STATE OF SOUTH CAROLINA

State Hazard Mitigation Plan

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MEMORANDUM

TO: Members of the Interagency Coordinating Committee

FROM: Kim Stenson, Director

DATE: January 26, 2023

SUBJECT: Adoption of the 2023 South Carolina Standard State Hazard Mitigation Plan Update

1. Based on its vote Thursday, January 26, 2023, the Hazard Mitigation Interagency Coordinating Committee (ICC) has adopted the South Carolina Hazard Mitigation Plan 2023 for the State of South Carolina under the requirements in 44 CFR §201 and in accordance with state Executive Order 99-60.

2. The plan update was developed through a partnership with numerous state agencies and other organizations to identify ways to reduce loss of life and property damage due to natural disasters.

3. As required by 44 CFR §13.11(d), the ICC will amend the plan to reflect new or revised federal regulations or statutes, or changes in state law, organization, policy, or state agency operation. The amendment can be added as an annex to the plan and later incorporated into the appropriate section(s) when the plan is formally updated as required by 44 CFR §201.

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Executive Summary

The State of South Carolina is vulnerable to the full range of natural and human-caused hazards. With this State Hazard Mitigation Plan (SHMP) update, the state seeks to better understand potential hazards and their impacts and identify cost-effective means to reduce future risk and harm.

Given the increasing frequency and in some cases increasing intensity of significant hazard events, South Carolina has made it a priority to develop, establish, and implement a SHMP that assesses risk and identifies mitigation priorities and actions that will aid in reducing destruction from hazard occurrences. This 2023 SHMP update includes consideration of social vulnerability factors and climate changes projections to support development of mitigation strategies that benefit the whole community and incorporate the realities of changing climate patterns.

This plan outlines the state's strategy for all natural hazard mitigation goals, actions, and initiatives. The South Carolina SHMP is the result of a systematic evaluation of the nature and extent of vulnerability to the impacts of hazards and includes actions needed to minimize future vulnerability to those hazards. It sets forth policies, procedures, and coordination approaches used to establish and implement hazard mitigation activities within the state. Effective use and implementation of this plan is crucial to the hazard mitigation program and the state's efforts to reduce or eliminate risk from future hazard occurrences. This SHMP, adopted in January 2023, incorporates updates associated with implementation of hazard mitigation programs, including the applicable sections of the Disaster Mitigation Act of 2000 (DMA2K) and FEMA hazard mitigation planning guidance. The state's hazard mitigation program includes more than 20 state agencies, each of which contributes capabilities and expertise from its areas of responsibility. Overall administration of the hazard mitigation planning program is the responsibility of the South Carolina State Emergency Management Division (SCEMD).

State Risk Assessment Findings

The State of South Carolina is vulnerable to a full range of natural and human-caused hazards. The state has at least some level of risk to all hazards other than direct effects of volcanic eruption. The following hazards with potential to impact people and property in South Carolina are addressed in this document:

- Extreme Temperatures
- Hail
- Lightning
- Severe Thunderstorms
- Tornado
- Tropical Cyclones
- Wind
- Winter Weather
- Coastal Hazard
- Drought
- Flood

- Landslide and Mass Wasting
- Wildfire
- Earthquake
- Infectious Disease
- Hazardous Materials
- Nuclear Release
- Terrorism and Mass Violence

Other state-level plans and procedures address these and possibly subsets of these hazard types. As described in detail in Section IV, Hazard Risk Analysis, hazards vary in probability or likelihood of occurrence as well as in the impacts and consequences they cause. Hazards are addressed thematically and then alphabetically within each category:

- Meteorological
- Hydrological
- Seismic/geological
- Wildfire
- Infectious disease
- Hazardous material
- Radiological
- Mass violence

Hazards can impact different regions of the state, vary in severity and scope, and cause different types of social, economic, and infrastructure damage. Wildfire is the most frequently occurring hazard in the state, with 65,787 total events from 1997 to 2022 and an average of 2,631.5 events annually. Tsunami events are considered the least likely hazard based on historical occurrences. Annually, the state experiences the greatest losses from winter weather, flooding, drought, tornado, and severe storms. Although they occur infrequently, hurricanes/tropical storms and earthquakes have the greatest potential for disaster damage in South Carolina. A significant earthquake or major hurricane could cost more than $20 billion in losses, take countless lives, and require years of recovery.

Notable additions in the hazard analysis for this SHMP include a swarm of earthquakes in Kershaw County during 2021-2022 and recent declared disasters (Hurricane Dorian, early February 2020 severe storms; COVID-19 pandemic; April 2020 tornado outbreak; Hurricane Ian). Climate change-related issues, including challenges in estimating future hazard occurrences based on climate change projections, are noted in applicable hazard narratives.

Figure 1 below, as compiled for the South Carolina Emergency Operations Plan (SCEOP), compares hazard probability (likelihood) and consequence (potential losses). Hazard events such as hurricanes and earthquakes can have extreme consequences, but they do not happen as frequently as extreme heat, severe storms, wildfires, lightning, and hail. Hazards that occur regularly and have the potential to cause a great amount of damage are the hazards for which the State spends the most time planning and preparing. The top right quadrant of the figure depicts those high-probability and high-consequence hazards. The hazards in the top left quadrant are also of great importance. These hazards have a high consequence but low probability of occurrence. The bottom two quadrants depict hazards that have a low consequence but range in likelihood of occurrence. Therefore, these hazards are not considered as a high in risk.

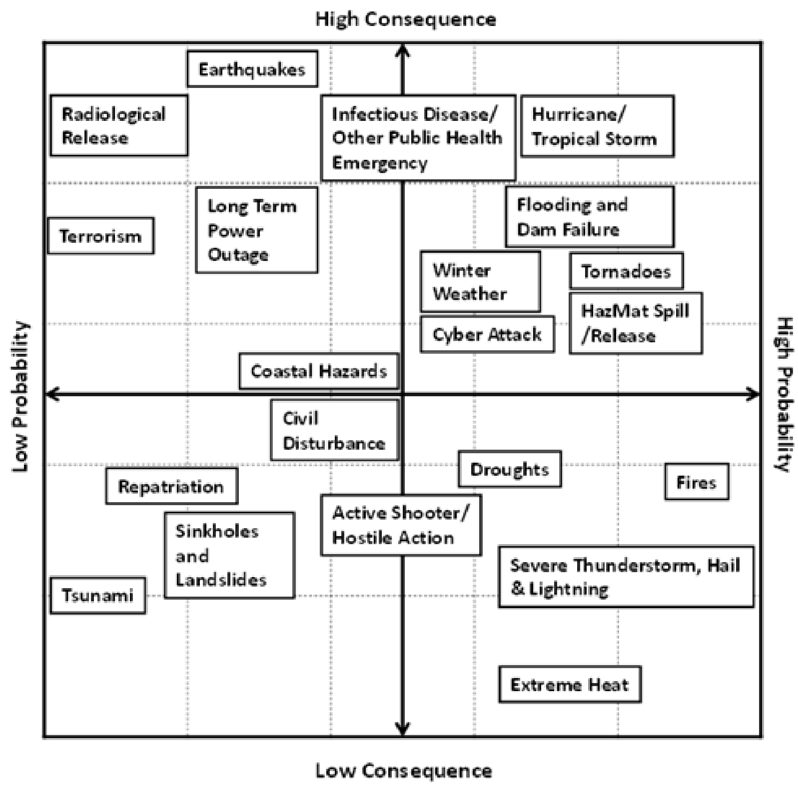

Figure 1: Hazard Probability and Consequence Matrix

Hazards displayed in Figure 1 that are not explicitly addressed in the hazard and risk analysis section of this plan are listed below with discussion of applicability of hazard analysis to them. Incident types may be companion or secondary effects of natural or human-caused hazards or occurrences for which the state has determined the need to prepare but not necessarily invest in the type of mitigation measures contemplated in this plan, which is the basis for those hazards being addressed in the SC Emergency Operations Plan (SCEOP) but not identified for mitigation measures in the SHMP. Information and analysis in the SHMP should still be considered relevant in reducing impacts of those incident types where applicable.

Incident Type Not Fully Addressed in SHMP Hazard Analysis	Considerations and Relevant SHMP Content
Active Shooter/Hostile Action	An incident type noted in the terrorism and mass violence subsection in Section IV; prevention, protection, and preparedness activities are most relevant and is not a hazard for which mitigation of the type described in this plan will be relevant.
Cyber Attack	A tactic noted in terrorism and mass violence subsection of Section IV. Is a specific technical area of prevention and preparedness addressed in other plans.

Long-Term Power Outage	A potential secondary effect of multiple hazard types addressed through preparedness activities and infrastructure protection programs of utility operators.
Radiological Release	A hazard that can be accidental or intentional, mitigation and protection for which is addressed through the nuclear release, hazardous materials, and terrorism and mass violence subsections in Section IV.
Repatriation	A social and humanitarian need and effort to be planned for but is not a hazard for which mitigation of the type described in this plan will be relevant.
Tsunami	Addressed nominally in coastal hazards and earthquake subsections in Section IV. Low probability leads the state to address through structural resilience and preparedness for other coastal hazards and public information and warning capabilities.

Looking at averages, Charleston County is the most hazardous county in the state. The county is vulnerable to all hazards and is located adjacent to the largest earthquake hazard on the East Coast. Richland, Lexington, Greenville, and Orangeburg counties round out the top five most hazardous counties. These five counties each have hazard risk scores of higher than 5.90 and are susceptible to at least 12 of the 13 hazards used to calculate risk scores by county. McCormick County is the least hazardous county in South Carolina, along with Bamberg, Hampton, Barnwell, and Edgefield counties with the next four lowest risk ratings. Relative distance from the coast and the winter weather-prone areas makes them less vulnerable to the effects of natural hazards.

South Carolina has developed hazard-specific disaster plans that address how the state coordinates to protect the life and safety of residents and respond to hazard incidents, ensure continued delivery of critical and essential functions and services, and reduce loss and damage to facilities and infrastructure system. Hazard-specific and functional plans work in concert with the SCEOP. The SCEOP base plan establishes a framework for an effective system of comprehensive emergency management for addressing the various types of emergencies that are likely to occur, from local emergencies with minor impact to major or catastrophic disasters.

Mitigation Goals

Based on the findings of the risk assessment and current state and federal policy priorities, mitigation goals for the SHMP update were revised to emphasize socially vulnerable communities, coordination of mitigation efforts, and climate change considerations. A goal was added to encourage multi-jurisdictional or regional mitigation initiatives. These goals guide day-to-day operations of mitigation programs and the long-term approach taken by the state to reduce the impacts of hazards. Goals represent broad statements that are achieved through the implementation of specific, action-oriented policies or projects. Goals and objectives provide the framework for achieving the intent of the SHMP. Objectives are outlined in Section VII, 2, B.

Goal 1: Implement policies and projects designed to reduce or eliminate the impacts of hazards on people and property.

Goal 2: Obtain resources necessary to reduce the impact of hazards on people and property.

Goal 3: Enhance training, education, and outreach efforts focusing on the effects of hazards, importance of mitigation, and ways to increase resilience.

Goal 4: Collect and utilize data, including studies and analyses, to improve policymaking to support hazard resilience and identify appropriate mitigation projects.

Goal 5: Improve interagency coordination and planning to reduce the impact of hazards on people and property.

Goal 6: Enhance policies and compliance to reduce risk and damage, incorporating current trends and projections regarding population growth and climate change.

Goal 7: Maximize use of natural resource protection measures and nature-based solutions as cost-effective means to reduce the impacts of hazards on people, property, and infrastructure.

Goal 8: Pursue and prioritize mitigation actions that include and benefit multiple stakeholders and geographic areas to achieve broad, comprehensive results and leverage available resources.

Policy Background

The Disaster Mitigation Act of 2000 (DMA2K) amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Public Law 93-288) of 1988 to establish a national disaster hazard mitigation program designed to:

> (1) reduce the loss of life and property, human suffering, economic disruption, and disaster assistance costs resulting from natural disasters; and
>
> (2) provide a source of pre-disaster hazard mitigation funding that will assist States and local governments (including Native American) in implementing effective hazard mitigation measures that are designed to ensure the continued functionality of critical services and facilities after a natural disaster

DMA2K also established a mandate for states and local communities to have an approved hazard mitigation plan to be eligible to receive pre- and post-disaster hazard mitigation funding.

In 1999, South Carolina Governor Jim Hodges signed Executive Order 99-60 establishing the South Carolina Hazard Mitigation Interagency Coordinating Committee (ICC). The ICC's purpose is to assist the Governor's Office and the General Assembly in identifying the hazard mitigation issues and opportunities facing the state for the purpose of developing comprehensive hazard mitigation strategies, policies, and reports on hazard mitigation issues, ensuring state agencies and local governments collaborate, develop, and execute sustainable hazard mitigation actions, and coordinate and support agency efforts in obtaining and administering federal and other mitigation grants to reduce the risks posed by all hazards to the State of South Carolina. In support of these policies, South Carolina has updated the SHMP to continue to meet federal guidelines for mitigation planning, risk assessment, and grant program management and to support the state's ongoing risk reduction efforts.

Interagency Coordination and Initiatives

The state ICC is composed of five state agencies: South Carolina Emergency Management Division (SCEMD), Department of Insurance (SCDOI), Department of Natural Resources (SCDNR), Governor's Office, and Department of Health and Environmental Control (SCDHEC). As of 2022, the South Carolina Office of Resilience (SCOR) serves as a Governor's Office representative on the ICC. These agencies meet periodically to discuss the state of mitigation in South Carolina, approve updates to the SHMP, identify and amend priorities and goals, and prioritize mitigation funding and actions pre- and post- disaster. Each agency participates in mitigation initiatives throughout the state to serve and protect the life and property of South Carolina residents. The ICC determines funding priorities for hazard mitigation grant funding, including from disasters declared since the last SHMP update: Hurricane Florence (DR-4394), Hurricane Dorian (DR-4464), February 2020 severe storms (DR-4479), COVID-19 (DR-4492), April 2020 tornadoes (DR-4542), and Hurricane Ian (DR-4677).

SCEMD is responsible for the application, award, grant management, and closeout of three mitigation grant programs: the Pre-Disaster Mitigation (PDM) grant program, Building Resilient Infrastructure in Communities (BRIC) grant program, and the Hazard Mitigation Grant Program (HMGP). All three grants offer federal mitigation assistance through the Federal Emergency Management Agency (FEMA) to conduct mitigation planning and hazard mitigation projects. SCEMD also is the lead agency on all-hazard risk assessment, mitigation planning at the state and local level, and post-disaster mitigation activities.

SCDOI is responsible for implementing mandates established in the Omnibus Coastal Property Insurance Reform Act of 2007. It established the nationally recognized SC Safe Home mitigation grant program to retrofit coastal homes and assist in lowering coastal property insurance cost for homeowners.

SCDNR is responsible for applications, award, grants management, and closeout of the Flood Mitigation Assistance (FMA) grant program. This annual grant program offers federal mitigation assistance through FEMA to update the flood mitigation portion of hazard mitigation plans and projects to protect against flooding. SCDNR is also the lead agency on the update and maintenance of statewide Digital Flood Insurance Rate Maps and related flood mapping and modeling activities.

SCDHEC conducts mitigation planning and activities by ensuring that facilities, business, and water and air quality businesses and agencies meet minimum environmental and public health standards established in regulations. Dam infrastructure is monitored by SCDHEC staff, and dam safety is an area of mitigation concern. The agency implements surveillance measures to monitor, advise, and protect the public and healthcare providers in the case of disease outbreaks or bioterrorism.

The SCDHEC Office of Ocean and Coastal Resource Management (OCRM), established by the SC Coastal Zone Management Act (1977), manages programs for the protection and enhancement of the State's coastal resources, including efforts to mitigate the impacts of hazards. OCRM promotes disaster mitigation through critical area permitting, local beach management plans, and renourishment funding assistance.

SCOR is responsible for applications, award, grants management, and closeout of Housing and Urban Development Community Block Grant Mitigation (CDBG-MIT) grant projects. SCOR also manages the state's Disaster Relief and Resilience Reserve Fund and based on requirements in a 2020 state statute is responsible for development of a Statewide Resilience Plan.

State-level agencies, programs, and capabilities that support hazard mitigation are outlined in Section VI State Capability Assessment.

Conclusion

The ICC has reviewed and updated this 2023 SHMP and has adopted it to guide the state's hazard mitigation efforts for the next five years. The SHMP includes updated hazard and risk analysis, mitigation priorities, and mitigation actions. The finished product is a comprehensive document based on scientific analysis and professional expertise in the fields of emergency management, hazards, code enforcement, and infrastructure protection. The risk assessment illustrates that South Carolina is at risk to numerous natural and human-caused hazards (accidental and intentional). The SHMP provides a foundation for comprehensive understanding of hazards and risk and for implementing mitigation actions as a sustainable and cost-efficient means of reducing future losses.

An important concept throughout the plan is collaboration. The State of South Carolina believes that mitigation is most successful in a collaborative environment where goals and resources are shared, local initiatives are prioritized, and benefits are felt statewide. Each state agency has shown its dedication to mitigation throughout participation in the ICC and/or the state hazard mitigation program.

This SHMP is designed to guide the state in fulfilling a state hazard mitigation mission and is structured to serve as a basis for ongoing as well as post-disaster hazard mitigation efforts. As required by 44 CFR §201.4(d), this plan was submitted to FEMA for review and approval in 2023. In subsequent years, annual and five-year review processes described in Section IX will continue.

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Acronyms and Abbreviations

ARC- American Red Cross
BRIC- Building Resilience in Communities
COG- Council of Government
DAODAS- Department of Alcohol and Other Drug Abuse Services
DEW- Department of Employment and Workforce
DHEC- Department of Environmental Control
DHEC OCRM- Department of Health and Environmental Control Ocean and Coastal Resource Management
DHHS- Department of Health and Human Services
DMV- Department of Motor Vehicles
DOA- Department of Administration
DOR- Department of Revenue
DOT-Department of Transportation
DPRT- Department of Parks, Recreation, and Tourism
DPS- Department of Public Safety
FEMA- Federal Emergency Management Agency
HMGP-Hazard Mitigation Grant Program
HVRI- Hazards Vulnerability and Resilience Institute
ICC- Interagency Coordinating Committee
LHMP- Local Hazard Mitigation Plan
LHMPG- Local Hazard Mitigation Planning Guidance
LLR- Labor Licensing Regulation
MJHMP-Multi-Jurisdictional Hazard Mitigation Plan
NCEI- National Center of Environmental Information
NEIC- National Earthquake Information Center
NOAA- National Oceanic and Atmospheric Administration
NRC-Nuclear Regulatory Commission
SCDA- Department of Agriculture
SCDNR- South Carolina Department of Natural Resources
SCDOI- South Carolina Department of Insurance
SCEMD- South Carolina Emergency Management Division
SCOR- South Carolina Office of Resilience
SHELDUS- Spatial Hazard Events and Losses Database
SHMP- State Hazard Mitigation Plan
SLED- State Law Enforcement Division
SoVI®- Social Vulnerability Index
TNC- The Nature Conservancy
USGS- United States Geological Survey

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I. Introduction

A. Hazard Mitigation Overview

Natural hazards including floods, hurricanes, earthquakes, and severe storms are an inevitable part of life on planet Earth and create risks to human health and safety, property, and infrastructure systems. Human-caused hazards such as hazardous material releases and explosions can cause significant harm and property damage. This plan assumes that while humans cannot prevent all hazards from occurring, people and their systems can minimize the impacts of hazards through thoughtful and comprehensive mitigation planning and actions.

Hazard mitigation involves the use of measures designed to reduce the impact of hazards on individuals and infrastructure. Mitigation measures can include both structural and non-structural techniques to reduce risk and damage to existing and future development. The most effective mitigation measures are implemented before a hazard event and at the local level, where decisions on the regulation and control of development are made and where impacts are most significantly felt. Information on hazard probability, vulnerability, and impacts throughout the State of South Carolina are included in Section IV, Hazard and Risk Analysis.

The SHMP is the result of a systematic evaluation of the probability and severity of hazards that can affect the state, the vulnerability of people and infrastructure to those hazards, and potential hazard impacts. The plan includes the state's mitigation strategy and actions needed to minimize future hazard vulnerability. It identifies policies, approaches, and practices to establish and implement hazard mitigation activities within the state. Effective and consistent implementation of this plan is crucial to the hazard mitigation program and the state's efforts to reduce or eliminate risk associated with future hazard occurrences. All agencies of state government are partners in development of the SHMP, and multiple agencies have roles in conducting hazard mitigation activities. Administration and maintenance of the hazard mitigation plan is the responsibility of the South Carolina Emergency Management Division (SCEMD). Information on hazard mitigation roles and capabilities of state agencies is presented in Section VI, State Capability Assessment.

B. Purpose of the SHMP

The South Carolina SHMP guides the state's efforts to reduce the effects of hazards by engaging stakeholders, identifying, and analyzing the state's hazards and vulnerabilities, developing a comprehensive long-term strategy, and outlining a process by which to implement the strategy using available and potential resources.

The SHMP sets forth a unified statewide vision for mitigation to protect the residents and property of South Carolina. The mitigation strategy emphasizes the use of broad policy goals to assist South Carolina in becoming less vulnerable to damage from potential hazards while improving the economic, social, and environmental health of the state. The SHMP also fulfills the state hazard mitigation plan requirement of the Disaster Mitigation Act of 2000 (DMA2K).

The following concepts describe the state's hazard mitigation mission:

- Protect life, safety and property by reducing the potential for future injury, damage, and economic loss that result from hazards;
- Reduce the needs, expense, and time involved to respond to and recover from hazard events;

- Enhance the capability of counties and municipalities to address identified hazards by providing technical support and training;
- Establish an effective forum for state agencies and statewide organizations to discuss and coordinate existing and future plans, programs, data, rules and regulations and expertise addressing hazard-related issues;
- Increase the effectiveness and efficiency of hazard mitigation programs and projects sponsored, financed, or managed by state agencies/statewide organizations;
- Meet the requirements established by the Disaster Mitigation Act of 2000 and so qualify to receive federal hazard mitigation funding under Unified Hazard Mitigation Assistance, which includes: disaster-based Hazard Mitigation Grant Program (HMGP) and annual Flood Mitigation Assistance (FMA) , High Hazard Potential Dams Grant Program (HHPD), and Building Resilient Infrastructures and Communities (BRIC) programs.
- Demonstrate the state's commitment to state and local hazard mitigation planning.

This SHMP update is part of the state's work to achieve enhanced plan status. Because of recent hazard events and policy evolution, this SHMP incorporates significant additional information and analysis regarding hazards, socioeconomic factors, and the challenges presented by climate change in understanding future hazard frequency and severity. This plan is accompanied by efforts to strengthen and expand capabilities for supporting and implementing hazard mitigation. If achieved, enhanced status will provide South Carolina an increased percentage of post-disaster funding under the HMGP program; this would mean additional post-disaster mitigation grant funds would be available to support hazard mitigation and resilience-building efforts in South Carolina.

C. Plan Adoption by the State

The State adopted the 2023 SHMP update during an ICC meeting on January 26, 2023 after completion of the initial draft of the SHMP. An adoption resolution is included in Appendix E.

D. Overview of Goals

The following goals have been identified by the South Carolina ICC to provide the framework for the state's mitigation strategy and mitigation funding priorities. Created by a governor's executive order, the ICC includes representatives of multiple state agencies and provides input on mitigation goals and funding priorities. Mitigation approaches, priorities, and actions identified in this SHMP align with these goals.

- Goal 1: Implement policies and projects designed to reduce or eliminate the impacts of hazards on people and property.
- Goal 2: Obtain resources necessary to reduce the impact of hazards on people and property.
- Goal 3: Enhance training, education, and outreach efforts focusing on the effects of hazards, importance of mitigation, and ways to increase resilience.
- Goal 4: Collect and utilize data, including studies and analyses, to improve policymaking to support hazard resilience and identify appropriate mitigation projects.
- Goal 5: Improve interagency coordination and planning to reduce the impact of hazards on people and property.
- Goal 6: Enhance policies and compliance to reduce risk and damage. This includes incorporating current trends and projections regarding population

growth and climate change in correlation to low-income/vulnerable communities.
- Goal 7: Maximize use of natural resource protection measures and nature-based solutions as cost-effective means to reduce the impacts of hazards on people, property, and infrastructure.
- Goal 8: Pursue and prioritize mitigation actions that include and benefit multiple stakeholders and geographic areas to achieve broad, comprehensive results and leverage available resources to all parties.

These goals will be used and addressed in more depth in VIII. Mitigation Strategy.

E. Authorities

This plan will be adopted by the State of South Carolina under the authority and powers granted in General Statutes. The following federal and state authorities guide the plan:

- Disaster Recovery Reform Act (DRRA) of 2018.
- Executive Order No. 99-11 of the Governor of South Carolina.
- Regulation 58-1, Local Government Management Standards, South Carolina Code of Regulations.
- Regulation 58-101, State Government Management Standards, South Carolina Code of Regulations.
- South Carolina Coastal Zone Management Act, as amended.
- South Carolina Code of Laws Ann., 25-1-420 through 25-1-460.
- South Carolina Disaster Relief and Resilience Act, S.C. Code Annotated, Sections 48-62-10, et al.
- Title 6, Chapter 9 of South Carolina Code of Laws, as amended.
- Biggert-Waters Flood Insurance Reform Act of 2012.
- Housing and Community Development Act of 1974, as amended, and the US Department of Housing and Urban Development's Consolidated Plan regulations in Title 24, parts 91 and 570 of the Code of Federal Regulations.
- Infrastructure Investment and Jobs Act of 2021.
- Presidential Executive Order 11988. Floodplain Management.
- Presidential Executive Order 13690. Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input.
- Robert T. Stafford Disaster Relief and Emergency Assistance Act (Public Law 93-288) as amended by the Disaster Mitigation Act of 2000 (Public Law 106-390 – October 30, 2000).
- Safeguarding Tomorrow Through Ongoing Risk Mitigation (STORM) Act of 2021.
- Title 44 of the Code of Federal Regulations.

F. Plan Update Requirement

As with other emergency plans maintained by the state, the SHMP is reviewed and updated regularly to align with changes in hazard risk, population and development, and regulation and policy. Based on DMA2K, states and local governments are required to develop and adopt a hazard mitigation plan to be eligible for Stafford Act mitigation grant funding. Each plan must be updated every five years. This plan is an update of the SHMP approved and adopted in 2018. It includes substantial revisions and new data regarding hazard and risk analysis, mitigation actions, climate change, and identification of vulnerable populations.

This plan is designed to meet the requirements of DMA2K while providing the state of South Carolina a comprehensive strategy for hazard mitigation. The state will continue to comply with the Stafford Act, DMA2K, and applicable federal statutes and regulations in effect during the periods for which it receives grant funding in compliance with 44 CFR §201.4.

G. Emergency Management Accreditation Program (EMAP)

The Emergency Management Accreditation Program (EMAP) is the voluntary assessment and accreditation process for state and local government emergency management programs. Accreditation is based on compliance with the national Emergency Management Standard.

South Carolina has maintained EMAP accreditation since October 2008 and last completed its full accreditation process in 2018. In 2023, the state participated in the reaccreditation process (review and reaccreditation decision pending with EMAP). The state has submitted required annual review responses, and all elements of the state's emergency management program are regularly reviewed and maintained to meet EMAP standards.

The SHMP and related documentation address standards that apply to hazard identification, risk assessment, and hazard mitigation planning activities (EMAP Standard 4.1: Hazard Identification, Risk Assessment and Consequence Analysis and 4.2 Hazard Mitigation). Notations are included throughout the SHMP to reference relevant EMAP standards.

II. Planning Process

A. Overview of Hazard Mitigation Planning In South Carolina

Mitigation planning is a critical component for a successful emergency management program. A comprehensive mitigation plan forms the foundation for a jurisdiction's long-term strategy to break the repetitive cycle of disaster damage, injuries, and loss of life. A core assumption of hazard mitigation is that pre-disaster investment can significantly reduce the demand for post-disaster assistance. Adoption of mitigation actions enables residents, businesses, and industries to more quickly recover from a hazard occurrence, which supports economic recovery with less disruption. Mitigation planning is an integral step to becoming more resilient and capable of returning to a steady state after a hazard event.

The benefits of mitigation planning extend beyond reducing hazard vulnerability. Measures such as the acquisition or regulation of land in known hazard areas can help achieve multiple community goals, such as preserving open space, maintaining environmental health, and enhancing recreational opportunities. Mitigation planning creates a framework for risk-based decision making that will continue to protect infrastructure and populations and prevent future generations and development from being significantly impacted by hazards.

B. Development of the Plan

This plan identifies natural and human-caused hazards and considers ways to reduce South Carolina's vulnerability to them. It assumes that multiple approaches to preserve life and property, including mitigation, floodplain management, infrastructure protection, and emergency preparedness, will be used. Both short- and long-term hazard mitigation measures are identified to help state and local agencies strategically allocate resources to reduce risk and thereby improve the public health, safety, and welfare of the people of South Carolina.

This plan incorporates mitigation experience and the results of mitigation efforts and projects from South Carolina and other states. It takes advantage of collective knowledge and expertise of state, federal, and local staff and officials as well as representatives from the private sector and is one of many planning components designed to work together to protect, inform, and empower the residents of South Carolina.

The hazard mitigation planning process includes gathering information, documenting, and drafting the following elements:

- Planning Process
- State Capability Assessment
- State Profile
- Risk Assessment
- Mitigation Strategy
- Plan Maintenance

This plan update began after the 2018 plan was adopted by ICC and later approved by FEMA on October 1, 2018. The SHMP Steering Committee was formed to include partner agencies in relevant areas such as resilience planning, climatology, and infrastructure safety. The Steering Committee met each quarter beginning in 2021 to discuss the schedule for the update, revisions to the previous plan, new mitigation initiatives for inclusion in the update, and modifications to mitigation goals and strategies. Input was sought from more than 20 state agencies and state-level organizations in the form of updates to previous mitigation actions and/or capability statements or providing subject matter expertise on topics of discussion. Relevant meeting minutes and agendas can be found in Appendix F.

While all sections of the plan were updated to reflect current mitigation strategies and planning priorities, special attention was focused on updating the risk analysis, better defining the role of climate change in understanding hazard probability, severity, and impacts, and integrating lessons from hazard events that occurred during the update cycle. To document changes, a subsection is included in each section of the plan that summarizes the information revised or updated.

C. Local Mitigation Plan Development and Coordination

Since the enactment of DMA2K, each South Carolina County has developed a FEMA-approved Local Hazard Mitigation Plan (LHMP). The hazard identification, risk analyses, and vulnerability assessments in LHMPs provide estimates of potential property losses and societal impacts on a county-by-county basis throughout the state. Some counties cooperate to develop regional HMPs rather than individual county plans. Based on the information in the assessments in LHMPs, counties identify hazard mitigation measures and provide an action plan for implementation. Key elements and priorities of LHMPs in South Carolina have been considered in the SHMP update process.

In accordance with federal regulations, an LHMP must be reviewed and updated every five years for the jurisdiction to be eligible for pre- and post-disaster federal mitigation funding. The state provides technical assistance and guidance to local governments throughout the plan update process and prior to submittal to FEMA. Upon approval by FEMA, the plan must be adopted by each participating jurisdiction within the county. A governing body choosing not to adopt the plan will be ineligible to apply directly for federal Hazard Mitigation Assistance (HMA) funding. If it desires to reinstate eligibility after one year, the jurisdiction will be required to make amendments to its components of the plan to address its gap in participation.

All 46 counties in South Carolina have developed a multi-hazard LHMP. Several independent institutions, including colleges, universities, and local municipalities, have chosen to develop their own hazard mitigation plans where it is determined this would benefit their respective community. Each of these plans are at different stages in the update and renewal process at any point in time, depending upon when the initial LHMP was approved. Status of local HMPs is monitored and supported by SCEMD mitigation planning staff on an ongoing basis.

Local plans being updated are sent to SCEMD for initial review from two to six months before the expiration date. The initial review period may take as long as 30 days with another two months allotted for revisions and secondary review by the state. Upon concurrence of the state and the local government, the plan is sent to FEMA for review. During disaster activations or other periods of emergency response, this timeline may be extended, at which point the revised timeline for review and approval will be coordinated among the local jurisdiction, SCEMD, and FEMA.

SCEMD provides technical assistance to counties, municipalities, councils of government, universities, and tribal governments to develop their LHMP as requested. This may come in the form of arranging and attending trainings, presentations, or other local coordination sessions to encourage participation from all jurisdictions, preparing maps or other forms of hazard assessment material, or providing guidance on interpretation of federal planning guidance. SCEMD and partner state agencies also assist in pursuing federal HMA or other grant assistance to fund the plan development process. See Section V for details on integration with local HMPs.

D. State Mitigation Plan Development and Coordination

SCEMD engages stakeholders at the local and state levels to solicit and encourage input to the SHMP. Input was sought from state agencies, and an opportunity for review and input was provided to the 46 county emergency management offices.

SCEMD conducted outreach by phone and email to stakeholders. In addition, the following agencies were contacted for their expertise in specific areas:

- South Carolina Department of Health and Environmental Control (SCDHEC) for input on health and social services and dam safety.
- South Carolina Department of Natural Resources (SCDNR) for input on climatology, climate change, flood modeling, land use, development, natural, and cultural resources.
- South Carolina Office of Resilience (SCOR) for alignment with its resilience planning project and coordination regarding flood modeling.
- University of South Carolina Hazard Vulnerability and Resilience Institute (HVRI) for hazard identification and risk assessment data and analysis.

E. Plan and Program Integration

The State of South Carolina is committed to maintaining and successfully executing an effective and comprehensive mitigation program. The state's mitigation program is a combination of mitigation and resilience planning, infrastructure investment, development decisions, and management of mitigation and related grant programs. The SHMP serves as strategic and technical guidance across these multiple areas and across multiple agencies. The Hazard Mitigation Grant Program (HMGP), Building Resilient Infrastructure and Communities (BRIC), Pre-Disaster Mitigation (PDM), and mitigation planning are the responsibility of SCEMD. The Community Development Block Grant Program-Mitigation (CDBG-MIT) is managed by SCOR. The Flood Mitigation Assistance (FMA) program is managed by SCDNR. Multiple additional state agencies and state-level organizations deliver or manage programs or funding that have a role in reducing future hazard risk. For these programs to achieve their full potential, a coordinated approach based on common mitigation goals and strategies is needed. Collaborative development of the SHMP and regular use of and reference to it in state, regional, and local planning, resource investment, and development activities are a key means of accomplishing the task of coordinating to meet mitigation and resilience-building goals.

The SHMP is not a stand-alone plan. The ICC and Steering Committee incorporated ideas and principles from a multitude of statewide and local and regional plans in the development of this plan. For example, the SHMP supports the goals established by the South Carolina Department of Insurance SC Safe Home Program, which promotes the strengthening of homes against damaging effects of high winds from hurricanes and severe storms. The flood mitigation and mapping practices found in SCDNR's Flood Mitigation Program are integrated throughout the SHMP. Natural hazard data and analysis from existing state plans (i.e., SC Hurricane Plan, SC Earthquake Plan) are incorporated into this update. The risk analysis and mitigation strategy in the SHMP inform other state and local plans, reinforcing the goals of the SHMP by promoting comprehensive and effective mitigation strategies.

SCDNR is integral in assisting with the development not only of the SHMP but also many local hazard mitigation plans that may require an increased level of support in natural hazard risk assessment. The agency provides information and expertise including climate change and floodplain management resources.

SCOR, formerly the South Carolina Disaster Recovery Office, was tasked by the state Legislature in the state Disaster Relief and Resilience Act of 2020 with creation of a the Strategic Statewide Resilience and Risk Reduction Plan. The Strategic Statewide Resilience and Risk Reduction Plan is intended to serve as a framework to guide state investment in flood mitigation projects and the adoption of programs and policies to protect the people and property of South Carolina from the damage and destruction of extreme weather events. SCOR is the lead state agency in the management of federal CDBG-MIT funds through the Department of Housing and Urban Development (HUD). SCEMD and SCOR coordinate on planning initiatives as well as maximizing grant funding to support mitigation projects.

F. Changes From the Last Plan

Additions were made to incorporate SCOR and its contributions to state and local resilience efforts. Additional contributions and efforts from other state agency partners were noted. Additional grant opportunities were included.

III. State Profile

South Carolina is a coastal state in the southeastern United States, bordered by the states of Georgia to the south and west and North Carolina to the north. The state is composed of 46 counties, the most recently formed of which were established in 1919. One federally recognized Native American tribe is located in the state, the Catawba Indian Nation. The state nickname is the Palmetto State, referring to the cabbage palm or sabal palmetto, which is the state tree.

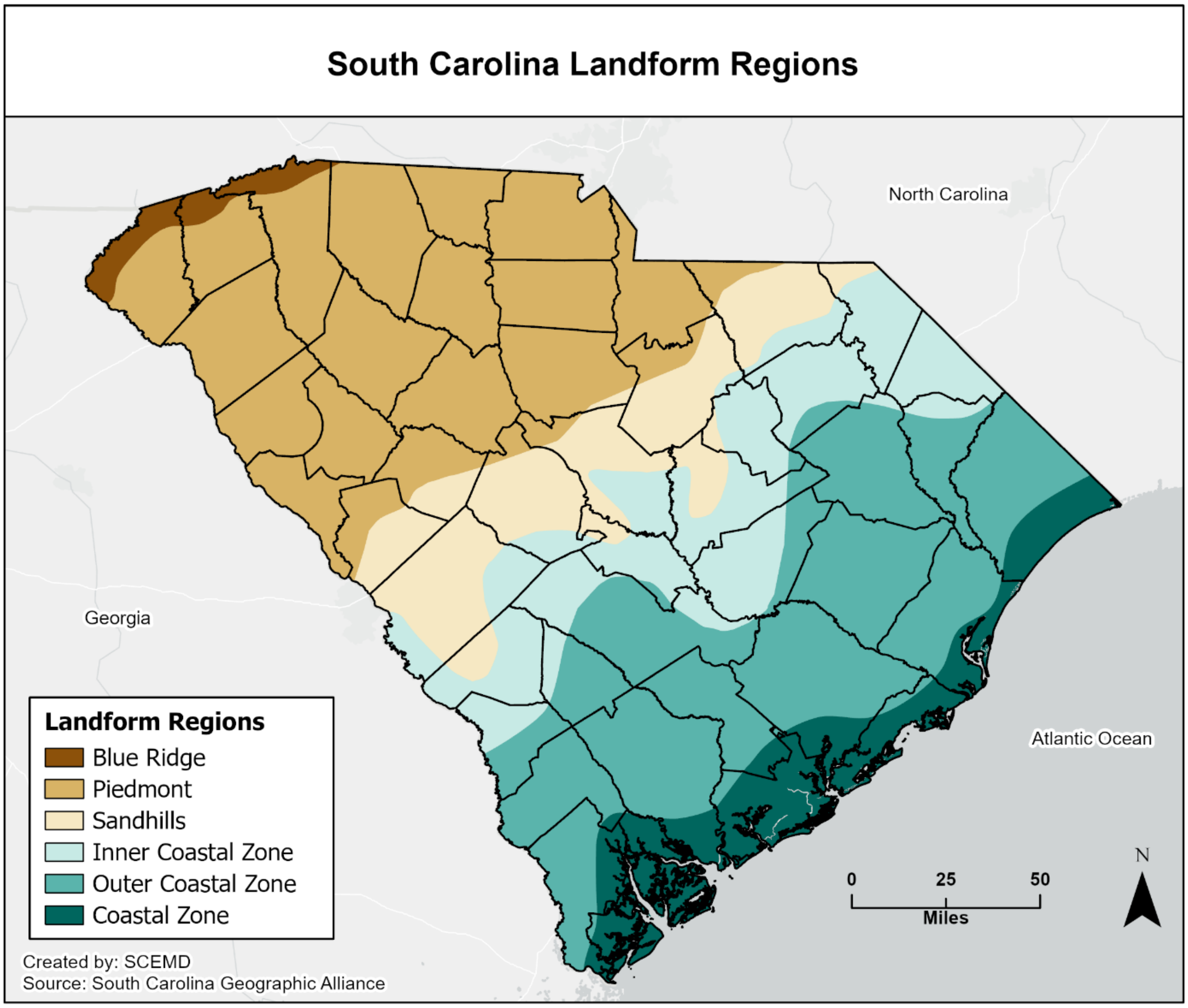


Figure 2 South Carolina Landform Regions

A. Geography and Environment

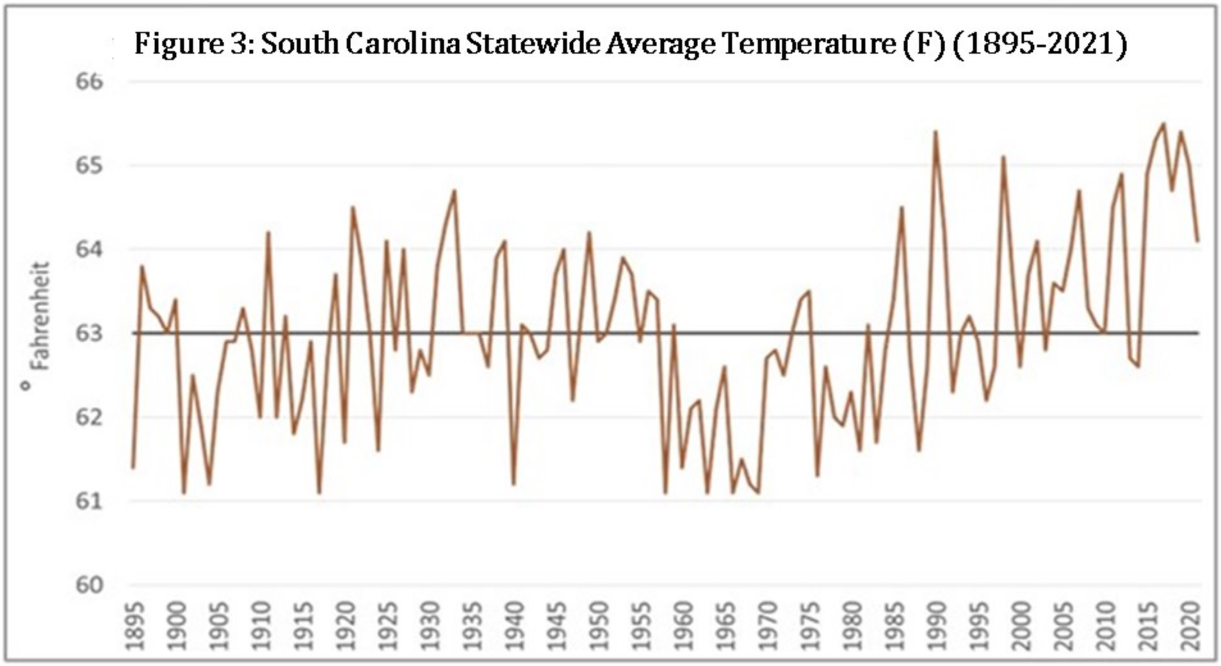
South Carolina ranks 40th in area among states in the U.S. It has an area of 32,020 square miles (82,931 square kilometers) that includes 1,008 square miles (2,611 square kilometers) of inland water and 72 square miles (186 square kilometers) of coastal waters as part of its jurisdiction. The maximum distance from east to west is 273 miles (439 kilometers), and the state's maximum extent north to south is 219 miles (352 kilometers). The state's mean elevation is 350 feet (110 meters) (SC Department of Parks Recreation and Tourism, 2020).

Three geographic land areas define South Carolina: the Atlantic Coastal Plain, the Piedmont, and the Blue Ridge. Two thirds of South Carolina is considered Atlantic Coastal Plain, which extends westward from the Atlantic Ocean. The land rises gradually from the southeast to the northwest. An area of the Atlantic Coastal Plain extending from the coast about 70 miles inland is referred to as the Outer Coastal Plain. The flat terrain of the Outer Coastal Plain includes many rivers as well as wetlands and swamps near the coast that extend inland. Inland to the west of the Outer Coastal Plain, the Inner Coastal Plain consists of rolling hills and is where the state's most fertile soils are found. South Carolinians refer to the southern portion of the Coastal Plain as the Lowcountry and the Piedmont and the Blue Ridge region as the Upstate (DePietro, 2021). A band of rolling hills in the upper part of the Outer Coastal Plain is referred to as the Sandhills, which extends south into Georgia and north into North Carolina.

To the northwest of the Atlantic Coastal Plain is the Piedmont. The Piedmont is marked by higher elevations, from 400 feet to more than 1,200 feet above sea level, reaching 1,400 above sea level on its western edge. The landscape consists of rolling hills, gentler in the east and increasingly hilly to the west and northwest. The border between the Piedmont region and the Atlantic Coastal Plain is called the Fall Line, marking the line where upland rivers drop in elevation to the lower Atlantic Coastal Plain (DePietro, 2021).

The Blue Ridge covers the northwestern corner of South Carolina. This region is part of the larger Blue Ridge Mountain Range that extends from southern Pennsylvania south to Georgia. The South Carolina Blue Ridge Mountains are lower and less rugged than the mountains in North Carolina. Few of the forest-covered Blue Ridge Mountains of South Carolina exceed 3,000 feet above sea level. The highest point in South Carolina, Sassafras Mountain, has an elevation of 3,554 feet (DePietro, 2021).

South Carolina has a humid subtropical climate with hot summers and mild winters. On average, July is the hottest month while January has the lowest temperatures. The coldest temperature on record in South Carolina is -19°F (January 21, 1985), and the hottest is 113°F (June 19, 2012). Since the late-1800s, statewide annual average temperatures show multiple periods of above and below normal temperatures. Despite year-to-year variability, the overall pattern of average temperatures across South Carolina has shown an increase since the mid-1970s.



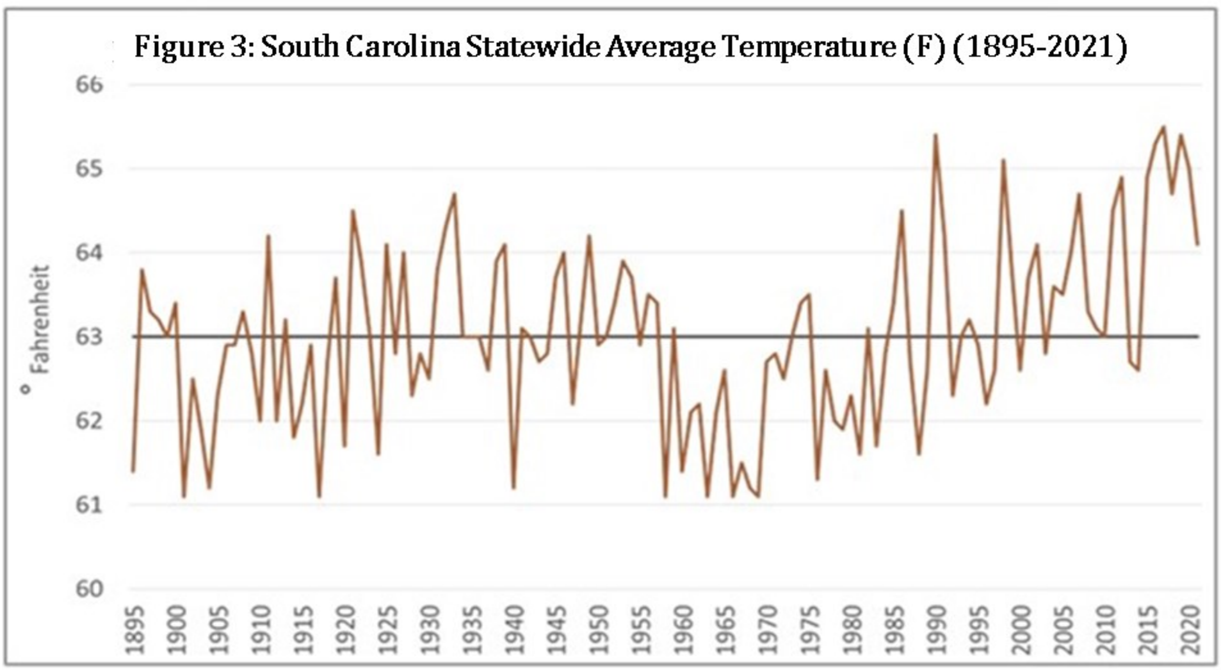


Figure 3: South Carolina Statewide Average Temperature (F) – 1895-2021

Statewide annual rainfall average from 1895 to 2021 was 47.80 inches. Annual precipitation averages across the state vary from less than 40 inches in the Sandhills to more than 80 inches in higher elevations. The driest year in recent records was 1954, with a statewide average rainfall of 31.72 inches. Ten years later (1964), the state reported its wettest year on record with an average of 69.32 inches. The state has seen an increase in extreme rainfall, including a new statewide record for rainfall set at Jocassee in 2018 with 123.45 inches of rain. Four of the 10 all-time wettest years on record in the state have occurred since 2013. : South Carolina Statewide Average Temperature (F) – 1895-2021) Drought and floods are a normal part of weather variability in South Carolina.

Droughts can occur at any time of the year and last for several months to several years. Historical records of droughts across the state indicate periods of dry weather have happened in every decade since the late 19th century. The most severe droughts occurred in 1925, 1933, 1954, 1986, 1998-2002, 2007-2009, and 2010-2013. Multiple types of flooding events occur in South Carolina, including riverine or fluvial floods, flash flooding, coastal flooding from storm surges and high tides, and nuisance flooding. Flooding is complex, and multiple types of flooding can occur within one flood event. Factors other than rainfall amounts affect flooding, including river basin size, the areal extent of rain, duration and rate of rainfall, and land use. South Carolina has experienced a sharp increase in flooding since 2015. The most significant impacts have come from tropical and non-tropical extreme rainfall events, including the October 2015 flood, Hurricane Matthew (2016), and Hurricane Florence (2018). See IV, Hazard and Risk Analysis, for additional detail.

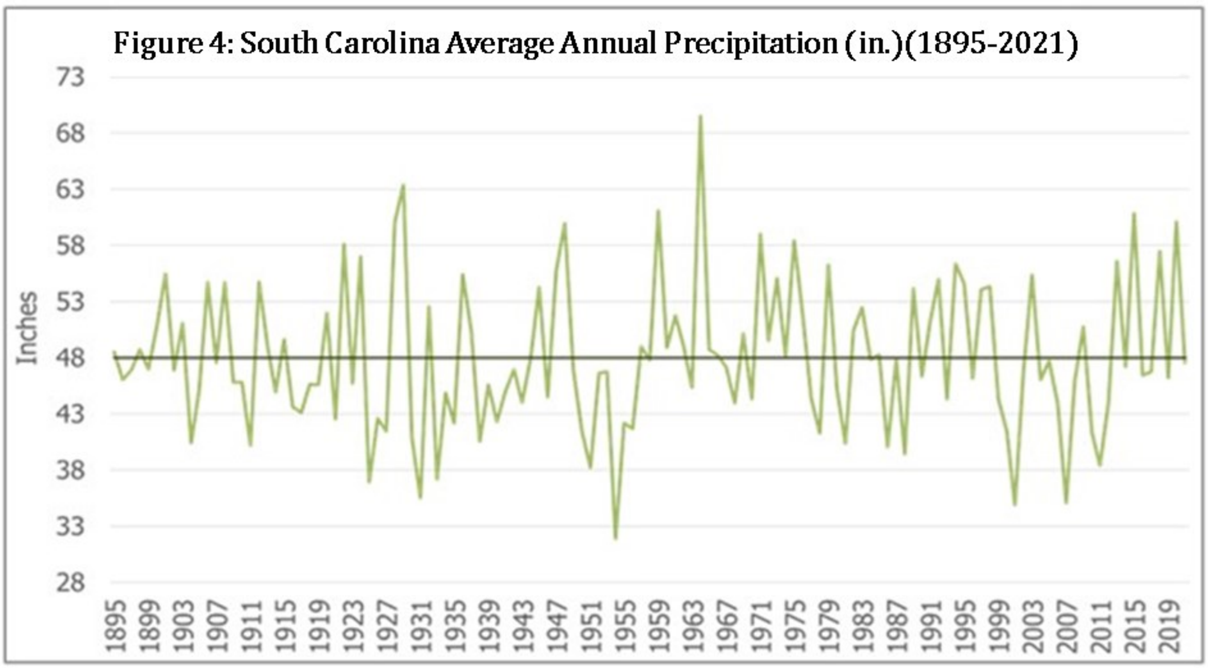


Figure 4: South Carolina Statewide Annual Precipitation

Winter weather events in South Carolina can be high-impact incidents because of their rarity. In the Upstate, two or three winter events with snow or ice accumulation or freezing rain accretion typically occur per winter season. The Midlands and Pee Dee regions average about one winter precipitation event per season. There may be several years between winter events in the Lowcountry. Most of the state averages two inches or less of snowfall each year. The annual snowfall average is higher in the mountains, with a mean yearly snowfall of five to seven inches at the state's highest elevations. Winter weather events that impact South Carolina often include a combination of snow, sleet, and freezing rain.

Severe weather more regularly occurs in South Carolina in the form of thunderstorms and tornadoes. On average, there are between 50 and 70 thunderstorm days each year across the Palmetto State. Since 1950, more than 1,000 tornadoes have been reported in the state, with a primary peak in activity during the spring from supercell thunderstorms and squall lines and a secondary peak in

August and September because of increased tropical cyclone activity. Most of South Carolina's tornadoes are short-lived EF-0 and EF-1 tornadoes, the lowest strengths on the Enhanced Fujita Scale, with winds between 65 and 110 miles per hour. However, stronger, more destructive tornadoes (EF-2 or greater) have occurred, with 11 EF-4 tornadoes on record. The most recent EF4 occurred in Hampton County in April 2020. The dramatic increase in the number of reported tornadoes after 1994 is at least partially attributed to improved Doppler Radar, use of social media, and heightened reporting practices.

Hurricanes and tropical storms are an essential piece of South Carolina's climatology, especially considering the growth of coastal communities in recent decades. However, impacts from these systems are not limited to areas along the coast. Inland portions of the state also have been affected by tropical cyclone-induced heavy rain, flooding, high wind, and tornadoes. From 1851 to 2021, 44 tropical cyclones made direct landfall along the South Carolina coast. Of these, four made landfall as major (Category 3 or higher) hurricanes: 1893 Sea Islands Hurricane, Hurricane Hazel (1954), Hurricane Gracie (1959), and Hurricane Hugo (1989). There is no record of a Category 5 hurricane making landfall in South Carolina.

B. Population and Housing

State Characteristics

The state's population was 5,118,429 in 2020 according to the 2020 Decennial Census, compared to 4.6 million in 2010, an increase of 12%, which is higher than the national average. South Carolina was the 10th fastest-growing state in the nation in 2010[2] and the 11th-fastest growing as of the 2020 Census. The U.S. Census American Community Survey (ACS), which provides annual and multi-year estimates for demographic data, indicates that in 2021, the state's median age was 40.2 years, and 21.5% of the total population was younger than 18 years old. Almost 15% (14.6%) of the population have incomes below the federal poverty level (U.S. Census Bureau, n.d.). The highest rate of poverty was seen in children under the age of 18 at 21.2%. The share of the state's population 65 years of age and older increased 51.7% from 2010 to 2021, from 13.7% percent in 2010 to 18.6% in 2021 (U.S. Census Bureau, n.d.).

According to ACS 2021 five-year average estimates, 14.2% of South Carolina residents have a disability (U.S. Census Bureau, 2021). The U.S. Centers for Disease Control and Prevention (CDC) estimates that nationwide, individuals who identify with having a functional disability fall into one or more of the following categories: mobility (14%), cognition (14%), independent living (8%), hearing (6%), vision, (7%), and self-care (4%) (National Center on Birth Defects and Developmental Disabilities, 2021).The likelihood of having a disability was highest in the 75 years or older category at 44.8%. As to highest level of education, according to ACS 2021 data, 89.6% of South Carolina residents 25 years old and older have graduated from high school, which means 10% of the state's residents 25 and older have not graduated from high school. Of the total in that age group, 31.5% have a bachelor's degrees or higher (U.S. Census Bureau, 2021).

Reducing vulnerability of residents and of the housing stock in which they reside is an important component in reducing risk. The U.S. Census Bureau defines a housing unit within the American Community Survey as "a house, an apartment, a mobile home, a group of rooms, or a single room that is occupied (or if vacant, is intended for occupancy) as separate living quarters. Separate living quarters are those in which the occupants live and eat separately from others in the building, and which have direct access from the outside of the building or through a common hall" (U.S. Census Bureau, 2021). The 2021 ACS estimated 2,395,957 million housing units in South Carolina (U.S.

Census Bureau, 2019). Of those, 72.6% were single family houses, 9.8% were in multi-unit structures or those containing two or more units, and 17.6% were mobile homes. The average household size was 2.34 people (U.S. Census Bureau, 2019). As of 2021, 63.5% of the state's households were family households that includes married couples with or without children (47.7%) and single head of household (11.3%). Non-family households make up the remaining 36.5% of South Carolina households, which includes persons living alone or households with non-related cohabitants (U.S. Census Bureau, 2021).

The median value of owner-occupied housing units from 2017-2021 based on the five-year ACS increased to $181,800 from $137,000 at the time of the 2010 Census, and by 2021 the average sale price of a median single-family home was $282,000 (U.S. Census Bureau, 2021). Manufactured homes make up a significant portion of South Carolina's housing stock. Of single-family homes in South Carolina, 18.3% were manufactured homes as of 2019 (U.S. Census Bureau, 2021; U.S. Census Bureau, 2021), which is 16.2% of all housing units (U.S. Census Bureau, 2021; U.S. Census Bureau, 2021). As of September 2021, despite having the 23rd highest population in the nation, South Carolina was the destination for the fourth highest number of manufactured homes, accounting for just over 5% of the national total (U.S. Census Bureau, 2021).

County Characteristics

Population Density

Table 1 provides population and housing unit estimates from the 2020 ACS as well as land and water area and density by county from 2019 (most recent data available). Of the 14 counties with population numbers higher than the state average county population, three of them (Beaufort, Charleston, and Horry) are along the South Carolina coast. Greenville County has the highest population and number of housing units in the state. The figure below illustrates population density by census tract. Table 1 provides data on population density and housing units by county.

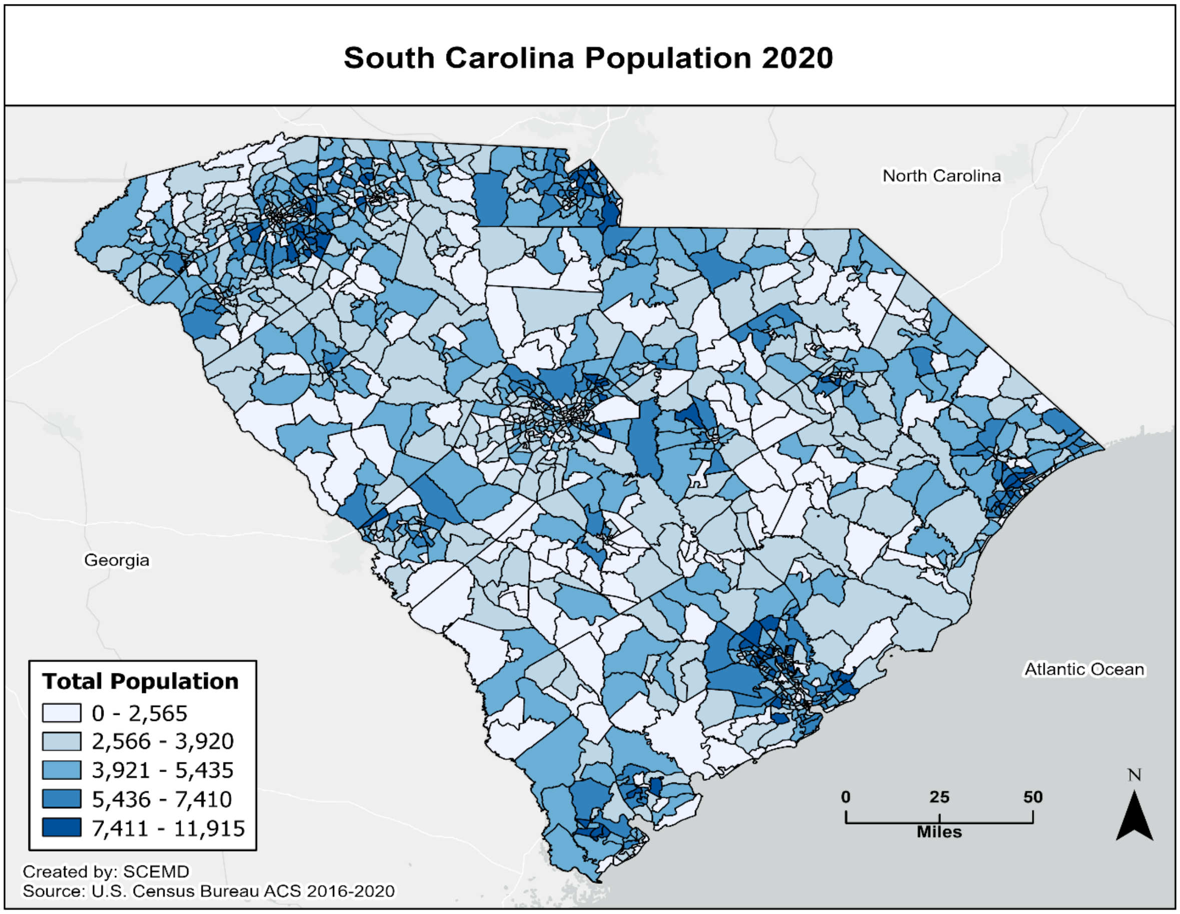


Figure 5: Population Density by Census Tract, 2020

County	Population	Housing Units (World Population Review, n.d.)	Area in Square Miles	Density per Square Mile			
			Total Area	Water Area	Land Area	Population Density	Housing Density
Abbeville	24,299	12,211	510.99	20.51	490.48	47.55	23.90
Aiken	170,776	77,606	1,080.60	9.56	1,071.03	158.04	71.82
Allendale	7,858	4,500	412.42	4.33	408.09	19.05	10.91
Anderson	206,908	89,095	757.44	42.01	715.43	273.17	117.63
Bamberg	13,189	7,715	395.56	2.19	393.37	33.34	19.50
Barnwell	20,580	10,581	557.26	8.87	548.39	36.93	18.99
Beaufort	191,748	101,059	923.4	347.12	576.28	207.65	109.44
Berkeley	236,701	86,274	1,229.24	130.38	1,098.86	192.56	70.18
Calhoun	14,165	7,501	392.48	11.33	381.15	36.09	19.11
Charleston	413,024	191,521	1,358.00	441.91	916.09	304.14	141.03
Cherokee	56,052	24,675	397.18	4.52	392.66	141.12	62.13
Chester	32,209	14,772	586.16	5.51	580.66	54.95	25.20
Chesterfield	43,268	21,764	805.75	6.67	799.08	53.70	27.01
Clarendon	31,024	17,908	695.65	88.71	606.94	44.60	25.74
Colleton	38,462	20,200	1,133.29	76.79	1,056.49	33.94	17.82
Darlington	62,755	30,895	566.8	5.65	561.15	110.72	54.51
Dillon	28,087	13,808	406.59	1.72	404.87	69.08	33.96
Dorchester	163,327	61,445	576.81	2.57	573.23	283.16	106.53
Edgefield	26,153	11,060	506.7	6.29	500.41	51.61	21.83
Fairfield	20,690	11,958	709.88	23.6	686.28	29.15	16.85
Florence	136,504	61,353	803.73	3.76	799.96	169.84	76.34
Georgetown	63,921	35,655	1,034.65	221.1	813.55	61.78	34.46
Greenville	533,834	214,785	794.87	9.75	785.12	671.60	270.21
Greenwood	69,241	31,549	462.93	8.2	454.73	149.57	68.15
Hampton	18,180	9,198	562.71	2.81	559.9	32.31	16.35
Horry	365,579	210,354	1,255.00	121.11	1,133.90	291.30	167.61
Jasper	30,324	12,234	699.36	44.04	655.32	43.36	17.49
Kershaw	66,130	29,444	740.4	13.83	726.56	89.32	39.77
Lancaster	100,336	38,529	555.12	5.96	549.16	180.75	69.41
Laurens	67,803	31,469	723.84	10.04	713.8	93.67	43.48
Lee	16,280	7,785	411.23	1.05	410.18	39.59	18.93
Lexington	300,137	126,241	757.73	58.82	698.91	396.10	166.60
Marion	9,760	5,669	494.14	4.91	489.23	19.75	11.47
Marlboro	28,784	15,051	485.27	5.6	479.67	59.32	31.02
McCormick	26,382	12,058	393.87	34.74	359.13	66.98	30.61

County	Population	Housing Units (World Population Review, n.d.)	Area in Square Miles	Density per Square Mile			
			Total Area	Water Area	Land Area	Population Density	Housing Density
Newberry	37,996	18,363	647.29	17.25	630.04	58.70	28.37
Oconee	79,203	40,774	673.51	478.18	626.33	117.60	60.54
Orangeburg	82,962	42,856	1,127.90	21.8	1,106.10	73.55	38.00
Pickens	132,229	54,939	512.03	15.62	496.41	258.24	107.30
Richland	418,307	175,052	771.71	14.64	757.07	542.05	226.84
Saluda	18,821	9,470	461.82	9.04	452.78	40.75	20.51
Spartanburg	335,864	131,725	819.24	11.32	807.93	409.97	160.79
Sumter	104,758	48,383	682.08	17.02	665.07	153.59	70.93
Union	27,016	14,118	516.03	1.86	514.17	52.35	27.36
Williamsburg	30,484	15,543	937.04	2.88	934.16	32.53	16.59
York	288,595	109,967	695.81	15.21	680.6	414.76	158.04
Total	5,190,705	2,286,826	32,020.49	1,959.79	30,060.70	162.11	71.42

Table 1 Population Density by County

See Appendix G for County Hazard Risk Scores.

Hazard events strike communities regardless of jurisdictional boundaries, and communities' ability to prepare for and recover from a hazard event are not equal. Individuals and groups of people can experience impacts differently and have varying capabilities to respond based on resources and other factors. The term "social vulnerability" describes pre-event social and demographic characteristics of a population that can cause different effects from hazard occurrences. These characteristics include age, gender, population, race and ethnicity, income, education and literacy, disability, housing type, transportation dependency, and other factors. For example, in an emergency evacuation scenario, people younger than age 19 or older than 64 may be more vulnerable than the general population because of the need for additional assistance.

Age

A 2017 report by the South Carolina Office on Aging noted that the state has experienced a significant growth in the number of senior or mature adult residents during recent decades (SC Lieutenant Governor's Office on Aging, US. Census Bureau, 2017-2021), and the trend continued during the past five years. This reflects the national trend in which retirement of the Baby Boom generation (those born between 1946 and 1964) is affecting communities and institutions.

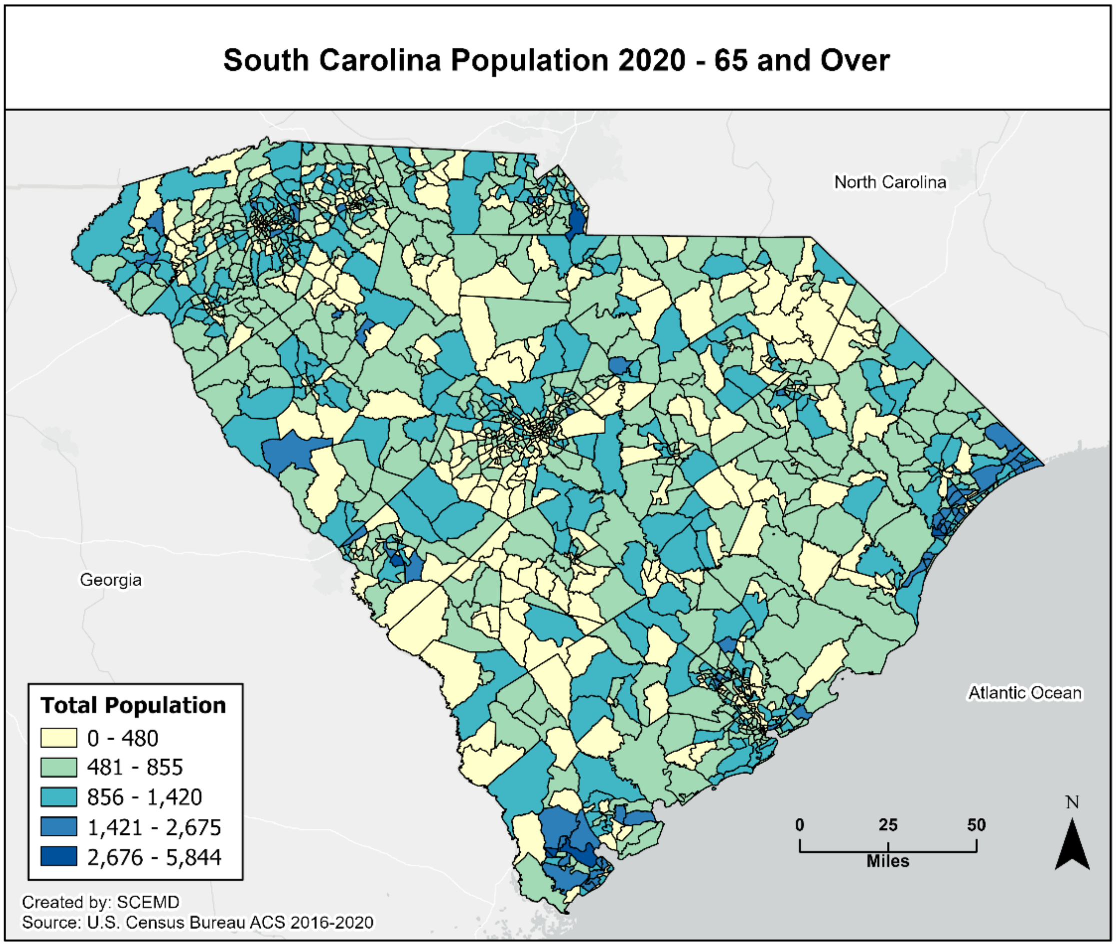


Figure 6: South Carolina Population 2020 – 65 and Over

Figure 6 shows the density of population aged 65 and older by census tract. The counties with the largest percentage concentration (30% or more) of persons 60 years or older as of 2019 were McCormick, Georgetown, Beaufort, Horry, Clarendon, Fairfield, and Oconee, with McCormick County having the highest percentage with 42% of its population 60 years or older (U.S. Census Bureau, n.d.).

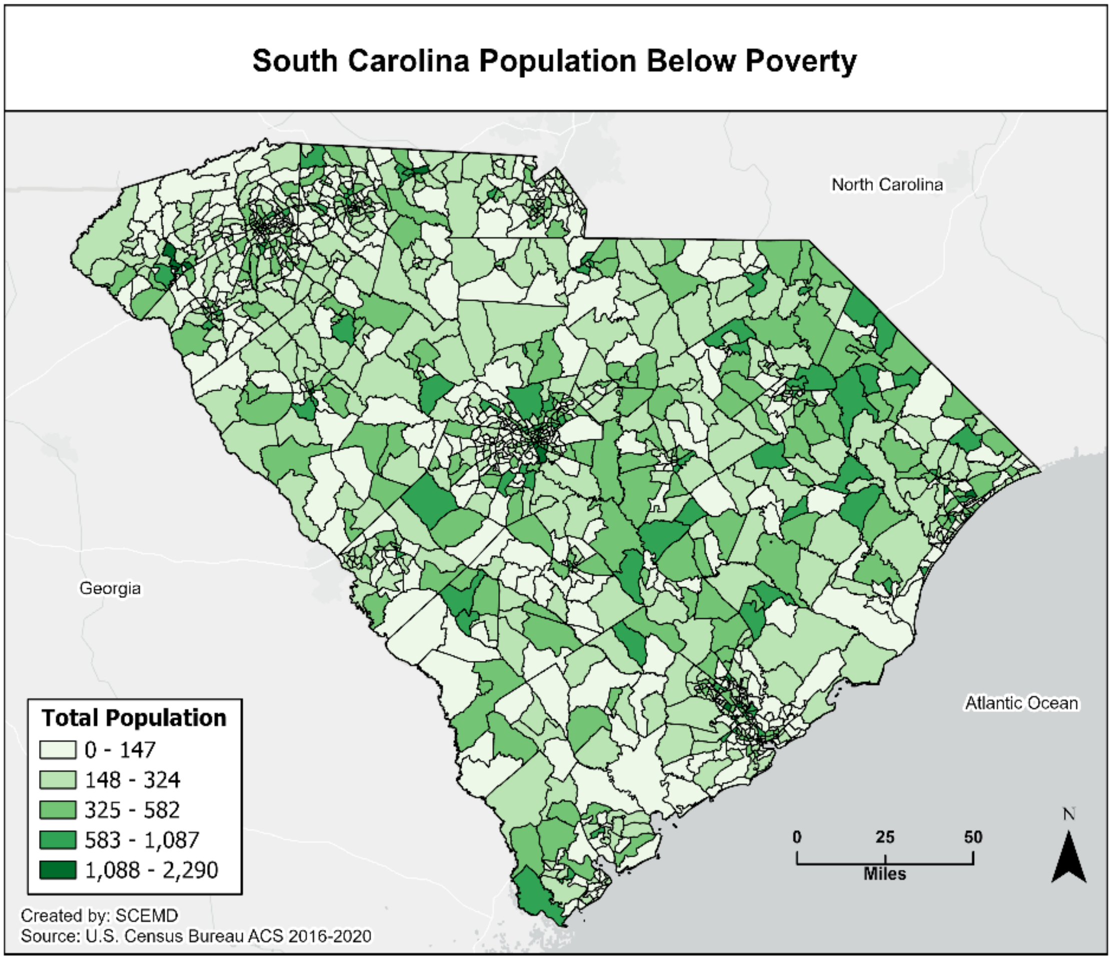


Figure 7: Low Income by County

Figure 7 shows the distribution of South Carolina's low-income population. In Williamsburg, Allendale, Dillon, Marlboro, Orangeburg, Marion, and Barnwell counties, 25-27% of the population has income below the poverty line (U.S. Census Bureau, n.d.; SC Revenue and Fiscal Affairs, US Census, 2021).

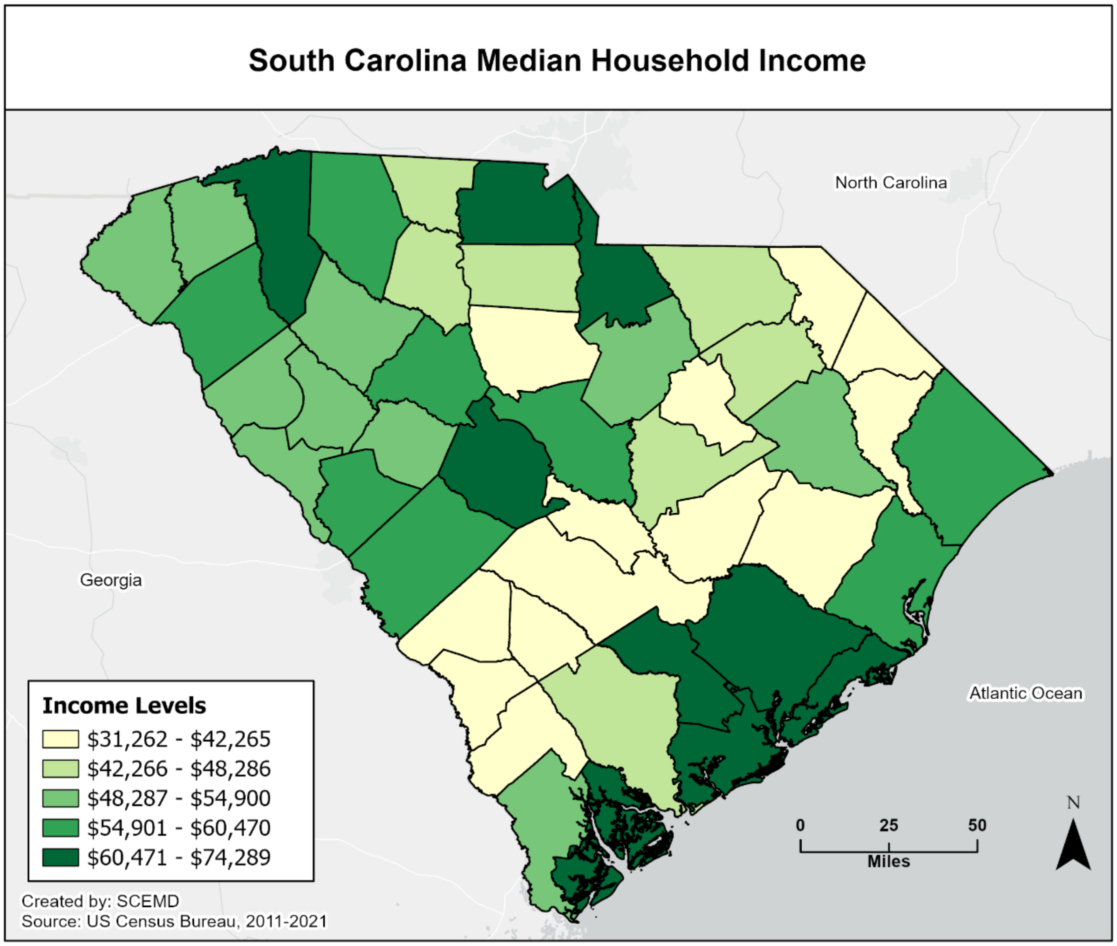


Figure 8: Median Household Income

US Census Bureau estimates indicate the five counties in the state with the highest median household incomes were Berkeley, York, Beaufort, Charleston, and Dorchester counties. The average median household income for the state was $59,447. These counties are all in proximity to major cities and areas of greatest economic development with a greater access to jobs and resources (SC Revenue and Fiscal Affairs, US Census, 2021). Figure 8 depicts medium household income by county.

