 lodging facilities and 2 supermarkets.
- Emergency response assets are impacted, as evidenced by 1 EMS facility, 2 evacuation pickup points, and 4 fire stations all with high vulnerability.
- The West Ashley Branch library along with 10 schools are vulnerable.
- In the open space category, 2 vacant county owned properties, 51% of vacant residential land, and 70% of protected land is exposed.

WOODWELL CURRENT 1% ANNUAL CHANCE FLOODING SCENARIO

- 44% of homes are vulnerable. This includes 16 manufactured homes, 7 mobile home parks, 92% of multifamily properties, and 40% of assisted housing.
- Commercial and industrial vulnerability is also fairly high, with 96 warehouses, 14 daycares, 15 lodging facilities, and 10 of the 11 identified supermarkets all highly vulnerable.
- Critical and government owned assets, including 3 evacuation pickup points, 4 fire stations, 15 school properties, and 2 libraries are highly vulnerable.
- 73% of vacant residential land, 93% of protected land, and both vacant county-owned parcels in the area are exposed.

ADDITIONAL FINDINGS

- In West Ashley, a highly vulnerable POD is located in a block group with very low median income (\$38,906) and high rate of households experiencing poverty (nearly 40%).
- A cluster of 10 block groups in southern West Ashley have a relatively high vulnerability to the urban heat effect.

St. Paul Planning Area



Figure A-20. St. Paul Planning Area

Table A-19. Vulnerability Assessment Summary Table for St. Paul Planning Area

Asset Category	Total Assets	Current					Future		
		NOAA OCM High Tide Flooding	USGS CoSMos 5% annual chance	USGS CoSMos 1% annual chance	Woodwell 1% annual chance	FEMA NFHL 1% and 0.2% annual chance	USGS CoSMos 5% annual chance +1.6ft SLR	USGS CoSMos 1% annual chance with 1.6ft SLR	Woodwell 1% annual chance +2.5 ft SLR
Residential	4,880	53 1%	449 9%	1,326 27%	1,326 27%	1,866 38%	788 16%	1,025 21%	1,912 39%
Critical and Government Owned	102	2 2%	5 5%	17 17%	17 17%	48 46%	8 8%	8 8%	8 8%
Cultural and Community	67	0 0%	4 6%	16 24%	16 24%	18 27%	9 13%	10 15%	18 27%
Commercial	205	2 1%	6 3%	54 26%	54 26%	34 17%	18 9%	20 10%	64 31%
Industrial	62	2 3%	5 8%	21 34%	21 34%	15 24%	9 15%	9 15%	23 37%
Open Space (exposure only)	4,243	821 19%	1317 305	3,666 84%	3,666 84%	1,763 41%	1,459 34%	1,643 38%	2,751 86%

FEMA NFHL 1% AND .2% ANNUAL CHANCE FLOODING SCENARIO

- 21% of manufactured homes are considered vulnerable. 1 manufacturing site and 15 warehouses have been identified as highly vulnerable.
- 2 evacuation pick up points are highly vulnerable.
- Vital community services and facilities, including 1 school property, 1 fire station, and the Wiltown Community Center (which includes a library) face moderate vulnerability in this area.
- Among the 10 utility parcels in the area, 1 is vulnerable to flooding as per FEMA floodplain data.
- 2 cemeteries are vulnerable to this threat.
- A total of 35% of all vacant residential properties and 88% of parcels identified as protected land in the area are exposed.

USGS COSMOS CURRENT 1% ANNUAL CHANCE FLOODING SCENARIO

- 48 manufactured homes are highly vulnerable.
- 1 manufacturing site is vulnerable, as well as 8 warehouse facilities.
- 2 of the 5 evacuation pickup points in the St. Paul's planning area are vulnerable, however all fire stations and EMS facilities are not considered vulnerable.
- Baptist Hill High school is identified as highly vulnerable.
- 29% of vacant residential properties and 82% of protected lands are exposed.

WOODWELL CURRENT 1% ANNUAL CHANCE FLOODING SCENARIO

- This flood scenario shows the highest vulnerability (of the current flood scenarios).
- 156 manufactured homes and 7 mobile home parks are considered to be vulnerable.
- Of the 3 identified supermarkets in the area, 2 are highly vulnerable.
- 2 manufacturing sites and 20 warehouses are vulnerable.
- 1 communication facility and 1 utility parcel are vulnerable.
- Emergency response and community services have moderate vulnerability to this threat, including 2 evacuation pickup points, 1 school (Baptist Hill High School), 2 fire stations, and 1 library (St. Paul's Hollywood Library).
- The Gethsemane Outreach Center, which is identified in the Vulnerability Assessment as a cultural asset, is vulnerable.
- 81% of vacant residential properties and 96% of protected land is exposed.