For this SHMP, South Carolina used the Social Vulnerability Index (SoVI)® developed by the University of South Carolina Hazard Vulnerability Research Institute to analyze and depict the degree to which social demographics have the potential to increase vulnerability of people in South Carolina. SoVI is a quantitative index used in the examination of social vulnerability; it is based on data from the 2020 U.S. Census five-year American Community Survey, 2016-2020 and synthesizes 29 socioeconomic variables that can contribute to the reduction in a community's ability to prepare for, respond to, and recover from hazards. SoVI is expressed in three classes (low, medium, or high) and five classes (low, medium-low, medium, medium-high, or high). For more information, see Hazard Analysis Methodology information in Appendix B.

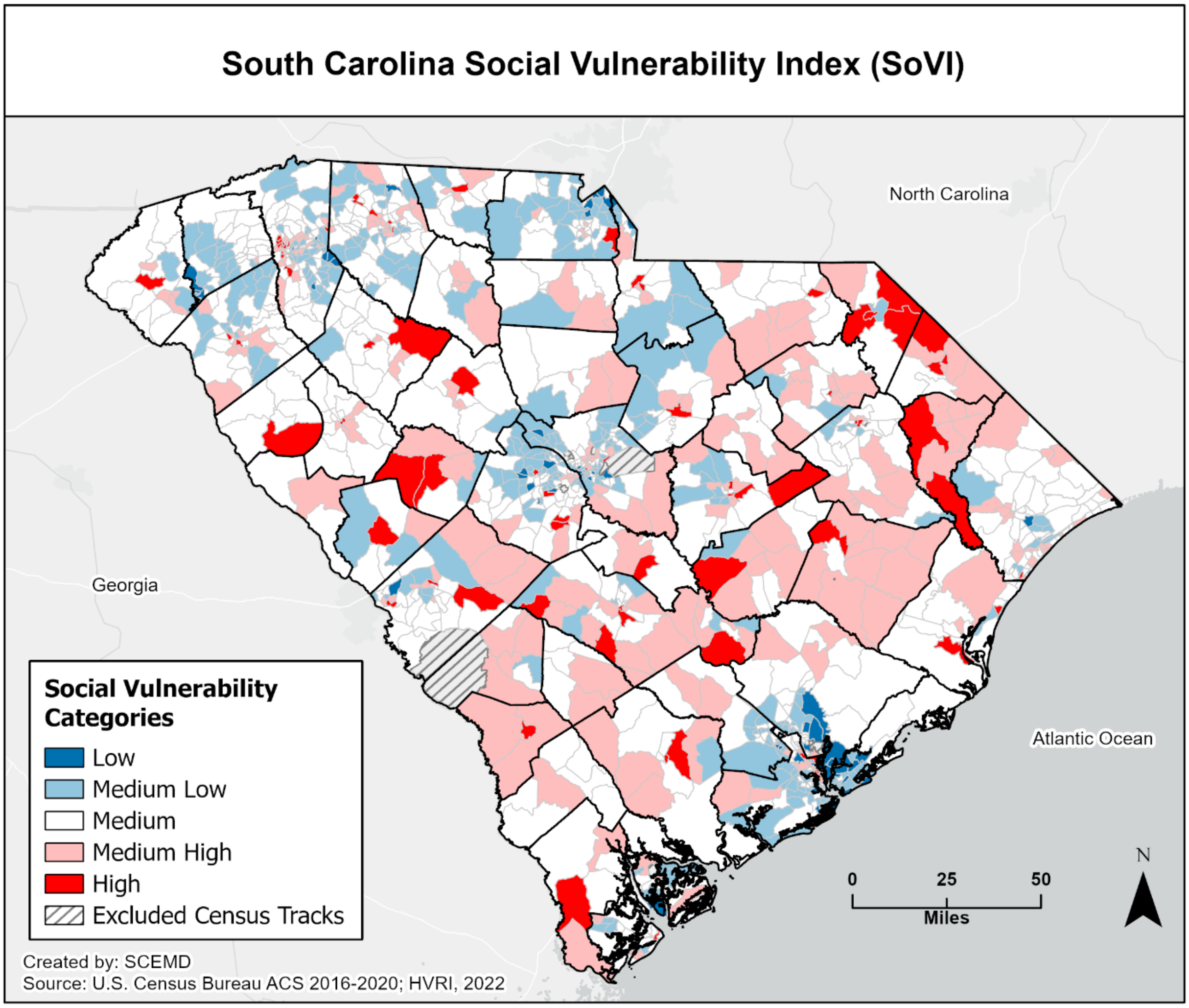


Figure 9: South Carolina Social Vulnerability Index

Table 2 below shows future population projections based on data updated in 2019, including projections through 2035. Twenty-two of the state's counties are projected to see a decrease in population, with Allendale County expected to have the lowest population by 2035 (SC Revenue and Fiscal Affairs Office, US Census , 2010-2019).

County	July 1, 2025 Projection	July 1, 2030 Projection	July 1, 2035 Projection
Abbeville	23,710	23,025	22,195
Aiken	175,635	178,735	180,550
Allendale	7,630	6,870	6,160
Anderson	214,715	224,750	234,420
Bamberg	12,635	11,525	10,425

County	July 1, 2025 Projection	July 1, 2030 Projection	July 1, 2035 Projection
Barnwell	19,515	18,395	17,250
Beaufort	213,985	231,950	248,860
Berkeley	261,625	293,125	326,615
Calhoun	13,655	13,060	12,345
Charleston	450,895	480,890	508,730
Cherokee	57,960	58,315	58,350
Chester	31,280	30,515	29,625
Chesterfield	44,750	43,765	42,475
Clarendon	32,235	30,940	29,340
Colleton	37,320	36,920	36,285
Darlington	64,760	62,970	60,820
Dillon	29,325	28,310	27,160
Dorchester	182,255	198,030	213,820
Edgefield	27,370	27,475	27,425
Fairfield	21,005	19,920	18,640
Florence	136,405	134,255	131,405
Georgetown	63,805	64,115	63,515
Greenville	573,060	616,105	659,270
Greenwood	71,385	71,575	71,430
Hampton	17,805	16,690	15,545
Horry	438,825	517,155	603,675
Jasper	33,390	37,060	40,895
Kershaw	69,340	71,845	74,145
Lancaster	119,370	138,925	160,500
Laurens	67,415	67,420	67,055
Lee	15,425	14,305	13,175
Lexington	324,860	345,560	365,575
McCormick	8,565	7,905	7,135
Marion	29,300	27,935	26,450
Marlboro	24,050	22,430	20,820
Newberry	39,620	40,325	40,855
Oconee	82,490	84,940	86,830
Orangeburg	80,950	76,480	71,710
Pickens	131,255	135,865	139,525
Richland	436,420	451,000	463,530
Saluda	20,905	21,055	21,110
Spartanburg	348,085	373,465	399,415

County	July 1, 2025 Projection	July 1, 2030 Projection	July 1, 2035 Projection
Sumter	103,570	100,870	97,690
Union	26,370	25,605	24,705
Williamsburg	27,290	24,955	22,575
York	329,925	374,385	423,060
Total	5,542,140	5,881,710	6,223,085

Table 2 Population Projections Through 2035. Source: Department of Revenue and Fiscal Affairs

Projections in the table above were calculated using the cohort-component model of demographic change based on 2019 data. The model uses a base population at a beginning date and applies assumed survival rates, fertility rates, and net migration to calculate population projections. These projections are not intended to be a forecast but are intended to demonstrate a likely scenario if future events unfold consistent with recent trends. The model does not account for unanticipated events that could alter birth rates, death rates, or migration.

C. Employment and Industry

South Carolina was established as and remained a primarily agricultural state until the early decades of the 20th century, when manufacturing developed as the leading economic activity, particularly the textile industry. However, agriculture continues to be an important part of the state's economy. The state's manufacturing field has diversified since the 1960s. Between 2010 and 2018, state employment in advanced manufacturing doubled as a result of new industrial activity, notably automotive manufacturing (Von Nessen, 2019). South Carolina's economy is no longer dependent on one sector. In 2021, during the COVID-19 pandemic, the state had the 13th largest growth in GDP of all 50 states (Davis, 2021).

D. Tourism

Tourism has grown into a large economic driver in South Carolina. In 2019, $24.4 billion was spent on travel or tourism in the state, with more than half of that by out-of-state visitors. Tourism also supported one in every 10 of the state's jobs and generated more than $1.8 billion in tax revenue. (Travel Impact Analysis LLC, 2020) Pre-COVID-19 data gathered in 2019 shows that the four counties of Horry, Charleston, Beaufort and Greenville accounted for 68% of the state's total visitor spending, bringing in almost $9.9 million, continuing a trend from previous years. (Travel Impact Analysis LLC , 2021) Of those visitors, 35% came for beaches, 28% for shopping, 25% to visit relatives, and 18% for fine dining (Travel Impact Analysis LLC , 2021). Safety and public health precautions in response to COVID-19 had a negative impact on tourism, causing a 30.7% decrease statewide. Not all areas saw a reduction in tourism, however; increased participation in outdoor activities caused 10 of the state's 46 counties – primarily rural ones -- to experience an increase in tourism spending (Travel Impact Analysis LLC , 2021). With the easing of pandemic restrictions in late 2021 and 2022, tourism revenue was expected to increase to or near pre-pandemic levels.

E. Land Use

While much of the land area in South Carolina is undeveloped, urban and suburban areas have continued to increase in coverage area. About 8% of the state's area is considered developed while approximately 17% is cultivated/agricultural. More than 40% of the state's area is forested, with a portion of that used for commercial timber production. Figure 10 illustrates the areas of the state that are developed and those that are forested or in cropland.

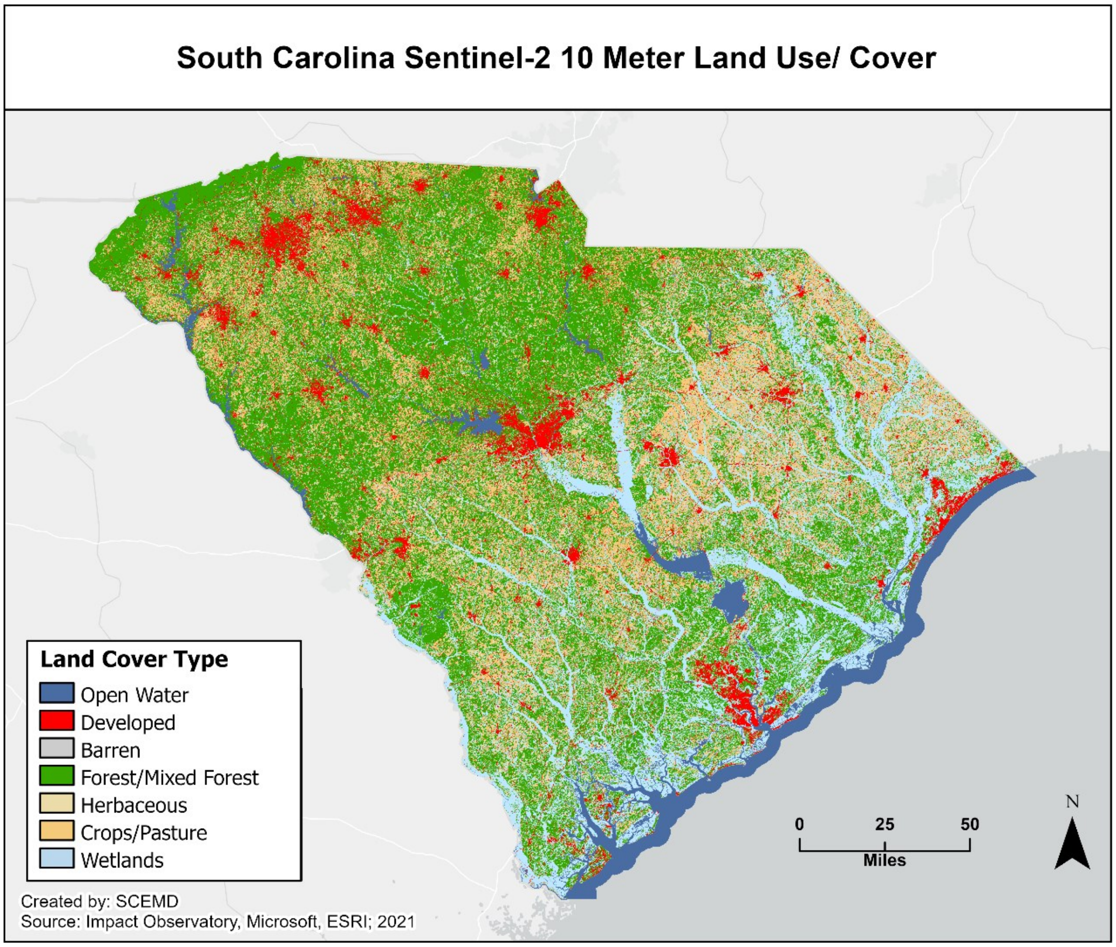


Figure 10: Land Use in South Carolina

Land Cover Type	Square Meters	Percentage
Open Water	2,026,594,057.16	2.59
Developed Open	4,074,297,209.72	5.21
Developed Low	1,620,811,612.26	2.07
Developed Medium	455,763,129.73	0.58
Developed High	176,752,887.47	0.23
Barren Land	348,035,254.56	0.44
Deciduous Forest	11,843,573,884.12	15.13
Evergreen Forest	19,373,084,710.03	24.75

Land Cover Type	Square Meters	Percentage
Mixed Forest	1,403,687,480.30	1.79
Shrub	1,545,288,508.42	1.97
Herbaceous	7,278,682,726.10	9.3
Hay/Pasture	7,256,564,367.20	9.27
Cultivated Crops	6,134,954,004.74	7.84
Woody Wetlands	12,864,322,852.33	16.44
Emergent Herbaceous	1,867,564,225.40	2.39
Total	78,269,976,909.54	

Table 3 State Land Cover by Type

Public and private land conservation protection for the state is monitored by SCDNR. Three million acres of land in the state is protected. Of this, 2 million acres is publicly owned, and 1 million is privately owned. While 3 million acres of land is protected within the state of South Carolina, that accounts for 15.04% of land within the state, which means 84.96% of land in South Carolina is unprotected. Of that, farms account for 4.7 million acres, with most being small, family-owned farms. The average farm size is 191 acres. Farms support timber, poultry, and crop production, which are the major commodities associated with agriculture in the state.

South Carolina has more than 60,000 miles of public roads, The South Carolina Department of Transportation (SCDOT) provides support and maintains 41,000 miles of public roadway. Management over the remaining public roads are operated by local governments or counties, private businesses, and individuals (SC Department of Transportation , 2022).

Long-term community planning is valuable in managing development and supporting beneficial growth. Local governments have the authority to plan and control land use and development through the creation and maintenance of a comprehensive plan. The 1994 South Carolina Local Government Comprehensive Planning Enabling Act requires that local plans and ordinances conform to the provisions in the act. Each comprehensive plan developed by a county or municipality is required to directly address, at a minimum, seven elements including natural resources. The natural resource element and zoning ordinances must address flooding and flood-related issues.

Local comprehensive plans have five objectives:

- Identify local problems and needs
- Collect appropriate data to study local problems and needs
- Arrive at a consensus on local objectives
- Develop plans and programs to fulfill such objectives
- Utilize available resources to execute plans and programs effectively.

Jurisdictional planning boards, state and local economic development leaders, and state natural resource managers work to incorporate land-use management initiatives into local comprehensive plans. The effects of land use changes, development, and population growth are addressed in greater detail in the IV. Hazard and Risk Analysis.

F. State Asset Vulnerability

South Carolina state government has facilities in each of the 46 counties, and many of them are at risk from multiple hazards identified in this SHMP. The state's Insurance Reserve Fund regularly reviews state asset values to present as it purchases reinsurance. The total value (replacement value, December 2022) for state buildings, contents, equipment, collections, and related items is $25.6 billion.[2] This amount does not include the value of vehicles, land, or business interruption losses. The five counties with the highest dollar values of state assets are Richland, Charleston, Pickens, Florence, and Horry, primarily because of concentrations of state government facilities in Richland County and state institutions of higher education and state-owned medical facilities in the others.

County	State Facility Total Value
Abbeville	$12,447,877
Aiken	$383,586,520
Allendale	$85,746,249
Anderson	$433,652,918
Bamberg	$42,999,502
Barnwell	$29,833,758
Beaufort	$196,088,809
Berkeley	$106,857,004
Calhoun	$7,363,576
Charleston	$5,662,819,179
Cherokee	$82,084,609
Chester	$64,774,171
Chesterfield	$46,299,660
Clarendon	$156,852,014
Colleton	$87,914,294
Darlington	$71,127,190
Dillon	$17,817,027
Dorchester	$186,519,938
Edgefield	$50,166,861
Fairfield	$28,390,130
Florence	$1,044,580,959
Georgetown	$71,643,212
Greenville	$784,293,180
Greenwood	$468,475,450
Hampton	$15,293,242
Horry	$929,424,705
Jasper	$93,900,239
Kershaw	$220,188,883
Lancaster	$364,412,715
Laurens	$73,962,282
Lee	$126,725,136
Lexington	$324,841,395

McCormick	$115,976,963
Marion	$170,105,905
Marlboro	$92,005,154
Newberry	$35,632,540
Oconee	$76,394,024
Orangeburg	$486,397,108
Pickens	$2,992,174,697
Richland	$7,540,364,993
Saluda	$11,003,835
Spartanburg	$718,940,049
Sumter	$267,711,766
Union	$29,021,927
Williamsburg	$33,290,996
York	$771,100,987
State Total	**$25,611,203,628**

Table 4 State Facility Total Value by County

State buildings and infrastructure generally have the same hazard exposure as other structures, with risk depending on proximity to the hazard occurrence and building type, construction materials, age, and other factors. Hazards associated with the greatest potential for damage to state assets include hurricane, earthquake, and flood.

Earthquake: Of South Carolina counties, Charleston County is considered to have the highest risk for earthquake damage. Charleston County has 562 state buildings with building and contents value of $5,662,819,179. See Section IV, Earthquake, for additional detail on earthquake probability and vulnerability.

Flood: Flooding can occur in most areas of the state, so for purposes of this analysis, all state assets are considered at risk for flood impacts. Vulnerability of state assets to damage from flooding depends on location and elevation. Ongoing work among multiple state agencies to improve flood inundation modeling statewide will strengthen more specific and complete analysis in the future.

Tropical cyclone: State assets in coastal counties of Beaufort, Charleston, Colleton, Georgetown, and Horry are at risk from storm surge, high wind, heavy rain (and associated flooding), and the potential for tornadoes from tropical systems. There is $5.7 billion in state building value and $6.9 billion total in state facility value in these five counties. As noted in the tropical cyclone subsection, tropical systems can cause impacts in other areas of the state.

G. Declared Disasters

From 1954 through 2022, South Carolina experienced 33 federally declared disasters, of which 20 were major disaster declarations, which allows federal Hazard Mitigation Grant Program (HMGP) funding to be made available statewide in addition to recovery assistance programs in declared counties. Of the 20 major disaster declarations, 10 have occurred since 2014. Since the 2014 Ice Storm, South Carolina has had $1,819,209,225 in disaster public infrastructure and response costs, with 4,247 total projects completed and 70% of those paid. The list of federally declared disasters, emergency declarations, and fire management assistance declarations is shown in Table 5. The types of hazards that led to these declarations are ice storms, fire, winter storms, hurricanes, severe storms, flooding, and pandemic disease.

Year	Declaration Date	Event	Declaration Type
2022	11/21	Hurricane Ian	Major Disaster Declaration
2022	09/29	Hurricane Ian	Emergency Declaration
2020	05/01	Severe Storms, Tornadoes, and Straight-Line Winds	Major Disaster Declaration
2020	03/27	COVID-19	Major Disaster Declaration
2020	03/17	Severe Storms, Tornadoes, Straight-Line Winds, and Flooding	Major Disaster Declaration
2020	03/13	COVID-19	Emergency Declaration
2019	09/30	Hurricane Dorian	Major Disaster Declaration
2019	09/01	Hurricane Dorian	Emergency Declaration
2018	09/16	Hurricane Florence	Major Disaster Declaration
2018	09/10	Hurricane Florence	Emergency Declaration
2017	10/16	Hurricane Irma	Major Disaster Declaration
2017	09/07	Hurricane Irma	Emergency Declaration
2016	11/12	Pinnacle Mountain Fire	Fire Management Assistance Declaration
2016	10/11	Hurricane Matthew	Major Disaster Declaration
2016	10/06	Hurricane Matthew	Emergency Declaration
2015	10/05	Severe Storms and Flooding	Major Disaster Declaration
2015	10/03	Severe Storms and Flooding	Emergency Declaration
2014	03/12	Severe Winter Storm	Major Disaster Declaration
2014	02/12	Severe Winter Storm	Emergency Declaration
2009	04/23	Highway 31 Fire	Fire Management Assistance Declaration
2006	01/20	Severe Ice Storm	Major Disaster Declaration
2005	09/10	Hurricane Katrina Evacuation	Emergency Declaration
2004	10/07	Tropical Storm Frances	Major Disaster Declaration
2004	09/15	Tropical Storm Gaston	Major Disaster Declaration
2004	09/01	Hurricane Charley	Major Disaster Declaration
2004	02/13	Ice Storm	Major Disaster Declaration
2003	01/08	Ice Storm	Major Disaster Declaration
2002	06/18	Legends Fire	Fire Management Assistance Declaration
2001	11/13	Long Bay Fire	Fire Management Assistance Declaration

Year	Declaration Date	Event	Declaration Type
2000	01/31	Winter Storm	Major Disaster Declaration
1999	09/21	Hurricane Floyd	Major Disaster Declaration
1999	09/15	Hurricane Floyd	Emergency Declaration
1998	09/04	Hurricane Bonnie	Major Disaster Declaration
1996	09/30	Hurricane Fran	Major Disaster Declaration
1990	10/22	Flood	Major Disaster Declaration
1989	09/21	Hurricane Hugo	Major Disaster Declaration
1984	03/30	Severe Storms, Tornadoes	Major Disaster Declaration
1977	08/04	Drought	Emergency Declaration
1955	08/20	Hurricanes	Major Disaster Declaration
1954	10/17	Hurricane Hazel	Major Disaster Declaration

Table 5 Declared Disasters, South Carolina, 1954 – 2022

Other than the declaration for COVID-19, the most significant recent disaster declaration was for Hurricane Florence, which made landfall on September 14, 2018. FEMA designated a disaster area including 19 South Carolina counties eligible for federal Public Assistance (PA) disaster assistance, which can reimburse 75 percent of the eligible costs for debris removal, emergency services related to the storm, and the repair of damaged public facilities.

After landfall, remnants of Hurricane Florence remained stationary over North Carolina, delivering significant rainfall into river basins that feed into South Carolina's rivers. The resulting downstream runoff led to historic flooding. Floodwaters took two weeks to arrive on the Great Pee Dee and Waccamaw rivers, causing flooding cross several tide cycles. In the town of Nichols in Marion County, approximately 150 homes were damaged again after being rebuilt following flooding from Hurricane Matthew in 2016. Flooding was described by residents as being worse than during Hurricane Matthew, which left Nichols under several feet of floodwater.

As a result of the unprecedented flooding from Hurricane Florence and its secondary riverine impacts, mitigation project priorities in the next few years focused on the Pee Dee region of the state where the heaviest impacts were felt. Projects included mitigation measures such as property elevation, flood and storm water studies, and localized flood reduction strategies.

Hurricane Florence impacts to South Carolina included:

- Nine deaths: four direct, five indirect;
- 100,000 residents lost power;
- 15,984 storm victims applied to FEMA for disaster assistance (NOAA National Weather Service , 2018);
- 13,002 residents applied to FEMA for emergency housing help (NOAA National Weather Service , 2018);
- $128 million in losses to South Carolina alone (IA and PA Obligated $ per FEMA) (NOAA National Weather Service , 2018)
- $18.1 million was provided for emergency housing assistance (NOAA National Weather Service , 2018);
- $17.2 million was provided to help reduce future storm losses (NOAA National

Weather Service , 2018);

- U.S. Small Business Administration made disaster loans totaling $200 million (NOAA National Weather Service , 2018);
- 11 dams breached or failed

Figure 11: Kingston Presbyterian Church, Conway, after Hurricane Florence (Photo Credit: Jonathan Lamb / NWS)

H. Changes From the Last Plan

This section was updated to include recent demographic and economic information and statistics (tourism data, population projections, employment data, etc.). U.S. Census or ACS one-year or five-year data, depending on most recent available data, was used in the state profile to provide up-to-date and accurate population and demographic statistics for reference and comparison. Information on disaster declarations since the last SHMP update was incorporated.

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IV. Hazard and Risk Analysis

South Carolina has a history of disasters ranging from the Charleston earthquake of 1886 to flooding in 2015 to hurricanes such as Hugo in 1989 and Matthew and Florence in 2016 and 2018 respectively. The impacts these events had on South Carolina proved to be long-lasting and key in motivating work to create a safer, more resilient state through hazard mitigation. While these disasters may be familiar to the residents of South Carolina, potential hazards are not limited to earthquakes, floods, and tropical cyclones. A key main objective of this plan is to coordinate efforts to minimize the impacts of future hazard occurrences in the state.

The purpose of this risk assessment is to analyze all potential hazards impacting South Carolina. The risk assessment addresses 19 hazards identified as potentially impacting the state:

- Coastal Hazards
- Drought
- Earthquake
- Extreme Cold
- Extreme Heat
- Flood
- Hail
- Hazardous Materials
- Infectious Disease
- Landslide and Mass Wasting
- Lightning
- Nuclear Release
- Severe Thunderstorms
- Terrorism and Mass Violence
- Tornado
- Tropical Cyclones
- Wildfire
- Wind
- Winter Weather

Hazards are organized thematically in this section starting with naturally occurring hazards and moving to human-caused hazards (accidental or intentional): meteorological, hydrological, seismic and geological, coastal, wildfire, infectious disease, hazardous material, nuclear release, and terrorism. Each hazard section includes the following subsections unless not relevant:

- Introduction
- Formation
- Classification
- Locational and Probability
- Vulnerability
- Impacts
- Future Climate Considerations

Sections include data and historical descriptions relating to the hazard. Not all sections will have the same types of data because of variations in the science and occurrence history associated with each hazard. In each hazard section, the formation section explains the science behind the hazard phenomenon and how it develops. The classification section lists how the hazard is designated or categorized, such as through scales or warnings and advisories. Understanding of a hazard's historic and potential intensity, magnitude, and/or severity plays a key role in classification.

Remaining subsections for each hazard are interconnected as their foundation relies on history of occurrence, impact data, and climate change considerations (i.e., limitations on use of historical data because of climate change). Location and probability sections provide a spatial and mathematical perspective to hazard occurrence. The location portion of the section displays where hazards have impacted South Carolina. Probability addresses the likelihood of a hazard occurring based on historic occurrences and other factors. The vulnerability section examines susceptibility to harm and damage from the hazard, including areas most vulnerable physically to the hazard and social vulnerability using the University of South Carolina's Hazard Vulnerability and Resilience Institute's Social Vulnerability Index (SoVI®). Loss information retrieved from SHELDUS is adjusted to 2020 U.S. dollar values.

Types and severity of impacts experienced or expected from the hazard are described based on recorded occurrences and/or modeling. Impacts provide context to the location, probability, and vulnerability information through event narratives and loss data collected over time or modeled. The future climate considerations section discusses projected potential impacts because of climate change and may note challenges climate change presents to understanding probability or frequency and impacts of certain hazard types. See Appendix B, Hazard Analysis Methodology, for additional detail on data sources and analysis process.

A. Extreme Temperatures

Extreme temperatures, whether extreme heat or cold, can create risk to human health and safety and stress or negatively impact infrastructure and social service and medical providers. Extreme temperatures are tracked on a day-to-day basis by weather services and emergency management and in the 21st century also on longer-term basis by researchers monitoring climate change and its impacts.

Extreme Heat

High temperatures are common in South Carolina in the summer and can occur anywhere in the state. Extreme heat, considered temperature above 95° F, can cause human health impacts and can pose challenges for infrastructure.

Classification

The National Weather Service issues outlooks for excessive heat days and through local weather forecast offices provides advisories.

The following are heat advisories issued by the National Weather Service (NOAA, n.d.):

- An **excessive heat warning** is issued within 12 to 24 hours before the onset of extremely dangerous heat conditions.
- An **excessive heat watch** is issued when conditions are favorable for excessive heat in the next 24 to 72 hours.
- A **heat advisory** is issued within 12 hours of the onset of dangerous heat conditions.

Location and Probability

Extreme heat events are seen throughout the state of South Carolina. According to the PRISM Climate Group at Oregon State University, days on which temperatures reach a minimum of 95° F are considered extreme heat events. On average, from 1981 to 2020, South Carolina extreme high temperature records ranged between 11 days of extreme heat events in Cherokee, Georgetown, and Oconee counties to as many as 29 days in Edgefield County.

The figures below show average annual extreme heat days across the 46 counties in South Carolina from 2015-2020 and 1981-2020, respectively, and indicate the variance between the central region extreme heat event concentration and lesser frequency in upstate and northern coastal regions.

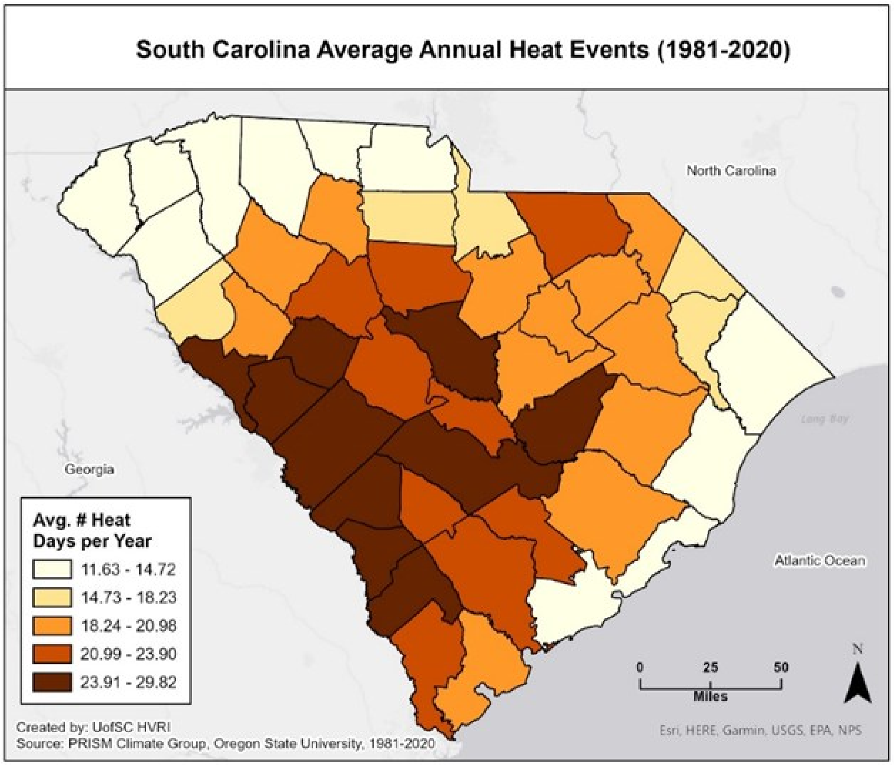


Figure 12: Average Annual Heat Events in South Carolina Counties, 1981-2020

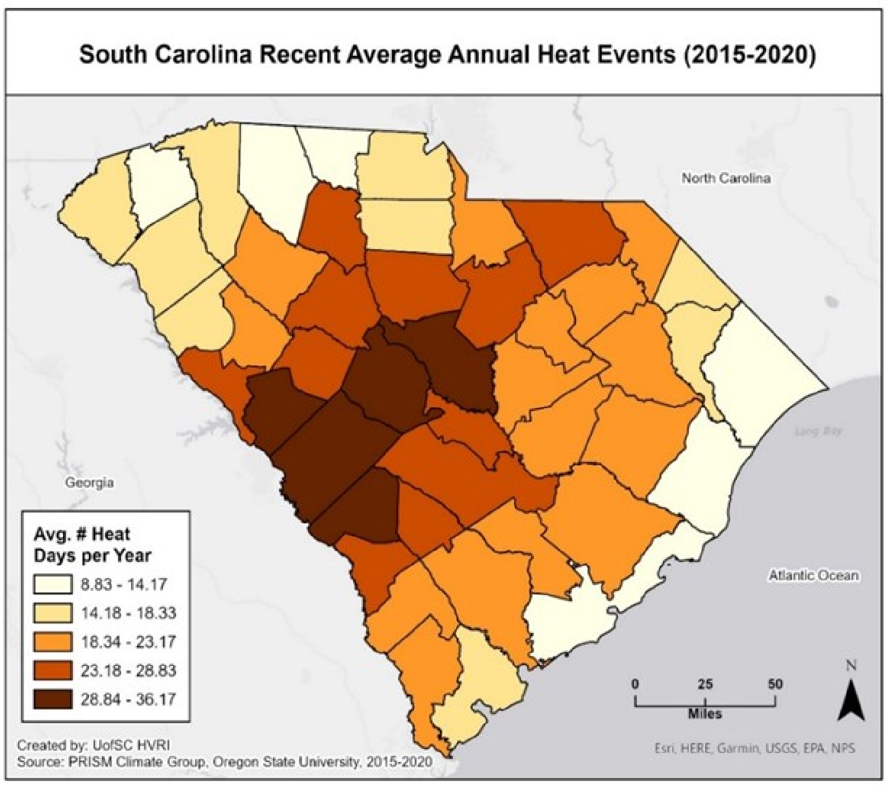


Figure 13: Recent Average Annual Heat Events in South Carolina Counties, 2015-2020

The table below lists extreme heat occurrences by county from 1981 through 2020. Annualized loss amounts are based on crop and property losses for the period covered. No losses were recorded in the most recent six years available (through 2020). Based on the recorded damage-causing occurrences from 1996-2021, future annual probabilities (percentage change of occurrence per year) and frequency intervals (years between events) for each county can be calculated. The higher percentage of future annual probability equates to a higher percentage of occurrence. Conversely, the lower the figure of frequency interval equates to a higher occurrence. Edgefield, Aiken, and McCormick counties have the highest chance per day of a heat event (8% chance per day). The average statewide daily frequency interval (# days in record/# of events) per county was 20, meaning that an extreme heat event can be expected to occur an average of every 20 days.

County	Hazard Occurrence (1981 - 2020)		Historical Events (1960-2020)	
	Future Probability (% chance per Day)	Frequency Interval (Years between event)	Deaths	Injuries
Abbeville	5	20.03	2	0
Aiken	8	12.74	4	0
Allendale	7	14.08	1	0
Anderson	4	24.79	3	0
Bamberg	6	15.92	1	0
Barnwell	7	14.85	2	0
Beaufort	5	19.44	1	0
Berkeley	5	18.39	2	0
Calhoun	6	16.19	0	0
Charleston	3	28.91	5	5
Cherokee	3	31.40	1	0
Chester	4	22.85	0	0
Chesterfield	6	16.94	0	0
Clarendon	7	14.75	3	0
Colleton	6	16.70	1	0
Darlington	5	18.43	3	0
Dillon	5	20.42	0	0
Dorchester	6	17.08	5	0
Edgefield	8	12.24	0	0
Fairfield	6	16.01	1	0
Florence	5	18.72	2	0
Georgetown	3	30.67	0	0
Greenville	4	25.30	6	0

County	Hazard Occurrence (1981 - 2020)		Historical Events (1960-2020)	
	Future Probability (% chance per Day)	Frequency Interval (Years between event)	Deaths	Injuries
Greenwood	6	18.11	3	0
Hampton	7	14.66	3	0
Horry	4	26.12	2	15
Jasper	6	16.55	2	0
Kershaw	5	19.34	5	0
Lancaster	4	23.55	0	0
Laurens	6	17.87	1	0
Lee	5	19.57	1	0
Lexington	6	15.57	0	0
Marion	5	20.71	0	0
Marlboro	5	18.65	0	0
McCormick	8	13.31	0	0
Newberry	7	15.27	0	0
Oconee	3	30.54	1	0
Orangeburg	7	14.69	1	0
Pickens	3	30.42	3	0
Richland	7	14.17	7	0
Saluda	7	14.23	0	0
Spartanburg	4	26.26	4	0
Sumter	6	17.46	0	0
Union	6	17.78	1	0
Williamsburg	6	17.40	0	0
York	4	28.57	2	0
Grand Total			83	29
State Average	5	19.51	2	1

Table 6 Extreme Heat Impacts and Occurrences

Vulnerability

All populations are vulnerable to health effects from extreme heat, which is magnified in prolonged exposure. Individuals who must spend time outside during hot days are at increased risk of exposure. The combination of relative humidity and air temperature amplifies what is experienced outside and impacts outdoor activities for people and animals. Heat-related illnesses are caused when the body is not able to regulate its internal temperature through sweating to cool the body. This can lead to cramps, fatigue, sweating and swelling, rash, vomiting, seizures and even death. Health impacts from extreme heat range from minor to life-threatening:

Heat Rash – red clusters of small blisters that look like pimples on the skin (usually on the neck, chest, groin, or in elbow creases). (Center for Disease Control, 2017)

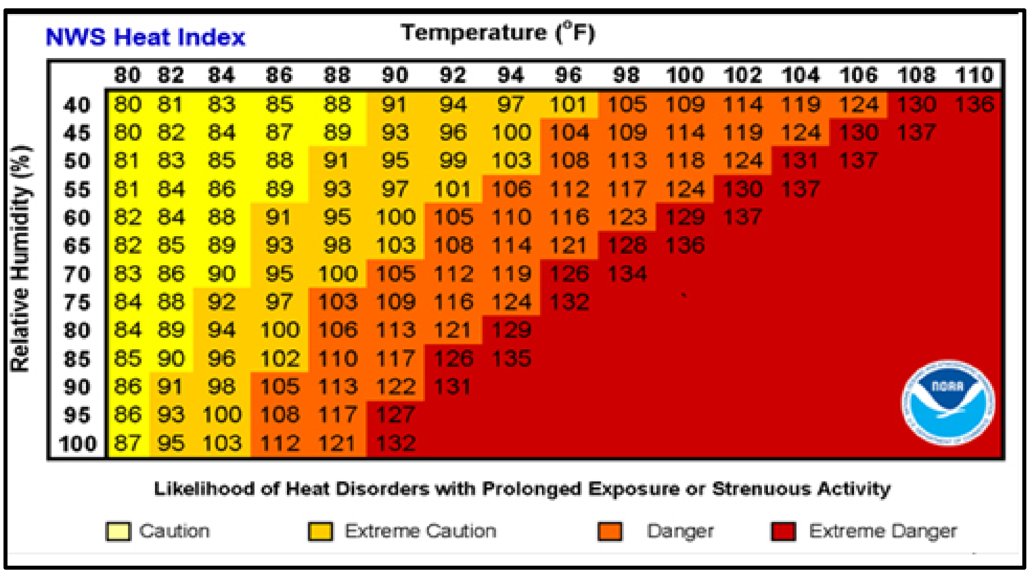
Sunburn – painful, red, and warm skin. May appear as blisters on the skin (Center for Disease Control, 2017)

Heat Cramps – muscle pain or spasms. An initial symptom is heavy sweating during intense exercise (Center for Disease Control, 2017).

Heat Exhaustion – heavy sweating; cold, clammy skin; headache; dizziness; nausea; and losing consciousness (Center for Disease Control, 2017).

Heat Stroke – symptoms from heat exhaustion persist and the body's temperature reaches 103° F or higher with hot, red, or damp skin and a rapid, strong pulse. Can result in nausea, confusion, dizziness, and loss of consciousness (Center for Disease Control, 2017).

The National Weather Service uses a relative heat measurement known as a heat index to describe to the public what the combination of high temperature and high humidity feels like during periods of high temperatures. "Heat Index is a measure of how hot it really feels when relative humidity is factored in with the actual air temperature." (Center for Disease Control, 2017) The combination of relative humidity and air temperature amplifies what is experienced outside and can impact the safety of outdoor activities for people and animals.


NWS Heat Index

Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution | Extreme Caution | Danger | Extreme Danger

Figure 14: Heat Index and exposure to heat related injuries

Based on probability and impacts, extreme heat risk scores by county are shown in the figure below.

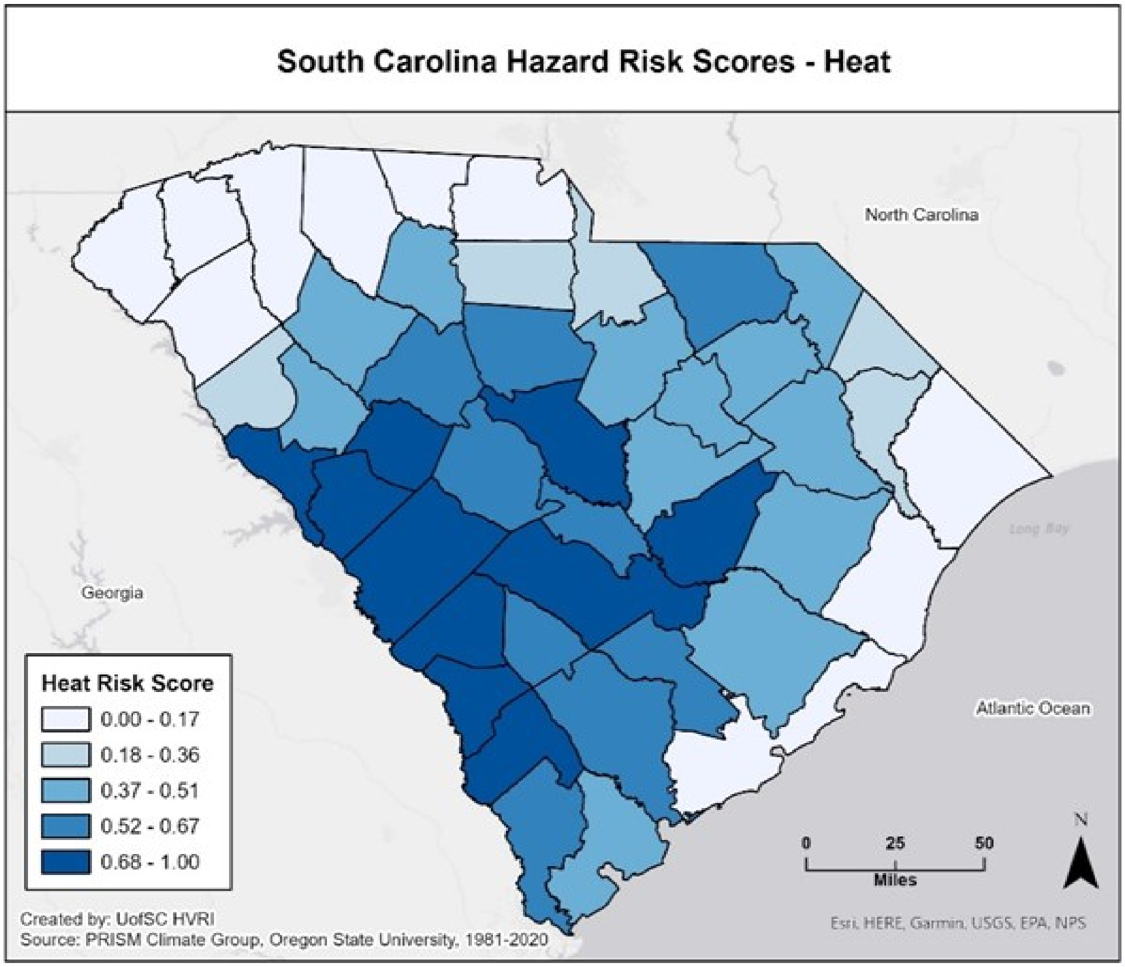


Figure 15: South Carolina Extreme Heat Risk

Vulnerability

Based on probability and climate data described above, all areas of South Carolina have vulnerability to extreme heat events. According to the CDC, populations most at risk of health impacts during periods of extreme heat include those aged 65 and older, infants and children, outdoor workers, individuals with chronic medical conditions, and low-income residents. People without access to adequate air conditioning also are more vulnerable. Figure 16 below shows social vulnerability combined with extreme heat risk.

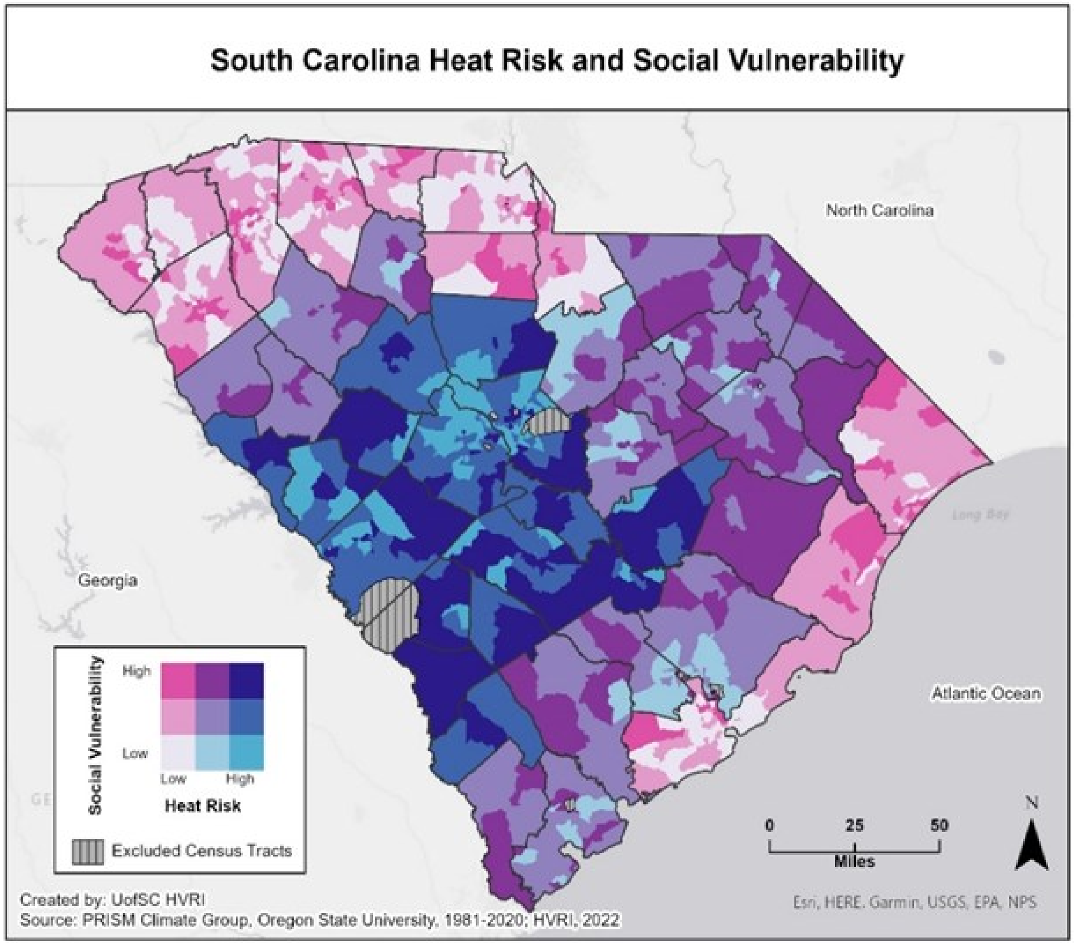


Figure 16: South Carolina Social Vulnerability and Extreme Heat Risk

Impacts

The table below lists extreme heat occurrences by county from 1981 through 2020. Annualized loss amounts are based on crop and property losses for the period covered. No losses were recorded in the most recent six years available (through 2020). Based on recorded damage-causing occurrences from 1996-2021, future annual probabilities (percentage change of occurrence per year) and frequency intervals (years between events) for each county can be calculated. The higher percentage of future annual probability equates to a higher percentage of occurrence. Conversely, the lower the figure of frequency interval equates to a higher occurrence. Edgefield, Aiken, and McCormick counties have the highest chance per day of a heat event (8% chance per day). The average statewide daily frequency interval (# days in record/# of events) per county was 20, meaning that an extreme heat event is projected to occur an average of every 20 days.

Impacts of extreme heat that are of most concern are impacts on human health and on agricultural production. Impacts of extreme heat on community lifelines are estimated in Table 7.

Community Lifeline	Level of Impact	Description of Impacts	Area of Impact
Communications	Low	No significant impact anticipated. Exposed telecommunications and broadband equipment and lines could experience damage from extreme heat.	Regional
Energy	Medium	Generation facilities and transmission lines could experience stress from high electricity demand. Energy disruptions could affect supply chains and create cascading impacts in other lifeline sectors.	Regional; potentially statewide
Food, Water, Shelter	Medium	Extreme heat could cause damage to crops and delays in outdoor agricultural activities, including harvesting and infrastructure maintenance and repairs. Impacts on food supply/supply chain and increased demand for water are possible. Cooling centers may be needed for residents who do not have access to air conditioning.	Regional
Hazardous Materials	Low	No significant impact is anticipated. Extreme high temperatures could degrade integrity of materials, fittings, and valves used in storage and transport of hazardous materials or create pressure, which could result in a release.	Localized
Health and Medical	Medium	High temperatures have the potential to cause serious human health impacts, so medical facilities would see increased numbers of dehydrated and heat-impacted patients, particularly the elderly. Medical facilities may require prioritization if electricity distribution is restricted because of high demand.	Regional
Safety and Security	Low	No significant impacts anticipated. Response personnel could see increased calls related to extreme high temperatures. Operations could be impacted by the need to reduce outdoor work of emergency personnel.	Regional
Transportation	Low	No significant impact anticipated. Roads exposed to extreme temperatures could experience damage to pavement. Transportation facilities, such as ports and airports, could see slowed operations because of need to reduce outdoor work of personnel.	Regional

Table 7 Potential Community Lifeline Impacts Based on Significant Extreme Heat Scenario

Historical and Notable Events

Historical and recent occurrence data is derived from NCEI's Storm Event Database unless stated otherwise. Loss-causing data is derived from SHELDUS V.20.0. For more information regarding hazard occurrence data sources, see the hazard narrative methodology in Appendix B.

August 6, 2007: An extreme heat event in the Midlands saw heat index higher than 100° F in Columbia (Richland County). One fatality was attributed to complications from heat stroke.

October 7, 2009: In Richland County, abnormally high temperatures were attributed as the cause of death for a recruit at Fort Jackson.

July 25-30, 2010: Brought extreme heat to the Lowcountry; heat index values ranged from 115 to 119° F for Beaufort, Charleston, and Colleton counties.

August 4, 2011: Extreme heat occurred in the Lowcountry. Observed heat index values ranged from 115 to 119° F for Allendale, Beaufort, Berkeley, and Charleston counties.

June 29-July 1, 2012: Extreme heat and record air temperatures in the Upstate led to heat index values ranging from 110 to 112° F. One heat-related fatality occurred in Easley (Pickens County).

March 16, 2017: A warm February and March led to an early growing season. A hard freeze led to crop losses of 80-90% in the Upstate, which was estimated at $750 million across Abbeville, Anderson, Cherokee, Chester, Greenville, Greenwood, Laurens, Oconee, Pickens, Spartanburg, Union, and York counties.

Recent Events 2018-2022

July 30, 2021: Extreme heat indexes were recorded in three counties in the Lowcountry: Beaufort and Berkeley counties reported a heat index of 115° F, and in Charleston County, heat index values reached 118° F.

Extreme Cold

Extreme cold in southern climates is viewed differently than in northern regions of the United States. Some states experience much colder temperature extremes than does South Carolina; temperatures at or near freezing are considered extreme cold in the state. Extreme cold events may be thought of as synonymous with winter weather events; however, not all extreme cold events are associated with winter precipitation. Extreme cold temperatures can occur without a winter storm. Extreme cold temperatures can cause impacts to human health and damage to infrastructure such as pipes and exposed equipment. Figure 17 shows the average annual extreme cold temperatures from 1981-2020.

Classification

Because of potential impacts associated with cold temperatures, the National Weather Service issues cold temperature advisories:

Frost Advisory - an 80 percent or greater probability that scattered or widespread frost will occur, usually within 12 to 24 hours. Patchy frost does not necessitate the issuance of a frost advisory, except in the late spring when vegetation is typically more sensitive (NOAA, 2020).

Freeze Watch - a 50 percent or greater probability that temperatures will be 32° or lower, usually within 12 to 48 hours (NOAA, n.d.).

Freeze Warning - an 80 percent or greater probability that temperatures will be 32° degrees or lower, usually within 12 to 48 hours (NOAA, n.d.).

Hard Freeze Warning - temperatures are expected to drop to 28° F for an extended period, killing many types of commercial crops and residential plants (NOAA, n.d.).

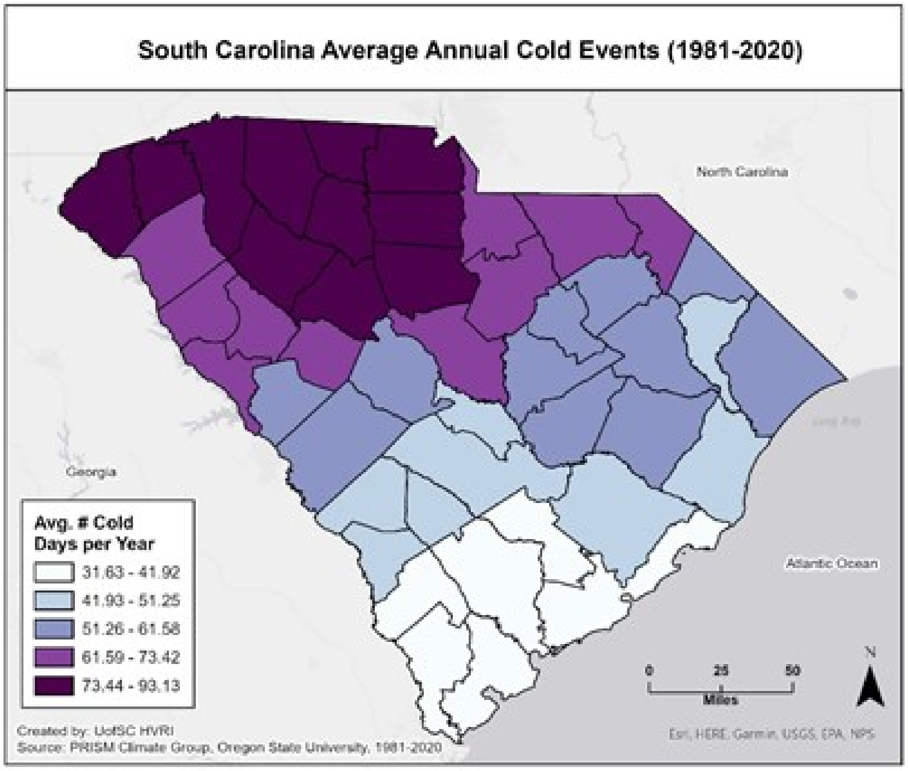


Figure 17: Average Annual Cold Events in South Carolina for 1981 – 2020

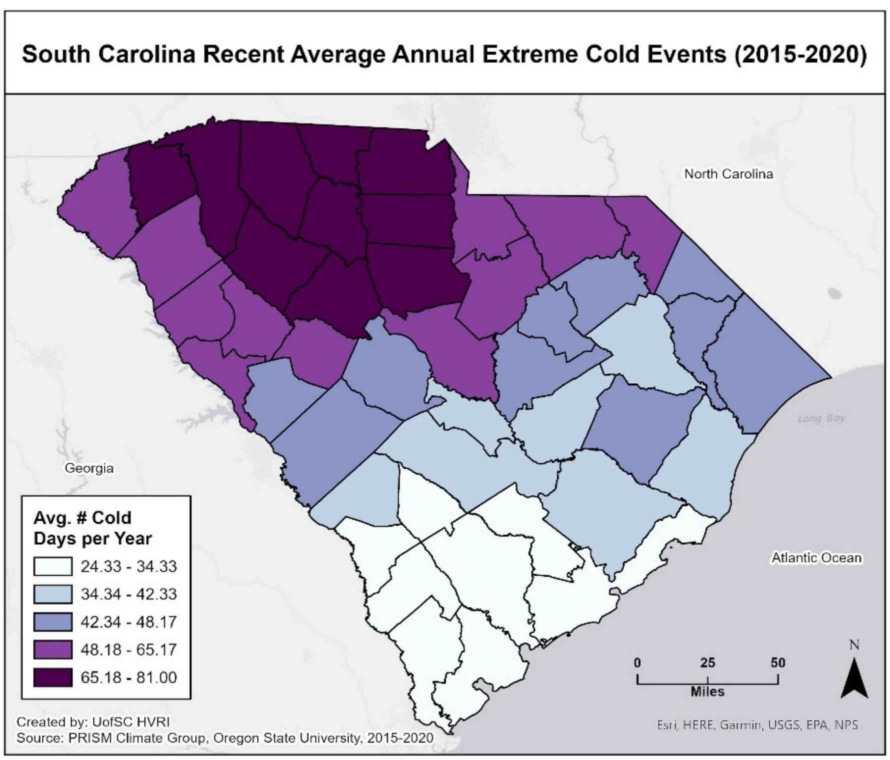


Figure 18: Recent Average Annual Extreme Cold Events in South Carolina Counties, 2015-2020

Location and Probability

Extreme cold temperature events are seen throughout the state of South Carolina with the Upstate experiencing a higher probability and occurrence of events because of location and elevation. According to the PRISM Climate Group, on average from 1981 to 2020, The number of annual cold events, meaning days on which temperatures are at or below 32° F, ranges from a low of 31 days in Beaufort and Charleston counties and as many as 93 days in Greenville County. Table 8, Figure 17, and Figure 18 display cold occurrence by county and the average annual extreme cold days across the 46 counties in South Carolina from 2015-2020. These figures illustrate that the Upstate has the most extreme cold events. The central portion of the state sees moderate numbers of extreme cold events; however, the events decrease significantly closer to the coast and in the Lowcountry.

County	Cold Occurrence (1981-2020)		County	Cold Occurrence (1981-2020)	
	Future Daily Probability (% chance per day)	Frequency Interval (Years between event)		Future Daily Probability (% chance per day)	Frequency Interval (Years between event)
Abbeville	20	4.97	Greenwood	19	5.22
Aiken	15	6.59	Hampton	11	9.14
Allendale	13	7.71	Horry	15	6.76
Anderson	20	5.08	Jasper	10	10.27
Bamberg	12	8.11	Kershaw	19	5.31
Barnwell	13	7.46	Lancaster	20	5.03
Beaufort	9	11.54	Laurens	23	4.26
Berkeley	13	7.95	Lee	16	6.29
Calhoun	14	7.34	Lexington	16	6.24
Charleston	9	11.53	Marion	14	7.12
Cherokee	24	4.09	Marlboro	18	5.58
Chester	23	4.32	McCormick	19	5.35
Chesterfield	19	5.38	Newberry	22	4.53
Clarendon	15	6.58	Oconee	22	4.59
Colleton	11	8.71	Orangeburg	14	7.22
Darlington	16	6.13	Pickens	22	4.45
Dillon	16	6.29	Richland	20	5.04
Dorchester	11	8.83	Saluda	19	5.37
Edgefield	17	5.93	Spartanburg	24	4.19
Fairfield	23	4.38	Sumter	15	6.71
Florence	15	6.81	Union	25	3.93
Georgetown	12	8.13	Williamsburg	16	6.44
Greenville	26	3.92	York	23	4.31
Grand Total					
State Average	17	6.33		17	6.33

Table 8 Cold Occurrences by County

Vulnerability

In extreme cold events, exposure to the elements for an extended period of time may result in cases of hypothermia and frostbite. Hypothermia occurs when the body falls below 95° F and is unable to produce internal heat fast enough to warm the body. The most vulnerable population to extreme cold temperatures are "elderly people with inadequate food, clothing, or heating; babies sleeping in cold bedrooms; people who remain outdoors for long periods – the homeless, hikers, hunters, etc.; and people who drink alcohol or use illicit drugs (NOAA, n.d.)". Signs of hypothermia include shivering, confusion, slurred speech, memory loss, and sluggishness, and may lead to losing consciousness. While hypothermia is not limited to cold weather events, the potential for hypothermia increases in the winter months. Extreme cold risk and social vulnerability are displayed in the figure below.

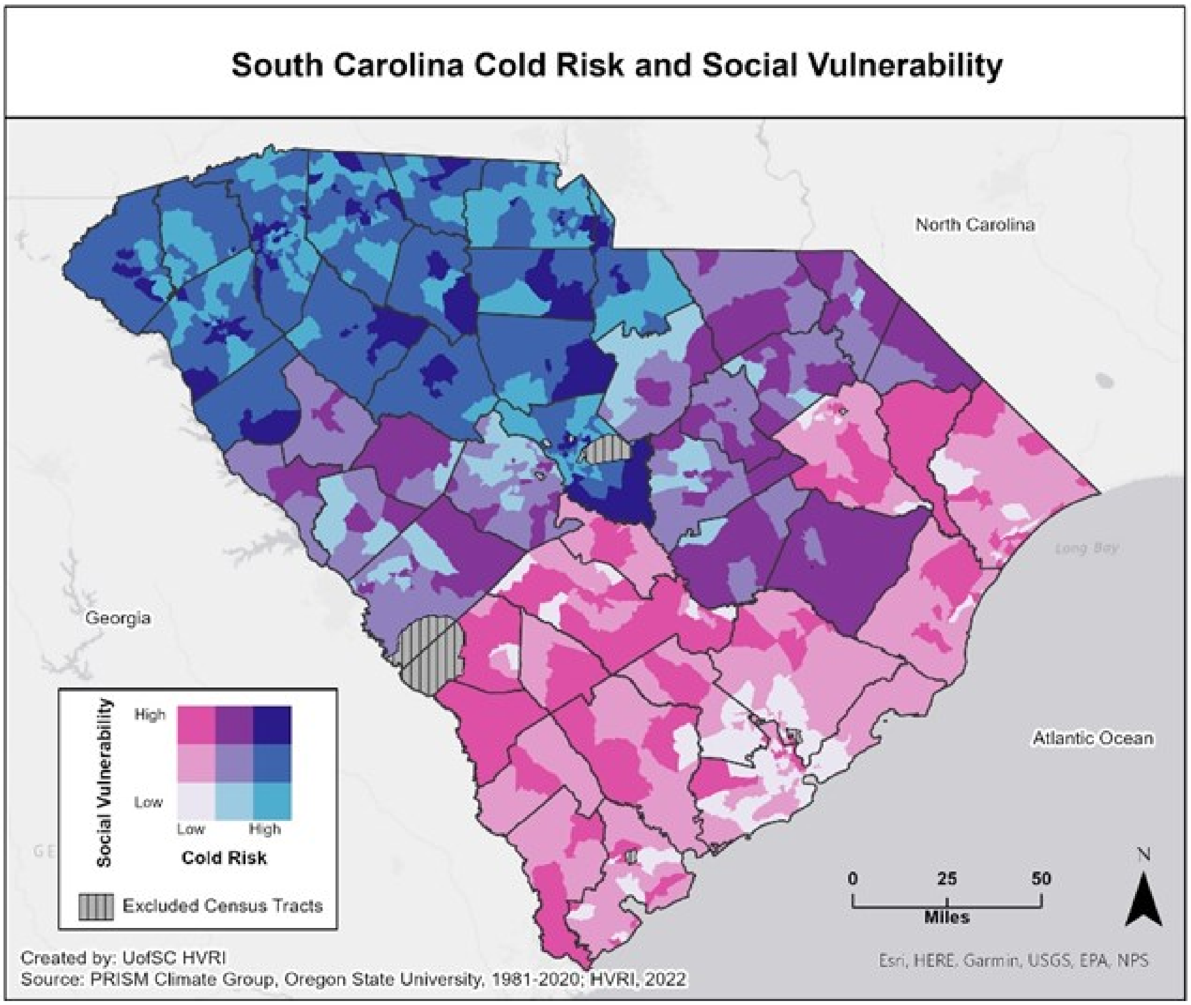
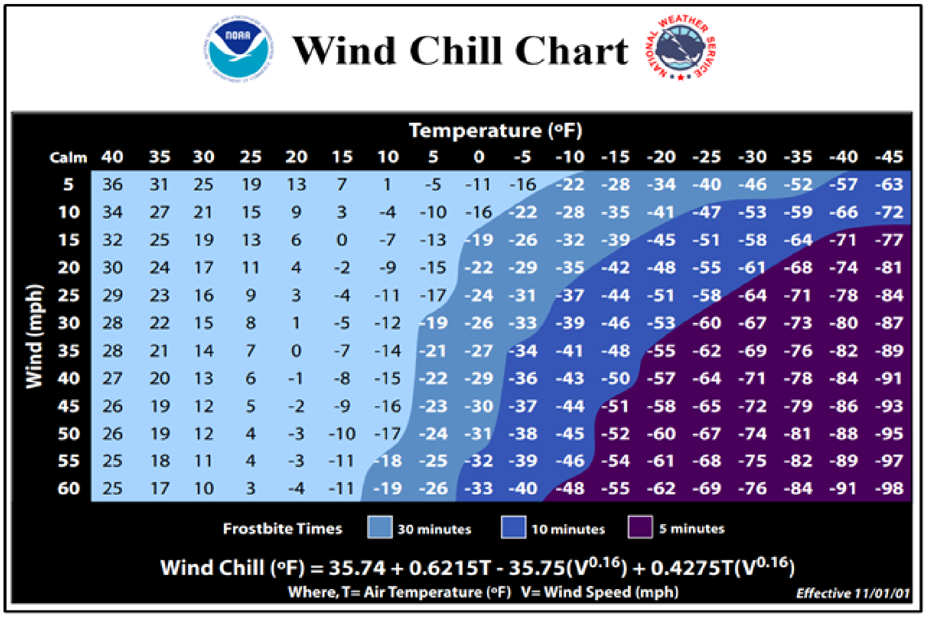


Figure 19: South Carolina Social Vulnerability and Cold Risk Map



Wind Chill Chart

Temperature (°F)

Wind (mph) Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes, 10 minutes, 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

Figure 20: Wind Chill Chart.

Source: NOAA/NWS

Frostbite is another potential medical condition experienced by those exposed to extreme cold conditions, particularly when cold is combined with wind. Frostbite occurs when areas of exposed skin and underlying tissues begin to freeze, leading to discoloration and loss of feeling. For example, frostbite can occur in 30 minutes when the temperature is at 30° F with winds of 15mph.

Impacts

While South Carolina experiences extreme cold weather events annually, there are no recorded property or crop loss extreme cold weather events. The historical and notable events section below highlights the impacts of extreme cold weather events through fatalities and/or injuries attributed to extreme cold weather events.

Extreme cold temperatures can have negative impacts on several community lifelines as described in Table *9* below.

Community Lifeline	Level of Impact	Description of Impacts	Area of Impact
Communications	Low	Significant impacts are not expected unless telecommunication or broadband lines or equipment are damaged by freezing temperatures, resulting in disruptions in service.	Regional
Energy	Medium	Generation operations and other electric power sources may be stressed by increased demand. Energy disruptions could affect supply chains and create cascading impacts in other lifeline sectors.	Regional
Food, Water, Shelter	Medium	Extended freezing conditions may damage water lines and/or wastewater management systems. Potential for power outages may result in food spoilage. Warming centers will be needed to	Regional

Community Lifeline	Level of Impact	Description of Impacts	Area of Impact
		protect human health and safety. Agricultural loss is possible depending on when the extreme cold occurs compared to the growing season	
Hazardous Materials	Low	No significant impacts are anticipated. Cold temperatures can damage fittings and valves associated with hazardous material storage and transport, which could cause a release.	Localized
Health and Medical	Medium	Cold temperatures may add an influx of patients to medical facilities for treatment for exposure; elderly patients and those in areas with power outages will be most vulnerable. Damage to water systems could result in disruptions of water supplies, requiring backup resupply or relocation of patients/residents.	Regional
Safety and Security	Low	Safety and security personnel could experience health risks from extreme cold temperatures.	Localized
Transportation	Low	Roadways, bridges, railways, and highways could have potential damage because of extreme cold. If ice is present, additional disruption and impacts would be expected.	Localized or regional

Table 9 Potential Community Lifeline Impacts Based on a Significant Extreme Cold Scenario

Historical and Notable Events

Historical and recent occurrence data is derived from NCEI's Storm Event Database unless stated otherwise. Loss-causing data is derived from SHELDUS V.20.0. For more information regarding hazard occurrence data sources, see Appendix B.

January 12, 1996: Two boys fell through the ice on a frozen pond. Both later died of hypothermia as a result.

February 3-5, 1996: Temperatures fell to record lows in the Lowcountry, and an arctic airmass produced snowfall. The event resulted in two reported fatalities: one in Charleston County and another in Anderson County.

March 8, 1996: Extreme cold temperatures resulted in record lows in the Upstate affecting the peach crop in Cherokee County. The estimated crop loss was approximately $20 million.

December 25, 1996: Cold weather in Greenville County was attributed as the cause of two fatalities from exposure to cold temperatures.

January 20, 2000: Cold weather in Anderson County resulted in an elderly woman succumbing to hypothermia.

January 25, 2000: Two fatalities were attributed to hypothermia: one in Anderson County and another in Greenwood County.

December 6, 2010: Cold weather in Mullins (Marion County) resulted in one man dying from hypothermia.

January 6-7, 2014: An arctic cold moving through the western Carolinas brought strong winds and extreme cold conditions. Air temperatures dropped into the teens and 20s while wind chills were recorded near -15° F.

January 7-8, 2015: A cold front moved through South Carolina resulting in single digit temperatures in the Upstate. Reported air temperatures were around 10° F. Wind chill readings were between 0° F and 5° F.

February 18-20, 2015: Mountainous areas of Greenville, Oconee, and Pickens counties experienced air temperatures near and below 0° F. Wind chills of -5° F to -20° F were reported.

March 16, 2017: A warm February and March led to an early start to growing season. A hard freeze led to crop losses estimated between 80-90% in the Upstate. The estimated crop loss totaled approximately $750 million from Abbeville, Anderson, Cherokee, Chester, Greenville, Greenwood, Laurens, Oconee, Pickens, Spartanburg, Union, and York counties.

Recent Events 2018-2022

January 1-7, 2018: Arctic air brought extreme cold temperatures to the Upstate. Reported wind chill values ranged from 0° F to -15° F with temperatures in the lower teens to single digits.

Future Climate Conditions

Climate studies anticipate the global average temperature will increase during the next few decades between "between 0.5°F and 1.3°F (0.3°–0.7°C)."[3] Many factors play a role in the anticipated increase in temperatures such as global aerosol, carbon, and greenhouse gas emissions; human activities such as development and land use; and the Earth's natural atmospheric and environmental feedback variabilities. As temperatures warm, vulnerability to temperature-related illnesses, injuries, and fatalities can be expected to increase.

South Carolina's average annual temperature increased one degree from 1895 to 2020. After a brief period between 1956 and 1970 where the average annual temperature dropped from 63°F to 61°F, the temperature increased more than 3° from 1970 to 2020.

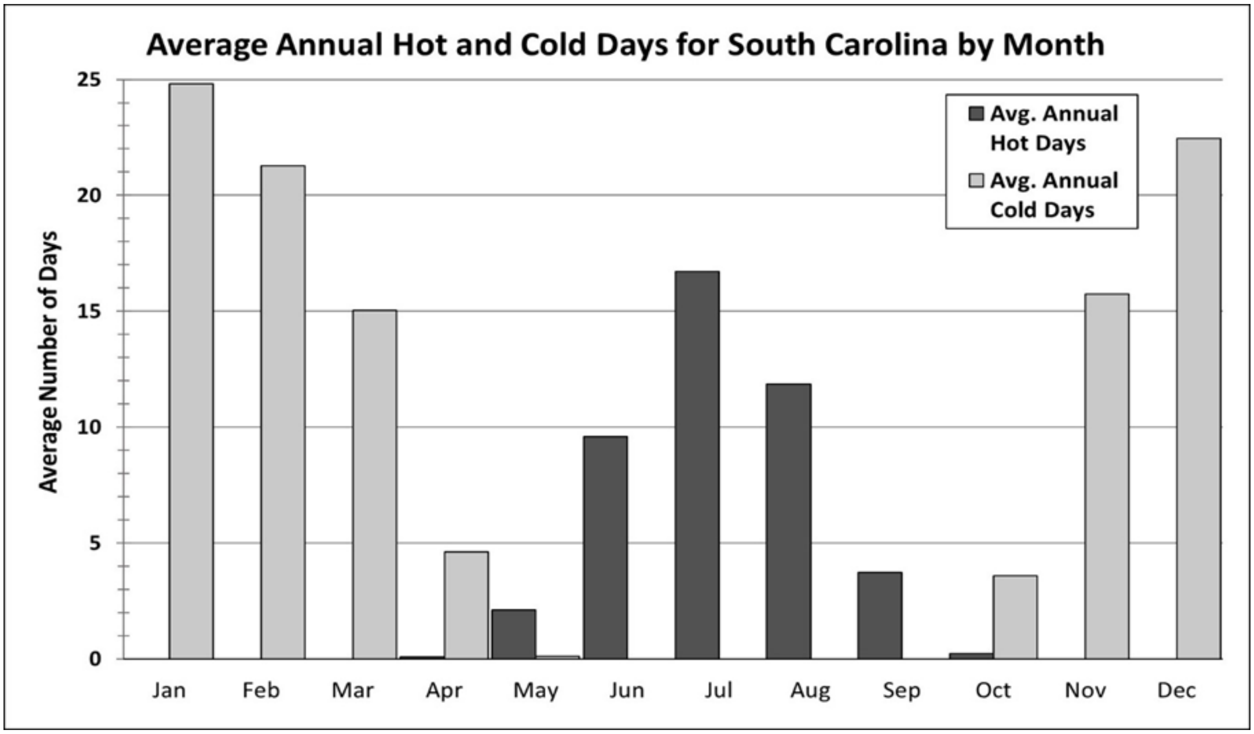


Figure 21: Recent Average Annual Number of Extreme Hot and Cold Days for South Carolina from 2015 - 2020

Of the 14 weather stations that can provide data from 1900 to 2020, all but three observed an increase in maximum temperature during at least one season; Blackville, Summerville, and Yemassee did not. The minimum temperature for the summer season showed a statistically significant increase in temperatures, which supports the increase in average annual temperatures across nine of the 14 weather stations. One assumption is that continued increases in minimum temperature in the summer season will compound warming because of a lack of cooling in the Earth's diurnal cycle. A diurnal cycle is the 24-hour daily pattern the Earth experiences as it heats up during the day and cools at night. If an effective cooling is not present during nighttime, temperatures would begin higher to start the day, thus potentially leading to higher temperatures during the day and night.

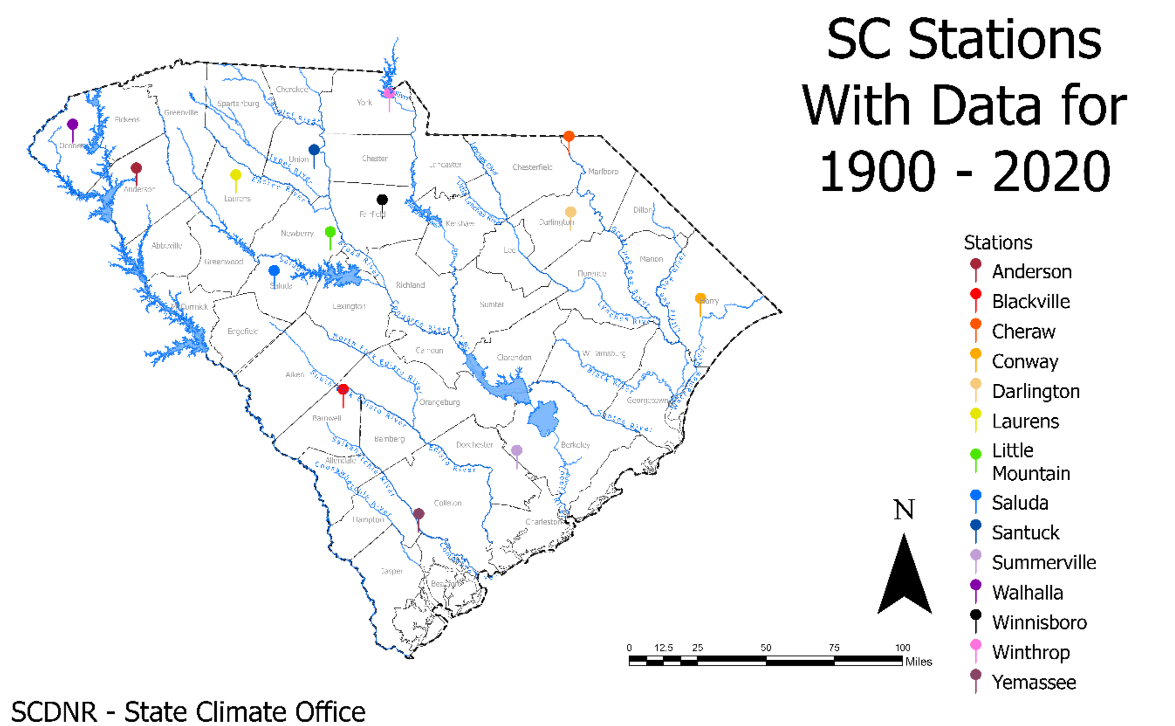


Figure 22: South Carolina Weather Data Collection Stations.

Source: South Carolina State Climatology Office

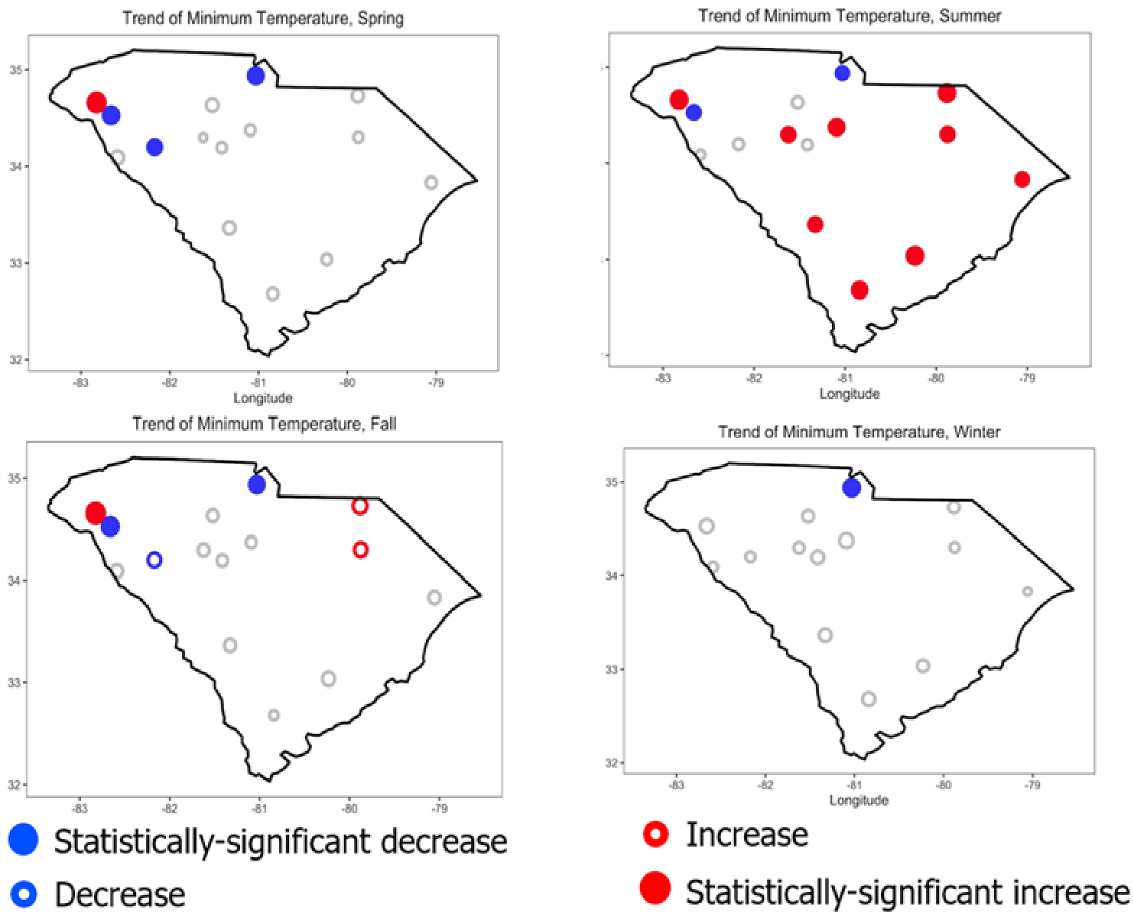


Figure 23: Trend of Minimum Temperature from 1902 - 2020

B. Hail

Hail can cause damage to agricultural resources, vehicles, and buildings. Hail is a type of precipitation consisting of ice pellets that form when updrafts of thunderstorms carry water droplets into the freezing level of the atmosphere (NOAA, n.d.). Small, pea-size hail is considered the most common version although hail can be larger. Large hail can damage property, kill livestock, and injure people.

Formation

Initially, water droplets are propelled by updrafts within thunderstorms high in a cloud, where they freeze. As droplets collide and combine with other supercooled droplets in the atmosphere, the droplets fall. Strong vertical motions can keep lifting hailstones, propelling them back into the freezing level. Once a droplet returns to the freezing level of the atmosphere, there is potential for another layer of ice to form around the original. The size of a hailstone is the direct consequence of the level of intensity an updraft has in a storm. When the hailstone develops sufficient weight to overcome the updraft, the hailstone falls towards the ground. The speed at which hail reaches the ground is its terminal velocity. The terminal velocity of an individual piece is determined by the accumulated size and weight. Figure 24 illustrates hail formation.

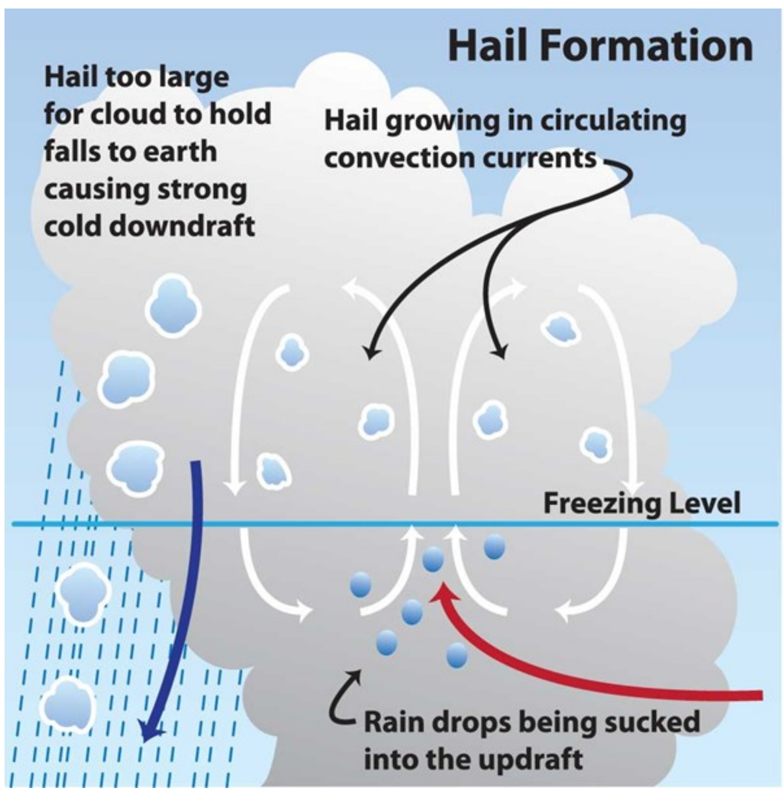


Figure 24: Hail Formation

Source: NOAA

Classification

Description of hailstone size often is by comparison to a familiar object. See Table 10 below.

Known-Object	Estimated Hail Diameter (Inch)	
Pea	1/4"	0.25"
Marble	1/2"	0.5"
Dime/Penny	3/4"	0.75"
Nickel	7/8"	0.875"
Quarter	1"	1"
Ping-Pong Ball	1 1/2"	1.5"
Golf Ball	1 3/4"	1.75"
Tennis Ball	2 1/2"	2.5"
Baseball	2 3/4"	2.75"
Teacup	3"	3"
Grapefruit	4"	4"
Softball	4 1/2"	4.5"

Table 10 Hail Size

Location and Probability

According to historical data collected by the NOAA Storm Prediction Center, 925 hail events occurred in South Carolina from 1955 to 2020 with approximately 128.8 events occurring annually statewide. Hail events cannot be predicted as to where they will occur. Typical events involve small hailstones (hail of 1 inch diameter or smaller). For the purpose of this plan, all buildings and facilities are considered equally exposed to this hazard. Maps below depict hail events since 1955 as well as hail events between 2015-2019.

Based on current data, the state average probability for a hailstorm is 199% per year. Greenville County has the highest probability, with a 588% chance per year, followed by Horry and Spartanburg counties. Allendale County has the lowest probability at 52% per year. It should be noted that historical data relies on reports of hail by the public and therefore may be incomplete because of a potential bias based on population density. Because of this, the number of incidents of hail, particularly in areas of lower population density, may be greater than what is indicated by the historical data. See Table 11 below.

County	Hail Occurrence (1955-2020)		County	Hail Occurrence (1955-2020)	
	Future Annual Probability (% chance per year)	Frequency Interval (Years between event)		Future Annual Probability (% chance per year)	Frequency Interval (Years between event)
Abbeville	114	0.88	Greenwood	156	0.64
Aiken	258	0.39	Hampton	64	1.57
Allendale	52	1.94	Horry	479	0.21

County	Hail Occurrence (1955-2020)		County	Hail Occurrence (1955-2020)	
	Future Annual Probability (% chance per year)	Frequency Interval (Years between event)		Future Annual Probability (% chance per year)	Frequency Interval (Years between event)
Anderson	298	0.34	Jasper	68	1.47
Bamberg	102	0.99	Kershaw	182	0.55
Barnwell	97	1.03	Lancaster	158	0.63
Beaufort	185	0.54	Laurens	200	0.50
Berkeley	444	0.23	Lee	86	1.16
Calhoun	108	0.93	Lexington	389	0.26
Charleston	402	0.25	Marion	106	0.94
Cherokee	167	0.60	Marlboro	88	1.14
Chester	135	0.74	McCormick	67	1.50
Chesterfield	167	0.60	Newberry	150	0.67
Clarendon	165	0.61	Oconee	283	0.35
Colleton	176	0.57	Orangeburg	277	0.36
Darlington	159	0.63	Pickens	235	0.43
Dillon	103	0.97	Richland	314	0.32
Dorchester	248	0.40	Saluda	106	0.94
Edgefield	106	0.94	Spartanburg	485	0.21
Fairfield	123	0.81	Sumter	192	0.52
Florence	223	0.45	Union	133	0.75
Georgetown	135	0.74	Williamsburg	124	0.80
Greenville	588	0.17	York	238	0.42
State Average				199	0.70

Table 11 Hail Impacts and Losses

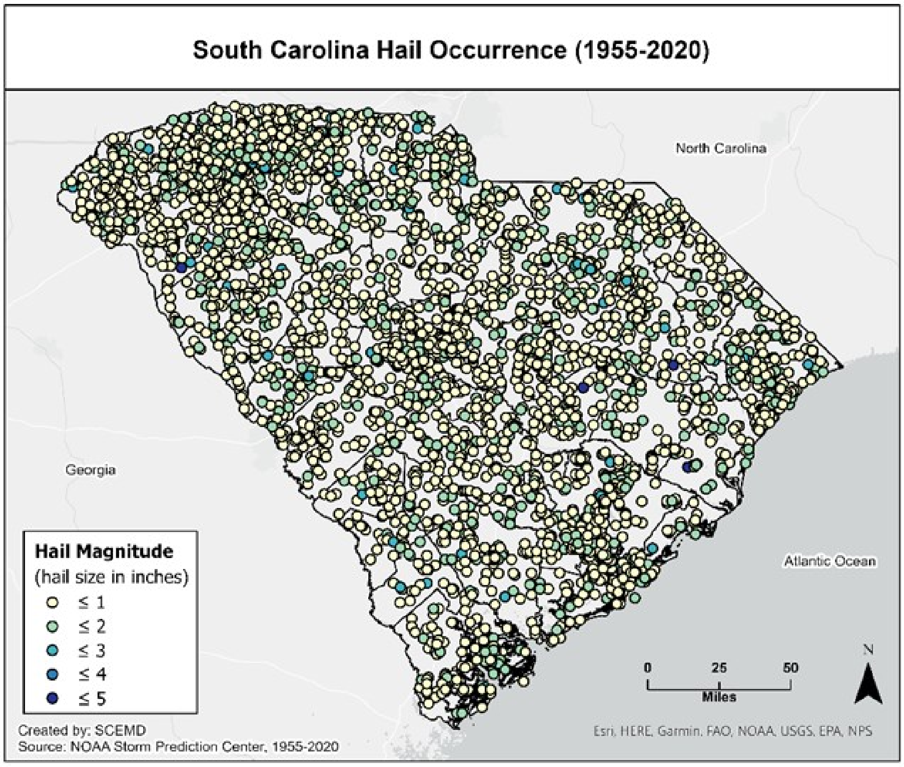


Figure 25: Hail Event Occurrence in South Carolina (1955–2020) by magnitude based on hail size

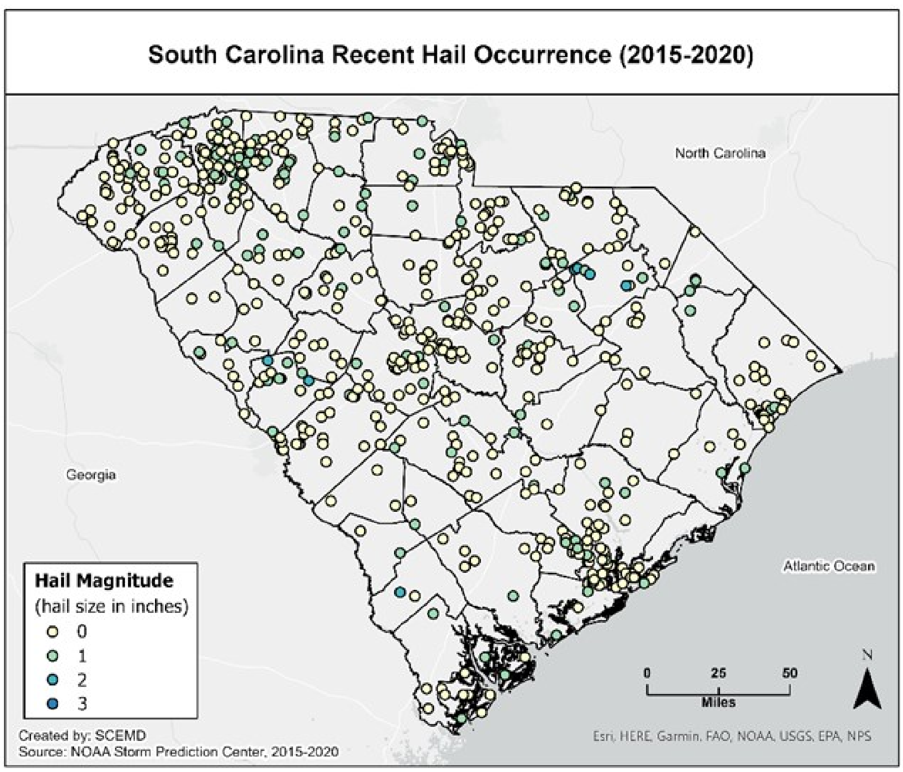


Figure 26: Recent Hail Event Occurrence in South Carolina (2015–2020) by magnitude based on hail size

Vulnerability

While hail can occur in any county, vulnerability to impacts from hail varies because of population and land use.

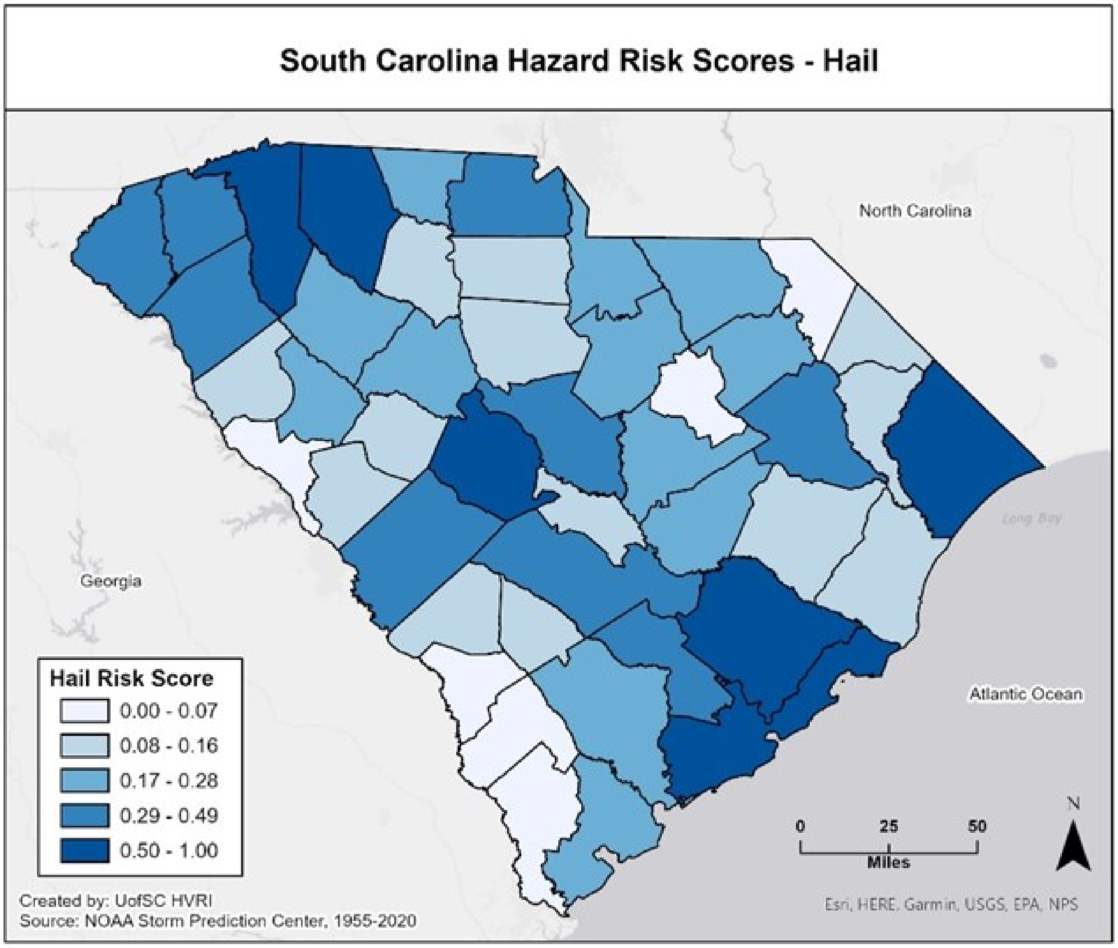


Figure 27: South Carolina Hail Risk Scores Per County

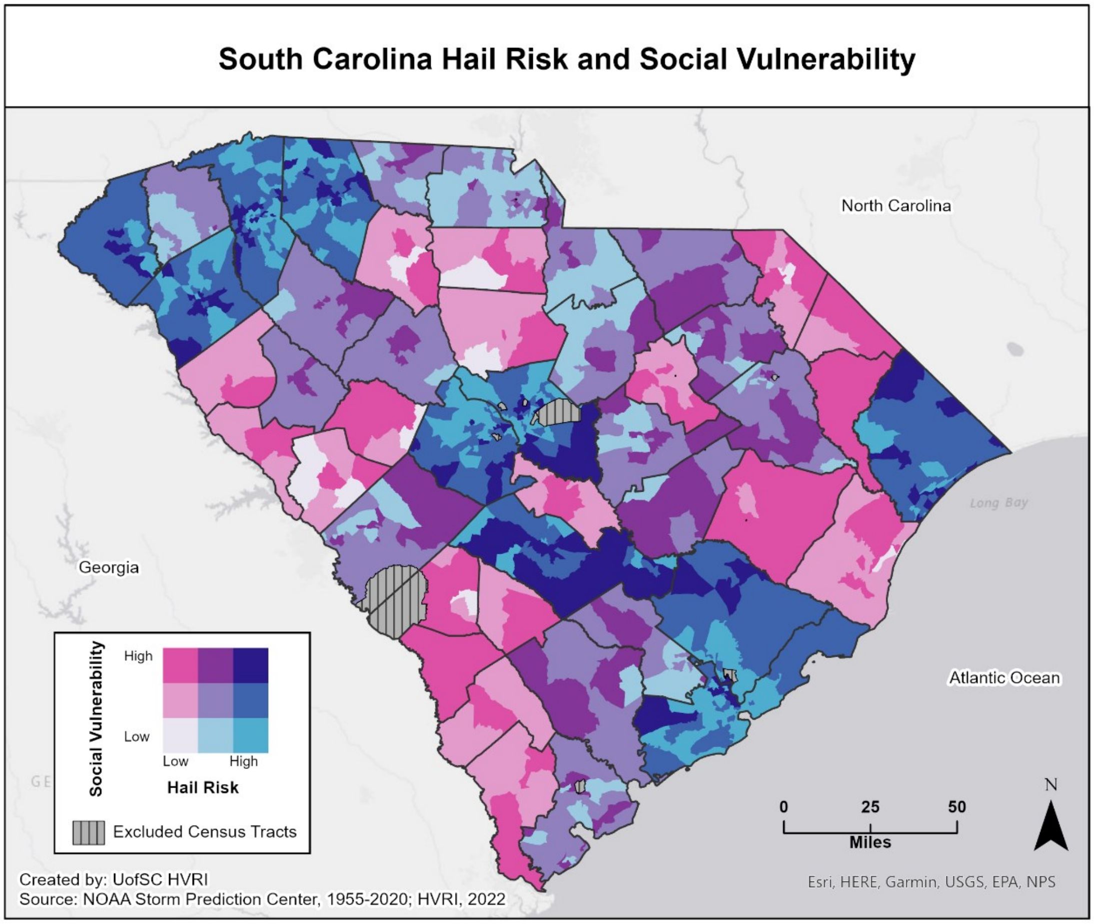


Figure 28: South Carolina Social Vulnerability and Hail Risk

Impacts

Impacts of hail damage are typically calculated based on deaths and injuries, as well as property damages measured in dollars. In addition, hailstorms can potentially create cascading effects, including power and communications outages. The following tables and maps are provided to summarize historical and recent hail events and their associated losses (property damage, crop damage, fatalities, and injuries).

Total annualized damages costs for the historical period (61 years) averaged $62,705 per county, while the recent period (6 years) averaged $299.35 per county. Many counties sustained no loss-causing events during this time. Florence has the highest annualized losses. Details on impacts and occurrences for all counties are provided in table the Impacts Table.

Hail is not considered to have significant impacts on community lifelines, although there is potential for agricultural losses that could impact food commodities.

Community Lifeline	Level of Impact	Description of Impacts	Area of Impact
Communications	Low	No significant impact anticipated. Hail could damage outdoor equipment but would not likely disrupt operations.	Localized
Energy	Low	No significant impact anticipated. Hail could damage facilities and outdoor equipment but would not likely disrupt operations.	Localized
Food, Water, Shelter	Low	No significant impact anticipated. Large hail can damage crops. Hail could damage facilities but would not likely affect habitability.	Localized
Hazardous Materials	Low	No significant impact anticipated. Hail could damage facilities but would not likely disrupt operations or cause hazardous material release.	Localized
Health and Medical	Low	No significant impact anticipated. Hail could damage facilities but would not likely disrupt operations.	Localized
Safety and Security	Low	No significant impact anticipated. Hail could damage facilities but would not likely disrupt operations.	Localized
Transportation	Low	No significant impact anticipated. Large hail could damage vehicles and/or aircraft and temporarily ground flights but would not likely disrupt operations long-term.	Localized

Table 12 Potential Community Lifeline Impacts Based on Significant Hail Scenario

Hail data occurrences range from 1955 to 2020; hail loss data found in SHELDUS is for 1960-2020.

County	Historical Impact (1960-2020)			Recent Impact (2015-2020)		
	Annualized Losses	Deaths	Injuries	Annualized Losses	Deaths	Injuries
Abbeville	$8,435	0	3	$0	0	0
Aiken	$8,996	0	1	$225	0	0
Allendale	$5,182	0	0	$0	0	0
Anderson	$40,997	0	3	$0	0	0
Bamberg	$10,949	1	31	$0	0	0
Barnwell	$10,085	0	1	$69	0	0
Beaufort	$23,936	0	0	$0	0	0
Berkeley	$8,151	1	2	$0	0	0
Calhoun	$9,006	0	0	$70	0	0
Charleston	$37,922	0	0	$0	0	0
Cherokee	$29,736	0	0	$0	0	0
Chester	$6,630	0	1	$0	0	0

County	Historical Impact (1960-2020)			Recent Impact (2015-2020)		
	Annualized Losses	Deaths	Injuries	Annualized Losses	Deaths	Injuries
Chesterfield	$24,969	0	0	$176	0	0
Clarendon	$13,750	0	0	$0	0	0
Colleton	$5,484	0	1	$0	0	0
Darlington	$28,688	0	4	$211	0	0
Dillon	$28,611	0	0	$310	0	0
Dorchester	$7,766	0	0	$0	0	0
Edgefield	$20,708	0	0	$3	0	0
Fairfield	$90,555	2	11	$33	0	0
Florence	$775,758	0	6	$535	0	0
Georgetown	$9,331	0	0	$486	0	0
Greenville	$29,095	1	3	$0	0	0
Greenwood	$69,880	0	0	$0	0	0
Hampton	$3,795	0	0	$0	0	0
Horry	$42,336	0	0	$1,463	0	0
Jasper	$2,639	0	0	$0	0	0
Kershaw	$132,354	0	19	$110	0	0
Lancaster	$180,521	0	2	$3,464	0	0
Laurens	$34,707	1	0	$0	0	0
Lee	$13,210	0	0	$34	0	0
Lexington	$16,687	0	0	$182	0	0
Marion	$19,852	0	0	$268	0	0
Marlboro	$23,981	0	0	$134	0	0
McCormick	$8,476	0	0	$37	0	0
Newberry	$156,121	1	22	$862	0	0
Oconee	$24,672	0	0	$0	0	0
Orangeburg	$14,301	0	0	$182	0	0
Pickens	$19,914	0	2	$0	0	0
Richland	$12,079	0	2	$234	0	0
Saluda	$109,244	0	2	$4,517	0	0
Spartanburg	$506,324	1	1	$0	0	0
Sumter	$22,367	0	10	$147	0	0
Union	$24,594	0	1	$0	0	0
Williamsburg	$10,520	0	0	$18	0	0
York	$201,128	0	0	$0	0	0
Grand Total	$2,884,442	8	128	$13,770	0	0
State Average	$62,705	< 1	3	$299	0	0

Table 13 Hail Historical and Recent Occurrences

Historical and Notable Events

The below narratives discuss historic events as well as more recent events that occurred since the last plan update. Historical and recent occurrence data is derived from NCEI's Storm Event Database unless stated otherwise. Loss-causing data is derived from SHELDUS v.20.0. For more information regarding hazard data sources, see the hazard narrative methodology in Appendix B.

April 24, 1999: A super cell thunderstorm moved through Saluda County and produced hail as large as baseball size objects along its entire path. Homes, buildings, farm equipment, vehicles, and crops were damaged. The thunderstorm, including the associated hail, caused damages across a three-mile-wide swath. Property damages were estimated to be $2 million; crop damages were estimated to be $2 million; and two injuries were reported.

May 25, 2000: A severe thunderstorm caused straight-line winds and dime size hail in Darlington, and 2-inch hailstones south of the city. Property damage was estimated at $150,000. The County Agricultural Service reported several areas of crop damage near Highway 401, estimated at $10,000. In Florence, a severe thunderstorm caused large hail and wind gusts estimated at over 80 mph. The largest hail size was estimated at over four inches in diameter, causing extensive damage to roof and siding. Approximately 2,000 homes were damaged, with repair costs exceeding 6 million dollars. The storm knocked out power to over 20,000 residences. Two injuries were reported because of broken glass impacted by hail.

May 23, 2010: A complex system of thunderstorms moved into Horry County during the afternoon, generating hail reported as half-dollar size. The hail event lasted for about 15 minutes; property damage estimates were $244,000.

April 9, 2011**:** Supercell thunderstorms across the upper Midlands and Pee Dee regions produced hail up to the size of baseballs. Property damage estimates were $45 million.

April 16, 2011: Supercell thunderstorms produced hail and two tornadoes, which knocked down trees in the eastern Midlands and Pee Dee regions. Estimated property damage was more than $210,000.

May 10, 2011: Widespread damaging hail of up to softball size was reported across eastern and southern South Carolina as a shortwave (middle to upper atmospheric disturbance that creates lift) moved across the area and resulted in scattered thunderstorms. Property damage estimates were $325,000.

June 15, 2011: A squall line that moved from Tennessee into the Upstate caused significant wind and hail damage. Property damage estimates were $250,000.

Recent Activity (2018 –2020)

March 20, 2018: Scattered thunderstorms across much of the state, primarily in coastal counties, produced hail up to 2-inch diameter with property damage estimated at $4,250.

June 25-27, 2018: Severe thunderstorms developed across South Carolina resulting in heavy rains, golf-ball sized hail and wind gusts up to 60 mph. Supercell thunderstorms produced large hail across the foothills. Greenville County was especially hard hit, mainly in the Eastside and Greer areas as severe thunderstorms produced multiple hail swaths with stones up to the size of baseballs, which caused damage to vehicles and structures.

April 25, 2020: Multiple supercell thunderstorms produced wind and hail damage. Reported hail size varied from 0.25" in Sumter County to 2" along Interstate 85 in Blacksburg along the North Carolina-South Carolina border.

Future Climate Considerations

As a component of severe thunderstorms, hail falls under similar climate projections. Overall, the climate trends are not as definitive because of interannual variation and the inconsistencies in recording past occurrences. Some climate model simulations suggest that convective available potential energy will increase in the future and the wind shear will decrease (Brooks H. , 2013). If simulations of heightened energy from severe thunderstorms hold true, a safe assumption would be an increase in severe thunderstorms. Less conservative climate models predict that a higher global average annual temperature increase will increase the potential for severe thunderstorms and the hazards that come with them. There is evidence supporting an increase in the number of observed hail events; with climate change, using previous occurrence data as a foundation for future projections is problematic (Allen, 2012).

C. Lightning

Formation

Lightning is a result of the conductive relationship between positive and negative ions. During thunderstorms, hot and cold air clash together creating a disruptive space for energy. Positive and negative ions generate large amounts of energy when colliding and rubbing together within a cloud system. Lighting is created when the energy becomes too high to be contained, and energy is released from thunderstorm cloud systems. The surrounding air can act as an insulator between these charges. Cloud-to-cloud or cloud-to-ground lighting occurs when the differences (voltage gradient) between the charges overpowers the insulating properties of the air.

Classification

If thunder can be heard, lightning can be present. Because lightning can cause injury and death, the best way to protect against it is to avoid it. The National Weather Service advises that best practice to avoid lightning are to find an enclosed building in which to shelter while staying away from electronics, showers, sinks, and bathtubs (National Weather Service , 2016).

Lightning that interacts with the ground is classified into two types: natural and artificially initiated. Natural lightning occurs when there is a normal electrification environment, where the strike travels from cloud to ground. Artificially initiated lightning is the opposite; it typically travels from ground to cloud, often initiated by tall structures, and travels upward.

Lightning that never reaches the ground is considered a cloud flash. Lightning that remains in a cloud are called intra-cloud lightning flashes. Sheet lightning is also another form of in-cloud lightning which describes lightning that lights up a "sheet of luminosity" throughout the cloud (NOAA, n.d.).

Location and Probability

Thunderstorms can occur in all regions of the United States but are most common in central and southern states. Lightning occurrence cannot be predicted; therefore, all locations, buildings, and facilities are considered equally exposed to these to hazards and can be impacted. Figure 29 and Figure 30 below display density of damaging lightning occurrences. See also Figure 31, which displays damaging lightning risk.

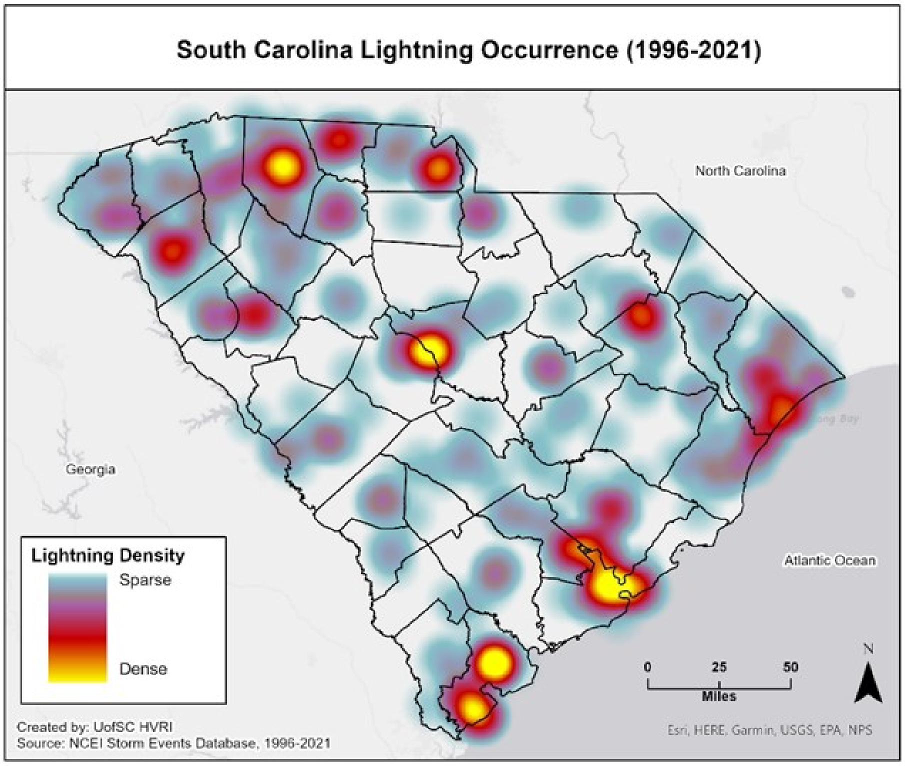


Figure 29: Lightning Occurrence Density, 1996-2021

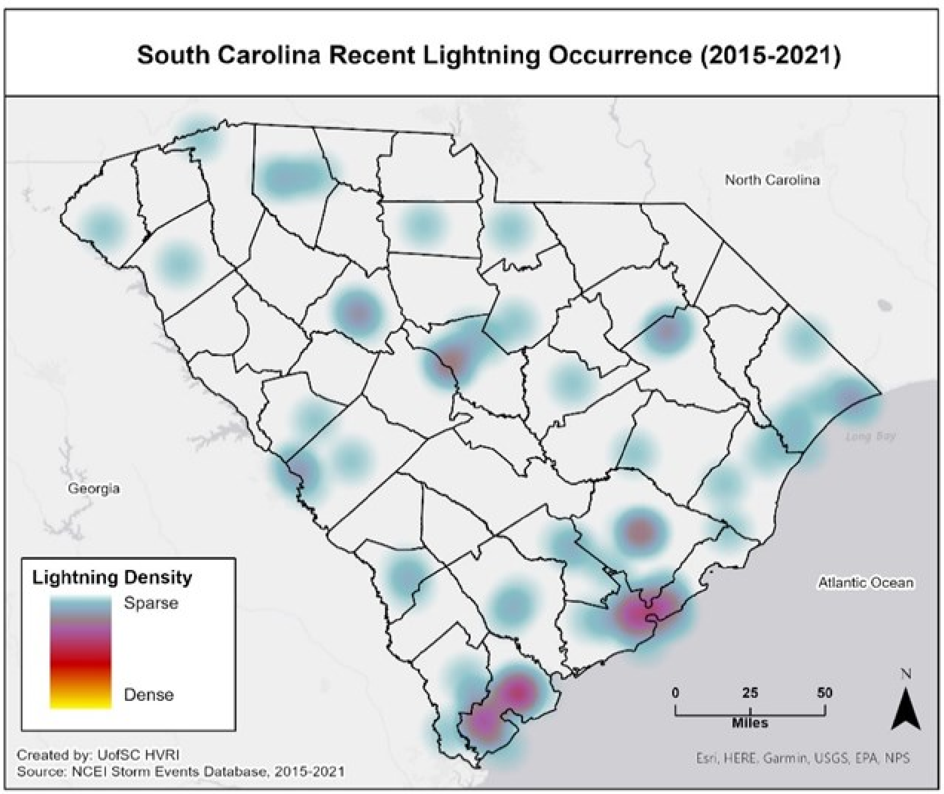


Figure 30: Lightning Occurrence Density, 2015-2021

Table 14 below addresses lightning occurrence by county from 1960 through 2020. Based on recorded damage-causing lightning occurrences from 1996-2021, future annual probabilities (percentage change of occurrence per year) and frequency intervals (years between events) for each county can be calculated. The higher percentage of future annual probability equates to a higher percentage of occurrence. Conversely, the lower the figure of frequency interval equates to a higher occurrence. Beaufort, Horry, and Charleston counties have the highest future annual probability and lowest frequency intervals for recorded counties. The table depicts Saluda as having the lowest probability and frequency intevals. These figures do not, however, reflect events that occurred outside of the observed timeframe (1996-2021).

County	Lightning Occurrence (1996 - 2021)		County	Lightning Occurrence (1996 - 2021)	
	Future Annual Probability (% chance per year)	Frequency Interval (Years between event)		Future Annual Probability (% chance per year)	Frequency Interval (Years between event)
Abbeville	0	0.07	Greenwood	0	0.00
Aiken	0	0.12	Hampton	0	0.00
Allendale	0	0.07	Horry	0	0.00
Anderson	0	0.02	Jasper	0	0.00
Bamberg	0	0.37	Kershaw	0	0.00
Barnwell	4	0.02	Lancaster	0	0.00
Beaufort	0	0.00	Laurens	0	0.00
Berkeley	1	0.37	Lee	0	0.00
Calhoun	13	0.40	Lexington	0	0.00
Charleston	1	0.28	Marion	0	0.00
Cherokee	0	0.23	Marlboro	0	0.00
Chester	0	0.05	McCormick	0	0.00
Chesterfield	5	0.86	Newberry	0	0.00
Clarendon	2	0.07	Oconee	0	0.00
Colleton	0	0.07	Orangeburg	0	0.00
Darlington	0	0.14	Pickens	0	0.00
Dillon	0	0.16	Richland	0	0.00
Dorchester	0	0.02	Saluda	0	0.00
Edgefield	0	0.23	Spartanburg	0	0.00
Fairfield	0	0.14	Sumter	0	0.00
Florence	0	0.07	Union	0	0.00
Georgetown	0	0.02	Williamsburg	0	0.00
Greenville	0	0.07	York	0	0.00
State Average				37	7.5

Table 14 Lightning Occurrences

Vulnerability

From 1959 to 2017, South Carolina ranked 17 out of the United States and territories for number of lightning deaths by state (NOAA, n.d.). During this time, 101 total fatalities occurred in South Carolina. The overall trend of lightning fatalities for the United States has decreased since the 1940s; 1943 saw the highest number of fatalities with 432. The total number of deaths nationwide dropped to 11 in 2021. Lightning deaths can be attributed to different factors such as being exposed outdoors during a storm or not being aware of storms being present in the area. For South Carolina, the statewide average lightning risk score is 0.22. Counties with the highest risk scores are Beaufort (1), Charleston (0.91), and Horry (0.86) counties. Those with the lowest lightning risk scores (0) were Fairfield and Saluda counties. Figure 31 shows the lightning risk statewide.

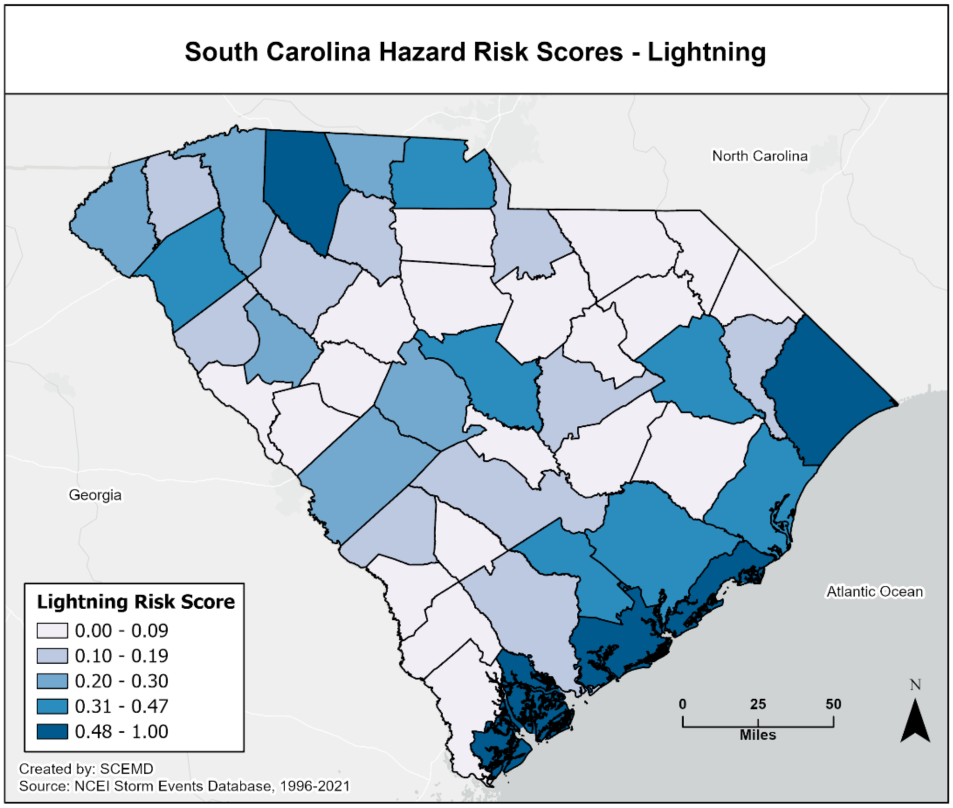


Figure 31: South Carolina Damaging Lightning Risk

In terms of social vulnerability and risk analysis, of the included 1,303 census tracts, 120 fall within the combined highest levels of social vulnerability and highest risk scores (dark blue). These high-high areas are concentrated in 11 counties throughout the state, which include areas in Anderson, Beaufort, Berkeley, Charleston, Dorchester, Florence, Georgetown, Horry, Richland, Spartanburg, and York counties. Demographic factors that increase likelihood of being outside during lightning events or not being able to take shelter increase vulnerability to harm from lightning. Figure 32 below shows the combination of lightning damage risk and social vulnerability.

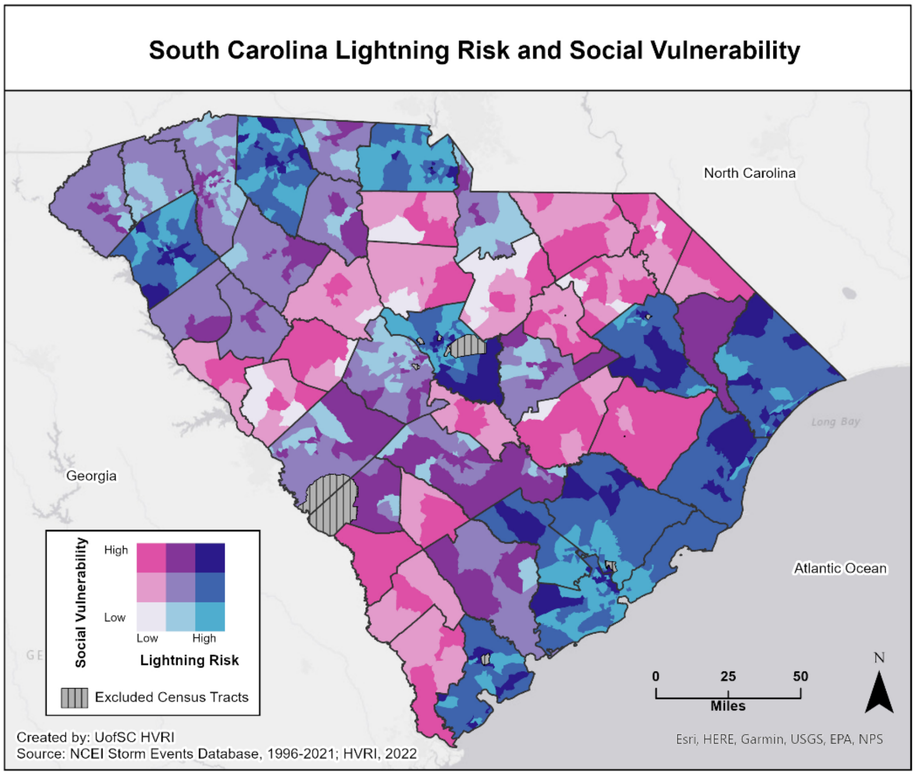


Figure 32: South Carolina Social Vulnerability and Lightning Risk

Impacts

Annualized loss amounts are based on crop and property losses for the period covered. The counties with the highest annualized monetary losses in the historical period are Anderson ($170,368), Charleston ($139,088), and Richland ($107,444) while those with the highest recent annualized monetary losses are Beaufort ($311,104), Williamsburg ($92,159), and Charleston ($80,473) counties. Details on impacts and occurrences for all counties are provided in the table.

County	Historical Events (1960-2020)			Recent Impact (2015-2020)		
	Annualized Losses	Deaths	Injuries	Annualized Losses	Deaths	Injuries
Abbeville	$15,234	1	1	$0	0	0
Aiken	$48,991	3	8	$14,481	0	0
Allendale	$16,670	0	0	$3,113	0	0
Anderson	$170,368	0	15	$0	0	0
Bamberg	$23,936	1	2	$0	0	0
Barnwell	$10,163	4	5	$0	0	0
Beaufort	$92,334	8	31	$311,104	0	1
Berkeley	$15,260	4	11	$13,053	0	0
Calhoun	$6,475	0	1	$0	0	0
Charleston	$139,088	7	27	$80,473	0	7

County	Historical Events (1960-2020)			Recent Impact (2015-2020)		
	Annualized Losses	Deaths	Injuries	Annualized Losses	Deaths	Injuries
Cherokee	$36,818	0	5	$0	0	0
Chester	$5,670	1	2	$0	1	0
Chesterfield	$8,536	1	2	$0	0	0
Clarendon	$15,922	6	7	$0	0	0
Colleton	$24,361	2	4	$18,836	0	0
Darlington	$7,510	3	2	$0	0	0
Dillon	$7,454	2	0	$0	0	0
Dorchester	$8,138	0	4	$16,857	0	0
Edgefield	$4,253	0	4	$0	0	4
Fairfield	$5,396	2	8	$0	0	0
Florence	$51,102	1	6	$15,944	0	1
Georgetown	$23,749	2	29	$0	1	13
Greenville	$75,588	3	9	$0	0	1
Greenwood	$11,381	2	2	$0	0	0
Hampton	$11,362	2	1	$0	0	0
Horry	$44,225	6	20	$37,131	0	5
Jasper	$1,160	0	2	$0	0	2
Kershaw	$22,982	1	1	$105	0	0
Lancaster	$13,838	0	1	$17	0	0
Laurens	$48,318	4	5	$0	0	0
Lee	$6,482	0	1	$0	0	0
Lexington	$42,948	3	9	$0	1	0
Marion	$19,945	0	3	$0	0	0
Marlboro	$9,751	1	3	$0	0	0
McCormick	$7,961	0	0	$0	0	0
Newberry	$10,324	0	2	$6,974	0	0
Oconee	$30,413	3	10	$12,260	0	0
Orangeburg	$27,059	8	11	$0	0	0
Pickens	$11,543	2	5	$0	0	0
Richland	$107,444	4	61	$876	0	1
Saluda	$5,560	0	1	$0	0	0
Spartanburg	$70,968	6	29	$12,871	0	0
Sumter	$45,915	2	1	$17	0	0
Union	$16,216	1	6	$0	0	0
Williamsburg	$13,100	1	1	$92,159	0	0
York	$22,872	4	9	$0	0	0

County	Historical Events (1960-2020)			Recent Impact (2015-2020)		
	Annualized Losses	Deaths	Injuries	Annualized Losses	Deaths	Injuries
Grand Total	$1,414,783	97	374	$636,271	3	35
State Average	$30,756	2	8	$13,832	0	2

Table 15 Lightning Impacts and Occurrences

While lightning events are not anticipated to cause major widespread impacts, they can cause damage and disruption for several key community lifelines including communications and electric power.

Community Lifeline	Level of Impact	Description of Impacts	Area of Impact
Communications	Medium	Telecommunications and broadband equipment and systems could be damaged by lightning, causing interruption of services.	Localized or regional
Energy	Medium	Energy generation, transmission, and distribution equipment and systems could be damaged by lightning strikes. Areas could be affected by power outages beyond the area of immediate impact.	Localized or regional
Food, Water, Shelter	Low	Significant impacts are not anticipated. Residential structures could be damaged by lightning or resulting fire. Food storage and water systems could be compromised by power outages caused by lightning.	Localized
Hazardous Materials	Low	Significant impacts are not anticipated.	Localized
Health and Medical	Low	Significant impacts are not anticipated. Facilities and equipment could be damaged by lightning or resulting fire.	Localized
Safety and Security	Low	Lightning may cause increased risk for response personnel who need to be outside. Fire caused by lightning could lead to increased strain on fire services.	Localized
Transportation	Low	Significant impacts to roads and bridges are not anticipated. Fallen trees from lightning strikes could temporarily block traffic. Temporary disruption of operations may be needed for ports or airports.	Localized

Table 16 Potential Community Lifeline Impacts Based on Significant Lightning Scenario

Historical and Notable Events

Historical and recent occurrence data is derived from NCEI's Storm Event Database unless stated otherwise. Loss-causing data is derived from SHELDUS V.20.0. For more information regarding the hazard data sources, see the hazard narrative methodology in Appendix B.

February 28, 2009: Lightning struck a house and caused a fire in Meriwether (McCormick County). Property damage was estimated at $200,000.

June 1, 2009: Lightning struck a home in Murrells Inlet (Horry County) that created a fire that destroyed the home. Property damage was estimated at $400,000.

June 11, 2009: Severe thunderstorms produced lighting, which caused two fires in Columbia (Richland County). Residential damages totaled $720,000.

June 28, 2009: Lightning struck Garden City Baptist Church in Garden City (Horry County) resulting in the church and an adjacent building catching fire. The fire caused $300,000 in damage.

June 26, 2010: Severe thunderstorms produced lightning across the Midlands. Lightning strikes led to multiple residential fires. One fire occurred in Saint Andrews (Richland County); two occurred in Lexington County (Irmo and Lexington). The monetary damage from both fires totaled $370,000.

April 9, 2011: Severe thunderstorms produced lightning that struck the Centenary Baptist Church in Rains (Marion County). Property damage was estimated at $300,000.

August 1, 2012: Lightning from a severe thunderstorm struck historic Shiloh United Methodist Church in Shiloh (Sumter County). The fire destroyed the structure, which was built in 1831, resulting in $1.3 million in damage.

July 9, 2013: Slow-moving thunderstorms over Upstate South Carolina caused areas of flash flooding and knocked down several trees. Lightning started a residential fire near Harris Springs (Laurens County) that destroyed the structure. Property damage was estimated at $300,000.

June 30, 2015: Lightning struck Mt. Zion AME Church in Greeleyville (Williamsburg County), causing a fire. Property damage was estimated at $500,000.

June 15, 2016: Lightning injured four people at a restaurant in Garden City (Horry County).

July 6, 2016: Lightning injured four agricultural workers in a peach field near Trenton (Edgefield County).

Recent Activity 2018-2022

May 11, 2018: One person was struck by lightning at a camp near River Falls (Greenville County) along the North Carolina-South Carolina border.

July 7, 2018: Three people were injured in a lightning strike on Isle of Palms beach (Charleston County).

August 8, 2018: Lightning struck a historic home on Lady's Island (Beaufort County), causing a fire that resulte in $1.7 million in damage.

July 3, 2019: Lightning struck a residence in Klondike (Horry County) resulting in a two-alarm fire (multiple department response). The fire caused $150,000 in damage.

July 4, 2019**:** A group of people at an event venue in Olin (Georgetown County) were struck by lightning resulting in 12 injuries and one fatality.

July 13, 2019: Lightning struck a business in Ridgeville (Dorchester County) resulting in a complete loss and $100,000 in damages.

May 5, 2020: One person was struck by lightning and killed in Chester (Chester County).

August 8, 2020: Lightning struck a residence in Sharp (Richland County) resulting in one person being injured.

September 9, 2020: One person was struck by lightning while working construction on a property in Baileys Landing (Beaufort County).

August 2, 2021: Lightning struck an oak tree in Charleston Heights (Charleston County) causing the tree to fall on a home resulting in $75,000 in damages.

September 8, 2021: Thunderstorms associated with Tropical Storm Mindy produced lightning that started a fire damaging two structures in Beaufort (SC State Climatology Office , 2021).

Future Climate Considerations

As referenced in the severe thunderstorm narrative, climate trends are not definitive because of interannual variation and inconsistencies in the recording of past occurrences. Some climate model simulations suggest that convective available potential energy will increase in the future and the wind shear will decrease (Brooks H. , 2012). If these simulations hold true with the energy for severe thunderstorms being more prevalent, a safe assumption would be an increase in severe thunderstorms. An increase in severe thunderstorm potential will mean a potential increase in lightning frequency. While lightning is often found in severe thunderstorms, lightning occurrence is not solely dependent on severe thunderstorms. Further study is needed on non-severe thunderstorm and lightning occurrence projections in relation to climate change.

D. Severe Thunderstorms

Thunderstorms occur frequently in South Carolina. When severe, thunderstorms bring high winds and potential for hail and tornadoes and can cause significant damage to property and risk to human safety and health.

Formation

Development of a thunderstorm begins when unstable air rises, and clouds undergo vertical growth. There is little rain at this stage, and because of the lifting mechanism, either by localized convection or some other trigger, clouds can grow vertically of 5 to 20 meters per second. Within the cloud, the temperature decreases with height and ice crystals start to form. Lightning may occur during this relatively short-lived stage.

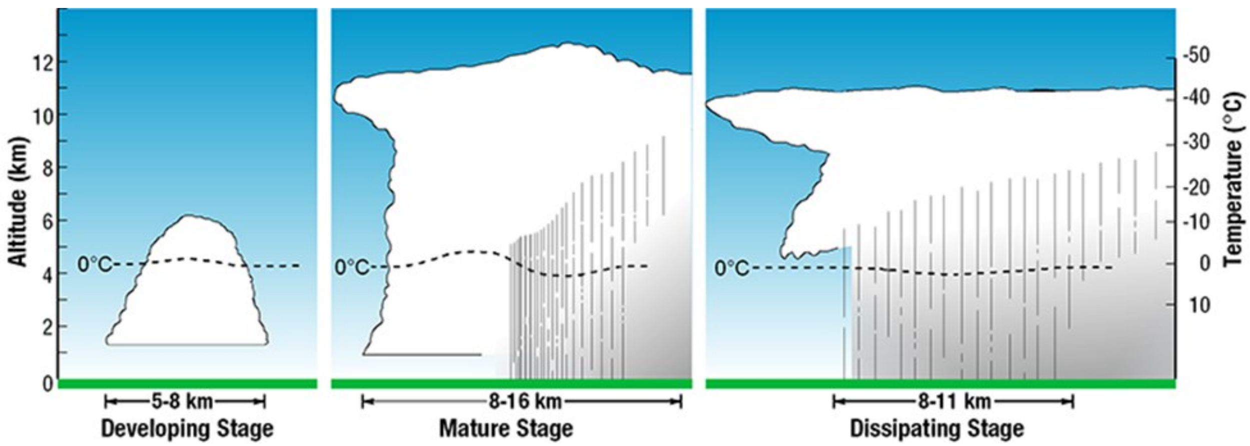


Figure 33: Stages of a Severe Thunderstorm.

Source : NOAA

The mature stage occurs when precipitation begins to fall. Downdrafts (columns of downward-pushed air) form in the most intense precipitation areas, with updrafts in the center that continue to feed the storm water vapor. Precipitation, lightning, and thunder are most intense during the mature stage.

The dissipating stage occurs when precipitation becomes heavy enough and occupies the entire cloud base, the updraft is overcome by the downdraft and the additional moist air is cut off from feeding the storm. Precipitation decreases in intensity at this stage.

Classification

A thunderstorm that includes at least one of the following is considered severe (NOAA, n.d.):

- Hail that is one (1) inch in diameter or larger
- Winds of 58 miles per hour (mph) or greater

According to NOAA, in the United States, about 10% of yearly thunderstorm events are classified as severe (NOAA, n.d.). Severe thunderstorms can also occur from supercells. A supercell contains a single persistent rotating updraft zone, meaning a single cell rather than multiple cells in a system

(NOAA, n.d.). A supercell storm can last up to several hours, is immensely powerful, and typically has the conditions to spawn violent tornadoes (NOAA, 2022).

A squall line is the term used to identify a line of active thunderstorms. A derecho describes substantial wind associated with thunderstorms (NOAA, n.d.). Derechos are identified by wind damage extending more than 240 miles accompanied by wind gusts exceeding 57 miles per hour (MPH). Mesoscale convective complexes (MCCs) are circular and typically occur and are most intense at night. MCCs generally consist of several isolated thunderstorms and last more than 12 hours. The primary threats from these complexes are heavy rain and flooding (NOAA, n.d.).

NWS emergency alerts for severe thunderstorms are (National Weather Service , 2016):

- Severe Thunderstorm Watch: Severe thunderstorms are possible in and near the watch area.
- Severe Thunderstorm Warning: Severe weather has been reported by spotters or indicated by radar.

One of the easiest ways to discern between a severe thunderstorm watch and a severe thunderstorm warning is a watch has all the ingredients or factors for severe weather to take place. For a severe thunderstorm warning, the event is occurring in the warning area.

Location and Probability

Thunderstorms can occur in all regions of the United States but are most common in the central and southern states. Figure 34 depicts average annual severe thunderstorm warnings as a means of illustrating likelihood of thunderstorms based on past events.

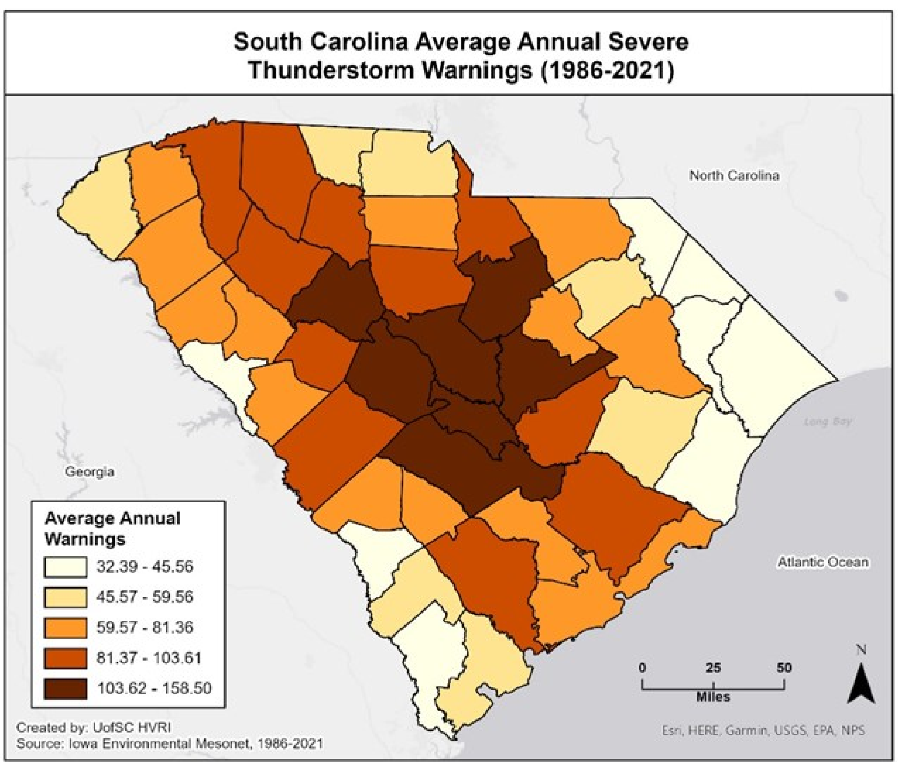


Figure 34: South Carolina Average Annual Severe Thunderstorm Warnings

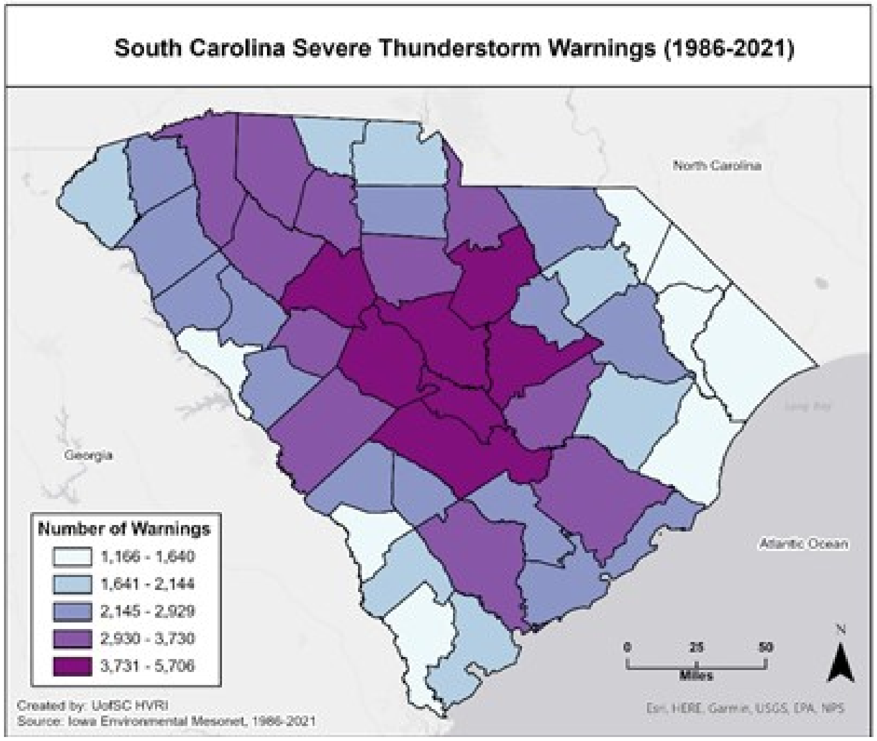


Figure 35: Severe Thunderstorm Warnings for South Carolina (1986-2021)

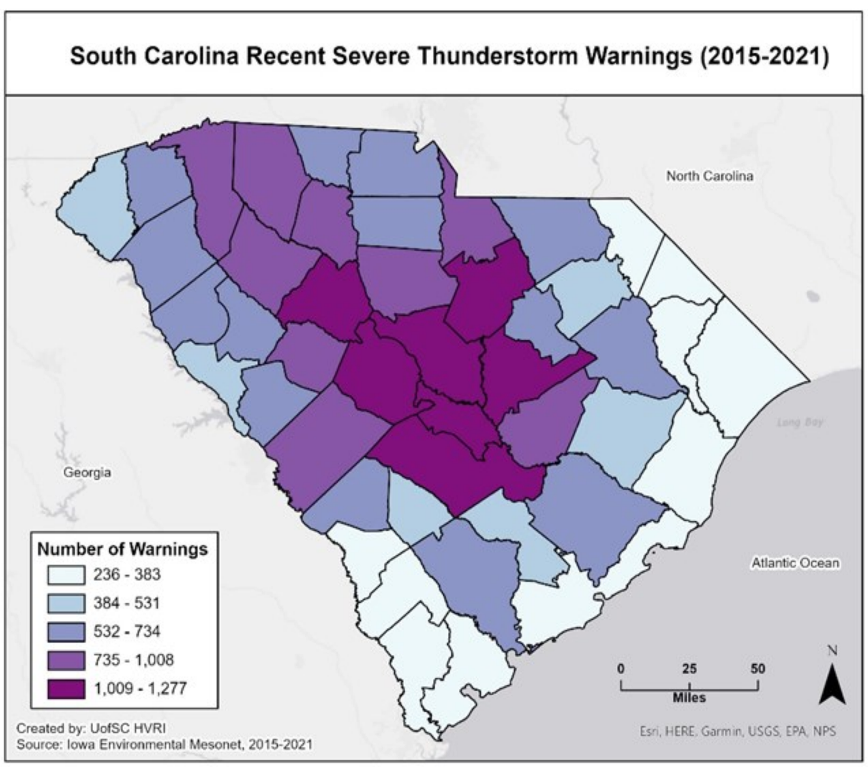


Figure 36: Recent Severe Thunderstorm Warnings for South Carolina (2015-2021)

Vulnerability

The average severe thunderstorm risk score is 0.36 per county. Counties with the highest risk scores are Orangeburg (1), Richland (0.79), and Lexington (0.79) counties. Counties with the lowest risk scores for severe thunderstorms are Horry (0), Dillon (0.03), and Marion (0.06) counties.

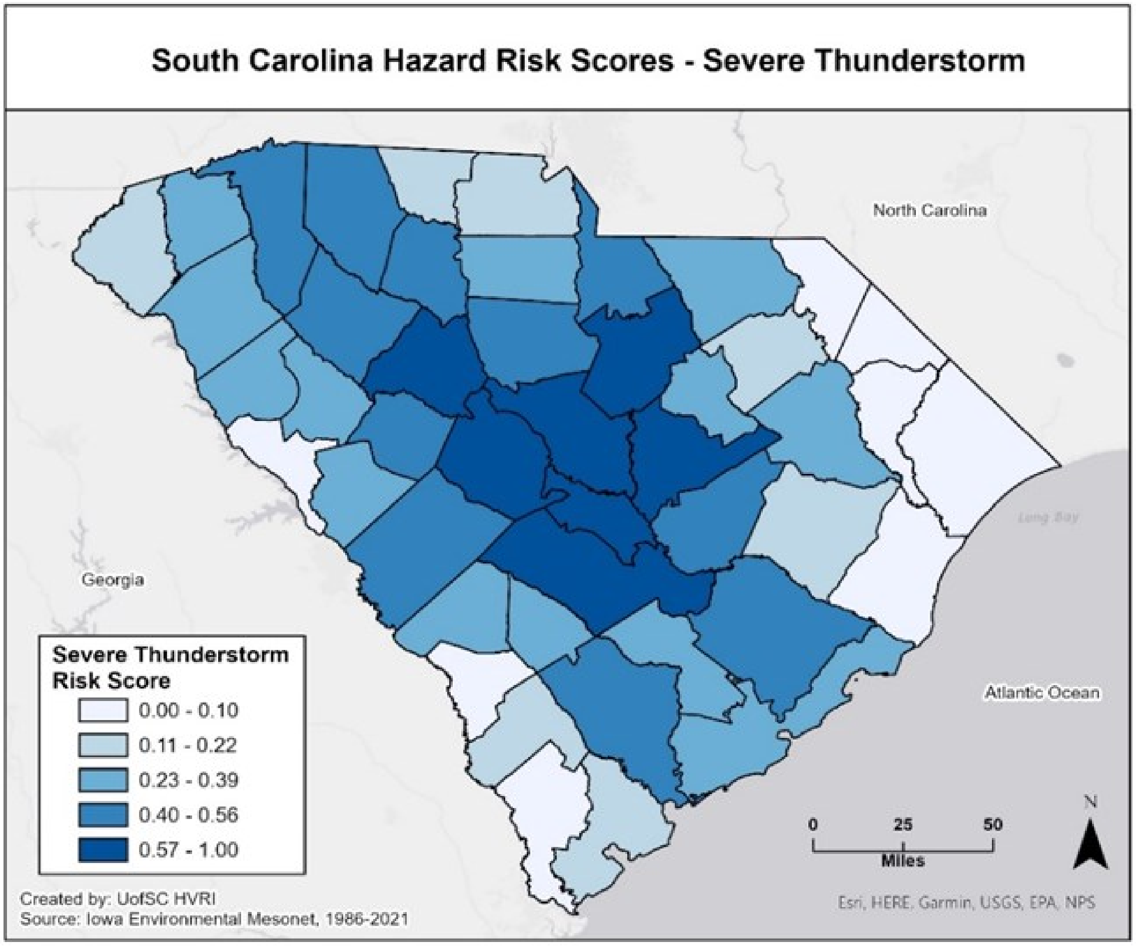


Figure 37: South Carolina Severe Thunderstorm Risk

In terms of social vulnerability, of the included 1,303 census tracts, 142 fall within the combined highest levels of social vulnerability and highest risk scores (dark blue). These high vulnerability areas are concentrated in 15 counties throughout the state, including areas in Aiken, Berkeley, Calhoun, Clarendon, Colleton, Fairfield, Greenville, Kershaw, Laurens, Lexington, Newberry, Orangeburg, Richland, Sumter, and Union counties. See Figure 38 below.

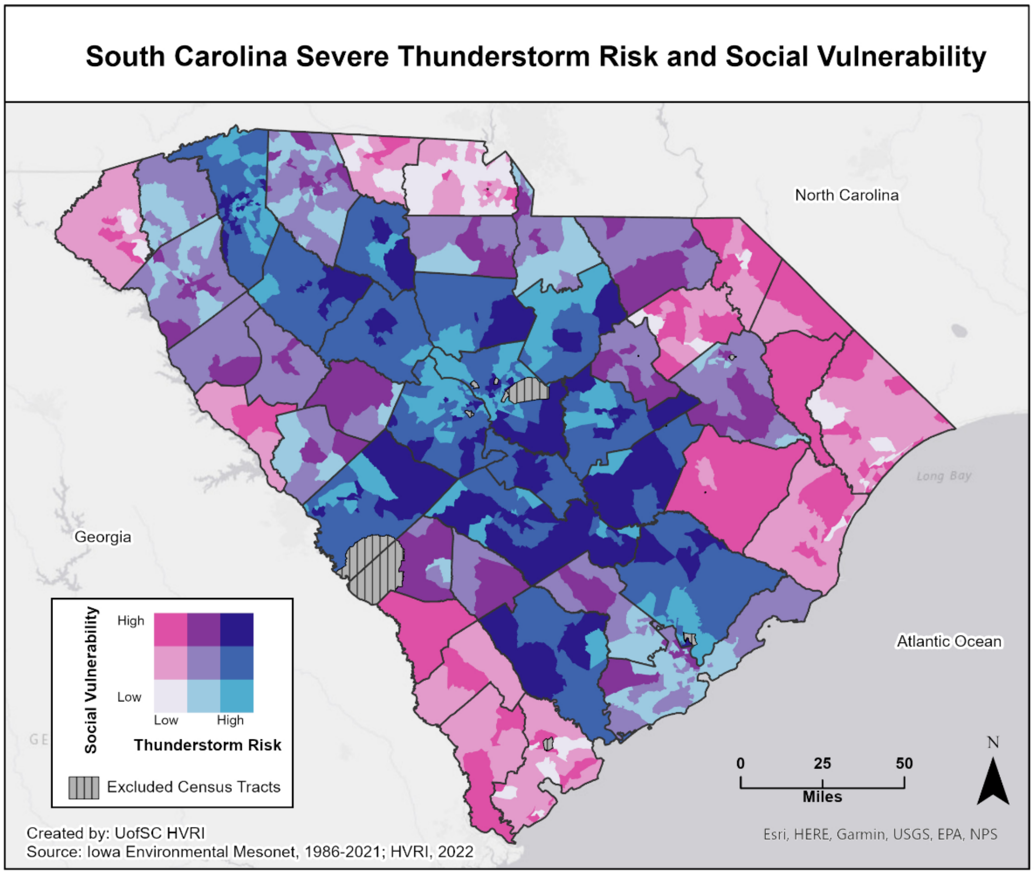


Figure 38: South Carolina Social Vulnerability and Severe Thunderstorm Risk

Impact

The table below lists severe thunderstorm occurrences by county from 1960 through 2020. Annualized loss amounts are based on crop and property losses for the period covered. Orangeburg has the highest probability of a future occurrence, and Oconee has the highest annualized losses. Details on impacts and occurrences for all counties are provided.

County	Historical Events (1960-2020)			Recent Impact (2015-2020)		
	Annualized Losses	Deaths	Injuries	Annualized Losses	Deaths	Injuries
Abbeville	$29,456	0	4	$6,654	0	0
Aiken	$53,175	3	5	$12,359	0	0
Allendale	$30,991	0	0	$146	0	0
Anderson	$107,203	2	14	$46,598	1	0
Bamberg	$93,535	0	1	$1,290	0	0
Barnwell	$37,013	0	2	$2,597	0	0
Beaufort	$59,990	0	10	$7,740	0	1
Berkeley	$57,588	2	6	$798	0	0

County	Historical Events (1960-2020)			Recent Impact (2015-2020)		
	Annualized Losses	Deaths	Injuries	Annualized Losses	Deaths	Injuries
Calhoun	$46,214	0	0	$9,631	0	0
Charleston	$94,857	2	3	$12,327	0	0
Cherokee	$58,549	1	2	$1,850	0	0
Chester	$31,148	2	4	$3,317	0	0
Chesterfield	$38,347	0	10	$4,202	0	3
Clarendon	$32,746	2	1	$4,031	0	0
Colleton	$64,016	1	4	$2,117	1	1
Darlington	$44,644	0	6	$25,779	0	3
Dillon	$37,316	2	3	$7,494	0	1
Dorchester	$39,575	3	4	$1,097	0	0
Edgefield	$23,861	1	2	$864	0	0
Fairfield	$28,542	0	2	$14,377	0	1
Florence	$104,015	0	5	$57,955	0	0
Georgetown	$78,884	2	1	$5,202	0	0
Greenville	$132,677	3	11	$43,246	0	0
Greenwood	$25,258	1	1	$6,891	0	0
Hampton	$21,822	1	1	$178	0	0
Horry	$181,052	1	13	$26,403	0	0
Jasper	$46,264	1	2	$2,475	0	0
Kershaw	$60,418	2	7	$9,970	0	0
Lancaster	$38,725	1	6	$15,704	1	0
Laurens	$115,385	2	3	$9,730	0	0
Lee	$221,093	0	1	$6,682	0	0
Lexington	$49,181	3	9	$40,894	1	0
Marion	$31,376	0	2	$7,379	0	0
Marlboro	$1,763,034	0	3	$43,545	0	0
McCormick	$16,316	0	1	$276	0	0
Newberry	$31,015	0	0	$6,543	0	0
Oconee	$105,775	0	1	$10,144	0	0
Orangeburg	$56,198	2	10	$6,754	1	0
Pickens	$116,136	2	7	$18,664	1	1
Richland	$189,094	4	12	$214,031	1	1
Saluda	$26,829	0	1	$2,811	0	0
Spartanburg	$237,003	2	7	$28,906	0	0
Sumter	$45,216	2	3	$9,739	0	0
Union	$33,389	0	2	$7,683	0	0

County	Historical Events (1960-2020)			Recent Impact (2015-2020)		
	Annualized Losses	Deaths	Injuries	Annualized Losses	Deaths	Injuries
Williamsburg	$39,469	1	2	$17,740	0	0
York	$46,369	2	7	$15,102	1	0
Grand Total	$4,820,759	49	202	$779,915	5	11
State Average	$104,799	1	4	$16,955	0	0

Table 17 Severe Thunderstorm Occurrences by County

The impacts of severe thunderstorms on community lifelines are not considered substantial. The highest impacts on lifelines are estimated in the communications, energy, and safety and security lifelines as noted below.

Community Lifeline	Level of Impact	Description of Impacts	Area of Impact
Communications	Medium	Severe thunderstorms could damage telecommunications and broadband equipment and systems. Extended power outages resulting from downed power lines could negatively impact services.	Localized or regional
Energy	Medium	Power transmission and distribution lines may be damaged by high winds, lightning, or wind-driven debris.	Localized or regional
Food, Water, Shelter	Low	Significant impacts are not anticipated. Residential structures and crops could see damage from high winds, large hail, or tornadoes.	Localized
Hazardous Materials	Low	Significant impacts are not anticipated.	Localized
Health and Medical	Low	Facilities may be damaged by severe thunderstorms. Injuries from the storms could lead to an increase in the number of people seeking emergency care.	Localized
Safety and Security	Medium	There may be an increase in traffic accidents and other needs for assistance. Response personnel may face hazardous conditions.	Localized
Transportation	Low	Road closures because of fallen debris could cause transportation disruptions. Delays in air traffic are anticipated from the severe thunderstorms.	Localized or regional

Table 18 Potential Community Lifeline Impacts Based on Significant Severe Thunderstorm Scenario

Historical and Notable Events

Historical and recent occurrence data is derived from NCEI's Storm Event Database unless stated otherwise. Loss-causing data is derived from SHELDUS v.20.0. For more information on hazard data sources, see Appendix B, Hazard Analysis Methodology.

September 12, 1997: Myrtle Beach (Horry County) experienced a thunderstorm microburst that brought heavy rains. The hardest hit area was beach berm and hotel area along a four-block strip from 26th Avenue to 30th Avenue in Myrtle Beach. Two people were injured, sustaining cuts and bruises from flying glass and debris. Damages were estimated at $500,000.

August 1, 2012: Scattered severe thunderstorms produced large hail and damaging winds in the Midlands of SC. *The Item* reported that the Shiloh United Methodist Church, built in 1831, was destroyed by fire. Damage estimates were at $1,300,000.

August 1, 2016: Thunderstorms swept southeast into the Midlands and the Central Savannah River area, meeting with weather systema sea breeze front pushing northwest into the southern Midlands. Strong low-level convergence and upper-level support focused heavy rain and damaging wind through the region in the early to mid-evening hours. Property damage was estimated at $1 million.

March 21-22, 2017: A mesoscale convective vortex moved through the state during the late afternoon into the evening hours. At the same time, thunderstorms developed along the Appalachian Mountains, and the two systems merged. The result brought severe storms throughout the state and produced golf and tennis ball sized hail in areas of Greenville County. Storms continued through the Midlands to the coast bringing high winds.

July 19, 2017: A large cluster of thunderstorms developed along the sea breeze boundary in the mid-afternoon and produced large hail and damaging winds across portions of southeast South Carolina. Property damage was estimated at $400,000.

Recent Activity (2018-2022)

April 15, 2018: Afternoon thunderstorms impacted much of the Upstate and Midlands resulting in severe weather. Wind gusts, hail, and a tornado resulted in more than $90,000 in reported damage.

April 19, 2019: A squall line caused severe weather in the Pee Dee region that included high winds as well as two tornadoes, resulting in damages estimated at $197,000.

May 31, 2019: A cold front produced severe storms across Darlington, Horry, and Marlboro counties during the afternoon and into the evening. Numerous reports of power outages resulted from high winds and one-inch hail. Property damage was estimated at $123,000.

June 20, 2019: Severe weather in the afternoon lead to multiple reports of high winds leading to multiple downed trees. A report in Fendall (Florence County) indicated trees fell on two mobile homes. Estimated damages reached $136,000 in Darlington, Florence, Horry, Marion, and Williamsburg counties.

July 18, 2019: Thunderstorms in the afternoon crossed into South Carolina from Georgia, bringing severe weather. High wind gusts were reported in Eastatoe (Pickens County) where two workers were killed and two others injured on a residential construction site after a home collapsed.

January 11-12, 2020: Multiple thunderstorms resulted in reports of straight-line wind damage and tornados in the Upstate and Midlands. Numerous trees were reported down with damage to infrastructure. Property damage was estimated at $36,000.

January 24, 2020: A downburst near Patrick (Chesterfield County) caused wind damage. A mobile home was lifted causing six people inside the residence to be injured.

February 6-7, 2020: A slow moving system brought severe weather to the Upstate.The storms brought heavy rainfall, resulting in flash flooding beginning in Oconee, Pickens, Greenville, and Spartanburg counties. A tornado touched down in Clevedale (Spartanburg County) and resulted in more than 400 home and businesses being damaged. One fatality was reported in Fort Mill (York County) when a tree fell on a vehicle. As the system moved east, flooding occurred.Flooding along the Saluda and Reedy rivers impacted homes and roads. Property damage and costs were estimated at $16,661,000.