ADDITIONAL FINDINGS

- There are 2 census tracts located in the St. Paul region that have been identified as disadvantaged by the Climate and Economic Justice Tool due to transportation barriers, based on the relative cost and time spent (94th percentile).

Sullivan's Island Planning Area



Figure A-21. Sullivan's Island Planning Area

Table A-20. Vulnerability Assessment Summary Table for Sullivan's Island Planning Area

Asset Category	Total Assets	Current					Future		
		NOAA OCM High Tide Flooding	USGS CoSMoS 5% annual chance	USGS CoSMoS 1% annual chance	Woodwell 1% annual chance	FEMA NFHL 1% and 0.2% annual chance	USGS CoSMoS 5% annual chance +1.6ft SLR	USGS CoSMoS 1% annual chance with 1.6ft SLR	Woodwell 1% annual chance +2.5 ft SLR
Residential	934	9 1%	113 12%	463 50%	641 69%	934 100%	462 49%	738 79%	924 99%
Critical and Government Owned	11	0 0%	2 18%	6 55%	6 55%	11 100%	6 55%	6 55%	6 55%
Cultural and Community	15	2 13%	8 53%	12 80%	15 100%	12 80%	12 80%	12 80%	12 80%
Commercial	18	0 0%	5 28%	8 44%	10 56%	18 100%	8 44%	10 56%	13 72%
Industrial	3	0 0%	1 33%	3 100%	3 100%	3 100%	3 100%	3 100%	3 100%
Open Space (exposure only)	108	38 35%	76 70%	107 99%	108 100%	108 100%	107 99%	108 100%	108 100%

Many assets are vulnerable across all flooding scenarios (excluding High Tide Flooding), such as one daycare, Sullivan's Island Elementary School, Sullivan's Island Fire Department, all 3 identified cultural properties, and the Edgar Allen Poe Library. Additionally, all vacant residential property (85 parcels) and all protected land (21 parcels) is exposed across threats (excluding one vacant residential property that is not exposed to USGS CoSMoS 1% Annual Chance flooding).

FEMA NFHL 1% AND .2% ANNUAL CHANCE FLOODING SCENARIO

- FEMA NFHL 1% and .2% Annual Chance Flooding Scenario.
- One utility property owned by Dominion Energy is vulnerable to FEMA flooding.
- The African American Cemetery and historical landmark located off Ben Sawyer Boulevard is highly vulnerable.