February 13, 2020: Midday thunderstorms led to high wind gusts in the Midlands. A tree fell on a car along Interstate 20 near mile marker 58 in Lexington County resulting in a fatality.

April 13, 2020: Easter weekend saw a major system develop in the Plains and work its way across the southeast to South Carolina. On Monday, April 13, the storm system impacted South Carolina producing a tornado outbreak unlike South Carolina had seen before. South Carolina recorded 28 confirmed tornadoes with 12 being significant (EF2+) – a daily record for the state. The outbreak resulted in a federal disaster declaration (see more information in tornado subsection). The strongest tornado was an EF-4 in Hampton County, which was the strongest tornado in South Carolina since 1995.

Overnight on April 13-14, the Upstate recorded its first EF3 tornado since 1994 in Seneca (Oconee County). The EF3 tornado led to one fatality and five injuries. Uprooted trees were reported, leading to damage in other parts of Oconee County. Greenville and Pickens counties also recorded tornadoes. A tornado in Pumpkintown (Pickens County) caused eight injuries. York County experienced multiple trees downed with gusts reaching 64 mph in Rock Hill (York County). Property damage for the Upstate was estimated at $100 million.

As the squall line moved east across the state, the Midlands experienced high wind gusts and multiple tornadoes. A long-track tornado began in Elko (Barnwell County) and intensified to an EF3 through Orangeburg County before it dissipated near Saint Matthews (Calhoun County). Multiple structures were damaged; the storm resulted in two fatalities and seven injuries in the Midlands.

In the Pee Dee region, the storm continued its intensity. A microburst near Wallace (Marlboro County) blew roofs of multiple residences and downed trees. Multiple tornadoes touched down in Georgetown County, leading to damage to structures, downed trees, and power outages. In total, property damage for the Pee Dee was estimated at $535,500.

June 21, 2020: Late afternoon scattered thunderstorms produced high winds that downed trees in Greenville and Spartanburg counties. Property damage was estimated at $260,000.

May 3-4, 2021: Late afternoon and evening storms produced severe weather through parts of the Upstate and Midlands. The storms produced hail, strong winds and two tornadoes. Hail was reported in Lee, Lexington, and Saluda counties ranging from 0.75 inches to 1.75 inches. High winds downed many trees in Bamberg, Newberry, Richland, and Sumter counties in addition to the previously mentioned areas. A tornado was later confirmed in Lowndesville (Abbeville County) that traveled 30 miles to Greenwood. On May 4, an EF1 tornado impacted the Fairfield County Airport in Winnsboro, which received damage to several planes and a hangar (SC State Climatology Office , 2021).

Future Climate Conditions

Climate change is expected to affect the frequency and severity of severe thunderstorms. Overall, climate trends are not definitive because of interannual variation and the inconsistencies in the recording of past occurrences. Some climate model simulations suggest that convective available potential energy will increase in the future and wind shear will decrease. If these simulations hold true with the energy for severe thunderstorms being more prevalent, a safe assumption would be an increase in severe thunderstorms (Brooks H. , 2012). Less conservative climate models predicting a higher global average annual temperature increase will also increase the potential for severe thunderstorms and the hazards that come with them.

E. Tornadoes

A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud extending to the ground. Tornadoes may be clearly visible, rain-wrapped, or translucent depending on weather conditions. Dust and debris often are picked up and may be one of the best indicators of a tornado touching down. The size and shape of a tornado does not explicitly indicate a tornado's strength or destructive potential (NOAA, 2022).

Although tornadoes occur worldwide, the United States has the greatest number of tornado events. On average there are more than 1,200 tornadoes reported nationwide annually (NOAA, 2022). resulting in an average of 100 deaths and 1,500 injuries each year (National Weather Service , 2016). Tornadoes may form at any time of the year. In the United States, the peak of events occurs in the spring and early summer months, March through June. Tornadoes occur most frequently during the late afternoon and early evening.

Formation

Tornadogenesis is the process of tornado formation (SC Climate Office , 2020).

While tornadoes are most often generated by thunderstorm activity or a situation of severe weather (sometimes spawning from tropical cyclones and other coastal storms), the exact mechanisms behind tornadogenesis are still being examined. Tornado development associated with supercell thunderstorm activity involves three key elements (Markowski, 2009):

- Development of a persistent rotating updraft (a key component of supercell thunderstorms) (NOAA, 2022)
- Development of a rear flank downdraft that contains rotation to aid in the development of rotation to the ground
- Focusing of the low-level rotation through convergence and upward spin up into the updraft.

More basically, conditions include cool, dry air intersecting and overriding a layer of warm, moist air, forcing the warm air to rise rapidly. The presence of vertical wind shear (large change in wind speed and/or direction over a short distance) at the surface and higher up at 5,000 feet in the same location causes a horizontal rotation of the air. Rising and rotating air from the cloud lifts this horizontal tube of rotating air so that it becomes vertical. This narrow column of air stretches downward, rotates, and is fed by the warm, moist air. Once this column extends to the ground, it becomes a tornado. Swirling dust and debris from the surface make the tornado visible.

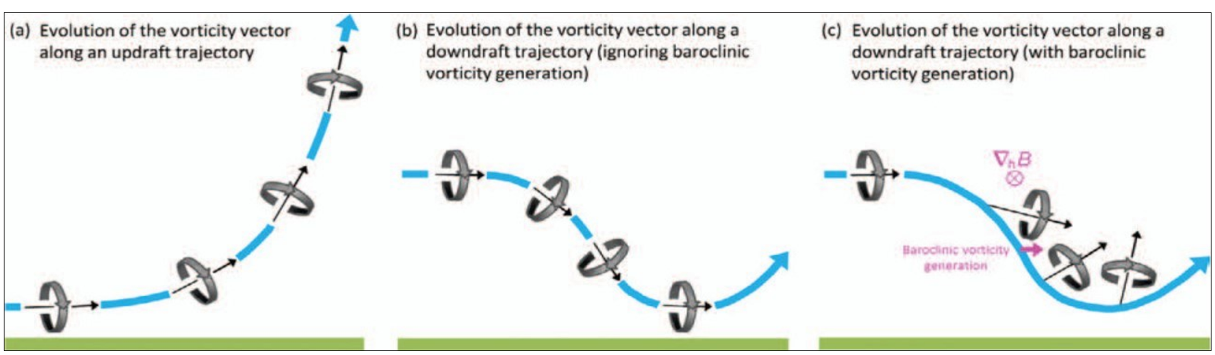


Figure 39: Vorticity evolution leading to Tornadogenesis.

Source: BAMS

All three elements are generally present for a tornado to form, although weak tornadoes can form without all three elements present. Many of the most intense tornadoes, which can cause widespread damage and large numbers of casualties, are generated by supercell thunderstorms (Wurman, 2012).

Classification

Damage from tornadoes is from powerful winds and flying debris. It is rare to be able to measure pressure changes and wind speeds of a passing tornado, but it is possible to classify a tornado's damage. Typically, tornadoes cause the greatest damages to structures of light construction such as residential homes (particularly mobile homes), and their impacts tend to remain localized. The Enhanced Fujita Scale for Tornadoes was developed to measure tornado strength and associated damage. The strongest tornado observed in South Carolina is an EF4. While rare, EF5 tornadoes are possible.

EF-Scale Number	Wind Speed (MPH)	Type of Damage Observed
EF0	65-85	Minor damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; and shallow-rooted trees push over
EF1	86-110	Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; and windows and other glass broken
EF2	111-135	Considerable damage. Roofs torn off well-constructed houses; foundations of frame houses shifted; mobile homes destroyed; large trees snapped or uprooted; light-object missiles generated; and cars lifted off ground
EF3	136-165	Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; and structures with weak foundations blown away some distance
EF4	166-200	Devastating damage. Well-constructed houses and whole frame houses completely leveled; and cars thrown, and small missiles generated
EF5	> 200	Extreme damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 meters; steel reinforced concrete structure badly damaged; and high-rise buildings have significant structural deformation

Table 19 Enhanced Fujita Scale

Location and Probability

Tornadoes can occur in all parts of the United States including all parts of South Carolina. Although tornadoes are more likely to develop from March through June, tornadoes are possible year-round in the state. In South Carolina, the prevailing winds usually come from the southwest, so tornado paths generally follow a southwest-to-northeast path. Based on past occurrence data, Orangeburg County has the highest probability of a future occurrence.

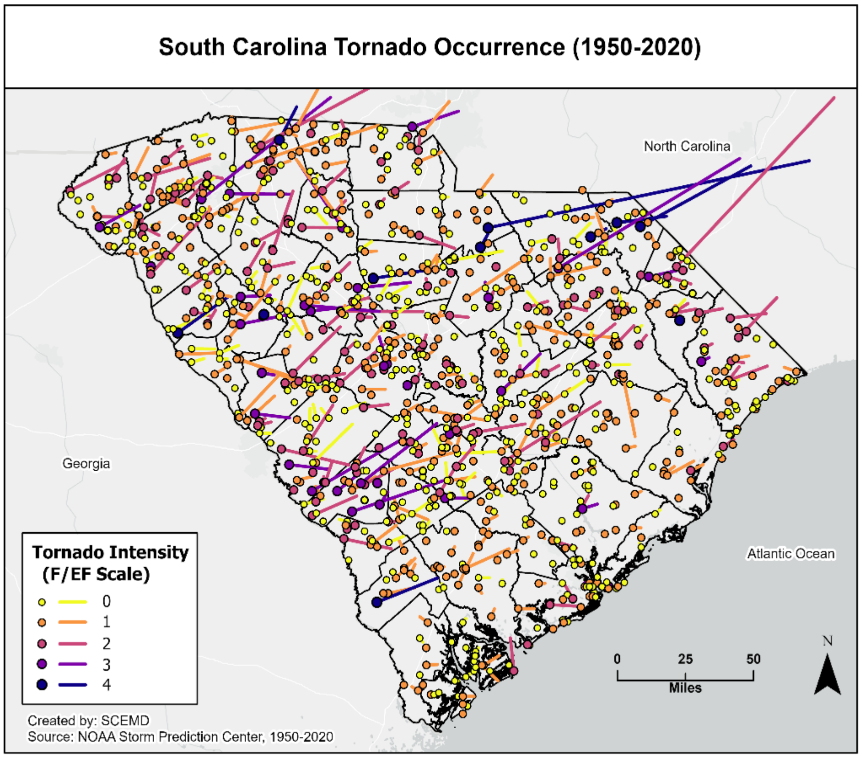


Figure 40: Tornadoes (1950-2020) by Fujita/Enhanced Fujita Scale Classification

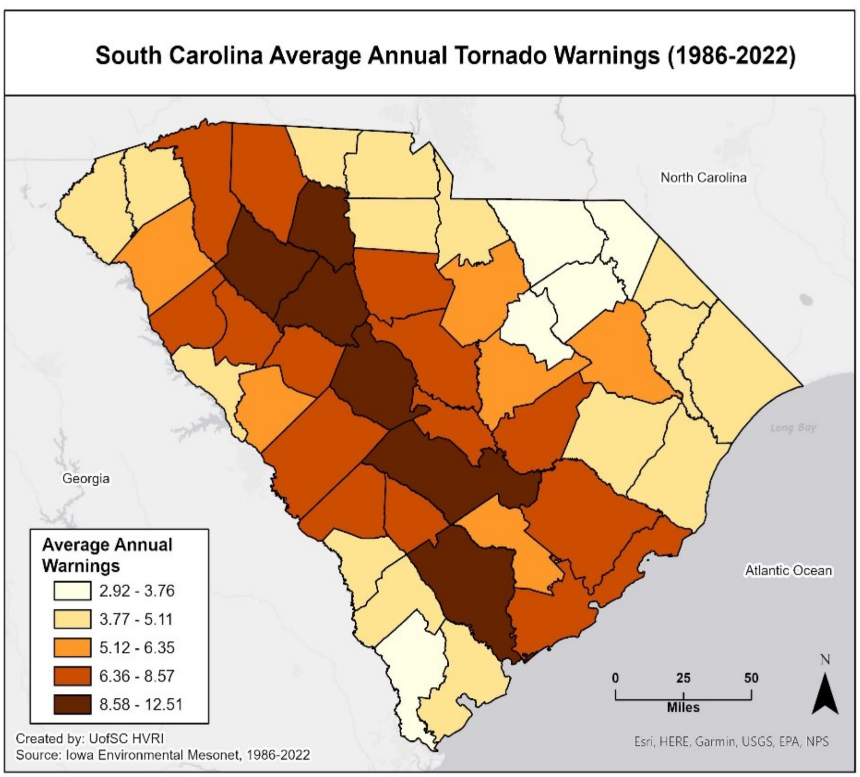


Figure 41: Average Annual Tornado Warnings in South Carolina Counties (1986-2022)

County	Hazard Occurrence (1950-2020)		County	Hazard Occurrence (1950-2020)	
	Future Annual Probability (% chance per year)	Frequency Interval (Years between event)		Future Annual Probability (% chance per year)	Frequency Interval (Years between event)
Abbeville	30	3.38	Greenwood	23	4.44
Aiken	55	1.82	Hampton	18	5.46
Allendale	23	4.44	Horry	72	1.39
Anderson	52	1.92	Jasper	11	8.88
Bamberg	34	2.96	Kershaw	32	3.09
Barnwell	39	2.54	Lancaster	21	4.73
Beaufort	31	3.23	Laurens	31	3.23
Berkeley	46	2.15	Lee	15	6.45
Calhoun	34	2.96	Lexington	55	1.82
Charleston	61	1.65	Marion	11	8.88
Cherokee	27	3.74	Marlboro	23	4.44
Chester	23	4.44	McCormick	20	5.07
Chesterfield	37	2.73	Newberry	49	2.03
Clarendon	42	2.37	Oconee	34	2.96
Colleton	38	2.63	Orangeburg	94	1.06
Darlington	38	2.63	Pickens	38	2.63
Dillon	28	3.55	Richland	54	1.87
Dorchester	28	3.55	Saluda	15	6.45
Edgefield	27	3.74	Spartanburg	49	2.03
Fairfield	41	2.45	Sumter	34	2.96
Florence	49	2.03	Union	24	4.18
Georgetown	24	4.18	Williamsburg	24	4.18
Greenville	52	1.92	York	31	3.23
State Average				36	3.4

Table 20 Average Tornado Occurance Probability by County

Historical and Notable Events

April 30, 1924: The Horrell Hill tornado ripped a 135-mile path across the state. The longest tornado path recorded in the state's history, it began in Aiken County and ended in Darlington County. Sixty-seven people lost their lives, with almost half the deaths occurring in Richland County and the community of Horrell Hill. Based on damage records and historical reports, estimates rate this storm an F4 on the Fujita Scale with wind speeds between 207 mph and 260 mph.

March 28, 1984: An intense low-pressure center moved across the state, spawning 11 tornadoes and numerous severe thunderstorms. The first tornado to appear struck Anderson County and was followed by a series of 10 tornadoes. The tornadoes traveled across Anderson and Newberry counties, moving east-northeast through Marlboro County before entering North Carolina. Fifteen people lost their lives, with an additional six deaths indirectly associated with the tornado events. Damages were estimated at more than $100 million.

October 11, 2002: A strong EF2 tornado touched down in Georgetown County and destroyed five manufactured homes, a car, and two houses before continuing along a northeastern path for a mile through a residential area of Georgetown. Twenty-eight structures were damaged, including homes, businesses, and churches. Eight people were hospitalized for minor injuries; property damage was estimated at more than $750,000.

September 4, 2004: An EF2 tornado caused three injuries and $1.7 million in property damage in Sumter County. Emergency managers reported nine homes were destroyed and 55 had major damage.

April 10, 2009: Supercell thunderstorms spawned tornadoes in the upstate in the evening. Large hail and straight-line wind damage also occurred. The largest tornado tracked through Aiken County where there was widespread damage, one indirect fatality, and approximatley a dozen injuries. Total damage was estimated at $6 million.

April 25, 2010: In Darlington County, a thunderstorm developed supercell characteristics and spawned a tornado that touched down multiple times near Oats and Darlington. Damage surveys confirmed an EF2 touched down with winds up to 115 mph. Residential homes sustained significant damage, while businesses near Highway 52 sustained moderate damage. Three direct injuries were attributed to this event. Loss estimates place damages at more than $7 million.

November 16, 2011: A supercell thunderstorm in the eastern part of the Upstate produced an EF2 tornado in Chester County that moved into York County. Dozens of homes were damaged, and many trees were downed. There were three direct fatalities and five direct injuries. The tornado was the strongest to impact York County in almost 40 years. Damage was estimated at more than $2 million.

April 05, 2017: An intensifying cluster of thunderstorms moved into the Upstate from northeast Georgia in advance of a strong storm system and attendant cold front. Anderson County bore the brunt of the storms as virtually the entire county was impacted by 60 to 80 mph wind gusts. Brief, weak tornadoes enhanced the damage in several locations. The storms weakened and were generally not severe by the time they reached the I-26 corridor. Property damage was estimated at $100,000.

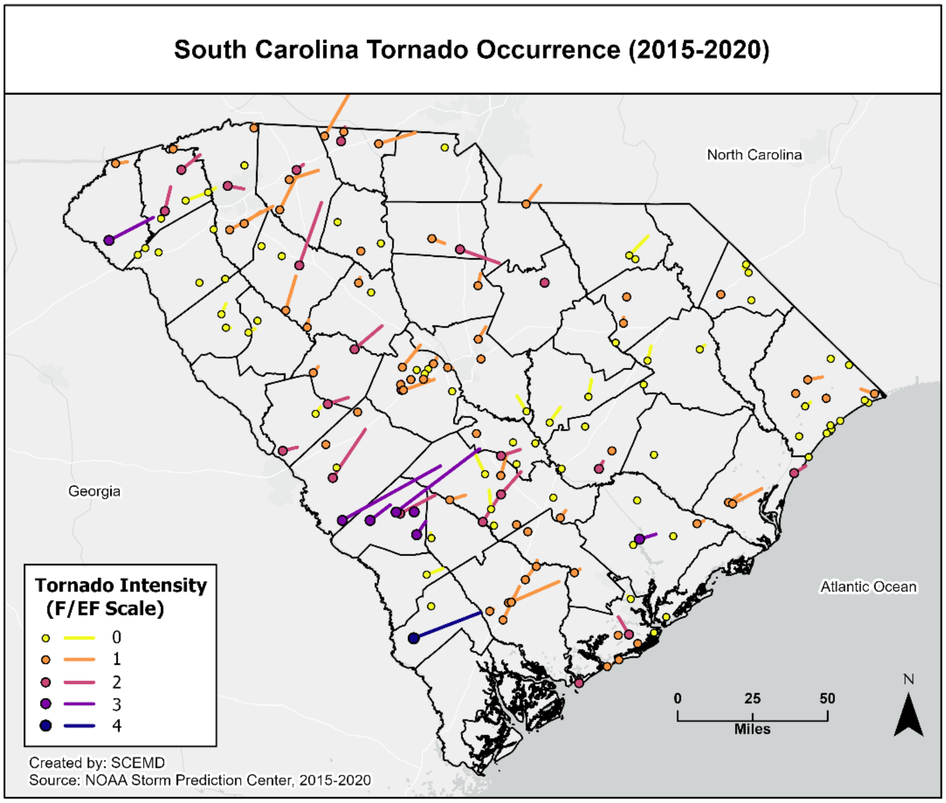


Figure 42 Recent Tornado Event Occurrence in South Carolina (2015-2020)

Recent Activity (2018–2023)

April 13, 2020: A large-scale outbreak of severe weather moved through the state on Monday morning, April 13, 2020, generating 25 tornadoes that impacted 14 counties. Communities in Aiken, Bamberg, Barnwell, Berkeley, Colleton, Charleston, Dorchester, Georgetown, Greenwood, Hampton, Marlboro, Oconee, Orangeburg, and Pickens counties sustained damage to residential and commercial structures. The storms also resulted in blocked roadways and power outages because of debris and downed trees and power lines.

There were multiple injuries and nine storm-related fatalities, which was the highest number of deaths attributed to tornadoes in South Carolina since 1984. The strongest tornado was an EF-4 in Hampton County. Prior to this outbreak, there had been only 10 EF-4 tornadoes on record in the state. The most recent EF-4 prior to April 13, 2020, occurred in 1995. The EF-4 tornado on April 13 was the first EF-4 recorded in the Lowcountry region and the first on record to occur before noon in South Carolina. The seven EF-3 tornadoes on April 13 were the most EF-3 or stronger tornadoes to occur in single day on record in South Carolina. Overall, 30 confirmed tornadoes made the April 2020 event the second largest tornado outbreak on record in the state.

South Carolina received a major disaster declaration for the April 13 tornadoes that includes Individual Assistance (IA) for seven counties (Aiken, Colleton, Hampton, Marlboro, Oconee, Orangeburg, and Pickens), Public Assistance (PA) for seven counties (Barnwell, Colleton, Georgetown, Hampton, Oconee, Orangeburg, and Pickens), and the Hazard Mitigation Grant Program (HMGP) statewide. PA damage estimates, which includes only public infrastructure and response costs and does not include insured damage, total $17.1 million. IA programs support to residents totaled $5.36 million.

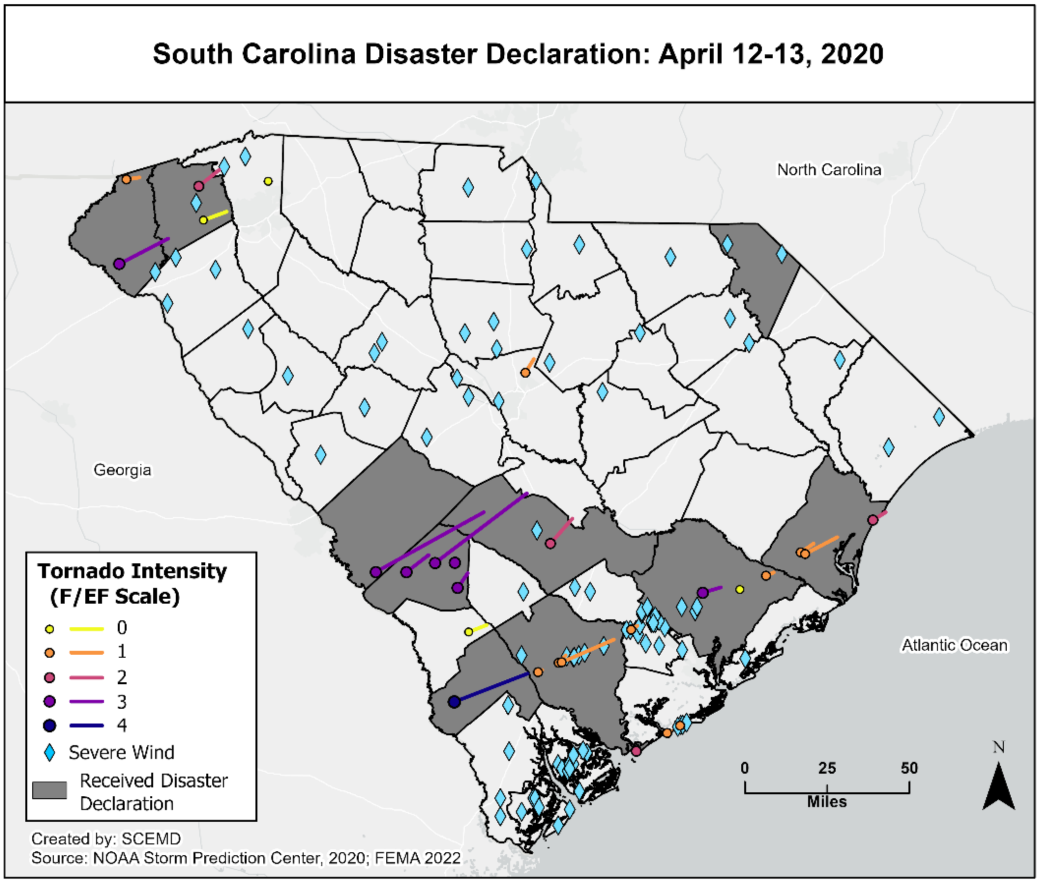


Figure 43: April 2020 Tornado Outbreak, Federal Disaster Declared Counties

Vulnerability

Based on occurrence data from 1950 to 2020, the statewide average tornado risk score is 0.29 per county. Orangeburg County has the highest tornado risk score (1.00), followed by Horry (.73) and Charleston (.59). Jasper and Marion counties received the lowest risk score for tornadoes (0.00), with Lee and Saluda having the next least tornado risk (0.05).

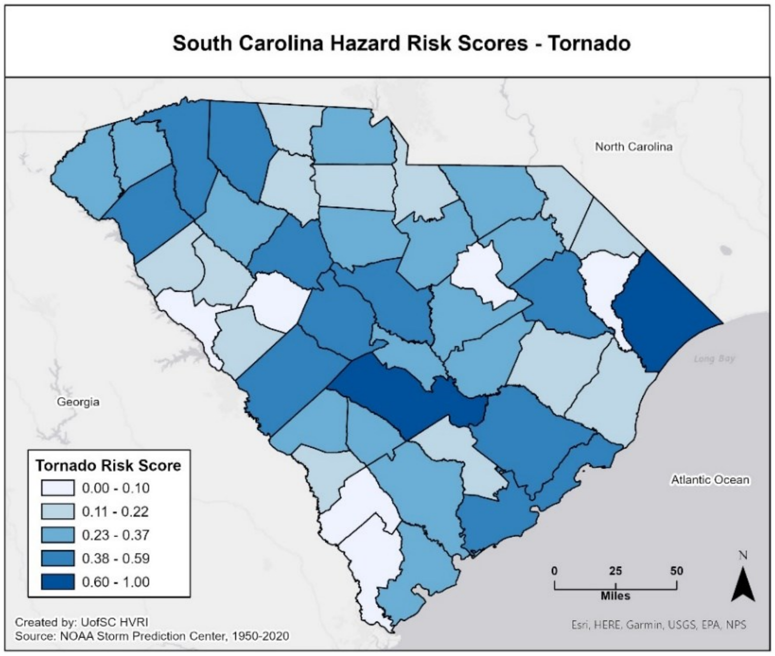


Figure 44: South Carolina Tornado Risk Scores by County

In terms of residents' vulnerability to tornadoes, structural integrity of residences can plan a key role in survivability in a tornado as can access to warning information and the ability to take shelter quickly. For this reason, housing types and income are related to outcomes in tornadoes. Regarding social vulnerability, of 1,303 census tracts in South Carolina, 181 fall within the combined highest levels of social vulnerability and highest risk scores for tornadoes (dark blue). These high-high areas are concentrated in 12 counties, including areas in Aiken, Anderson, Berkeley, Charleston, Florence, Greenville, Horry, Lexington, Newberry, Orangeburg, Richland, and Spartanburg counties.

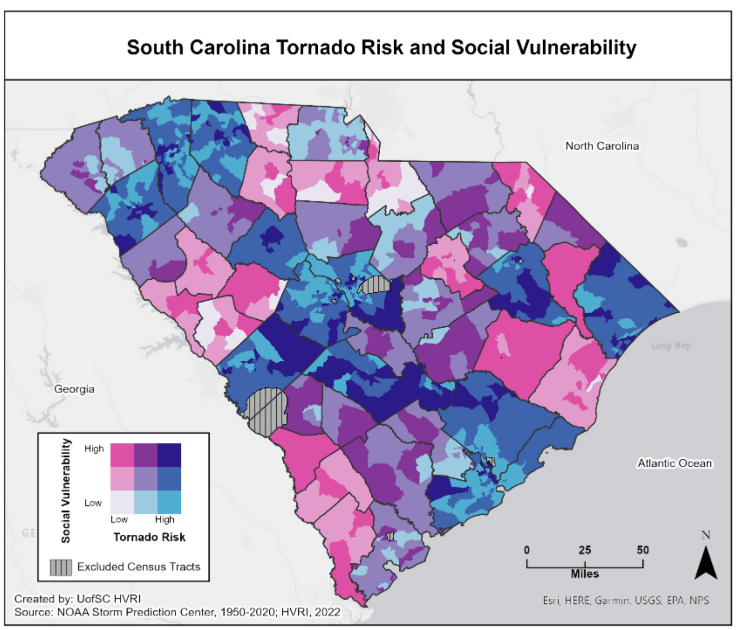


Figure 45: South Carolina Social Vulnerability and Tornado Risk

Impacts

The table below lists tornado impacts and losses by county from 1960 through 2020. Annualized loss amounts are based on crop and property losses for the period covered. Oconee has the highest annualized losses from recent events based largely on the April 2020 tornado outbreak.

County	Historical Events (1960-2020)			Recent Impact (2015-2020)		
	Annualized Losses	Deaths	Injuries	Annualized Losses	Deaths	Injuries
Abbeville	$102,344	6	24	$10,335	0	0
Aiken	$147,960	0	21	$0	0	0
Allendale	$101,544	1	6	$0	0	0
Anderson	$216,221	0	9	$508	0	0
Bamberg	$5,729	0	3	$0	0	0
Barnwell	$97,905	0	22	$0	0	1
Beaufort	$48,818	1	13	$0	0	0
Berkeley	$219,318	2	31	$3,318	0	6
Calhoun	$41,479	1	8	$36,864	0	2
Charleston	$142,603	0	15	$283,850	0	0
Cherokee	$53,479	0	36	$48,165	0	0
Chester	$43,974	1	4	$20,833	0	0
Chesterfield	$356,578	0	40	$0	0	0
Clarendon	$33,700	1	27	$0	0	0
Colleton	$10,175	0	10	$0	0	0
Darlington	$204,437	1	28	$30,418	0	1
Dillon	$125,961	3	42	$5,000	0	0
Dorchester	$53,657	0	3	$0	0	0
Edgefield	$102,113	1	26	$922	0	8
Fairfield	$90,605	3	24	$0	0	0
Florence	$70,521	0	35	$16,929	0	0
Georgetown	$62,593	6	11	$49,167	0	1
Greenville	$172,645	0	24	$980,264	0	0
Greenwood	$156,683	4	31	$0	0	0
Hampton	$7,400	5	66	$0	5	60
Horry	$424,174	0	108	$315,450	0	1
Jasper	$9,531	0	1	$0	0	0
Kershaw	$115,473	0	23	$0	0	0
Lancaster	$56,950	0	3	$0	0	0
Laurens	$353,391	0	55	$52,458	0	0
Lee	$2,079	0	8	$0	0	0
Lexington	$225,999	1	56	$8,939	0	0

County	Historical Events (1960-2020)			Recent Impact (2015-2020)		
	Annualized Losses	Deaths	Injuries	Annualized Losses	Deaths	Injuries
Marion	$60,661	0	11	$0	0	0
Marlboro	$433,602	9	218	$0	0	0
Mccormick	$12,323	0	6	$0	0	0
Newberry	$201,711	2	39	$0	0	0
Oconee	$1,828,285	1	28	$16,666,667	1	5
Orangeburg	$76,395	2	24	$0	2	7
Pickens	$151,217	0	32	$82,374	0	8
Richland	$324,238	1	17	$0	0	0
Saluda	$24,289	0	3	$0	0	0
Spartanburg	$267,178	2	81	$1,859,325	0	1
Sumter	$64,656	1	8	$0	0	0
Union	$40,011	1	2	$10,509	1	0
Williamsburg	$35,515	0	18	$0	0	0
York	$40,295	3	13	$8,699	0	0
Grand Total	$7,416,415	59	1313	$20,490,994	9	101
State Average	$161,226	1	28	$445,456	< 1	4

Table 21 Tornado Impacts and Losses

A significant tornado event can have major consequences in the areas in or near a tornado's path. Impacts on community lifelines in those locations can be severe; however, direct impacts in most cases do not extend beyond locations in proximity to the tornado path(s). This affects estimates of the levels of impacts on lifelines, keeping them at medium or lower.

Community Lifeline	Level of Impact	Description of Impacts	Area of Impact
Communications	Medium	A significant tornado could damage telecommunications and broadband equipment and systems in its path(s), creating service outages.	Localized or regional
Energy	Medium	A significant tornado may cause damage to power generation, transmission, or distribution equipment and systems in its path, resulting in outages. Fuel stations or pipelines may be damaged.	Localized or regional
Food, Water, Shelter	Medium	Locations in the tornado path(s) may see significant damage to residential structures, making homes uninhabitable. Residents may need emergency shelter and temporary housing. Water systems and food production and processing facilities in the tornado's path may be damaged, reducing locally available supplies and causing economic losses.	Localized or regional

Community Lifeline	Level of Impact	Description of Impacts	Area of Impact
Hazardous Materials	Medium	Hazardous materials storage or transportation may be damaged if in a tornado's path, potentially resulting in a release. Severity of impact would be determined by type and volume of material released.	Localized
Health and Medical	Medium	Healthcare facilities in a tornado's path may see direct structural damage and disruption to operations and services. Hospitals serving affected areas may see an influx of patients seeking emergency care. Hospital operations in the immediate area may be overwhelmed.	Localized or regional
Safety and Security	Medium	Facilities in a tornado's path may see damage and disruption of operations and critical services. Response personnel serving the area would see an increase in emergency calls and requests for response assistance, including search and rescue. Local resources may need to be augmented by personnel and equipment from other areas.	Localized or regional
Transportation	Low	Significant impacts are not expected. Roadways, bridges, and other transportation infrastructure may be blocked or damaged if in a tornado's path, resulting in temporary transportation delays or rerouting.	Localized

Table 22 Potential Community Lifeline Impacts Based on Significant Tornado Scenario

Future Climate Considerations

Short-term and long-term impacts from climate change on tornadoes in South Carolina are trending in different directions. While the recorded number of recent events is increasing because of better technology for observations and personnel training. Climate models show an upward trend in terms of event intensity. Future storm events are projected to occur less frequently and for shorter periods of time but may be more intense placing a higher risk to those directly affected

F. Tropical Cyclones

Hurricanes, typhoons, and cyclones are names for powerful tropical weather systems in which winds rotate around a closed circulation of low pressure. In the North Atlantic and the eastern Pacific, they are known as hurricanes once they reach sustained winds of 74 mph. In the western North Pacific, they are known as typhoons, and in the Indian Ocean and South Pacific Ocean they are called cyclones. In the Northern Hemisphere, hurricane winds rotate in a counterclockwise direction (clockwise in the Southern Hemisphere) (NOAA, 2019).

Formation

Conditions for hurricane formation include warm ocean waters, rotational force from the earth's spin (Coriolis Effect), and the absence of vertical wind shear (NOAA, 2019). Tropical disturbances that affect North America often originate off the west coast of Africa; however, storms may develop in other regions including the eastern Caribbean and the Gulf of Mexico (NOAA, 2022). If a tropical disturbance lowers in pressure and starts to rotate around a low-pressure center, it may become a tropical depression. Barometric pressure (measured in millibars or inches) continues to fall in the center as the storm system develops in intensity. When sustained wind speeds reach 39 miles per hour, the system is considered a tropical storm and is given a name by the National Hurricane Center (NHC). When sustained wind speeds reach 74 mph, the storm is classified as a hurricane. Hurricanes are large, powerful storms with an average diameter of 350 miles. According to the NHC, an average Atlantic hurricane season has 14 named storms, seven hurricanes, and three major hurricanes (NOAA, 2022). Tropical cyclones and hurricanes bring with them high winds, storm surge, heavy precipitation, and the potential for tornadoes. Storm surge and tidal flooding intensify damage along the coast.

As of 2023, the official start of the Atlantic hurricane season was June 1, and the season ends November 30. Forecast agencies were considering moving the start date of the hurricane season earlier because of changing weather patterns. For South Carolina, peak hurricane season occurs in August and September when water temperatures and evaporation rates are highest.

Classification

Hurricane wind strength is classified using the Saffir-Simpson Scale, which categorizes hurricane force based on maximum sustained wind speeds on a scale of 1 to 5, with 5 being the most intense. The scale does not account for storm surge, tornadoes, or flooding caused by rainfall (NOAA and National Weather Service , n.d.). Typically, higher category hurricanes have lower pressure and greater storm surge. Categories 3, 4, and 5 are classified as major hurricanes, and while hurricanes within this range make up only 20 percent of total landfalls, they account for more than 70 percent of tropical cyclone damage in the United States.

Category	Maximum Sustained Wind Speed (MPH)
1	74-95
2	96-110
3	111-130
4	131-155
5	>155

Table 23. Saffir-Simpson Scale (NOAA)

Location and Probability

Although hurricanes make landfall in coastal areas, all counties in South Carolina have experienced damage from hurricanes. Some of the most destructive hurricanes and tropical storms have originated in the Gulf of Mexico or traveled around the tip of Florida and through other southeastern states to impact the Upstate region. For example, Hurricane Frances spawned tornadoes in the Upstate in 2004 with enough damage to warrant a federal disaster declaration.

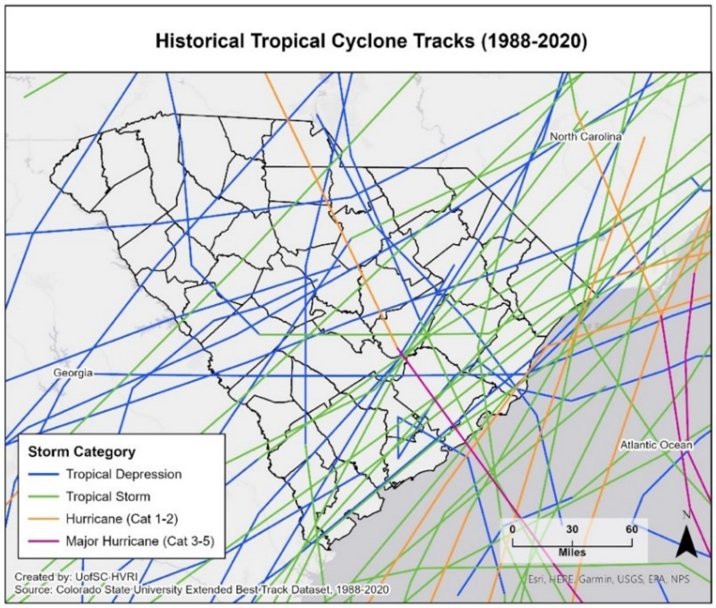


Figure 46: Historic Tropical Cyclone Tracks impacting South Carolina

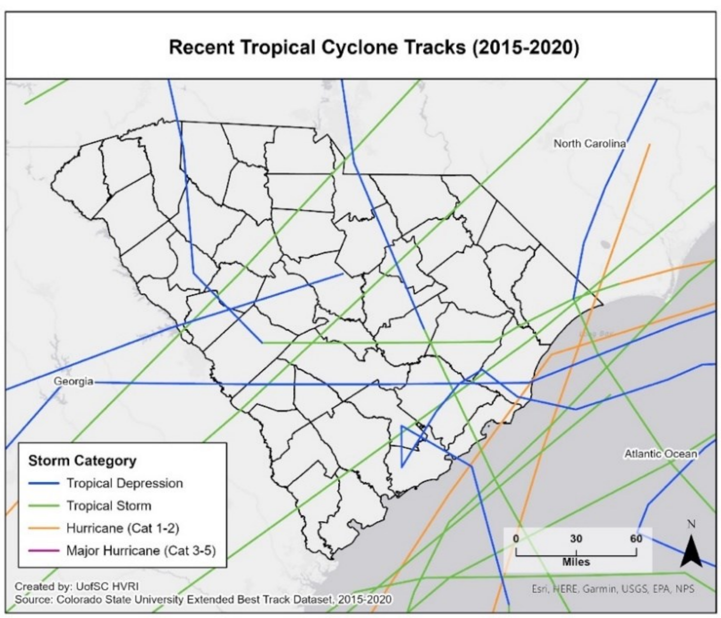


Figure 47: Recent Tropical Cyclone Tracks impacting South Carolina

The table below shows the future annual probability and recurrence intervals of tropical cyclone occurrences in each county in South Carolina based on occurrences from 1988 through 2020.

County	Hazard Occurrence (1988-2020)		County	Hazard Occurrence (1988-2020)	
	Future Annual Probability (% chance per year)	Frequency Interval (Years between event)		Future Annual Probability (% chance per year)	Frequency Interval (Years between event)
Abbeville	12	8.25	Greenwood	15	6.60
Aiken	36	2.75	Hampton	52	1.94
Allendale	42	2.36	Horry	76	1.32
Anderson	15	6.60	Jasper	55	1.83
Bamberg	48	2.06	Kershaw	30	3.30
Barnwell	39	2.54	Lancaster	24	4.13
Beaufort	58	1.74	Laurens	15	6.60
Berkeley	73	1.38	Lee	42	2.36
Calhoun	45	2.20	Lexington	33	3.00
Charleston	76	1.32	Marion	61	1.65
Cherokee	18	5.50	Marlboro	36	2.75
Chester	24	4.13	McCormick	18	5.50
Chesterfield	27	3.67	Newberry	24	4.13
Clarendon	48	2.06	Oconee	15	6.60
Colleton	64	1.57	Orangeburg	48	2.06
Darlington	42	2.36	Pickens	15	6.60
Dillon	55	1.83	Richland	39	2.54
Dorchester	58	1.74	Saluda	21	4.71
Edgefield	24	4.13	Spartanburg	18	5.50
Fairfield	24	4.13	Sumter	45	2.20
Florence	58	1.74	Union	18	5.50
Georgetown	70	1.43	Williamsburg	58	1.74
Greenville	18	5.50	York	18	5.50
State Average				38	3.46

Table 24 Tropical Cyclone Occurrences by County

Tropical Cyclone History

Historical and recent occurrence data is derived from NCEI's Storm Event Database unless stated otherwise. Loss-causing data is derived from SHELDUS V.20.0. For more information regarding methodology, refer to Appendix B, Hazard Analysis Methodology.

Significant Historic Storms

Great Sea Island Storm of 1893 (August 27–28, 1893): One of the deadliest hurricanes to strike the United States, the Sea Island Storm of 1893 made landfall in Georgia at high tide, bringing a tremendous storm surge that swept over and submerged islands. The storm's north-northeast track through the South Carolina midlands brought wind speeds between 96 mph and 125 mph, with maximum winds of 125 mph in the Beaufort area and up to 120 mph in Charleston. Major damage was reported as the storm moved north near Columbia and then northeast through the rest of the state, causing between 2,000 and 2,500 deaths and an estimated $10 million in damage and leaving 20,000 to 30,000 survivors homeless.

Hurricane Hazel (October 15, 1954): Hazel made landfall as a Category 4 hurricane near Little River bringing storm surge up to 16.9 feet. One fatality and approximately $27 million in damages were reported. Hurricane Hazel is considered one of the most severe storms to hit South Carolina.

Hurricane Gracie (September 29, 1959): Category 4 hurricane Gracie made landfall at St. Helena Island with winds of 140 mph, moving northwest before weakening to a tropical storm as it passed through Columbia and turned north-northwest on a path into North Carolina. Storm surge reached almost six feet above normal tides. Several fatalities as well as property damage were reported along the southern coastal area. Heavy crop damage occurred, and moderate to heavy flooding was reported because of six to eight inches of rainfall.

Hurricane Hugo (September 21, 1989): Hugo, a Category 4 hurricane, made landfall at Isle of Palms with sustained winds of 140 mph and wind gusts exceeding 160 mph. Hugo is the costliest storm in South Carolina history, causing more than $7 billion in damage to property and crops in the United States. It was the first major hurricane to strike the state since Gracie in 1959. Total damages, including those that occurred in Puerto Rico and the Caribbean, exceeded $10 billion (NOAA, 2022). Hurricane Hugo resulted in 35 storm-related fatalities, 20 of which occurred in South Carolina. Seven of the South Carolina fatalities occurred in mobile home parks northwest of Charleston. The storm's strongest winds passed over the Francis Marion National Forest between Bulls Bay and the Santee River. The Forest Service estimated that timber losses exceeded $100 million. While the most severe winds occurred to the northeast of Charleston, the city was hard hit. The Charleston City Hall and a fire station lost roofs, and more than 4,000 historic properties were damaged. Coastal storm surge reached 20 feet in some areas, making it the highest ever recorded in the state. Folly Beach was among the most significantly impacted coastal communities; approximately 80 percent of the homes were destroyed. Sullivan's Island and the Isle of Palms also were severely damaged. Numerous homes were knocked off their foundations, and boats in the local marina were tossed into a 50-foot-tall pile of debris. Severe inland wind damage also occurred; winds gusting to 109 mph at Sumter were reported. The hurricane exited the state just north of Rock Hill, also causing significant damage in Charlotte, North Carolina. South Carolina received a Presidential disaster declaration for the event.

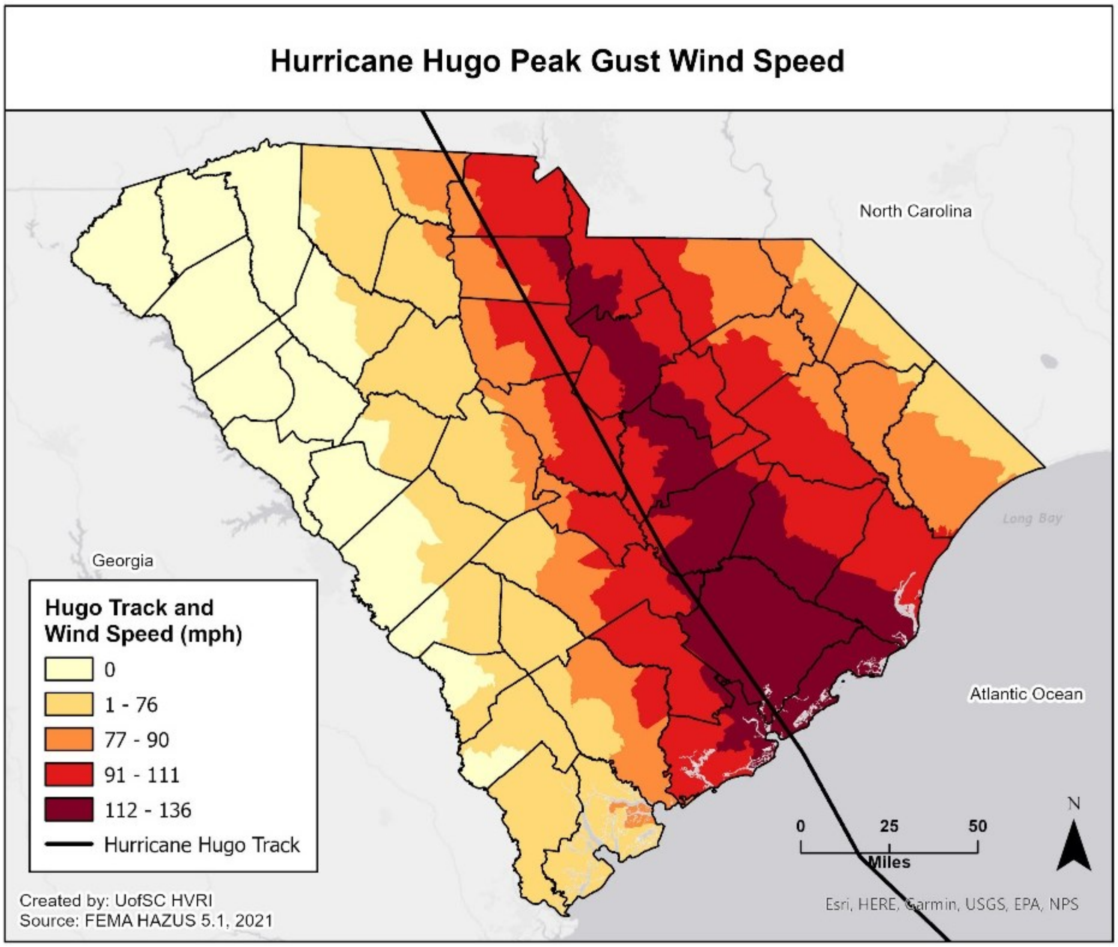


Figure 48: Hurricane Hugo Track and Peak Wind Gust Speed

Hurricane Fran (September 5, 1996): Although Hurricane Fran skirted the South Carolina coast before making landfall at the entrance of the Cape Fear River in North Carolina, it triggered the evacuation of 500,000 tourists in the coastal areas of both states. Wind gusts of 60 mph were reported along the Horry County coast. In Georgetown County, 57 mph winds in the City of Georgetown contributed to $150,000 in county government infrastructure damage. Eleven evacuation shelters housed 5,400 people. One death was attributed to the storm. In Horry County, agricultural losses of $19.8 million were reported, with corn, tobacco and sweet potato crops hardest hit. Downed trees caused power outages impacting about 60,000 customers. Horry County reported property losses totaling more than $1 million, including $448,000 at North Myrtle Beach, $341,000 at Myrtle Beach, $42,000 at Surfside Beach, $46,000 at Garden City Beach, and $135,000 in unincorporated areas. South Carolina received a Presidential disaster declaration for this event.

Hurricane Floyd (September 15, 1999): Hurricane Floyd weakened to a Category 3 hurricane as it approached the southern South Carolina coast on the morning of September 15. The storm skirted the coast, its center moving northeast about 60 miles offshore late in the afternoon and early evening as it took a north and northeast course toward North Carolina. Sustained winds of tropical storm force were reported from Savannah, Georgia, to Charleston, with wind gusting to hurricane force strength in the Charleston area. The highest recorded sustained wind speed was 58 mph in downtown Charleston, with gusts reaching 85 mph. Rainfall was heavy along coastal counties as 12 inches of rain fell in Georgetown County. A reported 18 inches fell in eastern Horry County, causing major flooding along the Waccamaw River in and around the City of Conway for a month. Waves were reported to be 15 feet at Cherry Grove Pier, where damage was the greatest. Minor to moderate beach erosion occurred along the South Carolina coast. Many businesses and homes suffered major damage, with thousands of homes experiencing at least minor damage in Charleston County, causing approximately $10.5 million in damage. In Horry County, approximately 400 homes and numerous roads were inundated for more than a month following the storm. Beaufort County reported $750,000 damage, and Berkeley and Dorchester counties reporting $500,000 each. More than 1,000 trees were blown down, knocking out power to more than 200,000 customers across the southern coast. In Myrtle Beach, tree and sign damage was reported to reach approximately $250,000. In Williamsburg County, total damage estimates because of high winds and rain reached approximately $650,000. In Florence County, high winds downed trees, caused power outages, and resulted in $150,000 in property damage. Total estimated property damage for impacted counties totaled approximately $17 million. While Hurricane Floyd did not make landfall in South Carolina, it resulted in the largest peacetime evacuation in the state's history, surpassing Hurricane Fran. It is estimated that around 3.5 million people evacuated from the coasts of Florida, Georgia, South Carolina, and North Carolina (NOAA, n.d.). South Carolina received a Presidential disaster declaration for this event.

Hurricane Gaston (August 29, 2004): Gaston reached Category 1 sustained wind speeds before making landfall near Awendaw (NOAA, 2022). The next day, Gaston weakened to a tropical depression in the northeastern portion of the state. Charleston and Georgetown counties issued voluntary evacuations for barrier islands, low-lying areas, beachfront areas, mobile homes, and other locations prone to flooding. Localized flooding occurred from storm surge of roughly four feet. Peak wind gusts were recorded at 82 mph in Charleston and Isle of Palms. Strong winds from this slow storm knocked down trees, power lines, and caused structural damage. Roughly 3000 structures were damaged from strong winds in Charleston, Berkeley, and Dorchester counties. An EF1 tornado was reported in Marlboro County (NOAA, n.d.). Property damage estimates for Charleston and Berkeley counties were $16.6 million.

Tropical Storm Frances (September 6-7, 2004): Frances formed as a tropical storm on August 25 and reached hurricane force on August 26. It reached as high as a Category 4 hurricane on August 28 (NOAA, 2022) before weaking to a Category 2 as it crossed the Bahamas and to a tropical depression as it moved through Georgia and up the southern Appalachians (NOAA, 2022; NOAA, NCEI, 2022). Significant for South Carolina were the tornado outbreaks from the remnants of Frances. Approximately 41 tornadoes were reported for South Carolina on September 7, breaking the previous one-day record of 23 tornadoes on August 16, 1994, from Tropical Storm Beryl. Sumter County had the worst damage (NOAA, n.d.). An F2 destroyed nine homes, damaged 55 homes, injured three people, and caused more than $1.7 million in damage. Kershaw County had an F3 tornado that destroyed several stables and caused other damage. The total loss estimate for the state was more than $93 million.

Hurricane Matthew (October 8, 2016): A month after Tropical Storm Hermine brought heavy rain and high winds to southeast Georgia and southeastern South Carolina, Hurricane Matthew moved up the southeast coast and slowly weakened to a category 1 storm as it moved northward along the South Carolina coast and then eastward near the North Carolina coast. The hurricane brought 6 to 12 inches of rain and up to 15 inches to some areas of northeastern South Carolina, with the bulk of the rainfall occurring within a 12-hour period. The rain fell on wet or saturated soil because of above-normal rainfall in September. The result was historic flood levels, widespread flash flooding, and an extended period of river flooding. Matthew's flooding rains, surge, and wind brought loss of life, temporarily displaced tens of thousands of people, and caused hundreds of millions of dollars in structural damage to homes and businesses. Major infrastructure had to be repaired or rebuilt. Property damage was estimated at $67 million. South Carolina received a Presidential disaster declaration for this event.

Hurricane Irma (September 11, 2017): Hurricane Irma tracked well to the west of southeast South Carolina but caused significant impacts because of heavy rainfall, strong winds, tornadoes, and storm surge. The peak storm total rainfall of 9.07 inches was recorded by an observer near Beaufort, SC. Widespread heavy rain resulted in reports of flash flooding with water entering homes and businesses. Wind damage produced numerous power outages across the region with some damage to structures and numerous downed trees. The strongest winds were confined to coastal locations, but frequent gusts into the 40-50 mph range occurred well inland. One fatality and one injury occurred from trees falling on homes and across roadways in southeast South Carolina. The entire southeast Georgia and southeast South Carolina coast was impacted by storm surge generally ranging from 3 to 6 feet. Significant beach erosion occurred at area beaches with widespread damage to docks and piers all along the coast; there were numerous reports of inundated roadways. South Carolina received a Presidential disaster declaration for this event that totaled at $37,224,058 with Public Assistance and Hazard Mitigation Assistance combined (NOAA, NCEI, 2022).

Recent Events 2018-2022

Hurricane Florence (September 15, 2018): In early September, Florence moved from off the west African coast toward the US. It made landfall in Wrightsville Beach, NC, on September 14. At the time of Florence's arrival on the North Carolina coast, the barometric pressure was 28.32 inches, and the highest recorded winds were at 106 mph. South Carolina had substantial damage from Hurricane Florence because of large amounts of rainfall, damaging winds, and riverine flooding as water flowed south from North Carolina into river basins in South Carolina. Areas still recovering from Hurricane Matthew in 2016 were affected by another large-scale flooding event caused by Florence. There were record peak flooding levels on the Little Pee Dee River in Galivants Ferry that indicate that this was one of the largest flood events within the area since 1928. The system spawned six tornadoes in South Carolina; two tornadoes in Dillon County caused minimal damage, while a tornado in Horry County caused roof damage. Florence impacted several counties along the North Carolina and South Carolina border and contributed to four direct fatalities and five indirect fatalities within the state (NOAA National Weather Service , 2018). South Carolina received a Presidential disaster declaration for this event as well as CDBG-DR funds to support recovery.

Hurricane Dorian (September 4-6, 2019): While moving through the Bahamas, Hurricane Dorian strengthened into a Category 5 hurricane, causing extreme damage. The storm had decreased in intensity to a Category 3 storm by the time it skirted the South Carolina coast and made landfall in North Carolina. Several tornadoes were spun off by Dorian, and the storm brought 10 to 15 inches of rain in some areas on the coast as well as inland counties. Wind gusts higher than 60 mph were reported along the coast. Tornadoes and flash flooding damages were reported within the state. South Carolina received a Presidential disaster declaration for this event (FEMA, n.d.).

Hurricane Isaias (August 3–4, 2020): Isaias, a Category 1 hurricane over the Atlantic, weakened to a tropical storm with sustained winds of 60 mph as it approached Florida. The storm strengthened back to into a hurricane with sustained winds of 85 miles per hour before making landfall in North Carolina. Rainfall totals exceeded 6 inches in Georgetown and Pawleys Island with the most intense rainfall remaining offshore. The peak recorded wind gust in South Carolina was 53 miles per hour in Myrtle Beach. Areas of Horry County flooded because of storm surge inundation, resulting in water rescues near Cherry Grove. Storm surge inundation of up to 4 feet was recorded at Springmaid Pier in Myrtle Beach. Sand dune erosion was extensive because of storm surge.

Hurricane Ian (September 30, 2022): Hurricane Ian caused major damage in Cuba and the western coast of Florida in late September before crossing Georgia, moving into the Atlantic, and turning northwestward to make a second U.S. landfall near Georgetown on September 30. High winds and storm surge caused damage in multiple counties with the most severe damage reported in Berkeley, Charleston, Georgetown, and Horry counties. Power outages peaked at 239,349, but most customers were restored within a day. One death resulted indirectly from the storm. South Carolina received a presidential disaster declaration for Hurricane Ian.

Historic Impacts

The table below summarizes the number of deaths and injuries and dollar amount of annualized losses from tropical cyclone events in South Carolina through 2020.

County	Historical Events (1960-2020)			Recent Impact (2015-2020)		
	Annualized Losses	Deaths	Injuries	Annualized Losses	Deaths	Injuries
Abbeville	$6,660	0	0	$0	0	0
Aiken	$6,838	0	0	$0	0	0
Allendale	$61,647	0	1	$0	0	1
Anderson	$6,660	0	0	$0	0	0
Bamberg	$19,895	0	0	$0	0	0
Barnwell	$6,838	0	0	$0	0	0
Beaufort	$268,217	0	0	$44,693	0	0
Berkeley	$19,145,891	6	8	$0	0	0
Calhoun	$712,776	0	0	$0	0	0
Charleston	$36,872,594	3	2	$3,333	0	2
Cherokee	$24,160	0	0	$0	0	0
Chester	$353,306	0	0	$0	0	0
Chesterfield	$950,070	0	0	$0	0	0
Clarendon	$3,485,062	0	2	$0	0	0
Colleton	$337,831	2	0	$0	0	0
Darlington	$3,307,198	0	0	$6,959	0	0
Dillon	$624,719	0	0	$2,681,550	0	0
Dorchester	$13,318,091	0	13	$0	0	1
Edgefield	$6,660	0	0	$0	0	0
Fairfield	$210,232	0	0	$0	0	0
Florence	$3,479,781	2	0	$0	2	0
Georgetown	$22,080,696	0	0	$12,164,126	0	0
Greenville	$9,466	0	0	$25,000	0	0
Greenwood	$6,660	0	0	$0	0	0
Hampton	$74,752	0	0	$0	0	0
Horry	$22,451,375	2	3	$23,968,579	0	0
Jasper	$84,306	0	0	$0	0	0

County	Historical Events (1960-2020)			Recent Impact (2015-2020)		
	Annualized Losses	Deaths	Injuries	Annualized Losses	Deaths	Injuries
Kershaw	$4,216,252	0	0	$0	0	0
Lancaster	$4,303,813	0	0	$0	0	0
Laurens	$7,007	0	0	$0	0	0
Lee	$3,485,062	1	20	$0	0	0
Lexington	$21,610	0	0	$0	0	0
Marion	$259,230	0	0	$521,928	0	0
Marlboro	$222,901	0	0	$181,809	0	0
McCormick	$6,660	0	0	$0	0	0
Newberry	$19,527	0	0	$0	0	0
Oconee	$6,660	0	0	$0	0	0
Orangeburg	$1,267,233	1	20	$0	0	0
Pickens	$13,217	0	0	$66,667	0	0
Richland	$1,752,383	1	31	$0	0	1
Saluda	$19,527	0	0	$0	0	0
Spartanburg	$7,007	0	1	$0	0	1
Sumter	$13,881,134	1	328	$0	0	0
Union	$7,117	0	0	$0	0	0
Williamsburg	$11,226,157	0	0	$893,850	0	0
York	$7,212,981	0	0	$0	0	0
Grand Total	$175,847,859	19	429	$40,558,494	2	6
State Average	$3,822,780	< 1	9	$881,706	< 1	< 1

Table 25 Tropical Cyclone Impacts by County

Vulnerability

Vulnerability to effects of tropical cyclones is based on location, such as proximity to the coast and land elevation, resilience and types of structures, and socioeconomic factors like age and income that can affect ability to take protective measures. Vulnerability to the impacts of tropical cyclones can be heightened in areas with fewer economic resources because of resulting challenges in mitigating, evacuating, and recovering. Figure 49 displays the tropical cyclone risk of South Carolina counties based on past occurrences and losses.

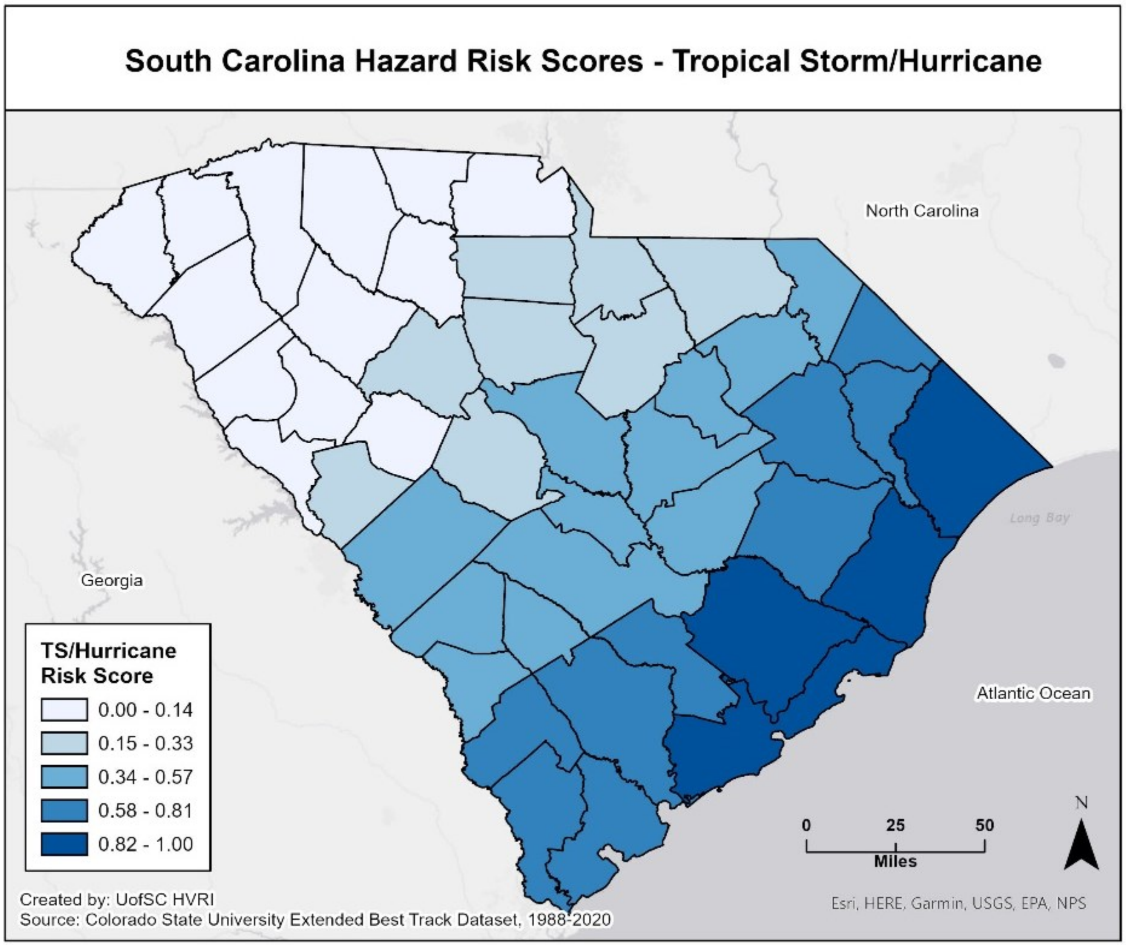


Figure 49: South Carolina Tropical Storm and Hurricane Risk

Storm surge is an elevated water level pushed toward the shore by the force of a tropical cyclone's strong winds (NOAA, n.d.). The advancing surge of a tropical cyclone combines with normal tides, which in extreme cases can increase the normal water height to more than 20 feet. Storm surge arrives ahead of the tropical cyclone's landfall, and the more intense the hurricane, the sooner the surge arrives (NOAA, n.d.). Water rise can be rapid and can move far inland, posing a serious threat to those who have not yet evacuated flood-prone areas. The National Hurricane Center designated the area of coastline between the Florida/Georgia state line and the North Carolina/South Carolina state line as the Charleston Basin (CH3).

To analyze potential vulnerability to storm surge, the Sea, Lake, and Overland Surges from Hurricanes (SLOSH) model was used to estimate storm surge heights from historical, hypothetical, and predicted hurricanes (NOAA, 2019). Storm surge inundation risk is displayed in Figure 50 below. GIS analysis using census block population data (aggregated to the county level), in conjunction with SLOSH data, estimates population exposure to storm surge zones. GIS analysis also was used to analyze state-owned facility exposure to storm surge with the SLOSH data (see Table 26 and Table 27 below).

In SLOSH model results, MOM refers to maximum of the maximum, which represents an aggregate several points of data including the maximum envelope of water (maximum area of rise from storm surge).

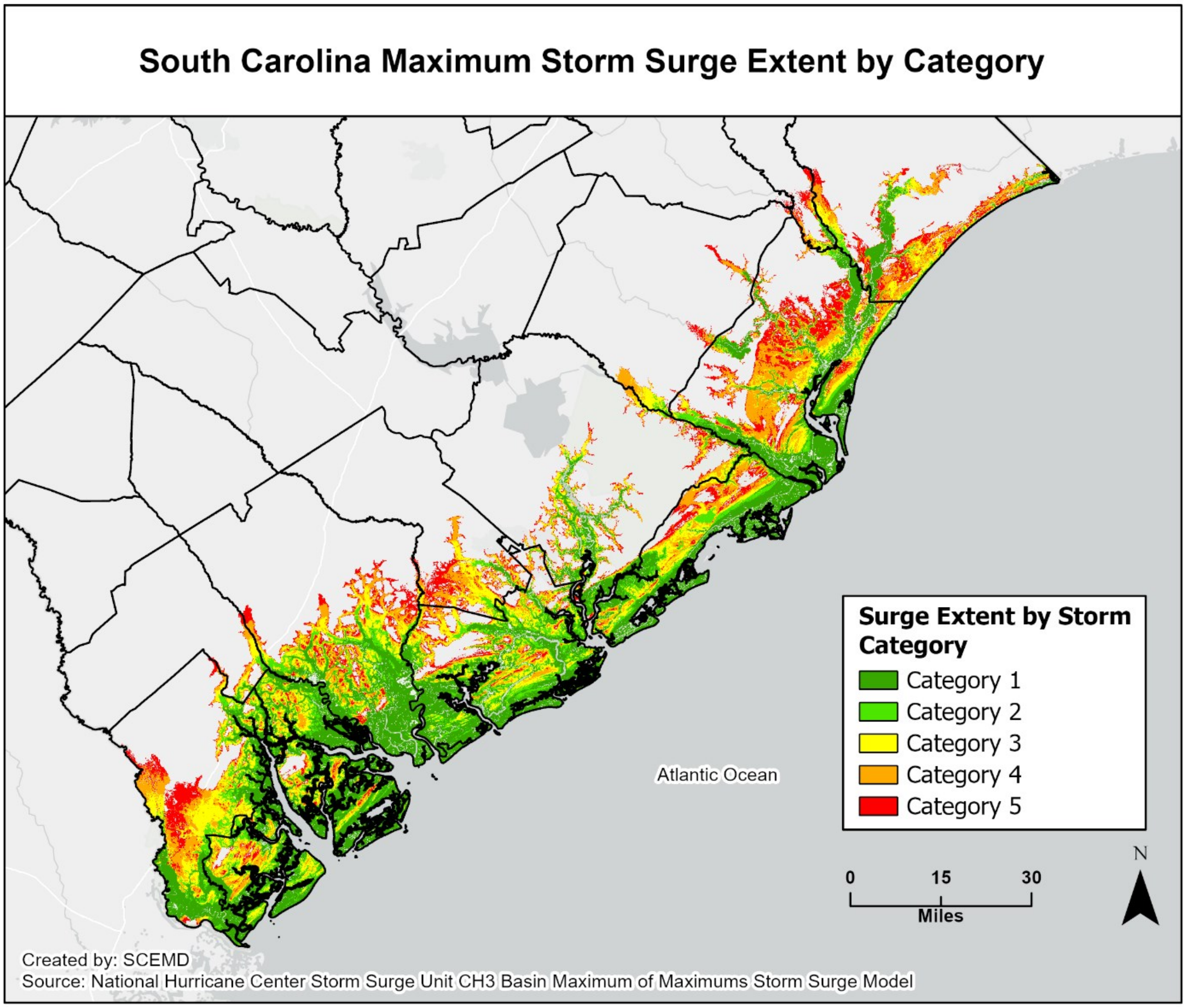


Figure 50: Storm Surge Inundation Risk

The table below displays the population exposed to storm surge through four different SLOSH models. Each SLOSH MOM represents a different category of tropical cyclone event, the population numbers for each coastal county are displayed based on the likelihood of population exposure to storm surge.

County	Population Exposed to Storm Surge				
	SLOSH MOM 1	SLOSH MOM 2	SLOSH MOM 3	SLOSH MOM 4	SLOSH MOM 5
Beaufort	100,294	122,115	152,419	173,077	178,051
Berkeley	30,689	44,639	55,772	72,004	93,629
Charleston	194,305	294,063	334,655	361,191	383,321
Colleton	3,458	5,193	7,841	10,027	11,835
Dorchester	9,596	26,883	57,637	70,187	88,347

County	Population Exposed to Storm Surge				
	SLOSH MOM 1	SLOSH MOM 2	SLOSH MOM 3	SLOSH MOM 4	SLOSH MOM 5
Florence	0	0	0	0	0
Georgetown	27,370	38,058	51,391	54,779	57,603
Hampton	215	326	515	568	1,035
Horry	74,804	93,859	148,991	203,960	231,461
Jasper	5,043	9,154	15,738	17,728	18,482
Marion	0	0	0	0	0
Williamsburg	98	965	1,169	1,278	1,634
Grand Total	445,872	635,255	826,128	964,799	1,065,398

Table 26 Storm Surge Exposure analyzed using SLOSH Model: Population

The table below displays the likelihood of state assets on South Carolina's coast to be exposed to storm surge. Each SLOSH MOM identifies a different category of tropical cyclone event. The state asset numbers for each coastal county based on each type of event.

County	State Assets Exposed to Storm Surge				
	SLOSH MOM 1	SLOSH MOM 2	SLOSH MOM 3	SLOSH MOM 4	SLOSH MOM 5
Beaufort	4	8	13	23	27
Berkeley	0	0	0	0	0
Charleston	47	152	182	190	199
Colleton	5	7	8	9	9
Dorchester	0	0	1	1	1
Florence	0	0	0	0	0
Georgetown	1	3	12	15	16
Hampton	0	0	0	0	0
Horry	0	1	1	12	14
Jasper	0	0	0	1	3
Marion	0	0	0	0	0
Williamsburg	0	0	0	0	0
Grand Total	57	171	217	251	269

Table 27 Storm Surge Exposure analyzed using SLOSH Model: State Facilities/Infrastructure

To identify locations where demographic and socioeconomic factors indicate potential for increased vulnerability, social vulnerability indices are reviewed and mapped. Understanding social vulnerability can help focus mitigation and response planning as well as investment in mitigation and preparedness activities.

In the figure below, each census tract is assigned the county's risk score value and overlaid with the tract's SoVI® score. The lightest areas indicate the tracts with the lowest social vulnerability and lowest tropical storm/hurricane risk score. Areas of higher social vulnerability and lowest tropical storm/hurricane risk are brighter pink, and areas of highest tropical storm/hurricane risk and lowest social vulnerability are brighter blue. Areas of the highest combined social vulnerability and tropical storm/hurricane risk are dark blue. Excluded census tracts (shown in gray/black hatching) are those with zero population and/or zero households and so were not included in the SoVI® analysis. Of the included 1,303 census tracts, 129 fall within the combined highest levels of social vulnerability and highest risk scores (dark blue).

The areas with high physical vulnerability to tropical cyclones plus high social vulnerability are concentrated in 16 counties, including areas in Bamberg, Beaufort, Berkeley, Charleston, Clarendon, Colleton, Dillon, Dorchester, Florence, Georgetown, Hampton, Horry, Jasper, Marion, Orangeburg, and Williamsburg counties.

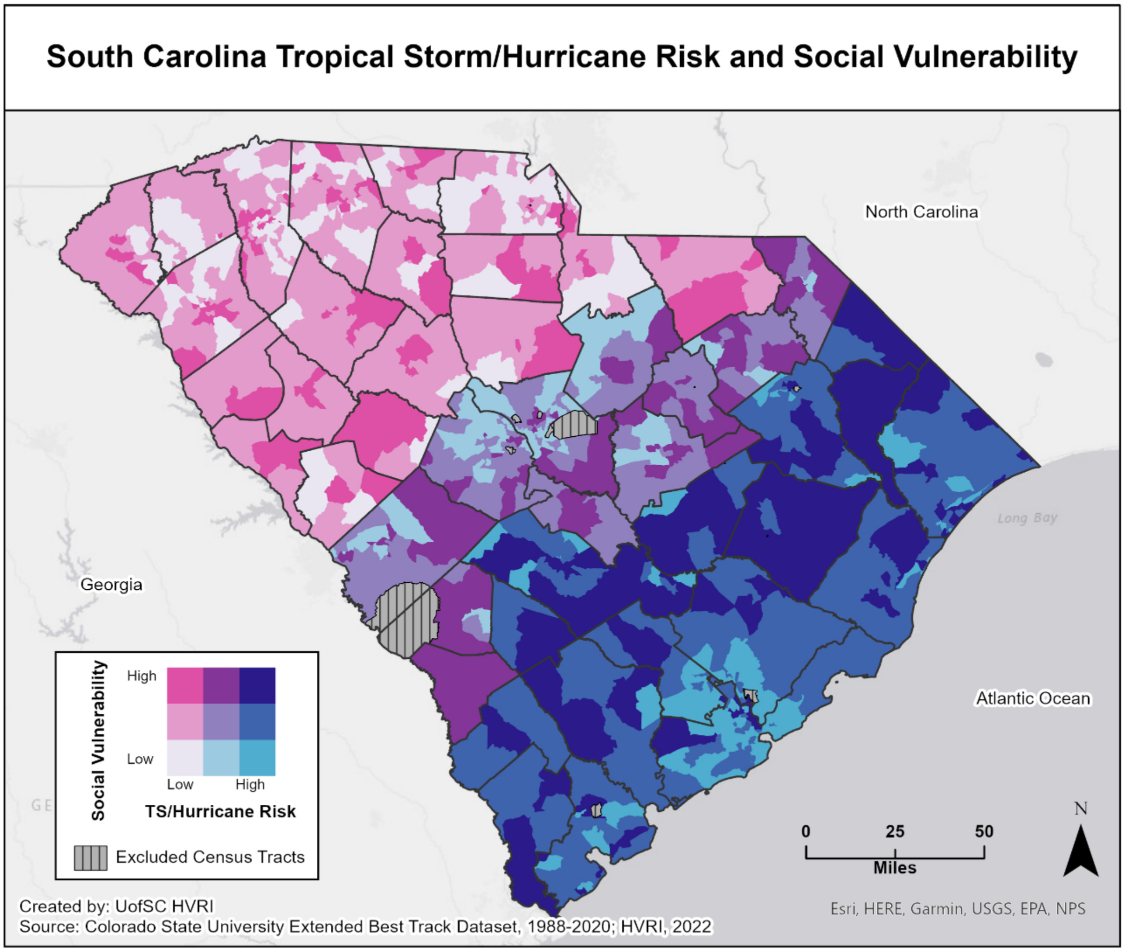


Figure 51: Tropical Cyclone Risk and Social Vulnerability

Impacts

Hurricane winds can cause widespread destruction; even tropical storm-force winds can be dangerous. High winds from a tropical cyclone can pick up debris and turn items into dangerous projectiles, knock down trees and buildings, and destroy mobile homes. The Saffir-Simpson Scale categorizes hurricane intensity based on sustained wind speeds and correlated potential property damage (NOAA, 2019).

Hurricanes can generate significant rainfall. Slower moving and large storms tend to generate more rain. Hurricane Florence in 2018. caused tremendous amounts of flooding and throughout the state and specifically in counties that border North Carolina. The size of the storm event, time, weather conditions, and forward speed upon arrival can all play a significant part in flooding events associated to tropical storm events.

While not represented in the Saffir-Simpson Scale, storm surge remains the leading killer of residents along immediate coastal areas in tropical cyclone events (NOAA, 2019). Debris carried by storm surge waves also contributes to damage. As the storm approaches shore, the greatest storm surge generally will be to the north of the hurricane eye, in the right front quadrant of the direction in which the hurricane is moving (NOAA, n.d.) . The surge of high water topped by waves driven by hurricane force winds can be devastating, causing severe beach erosion and property damage along the coast. Storm surge heights and the height of associated waves vary based on the shape of the continental shelf (narrow or wide) and the depth of the ocean bottom (bathymetry) (NOAA, n.d.). A narrow shelf, or one that drops steeply from the shoreline and subsequently produces deep water close to the shoreline, tends to produce a lower surge but higher and more powerful storm waves (NOAA, n.d.).

Hurricanes and tropical storms may spawn tornadoes, typically away from the center of the system and embedded in rain bands that circle around the eye. Hurricane-spawned tornadoes tend to have a shorter lifespan than non-tropical tornadoes but can still cause great damage (Tibbetts, 2002).

Estimated Impacts of a 21st Century Hurricane Hugo

Hurricane Hugo in 1989 was the most powerful and damaging tropical cyclone to impact South Carolina in recent decades. Since 1989, population and infrastructure development in coastal areas of the state have increased significantly. The HAZUS loss estimation model is used in this section to depict the impacts of a Hurricane Hugo-like storm on South Carolina considering more recent population and infrastructure numbers. The model approximates Hurricane Hugo's wind strength and applies it to 2018 census information (the most recent available in the HAZUS model), estimating the damage and impacts that would occur if Hurricane Hugo occurred today.

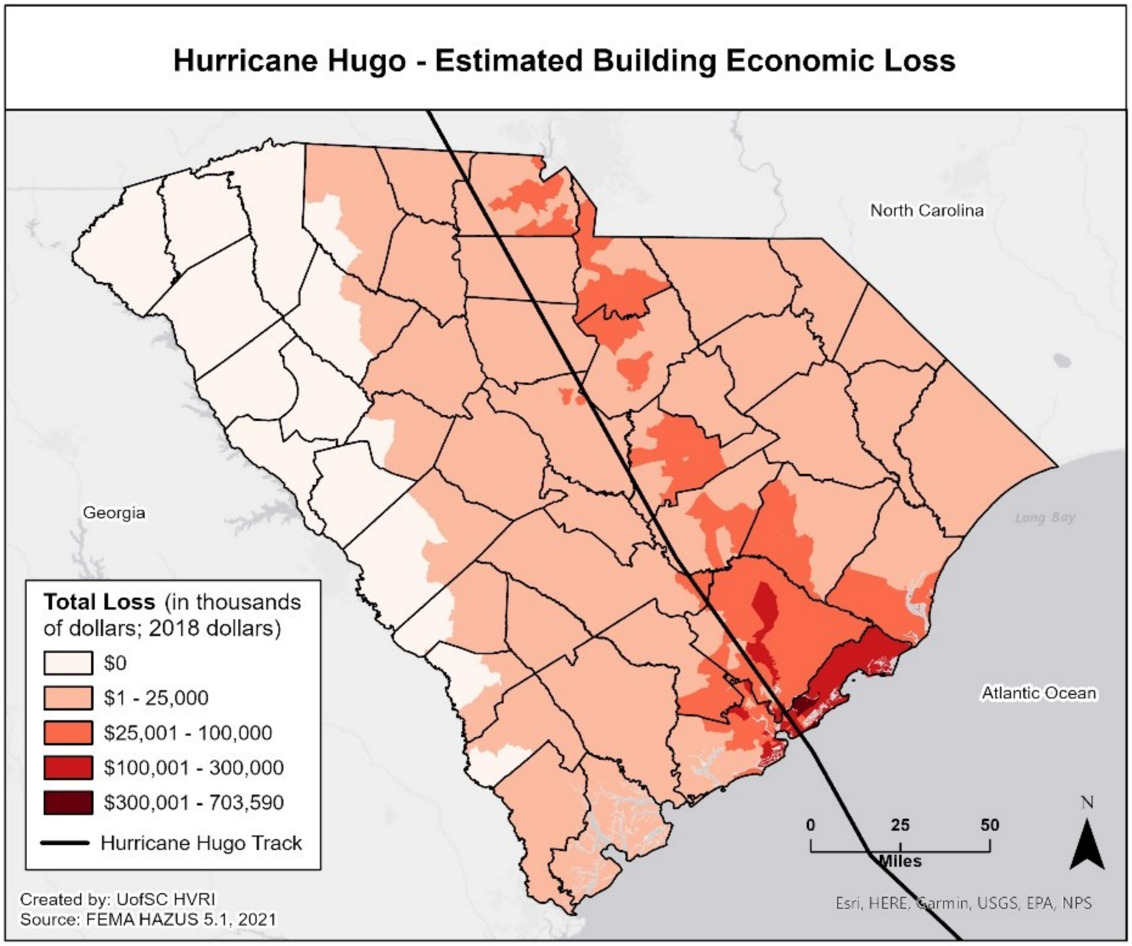


Figure 52: Estimated Building Damage Costs in a Hurricane Hugo Scenario

The total estimated building loss using the model is $515,767,250. The county with the highest modeled total damage is Charleston County ($4.6 billion) followed by Berkeley ($1.6 billion) and York ($664 million) counties. The counties with the highest proportion of buildings that are at least moderately damaged are Charleston (52%), Berkeley (28%), and York (13%) counties.

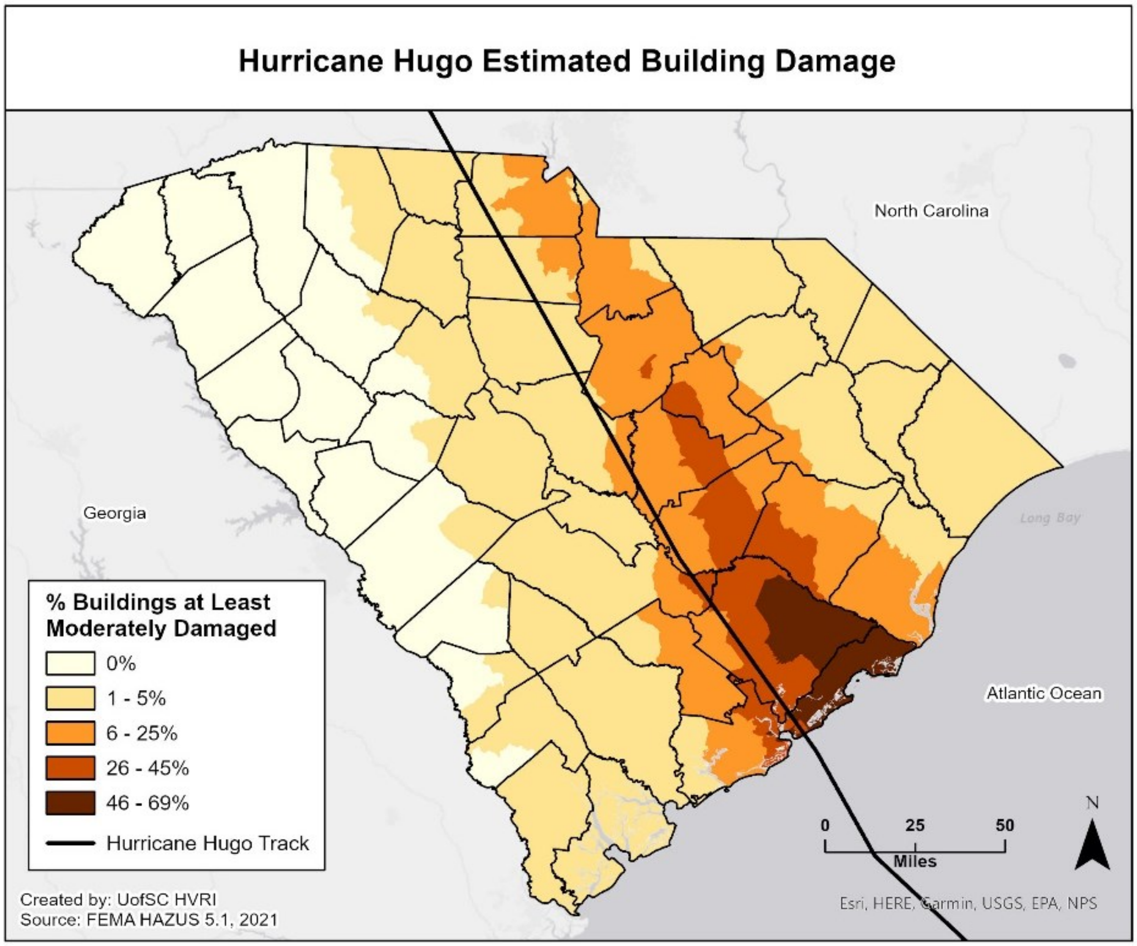


Figure 53: Estimated Percent of Buildings at least Moderately Damaged in Hurricane Hugo Scenario

The following table describes the estimated residential, commercial, industrial, and other damage that could be expected to buildings in each county in a Hurricane Hugo scenario.

County	Building Exposure (in thousands of dollars; 2018 dollars)				
	Residential	Commercial	Industrial	Other	Total
Abbeville	$1,739,104	$202,965	$213,212	$153,846	$2,309,127
Aiken	$13,569,288	$1,998,477	$457,777	$628,508	$16,654,050
Allendale	$633,522	$90,205	$65,745	$93,517	$882,989
Anderson	$15,499,946	$2,797,674	$1,158,228	$859,253	$20,315,101
Bamberg	$1,291,887	$169,055	$63,721	$86,623	$1,611,286
Barnwell	$1,487,287	$252,072	$118,978	$152,409	$2,010,746
Beaufort	$19,460,525	$2,490,084	$353,192	$500,749	$22,804,550
Berkeley	$14,648,982	$1,547,973	$577,131	$436,605	$17,210,691
Calhoun	$1,075,463	$104,139	$54,881	$62,789	$1,297,272
Charleston	$37,719,156	$7,667,939	$1,646,347	$1,688,634	$48,722,076
Cherokee	$3,469,829	$672,051	$328,918	$271,000	$4,741,798
Chester	$2,174,950	$396,419	$210,445	$161,165	$2,942,979

County	Building Exposure (in thousands of dollars; 2018 dollars)				
	Residential	Commercial	Industrial	Other	Total
Chesterfield	$2,909,452	$437,907	$317,875	$217,605	$3,882,839
Clarendon	$2,346,113	$248,405	$79,388	$134,005	$2,807,911
Colleton	$2,889,222	$528,853	$137,590	$222,564	$3,778,229
Darlington	$4,594,706	$795,395	$501,306	$304,495	$6,195,902
Dillon	$1,696,772	$321,401	$142,787	$158,602	$2,319,562
Dorchester	$12,315,752	$1,164,188	$473,798	$365,917	$14,319,655
Edgefield	$2,043,144	$241,598	$171,732	$144,808	$2,601,282
Fairfield	$1,844,028	$207,007	$61,956	$134,295	$2,247,286
Florence	$10,038,876	$2,761,477	$552,649	$786,317	$14,139,319
Georgetown	$6,258,481	$1,059,006	$241,159	$395,560	$7,954,206
Greenville	$40,658,436	$8,084,189	$3,172,634	$1,818,475	$53,733,734
Greenwood	$5,577,549	$1,150,949	$384,246	$480,439	$7,593,183
Hampton	$1,183,698	$207,479	$58,639	$124,219	$1,574,035
Horry	$30,556,378	$4,419,973	$711,828	$902,627	$36,590,806
Jasper	$1,404,218	$300,854	$70,591	$78,380	$1,854,043
Kershaw	$4,788,104	$701,654	$196,307	$261,369	$5,947,434
Lancaster	$5,902,922	$705,727	$332,970	$400,492	$7,342,111
Laurens	$4,677,284	$681,690	$449,956	$308,369	$6,117,299
Lee	$998,071	$157,675	$68,433	$102,527	$1,326,706
Lexington	$23,838,187	$3,624,848	$1,088,409	$967,525	$29,518,969
Marion	$2,043,518	$417,618	$236,092	$160,860	$2,858,088
Marlboro	$1,651,980	$238,125	$154,361	$151,856	$2,196,322
McCormick	$889,306	$65,293	$18,129	$74,522	$1,047,250
Newberry	$3,139,244	$447,409	$196,552	$179,386	$3,962,591
Oconee	$6,753,025	$836,770	$391,537	$460,919	$8,442,251
Orangeburg	$6,143,737	$1,302,613	$455,710	$538,180	$8,440,240
Pickens	$9,454,641	$1,536,912	$548,841	$532,353	$12,072,747
Richland	$37,567,372	$6,542,379	$1,370,235	$2,738,846	$48,218,832
Saluda	$1,522,437	$125,098	$83,559	$88,968	$1,820,062
Spartanburg	$23,592,235	$4,896,268	$2,495,524	$1,393,589	$32,377,616
Sumter	$7,873,888	$1,280,098	$788,364	$455,660	$10,398,010
Union	$2,090,878	$306,875	$173,502	$171,634	$2,742,889
Williamsburg	$1,967,805	$306,632	$90,772	$161,797	$2,527,006
York	$20,568,501	$2,681,456	$890,263	$1,175,950	$25,316,170
Grand Total	$404,549,899	$67,172,874	$22,356,269	$21,688,208	$515,767,250

Table 28 Building Exposure by Category – Hurricane Hugo Scenario

A significant tropical cyclone would cause major impacts to all community lifelines as seen in the table below.

Community Lifeline	Level of Impact	Description of Impacts	Area of Impact
Communications	High	Telecommunications and broadband equipment and systems may be damaged by high wind, storm surge, and/or flooding, which would cause communication disruptions or outages. Additional disruption may occur because of power outages. Outages could impact public sector information sharing platforms, dispatch centers, media transmissions, and the financial sector.	Regional
Energy	High	High wind, storm surge, and flooding may damage power generation, transmission, or distribution facilities, equipment, or systems. Fuel stations may be damaged, inaccessible, or without power as a result. Pipelines may be damaged. Control systems may be affected by power or communication outages.	Regional
Food, Water, Shelter	High	Residential structures, particularly near the coast or low-lying areas may be damaged by high wind, storm surge, and/or flooding, resulting in the need for emergency shelter and possibly temporary housing. Local water systems and retailers that supply food may be damaged, without power, or inaccessible. Flooding from tropical cyclones may damage crops. Extended power outages could disrupt food processing and distribution operations.	Regional
Hazardous Materials	High	Hazardous materials storage and transportation equipment and systems may be damaged by high wind, storm surge, and flooding, potentially resulting in release of hazardous materials. Damage to storage containers and transportation infrastructure could cause environmental, human, and animal health risks.	Localized, Regional
Health and Medical	High	Healthcare facilities, particularly in or near coastal or low-lying areas, may be damaged by high winds, storm surge, or flooding and may be affected by power or communication outages. Facilities may be inaccessible because of high water. Hospitals may see an influx of patients and shortages of supplies. Relief staff may not be able to reach medical facilities in heavily impacted areas. Mandatory	Regional or statewide

Community Lifeline	Level of Impact	Description of Impacts	Area of Impact
		evacuation of medical facilities pre-storm may be required depending on storm forecast.	
Safety and Security	High	Evacuation of coastal communities may be required for community safety. Response personnel may need to support evacuation and search and rescue activities. Responders may see increased calls for assistance. Response and emergency management agencies may see extended operating/shift periods, and specialized equipment or training may be required.	Regional
Transportation	High	Transportation routes may be altered because of lane reversal to support evacuations, road closures or damage, bridge closures or damage, and/or railway closures or damage. Port and airport operations may be disrupted, and infrastructure may be damaged or destroyed. Disrupted transportation routes may affect supply chains.	Regional

Table 29 Potential Community Lifeline Impacts Based on Significant Tropical Cyclone Scenario

Future Climate Considerations

Based on scientific research, warming of the climate and of ocean waters are projected to increase the intensity of tropical cyclone activity. Some areas are expected to see greater likelihood of rapid intensification of tropical systems (Maya Chung, 2021). Increases in the overall level of the ocean will continue to increase storm surge and inundation levels. More intense tropical cyclones and hurricanes are to be expected from the change in atmospheric conditions. This coupled with higher water levels will increase the damaging effects of storm surge, overall inundation, wind, and tornadoes caused by tropical cyclones.

G. Wind

For the purposes of this assessment, wind hazards refer to events that are not occurring in conjunction with other specific hazards including thunderstorms, winter storms, tropical cyclones, or tornadoes. Wind events can create significant damage to property and generate cascading effects such as power and communications outages.

Formation

Winds are created because of variations in heating and cooling of air based on multiple factors, including geographical features, such as types of land and water, as well as location and proximity to bodies of water, mountains, and other features. In addition, winds can be created at the meeting of certain types of pressure systems, which can generate changes in air density and temperatures (NOAA, n.d.).

Classification

Multiple types of winds can create damage. Straight-line wind is a term used to describe winds that do not incorporate rotatory forces as opposed to cyclonic or tornadic winds. Macrobursts occur when a downdraft reaches the surface and produces an outward burst of powerful winds over a surface area greater than 2.5 miles. A microburst is similar but with a surface area less than 2.5 miles. Gust fronts are winds that precede other storms. Finally, derechos are extensive, prolonged windstorms with minimum gusts of 58 mph and a damage area greater than 240 miles (NOAA, n.d.).

Wind speeds are generally measured in knots or using the Beaufort Wind Scale as shown below.

Force	Wind (Knots)	Classification
0	Less than 1	Calm
1	1-3	Light Air
2	4-6	Light Breeze
3	7-10	Gentle Breeze
4	11-16	Moderate Breeze
5	17-21	Fresh Breeze
6	22-27	Strong Breeze
7	28-33	Near Gale
8	34-40	Gale
9	41-47	Strong Gale
10	48-55	Storm
11	56-63	Violent Storm
12	64+	Hurricane

Table 30 Wind Speed Classification

Location and Probability

According to historical data from the National Climatic Data Center, since 1955, approximately 0.12 wind events occur annually per county in South Carolina. The figures below depict occurrences as well as the wind risk scores of counties. In addition, the Probability Table addresses future probability by county. Based on current data, the state average probability for a windstorm is 1% per day, with Colleton, Lexington, and Richland counties having the highest probability with a 3% chance per day.

The 13,338 total damaging wind point events are distributed through all 46 counties, with the Columbia and Charleston Metropolitan areas displaying the densest concentrations (yellow shading). Severe thunderstorm wind events are generally reported and verified based on damages from falling trees rather than observed wind gusts. Because of this reporting of damaging winds, wind occurrence records tend to be higher in areas with more trees or property that could be damaged. The statewide average number of wind events within South Carolina counties for the 65-year period was 290.02. The counties with the highest number of events were Lexington (639), Colleton (632) and Richland (619). The counties with the lowest number of events were McCormick (101), Williamsburg (136) and Abbeville (140). (Data Source: NOAA Storm Prediction Center, 1955-2019; Point Data Clustered in a Heat Map).

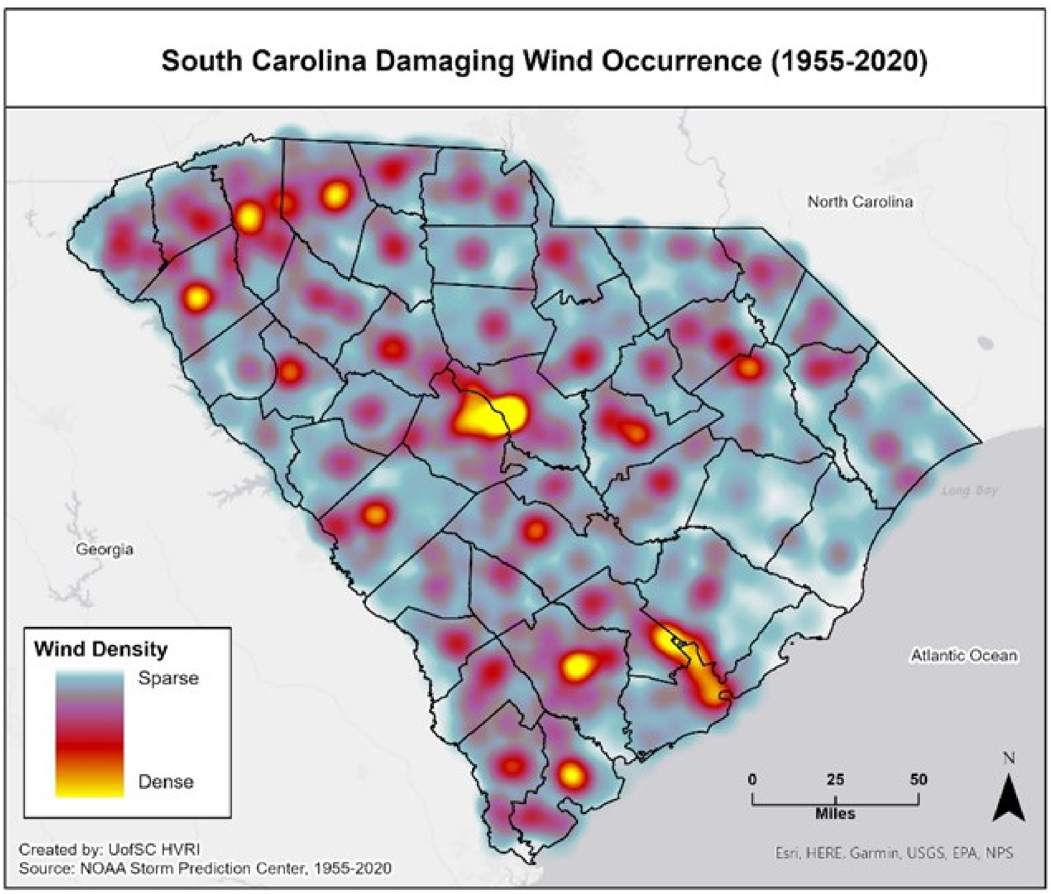


Figure 54: South Carolina Damaging Wind Occurrence (1955 - 2020)

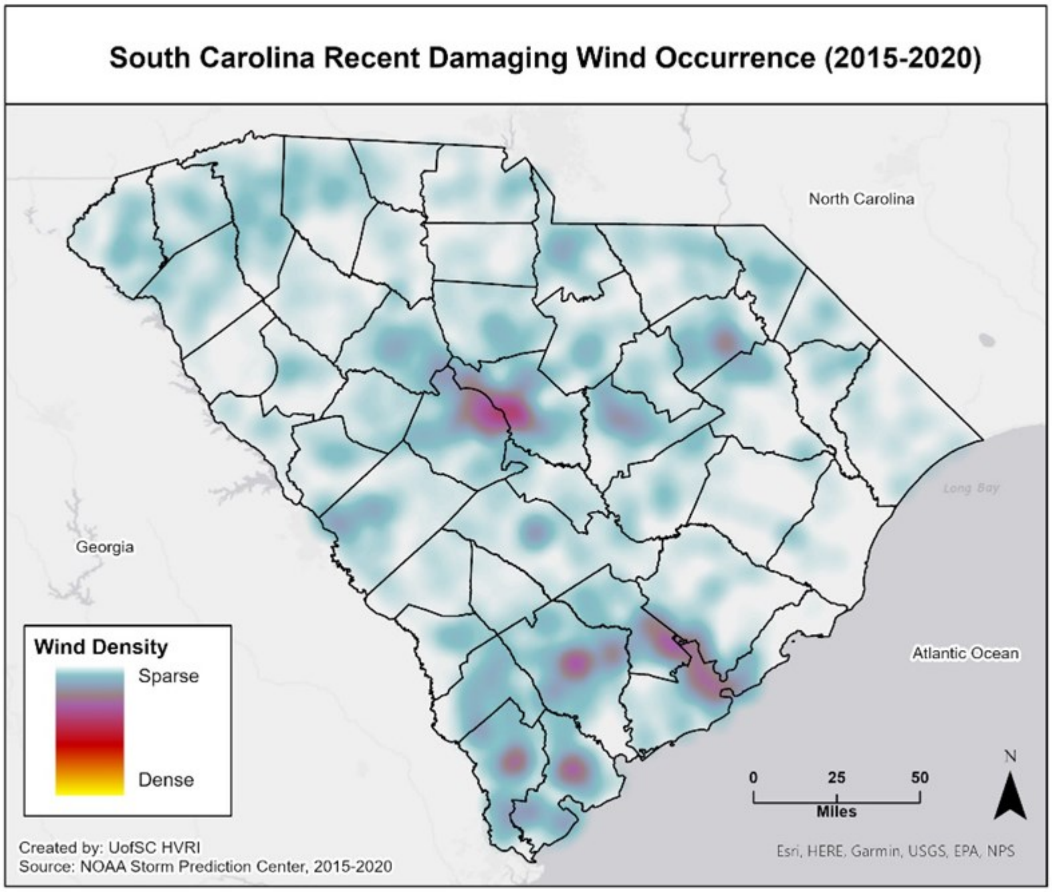


Figure 55: South Carolina Recent Damaging Wind Occurrence (2015 - 2020)

The pattern of wind occurrence for the recent period is less dense, with 2,908 damaging wind point events recorded (22% of the total events). A similar distribution is found for this 5 -year period when compared to the complete 65-year record. The statewide average number of damaging wind events in the recent period was 63.17 per county. The counties with the highest number of events based on 2015-2020 data were Colleton (191), Richland (170), and Charleston (167). The counties with the lowest number of events were Abbeville (9), McCormick (19), and Bamberg/Union (20). (Data Source: NOAA Storm Prediction Center, 2015-2019; Point Data Clustered in a Heat Map).

County	Hazard Occurrence (1955-2020)		County	Hazard Occurrence (1955-2020)	
	Future Daily Probability (% chance per day)	Frequency Interval (Days between event)		Future Daily Probability (% chance per day)	Frequency Interval (Days between event)
Abbeville	1	168.46	Greenwood	1	106.59
Aiken	2	55.51	Hampton	1	92.30
Allendale	1	141.71	Horry	1	77.21
Anderson	2	51.36	Jasper	1	69.83
Bamberg	1	153.44	Kershaw	1	91.60
Barnwell	1	128.82	Lancaster	1	105.66
Beaufort	2	54.63	Laurens	1	79.77
Berkeley	2	61.93	Lee	1	163.88
Calhoun	1	136.88	Lexington	3	36.28
Charleston	2	45.28	Marion	1	143.39
Cherokee	1	117.51	Marlboro	1	121.06
Chester	1	135.34	McCormick	0	231.63
Chesterfield	1	106.12	Newberry	1	74.35
Clarendon	1	94.84	Oconee	1	81.11
Colleton	3	36.72	Orangeburg	2	52.48
Darlington	1	81.66	Pickens	1	83.94
Dillon	1	154.42	Richland	3	36.95
Dorchester	2	57.77	Saluda	1	132.36
Edgefield	1	135.34	Spartanburg	2	46.06
Fairfield	1	98.73	Sumter	1	69.83
Florence	1	75.52	Union	1	135.34
Georgetown	1	153.44	Williamsburg	1	177.13
Greenville	2	47.05	York	1	77.46
State Average				1	99.5

Table 31 Wind Impacts and Occurrences

Vulnerability

Figure 56 depicts wind event risk by county. The average wind risk score was 0.35. Lexington County has the highest wind risk score (1.00) with Colleton (.99) and Richland counties (.96) following closely behind. McCormick County received the lowest risk score (0.00) followed by Williamsburg and Abbeville counties (0.07).

The most recent data indicates a mostly uniform level of risk across the state. Areas with increased population density will see a greater vulnerability to damage than areas with lower population density.

In addition, certain structures are more vulnerable to wind damage than others. For example, homes with hip style roofs are less vulnerable than homes with gabled roofs. Manufactured homes are more vulnerable than traditionally built homes, while timber framed structures are more vulnerable than masonry-built structures, such as brick or stone buildings. Low-income populations, particularly those living in manufactured homes, are at a higher level of vulnerability to damage from strong wind events. Figure 57 illustrates the combination of wind risk and social vulnerability.

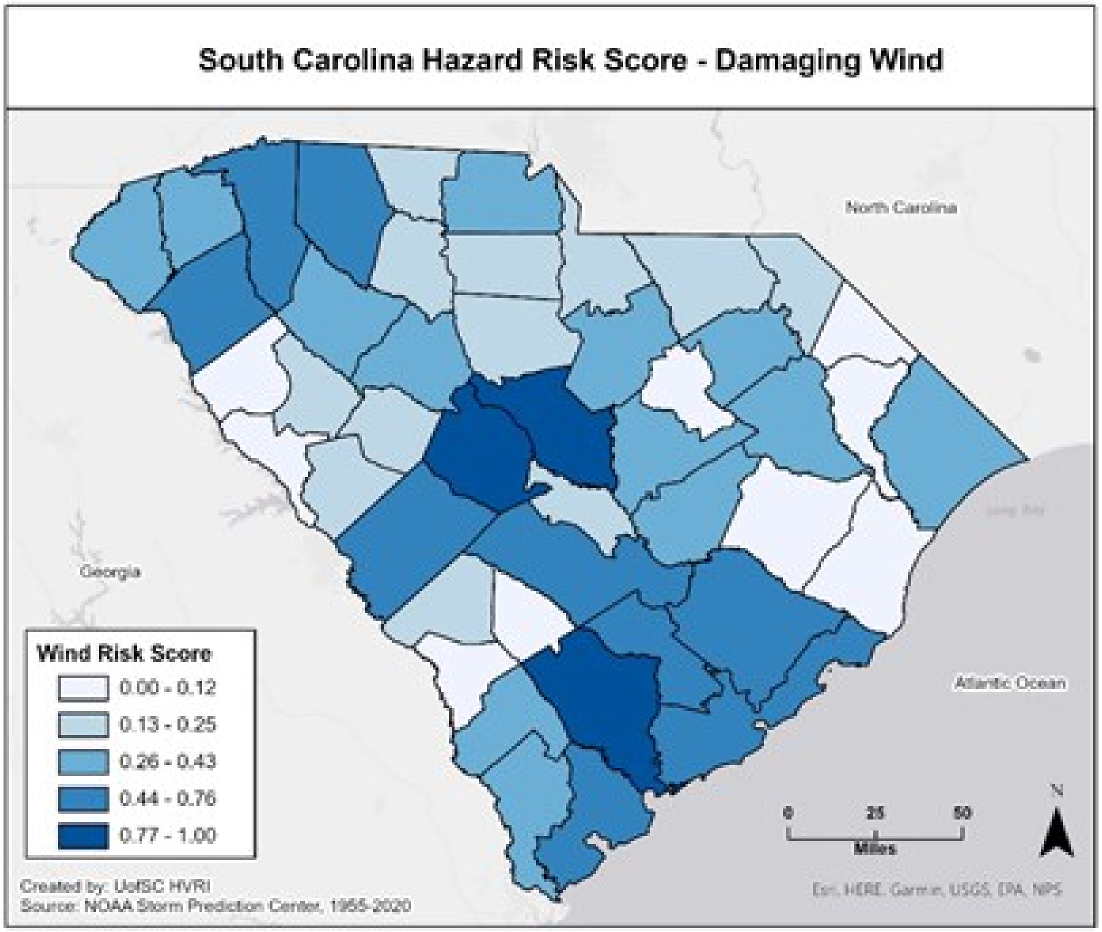


Figure 56: South Carolina Damaging Wind Risk

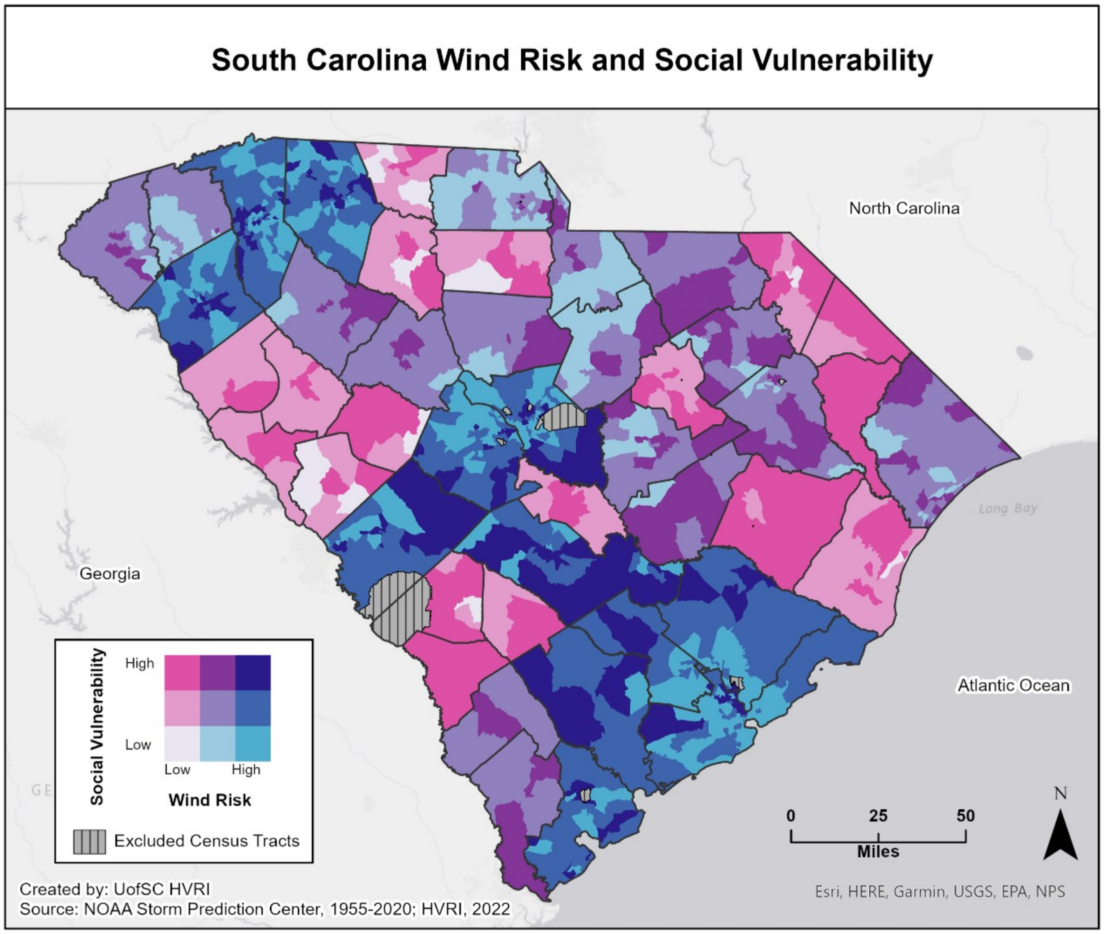


Figure 57: South Carolina Social Vulnerability and Damaging Wind Risk Map

Impacts

Impacts of wind events are typically calculated in terms of lives lost, injuries incurred, and property damage sustained in dollars. Windstorms can also create cascading impacts, as noted above.

High wind can cause significant impacts to critical community lifelines, though these are local or regional to the area of the event. Table 32 below outlines impacts to community lifelines.

Community Lifeline	Level of Impact	Description of Impacts	Area of Impact
Communications	Medium	Telecommunication and broadband equipment and lines may be damaged by strong wind gusts and falling debris.	Localized or regional
Energy	Medium	Power lines may be damaged by high winds and wind-borne or falling debris, resulting in power outages. Generators could also be damaged from falling debris during a large-scale wind event.	Localized or regional
Food, Water, Shelter	Medium	Residential, food storage/retail, and water/wastewater treatment structures may be	Localized

Community Lifeline	Level of Impact	Description of Impacts	Area of Impact
		damaged by high winds. Significant damage could result in displacement of residents to emergency shelter and temporary housing and spoilage of food inventory. High winds may damage or destroy crops. Significant impacts to water systems and supplies is not anticipated.	
Hazardous Materials	Low	Significant impacts are not anticipated. Hazardous materials storage and transport equipment may be dislodged or damaged by high winds, which may result in a release and loss of material.	Localized
Health and Medical	Low	Significant impacts are not anticipated other than potential structural damage and potential for power outages at medical facilities without generators.	Localized
Safety and Security	Low	Significant impacts are not anticipated other than potential structural damage and potential for power outages at critical facilities without generators.	Localized
Transportation	Low	Significant impacts are not anticipated other than potential structural and vehicle damage and potential for power outages at critical facilities such as airports without generators. Transportation routes may be blocked or rerouted because of debris or downed power lines.	Localized

Table 32 Potential Community Lifeline Impacts Based on Significant High Wind Scenario

Historical and Notable Events

All historical and recent occurrence data is derived from NCEI's Storm Event Database unless stated otherwise. Loss-causing data is derived from SHELDUS V.20.0. For more information regarding the methodology, please examine the hazard narrative methodology Appendix B.

March 27, 1996: Gale force winds, with gusts up to 38 knots, developed by early afternoon at approximately 2:00 PM and continued through the night. A ship off the coast of Beaufort capsized during the night of March 27 or early morning on March 28, killing all five passengers on board.

July 13, 2004: At approximately 4:45 PM, gale force winds gusting up to 40 knots knocked down a rotten tree which landed on a car traveling along Highway 17 in Awendaw, killing a passenger in the vehicle.

April 2, 2005: Deep low pressure developed north of southern South Carolina, including Hampton County. Strong gale winds gusting up to 45 knots were common across the region, bringing down numerous trees. One man was killed in Yemassee when a tree struck his truck at approximately 1:00 PM.

November 12, 2006: Strong breeze winds gusting up to 25 knots caused a boat on Lake Moultrie to capsize at approximately 12:00 PM. Two people drowned as a result, despite a Lake Wind Advisory having been issued.

April 15, 2008: A strong high-pressure system building into coastal South Carolina region combined with an intensifying area of low pressure in the western Atlantic resulted in gale force winds across southern South Carolina, with gusts up to 40 knots. At approximately 11:30 AM, an oak tree 3 feet in diameter was downed winds, striking a truck traveling on County Line Road off of Highway 165. The driver and a passenger in the vehicle were killed and causing $5,000 in damages.

October 8, 2008: A gravity wave over the Western moved across the Anderson area. This combination of 40 knot gale force winds and wet ground downed several trees in the city. This included a tree falling on multiple vehicles and homes, causing approximately $100,000 in damages.

Recent Events 2018–2020

March 6, 2020: As a cold front departed across southeast South Carolina, gale force winds developed with gusts up to 35 knots, in and around Jasper County. At approximately 4:05 PM, law enforcement reported 4 trees down on Highway 336, one of which struck a car, injuring the driver and causing $10,000 in damage.

November 30, 2020: Gale force winds developed behind a departing cold front, impacting portions of southeastern South Carolina, include Beaufort County. From approximately 5:15 AM through 4:29 PM, wind gusts up to 40 knots downed several trees, one of which struck a vehicle and injured the driver. Total damage caused by winds were approximately $7,000.

County	Historical Events (1960-2020)			Recent Impact (2015-2020)		
	Annualized Losses	Deaths	Injuries	Annualized Losses	Deaths	Injuries
Abbeville	$480,016	1	4	$4,382,389	0	0
Aiken	$42,763	5	16	$21,263	0	0
Allendale	$11,858	0	1	$146	0	0
Anderson	$552,630	2	15	$4,430,627	1	0
Bamberg	$79,861	1	1	$19,167	0	0
Barnwell	$31,476	0	3	$15,146	0	1
Beaufort	$51,494	8	8	$10,979	0	2
Berkeley	$51,016	4	8	$1,501	0	0
Calhoun	$43,616	1	0	$268,854	0	0
Charleston	$288,077	8	9	$20,916	0	1
Cherokee	$469,602	1	4	$4,380,442	0	0
Chester	$448,271	0	2	$4,381,909	0	0
Chesterfield	$143,081	0	9	$5,660	0	3
Clarendon	$34,617	3	3	$93,416	0	0
Colleton	$56,295	1	3	$10,184	1	1
Darlington	$47,802	1	12	$30,639	0	3
Dillon	$209,441	0	6	$8,047	0	1

County	Historical Events (1960-2020)			Recent Impact (2015-2020)		
	Annualized Losses	Deaths	Injuries	Annualized Losses	Deaths	Injuries
Dorchester	$32,040	1	4	$2,823	0	0
Edgefield	$16,932	0	1	$833	0	0
Fairfield	$86,513	2	10	$17,093	0	1
Florence	$62,065	1	10	$61,435	0	1
Georgetown	$80,676	1	2	$7,405	0	0
Greenville	$944,527	1	17	$8,812,019	0	0
Greenwood	$453,055	1	1	$4,397,355	0	0
Hampton	$21,183	1	1	$1,040	0	0
Horry	$226,848	4	19	$27,447	0	0
Jasper	$37,247	1	4	$5,024	0	1
Kershaw	$174,305	1	26	$117,232	0	0
Lancaster	$199,681	2	7	$16,970	2	0
Laurens	$517,627	3	7	$4,393,648	0	0
Lee	$50,929	0	4	$319,529	0	0
Lexington	$65,432	2	13	$178,636	2	2
Marion	$50,255	1	5	$7,379	0	0
Marlboro	$33,852	0	7	$53,308	0	1
McCormick	$9,320	0	2	$280	0	0
Newberry	$19,486	0	1	$6,722	0	0
Oconee	$897,257	3	6	$8,772,857	0	0
Orangeburg	$62,950	2	10	$185,559	1	0
Pickens	$911,345	1	5	$8,781,377	1	1
Richland	$169,602	3	16	$216,586	2	1
Saluda	$13,188	0	0	$2,990	0	0
Spartanburg	$604,421	1	8	$4,411,521	0	0
Sumter	$62,193	3	3	$280,579	0	0
Union	$458,026	0	2	$4,387,908	0	0
Williamsburg	$64,611	1	6	$17,740	0	0
York	$573,575	2	9	$4,397,781	1	0
Grand Total	$9,941,057	74	310	$67,962,361	11	20
State Average	$216,110	2	7	$1,477,443	< 1	< 1

Table 33 Wind Historical and Recent Losses by County

Future Climate Considerations

Based on warning climate, conditions conducive to increased occurrences and intensified extent of damaging winds may develop. When combined with increases in infrastructure development and growing population, it may be projected that strong winds will have a heightened impact on people and property.

H. Winter Weather

Winter storms are storms of heavy snow, blowing snow, dangerous wind chills, freezing rain, and/or sleet. Winter weather is capable of creating widespread disruptions, injuries, and fatalities in a matter of hours. It is possible for all portions of the state to be impacted by these events. Winter weather and storms bring freezing rain, poor visibility, sleet, and strong winds. Record snowfall and ice accumulation events have caused closures and damaged infrastructure at least partially because of the uncommon nature of intense winter weather events in the state, which has led to inconsistencies in infrastructure resilience and capabilities to withstand the effects of severe winter weather.

Formation

There are three components for winter storm formation: cold air, moisture, and lift. Cold temperatures below freezing at ground level allow for snow and ice formation; moisture from bodies of water allow for precipitation to eventually freeze into snow and ice; lift allows moisture to rise for cloud and precipitation formation. For South Carolina, this requires temperatures to be colder than average even during the coldest part of the year, which is typically mid-January.

Most deaths associated with winter weather and storms are indirectly related and include fatalities from traffic accidents because of icy conditions, hypothermia from prolonged exposure, or cardiac episodes caused by overexertion when clearing snow.

Classification

The following are examples of winter weather (NOAA, n.d.):

Blizzard

A blizzard is defined as a winter storm that causes for at least three consecutive hours snow heavy enough to restrict visibility to one-quarter mile or less and winds of at least 35 mph. A ground blizzard, where strong winds of at least 35 mph occur where freshly falling snow is present, can cause visibility of less than one-quarter mile. Blizzards are rare in South Carolina; in fact, only one storm verifiably caused blizzard conditions in the state: a mid-February 1973 snowstorm that caused blizzard conditions at Florence Regional Airport.

Blowing Snow

Blowing snow is wind-driven snow that reduces visibility and causes significant drifting from falling or loose snow on the ground picked up by the wind.

Freezing Rain

Freezing rain occurs when snowflakes descend into a warmer layer of air and melt completely. When these liquid water drops fall through another thin layer of freezing air just above the surface, they do not have enough time to refreeze before reaching the ground. Because they are supercooled, they instantly refreeze upon contact with anything that that is at or below 0 degrees C, creating a glaze of ice on the ground, trees, power lines, or other objects. A significant accumulation of freezing rain lasting several hours or more is called an ice storm.

Ice Storm

When ice accumulates to at least one-fourth of an inch or more on bare surfaces, it is considered an ice storm. Ice storms often are caused by the accumulation of ice produced by freezing rain.

Nor'easter

Nor'easters are strong winter storms that occur along the east coast and most commonly along the northeast coast. Strong warm winds blow northward from the Atlantic and Gulf Coast where they collide with the polar jet stream that moves south from Canada toward the eastern portion of the United States. The warm northward moving wind allows for stable conditions over the Atlantic Ocean and prevents further movement of the cold southward moving polar jet stream, allowing it to stabilize over the eastern U.S. This creates the perfect scenario for a large-scale winter storm. Heavy snow, rain, and wind associated with these storms often cause structural damage. Waves generated from nor'easters often cause storm surge and coastal flooding that further intensify structural damage, but also tend to cause beach erosion (NOAA, n.d.).

Sleet

Sleet occurs when snowflakes partially melt as they fall through a shallow layer of warm air. These slushy drops refreeze as they continue to fall through a deep layer of freezing air above the surface, and eventually reach the ground as frozen rain drops that bounce on impact.

Snow Flurries

Snow flurries are light snow falling for short durations with no accumulation or light dusting.

Snow Showers

Snow showers refers to snow falling at varying intensities for brief periods of time where some accumulation is possible.

Snow Squalls

Brief, intense snow showers accompanied by strong, gusty winds are described as a snow squall.

Cold Air Damming

The phenomenon in which a low-level cold air mass is trapped topographically is cold air damming. Often, this cold air is entrenched on the east side of mountainous terrain. Cold air damming often implies that the trapped cold air mass is influencing the dynamics of the overlying air mass. Cold air damming is a common occurrence in areas east of the Appalachian Mountains. Effects on the weather may include cold temperatures, freezing precipitation, and extensive cloud cover.

Advisories

The National Weather Service issues outlooks for winter weather through the local weather forecast office. Advisories are based on local criteria, which means different locations may have different sets of criteria to meet for an advisory to take place (NOAA, n.d.).

The following are advisories issued by the National Weather Service:

Winter Weather Advisory

A winter weather advisory is issued when snow, blowing snow, ice, sleet, or a combination of these wintry elements is expected, but conditions should not be hazardous enough to meet warning criteria (NOAA, n.d.).

Winter Storm Watch

A watch is issued when conditions are favorable for a significant winter storm event around 48 hours prior to the expected onset of winter precipitation (heavy sleet, heavy snow, ice storm, heavy snow and blowing snow, or a combination of events).

Winter Storm Warning

A winter storm warning is issued for a significant winter weather event at around 24 hours prior to the expected onset of winter precipitation.

Blizzard Warning

A blizzard warning is issued when severe blizzard and winter weather conditions are expected or occurring. Falling or blowing snow with strong winds and poor visibilities are likely, leading to whiteout conditions that can make travel difficult.

Ice Storm Warning

An ice storm warning is usually issued for ice accumulation of around one-fourth of an inch or more to begin within 24-36 hours.

Wind Chill Advisory

A wind chill advisory is issued when seasonably cold wind chill values, but not extremely cold values, are expected or occurring.

Wind Chill Watch

A wind chilld watch issued when dangerously cold wind chill values are possible.

Wind Chill Warning

A wind chill warning is issued when dangerously cold wind chill values are expected or occurring.

Frost Advisory

A frost advisory means areas of frost are expected or occurring, posing a threat to sensitive vegetation.

Freeze Watch

A freeze watch is issued when there is a potential for significant, widespread freezing temperatures within the next 48 hours. A freeze watch is issued in autumn until the end of the growing season and in spring at the start of the growing season.

Freeze Warning

A freeze warnikng is issued when temperatures are forecasted to go below 32°F for a long period of time. This temperature threshold kills some types of commercial crops and residential plants.

Hard Freeze Warning

A hard freeze warning is issued a hard freeze warning when temperatures are expected to drop below 28°F for an extended period of time, which are conditions that can kill most types of commercial crops and residential plants.

Location and Probability

Winter storms typically affect a broad geographic area that includes multiple counties. South Carolina does not frequently encounter winter storms; however, events have occurred throughout the state with the Upstate having the highest number of occurrences. Figure 58 shows average number of winter weather days. Greenville, Pickens, and Oconee counties have the highest probabilities for winter weather as well as the highest annual monetary losses.

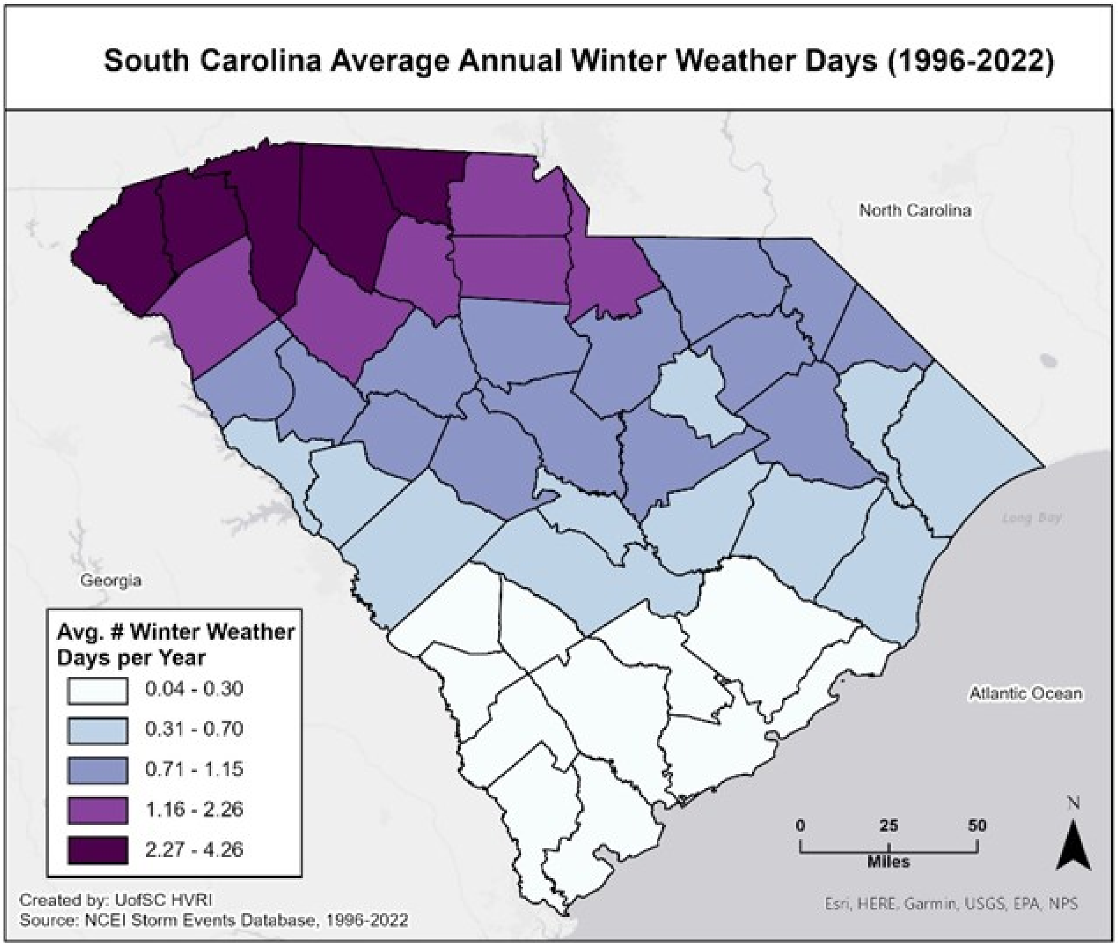


Figure 58: South Carolina Counties Average Number of Days in Winter Weather per Year (1996 – 2022)

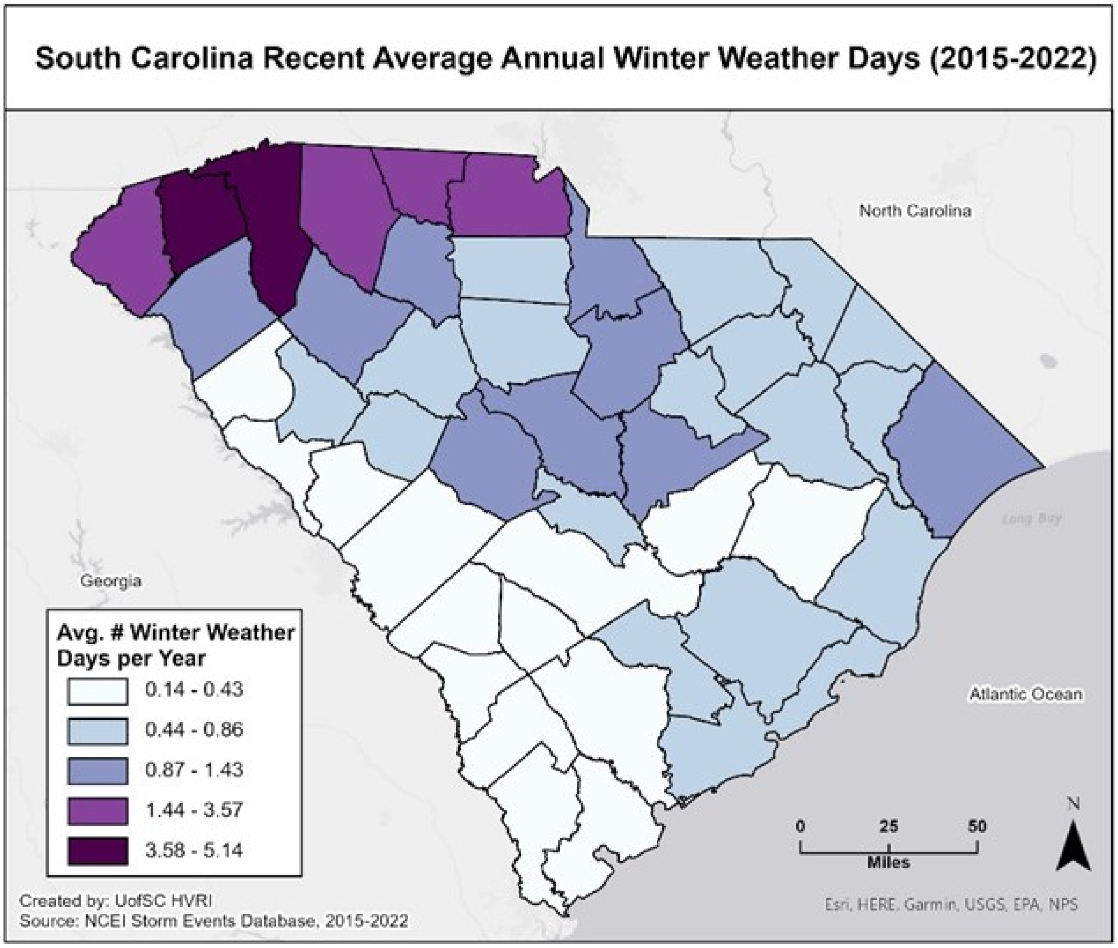


Figure 59: South Carolina Counties Recent Average Number of Days in Winter Weather per Year (2015 - 2022)

Average Number of Winter Weather Days per Year (1996-2022)					
County	Days	County	Days	County	Days
Abbeville	1.07	Dillon	0.78	Marion	0.67
Aiken	0.48	Dorchester	0.15	Marlboro	0.81
Allendale	0.04	Edgefield	0.59	McCormick	0.56
Anderson	1.74	Fairfield	0.85	Newberry	0.93
Bamberg	0.3	Florence	0.85	Oconee	3.67
Barnwell	0.3	Georgetown	0.52	Orangeburg	0.44
Beaufort	0.04	Greenville	4.26	Pickens	3.89
Berkeley	0.15	Greenwood	1.04	Richland	0.85
Calhoun	0.52	Hampton	0.07	Saluda	0.74
Charleston	0.19	Horry	0.63	Spartanburg	2.85
Cherokee	2.67	Jasper	0.07	Sumter	0.78
Chester	1.56	Kershaw	1.04	Union	1.63
Chesterfield	1.15	Lancaster	1.37	Williamsburg	0.59
Clarendon	0.44	Laurens	1.37	York	2.26
Colleton	0.11	Lee	0.7		
Darlington	0.85	Lexington	0.85		
Statewide Average Winter Weather Days per Year					1.03

Table 34 Average Winter Weather Days Per Year (1996-2022)

County	Hazard Occurrence (1996 - 2022)		County	Hazard Occurrence (1996 - 2022)	
	Future Annual Probability (% chance per year)	Frequency Interval (Years between event)		Future Annual Probability (% chance per year)	Frequency Interval (Years between event)
Abbeville	85	1.17	Greenwood	81	1.23
Aiken	30	3.38	Hampton	4	0.00
Allendale	4	0.00	Horry	33	3.00
Anderson	137	0.73	Jasper	7	13.50
Bamberg	15	6.75	Kershaw	74	1.35
Barnwell	15	6.75	Lancaster	96	1.04
Beaufort	4	0.00	Laurens	107	0.93
Berkeley	11	0.00	Lee	48	2.08
Calhoun	30	3.38	Lexington	63	1.59
Charleston	15	6.75	Marion	44	2.25
Cherokee	178	0.56	Marlboro	52	1.93
Chester	96	1.04	McCormick	33	3.00
Chesterfield	78	1.29	Newberry	67	1.50
Clarendon	30	3.38	Oconee	263	0.38
Colleton	7	0.00	Orangeburg	26	3.86
Darlington	56	1.80	Pickens	285	0.35
Dillon	48	2.08	Richland	59	1.69
Dorchester	11	0.00	Saluda	52	1.93
Edgefield	37	2.70	Spartanburg	196	0.51
Fairfield	59	1.69	Sumter	52	1.93
Florence	56	1.80	Union	107	0.93
Georgetown	30	3.38	Williamsburg	37	2.70
Greenville	307	0.33	York	152	0.66
State Average				71.24	2.12

Table 35 Future Winter Weather Probability

Vulnerability

Winter weather affects the entire state, especially more vulnerable populations. As conditions continue to worsen because of winter weather, people must be prepared to prevent long-term damaging effects and casualties in what can be life-threatening conditions. “Researchers say that 70 percent of the fatalities related to ice and snow occur in automobiles, and about 25 percent of all winter related fatalities are people that are caught off guard, out in the storm. (NOAA, n.d.)” Type of structures and resilience of infrastructure as well as accessibility and understanding of warning information can be important factors in vulnerability. Figure 61 below illustrates the combination of winter weather risk and social vulnerability. Automobile-related injuries are often attributed to incidences involving numerous vehicles as a result of rapidly changing, poor road conditions and declining visibility. In terms of exposure to the cold, 50 percent of injuries occur to people over the age of 60 and 20 percent occur in homes because of loss of power or an inadequate heat source (NOAA, n.d.). See also the subsection addressing Extreme Cold temperatures in Section IV.

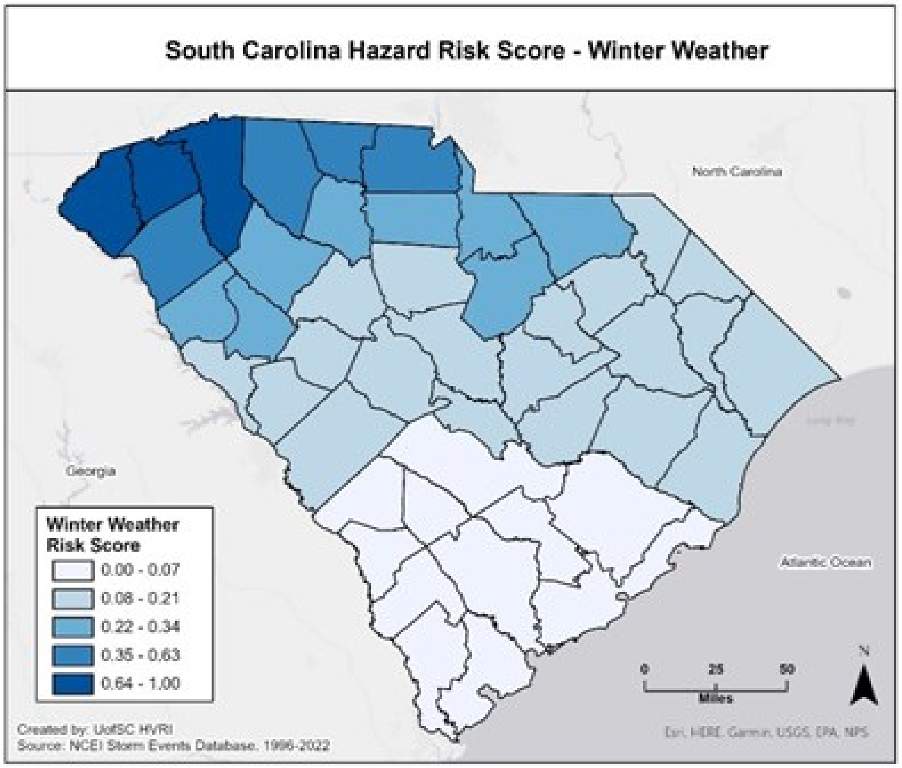


Figure 60:Winter Weather Hazard Risk Scores

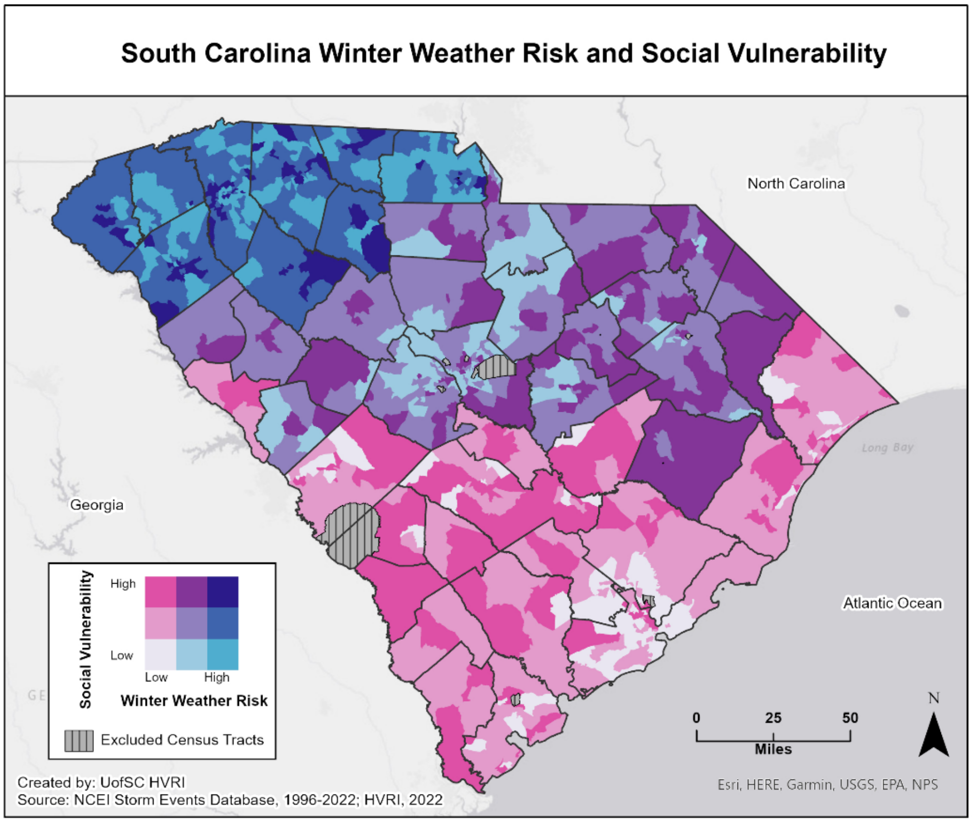


Figure 61: South Carolina Social Vulnerability and Winter Weather Risk

Impacts

Statewide, winter weather events resulted in a total of $1.62 billion throughout the historical period (1960-2020) and $394 million in the recent period (2015-2020). Total annualized monetary losses (dollar losses/# years in record) for the 61-year historical period averaged $577,912 statewide per county. The recent period (6 years) averaged $1,428,042 annualized monetary losses statewide per county because of events that caused higher losses during the period. The counties with the highest annualized monetary losses in the historical period are Greenville ($1,758,480), Pickens ($1,704,037), and Oconee ($1,632,655). Greenville, Pickens, and Oconee counties also had the highest annualized monetary losses in the recent period ($8,757,183 each). Some counties were attributed an equal share of losses in the SHELDUS database because they experienced the same winter weather event(s), and the database distributes losses among affected counties equally. Throughout the historical period, a statewide average of four fatalities and two injuries were reported per county because of winter weather events.

County	Historical Impact (1960-2020)			Recent Impact (2015-2020)		
	Annualized Losses	Deaths	Injuries	Annualized Losses	Deaths	Injuries
Abbeville	$985,886	2	2	$4,379,513	0	0
Aiken	$291,796	4	1	$0	0	0
Allendale	$295,440	1	1	$0	0	0
Anderson	$1,215,466	11	2	$4,378,591	0	0
Bamberg	$301,801	1	2	$0	0	0
Barnwell	$291,796	1	1	$0	0	0
Beaufort	$263,595	2	1	$0	0	0
Berkeley	$334,560	1	1	$0	0	0
Calhoun	$302,635	1	1	$0	0	0
Charleston	$268,309	14	1	$0	0	0
Cherokee	$1,222,941	5	3	$4,378,591	0	0
Chester	$996,142	2	2	$4,380,435	0	0
Chesterfield	$350,479	3	4	$0	0	0
Clarendon	$303,749	3	1	$0	0	0
Colleton	$276,837	2	1	$0	0	0
Darlington	$434,619	6	2	$0	0	0
Dillon	$399,880	4	2	$0	0	0
Dorchester	$330,967	1	1	$0	0	0
Edgefield	$315,792	3	2	$0	0	0
Fairfield	$359,868	5	8	$0	0	0
Florence	$410,669	3	1	$0	0	0
Georgetown	$344,566	3	4	$0	0	0
Greenville	$1,758,480	14	2	$8,757,183	0	0
Greenwood	$987,546	4	2	$4,382,278	0	0
Hampton	$268,035	2	1	$0	0	0
Horry	$515,927	4	2	$0	0	0
Jasper	$263,494	1	1	$0	0	0
Kershaw	$347,249	3	6	$0	0	0
Lancaster	$352,729	3	12	$0	0	0
Laurens	$1,064,049	2	2	$4,380,435	0	0
Lee	$304,112	1	1	$0	0	0
Lexington	$302,996	2	1	$0	0	0
Marion	$364,040	5	2	$0	0	0
Marlboro	$443,021	3	4	$0	0	0
McCormick	$316,555	1	2	$0	0	0
Newberry	$361,548	2	5	$0	0	0
Oconee	$1,632,655	6	5	$8,757,183	0	0

County	Historical Impact (1960-2020)			Recent Impact (2015-2020)		
	Annualized Losses	Deaths	Injuries	Annualized Losses	Deaths	Injuries
Orangeburg	$301,583	4	1	$0	0	0
Pickens	$1,704,037	3	2	$8,757,183	0	0
Richland	$302,777	5	1	$0	0	0
Saluda	$318,170	1	1	$0	0	0
Spartanburg	$1,450,479	15	9	$4,378,591	0	0
Sumter	$303,761	3	2	$0	0	0
Union	$1,083,735	5	2	$4,380,435	0	0
Williamsburg	$438,832	2	1	$0	0	0
York	$1,100,351	4	2	$4,379,513	0	0
Grand Total	$26,583,954	173	113	$65,689,931	0	0
State Average	$577,912	3.76	2.46	$1,428,042	0	0

Table 36 Winter Weather Impacts and Occurrences

Winter weather can have major impacts on community lifelines, particularly infrastructure that is not hardened or protected or otherwise prepared. The table below identifies the community lifeline areas of high impact.

Community Lifeline	Level of Impact	Description of Impacts	Area of Impact
Communications	Medium	Telecommunications and broadband equipment, lines, and systems may be damaged by ice or snow accumulations or other storm-related conditions, resulting in disruption of service. Extended power outages may lead to additional communications disruptions.	Regional
Energy	High	Power transmission and distribution equipment, lines, and systems may be damaged by ice or snow accumulations or other storm-related conditions, resulting in power outages. Fuel stations may be inaccessible or inoperable.	Regional
Food, Water, Shelter	High	Winter weather conditions may damage water systems and residential and food storage/retail structures. Residents in homes with damage or inadequate heat may require emergency shelter. Food suppliers/retailers may be closed or inaccessible because of snow or ice accumulations on roadways or because of power outages, which may result in food spoilage. Freezing temperatures and winter weather conditions may damage crops or livestock. Extreme cold may lead to loss of water supply due to broken pipes.	Regional or statewide

Community Lifeline	Level of Impact	Description of Impacts	Area of Impact
Hazardous Materials	Low	Significant impacts are not anticipated other than potential structural or equipment damage from freezing temperatures or ice/ snow accumulation. Freezing temperatures and winter weather conditions can damage fittings and valves associated with hazardous material storage and transport, which could cause a release.	Localized
Health and Medical	High	Winter weather conditions may damage healthcare facilities or make them inaccessible via roadway. Power outages may cause disruptions in critical services and require backup/alternate systems or resources. Conditions may create challenges for medical staff travel to facilities or locations where medical assistance is needed. Road and sidewalk conditions, freezing temperatures, and snow accumulations may cause an increase in the number of patients seeking emergency care.	Localized or regional
Safety and Security	Medium	Winter weather conditions may damage response agency facilities and equipment or make them inaccessible. Communication and power outages may cause disruptions in critical services and require backup/alternate systems or resources. Personnel may experience increased risk in responding to emergency calls for assistance because of weather conditions, and conditions may create challenges for responders trying to reach locations where assistance is needed.	Localized or regional
Transportation	High	Winter weather conditions may make paved surfaces impassable or unsafe, resulting in inaccessibility or closures, which will cause transportation and supply chain disruptions. Frozen precipitation may disable or damage transportation infrastructure and equipment or require operational delays for human safety and/or property or system protection.	Regional

Table 37 Potential Community Lifeline Impacts Based on Significant Winter Weather Scenario

Historical and Notable Events

Historical and recent occurrence data is derived from NCEI's Storm Event Database unless stated otherwise. Loss-causing data is derived from SHELDUS V.20.0. For more information regarding data sources and methodology, see the hazard narrative methodology Appendix B.

February 8-11, 1973: A snowstorm of historic proportions impacted the state, leaving behind a record 24 inches of snow in some areas. Snowdrifts of up to eight feet were recorded. Approximately 17,000 motorists were stranded on the state's highways - many rescued by helicopter. Eleven exposure-related fatalities were reported. More than 200 buildings, in addition to thousands of awnings and carports, collapsed under the weight of the snow. Property and road damages, the cost of snow removal, and rescue operations brought the cost of the storm to an estimated total of $175 million.

March 13, 1993: This winter storm, which possessed an extremely low atmospheric pressure, passed across South Carolina bringing damaging winds and snow flurries on the southeast tip of the coast. Recorded snowfalls were as high as 14.5 inches in portions of the mountains. Preliminary damage assessments estimated damage costs above $39 million. Two fatalities in South Carolina resulted from this event. The historic storm impacted 26 states and broke many historical weather records in the affectedareas causing such an impact on the southeast that it is referred to as the "Superstorm of the Century".

January 22, 2000: Low pressure rapidly deepened near the Carolina coast, wrapping abundant moisture back across the Piedmont of the Carolinas. By the time snow ended, accumulations ranged from 12 to 18 inches. Heavy wet snow resulted in numerous power outages and instances of building collapse.

January 29, 2000: A weakening low-pressure system in the Ohio River Valley, a low-pressure system along the Gulf Coast, and arctic air across the Carolinas, collided resulting in an icy mess throughout Upstate South Carolina. Precipitation, which briefly began as a light mixture of sleet and snow, turned to freezing rain, resulting in a glaze one-fourth to one-half of an inch thick on exposed surfaces. Power outages were common across the region, especially in the Lower Piedmont from Abbeville to Greenwood. South Carolina requested $9.2 million in federal disaster aid to remove snow and downed trees. A total of 38 counties received a Presidential disaster declaration.

December 4, 2002: An ice storm causing $100 million in property damages affected most of the counties within the state. Abbeville, Anderson, Cherokee, Chester, Greenville, Oconee, Pickens, Greenwood, Laurens, Spartanburg, Union, and York counties suffered most of the losses from this event, which included ice accumulations up to one and one-half inches in some areas. Hundreds of thousands of homes were without power - some for as long as two weeks.

January 24-26, 2004: A cold front in North Carolina produced cold air damming on Saturday, January 24, causing temperatures in the 60s for South Carolina to drop into the upper 30s and low 40s early Sunday, January 25. As the temperature began to drop, precipitation began to set in resulting in ice, sleet, and snow throughout the Midlands. The Upstate experienced freezing rain and snowy conditions. Monday, January 26, saw another round of precipitation fall across the state with freezing temperatures reaching as far south as Allendale and Hampton counties. Ice accumulation continued as a final round of freezing precipitation extended its reach across the state. The figure below displays the ice accumulation for the event. South Carolina Forestry Commission reported the most tree damage since Hurricane Hugo in 1989. Thirty-seven counties were coverd by a State of Emergency.

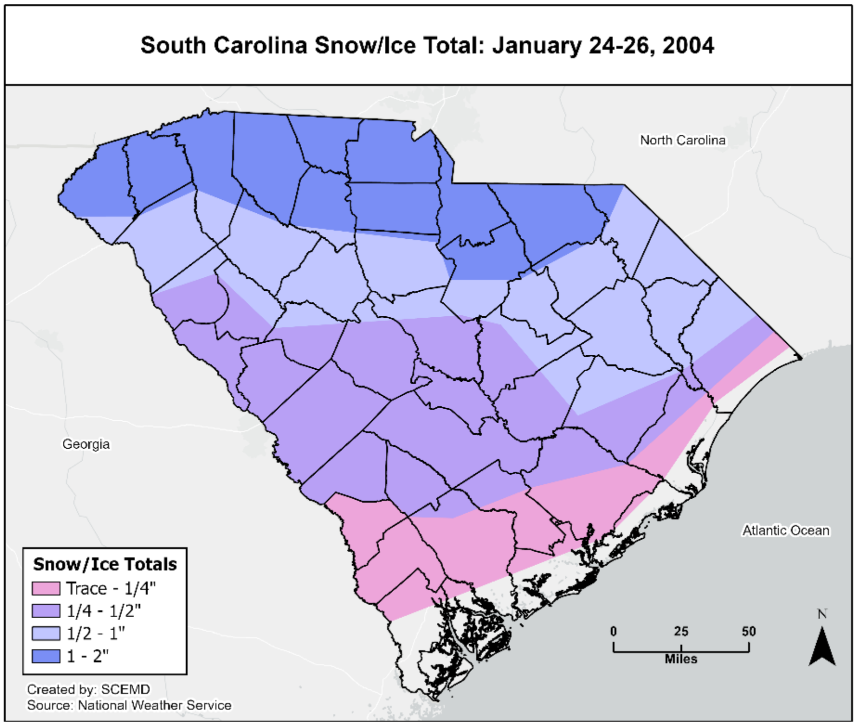


Figure 62: Statewide Snow/Ice Totals for January 24-26, 2004, Ice Storm.

Source: South Carolina State Climatology Office

February 25-27, 2004: A record-breaking snowfall event occurred as a series of low-pressure systems from Texas made its way east into South Carolina on Wednesday, February 25. Initial recorded snowfall began at 0.25-.5 inches in Pickens County; however, the snow intensity would pick up into mid-morning Thursday. As the second low pressure came through, the Upstate's snowfall totals began to rise. The final low pressure moved through the state beginning Thursday and remained until Friday afternoon dropping heavy snow across the Upstate and into the Midlands and Pee Dee. Thundersnow as well as the highest recorded snowfall was in the Rock Hill area at 22 inches with snow drifts between 24 and 28 inches (South Carolina Climatology Office , 2004).

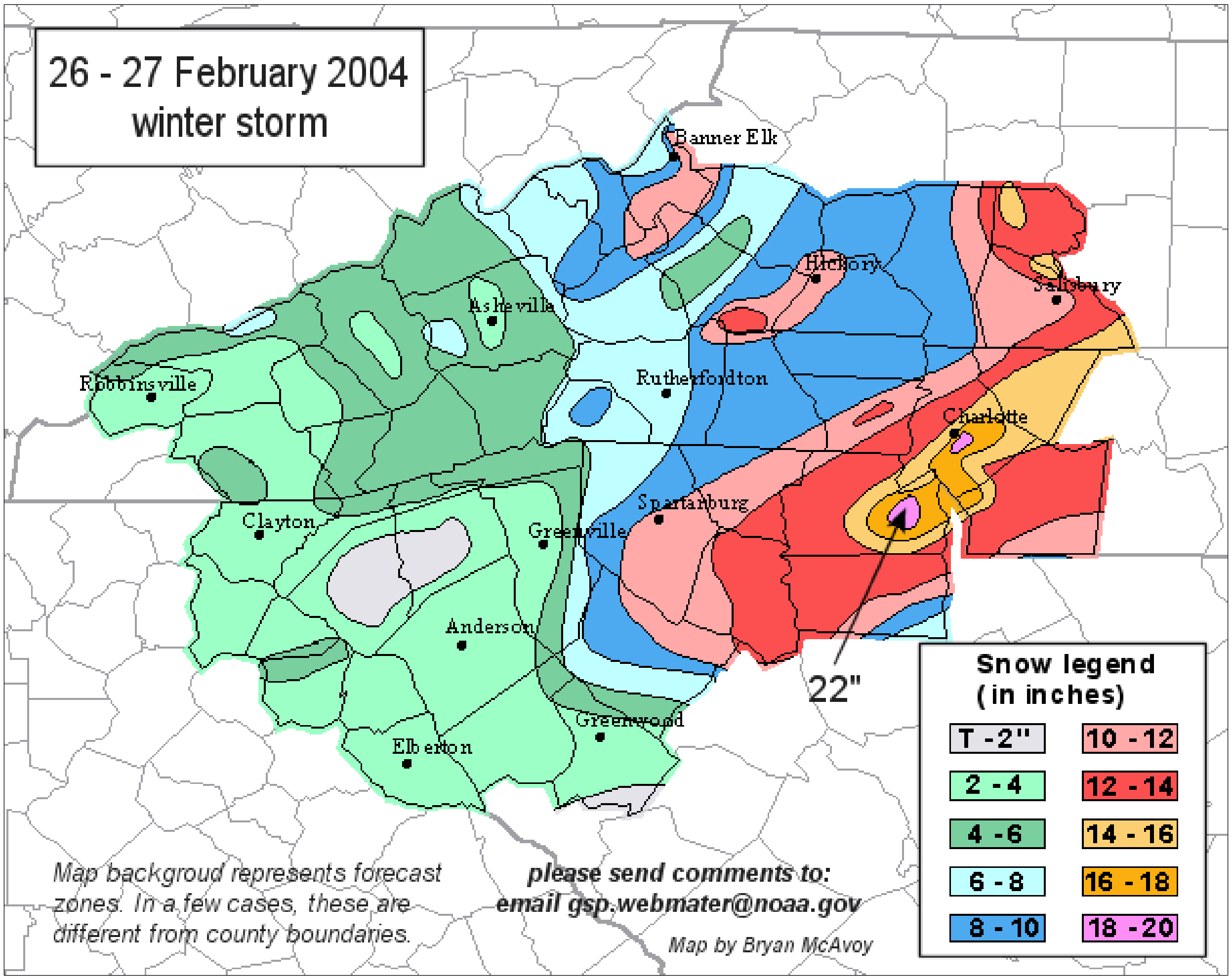


Figure 63: Snowfall Totals for February 26-27, 2004, Winter Storm.