Wadmalaw Island Planning Area

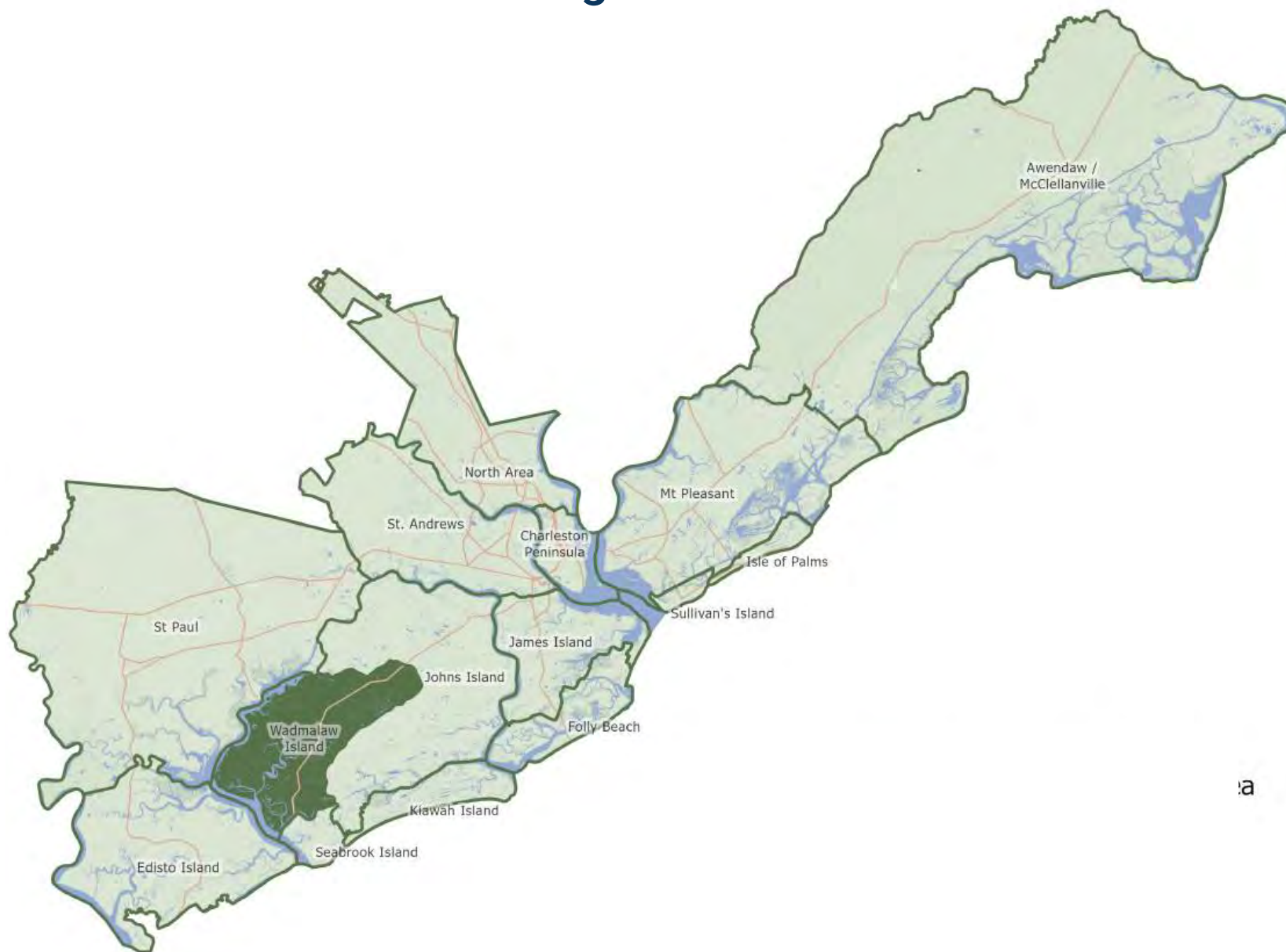


Figure A-22. Wadmalaw Planning Area

Table A-21. Vulnerability Assessment Summary Table for Wadmalaw Island Planning Area

Asset Category	Total Assets	Current					Future		
		NOAA OCM High Tide Flooding	USGS CoSMos 5% annual chance	USGS CoSMos 1% annual chance	Woodwell 1% annual chance	FEMA NFHL 1% and 0.2% annual chance	USGS CoSMos 5% annual chance +1.6ft SLR	USGS CoSMos 1% annual chance with 1.6ft SLR	Woodwell 1% annual chance +2.5 ft SLR
Residential	1,197	7 1%	119 10%	169 14%	231 19%	746 62%	234 20%	335 28%	527 44%
Critical and Government Owned	28	0 0%	3 11%	5 18%	5 18%	23 82%	8 29%	12 43%	14 46%
Cultural and Community	14	0 0%	1 7%	2 14%	2 14%	8 57%	3 21%	3 21%	6 43%
Commercial	17	1 6%	3 18%	3 18%	5 29%	9 53%	3 18%	3 18%	5 29%
Industrial	3	0 0%	0 0%	0 0%	1 33%	1 33%	0 0%	0 0%	1 33%
Open Space (exposure only)	1,067	418 39%	562 53%	605 57%	927 87%	808 76%	613 57%	672 63%	964 90%

FEMA NFHL 1% AND .2% ANNUAL CHANCE FLOODING SCENARIO

- 41% of manufactured homes in the area are highly vulnerable.
- 1 of 3 identified warehouses is highly vulnerable.
- 1 school (Edith L Frierson Elementary School) is vulnerable.
- 2 of 3 identified cemeteries have high vulnerability.
- 69% of vacant residential property and 93% of protected land is exposed.

USGS COSMOS CURRENT 1% ANNUAL CHANCE FLOODING SCENARIO

- 8 manufactured homes are vulnerable.
- 46% of vacant residential property and 86% of protected land is exposed.

WOODWELL CURRENT 1% ANNUAL CHANCE FLOODING SCENARIO

- 20 of the 114 identified manufactured homes are vulnerable.
- 1 school (Edith L Frierson Elementary School) is vulnerable.
- 82% of vacant residential property and 92% (all but one property) of protected land is exposed.