Source: South Carolina State Climatology Office

December 2005: A winter storm producing ice and snow in the upstate counties of Abbeville, Anderson, Cherokee, Chester, Greenville, Laurens, Oconee, Pickens, Spartanburg, Union, and York caused almost $1.5 million in property damage because of power outages and housing unit damage from falling limbs and trees. Four (indirect) fatalities associated with carbon monoxide poisoning from indoor generator use occurred in Anderson. This winter storm resulted in a federal disaster declaration in January 2006.

January 29-30, 2010: A winter storm moved up the coast with snow, sleet, and freezing rain, with accumulation primarily in Lancaster, Chesterfield, and Newberry counties. About one-eighth of an inch of ice was reported for elevated surfaces and trees, and snow was reported to be one to three inches for some counties. Property loss estimates for these three counties totaled about $125,000 dollars. Other counties that received freezing rain and sleet include Fairfield, Kershaw, Lee, Saluda, Lexington, Richland, Sumter, and Clarendon.

February 12-13, 2010: An area of low pressure moved across the Gulf of Mexico on Friday, February 12, and moved along up the Southeast coast from Friday into Saturday. Cold air hovered over the Midlands and snow started falling around 4pm Friday and continued into the next morning. This significant snowstorm impacted central South Carolina with snowfall totals ranging from one to more than eight inches. The greatest accumulation was recorded at the Columbia Metropolitan Airport weather station at 8.6 inches.

February 11-14, 2014: A complex group of systems converged over South Carolina on Tuesday, February 11. A high-pressure system from Canada brough cold, dry air to the South. On the same day, a weak low-pressure system developed bringing rain that transitioned into snow and sleet across the state. On Wednesday, February 12, a low-pressure front deepened off the coast resulting in widespread freezing rain for the Lowcountry and Midlands. The event continued into Thursday where the freezing rain transitioned into snow as it moved northeast through the state.

Observed ice accumulation on February 13 ranged from 0.1 in Johns Island (Charleston County), Tarboro (Jasper County), and Abbeville to 1.25 inches in Barnwell. The Midlands received much of the ice accumulation recorded during the event. Snowfall accumulation covered the central Midlands north to the Upstate. The highest observed totals reached 10 inches in Clover (York County) and Pageland (Chesterfield County).

The ice impacted critical infrastructure resulting in 346,000 power outages. The total estimated losses were approximately $435 million. Insured losses from the storm totaled near $20 million. The South Carolina Forestry Commission estimated timber losses at $360 million over 1.5 million acres. Additionally, the state saw $55 million in impact on local and state agencies directly related to the event. In total, 21 counties were included in the issued State of Emergency. The state received a presidential disaster declaration for the event.

***November 1, 2014*:** A low pressure system swept through the state resulting in snowfall across the Midlands. The highest reported accumulation was recorded in Pelion (Lexington County), and at the time, became the earliest heavy known snowfall in the history of South Carolina eclipsing the 2-inch event at Caesars Head (Oconee County) from November 4, 1930 (NOAA, n.d.).

Recent Events 2018-2022

January 3, 2018: The one of the heaviest snowfall events on record occurred across the Lowcountry as a low-pressure system developed offshore. Several reports came in of snowfall between one and eight inches. Dillon, Marion, and Marlboro counties all received up to six inches of snow. The highest accumulation was recorded outside of Summerville (Dorchester County) at 7.3 inches.

December 8-9, 2018: A low pressure system led to an early snowstorm for the Upstate. The National Weather Service station at Caesar's Head (Greenville County) recorded 14.4 inches of snowfall. Greenville-Spartanburg Airport recorded its largest December snowfall in over 50 years.

Future Climate Conditions

Future trends for winter weather point to warmer temperatures and a decrease in cold weather extremes. The average annual temperature increased between 1.2°-1.8° F since 1901 (the variance is because of the method by which the temperature analysis is computed). Since the early 1900s, recorded cold waves decreased for the contiguous United States. Future climate projections indicate an increase of around 2.5° F over the course of the next 30 years. As a result of warming conditions, the annual number of days below freezing will continue to decline. The trends in the frequency and intensity in which winter storms occur remains uncertain because of conflicting climate model outputs. With the uncertainty surrounding the climate both near- and long-term, it can be determined that current projections will change over time.

I. Coastal Hazards

South Carolina's coast is subject to a variety of coastal hazards, including coastal storms, long-term sea level rise, erosion, and saltwater intrusion (SCDHEC OCRM, 2019). Other coastal hazards include flooding, tsunamis, and land subsidence (NOAA, n.d.). Development and human settlement have put lives and properties at risk to these coastal hazards. Coastal regions such as beaches and wetlands are crucial in protection efforts of South Carolina wildlife and coastal communities.

Classification

Waves

Wave energy impacts almost every series of damages caused by a coastal hazard (NOAA , 2021). Waves are created by large amounts of energy moving in a circular motion throughout the ocean floor (NOAA , 2021). When a wave hits the sea floor it breaks up into two the circular motions simultaneously moving in the same circular pattern, the bottom half ultimately slows down because of surface friction, which causes the top half of the wave to be pushed forward, making the crest (NOAA , 2021). Once the wave becomes off balance the crest falls, making impact with the beach surface. This is how sediment is deposited and taken from coastal beaches and estuaries. Once the wave crashes, the water moves back out to the ocean, and the cycle begins again. The amount of energy creating wave forces can significantly impact erosion, storm surge, flooding, as well as the type of wave.

Erosion

Erosion is a process that breaks down and wears away land because of physical and chemical processes of water, wind, and meteorological conditions. An area's potential for erosion is determined by four factors: soil characteristics, vegetative cover, climate or rainfall, and topography. The two major erosion mechanisms are wind and water. Wind that blows across sparsely vegetated or disturbed lands can cause erosion by picking up soil, carrying it through the air, and displacing it in another place. Water erosion occurs over land and in streams and channels. The scale of wave energy making impact often exacerbates the amount of erosion on a specific coastline. Major storms can cause coastal erosion from the combination of high winds and heavy surf and storm surge. Human interactions, such as construction and development in coastal and riparian regions as well as large wake zones that pick up and deposit sediment, can also determine overall erosion amount. The two main focuses of coastal erosion in South Carolina are oceanfront shorelines as well as Lowcountry estuarine shores, which have seen a large loss impacts in recent years.

DHEC-OCRM revises long-term beach erosion rates, as well as the state's beachfront baseline and 40 year set-back line, every eight to 10 years. This process was last conducted in 2018; updated rates and beachfront jurisdictional line maps can be found on the SC DHEC Ocean and Coastal Resource Management website (SCDHEC, 2017).

Based on analysis of shoreline changes since the mid-1800s and other research, South Carolina's beaches appear to be experiencing net erosion in general, but beach renourishment has been keeping pace with this underlying trend in most cases. Long-term shoreline change rates vary from marginally accretional along some standard beaches, to highly erosional (as much as 20 feet per year) in some highly dynamic inlet areas. Beginning with Hurricane Irene in 2011, Folly Beach in Charleston County has experienced above-average erosion rates and is considered one of the most vulnerable beaches in South Carolina.

Coastal Flooding

The inundation of coastal areas is considered coastal flooding when the source of floodwater is from the ocean. Coastal flooding has significant impacts on developments because of high erosion influence, life safety, and monetary damages. In most scenarios, coastal flooding occurs during king tide events, which are exceptionally high or astronomical tides. Other cases of coastal flooding occur on a regular basis in places where the land is below sea level. Charleston experiences significant flooding on recurring basis days and extreme flooding during storm events and king tides. Coastal flooding along South Carolina's coast is becoming more frequent and in longer intervals; there are indications that accelerations in sea level rise as well as increased storm event and rainfall intensities associated with rising temperatures and climate change are affecting coastal flooding.

Storm Surge

Storm surge is the rise of water levels caused by a coastal storm above what would be the predicted astronomical tide. Storm surge inundation refers to the water level that occurs on normally dry ground because of storm surge and is expressed in terms of the height of water in feet above ground level. The term inundation provides a clear and commonly understood means to describe the amount or level of storm surge-driven coastal flooding. Water is moved by storm winds, low pressure, and wave energy causing the overall impact of storm surge to surpass normal water levels, sometimes in extreme amounts. There are many contributing factors to storm surge, including wind, strength of storm, topography and land features, continental shelf slope, and angle of approach (NOAA, n.d.). Storm surge can move inland beyond sand dunes and enter residential and commercial property areas. Storm surge is often the greatest threat to life and property from a hurricane because of the ability to reach areas further inland (NOAA, n.d.). One of the highest recorded storm surge events was during Hurricane Hugo (M.G., 2019). Hugo caused storm surge 10 miles inland along the Cooper, Ashley, and Santee rivers. The storm surge caused destruction to piers and ocean front property along with costly erosion impacts throughout the coast (M.G., 2019).

Tsunami

While tsunamis usually result from earthquakes or other earth movements such as landslides, they are addressed in this section because they potentially impact coastal areas. While rare in the eastern U.S., tsunamis have been recorded on the U.S. Atlantic coast. Tsunamis can be caused by a distance source (more than 620 miles away from U.S.) or a local or regional source (closer than 620 miles). Local/regional sources are of more concern because of shorter notice to take protective action. NOAA's National Tsunami Warning Center (NTWC) disseminates tsunami information statements, advisories, watches, and warnings. There are no tsunami occurrences in South Carolina in the recent record. Counties considered to be at risk for tsunami because of their coastal location or tidal waters are Beaufort, Berkeley, Charleston, Colleton, Dorchester, Georgetown, Horry, and Jasper.

Location and Probability

Eight of the 46 counties in South Carolina are located along the Atlantic coast, making those portions of the state vulnerable to tropical cyclones, sea level rise, erosion, saltwater intrusion, and other coastal events. Coastal events can also have inland-reaching impacts; in particular, the inland counties of Williamsburg, Orangeburg, and Florence have historically been affected by hurricanes and coastal storms. Larger rivers located near the coastal waterways allows for greater coastal impacts upstream (or inland), these rivers include Salkehatchie, Edisto, Santee, Black, Lynches, Great Pee Dee, and Little Pee Dee.

County	Coastal Occurrence (2007-2020)		County	Coastal Occurrence (2007-2020)	
	Future Annual Probability (% chance per year)	Frequency Interval (Years between event)		Future Annual Probability (% chance per year)	Frequency Interval (Years between event)
Abbeville	0	-	Greenwood	0	-
Aiken	0	-	Hampton	0	-
Allendale	0	-	Horry	43	2.33
Anderson	0	-	Jasper	0	-
Bamberg	0	-	Kershaw	0	-
Barnwell	0	-	Lancaster	0	-
Beaufort	57	1.75	Laurens	0	-
Berkeley	0	-	Lee	0	-
Calhoun	0	-	Lexington	0	-
Charleston	336	0.30	Marion	0	-
Cherokee	0	-	Marlboro	0	-
Chester	0	-	McCormick	0	-
Chesterfield	0	-	Newberry	0	-
Clarendon	0	-	Oconee	0	-
Colleton	79	1.27	Orangeburg	0	-
Darlington	0	-	Pickens	0	-
Dillon	0	-	Richland	0	-
Dorchester	0	-	Saluda	0	-
Edgefield	0	-	Spartanburg	0	-
Fairfield	0	-	Sumter	0	-
Florence	0	-	Union	0	-
Georgetown	14	7.00	Williamsburg	0	-
Greenville	0	-	York	0	-
Grand Total					
State Average				12	2.53

Table 38 South Carolina County Coastal Flooding Episode Occurrence

Coastal flooding episode annual probability and frequency interval information calculated by county is displayed in Table 38 above. The NCEI Storm Events Database defines coastal flooding events as any flooding of coastal areas because of persistent onshore wind, high tide, and/or low atmospheric pressure. The average future annual coastal flood event probability is 11.5% chance per year (or roughly 5.3 events for the entire year statewide). However, in the coastal counties (Beaufort, Colleton, Charleston, Georgetown, Horry, and Jasper), the future annual probability is 88% chance per year. Charleston County has the highest chance per year of a coastal flood event (336% chance per year). The average statewide frequency interval (# years in record/# of events) per county is

2.53. Most counties have no frequency interval, meaning they have not experienced coastal floods because they are inland counties.

Coastal erosion rates for impacted counties are depicted in the maps below.

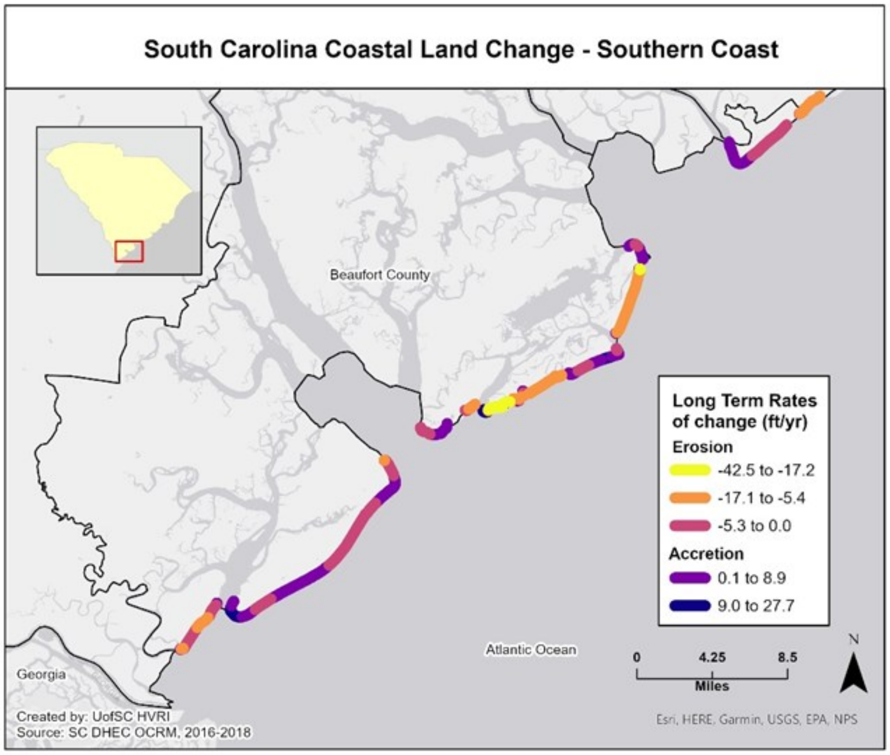


Figure 64: Southern South Carolina Coastal Erosion Rates (2016-2018) for Charleston and Beaufort Counties.

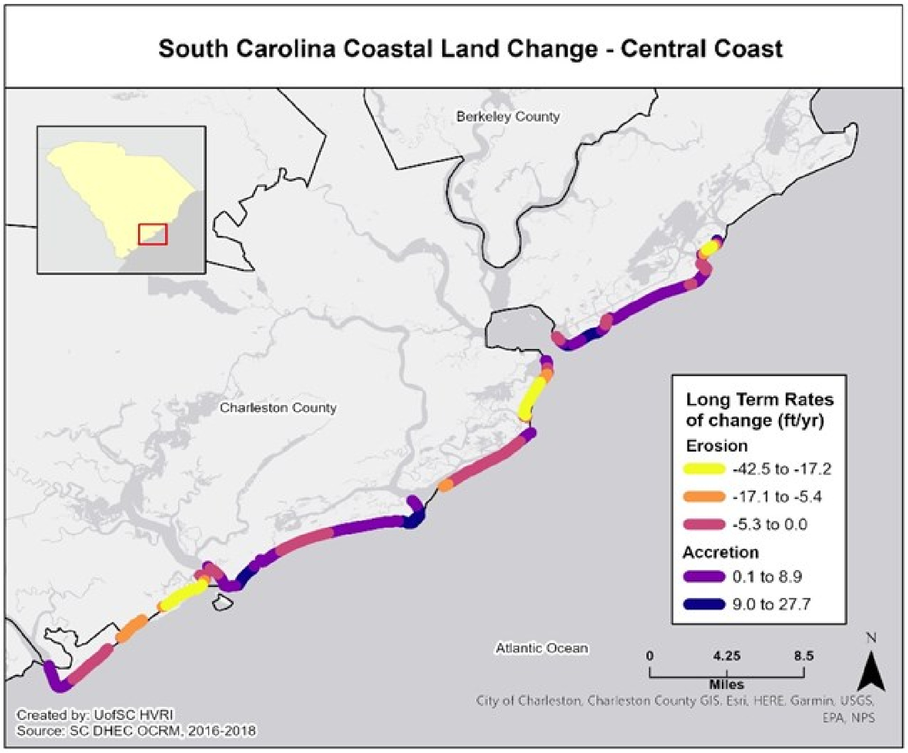


Figure 65: Central South Carolina Coastal Erosion Rates (2016-2018)

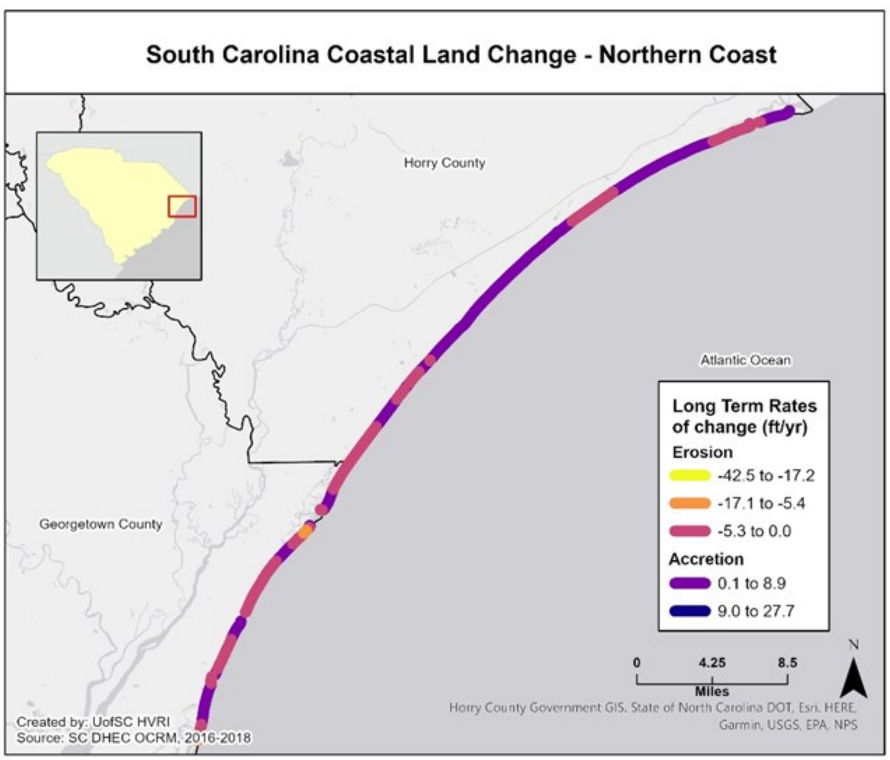


Figure 66: Northern South Carolina Coastal Erosion Rates (2016-2018) in Horry and Georgetown Counties.

Beach erosion occurs when a beach loses more sand than it gains, generally through long-term coastal processes and sea level rise as well as through short-term storm action. Beach erosion is reflected as negative numbers that show how much the coastline is receding. Beach accretion is the opposite of erosion. With accretion, a beach or coastal area gains sand as a result of coastal processes. The average erosion rate for coastal areas in the entire state is -1.837 ft/year. The average land change rate for SC coastal areas overall is -2 ft/year. (SC DHEC-OCRM, 2016-2018; Data Categorized By: Natural Jenks). Coastal erosion data is provided by SCDHEC Office of Ocean and Coastal Resource Management (SCDHEC OCRM, 2019). The dataset includes long-term erosion rates rather than event-specific data. No erosion or accretion data was available for Colleton and Jasper counties or the northern third of Charleston County.

The highest erosion rates in Beaufort and Charleston counties are at two Beaufort County locations along Bull Point Beach on Capers Island (-42.5 and -38.5 ft/year). The average erosion rate for the two counties pictured in Figure 65 is -2.58 ft/year. The highest accretion rate within these two counties is in Charleston County at Kiawah Island (27.7 ft/year) followed by a section of Harbor Island in Beaufort County (21.5 ft/year).

The highest erosion rate in Charleston County is located along Morris Island (-33 ft/year). As noted above, the highest accretion rate in Charleston County is at Kiawah Island (27.7 ft/year). The overall average land change rate in Charleston County is -1.9 ft/year. (SC DHEC Ocean and Coastal Resource Management, 2016-2018; data categorized by Natural Jenks)

The highest erosion rate in the two northern coastal counties is in Georgetown County at Debidue Beach (-7.94 ft/year) followed by a section of Huntington Beach State Park (-7.19 ft/year). See Figure 66. The average erosion rate for the two northern counties is -0.354 ft/year. The highest accretion rates in the two northern coastal counties are in Horry County, both in sections of Waites Beach (5.95 and 4.53 ft/year).

Vulnerabilty

Hazard risk and vulnerability to coastal flooding is isolated to the coastal counties and those with tidal waterways. Hazard risk scores are calculated by comparing the annual probability of a coastal flooding occurrence by county. Generally, a risk score of zero or near zero does not mean that the county does not experience any coastal flooding events or episodes, just that it is less likely to experience a coastal flooding event in the future compared to those counties with higher risk scores. However, in this case, coastal flooding events were limited to the coastal counties. Of the coastal counties with a non-zero risk score, Charleston County had the highest (1.000), followed by Colleton (0.234), Beaufort (0.170), Horry (0.128), and Georgetown (0.043) counties. See Figure 67 below.

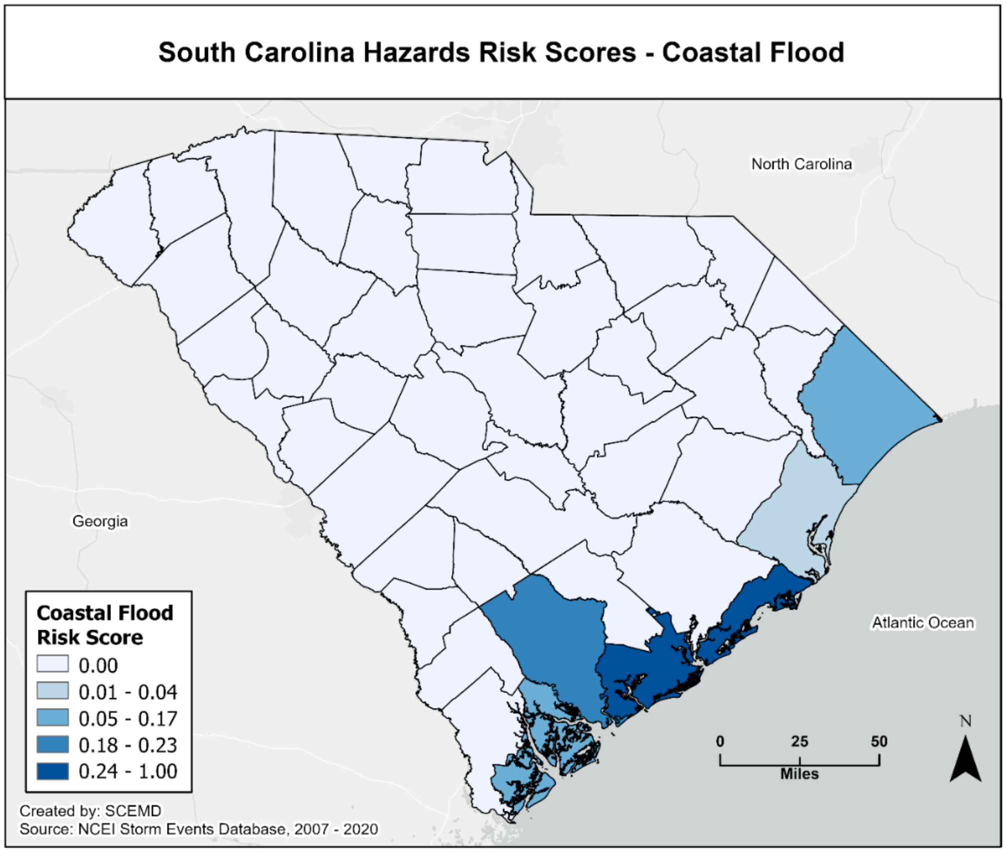


Figure 67: South Carolina Coastal Flooding Risk.

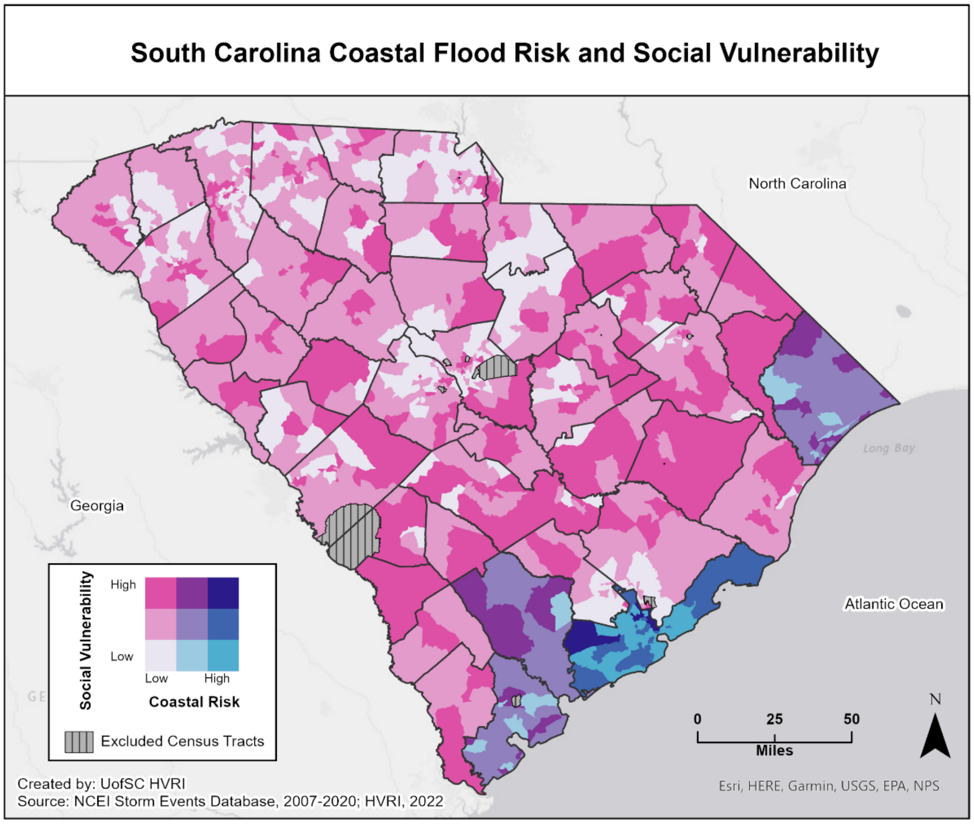


Figure 68: South Carolina Coastal Flooding Risk and Social Vulnerability

Local vulnerability to coastal erosion can also be seen in investments local governments and communities have made in coastal and beach renourishment projects. Table 39 provides information on beach renourishment projects permitted by DHEC-OCRM since 1979. Beach renourishment projects replace sand and sediment to mitigate shoreline erosion caused by storms in the short-term, and through persistent coastal processes and sea level rise in the longer term. Funding sources for the 55 projects are divided into four categories: (1) local; (2) private; (3) state; and (4) federal. Most of the funding (71.7%) was from federal and local sources. The costliest project ($30.7 million) was in 2014 at Folly Beach and the second costliest ($20.15 million) was a 1997 project in North Myrtle Beach.

Coastal Renourishment Project	Year	Cost (in millions of dollars; period dollars)				
		Local	Private	State	Federal	Total
Isle of Palms	2018	2.35	5.39	3.54	2.96	14.25
Edisto Beach	2017	7	0	9.34	2.51	18.85
Hilton Head Island	2016	29.2	0	0	0	29.2
Hilton Head Island	2016	2.7	0	0	0	2.7
Debidue	2015	0	10	0	0	10

Coastal Renourishment Project	Year	Cost (in millions of dollars; period dollars)				
		Local	Private	State	Federal	Total
Folly Beach	2014	5	0	1	24.7	30.7
Hilton Head Island	2014	1.06	0	0	0	1.06
Folly Beach	2013	2.3	0	0	0	2.3
Hilton Head Island	2012	9.2	0	0.8	0	10
Arcadian Shores	2009	3.4	0	0.69	0	4.1
Myrtle Beach	2009	3.92	0	2.24	11.45	17.61
Isle of Palms	2008	2.8	7.1	0.7	0	10.6
North Myrtle Beach	2008	1.47	0	1.88	6.21	9.55
Surfside-Garden City	2008	1.83	0	1.83	6.79	10.45
Folly Beach	2007	0	0	0	8.19	8.19
Hilton Head Island	2007	19	0	0	0	19
Debidue	2006	0	5.6	0	0	5.6
Edisto Beach	2006	3	0	4.7	0	7.7
Hunting Island	2006	0	0	4.38	0	4.38
Folly Beach	2005	1	0	0	11.5	12.5
Hunting Island	2005	0	0	0	1.67	1.67
Hunting Island	2003	0	0	0	2.48	2.48
Folly Beach	2000	0	0	0	0.31	0.31
Arcadian Shores	1999	3.09	0	1	0	4.09
Hilton Head Island	1999	1.2	0	0	0	1.2
Pawleys Island	1999	0	0	1.3	0	1.3
Daufuskie	1998	0	6	0	0	6
Debidue	1998	0	0.95	0	0	0.95
Folly Beach	1998	0	0	0	0.12	0.12
Sullivans Island	1998	0	0	0.23	0	0.23
Surfside-Garden City	1998	2.5	0	2.5	9.29	14.29
Hilton Head Island	1997	11	0	0	0	11
Myrtle Beach	1997	2.95	0	2.95	10.97	16.87
North Myrtle Beach	1997	3.53	0	3.53	13.1	20.15
Edisto Beach	1995	0.5	0	1	0	1.5
Folly Beach	1993	0	0	3	11.5	14.5
Hunting Island	1991	0	0	2.88	0	2.88
Debidue	1990	0	0.86	0	0	0.86
Folly Beach	1990	0	0	0	0.6	0.6
Hilton Head Island	1990	3.2	0	6.5	0	9.7
Seabrook Island	1990	0	1.66	0	0	1.66
Folly Beach	1988	0	0	0	0.07	0.07

Coastal Renourishment Project	Year	Cost (in millions of dollars; period dollars)				
		Local	Private	State	Federal	Total
Huntington Beach State Park	1988	0	0	0	0.9	0.9
Folly Beach	1987	0	0	0	0.07	0.07
Myrtle Beach	1987	0	0	4.74	0	4.74
Folly Beach	1986	0	0	0	0.07	0.07
Folly Beach	1985	0	0	0	0.07	0.07
Folly Beach	1984	0	0	0	0.07	0.07
Isle of Palms	1984	0	1	0	0	1
Folly Beach	1983	0	0	0	0.07	0.07
Folly Beach	1982	0	0	0	0.07	0.07
Waites Island	1982	0	0	0	0.85	0.85
Huntington Beach State Park	1980	0	0	0	0.82	0.82
Folly Beach	1979	0	0	0	0.03	0.03
Huntington Beach State Park	1979	0	0	0	0.53	0.53
Grand Total		123.21	38.56	60.73	127.97	350.46

Table 39 South Carolina Beach Renourishment Projects.

Impacts

This section provides tables and maps to summarize historical and recent coastal hazard events and their associated losses (property damage, crop damage, fatalities, and injuries). The totals for these losses were calculated from the National Climatic Data Center (NCDC) Storm Events database, and the Spatial Hazard Events and Losses Database for the United States (SHELDUS).

Statewide, coastal floods resulted in a total of $14.5 million in damage throughout the historical period (1960-2020) and $0 in the recent period (2015-2020). Total annualized monetary losses ((crop + property)/# Years in Record) for the historical period (61 years) averaged $5,182 statewide per county, while no losses were recorded in the recent period (6 years). The counties with the highest annualized monetary losses in the historical period are Horry ($43,853), Georgetown ($43,853), and Charleston ($33,275). Throughout the historical period, a total of 49 fatalities and 13 injuries were reported statewide because of coastal flooding events.

County	Historical Impact (1960-2020)			Recent Impact (2015-2020)		
	Annualized Losses	Deaths	Injuries	Annualized Losses	Deaths	Injuries
Abbeville	$129	0	0	$0	0	0
Aiken	$129	0	0	$0	0	0
Allendale	$129	0	0	$0	0	0
Anderson	$129	0	0	$0	0	0

County	Historical Impact (1960-2020)			Recent Impact (2015-2020)		
	Annualized Losses	Deaths	Injuries	Annualized Losses	Deaths	Injuries
Bamberg	$129	0	0	$0	0	0
Barnwell	$129	0	0	$0	0	0
Beaufort	$29,252	4	3	$0	1	3
Berkeley	$23,642	0	0	$0	0	0
Calhoun	$129	0	0	$0	0	0
Charleston	$33,275	5	5	$0	3	2
Cherokee	$129	0	0	$0	0	0
Chester	$129	0	0	$0	0	0
Chesterfield	$129	0	0	$0	0	0
Clarendon	$129	0	0	$0	0	0
Colleton	$24,066	2	2	$0	0	1
Darlington	$129	0	0	$0	0	0
Dillon	$129	0	0	$0	0	0
Dorchester	$5,904	0	0	$0	0	0
Edgefield	$129	0	0	$0	0	0
Fairfield	$129	0	0	$0	0	0
Florence	$129	0	0	$0	0	0
Georgetown	$43,853	6	0	$0	0	0
Greenville	$129	0	0	$0	0	0
Greenwood	$129	0	0	$0	0	0
Hampton	$302	0	0	$0	0	0
Horry	$43,853	32	3	$0	9	0
Jasper	$18,097	0	0	$0	0	0
Kershaw	$129	0	0	$0	0	0
Lancaster	$129	0	0	$0	0	0
Laurens	$129	0	0	$0	0	0
Lee	$129	0	0	$0	0	0
Lexington	$129	0	0	$0	0	0
Marion	$5,731	0	0	$0	0	0
Marlboro	$129	0	0	$0	0	0
McCormick	$129	0	0	$0	0	0
Newberry	$129	0	0	$0	0	0
Oconee	$129	0	0	$0	0	0
Orangeburg	$129	0	0	$0	0	0
Pickens	$129	0	0	$0	0	0
Richland	$129	0	0	$0	0	0
Saluda	$129	0	0	$0	0	0
Spartanburg	$129	0	0	$0	0	0

County	Historical Impact (1960-2020)			Recent Impact (2015-2020)		
	Annualized Losses	Deaths	Injuries	Annualized Losses	Deaths	Injuries
Sumter	$129	0	0	$0	0	0
Union	$129	0	0	$0	0	0
Williamsburg	$5,904	0	0	$0	0	0
York	$129	0	0	$0	0	0
Grand Total	$238,394	49	13	$0	13	6
State Average	$5,182	1	< 1	$0	< 1	< 1

Table 40 Coastal Impacts and Losses

Coastal hazard impacts described in the table below were projected based on a significant storm surge and coastal flooding event.

Community Lifeline	Level of Impact	Description of Impacts	Area of Impact
Communications	Medium	Most communications infrastructure is considered at low risk for coastal flood impacts because it is not in low-lying areas or is built to be resilient against coastal hazards. Storm surge could cause issues for communications towers and systems near the coast.	Localized
Energy	Low	Small energy sources such as generators and fuel stations could be affected by large coastal flooding and storm surge. Fuel supply could be disrupted by damage to fuel terminals or port or other transportation infrastructure. Long-term consequences not anticipated.	Localized; possibly regional
Food, Water, Shelter	Medium	Isolated areas could be affected by disruptions to supplies of food and water. Habitability and safety of housing stock could be negatively impacted by storm surge or coastal flooding. Boil water advisories may be needed because of damage to water treatment systems. Inundation may cause crop losses.	Localized
Hazardous Materials	Medium	Hazardous material releases could result from damage from coastal flooding or storm surge, causing public health and environmental risks. Damage could result in loss of material, causing economic loss.	Localized
Health and Medical	Medium	Potential risks to human health and related increased need for medical services. Also increased time to access or transport residents needing medical care. Facilities in storm surge or coastal flooding zones could see damage to facilities or infrastructure.	Localized

Community Lifeline	Level of Impact	Description of Impacts	Area of Impact
Safety and Security	Low	No major impacts on safety and security departments or personnel are anticipated. Challenges in reaching affected areas to provide search and rescue and response.	Localized
Transportation	Medium	Coastal roads could be closed or damaged from storm surge, high tides, and coastal flooding. Airports near the coast and ports may see disruptions to operations because of flooding or to minimize damage.	Localized

Table 41 Potential Community Lifeline Impacts Based on Significant Coastal Hazard Scenario

Future Climate Considerations and Sea Level Rise

Sea level rise has had a significant impact on coastal hazards and is expected to continue to increase the potential for coastal hazard occurrences and related damage to communities and infrastructure along the South Carolina coast. Sea level rise is expected to occur at varying rates in different coastal areas based on factors including location, terrain, geology, and bathymetry. In some locations, the impact of sea level rise may not be seen as a major imminent threat until damage has occurred. Land subsidence may exacerbate the effects of sea level rise. As erosion rates, coastal flooding, and land subsidence have become more frequent, the shift in hazard priorities has led to many state agencies and jurisdictions along the coast to establish codes and planning principles that acknowledge the risk of sea level rise and implement buffers to address for future conditions. With projections for continued increases in global temperatures and resulting continued increases in sea level, additional and refined research and sea level rise projections specific to South Carolina locations are needed to better understand future potential probability, vulnerability, and consequences.

J. Drought

South Carolina's Drought Response Act defines drought as "a period of diminished precipitation which results in negative impacts upon the hydrology, agriculture, biota, energy, and economy of the State." In contrast to other environmental hazards, droughts develop slowly over a period of weeks, months, or years. According to NOAA, drought is the third most costly weather and climate disaster affecting the United States, preceded only by tropical cyclones and severe storms respectively. From 1980 to 2022, monetary losses from drought equaled $300 billion, accounting for 13% of the total losses from natural disasters during that time. Drought, in conjunction with associated heat waves, contributed to 4,139 deaths nationwide during that time period (NOAA, NCEI, 2022).

Drought is a natural part of South Carolina's climate and has occurred in all months and seasons – with some droughts lasting multiple years. Droughts have impacted multiple sectors including agriculture, forestry, tourism, power generation, public water supply, fisheries, and ecosystems. Drought conditions can also contribute to diminished water and air quality, increased public health and safety risks, and reduced quality of life and social wellbeing.

Formation

Drought is caused by a lack of precipitation over an extended period of time, often resulting in a water shortage for some activity, sector, or the environment. South Carolina receives adequate precipitation during normal years; the long-term, statewide annual precipitation average is 47.8 inches. However, South Carolina experiences high seasonal and interannual variability. Summer normally sees the most precipitation, but of the precipitation that occurs then it is considerably variable because of localized showers and thunderstorms. Typically, fall is South Carolina's driest season. Winter and spring precipitation generally occurs as part of frontal systems. Figure 69 shows interannual variability since 1895; 10-year moving averages are used to show wet and dry periods. Wetter periods occurred during the 1960s, 1970s, and 1990s, while drier periods occurred from the 1920s to 1950s and from the mid-2000s to mid-2010s.

South Carolina's precipitation also varies geographically. The Upstate region receives the highest annual average precipitation, ranging from 48 inches to between 70 and 80 inches of rainfall at the highest elevations. The central region is, on average, the State's driest. Annual totals are less than 48 inches. Areas in the Coastal Plain receive annual precipitation amounts that range from 48 to 56 inches.

Other factors, such as extreme heat, wind, and evapotranspiration rates, can influence the development of droughts. The strength and geographic placement of the Bermuda High, a semi-permanent subtropical area of high pressure in the North Atlantic Ocean, influences precipitation variability in late spring and early fall seasons. This high-pressure system increases solar radiation, air subsidence, and temperature. As a biproduct, these forces promote air stagnation and decrease cloud cover reducing the probability of substantial precipitation (SC Climate Office , 2020).

The El Niño–Southern Oscillation (ENSO) is a major phenomenon influencing the climate globally. ENSO refers to the interannual shift in the equatorial Pacific Ocean trade winds. The variation in winds results in changes to sea surface temperatures in the eastern equatorial Pacific and in sea-level pressures in the southern Pacific at time scales of two to seven years, which causes effects in the global climate. ENSO is classified in three phases: warm conditions (El Niño), cold conditions (La Niña), and neutral or normal conditions. In the southeastern U.S., winter precipitation increases during the warm phase (El Niño) and reduces during the cold phase (La Niña). There is a less consistent signal during fall and no evident connection between ENSO and spring and summer precipitation. The La Niña stage of the ENSO is an aid for forecasting seasonal droughts in the region.

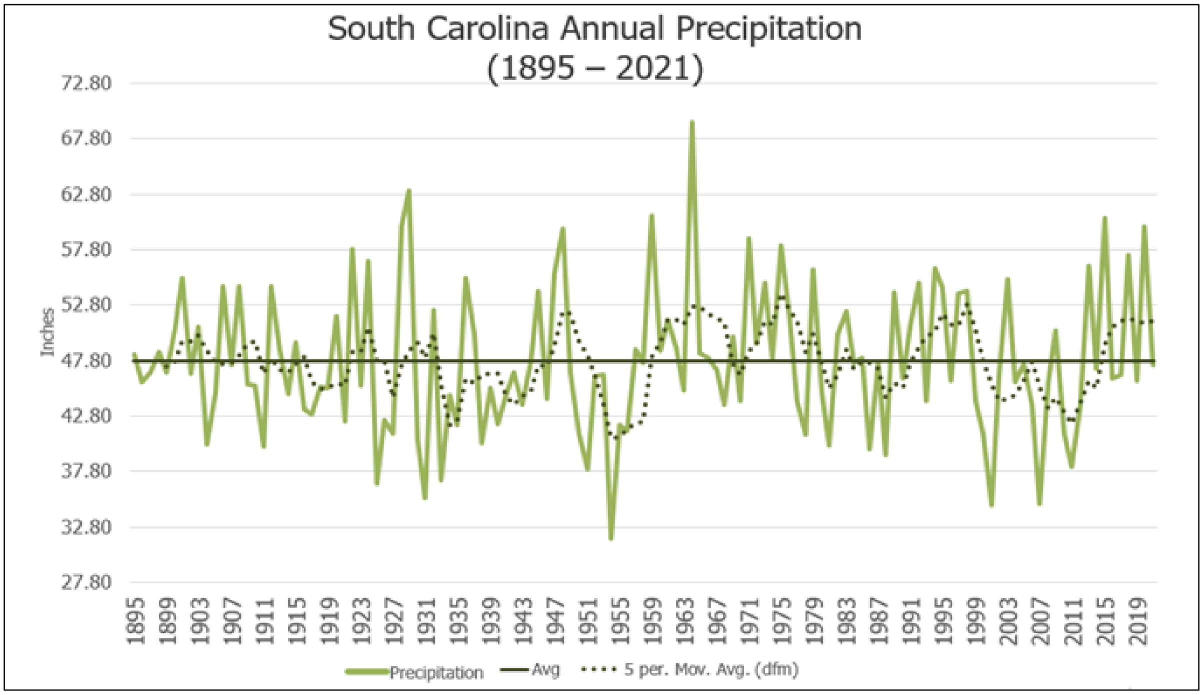


Figure 69: Annual Precipitation, 1895-2021

Source: South Carolina State Climatology Office

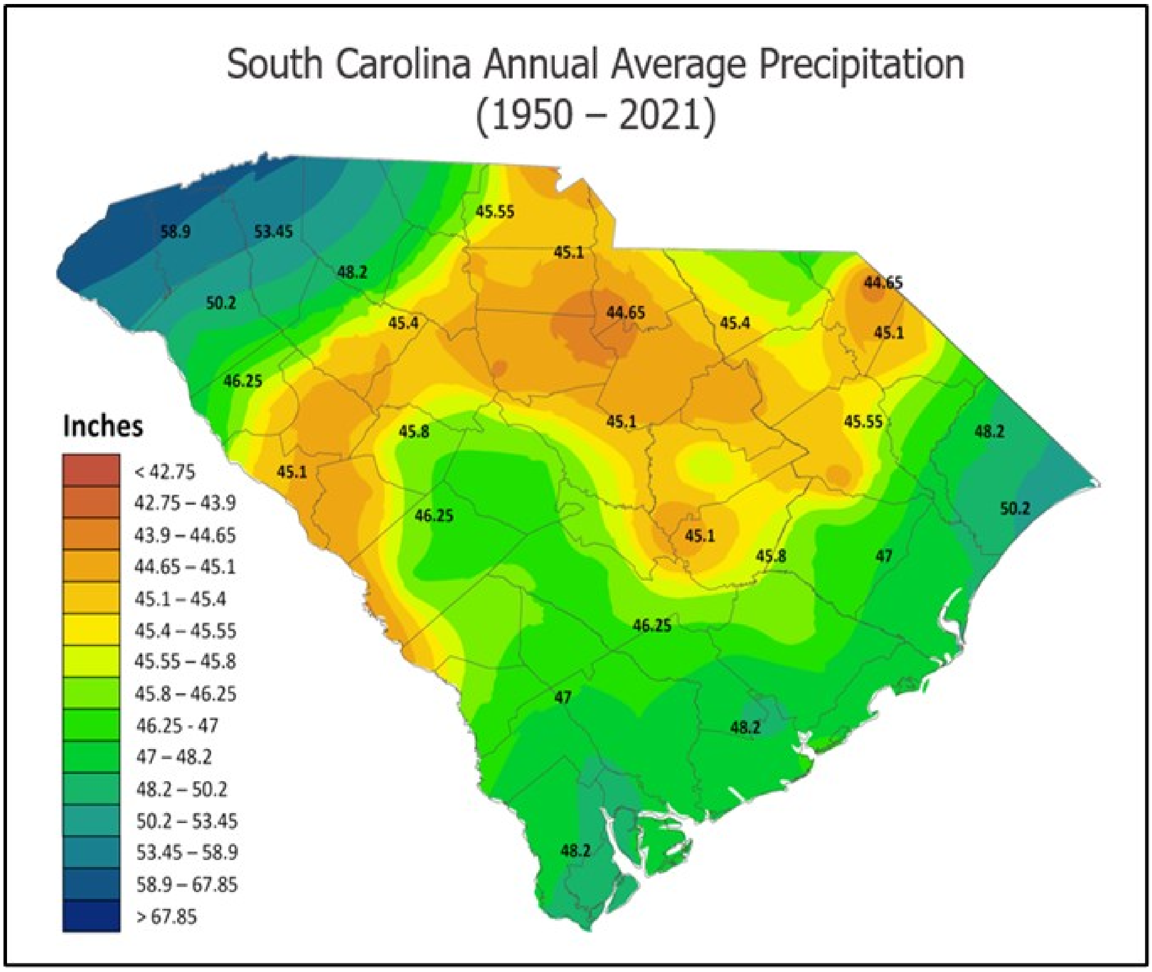


Figure 70: Statewide average annual precipitation for South Carolina

Source: State Climatology Office

Classification

Drought is distinguished in three common types: (Sc State Climate Office , n.d.)

> Meteorological Drought - An extended period of departure from average precipitation for a specific location or region. The amount of deficit is determined using the normal amount of precipitation that would be expected over a given time for that location.
>
> Agricultural Drought - A lack of adequate moisture to sustain plant growth and development.
>
> Hydrological Drought - Decreased streamflow, reservoirs, lakes, and groundwater. As these effects may take longer to become noticeable, hydrological drought often lags behind meteorological and agricultural droughts.

Drought is monitored nationally by the United States Drought Monitor (USDM). The USDM, which is maintained by several federal agencies including NOAA and U.S. Department of Agriculture, focuses on broad-scale conditions and local conditions using multiple indicators to identify areas where drought impacts are occurring. The USDM has five classifications: abnormally dry, moderate, severe, extreme, and exceptional drought.

The State Climatology Office is responsible for providing local input to the USDM and for being the lead for the South Carolina Drought Response Program. The Drought Response Committee meets regularly when needed to evaluate conditions and impacts within Drought Management Areas. The committee votes county by county to issue drought status declarations in four drought severity categories: incipient, moderate, severe, and extreme.

Location and Probability

As drought is a natural part of South Carolina's climate, all counties have potential for drought periods in the future. Drought likelihood is based on previous occurrences and severities of drought using indices such as the Palmer Drought Severity Index and statistical probabilities of return periods with below average precipitation (Table 43, Figure 71, and Figure 72).

Drought is caused by a deficiency of precipitation over an extended period. Many economic sectors are water-dependent but may be affected by precipitation shortfalls at different time scales. For example, droughts of one year or less can affect agriculture while other water uses might be affected by precipitation deficiencies persisting over several years.

The table below shows the likelihood of below average precipitation for one- to five-year durations. These probabilities are averaged for all climate stations and climate divisions in South Carolina. A probability of "1/5" means that there is a 1 in 5 (20%) chance, and "1/1000" means that there is a 1 in 1000 (0.001%) chance of receiving the specified percentage of average precipitation. Each value in the table represents the expected percentage of average precipitation associated with the different probabilities and time periods. For example, there is a 1/50 (2%) probability of receiving 67%* of average precipitation in a 12-month period.

	Duration				
Probability	1-year	2-year	3-year	4-year	5-year
1/5	86	90	92	94	94
1/10	79	85	88	90	91
1/25	72	80	83	85	87
1/50	67*	76	80	83	84
1/100	64	73	78	81	82
1/200	60	71	75	78	81
1/500	56	68	73	76	78
1/1000	54	66	71	74	77

Table 42 Mean percentage of average precipitation for different probabilities and different durations in South Carolina

Source: Carolinas Precipitation Patterns and Probabilities, an Atlas of Hydroclimate Extremes (Carolinas Integrated Sciences and Assessments and National Integrated Drought Information System., 2019)

Historical drought occurrences, statistical probabilities of future occurrences, changing climate patterns, demand and availability of water supply, and changes in population indicate that drought is more likely in some areas of the state, typically the Upstate and Midlands/Piedmont. Figure 74 shows the average number of weeks per year that South Carolina experienced drought conditions in locations across the State from 2000 to 2016. County drought status is determined by the South Carolina Drought Response Committee (DRC) supported by the State Climatology Office and the Department of Natural Resources.

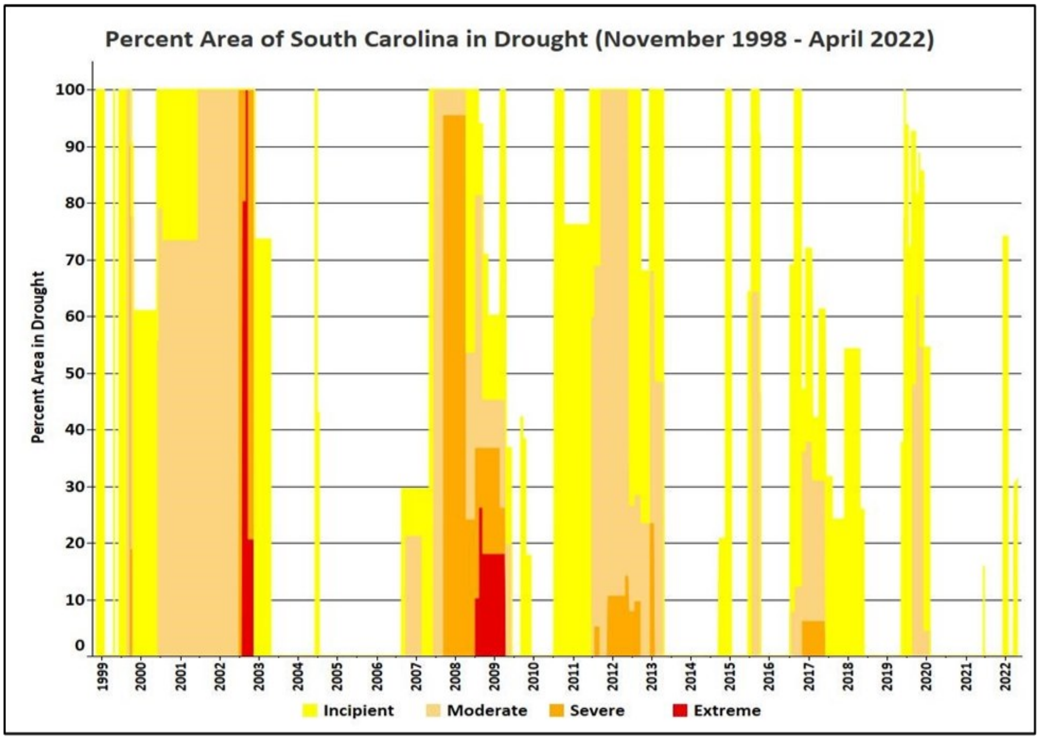


Figure 71: Percent area of South Carolina in Drought 1998-2022

Using the U.S. Drought Monitor declarations of drought higher than D1 (Moderate Drought), the map in Figure 72 shows the average number of weeks of drought South Carolina experienced during the 2000-2021 period. Comparing the 2000-2021 period to the 2015-2021 period shown in Figure 73 illustrates that there were fewer areas with high averages of weeks in drought in the 2015-2021 timeframe and less drought overall during the 2015-2021 period.

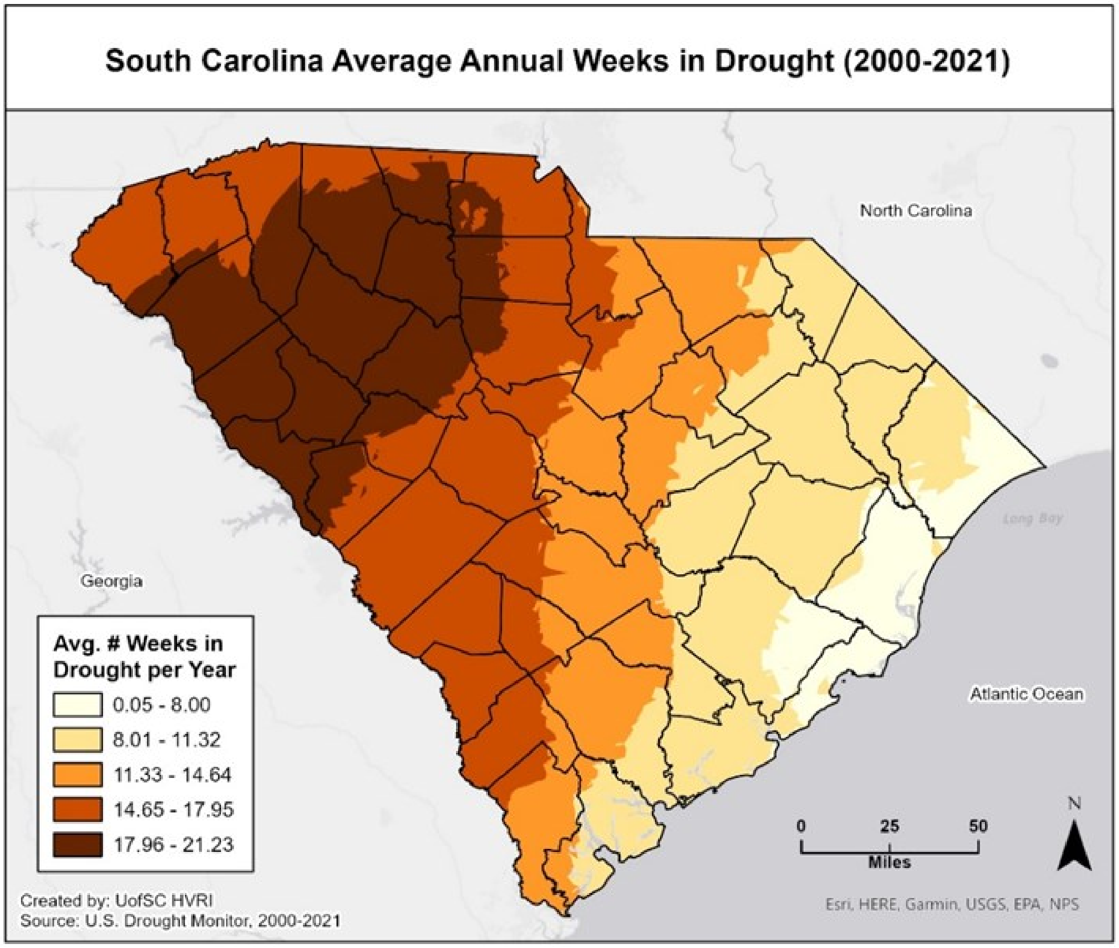


Figure 72: Average Annual Weeks in Drought (2015-2021)

Source: Carolinas Precipitation Patterns & Probabilities an Atlas of Hydroclimate Extremes

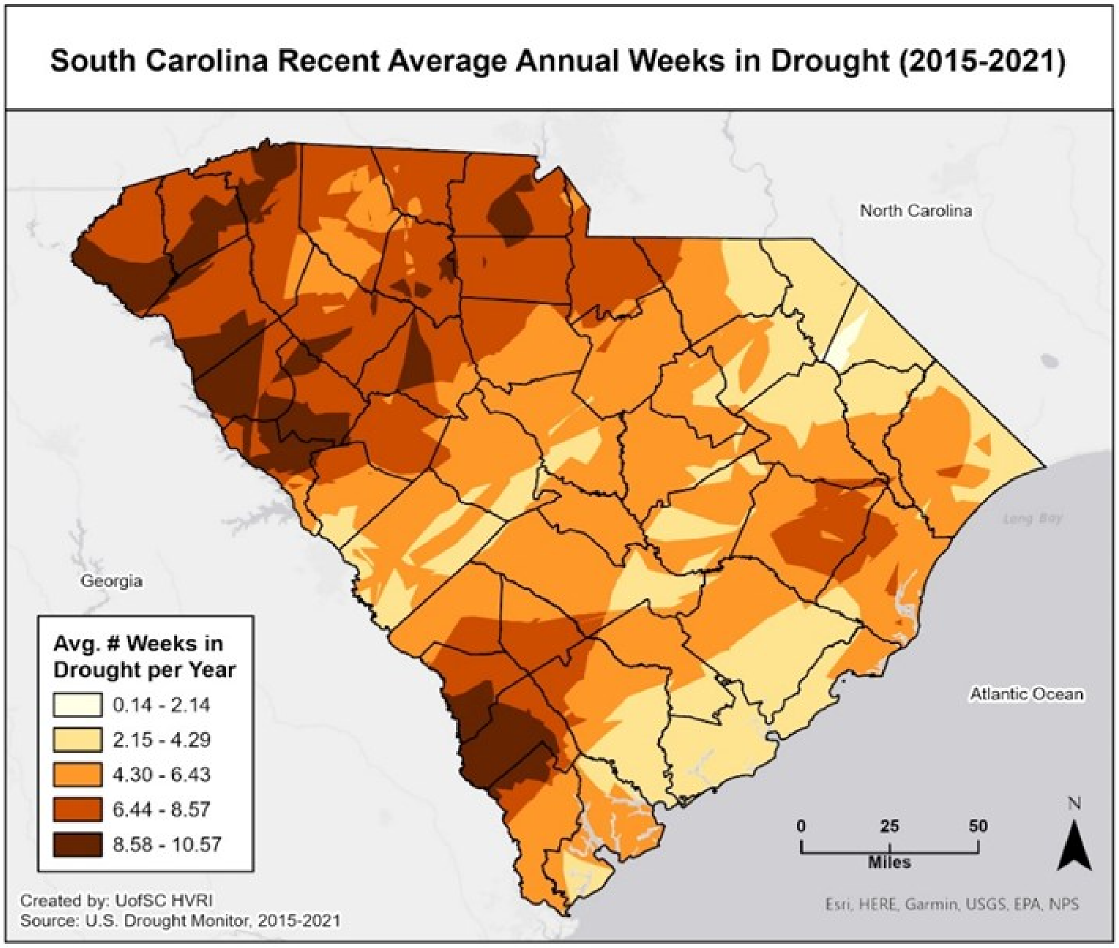


Figure 73: Average Annual Weeks in Drought in South Carolina (2015-2021)

Droughts are assessed in terms of spatial extent, duration, and severity (or intensity). Droughts can extend beyond single states into multi- state regions. Short-term droughts last less than six months and bring agricultural impacts, especially when occurring during growing season. Long-term droughts last more than six months and can last for many years, affecting hydrology, ecology, and societal well-being.

Many indicators and methods are used to measure and monitor drought severity. The choice of an indicator may depend on the type or classification of drought being considered, the impacts of most interest, and the region or location in which drought is occurring. Different indicators may be calculated using one or more types of information, such as precipitation, temperature, soil moisture, or hydrological data. Because of drought's complexity, multiple indicators are often used to depict severity. The table below shows the indicators used by the South Carolina Drought Response Committee to detect drought development, most often referred to as incipient drought, and track drought as it progresses from incipient to moderate, severe, and extreme stages.

Palmer Drought Severity Index	Indicates prolonged (months, years) abnormal dryness or wetness; incorporates temperature, precipitation, and soil moisture data
Crop Moisture Index	Depicts short-term (up to 4 weeks) abnormal dryness or wetness affecting agriculture
Standard Precipitation Index	Compares observed precipitation amount (from (1- to 24-month periods) with long-term averages for the same period
Keetch-Byram Drought Index	Depicts moisture deficiencies in the upper layers of the soil; used to monitor fire danger
U.S. Drought Monitor	A weekly product that uses a variety of drought, climatological, hydrological, soil moisture and other indicators and indices as inputs; designed to provide a national-scale view of drought extent and severity
Average daily streamflow	Considers average streamflow over two consecutive weeks, as compared to historic minimum flows for those same weeks
Ground Water, Static water level in an aquifer	Considers groundwater levels over two consecutive months, as compared to historic levels for those same months

Table 43 Drought Severity

The South Carolina Drought Response Committee and the State Climatology Office (within the Land, Water and Conservation Division of the South Carolina Department of Natural Resources) address drought related issues and responses. The Drought Response Committee is composed of state-level and local members and includes: The South Carolina Emergency Management Division of the Office of the Adjutant General (SCEMD), Department of Health and Environmental Control (SCDHEC), Department of Agriculture (SCDA), Forestry Commission (SCFC), and Department of Natural Resources (SCDNR).

Figure 74 represents the percent area in drought based on an analysis of the South Carolina Drought Response Committee's drought status for 2000-2022, during this time at least one county had a confirmed drought status. The figure is organized and color-coded according to drought severity designations.

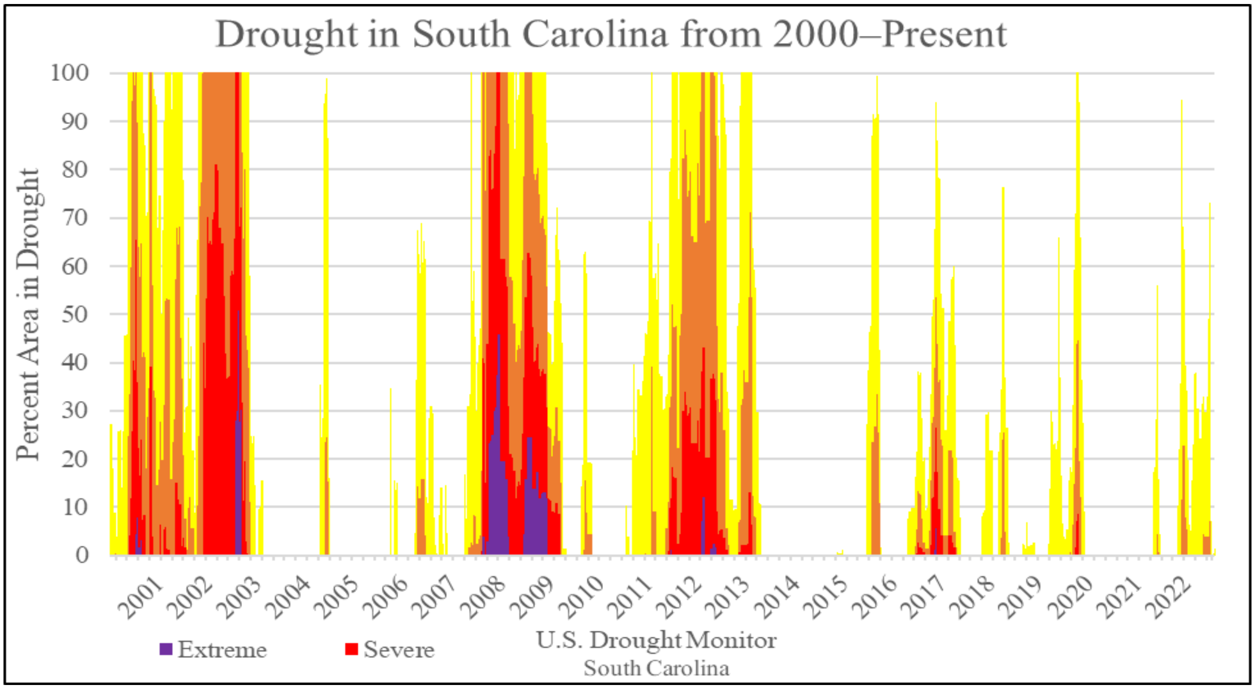


Figure 74: Average Annual Weeks in Drought in South Carolina (2000-2022)

Figure 75 identifies unusually wet and dry periods using the Palmer Drought Severity Index, one of the most-used drought indices, for 1895 through 2020. Severe, multi-year droughts are not uncommon in South Carolina. Such droughts persisted in the 1920s, 1930s, 1950s, and 1980s. South Carolina experienced an extended period of dry conditions in recent decades with severe- to extreme droughts occurring in 1998-2003, 2007-2009, and 2010-2013.

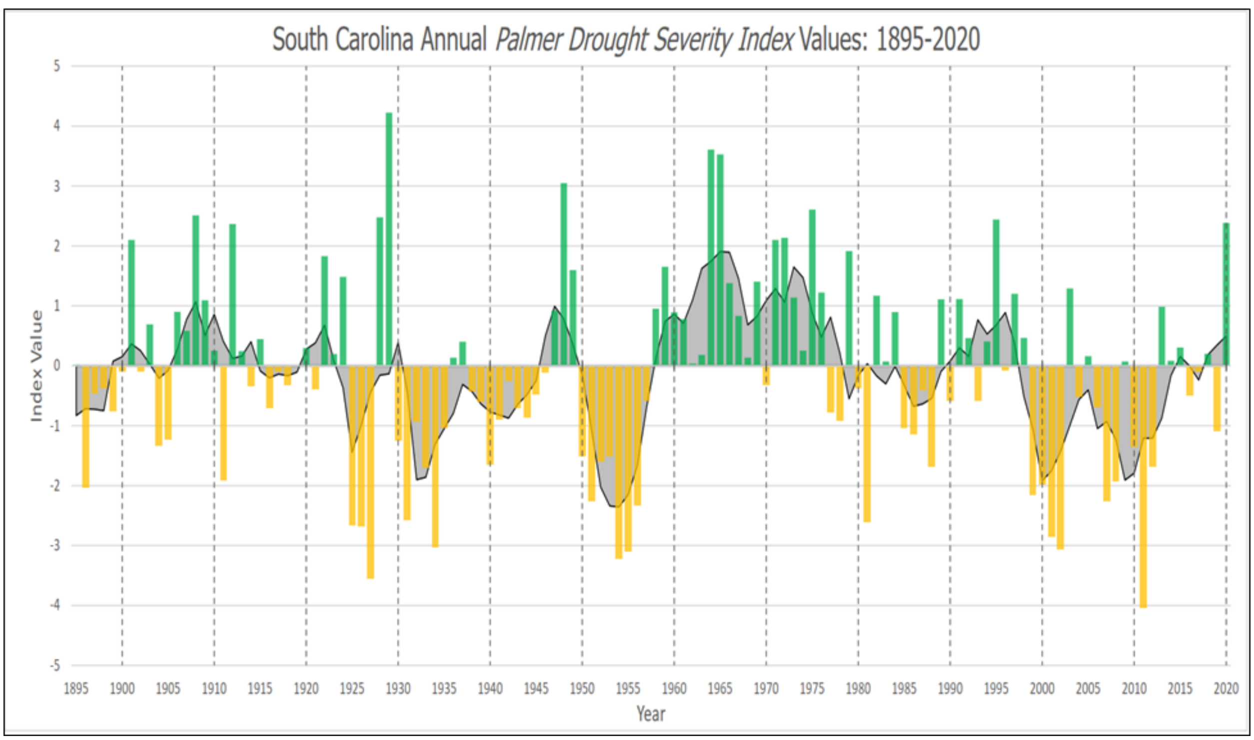


Figure 75: South Carolina Annual Palmer Drought Severity Index Values (1895-2020)

Figure 76 displays the Palmer Drought Severity Index for South Carolina from 1895-2021. Measuring by month, the figure uses the PDSI to convey various stages of drought. From 1.9 to -1.9 is near normal drought conditions. -2.0 to -2.9 is moderate drought conditions. -3.0 to -3.9 represents severe drought conditions and -4.0 or less displays extreme drought conditions. The Palmer Drought Severity Index was adapted for the South Carolina and South Carolina Drought Response Committee needs.

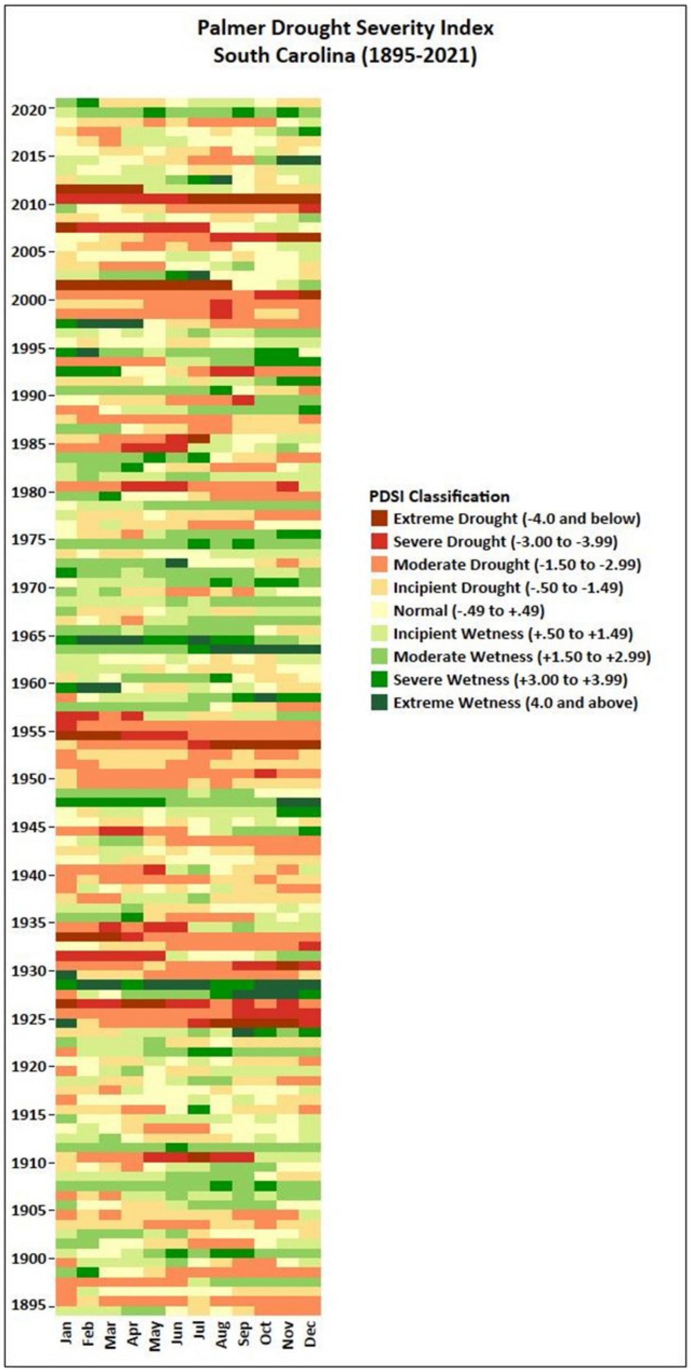


Figure 76: South Carolina Palmer Drought Severity Index Values

Vulnerability and Impact

Multiple sectors including agriculture, tourism, water and wastewater systems, and energy are susceptible to impacts of drought. Determining the direct and indirect costs associated with drought can be difficult because of the broad spatial extent and difficulty in determining specific beginning and end dates of a drought period.

Often buildings, infrastructure, and critical facilities are exposed to impacts of drought depending on their location. State assets that are more vulnerable to droughts are in counties that experienced more frequent drought duration and higher drought severity. A drought of a particular severity in the present time could have different impacts compared to past droughts because of changes in water supply and demand, assets, and populations.

Drought Severity

South Carolina's modern climatological records of precipitation and temperature are available starting with the 19th century. Palmer Drought Severity Index (PDSI) measurements were constructed from these records to assess drought extent in terms of duration and severity for each climate division in the State, as shown in Figure 77. Figure 78 shows the level of drought severity (incipient, moderate, severe, extreme) for each climate division, for two time periods (1895-2016 and 2000-2016). During the full period of record (1895-2016), the State was in some level of drought for approximately 38% of the time. In comparison with the full record, South Carolina has experienced droughts of greater severity and a longer time duration from 2000-2016.

Northwest and north central divisions experienced drought 63% of the time and west central and central divisions 60% of the time. In addition, the 2000-2016 period shows a larger percentage of time was spent in severe or extreme drought compared to the full record.

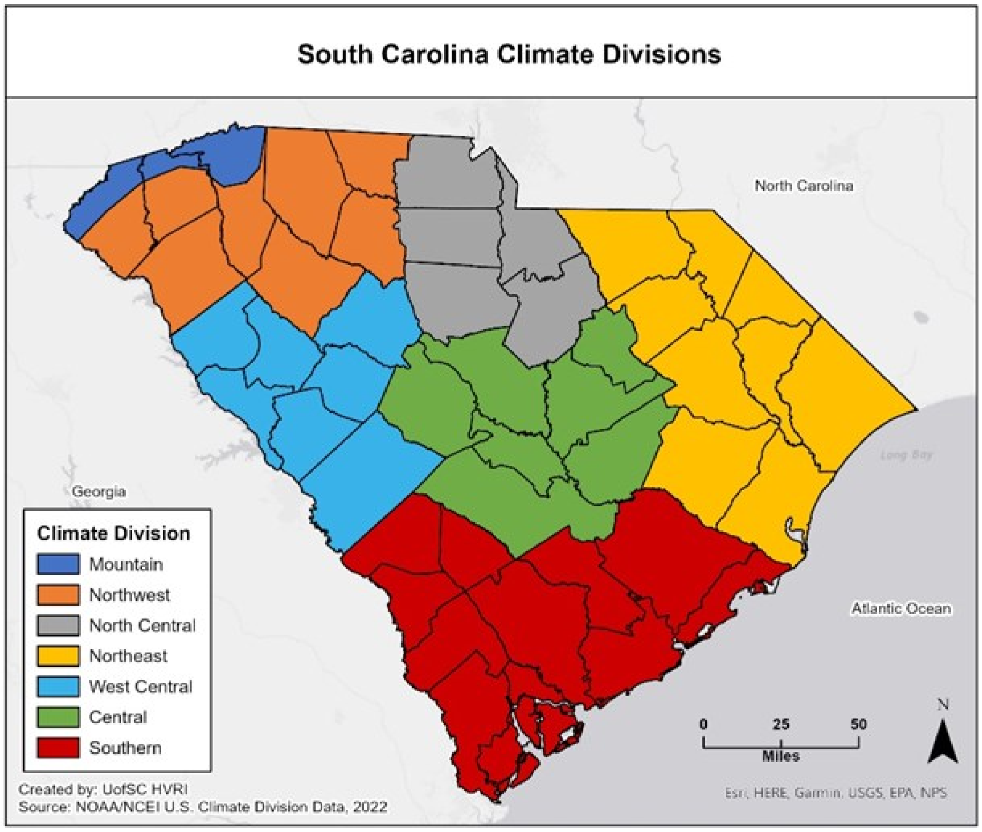


Figure 77: SC Climate Divisions

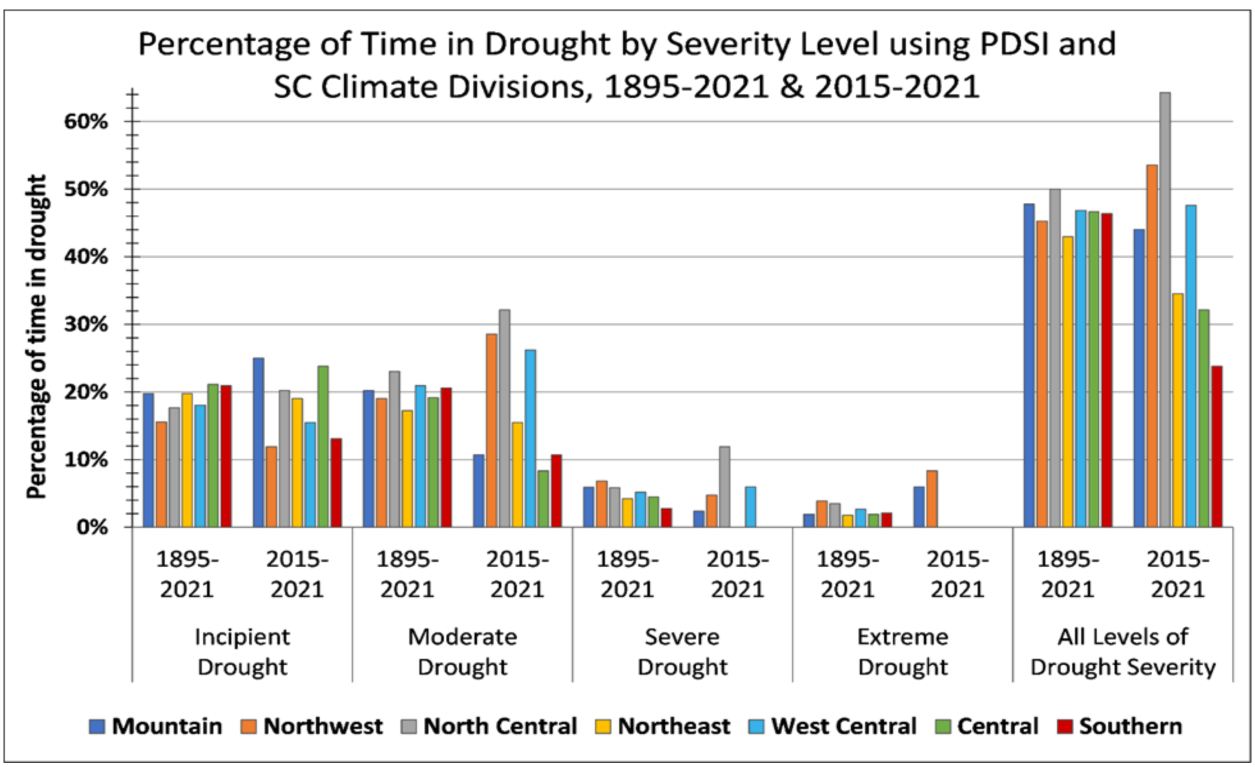


Figure 78: The Palmer Drought Severity Index (PDSI) classification for South Carolina by month (1895-2021)

The table below provides an overview of the range of impacts that drought produces and the sectors that are vulnerable to and have been affected by drought in South Carolina.

Affected Sectors and Resources	South Carolina Examples
Agriculture: Agriculture, farming, aquaculture, horticulture, forestry, and ranching	**Reduced crop yields**: Figure 78 shows corn crop yield anomalies during past droughts (1954, 1970, 1977, 1986, 1993, 1998, 2002, 2008, and 2011). **Loss of pastureland and grazing grasses for livestock**: The USDA Livestock Forage Program provided South Carolina farmers with $17.1 million to compensate for losses during this period (United States Department of Agriculture , 2017).
Plants and Wildlife: Wildlife, fisheries, forests, and other fauna	**Increased vulnerability to disease**: Four years of drought made pine trees more susceptible to Southern Pine Beetle infestation, leading to estimated timber losses of $220 million (Carolinas Integrated Sciences and Assessments , 2002). **Habitat degradation**: blue crab and shrimp fisheries were below normal, due to drought's negative effects on nursery habitat (SC Department of Natural Resources, 2003).
Fire: Forest, range, and urban fires that occur during drought events	**Increased risk of fire:** Drought conditions contributed to increased fire occurrence and number of acres burned. The Pinnacle Mountain fire was the largest in Upstate history; more than 10,000 acres burned and firefighting costs were more than $5 million.
Water Supply and Quality: Surface or subsurface water supplies (i.e., reservoirs or aquifers)	**Private wells ran dry;** new or deeper wells were needed. **Saltwater intrusion** in water systems in Pee Dee and Waccamaw River Basin (SC Department of Natural Resources, 2009).
Energy: Power production and demand	**Reduced hydropower generation** in the Santee and Savannah River Basins (SC Department of Natural Resources, 2009). **Purchase and use of alternate sources of energy** to compensate for loss of hydropower generation.
Business and Industry: Non- agriculture businesses	**Lost revenue/increased costs** to landscapers, golf courses, recreation-based businesses due to water shortages.
Tourism and Recreation	**Closed boat ramps** because of low water levels; canceled fishing tournaments. **Closed trails** at Table Rock State Park because of the Pinnacle Mountain fire.
Society and Public Health: Changes in public behavior and human health effects	**Water use restrictions; burning bans.** **Road closures** and **widespread smoke** because of Pinnacle Mountain fire.

Table 44 Impacts Produced by Drought

Agriculture

One of the earliest indications onset to a drought is the agricultural sector. The figure below shows corn crop yield anomalies during selected drought years (from 1944 to 2016). Using statistical and modeling techniques, the effects of weather events and climate variability on corn yields were separated from other factors (such as technological advances) to compare droughts' effects on crop yields over time. "Normal yield" refers to the expected yield under the technological conditions of that particular time. Crop yields were considerably lower than expected during drought years, as demonstrated below.

The maps below show the percentage of corn yields that are lower (red) or higher (green) than normal yield conditions (yellow). Counties in white did not produce corn, had no available data, or corn yield data was not reported for that year.

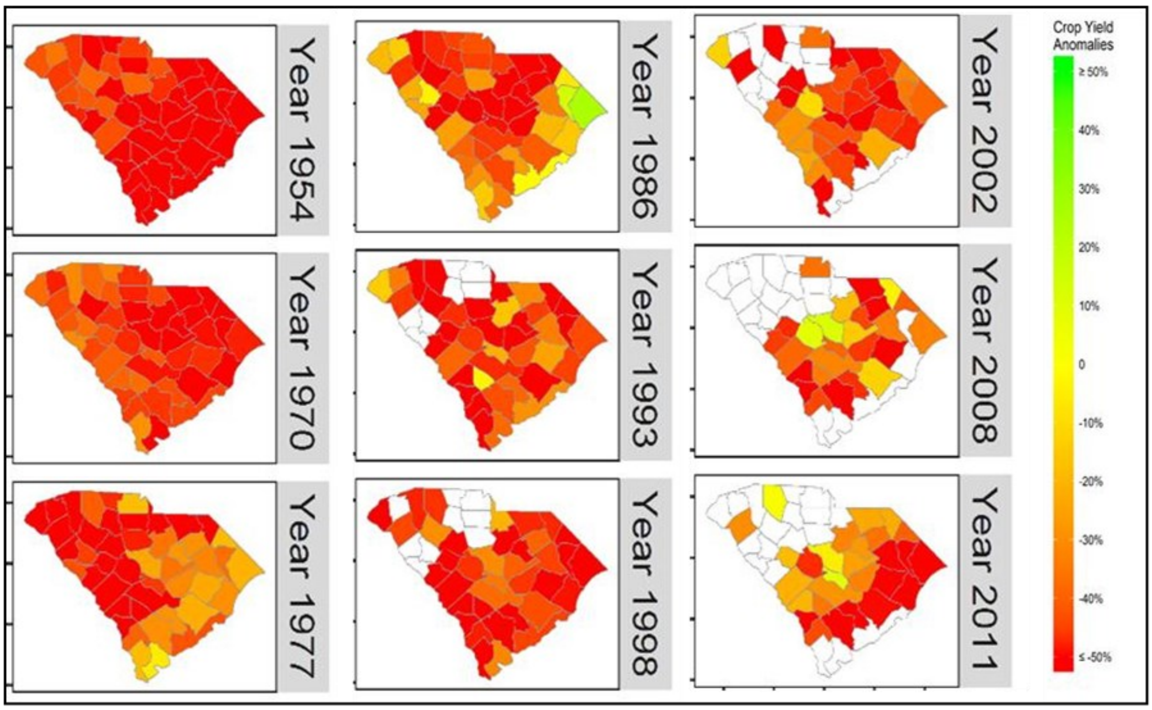


Figure 79: Corn Crop Yield Anomalies in Drought Years

Source: CISA/University of South Carolina

South Carolina has regularly received United States Department of Agriculture secretarial disaster declarations because of drought. Figure 80 shows the number of South Carolina counties with disaster declarations issued for drought since 2012. USDA secretarial disaster declarations make emergency loans available to producers suffering losses in those counties.

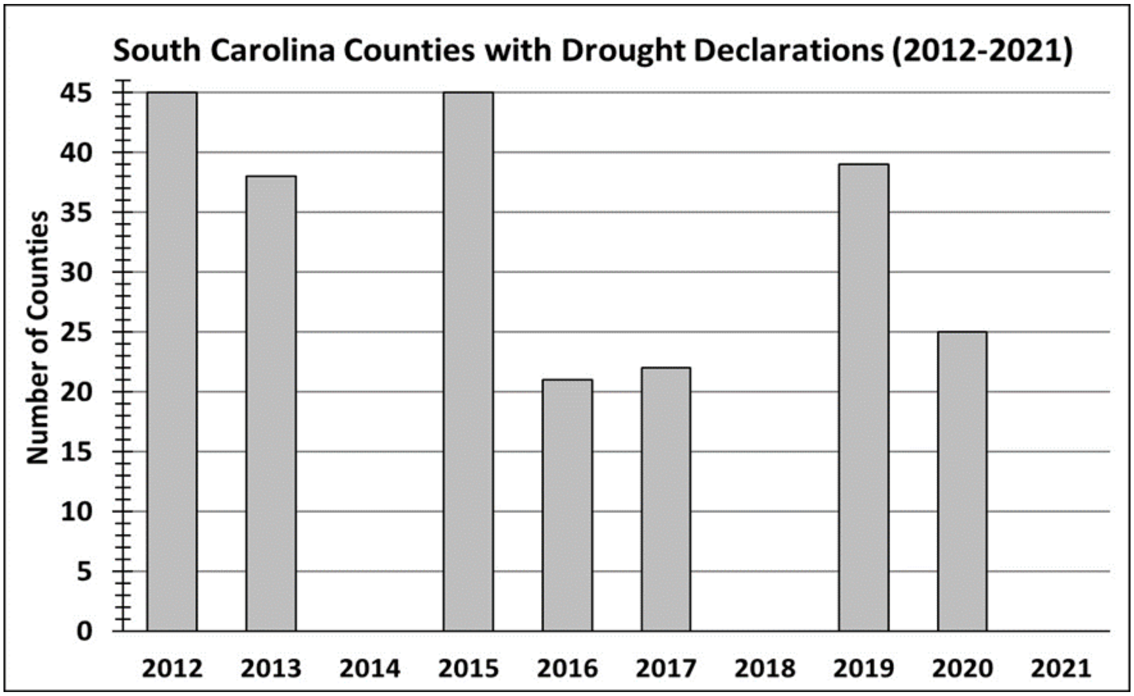


Figure 80: Number of USDA Secretarial Drought Declarations in South Carolina Counties (2012-2021)

Water Resources

South Carolina's surface water resources depend on precipitation. Short-term droughts, that take place during the growing season, are more likely to primarily affect agriculture. Too little rainfall occurring over several seasons can contribute to lower streamflow and reservoir levels, resulting in hydrological drought and impacts to water supplies and water quality. During winter, South Carolina relies on rainfall to replenish streams, reservoirs, groundwater, and soil moisture. Spring and summer are times of increased demand for water resources for agriculture, drinking water, energy production, recreation, and other uses.

Historial and Notable Events

Historical and recent occurrence data is derived from NCEI's Storm Event Database unless stated otherwise. Loss-causing data is derived from SHELDUS V.20.0. For more information regarding data sources and methodology, see Appendix B.

1925: The growing season had a recorded 12.41-inch rain deficit, and the State experienced an overall rainfall deficit of 18.23 inches. Water for livestock was scarce; many streams had record lows, and deep wells went dry affecting water supply and power production.

1954: The year set the current record for the State's driest year with total statewide precipitation of 32.96 inches. An excessively hot summer exacerbated the impacts of limited rainfall. According to National Weather Service reports, crop yield was only 10 percent of 10-year average production. Hurricane Hazel ended extreme drought conditions in eastern South Carolina, although drought continued in western areas of the state.

1985-1986: Because of drought conditions and accompanying reduced stream flows. hydroelectric power generation was curtailed by 183,978-megawatt hours at the Lake Murray Saluda Hydropower plant. The U.S. Army Corps of Engineers was forced to purchase $10 million in substitute electricity on the open market to compensate for the reduced hydroelectric power production at the Savannah River Plant.

1993: The Greenville-Spartanburg Airport recorded the hottest and driest month on record up to date in July of 1993. Similar records were set at other locations around the State. The drought, which started at the height of the crop growing season in May and June, devastated South Carolina pastures and hay production. The drought and record heat cost the State a total of $22.5 million in crop losses. The total loss for livestock, hay, and pasture was estimated at $34.7 million.

1998-2002: This drought lasted four years and the precipitation deficits were among the largest in the State history. The two highest levels of drought severity, extreme and severe drought (state classifications), lasted throughout summer of 2002; in August, State officials declared the entire State to be in the extreme drought. The drought significantly contributed to the southern pine beetle epidemic. The South Carolina Forestry Commission estimated the total impact of the drought at more than $1.3 billion dollars (South Carolina Forestry Comission, 2022).

2007-2008: Drought affected water levels in many lakes. The Savannah Lakes were more than 19 feet below the target level. Lake Marion dropped 9 feet during 2007 reaching the lowest elevation (66.27 ft-msl) since the 1950s. The hydrological drought impacted water supplies, irrigation capacity, and many lake-related businesses as well as golf courses. Voluntary and mandatory water restrictions were issued across the State because of prolonged drought conditions and associated water supply shortages.

2010-2013: Lake Hartwell and Lake Thurmond were 6.5 feet and Lake Jocassee was 21 feet below their target guide curves in March 2012. The inflows into Lake Thurmond for the following three-month were the lowest recorded since 1954. The deteriorating hydrologic conditions reduced the amount of water stored in shallow and deep aquifers.

2015-2016: South Carolina experienced alternating wet and incipient drought conditions. In June 2015, all counties were in incipient or moderate drought. Historic floods in October 2015 alleviated the dry spell for several months. However, in August 2016 drought returned to the State. Hurricane Matthew brought excessive rainfall to most counties, but a lack of adequate moisture persisted in the Upstate region.

A significant drought can create a range of impacts on community lifelines. The table below identifies potential impacts a drought can have on community lifelines in the state.

Community Lifeline	Level of Impact	Description of Impacts	Area of Impact
Communications	Low	No significant effects anticipated.	Regional
Energy	Low	Hydroelectric and nuclear power generation could see challenges because of reduced water resources. Severe drought may result in structural stresses to infrastructure.	Regional
Food, Water, Shelter	High	Agricultural crop production will be reduced. Food and water resources will be reduced locally and regionally based on lack of rain and potential high heat conditions, if present. Economic impacts to agricultural interests because of lower productivity and increased costs, including irrigation.	Regional
Hazardous Materials	Low	No significant effects anticipated.	Regional
Health and Medical	Medium	Reduced availability of water could have negative health effects on people and animals. Reduced water resources could negatively impact emergency and medical operations.	Regional
Safety and Security	Low	Reduced availability or consistency in water supplies may compromise firefighting capabilities.	Regional
Transportation	Low	No significant effects anticipated. Severe drought may result in structural stresses to transportation infrastructure.	Regional

Table 45 Community Lifeline Impacts Based on Significant Drought Scenario

Future Climate Considerations

Drought is a combination of several climate factors that also affect other hazards. Major climatic drivers such as ENSO affect the United States, more specifically the Southeast, in ways climate scientists and researchers are further analyzing. One area of agreement is that average annual global temperatures are rising. Another is that while future precipitation levels are uncertain, extreme precipitation events are rising. These factors may mean that past drought occurrences may not be a good predictor of future development of drought conditions.

Contextually to South Carolina, the average annual temperature rose more than 1°F since the beginning of the 20th century. Spells of hotter and cooler average temperatures occurred over the observed time period with periods of cooler temperatures at the beginning of the century. The 1930s through 1950s saw warmer temperatures. The 1960s brought another round of cooler temperatures that lasted until the early 1970s. Other than a few years of cooler temperatures, the overall annual temperature has increased beyond those observations in the 1930s. While there is no decisive trend leaning towards increasing extreme heat days in the record incorporated for this SHMP update, the more telling story lies within the annual days where the low temperature does not fall below 75° F. Statewide, warm nights have been above average since 1980 and coincides with the increasing trend of overall average annual temperature. Without an effective cooling diurnal cycle in the evenings, the temperature does not have the ability to decrease and so compounds the rising average temperatures.

Observed precipitation levels and droughts affecting the state are easily discernable. Notable drought years in the state, such as 1950s, 1985-86, 2007-09, and 2010-13, could be attributed by lower annual precipitation levels playing a major role in drought conditions. An overall precipitation trend is not as clear; however, the expected trend is for more intense hourly accumulations with fewer, shorter rain events. This trend is explained using the annual precipitation total over the observed precipitation duration.

Major storms tropical cyclones and severe thunderstorms provide the change for extreme rainfall conditions. South Carolina is no stranger to notable events with the 2015 Floods in the Midlands, Hurricane Matthew, Tropical Storm Florence, and Hurricane Dorian all producing extreme rainfall events in the last ten years. The extreme rainfall events increase during the warmer seasons of the year and are often associated with tropical cyclone activity.

Higher average annual temperatures and drier conditions in response to temperature and precipitation levels hold the keys to South Carolina's future in terms of climate and drought. With warmer evenings, daily average temperatures during the warmer months would lead to drier conditions. Precipitation levels may change in terms of their intensity; however, the extent to which the annual precipitation levels changing is not certain. The lasting impacts drought has on South Carolina take years to recuperate from and affect agriculture, forestry, tourism, power generation, public water supply, fisheries, ecosystems, water and air quality, public health, life, and safety.

K. Flood

Flooding is the most frequent and costly natural hazard in the United States. Within South Carolina, the entire state is considered to have at least some potential risk for flooding. Specifically, "99% of U.S. counties were impacted by a flooding event from 1996-2019. A flooding event is "any high flow, overflow, or inundation by water which causes damage" (NCEI) (NOAA , n.d.)

Because of the frequency and significance of flooding events, the National Weather Service monitors conditions that could potentially lead to flooding 24 hours a day, 7 days a week, and oversees issuing forecasts, watches, and warnings.

Formation

"The most basic definition of flooding is the overflow of water onto land that is normally dry" (NOAA , n.d.) Flooding formation generally begins as the result of excessive precipitation over a span of days, intense rain in a short period of time, river overflow from an ice or debris jam, failure of water structures (dams, levees), or when excessive snow melt and rain occur in combination. When water amounts exceed the maximum capacity an area can hold, flooding can be expected (NOAA , n.d.).

Classification

Fluvial	Pluvial	Flash	Coastal
River floods occur when the water level in a river, lake, or stream rises and overflows in neighboring land.	Surface water heavy rain creates flood independent of an overflowing body of water, strain on drainage and run-off from elevated terrain	Can be caused by heavy rain or the sudden release of water.	Inundation of land along the coast by sea water. Includes high tides, storm surge, and tsunamis.

Table 46 Types of Flooding

The terms used to classify floods are diverse, as are the number of subtypes. Floods may be broadly classified into three categories, as either pluvial, fluvial, and coastal.

Fluvial Flooding

These floods are usually long-term events that may last for several days: riverine flooding fall under this general flood type. Fluvial flooding only occurs when the source of the flooding is a body of water that has overflowed past it's standard holding point.

Pluvial Flooding

Pluvial floods are caused by locally heavy rains in areas where water runs off quickly, moving at very high speeds. "Waves" of water can reach heights of 10 to 20 feet from this sudden movement. These floods can cause severe damage; they are able to pick up great debris, uproot trees, roll boulders, destroy buildings, and damage bridges and roads. Because of the speed of onset of pluvial flooding, it is common for people to be caught unaware in their vehicles when bridges and roads are washed out. In fact, 70% of flash flood deaths occur when vehicles are driven into the water. Pluvial flooding can occur without a body of water being present.

Coastal Flooding

Flash flooding: falls under pluvial flooding and is the rapid onset event that occurs from fast, heavy rainfall, accumulating in areas faster than the ground can absorb it[4]. Urban flooding: occurs because of impervious surfaces (streets, roads, parking lots, residential and business areas) that inhibit rainfall absorption, causing runoff. Flash Floods can be seen in areas without any significant weather changes often far from the source of flooding.

South Carolina's most prominent flash flood areas in order are Charleston, Richland, Greenville, and Horry counties which have the highest number of flash flooding events form 21996-202. While soils within these areas differ, urban developments and the use of non-permeable concrete has increased the chance for flash flooding possibilities.

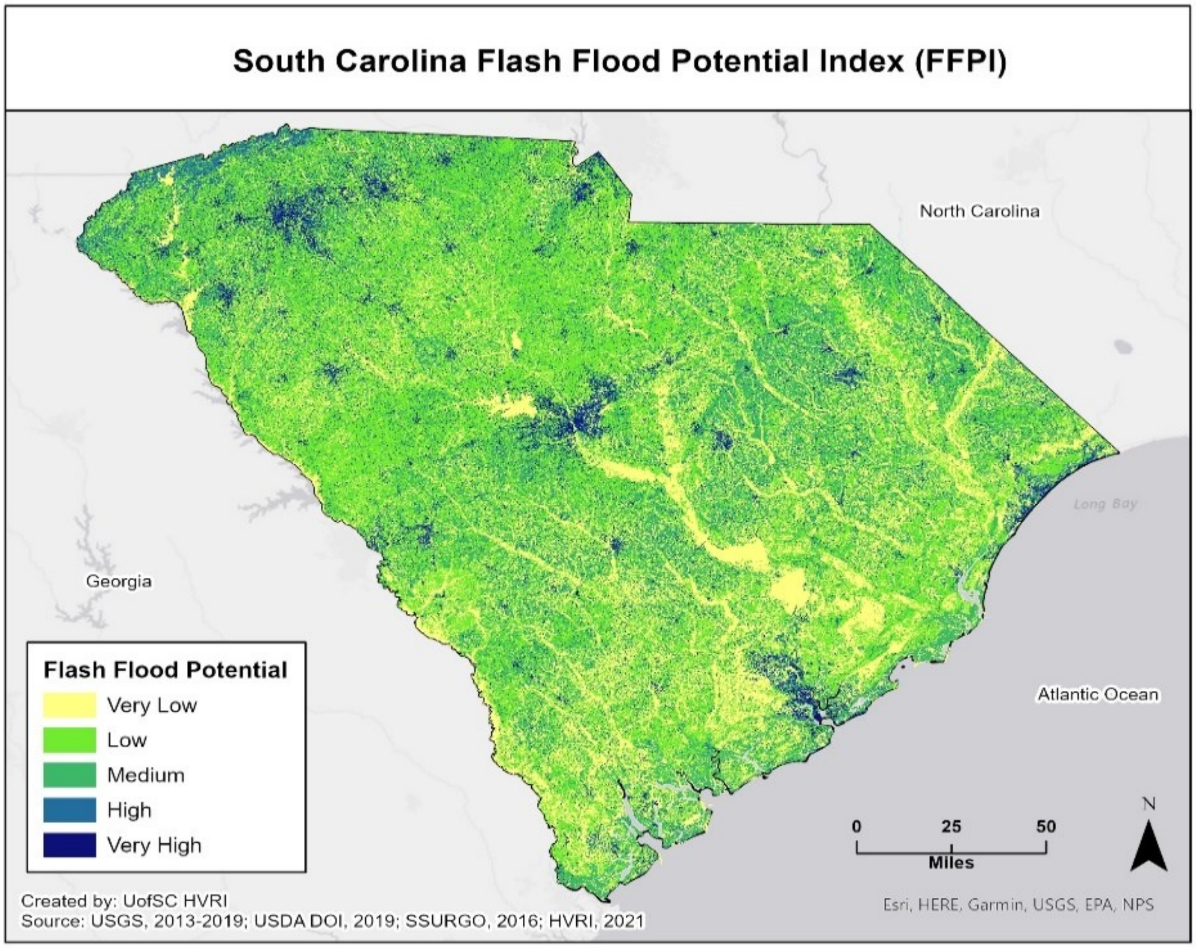


Figure 81: South Carolina Flash Flood Potential Index (FFPI)

Riverine flooding

Fluvial flooding occurs when an increase in water volume within a river channel causes an overflow onto the surrounding floodplain or surrounding land. This type of flooding usually occurs from strong thunderstorms, tropical systems, or excessive rainfall (NOAA , n.d.). Riverine flooding has the potential to occur within any South Carolina River channel.

Coastal flooding

Coastal waters can inundate shoreline and inland areas because of lack of proper drainage, sea level rise. In addition, water pushed inland by storm surge, wind-driven waves, and heavy rainfall produced by hurricanes, tropical storms, nor'easters, and other coastal storms can create coastal flooding. The highest number of NFIP claims can in South Carolina are associated with coastal areas based on a variety of factors and the frequency of coastal flooding within the state. See IV. C, Coastal Hazards and IV. B, Tropical Cyclones.

Local drainage problems

Local Drainage problems can be contributing factors for both pluvial and fluvial flooding depending on the surrounding environment and what other environmental contributors there are. They can occur anywhere in the State where the ground is flat, where the drainage pattern has been disrupted, or where channels or culverts have not been maintained. As previously mentioned, sea level rise has become a major contributing factor to localized flooding in coastal areas on blue sky (no weather disruptions) days, particularly where drainage is insufficient or is not functioning.

Dam/levee failure

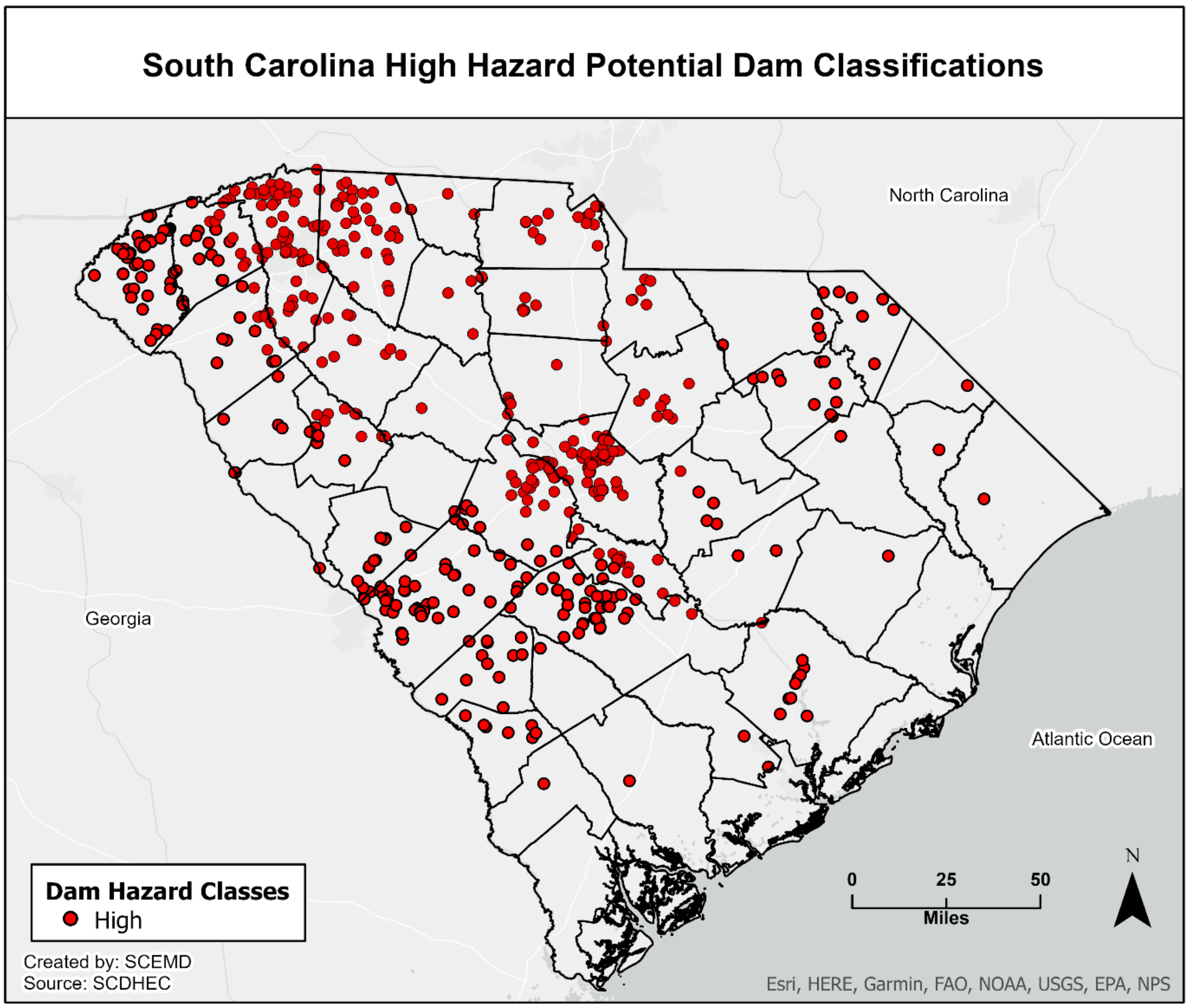


Figure 82: South Carolina High Hazard Potential Dams

Dams have the potential to fail and suddenly release impounded water, flooding land downstream. The threat from dam failure increases from aging dams and when additional dams are built for retention basins and amenity ponds in new developments. Older dams may not have been built using current engineering standards. Many dams exist on smaller streams that are not mapped as floodplains or subject to floodplain regulation, leaving downstream residents unaware of potential risks. For more information on high-hazard potential dams, see Appendix A.

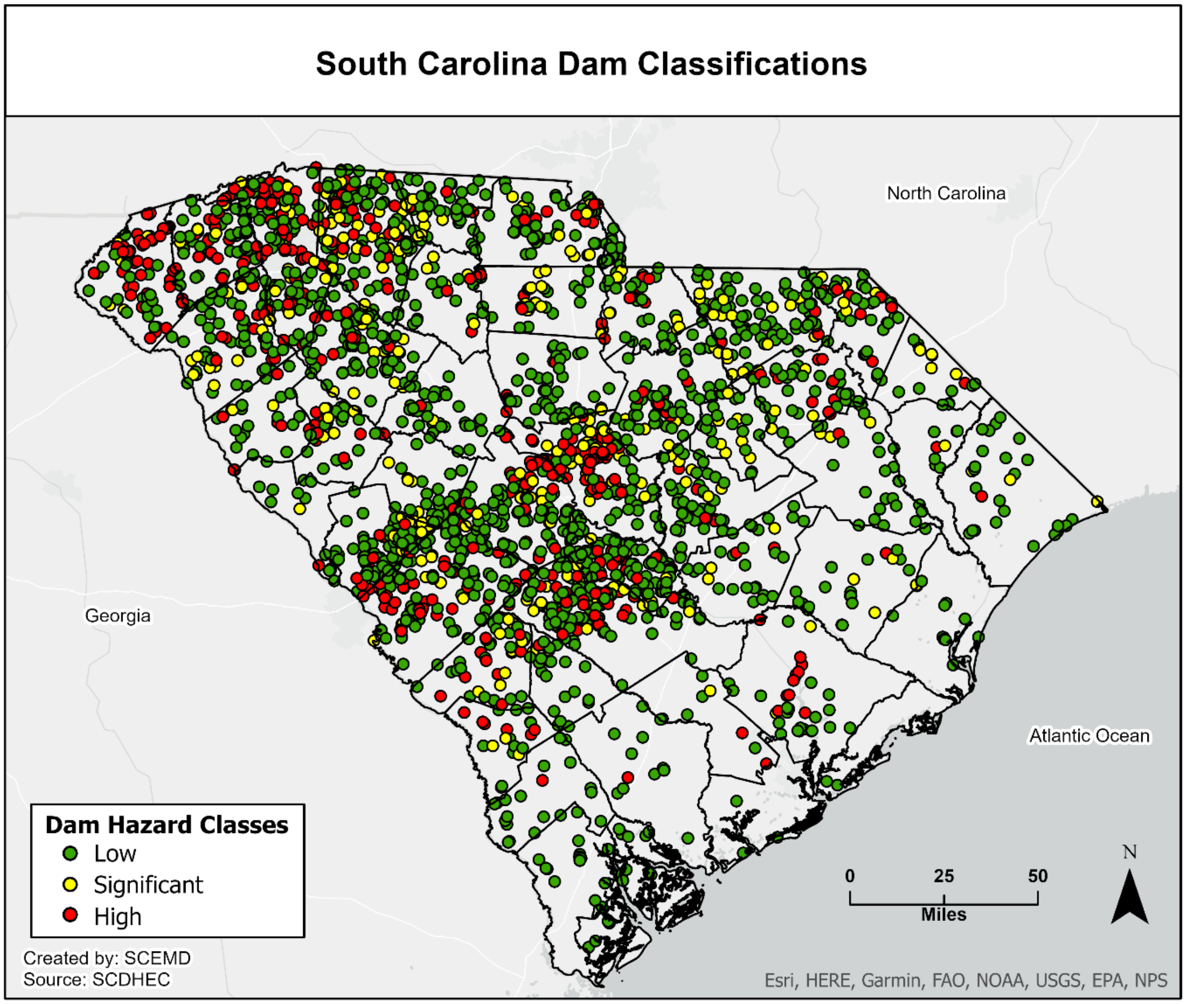


Figure 83: South Carolina Dams by Classification

Tools

Tools and technology can assist with flood modeling, prediction, and monitoring. Some focus on frequency of flooding, while others focus on impacts of a given scenario. South Carolina has access to tools that help in local decision making and identification of safety protocols and protective action recommendations. The National Weather Service leads efforts to monitor conditions that may lead to flooding. The National Weather Service River Forecast System (NWSRFS) assists in forecasting flash floods by assessing soil moisture condition (soil type and moisture content) to develop flash flood guidance. Additional tools used for gathering and delivering information on key developments during flooding situations are FEMA Flood Maps, SCDNR inundation maps, flood sirens, dam breach or failure sirens, river and rain gages. Each of these tools can provide valuable information in times of need to people potentially effected by flooding scenarios.

Flooding causes major damages to residential homes, public buildings, and environmental spaces. To mitigate for the least amount of dollar damages that a flood can cause tools like NFIP claims, The Community Collaborative Rain, Hail and Snow Network or CoCoRaHS- a site that identifies historical rain levels during major events (insert cite), and SCDNR inundation maps provide insight on previously affected areas and hardest hit areas that need additional focus (cross-reference). Social vulnerability Indices can also be used to establish areas where they face a harder rebound to extreme flooding events. This can provide important information on where mitigation efforts will maximize the most benefits.

Location and Probability

South Carolina has four major river basins that include eight watersheds. The State's rivers generally start in the northwest and flow southeasterly to the Atlantic Ocean, passing through three physiographic areas:

- The Blue Ridge Mountains in the far northwestern corner of the state
- Piedmont Plateau
- The Coastal Plain

Below are the primary watersheds within these regions:

- Broad Watershed
- Cawtaba Watershed
- Edisto Watershed
- Pee Dee Watershed
- Salkehatchie Watershed
- Saluda Watershed
- Santee Watershed
- Savannah Watershed

Although flooding can happen anywhere in South Carolina, given the atmospheric conditions and/or lack of proper maintenance to flood control and drainage systems, flooding typically occurs in floodplains. Floodplains are areas adjacent to streams and rivers that are prone to flooding. This area contains the overflow of water from surrounding streams or riverbanks until it is returned to the stream channel or absorbed. Floodplains are designated by the frequency of the flood that is large enough to inundate the designated area. For example, the floodplain will be covered by the 10-year flood and the 100-year floodplain by the 100-year flood. It should be noted that significant rain events do not necessarily correlate to flood events.

Flood frequencies such as the 100-year flood are determined by plotting a graph of the size of all known floods for an area and determining how often floods of a particular size occur. Another way of expressing the flood frequency is the chance of occurrence in any given year, which is the percentage of the probability of flooding each year. For example, a 10-year flood has a 10 percent probability of occurring in any given year, a 50-year event has a 2% probability, a 100-year event a 1% probability, and a 500-year event a 0.2% probability. While unlikely, it is possible to have two 100 or even 500-year floods within months or years of each other.

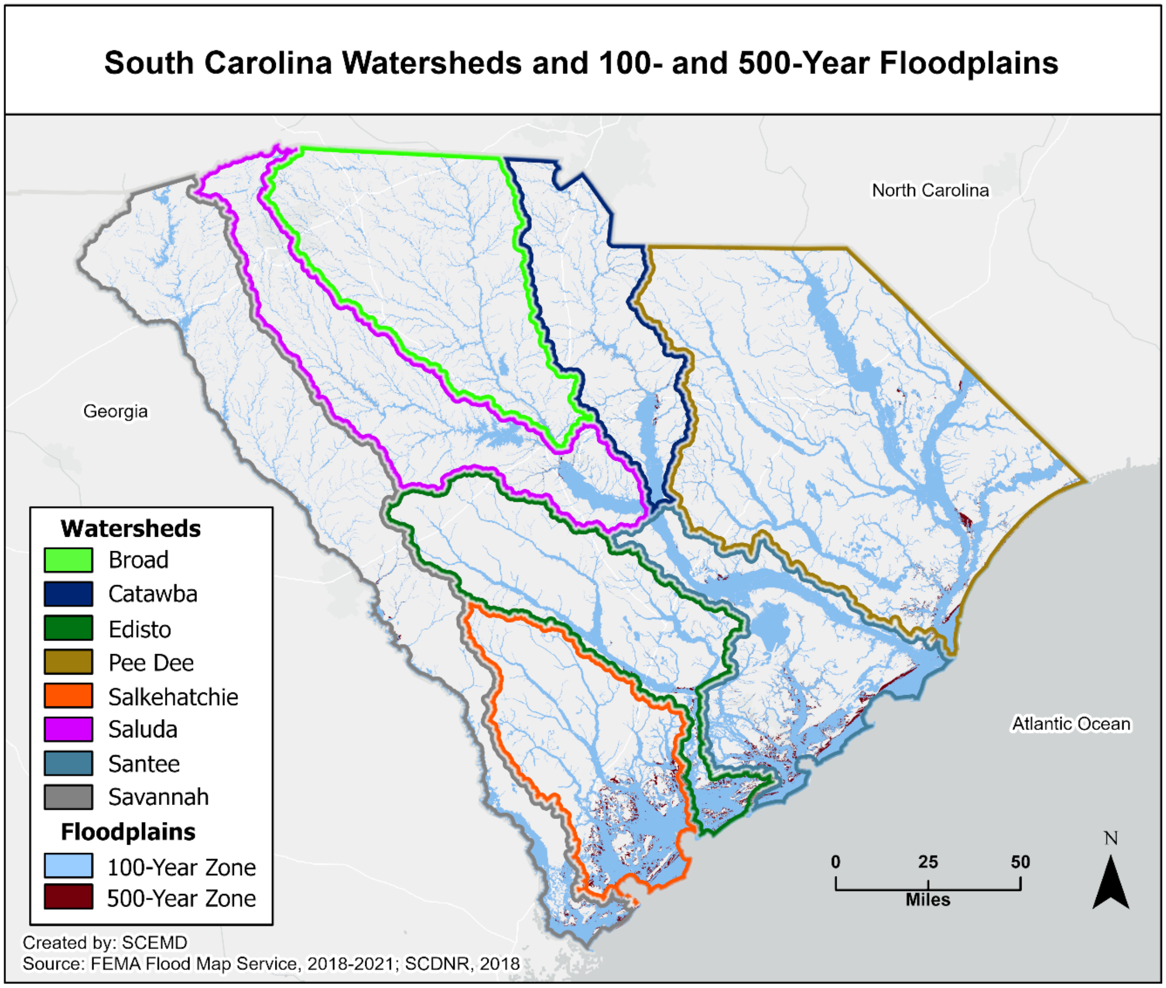


Figure 84: State 100- and 500-year flood zones

(Figures below are subsections of this figure divided by basin)

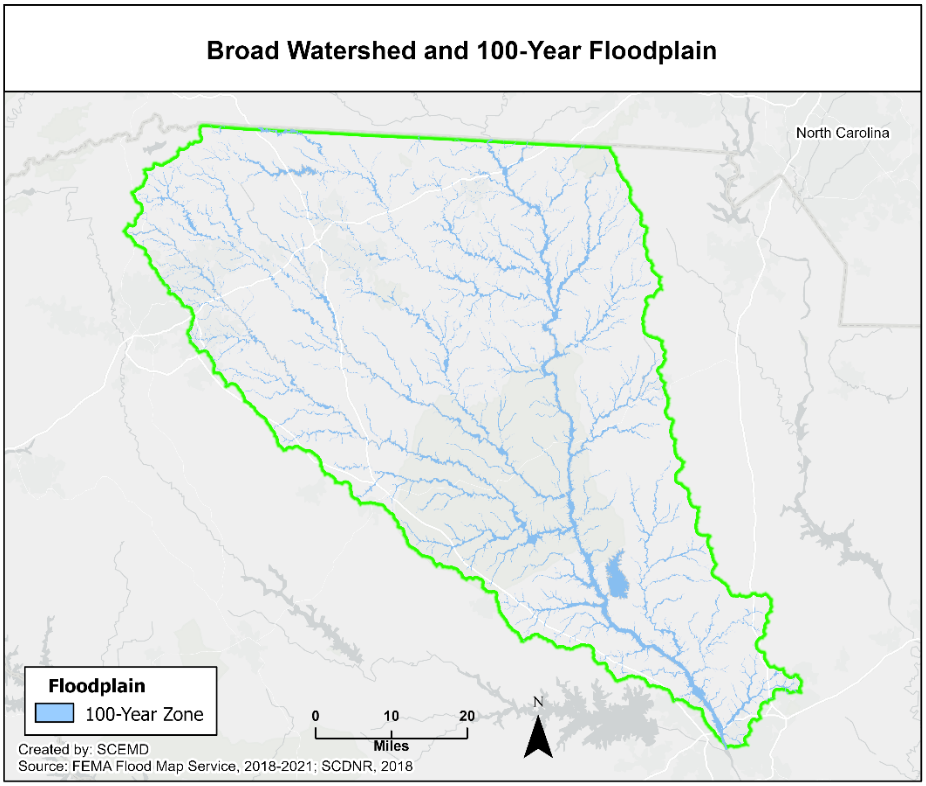


Figure 85: Broad Watershed -year Floodplain

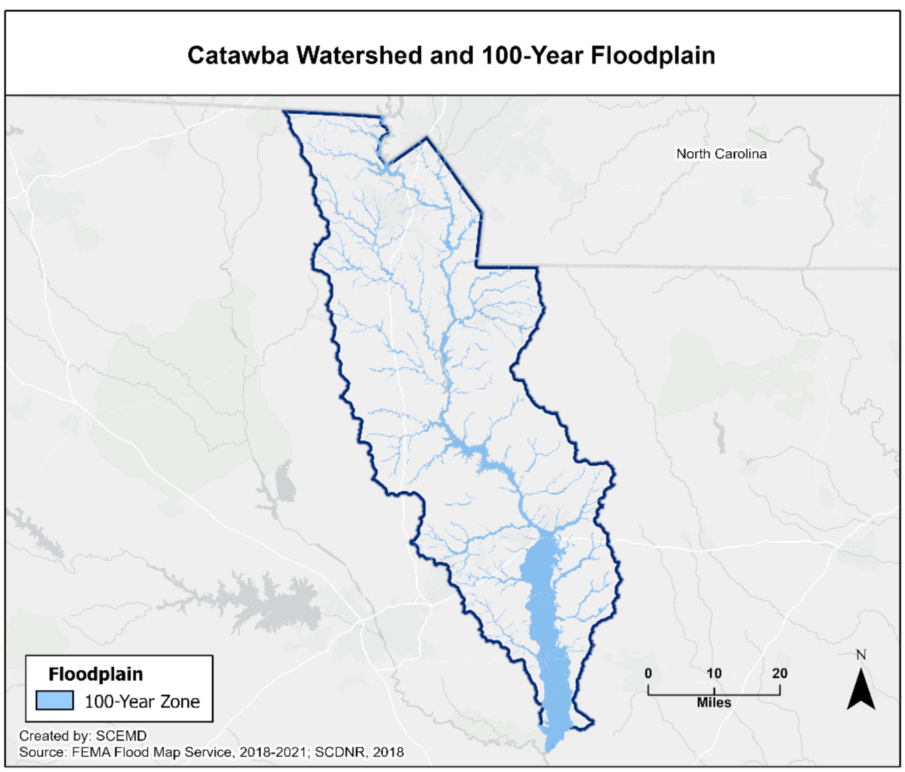


Figure 86: Catawba Watershed 100-year Floodplain

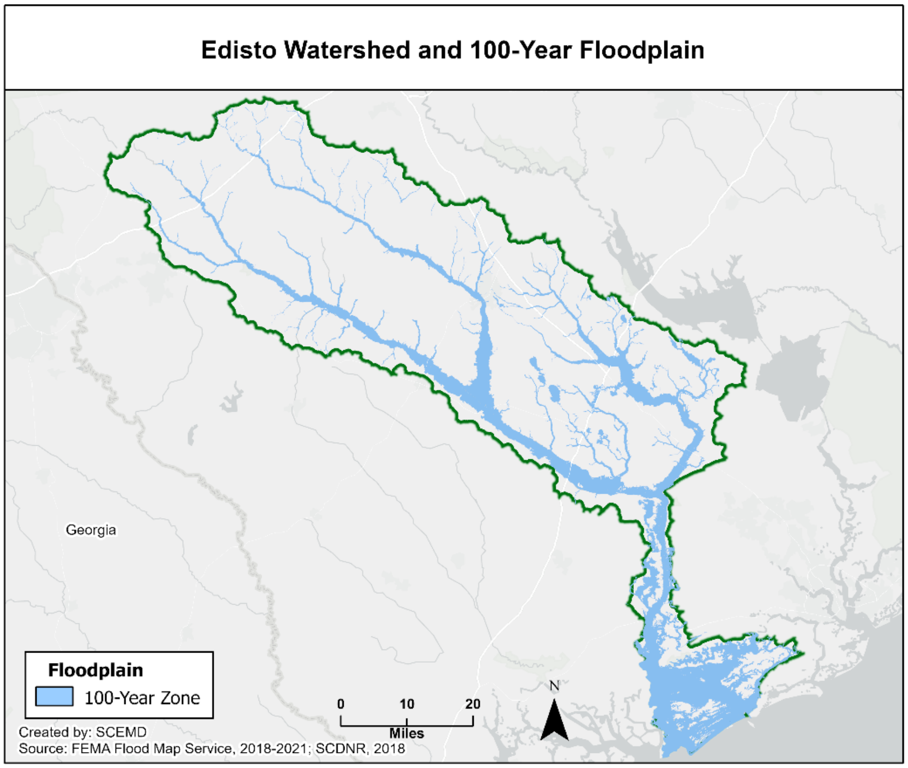


Figure 87: Edisto Watershed 100-year Floodplain

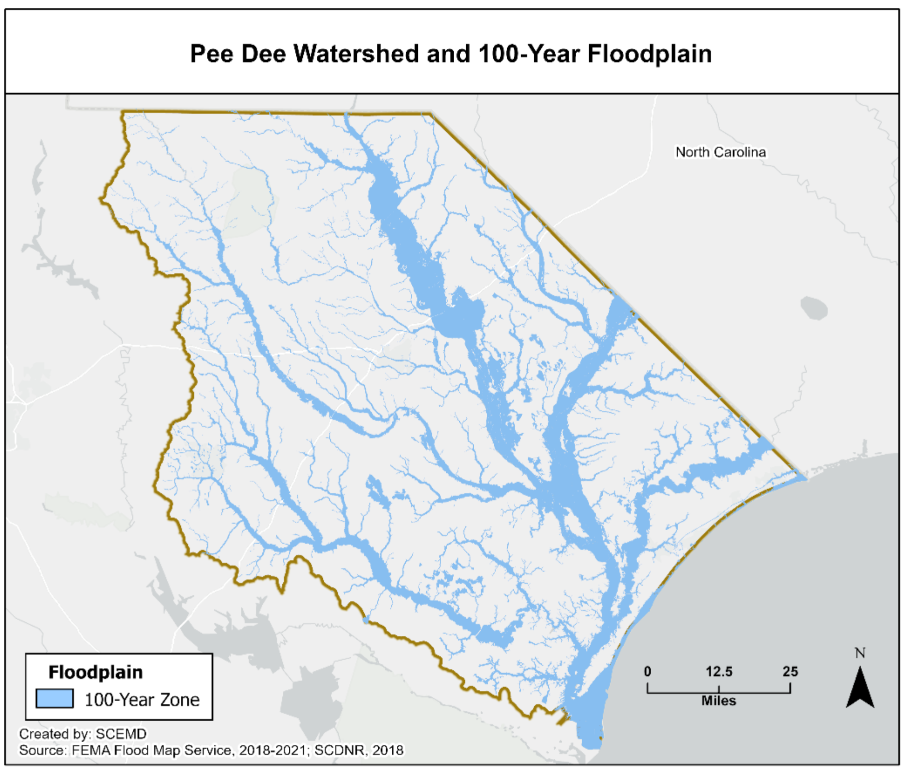


Figure 88: PeeDee Watershed 100-year Floodplain

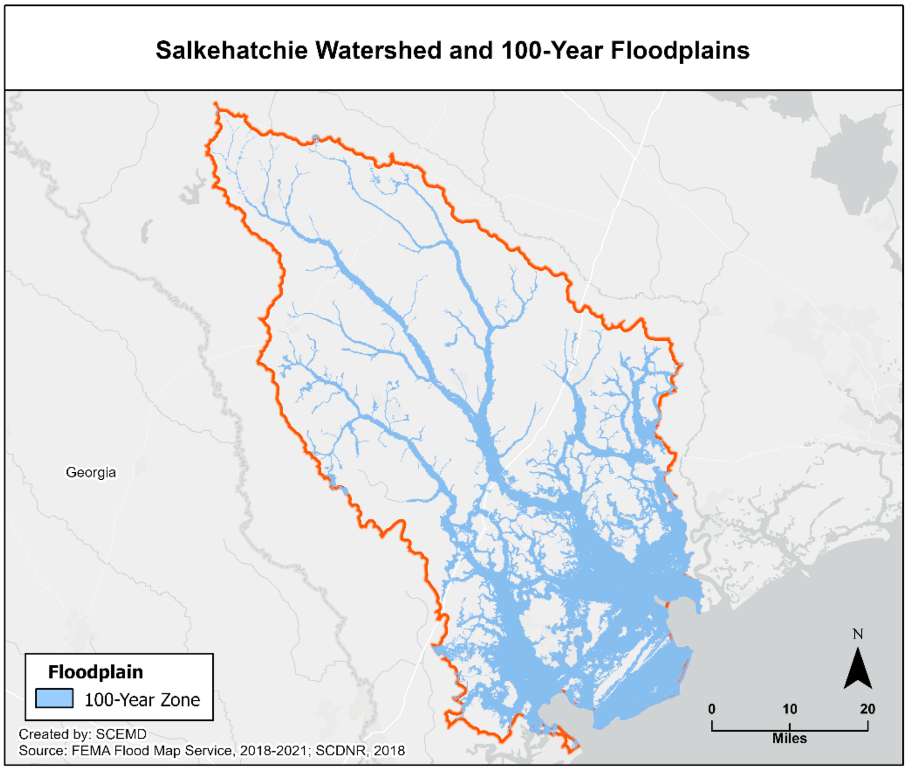


Figure 89: Salkehatchie Watershed 100 Year Flood Plain

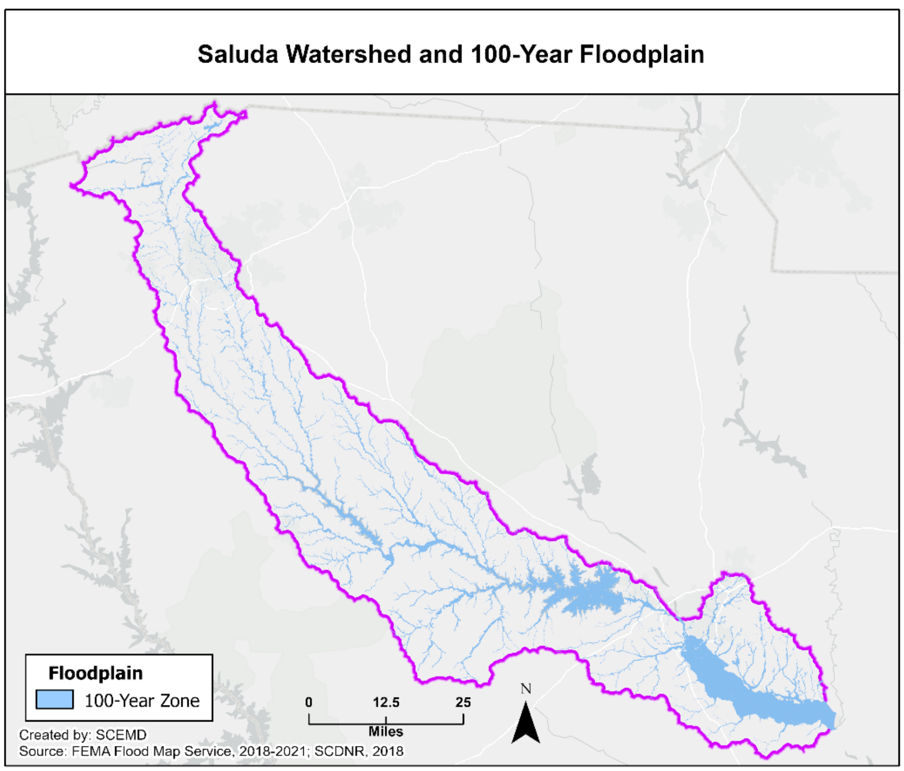


Figure 90: Saluda Watershed 100 Year Flood Plain

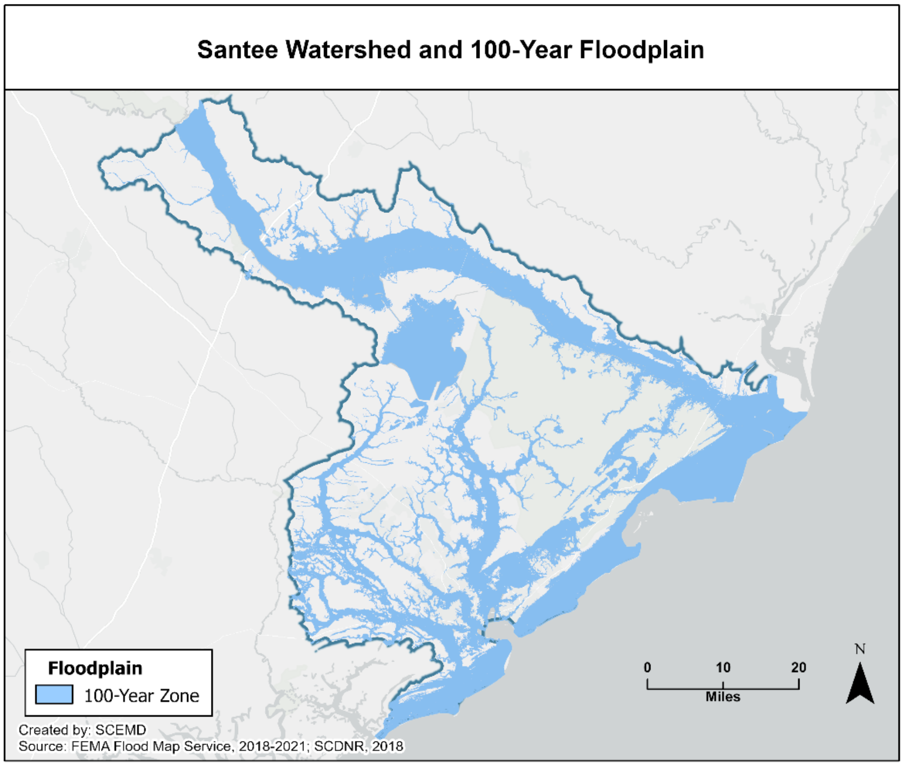


Figure 91: Santee Watershed 100 Year Flood plain

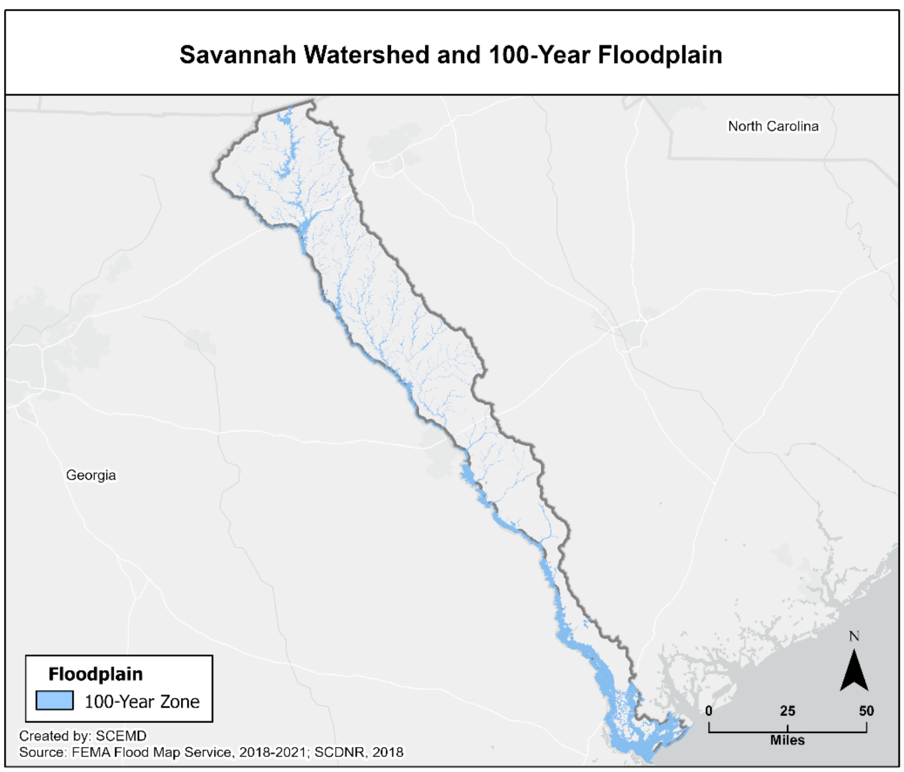


Figure 92: Savannah Watershed 100 Year Floodplain

County	Hazard Occurrence (1996-2020)		County	Hazard Occurrence (1996-2020)	
	Future Annual Probability (% chance per year)	Frequency Interval (Years between event)		Future Annual Probability (% chance per year)	Frequency Interval (Years between event)
Abbeville	52	1.92	Greenwood	80	1.25
Aiken	44	2.27	Hampton	32	3.13
Allendale	16	6.25	Horry	180	0.56
Anderson	188	0.53	Jasper	40	2.50
Bamberg	28	3.57	Kershaw	52	1.92
Barnwell	32	3.13	Lancaster	76	1.32
Beaufort	104	0.96	Laurens	108	0.93
Berkeley	176	0.57	Lee	12	8.33
Calhoun	24	4.17	Lexington	136	0.74
Charleston	384	0.26	Marion	60	1.67
Cherokee	48	2.08	Marlboro	28	3.57
Chester	48	2.08	McCormick	16	6.25
Chesterfield	84	1.19	Newberry	28	3.57
Clarendon	44	2.27	Oconee	100	1.00
Colleton	56	1.79	Orangeburg	68	1.47
Darlington	64	1.56	Pickens	140	0.71
Dillon	20	5.00	Richland	360	0.28
Dorchester	136	0.74	Saluda	20	5.00
Edgefield	12	8.33	Spartanburg	236	0.42
Fairfield	16	6.25	Sumter	44	2.27
Florence	92	1.09	Union	56	1.79
Georgetown	108	0.93	Williamsburg	40	2.50
Greenville	388	0.26	York	128	0.78
Grand Total					
State Average				91	2.4

Table 47 Flood Occurrences

Vulnerability

As described above, residents and infrastructure in all parts of the state are vulnerable to harm or damage from flood incidents. Flood risk by county is depicted in the figure below.

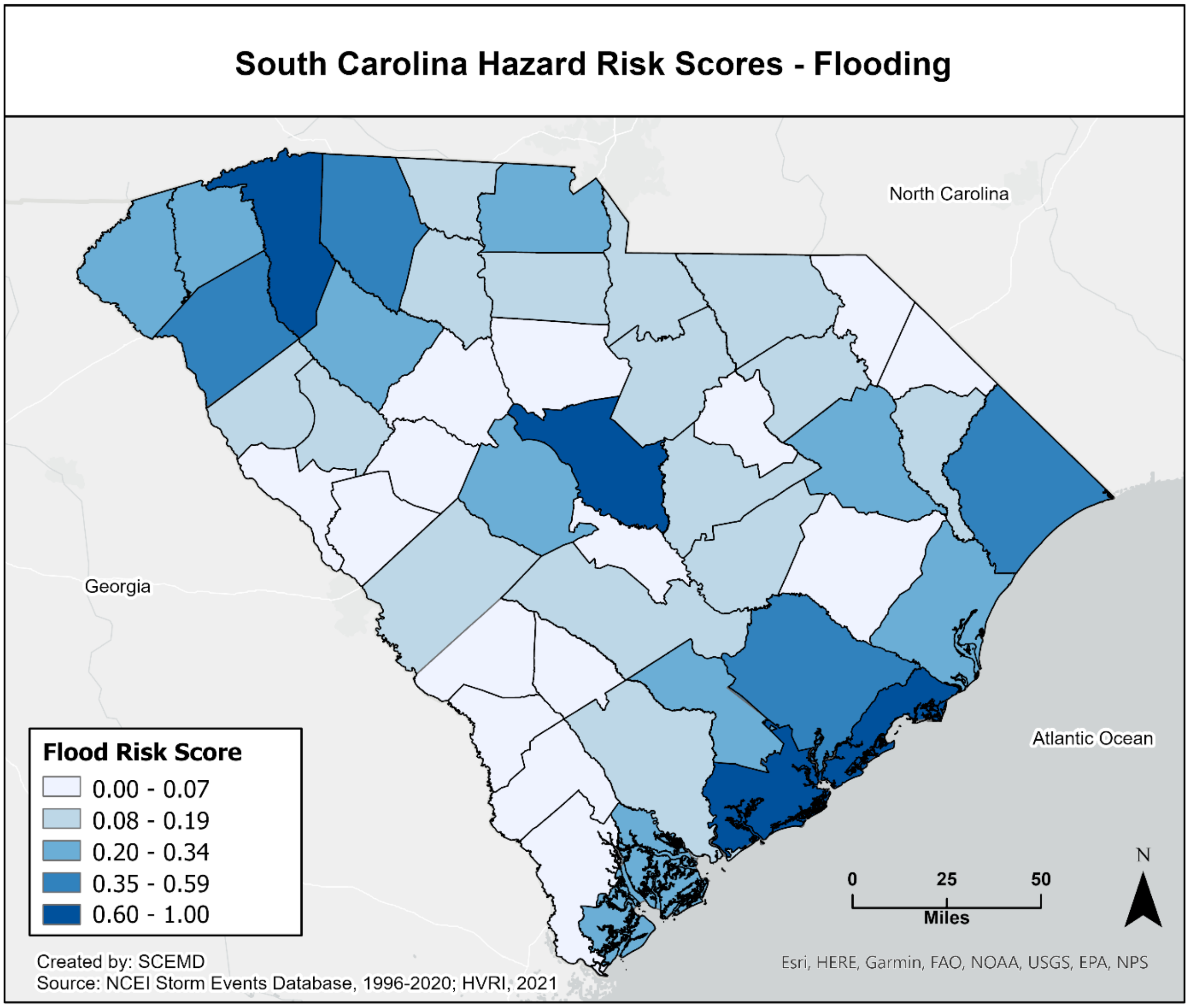


Figure 93: Flood Risk Score by County

Demographic factors can impact residents' vulnerability to harm and damage from flood events based on a range of reasons from affordability of property in flood-prone areas and historic patterns of residential development, to challenges for low-income residents in affording flood insurance, to communication and transportation barriers that reduce ability to evacuate quickly. Of the included 1,303 census tracts, 124 fall within the combined highest levels of social vulnerability and highest risk scores (dark blue). These high-high areas are concentrated in eight counties including areas of Anderson, Berkeley, Charleston, Greenville, Horry, Pickens, Richland, and Spartanburg counties.

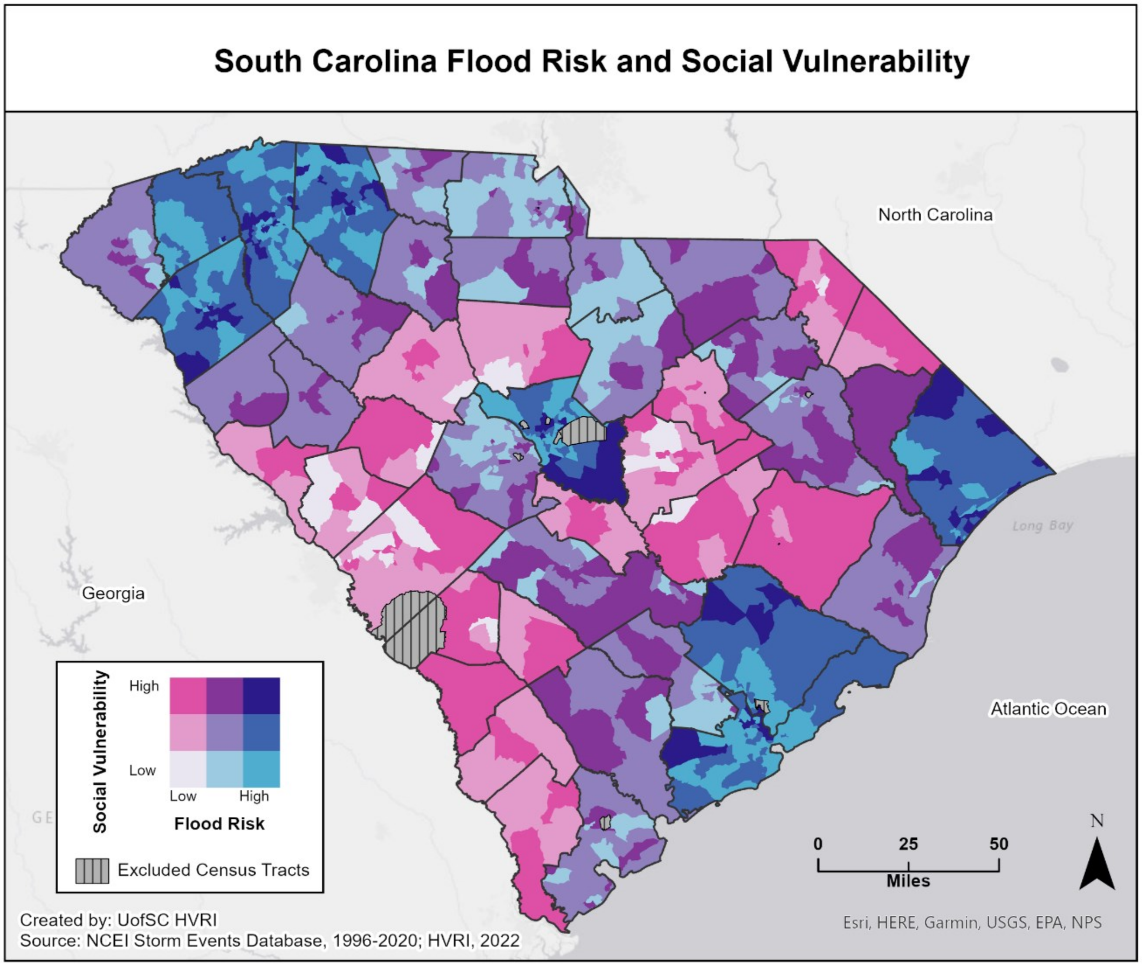


Figure 94: South Carolina Social Vulnerability and Flood Risk

Repetitive Loss Properties

Another way to gauge flood hazard risk is to identify and analyze the number of properties that have filed multiple flood insurance claims. Properties that meet this criterion are typically referred to as repetitive loss properties. Severe repetitive loss properities are properties that have had more than four separate incidents. (FEMA, 2009) For planning purposes, information on repetitive loss properties in the state has been researched and information is available for each county. To provide a frame of reference for this study, the Federal Emergency Management Agency's Repetitive Loss Properties Strategy was used. The annualized losses table provides a summary of these target properties within the state by jurisdiction, including, the number of claims, the dollar amount of cumulative losses paid for claims, the number of repetitive loss properties. Local officials maintain specific property information for repetitive loss properties.

Five counties - Beaufort, Charleston, Dorchester, Georgetown, and Horry - share approximately 60% percent of the total repetitive loss properties. Horry County has the largest number of repetitive loss properties; Georgetown County has the highest average claim payment. The City of Charleston has the 1893 losses from 633 properties. For severe repetitive loss properties, the City of Charleston has the greatest number of losses with 316 losses from 66 properties.

FEMA is responsible for the administration of the Repetitive and Severe Repetitive Loss program. Local communities must have an approved mitigation plan to be eligible for the grant. Local hazard mitigation plans must meet guidance requirements, specifically element B4 addressing 44 CFR 201.6(c)(2)(ii). Local governments apply directly to SCDNR for FMA grants.

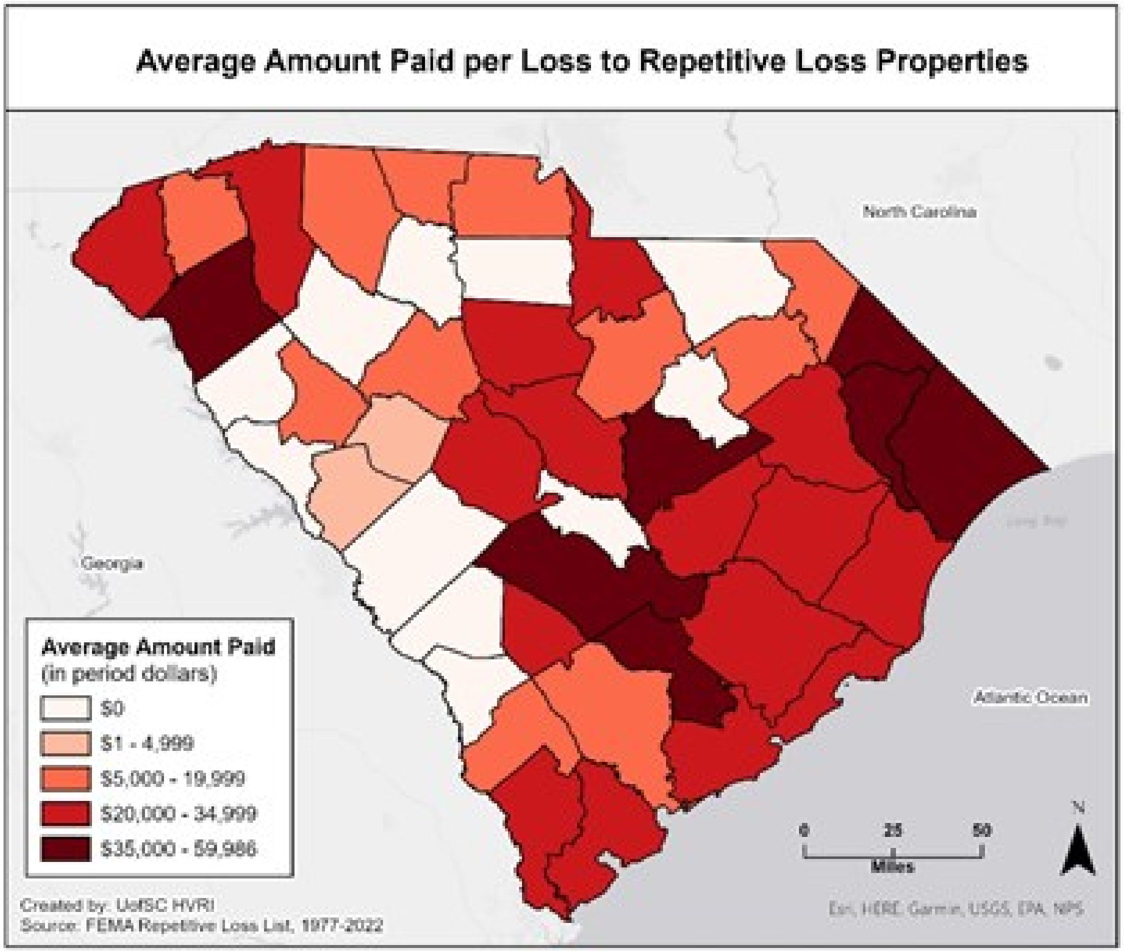


Figure 95: Average Amount Paid per Loss to Repetitive Loss Properties

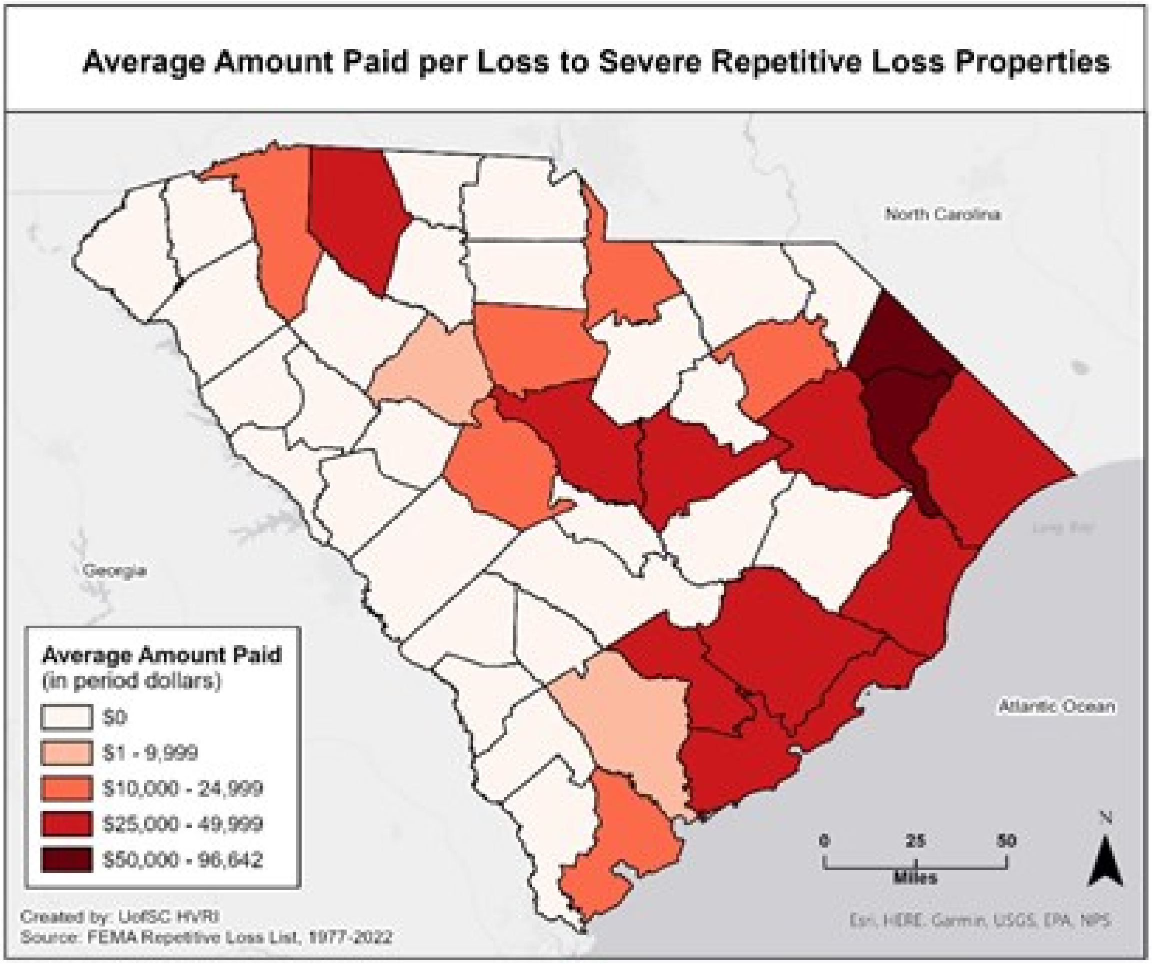


Figure 96: Average Annual Paid Per Loss to Severe Repetitive Loss Properties

Community Name	Number of Properties	Number of Losses	Total Building Payments	Total Contents Payments	Total Paid	Average Paid per Loss
Anderson County (Uninc.)	1	3	$62,251	$4,975	$67,226	$22,409
Anderson	1	3	$72,953	$2,709	$75,662	$25,221
Bamberg County (Uninc.)	1	2	$47,483	$10,700	$58,183	$29,092
Bamberg	1	2	$20,691	$4,090	$24,781	$12,391
Beaufort County (Uninc.)	240	524	$13,474,054	$1,848,279	$15,322,333	$29,241
Beaufort	21	45	$1,245,280	$174,812	$1,420,092	$31,558

Community Name	Number of Properties	Number of Losses	Total Building Payments	Total Contents Payments	Total Paid	Average Paid per Loss
Hilton Head Island	134	310	$8,393,571	$1,224,759	$9,618,330	$31,027
Berkeley County (Uninc.)	17	41	$1,071,088	$278,654	$1,349,742	$32,921
Goose Creek	5	10	$160,620	$55,886	$216,506	$21,651
Hanahan	37	112	$2,065,464	$186,091	$2,251,554	$20,103
Moncks Corner	3	10	$99,990	$0	$99,990	$9,999
Charleston County (Uninc.)	223	633	$13,233,957	$1,423,447	$14,657,405	$23,155
Awendaw	1	2	$48,342	$47,646	$95,988	$47,994
Charleston	716	2,185	$63,626,362	$6,797,869	$70,424,231	$32,231
Folly Beach	59	186	$3,196,967	$423,519	$3,620,486	$19,465
Hollywood	4	8	$88,490	$5,618	$94,108	$11,764
Isle of Palms	45	122	$2,975,177	$584,035	$3,559,212	$29,174
James Island	8	22	$330,655	$37,230	$367,885	$16,722
Kiawah Island	10	24	$205,872	$0	$205,872	$8,578
McClellanville	2	4	$152,250	$57,400	$209,650	$52,413
Meggett	2	4	$53,919	$21,288	$75,207	$18,802
Mount Pleasant	53	152	$2,093,005	$286,728	$2,379,733	$15,656
North Charleston	82	225	$6,496,538	$1,525,945	$8,022,483	$35,655
Seabrook Island	11	27	$339,952	$1,144	$341,095	$12,633
Sullivans Island	27	71	$1,325,041	$218,911	$1,543,952	$21,746
Cherokee County (Uninc.)	1	2	$27,152	$0	$27,152	$13,576
Clarendon County (Uninc.)	3	6	$109,376	$13,632	$123,008	$20,501
Colleton County (Uninc.)	13	29	$236,682	$39,706	$276,388	$9,531
Edisto Beach	53	138	$1,617,815	$103,450	$1,721,265	$12,473
Walterboro	1	2	$10,036	$1,857	$11,893	$5,946
Darlington County (Uninc.)	10	27	$326,897	$49,210	$376,107	$13,930
Darlington	6	21	$398,528	$92,693	$491,221	$23,391
Hartsville	3	6	$60,981	$0	$60,981	$10,163
Dillon County (Uninc.)	9	19	$1,071,364	$246,038	$1,317,402	$69,337
Dillon	2	4	$229,511	$32,837	$262,348	$65,587

Community Name	Number of Properties	Number of Losses	Total Building Payments	Total Contents Payments	Total Paid	Average Paid per Loss
Latta	4	8	$214,847	$34,786	$249,633	$31,204
Dorchester County (Uninc.)	52	131	$4,346,285	$869,502	$5,215,787	$39,815
Summerville	13	30	$916,110	$184,984	$1,101,094	$36,703
Edgefield County (Uninc.)	1	2	$5,353	$0	$5,353	$2,676
Fairfield County (Uninc.)	6	19	$422,991	$66,620	$489,611	$25,769
Florence County (Uninc.)	45	115	$2,218,632	$353,233	$2,571,864	$22,364
Florence	9	20	$393,073	$36,952	$430,025	$21,501
Lake City	1	2	$7,841	$0	$7,841	$3,920
Georgetown County (Uninc.)	312	759	$20,871,933	$3,711,156	$24,583,089	$32,389
Andrews	1	2	$22,581	$0	$22,581	$11,290
Georgetown	35	121	$3,844,182	$1,090,460	$4,934,642	$40,782
Pawleys Island	60	177	$4,668,884	$672,035	$5,340,918	$30,175
Greenville County (Uninc.)	55	159	$2,322,352	$530,653	$2,853,005	$17,943
Greenville	8	31	$305,232	$694,934	$1,000,166	$32,263
Mauldin	13	50	$905,122	$155,183	$1,060,306	$21,206
Simpsonville	2	6	$78,499	$26,498	$104,997	$17,500
Greenwood County (Uninc.)	-	-	-	-	-	-
Greenwood	1	2	$28,386	$9,138	$37,524	$18,762
Hampton County (Uninc.)	-	-	-	-	-	-
Hampton	2	4	$34,517	$11,620	$46,137	$11,534
Horry County (Uninc.)	557	1,647	$66,702,221	$13,338,175	$80,040,396	$48,598
Conway	65	177	$9,513,593	$1,660,118	$11,173,711	$63,128
Grand Strand Flood District	2	4	$28,618	$10,818	$39,436	$9,859
Loris	9	20	$541,037	$27,310	$568,347	$28,417
Myrtle Beach	83	230	$7,090,403	$1,919,182	$9,009,586	$39,172
North Myrtle Beach	321	894	$15,595,718	$3,490,586	$19,086,304	$21,349
Surfside Beach	37	101	$2,652,501	$308,415	$2,960,916	$29,316

Community Name	Number of Properties	Number of Losses	Total Building Payments	Total Contents Payments	Total Paid	Average Paid per Loss
Waccamaw Neck Flood District	1	2	$4,318	$3,041	$7,359	$3,680
Jasper County (Uninc.)	11	23	$567,350	$89,297	$656,647	$28,550
Hardeeville	2	4	$19,805	$9,320	$29,124	$7,281
Ridgeland	2	4	$208,635	$103,096	$311,731	$77,933
Kershaw County (Uninc.)	6	12	$139,913	$668	$140,581	$11,715
Lancaster County (Uninc.)	3	12	$285,306	$18,459	$303,766	$25,314
Lexington County (Uninc.)	22	53	$1,433,886	$124,700	$1,558,586	$29,407
Cayce	3	7	$534,048	$125,460	$659,508	$94,215
Springdale	1	4	$7,544	$0	$7,544	$1,886
Batesburg-Leesville	1	2	$9,178	$0	$9,178	$4,589
Marion County (Uninc.)	54	125	$6,040,625	$902,479	$6,943,105	$55,545
Marion	7	15	$240,410	$3,874	$244,283	$16,286
Mullins	2	6	$142,475	$31,036	$173,511	$28,919
Nichols	9	19	$1,094,754	$252,059	$1,346,813	$70,885
Sellers	1	3	$139,207	$33,449	$172,656	$57,552
Marlboro County (Uninc.)	1	2	$12,036	$0	$12,036	$6,018
Bennettsville	1	2	$19,128	$0	$19,128	$9,564
Newberry County (Uninc.)	1	2	$4,834	$0	$4,834	$2,417
Newberry	2	11	$53,234	$29,133	$82,367	$7,488
Oconee County (Uninc.)	1	2	$34,786	$9,100	$43,886	$21,943
Orangeburg County (Uninc.)	4	9	$247,756	$91,484	$339,240	$37,693
Holly Hill	2	4	$222,469	$69,762	$292,231	$73,058
Orangeburg	2	4	$80,457	$12,000	$92,457	$23,114
Pickens County (Uninc.)	1	5	$58,868	$10,139	$69,007	$13,801
Easley	2	5	$112,740	$522	$113,262	$22,652

Community Name	Number of Properties	Number of Losses	Total Building Payments	Total Contents Payments	Total Paid	Average Paid per Loss
Richland County (Uninc.)	20	44	$752,633	$149,600	$902,233	$20,505
Columbia	29	82	$1,780,268	$364,355	$2,144,623	$26,154
Forest Acres	11	28	$639,187	$58,932	$698,119	$24,933
Irmo	3	7	$95,341	$3,459	$98,800	$14,114
Saluda County (Uninc.)	1	2	$5,925	$2,689	$8,614	$4,307
Spartanburg County (Uninc.)	6	15	$242,381	$41,353	$283,734	$18,916
Spartanburg	3	11	$104,882	$4,256	$109,138	$9,922
Sumter County (Uninc.)	4	12	$297,329	$40,828	$338,157	$28,180
Sumter	8	16	$944,740	$63,649	$1,008,388	$63,024
Williamsburg County (Uninc.)	5	11	$232,082	$99,703	$331,785	$30,162
Kingstree	4	11	$271,234	$6,149	$277,383	$25,217
York County (Uninc.)	2	6	$94,870	$6,245	$101,115	$16,852
Rock Hill	1	2	$20,490	$0	$20,490	$10,245
Grand Total	3,738	10,276	$285,894,348	$47,763,810	$333,658,159	$32,470

Table 48 Severe Repetitive Loss Properties

Community Name	Number of Properties	Number of Losses	Total Building Payments	Total Contents Payments	Total Paid	Average Paid per Loss
Beaufort County (Uninc.)	6	32	$449,253	$67,881	$517,133	$16,160
Beaufort	1	2	$158,206	$37,133	$195,340	$97,670
Hilton Head Island	6	29	$610,794	$113,978	$724,771	$24,992
Berkeley County (Uninc.)	1	4	$71,111	$19,953	$91,064	$22,766
Hanahan	4	23	$551,502	$58,901	$610,404	$26,539
Charleston County (Uninc.)	27	134	$3,614,888	$381,163	$3,996,050	$29,821
Charleston	104	495	$18,202,805	$2,019,270	$20,222,075	$40,853
Folly Beach	7	41	$729,486	$125,269	$854,755	$20,848
Isle of Palms	7	23	$663,912	$74,765	$738,676	$32,116

Community Name	Number of Properties	Number of Losses	Total Building Payments	Total Contents Payments	Total Paid	Average Paid per Loss
Kiawah Island	1	4	$57,855	$0	$57,855	$14,464
Mount Pleasant	4	24	$292,298	$32,845	$325,143	$13,548
North Charleston	13	65	$2,293,275	$180,249	$2,473,524	$38,054
Sullivans Island	1	1	$14,908	$0	$14,908	$14,908
Colleton County (Uninc.)	-	-	-	-	-	-
Edisto Beach	1	9	$44,125	$5,984	$50,109	$5,568
Darlington County (Uninc.)	2	9	$122,104	$35,915	$158,019	$17,558
Darlington	1	4	$90,375	$0	$90,375	$22,594
Dillon County (Uninc.)	1	3	$156,965	$79,993	$236,958	$78,986
Dillon	1	2	$173,005	$30,790	$203,795	$101,898
Dorchester County (Uninc.)	4	17	$542,044	$153,418	$695,462	$40,910
Fairfield County (Uninc.)	1	4	$90,254	$0	$90,254	$22,563
Florence County (Uninc.)	3	12	$489,381	$70,244	$559,625	$46,635
Georgetown County (Uninc.)	16	69	$2,673,787	$509,812	$3,183,599	$46,139
Georgetown	10	51	$1,718,987	$334,040	$2,053,028	$40,255
Pawleys Island	5	23	$679,555	$191,157	$870,711	$37,857
Greenville County (Uninc.)	5	32	$308,463	$112,065	$420,528	$13,141
Greenville	1	11	$0	$120,900	$120,900	$10,991
Mauldin	6	31	$577,637	$106,776	$684,413	$22,078
Horry County (Uninc.)	124	575	$25,233,167	$6,343,648	$31,576,815	$54,916
Conway	11	39	$2,195,743	$256,985	$2,452,728	$62,890
Myrtle Beach	6	30	$664,414	$341,839	$1,006,254	$33,542
North Myrtle Beach	31	162	$3,408,462	$1,762,144	$5,170,606	$31,917
Surfside Beach	2	11	$522,051	$23,896	$545,946	$49,631
Lancaster County (Uninc.)	1	8	$138,165	$15,282	$153,447	$19,181
Lexington County (Uninc.)	1	8	$157,260	$3,454	$160,714	$20,089

Community Name	Number of Properties	Number of Losses	Total Building Payments	Total Contents Payments	Total Paid	Average Paid per Loss
Marion County (Uninc.)	11	29	$2,333,362	$448,696	$2,782,059	$95,933
Nichols	1	3	$241,927	$68,556	$310,483	$103,494
Newberry County (Uninc.)	-	-	-	-	-	-
Newberry	1	8	$41,989	$28,272	$70,261	$8,783
Richland County (Uninc.)	-	-	-	-	-	-
Columbia	2	9	$163,561	$67,540	$231,101	$25,678
Forest Acres	1	4	$115,457	$0	$115,457	$28,864
Spartanburg County (Uninc.)	2	7	$221,062	$26,300	$247,362	$35,337
Spartanburg	1	5	$62,878	$4,256	$67,133	$13,427
Sumter County (Uninc.)	1	4	$107,177	$32,069	$139,246	$34,811
Grand Total	435	2056	$70,983,649	$14,285,434	$85,269,084	$41,473

Table 49 Repetitive Loss Properties

Impacts

Statewide, flood events resulted in a total of $482 million in damage through the historical period (1960-2020) and $221 million in the recent period (2015-2020). Total annualized monetary losses for the historical period (61 years) averaged $171,869 statewide per county, while the recent period (6 years) averaged $800,633 because many counties had large loss-causing events. The counties with the highest annualized monetary losses in the historical period are Charleston ($650,579), Horry ($633,208), and Orangeburg ($608,649) counties. The counties with the highest recent annualized monetary losses are Orangeburg ($5,838,014), Richland ($5,654,824), and Horry ($3,559,883) counties. Throughout the historical period, a statewide total of 56 fatalities and 76 injuries occurred because of flood events.

County	Historical Events (1960-2020)			Recent Impact (2015-2020)		
	Annualized Losses	Deaths	Injuries	Annualized Losses	Deaths	Injuries
Abbeville	$73,778	0	0	$2,304	0	0
Aiken	$39,624	1	0	$4,737	0	0
Allendale	$39,212	0	0	$0	0	0
Anderson	$80,982	0	1	$167,202	0	0
Bamberg	$21,230	0	0	$894	0	0
Barnwell	$22,748	0	0	$35	0	0
Beaufort	$422,629	0	0	$1,667	0	0
Berkeley	$118,973	1	0	$849,627	0	0

County	Historical Events (1960-2020)			Recent Impact (2015-2020)		
	Annualized Losses	Deaths	Injuries	Annualized Losses	Deaths	Injuries
Calhoun	$224,630	0	0	$1,984,105	0	0
Charleston	$650,579	1	3	$3,390,077	0	0
Cherokee	$93,329	1	1	$16,835	0	0
Chester	$24,077	0	1	$8,333	0	0
Chesterfield	$12,754	0	0	$4,143	0	0
Clarendon	$340,001	1	0	$3,169,691	0	0
Colleton	$331,818	0	0	$374,329	0	0
Darlington	$54,297	0	0	$242,506	0	0
Dillon	$63,263	0	0	$459,343	0	0
Dorchester	$157,706	0	1	$1,238,875	0	0
Edgefield	$23,371	0	0	$6,900	0	0
Fairfield	$37,222	0	0	$185,056	0	0
Florence	$335,070	2	0	$2,421,287	2	0
Georgetown	$105,176	2	1	$351,660	1	0
Greenville	$472,036	4	9	$378,526	0	0
Greenwood	$62,466	1	0	$81,229	0	0
Hampton	$39,790	2	0	$0	0	0
Horry	$633,208	4	0	$3,559,883	3	0
Jasper	$214,595	0	0	$6,166	0	0
Kershaw	$48,502	5	2	$3,686	1	2
Lancaster	$31,458	1	5	$12,589	1	0
Laurens	$134,413	1	0	$2,765	0	0
Lee	$29,764	0	0	$333	0	0
Lexington	$377,881	1	4	$3,444,396	0	0
Marion	$46,238	1	0	$314,489	0	0
Marlboro	$28,671	1	0	$137,557	0	0
McCormick	$10,165	0	0	$1,843	0	0
Newberry	$44,063	2	1	$48,844	0	0
Oconee	$115,907	1	3	$77,227	0	0
Orangeburg	$608,649	1	0	$5,838,014	0	0
Pickens	$297,881	6	6	$335,432	0	0
Richland	$607,195	9	33	$5,654,824	9	32
Saluda	$19,341	0	0	$6,696	0	0
Spartanburg	$441,817	5	5	$205,159	1	1
Sumter	$30,760	0	0	$7,993	0	0
Union	$62,644	1	0	$0	0	0
Williamsburg	$221,846	1	0	$1,799,864	0	0

County	Historical Events (1960-2020)			Recent Impact (2015-2020)		
	Annualized Losses	Deaths	Injuries	Annualized Losses	Deaths	Injuries
York	$54,193	0	0	$32,015	0	0
Grand Total	$7,905,952	56	76	$36,829,136	18	35
State Average	$171,869	1	2	$800,633	< 1	< 1

Table 50 Flood Impacts and Annualized Losses

Based on previous significant occurrences in the state, flooding can cause extreme impacts to community lifelines such as food, water, and shelter, health and medical, safety and security, and transportation. Table *51* identifies potential impacts based on a significant flood event.

Community Lifeline	**Level of Impact**	**Description of Impacts**	**Area of Impact**
Communications	Medium	Telecommunications and broadband equipment could be damaged if located in areas inundated by floodwater, which could result in disruption of communications.	Regional
Energy	Medium	Fuel stations and energy transmission equipment/substations in inundated areas may be damaged or inoperable. Energy disruptions could affect supply chains and have cascading impacts in other lifeline sectors.	Regional
Food, Water, Shelter	High	Evacuations and displacement because of high water and/or residential damage from floodwaters could require emergency shelter. Water treatment infrastructure could be negatively impacted by intrusion of stormwater or contaminated water, resulting in disruption of water supplies and/or wastewater systems. Food supplies may be depleted in areas isolated by floodwaters for an extended period. Crops and animal stock could see damage from high water and extended duration flooding.	Localized or regional
Hazardous Materials	Medium	Floodwater inundation may result in release of hazardous materials because of damage to storage equipment or accidents in transport, causing public health and environmental risks. Damage could result in loss of material, causing economic loss.	Localized
Health and Medical	High	Medical facilities in the hazard area may see flood damage to structures and equipment as well as reduced accessibility. Access issues and transportation disruptions may result in delays	Regional

Community Lifeline	Level of Impact	Description of Impacts	Area of Impact
		in deliveries of supplies, in staffing shortages, and in patient movement. Injuries associated with flooding could result in increased patient numbers.	
Safety and Security	High	Response personnel in the affected area will have challenges accessing inundated areas and may see increased safety risks from high-water conditions and water-borne debris. Need for search and rescue operations may stress available resources and increase risk to responders. Operational facilities may be damaged or inaccessible because of floodwaters.	Regional; possibly statewide
Transportation	High	Roadways, bridges, railroads, and port/airport facilities in and near flooded areas may see hazardous conditions, damage, and disruptions in service. Damage and inaccessibility may create broader disruptions in transportation and supply chains.	Localized or regional

Table 51 *Potential Community Lifeline Impacts Based on Significant Flood Scenario*

Historical and Notable Events

Historical and recent occurrence data is derived from NCEI's Storm Event Database unless stated otherwise. Loss-causing data is derived from SHELDUS V.20.0. For more information regarding data sources and methodology, see Appendix B.

June 6, 1903 (Flash and Riverine Flooding): The greatest number of people killed by floodwaters in one South Carolina flood event occurred on the Pacolet River in Spartanburg County. Floods were reportedly 20 feet above normal stage in some areas. Six textile mills in Pacolet and Clifton were destroyed, 70 homes and businesses were decimated, and reports of 50-80 people lost their lives (NOAA, NCEI, 2022).

September 21–24, 1928 (Coastal and Riverine Flooding): Severe flooding caused by a hurricane was reported statewide, with rainfall totals ranging from 10 to 12 inches. Many bridges were destroyed, and roads and railways were impassable. Property losses reached an estimated $4 to $6 million.

October 3, 1994 (Coastal and Flash Flooding): Record-breaking rainstorms, with unofficially recorded rainfall exceeding 13 inches within 24-hour period in Beaufort County, impacted the South Carolina coast. Heaviest flooding was reported on Hilton Head Island. Floodwaters covered many streets, damaged more than 147 homes, six government buildings, 36 businesses and at least 45 cars. Approximately 37 roads washed out or were damaged. Based on current cost estimations, $1,466,073 in property damages was reported.

O***ctober 13, 1994 (Coastal and Flash Flooding):*** Bands of heavy precipitation produced four to ten inches of rain along the South Carolina coast, causing varying degrees of flash flooding in 40 counties. Flash flooding caused $2,932,000 in property damages and $11,720 in crop damages, based on current dollar estimations. The heaviest rainfall and the worst flooding occurred in Charleston, southern Colleton County, Beaufort County and southern Jasper County. Coastal flooding caused $36,651,824 in property damages and $73,260 in crop damages based on current dollar estimates.

August 24–31, 1995 (Flooding and Flash Flood): Remnants of Tropical Storm Jerry dumped an initial three to five inches of rain. As additional bands moved across the state, flash flooding developed in various areas and roads became flooded and impassable. At least six bridges were destroyed in Laurens County, several small dams broken, and three fatalities. The current total cost estimates for the damages caused by this extended flood event equal $18,717,472.

August 14–15, 1998 (Flash Flood): A flash flood in Spartanburg County rapidly developed after four to five inches of rainfall, which fell during a very short time period. Property damages of $3,145,092, based on current cost estimates, were reported. For a second consecutive night, on August 15, a flash flood occurred in Spartanburg County causing additional property damages of $629,018.

March 20, 2003 (Flash Flood): Heavy rainfall caused floods that contributed to $1.3 million in property damage in Greenville, and over $1.0 million in Spartanburg. The flooding was significant in Berea, Taylors, and Mauldin. In Berea, some residents had to be rescued via canoe from their homes (NCDC Storm Data Reports Online).

July 29, 2004 (Flash Flood): In Greenville, $3.5 million in property damage was caused by a nearly stationary thunderstorm which produced four to nine inches of rainfall in approximately four hours resulting in major flooding in areas from Berea to downtown Greenville. The Reedy River crested at 19.2 feet in downtown Greenville, the second highest level on record (NCDC Storm Data reports Online, 2006). At least 30 homes were condemned (NCDC Storm Data Reports, 2006).

July 22, 2009 (Flash Flood): Torrential downpours caused flash flooding in east central Lexington and west central Richland. Three to five inches of rain fell within one to three hours and water levels was recorded to be nearly twelve feet at the gage on Rocky Branch Creek (Main and Whaley Streets). Several people had to be rescued from their vehicles. Flooding extended to the USC campus and Five Points in Columbia. Property damage was estimated to be at $300,000.

January 25, 2010 (Flash and Urban Flooding): Widespread and heavy rain produced between two and four inches of rain across the Upstate. Flash flooding developed because the ground was already saturated. Widespread flooding was observed across eastern York County and severe urban flooding required the rescue of five motorists. Property damage was estimated to be at $120,000.

September 25, 2011 (Flash Flood): Scattered thunderstorms around Richland County produced heavy rain of one to three inches within an hour. Wind also took down trees and power lines, and there were widespread reports of flooding and road closures through Columbia. Property damage is estimated to be at $104,000.

October 1 – 05, 2015 (Flash and Riverine Flooding): A stalled cold front pulled moisture from nearby Hurricane Joaquin. Record breaking rainfall caused extreme riverine flooding across large areas of the state. Accumulations reached as high as 26.88 inches. Flash flood emergencies were issued for several counties. 51 dams across the state were breached or collapsed. Several rivers reached major flood stage. 19 fatalities were confirmed as a result of the flooding. Property damage was estimated to be at least $75,000,000. Emergency orders were issued for 75 dams, and 192 additional dams were identified as needing inspection and potential repairs (NOAA, NCEI, 2022).

August 1, 2016 (Flash Flood): Thunderstorms swept southeast into the Midlands and the Central Savannah River Area, meeting up with development along a sea breeze front pushing northwest up into the Southern Midlands. Strong low-level convergence and upper-level support focused heavy rain and damaging wind through the region in the early to mid-evening hours. SCHP reported Garner's Ferry Road at I-77 flooded and impassable. Property damage was estimated at $1,000,000.

September 12, 2016 (Flash Flood): Scattered thunderstorms developed along a stalled front over the area. An isolated severe thunderstorm produced wind damage. These thunderstorms also produced locally heavy rain and flooding in Orangeburg County. The emergency manager estimates 40 structures were flooded, with 20 to 25 of them sustaining substantial damage. Property damage was estimated at $400,000.

October 8, 2016 (Flash and Riverine Flooding): Hurricane Matthew moved up the southeast coast and slowly weakened to a category 1 storm as it moved up along the South Carolina coast and then eastward near the North Carolina coast. The hurricane brought 6 to 12 inches of rain and up to 15 inches to some areas of northeast South Carolina, with the bulk of the rainfall occurring within a 12-hour period. The rain fell on wet and in some cases saturated soil because of above normal rainfall that September. The result was historic flooding, widespread flash flooding, and an extended period of river flooding. Approximately 25 dams breached, and 12 emergency order dams had severe storm damage42. Matthew's flooding rains, surge and wind brought loss of life, displaced tens of thousands of people, and caused hundreds of millions of dollars in structural damage as homes and businesses were devastated or destroyed. Major infrastructure will have to be repaired or rebuilt.

September 11, 2017 (Flash Flood): As part of the impacts from Hurricane Irma, Dorchester County Emergency Management reported that water entered at least 31 homes because of flash flooding along Eagle Creek. Of the 31 impacted structures, 18 had 12 inches or less of water, 10 had between 13 and 23 inches of water, and 3 had between 24 and 35 inches of water inside. Property damage was estimated at $575,000.

Recent Events 2018-2022

September 14, 2018 (Flash Flood): Hurricane Florence became a hurricane on September 4, 2018, as its path traveled straight for the South Carolina and North Carolina Coasts. The storm made landfall in Wrightsville Beach North Carolina flooding impacts form large amounts of rain ran downstream into South Carolina's counties along with the additional rain Florence initially brought to the state. Over 11,000 South Carolina residents were evacuated because of flooding. Of the residents that had not evacuated there were 129 technical water rescues and 1,063 water rescue evacuations. Before the state resumed to normal operations on October 1, 2018, there were a total of 9 confirmed Florence-related fatalities for the state. 55 homes were considered destroyed, 704 homes were with major damage, and 829 homes had minor damage.

February 5-7, 2020 (Flash Flood and Flood): Large-scale flash flooding was reported across Pickens County which was caused by 4 to 7 inches of rain fall (some higher amounts reported locally). Of that, more than half fell within a six-hour window from daybreak to late morning on the day of February 6. Impacts primarily effected the Twelve Mile Creek area which included most bridges within the area to be inundated with water. One home within the area was considered inhabitable after the event. The Saluda River also experienced flooding that led many homes in Pickens County to be inundated. One industrial park within the Pickens City limits had significant flooding damages, and two people on-site had to be rescued. Road closures were seen across counties and dozens were closed at the maximum flooding levels associated with this event. A flash flooding incident became concentrated throughout the Greenville metro area in the early evening hours. As magnitudes worsened moderate flooding began to occur along the reedy river as well as the main portion of the Saluda River which was identified as flash flooding. Flash flooding occurred on the Enoree River as well. This led to inundation of numerous roads and a few structures.

Future Climate Conditions and Sea Level Rise

Global warming has added to variability for flooding in different parts of the country. Overwhelmingly large dry periods have played a major role in the lack of available water in the western U.S. In the east, large flooding events are becoming more frequent because of major storms and longer wet periods. Flooding events are becoming larger generally because of the increase in intensity of precipitation events. Many farmers rely on flooding patterns to continue crop productions. Increased variability in flooding seasons adds to challenges in meeting agricultural production needed for large populations. Changes and variability within near and far future climates are expected to continue, and the adverse effects of this variability will continue to intensify unexpected changes in flooding patterns.

Coastal flooding also is seeing variability because of changes in sea level. Sea level rise has amplified the effects of coastal flooding as well as added to inconsistency in patterns associated with coastal flooding. Sea level rise will continue to play a major role in coastal flooding impacts. With the continuation of climate change effects, including rising sea levels, the adverse impacts of sea level rise on South Carolina's coast will cause more fluctuation in coastal flooding and potentially increase intensity and extent of impacts.

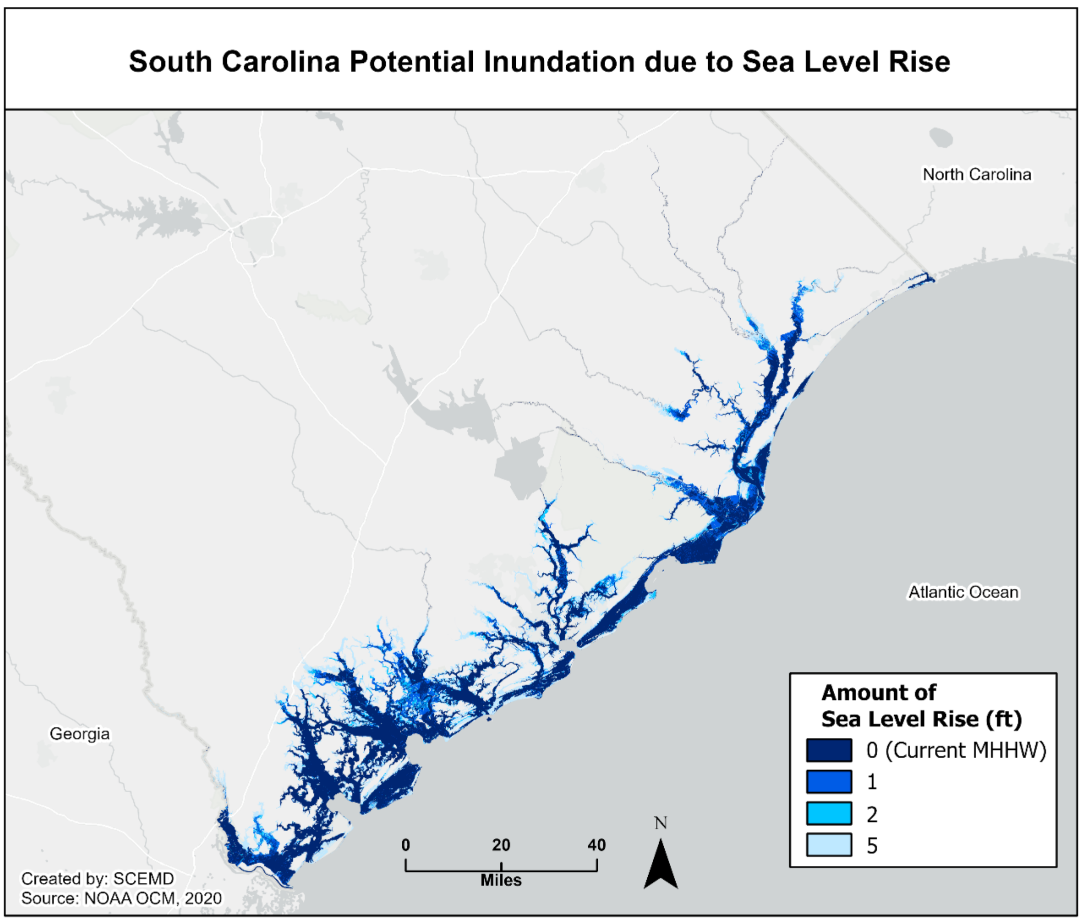


Figure 97: Potential Inundation of South Carolina Coast Because of Sea Level Rise.

L. Wildfire

According to the South Carolina Forestry Commission, any type of forest, grass, brush, or outdoor fire that is not controlled or managed is a wildfire. In South Carolina, the average number of fires per year is 3,000 and yearly average acreage burned is 18,000. Accounting for the size and population of the state, this is one of the highest rates in the United States. Fire danger season is highest in late winter and early spring. For South Carolina, the highest danger of fire is during the winter because of dead or dormant vegetation that can act as forest fuel as it aids the natural process for the environment to clear dead vegetation (Littell, 2016).

Formation

More than 80 percent of forest fires are started by negligent human behavior (campfires, smoking, debris burning, arson, fireworks). Two percent of wildfires in South Carolina are attributed to lightning. Wildfires are fueled by any material that can burn including dead leaves, grasses, branches and logs, and pine needles. Different variables including human behavior and weather can contribute to the potential for a wildfire to start or grow. Lack of humidity and wind can add to maximizing the potential for large-scale wildfire events and specifically affect fire spread and flammability (Littell, 2016).

Fire Cause	Number of Fires	Percentage of Fires	Acres Burned	Percentage of Acres Burned
Campfire	520	0.8%	16,294	3.8%
Children	3,413	5.2%	8,256	1.9%
Debris Burning	30,698	46.7%	182,639	42.8%
Equipment Use	4,528	6.9%	22,856	5.4%
Fireworks	134	0.2%	1,603	0.4%
Incendiary	15,307	23.3%	121,915	28.6%
Lightning	2,046	3.1%	25,882	6.1%
Power Line	619	0.9%	2,847	0.7%
Railroad	575	0.9%	3,204	0.8%
Smoking	1,678	2.6%	7,664	1.8%
Structure	367	0.6%	825	0.2%
Miscellaneous	5,915	9.0%	32,690	7.7%
Total	65,800	100%	426,675	100%

Table 52 Fire Causes

Classification

There are three classes of wildfires: surface fire, ground fire, and crown fire. A surface fire is the most common of these three classes. These fires move slowly and burn along a forest floor. A ground fire (muck fire) is usually started by lightning or negligent human behavior and burns on or below the forest floor. Crown fires spread rapidly by wind and move quickly by jumping along the tops of trees.

Advisories

The National Weather Service issues outlooks for fire conditions and provides daily fire weather forecasts and warnings in coordination with local, state, and federal fire agencies (NOAA, n.d.):

- A red flag warning is issued when fire conditions are ongoing or expected to occur shortly.
- A fire weather watch occurs when upcoming weather conditions could result in extensive wildland fire occurrence or extreme fire behavior. A watch means critical fire weather conditions are possible but not imminent or occurring.

Extreme fire behavior implies a wildfire is likely to rage out of control. One of the following criteria has to be met:

- Moving fast with a high rate of spread
- Prolific crowning (the movement of fire through the crowns of trees or shrubs more or less independently of the surface fire) and/or spotting (behavior of a fire producing sparks or embers that are carried by the wind and start new fires beyond the zone of direct ignition by the main fire)
- Presence of fire whirls (spinning vortex column of ascending hot air and gases rising from a fire and carrying aloft smoke, debris, and flame. Fire whirls range in size from less than one foot to more than 500 feet in diameter. Large fire whirls have the intensity of a small tornado)
- Strong convection column

The most dangerous part of a fire is the head. Firefighters typically attack this part of the fire first since this is the most damaging.

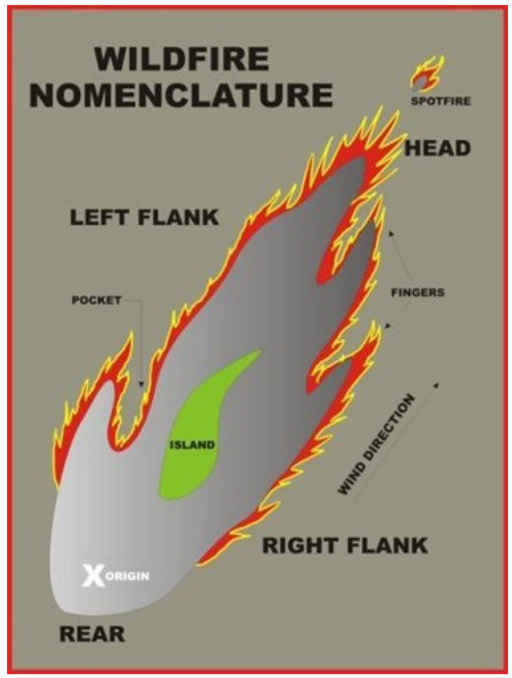


Figure 98: Wildfire Terms. Source: SC Forestry Commission

Location and Probability

The majority of wildfires are human-caused or from lightning strikes, Wildfires can occur anywhere in the state of South Carolina. The large-scale opportunities wildfires must have to spread far and wide within South Carolina suggests that all buildings and facilities are equally exposed to damages caused by this hazard. The statewide average future daily wildfire probability per county is 16% chance per day (or roughly seven events per day statewide). Williamsburg (49%), Berkeley (41%) and Orangeburg (40%) counties contain the highest daily probabilities of wildfire events. The average statewide daily frequency interval per county is 10, meaning that the expected wildfire event frequency is once every 10 days. A smaller frequency interval indicates a shorter period between wildfire events, with counties ranging from roughly one event every two days to one event every 22 days.

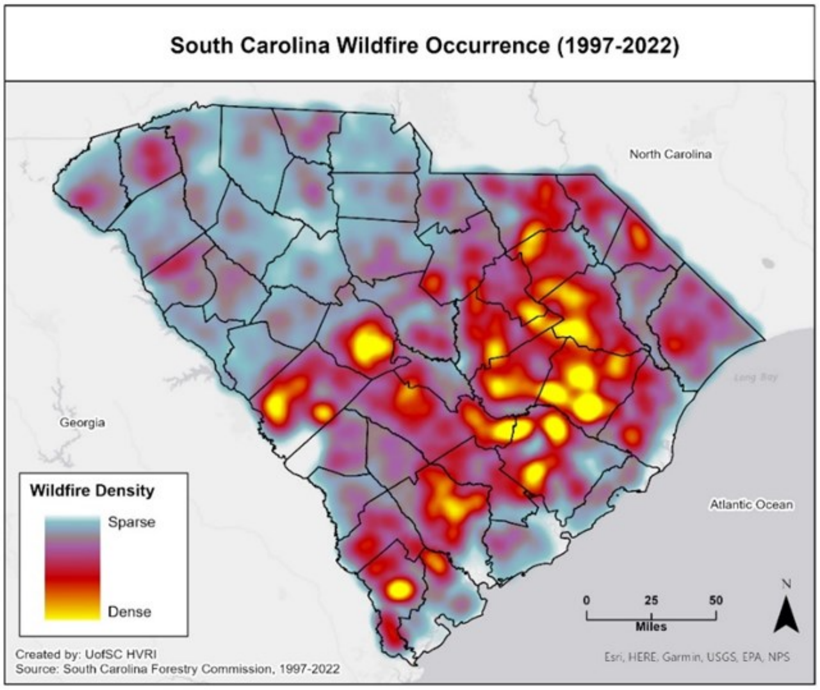


Figure 99: Wildfire Event Occurrence Density in South Carolina (1997-2022)

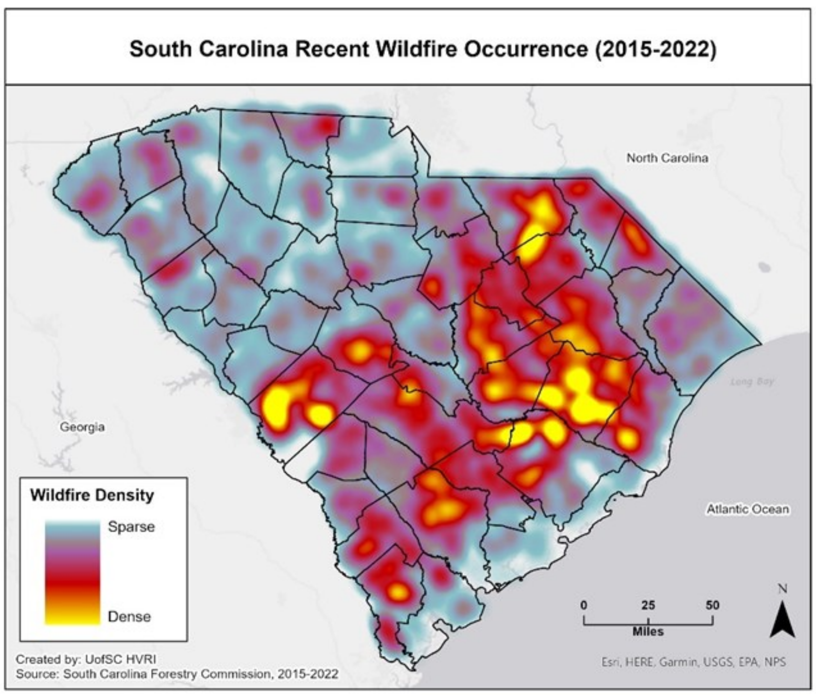


Figure 100: Wildfire Event Occurrence Density in South Carolina (2015-2022)

County	Hazard Occurrence (1997-2022)		County	Hazard Occurrence (1997-2022)	
	Future Daily Probability (% chance per Day)	Frequency Interval (Days between events)		Future Daily Probability (% chance per Day)	Frequency Interval (Days between events)
Abbeville	10	9.80	Greenwood	7	14.96
Aiken	35	2.89	Hampton	15	6.56
Allendale	5	20.23	Horry	27	3.66
Anderson	8	12.07	Jasper	22	4.53
Bamberg	7	13.89	Kershaw	19	5.18
Barnwell	8	12.80	Lancaster	8	12.09
Beaufort	11	9.52	Laurens	7	13.64
Berkeley	41	2.46	Lee	15	6.76
Calhoun	9	11.02	Lexington	28	3.62
Charleston	12	8.38	Marion	7	13.64
Cherokee	7	14.81	Marlboro	14	7.31
Chester	7	15.36	McCormick	5	21.83
Chesterfield	23	4.39	Newberry	5	19.29
Clarendon	26	3.82	Oconee	10	10.38
Colleton	32	3.10	Orangeburg	40	2.50
Darlington	22	4.50	Pickens	10	9.77
Dillon	13	7.92	Richland	13	7.96
Dorchester	16	6.44	Saluda	6	17.02
Edgefield	5	18.78	Spartanburg	8	12.15
Fairfield	10	9.78	Sumter	24	4.09
Florence	36	2.77	Union	6	17.65
Georgetown	19	5.24	Williamsburg	49	2.04
Greenville	9	10.85	York	6	16.90
State Average				16	9.7

Table 53 Wildfire Probability

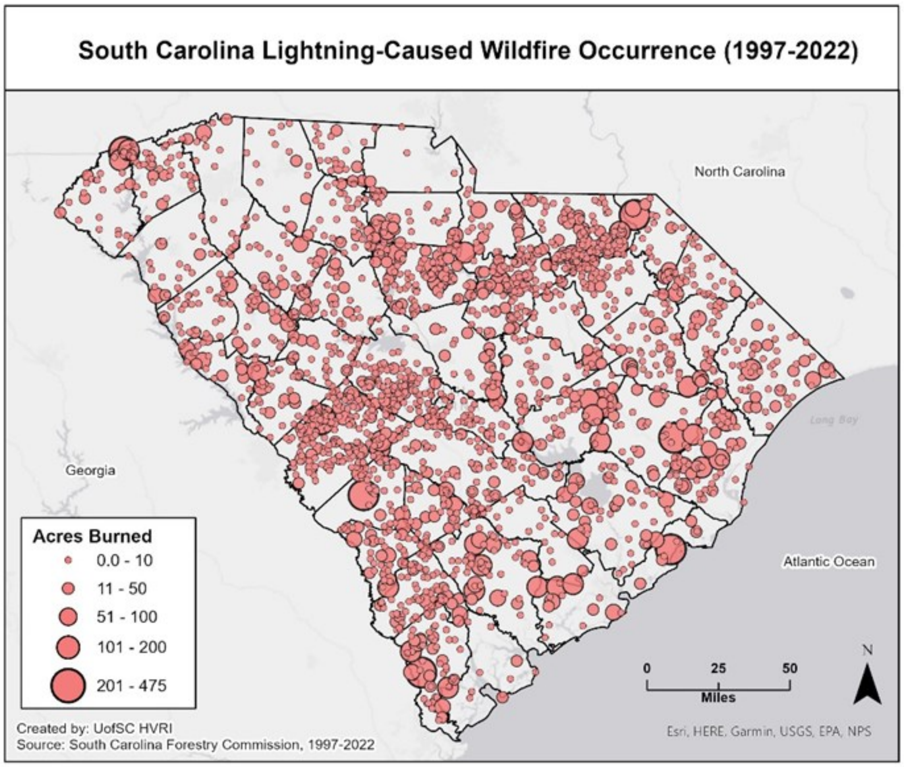


Figure 101: Wildfire Events Caused by Lightning in South Carolina by Burned Acreage (1997-2022)

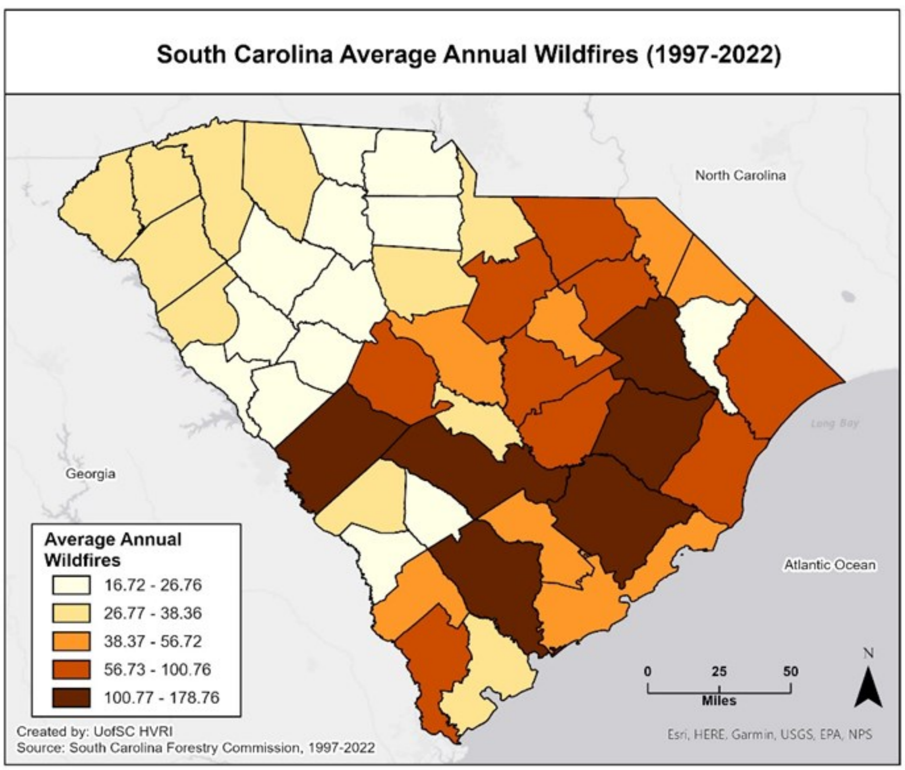


Figure 102: Average Annual Wildfires in South Carolina Counties (1997-2022)

Vulnerability

The statewide average wildfire risk score was 0.25 per county. Williamsburg County had the highest wildfire risk score (1), followed by Berkeley (.81) and Orangeburg (.80) counties. McCormick County received the lowest risk score (0), followed by Allendale (0.01) and Newberry (0.01) counties.

In terms of social vulnerability, of the included 1,303 census tracts, 135 fall within the combined highest levels of social vulnerability and highest risk scores (dark blue). These high-high areas are concentrated in 13 counties throughout the state, which include areas in Aiken, Berkeley, Chesterfield, Clarendon, Colleton, Darlington, Florence, Horry, Jasper, Lexington, Orangeburg, Sumter, and Williamsburg counties.

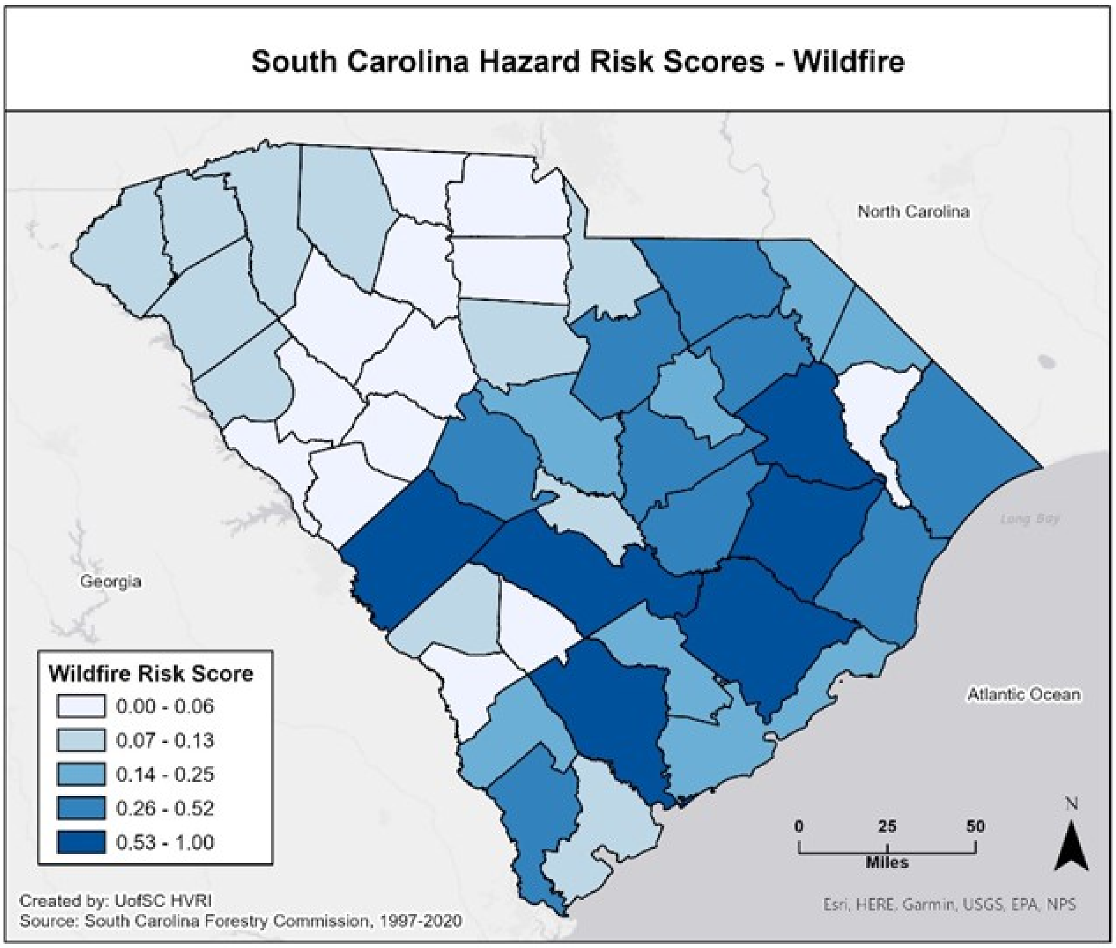


Figure 103: South Carolina Wildfire Risk Scores Per County

Fire vulnerability and risk can be reduced through public awareness about preventing fires and through measures to manage the fuel fire needs whether in natural areas or near structures.

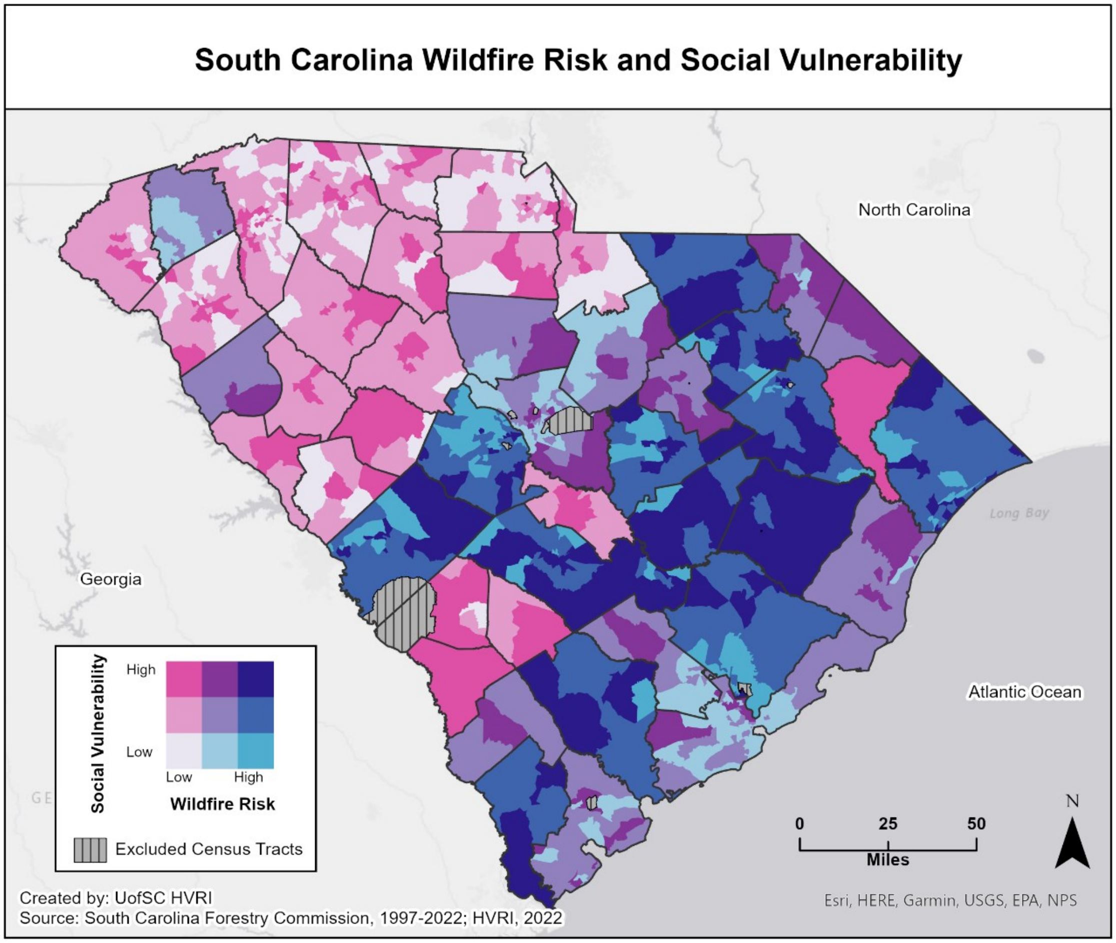


Figure 104: South Carolina Social Vulnerability and Wildfire Risk

Impacts

Wildfires can impact many key lifelines in South Carolina. Some of the largest impacts of wildfires include disrupting communication, transportation, power and gas services, and water supply and property destruction.

A significant wildfire can cause local and even regional impacts, though safety and security could see potential statewide impacts as seen in the community lifeline impacts table below.

Community Lifeline	Level of Impact	Description of Impacts	Area of Impact
Communications	Medium	A wildfire event could damage telecommunications and broadband equipment and systems, causing interruptions in service. Communications outages could negatively impact public sector information sharing platforms, 911/dispatch operations, and the finance sector. Additional communications outages are possible in extended power outages.	Localized or regional

Community Lifeline	Level of Impact	Description of Impacts	Area of Impact
Energy	Low	Power generation, transmission, and distribution facilities, equipment, and systems may be damaged by wildfire. Fuel storage facilities and stations may be damaged, closed, or inoperable. Pipelines may be damaged or operations altered to minimize risk.	Localized or regional
Food, Water, Shelter	Low	Wildland-interface fire could damage residential structures. Food supplies, including crops and livestock, could be damaged. Displaced citizens will need short- or long-term housing.	Localized
Hazardous Materials	Medium	Hazardous material storage or transport facilities and equipment could be damaged, releasing hazard materials. Damage to storage containers and transportation infrastructure could cause environmental-human, and animal health risks. Facilities and transport may alter operations or routes to minimize risk, which may delay supply chains or services. Wildfires may ignite fuel storage or transport facilities or equipment.	Localized and Regional
Health and Medical	Medium	Healthcare facilities in the immediate area may be damaged by wildfire or require evacuation of patients. Poor air quality may result in medical issues that increase the number of patients seeking emergency care. Facilities may be inaccessible or see delays in access based on fire location and smoke. Medical staff may have difficulty accessing areas of need because of wildfire or smoke.	Regional
Safety and Security	High	Evacuation of local communities near the wildfire may be required. Firefighting and other response and emergency management resources may be stressed by high demand for firefighting, coordination, logistics, communications, and evacuation support tasks. Personnel and equipment assigned to fight wildfire will be at increased risk of injury, health effects, and damage.	Regional
Transportation	Medium	Surface transportation routes may be closed, damaged, or inaccessible because of wildfire or smoke. Air transportation may be hindered and require grounding in immediate area or rerouting because of smoke.	Localized or regional

Table 54 Potential Community Lifeline Impacts Based on Significant Wildfire Scenario

Historical and Notable Events

All historical and recent occurrence data is derived from NCEI's Storm Event Database unless stated otherwise. Loss-causing data is derived from SHELDUS V.20.0. For more information regarding the methodology, please examine the hazard narrative methodology Appendix B.

March 30 – April 5, 1966: In what became the worst week in South Carolina wildfire history, this event had firefighters battling hundreds of fires, with ten major fires between 1,500-8,000 acres. The Gaston fire was already one of the many but by Friday, within an hour of early afternoon, almost one thousand acres of forest burned. The blaze lasted a day and a half, burning a total of 7,400 acres. The heat intensity of this fire is estimated to be eleven times that of a normal wildfire and it is speculated this wildfire spawned thunderstorms.

April 10-17, 1976: The largest forest fire in South Carolina, the Clear Pond Fire burned 30,000 acres in Horry County and was caused by an unattended campfire. Low relative humidity and winds pushed the fire to burn 11,000 acres by midnight on April 10, 1976. The fire was not contained until April 17. No homes were lost, and no fatalities or injuries occurred from this fire.

March 1985: The Red Fox Fire started on the morning of March 12, when a tree branch "ripped into a power line along Kershaw County's Highway 97". Winds estimated as high as 40 miles per hour caused this fire to burn out of control. Over two thousand acres burned, and eight homes were destroyed.

April 22-28, 2009: The Highway 31 Fire started near the city of Conway in Horry County. Dry and windy conditions allowed the fire to spread east and northeast. A state of emergency was declared for Horry County on April 23. A total of 19,600 acres were burned, 2,500 people evacuated, 76 homes destroyed, and 100 homes with fire damage. The fire was contained on April 28. The estimated total damage from this fire was at $40 million with $25 million attributed to structural damage and $15 million worth of damage to woodland loss. South Carolina received a Fire Management Assistance Grant for this fire.

March 22, 2011**:** Warm temperatures and low moisture set the conditions for a wildfire in Jasper County. The SC Forestry Commission reported a 125-acre fire, which damaged a home and a shed. Property damage estimates were given at $50,000.

March 24-25, 2011**:** In Dorchester County a 1,247-acre fire burned because of continued warm temperatures and low relative humidity. Around 60 to 70 homes were ordered to evacuate. The property damage estimates were at $500,000.

November 09, 2016: An extended period of abnormally dry weather and drought resulted in very dry vegetation across South Carolina's mountains and foothills in mid-autumn. This provided perfect conditions for the Pinnacle Mountain Fire to be ignited and spread during early November. According to the South Carolina Forestry Commission, the Pinnacle Mountain Fire burned 10,623 acres in the Table Rock State Park/Pinnacle Mountain area throughout the last three weeks of November resulting in approximately $5 million in damages. The fire was not completely contained until a cold front brought rain into the area at the end of the month. The Pinnacle Mountain Fire is the costliest, largest, and longest mountain fire in South Carolina history.

Recent Activity (2018 –2021)

May 26-31, 2019: Dry conditions, lack of precipitation, record heat, and wind led to wildfires in portions of the state. A controlled burn in Francis Marion National Forest (Charleston County) burned approximately 1,600 acres. A wildfire in Aiken County spread nearly 200 acres. From May 28-29, the fire closed a portion of Interstate 20 and led to an evacuation. No fatalities, injuries, or significant structural damage was reported as a result of the manmade event.

April 21, 2021: A wildfire in the city of Loris located in Horry County spread across Highway 9 leading to evacuations. Two structures were damaged. In Aiken County, a wildfire burned an estimated 90 acres leading to a voluntary evacuation.

County	Historical Impact (1960-2020)			Recent Impact (2015-2020)		
	Annualized Losses	Deaths	Injuries	Annualized Losses	Deaths	Injuries
Abbeville	$49	0	0	No recent loss-causing wildfire events have been recorded.		
Aiken	$5	0	0			
Allendale	$0	0	0			
Anderson	$0	0	0			
Bamberg	$0	0	0			
Barnwell	$0	0	0			
Beaufort	$0	0	0			
Berkeley	$0	0	0			
Calhoun	$0	0	0			
Charleston	$0	0	0			
Cherokee	$0	0	0			
Chester	$0	0	0			
Chesterfield	$0	0	0			
Clarendon	$0	0	0			
Colleton	$0	0	0			
Darlington	$0	0	0			
Dillon	$0	0	0			
Dorchester	$0	0	0			
Edgefield	$0	0	0			
Fairfield	$0	0	0			
Florence	$0	0	0			
Georgetown	$0	0	0			
Greenville	$0	0	0			
Greenwood	$0	0	0			
Hampton	$0	0	0			
Horry	$0	0	0			
Jasper	$0	0	0			
Kershaw	$0	0	0			

County	Historical Impact (1960-2020)			Recent Impact (2015-2020)		
	Annualized Losses	Deaths	Injuries	Annualized Losses	Deaths	Injuries
Lancaster	$0	0	0			
Laurens	$0	0	0			
Lee	$0	0	0			
Lexington	$0	0	0	No recent loss-causing wildfire events have been recorded.		
Marion	$0	0	0			
Marlboro	$0	0	0			
McCormick	$0	0	0			
Newberry	$0	0	0			
Oconee	$0	0	0			
Orangeburg	$0	0	0			
Pickens	$0	0	0			
Richland	$0	0	0			
Saluda	$0	0	0			
Spartanburg	$0	0	0			
Sumter	$0	0	0			
Union	$0	0	0			
Williamsburg	$0	0	0			
York	$0	0	0			
Grand Total	$54	0	0			
State Average	$30,627	< 1	< 1			

Table 55 Wildfire Annualized Losses

Future Climate Considerations

A combination of human and natural drivers will continue to influence the occurrence of wildfires. Indicators including increased high temperatures and changes in soil moisture, relative humidity, wind speed and vegetation suggest that wildfire occurrences may increase in the coming years. Drought conditions and wildfires are directly linked, as an increase in dry conditions increases the fire risk for an ecosystem (Littell, 2016). From a human perspective, management activities such as forest management through various burn and brush activities will attempt to counter wildfire events.

M. Earthquake

Earthquakes can affect hundreds of thousands of square miles, cause billions of dollars of property damage (primarily because of failure and collapse of structures from ground shaking), result in the loss of life and injury to thousands of people, and disrupt the social and economic functioning of the affected area. South Carolina experiences an average of 10 to 20 earthquakes magnitude 3 or less a year (SCDNR , 2022). Because of this low frequency of noticeable events, many people are unaware of earthquake risk. However, all 46 counties in the state are susceptible to effects of earthquakes. Most significant earthquake activity in the state has been in the Middleton Place-Summerville seismic zone, about 12 miles northwest of Charleston, which is historically the most active zone in South Carolina (SCDNR , 2022). A series or swarm of earthquakes in Kershaw County from late 2021 to 2022, with the strongest a magnitude 3.6, (SCDNR , 2022) increased attention to earthquake risk and preparedness in the state.

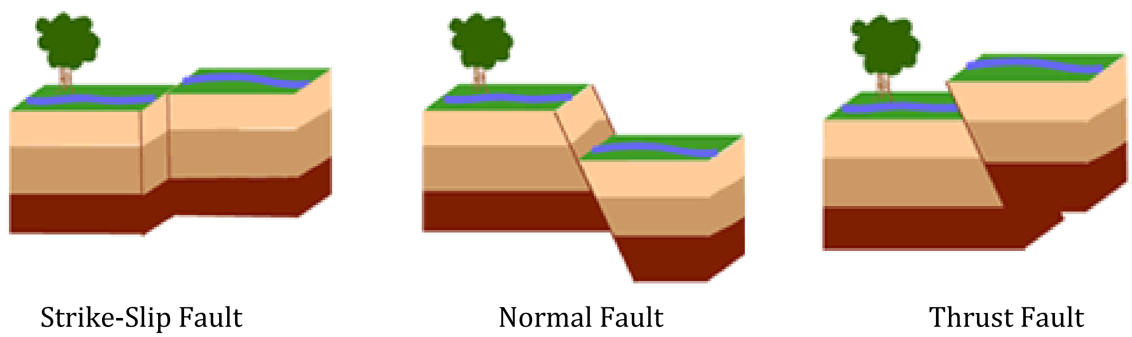


Figure 105: Types of Seismic Faults Classification. Source: USGS

Formation

Earthquakes are caused by the sudden movement of rock beneath the Earth's surface. Stress built up in the crust causes rocks near the surface to break and slip, and when this occurs, an earthquake results. The region along which the slip occurs at the Earth's surface is called a fault (USGS, n.d.). Earthquakes occur along faults, tectonic plate boundaries, and mid-oceanic ridges (underwater mountain ranges) (USGS, n.d.). Most earthquakes occur along tectonic plate boundaries, although that may not be the case in South Carolina. There are three types of faults Figure 105 : strike-slip (rock blocks move horizontally), normal (rock moves down relative to the other side), and thrust (rock moves up relative to the other side) (USGS, n.d.).

Within a fault plane, two main points of focus are used to describe the location, start, and cause of an earthquake. The point below the surface within the Earth's crust where an earthquake begins is called the hypocenter or focus, and the point directly above this depth on the Earth's surface is the epicenter, as shown in Figure 106.

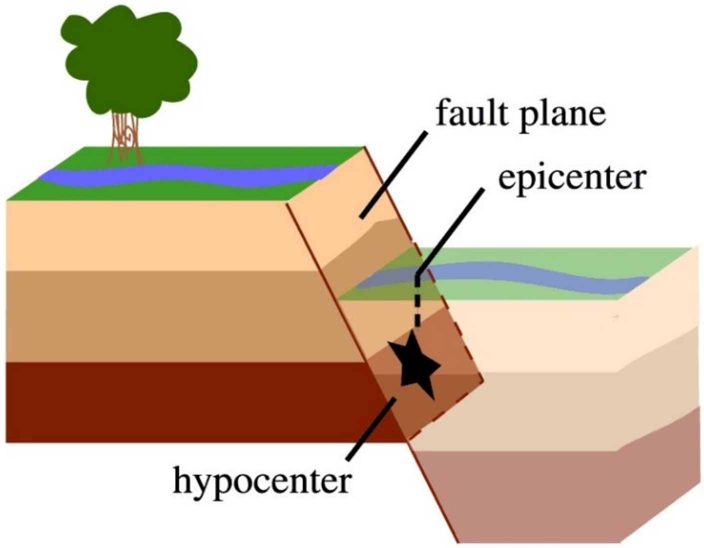


Figure 106: Anatomy of an Earthquake. Source: USGS

Ground motion produced at these points by the energy released from a sudden displacement of rock within the Earth's crust is detectable by seismographs (USGS, n.d.). Seismographs record ground movement through two different waves of energy, P (primary) and S (secondary) waves. P waves travel faster and reach the seismograph first, in a forward and backward motion parallel to the ground in the same direction the energy produced by the earthquake is moving. S waves travel perpendicular and have a considerably larger magnitude, moving forward and backward to the direction the wave of energy is moving (USGS, n.d.). Seismographs are essential in allowing scientists to determine the location of the earthquake epicenter via triangulation. Triangulation uses the intersection of the circle of distance of three seismographs that pickup movement from an earthquake occurrence to determine the exact location of an earthquake epicenter (USGS , n.d.).

Aftershocks are smaller earthquakes that can occur after the initial main shock and can cause considerable damage (USGS, n.d.). The area of land determined to have the maximum damage is known as the meizoseismal area (University of South Carolina, School of Earth Ocean and Environement, n.d.).

The level of damage depends on the amplitude and duration of the shaking, which are directly related to the earthquake size, distance from the fault, time of occurrence (greater fatalities tend to occur during weekday work hours when more people are in large office buildings or schools), site, and soil type (USGS, n.d.). Strength of shock waves diminish from the hypocenter/focus, so greater distance from the earthquake origin will decrease likelihood or extent of damage. Other damaging earthquake effects include landslides and liquefaction, in which ground soil loses the ability to resist shear and flows, much like quicksand. In the case of liquefaction, anything relying on the substrata for support can shift, tilt, rupture, or collapse. In urban areas, damage to electric and gas lines may lead to fire as a secondary impact. Earthquakes that trigger movement of the sea floor also may generate a tsunami.

Earthquakes are measured in terms of magnitude and intensity. Measuring magnitude can be difficult based on the geology of an area and the distance between points of measurement (seismographs) and frequencies. To provide a uniform approach to defining the magnitude of an earthquake, the moment magnitude scale is used as the standard practice of measurement (USGS Natural Hazards , n.d.). This scale focuses on the total amount of energy released during the movement, or slip, of a fault. This can be more accurately represented from seismograms and geodetic measurements and requires an equation to be performed that takes into account the physical quantity proportional to the slip on the fault multiplied by the area of the fault that slips.

Intensity is commonly measured using the Modified Mercalli Intensity (MMI) Scale based on direct and indirect measurements of seismic effects. The scale levels are described using roman numerals, with a I corresponding to imperceptible (instrumental) events, IV corresponding to moderate (felt by people awake), to XII for catastrophic (total destruction). A description of the Modified Mercalli Intensity Scale of earthquake intensity is shown in Table 56.

Scale	Description of Effects
I	Only detectable by instruments
II	Felt by some people, especially if on higher floors, some objects may swing
III	Felt indoors, feels like a truck rumbling by
IV	Felt indoors by many people, felt by some outdoors, dishes and doors may move
V	Felt by most people, some dishes and windows break, objects fall
VI	Felt by everyone, may move heavy furniture, slight damage
VII	Slight to moderate damage in ordinary-built structures, great damage in poorly built structures
VIII	Considerable damage in ordinary-built structures, chimneys, columns, walls fall
IX	Great damage, buildings may shift from foundation
X	Most masonry and frame structures collapse, rails bent
XI	Few buildings remain, bridges collapse and rails damaged
XII	Total destruction, lines of sight distorted

Table 56 Modified Mercalli Intensity Scale. Source: USGS

Location and Probability

Advances in technology allow more information to be gathered on earthquake intensity, time, exact location, and present and future effects. An Advanced National Seismic System (ANSS) monitor in Charleston measures seismic activity in that area because of the potential for a earthquake on a nearby fault. The University of South Carolina partners with ANSS to monitor seismic activity by operating multiple seismographs throughout the state. This information is used to help predict potential earthquake impact locations as well as identify the status of faults within South Carolina. Seismographs can provide early detection of seismic activity, although use of early warning systems within the U.S. is more prevalent in western states because of more common and severe earthquakes. The USGS can provide earthquake notifications to cell phones when an earthquake is detected.

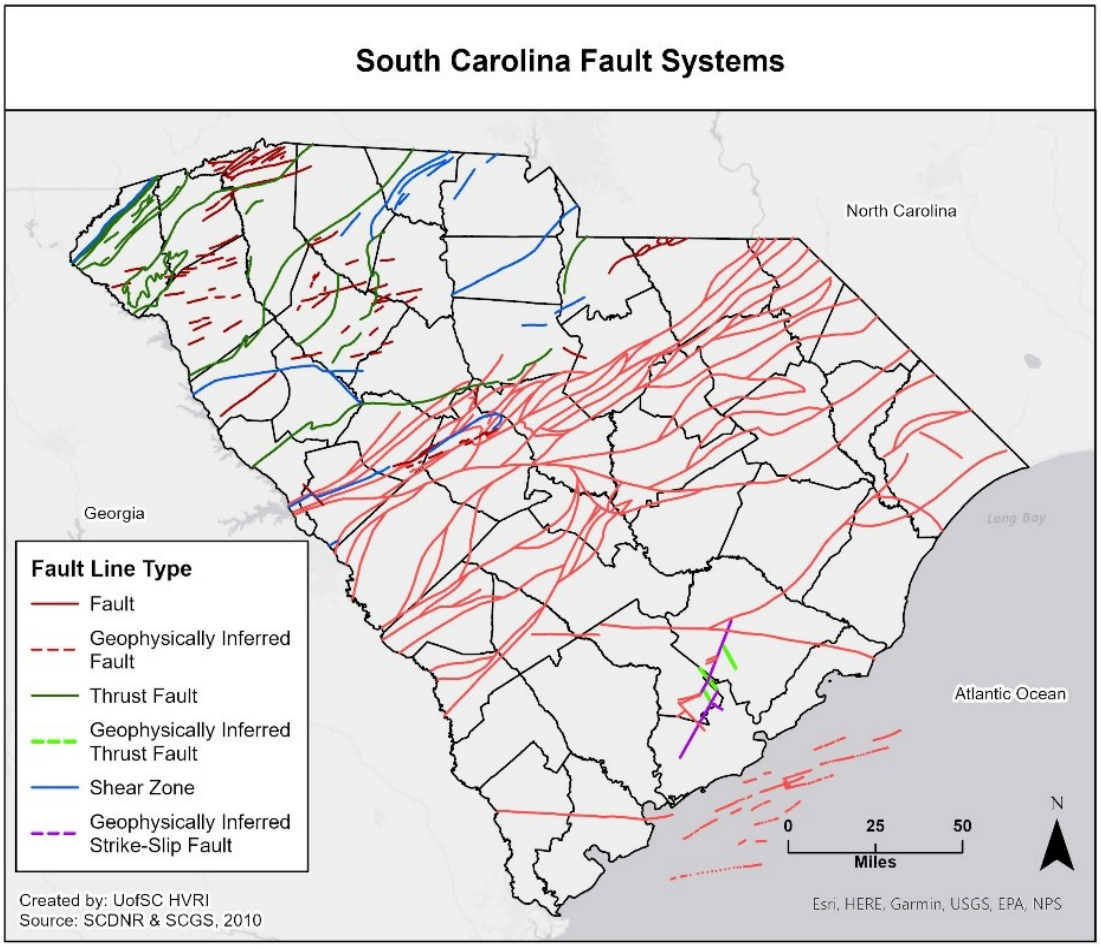


Figure 107: South Carolina Faults

South Carolina is in the interior of the North American plate. While South Carolina has a complex fault system, historically most earthquakes have occurred within the coastal plain. Earthquake activity in South Carolina is based on three main causes: fault activity, reservoir-induced seismicity, and Appalachian rise. A map showing the fault system in South Carolina is shown above. Most fault activity within South Carolina occurs within the coastal plain, though the entire state is considered a medium to high hazard area for earthquake occurrence. On average, South Carolina has 10 to 20 earthquakes a year.

Reservoir-induced seismicity occurs when man-made lakes and dams cause water-pore pressure to increase, thereby reducing the strength of the underlying rock and allowing the rock to slip. Geological activity provides a source of energy for the occurrence of Appalachian rise-related events. As significant disturbances erode and weather the Appalachian Mountains, weight is removed from the land causing the mountains to slowly rise, disrupting land patterns along the mountain ranges and in close proximity. These movements cause earthquake activity in the upstate.

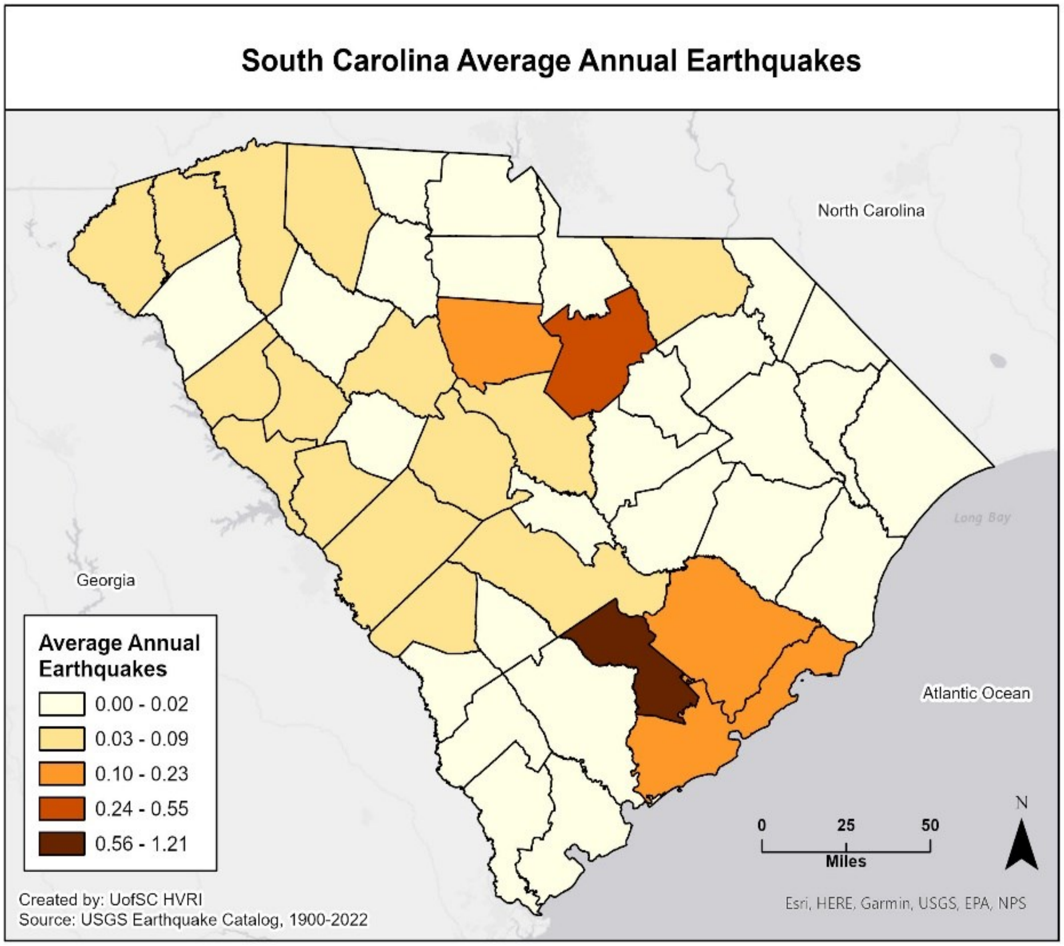


Figure 108: Average Annual Earthquake Events in South Carolina Counties (1900 - July 2022)

Error! Reference source not found.The figure above shows averge annual earthquake by county from 1900 through mid-2022. Table 57 below shows earthquake probability based on historical occurrence data.

County	Earthquake Occurrence (1900-2022)		County	Earthquake Occurrence (1900-2022)	
	Future Annual Probability (% chance per year)	Frequency Interval (Years between event)		Future Annual Probability (% chance per year)	Frequency Interval (Years between event)
Abbeville	6	17.57	Greenwood	4	24.60
Aiken	4	24.60	Hampton	0	--
Allendale	2	61.50	Horry	0	--

County	Earthquake Occurrence (1900-2022)		County	Earthquake Occurrence (1900-2022)	
	Future Annual Probability (% chance per year)	Frequency Interval (Years between event)		Future Annual Probability (% chance per year)	Frequency Interval (Years between event)
Anderson	1	123.00	Jasper	0	--
Bamberg	1	123.00	Kershaw	54	1.84
Barnwell	5	20.50	Lancaster	0	--
Beaufort	1	123.00	Laurens	2	61.50
Berkeley	23	4.39	Lee	0	--
Calhoun	1	123.00	Lexington	5	20.50
Charleston	12	8.20	Marion	0	--
Cherokee	0	--	Marlboro	2	61.50
Chester	2	41.00	McCormick	9	11.18
Chesterfield	4	24.60	Newberry	9	11.18
Clarendon	1	123.00	Oconee	7	13.67
Colleton	1	123.00	Orangeburg	8	12.30
Darlington	1	123.00	Pickens	6	17.57
Dillon	1	123.00	Richland	7	13.67
Dorchester	120	0.83	Saluda	0	--
Edgefield	4	24.60	Spartanburg	4	24.60
Fairfield	20	5.13	Sumter	1	123.00
Florence	0	20.50	Union	2	61.50
Georgetown	0	50.22	Williamsburg	0	--
Greenville	5		York	2	61.50
Grand Total	7				

Table 57 Earthquakes by County

Figure 109 displays projected potential earthquake intensity. Intensity projections (from SCDNR) are based on the Modified Mercalli Intensity Scale and show likely intensities considering combined conditions of the 1886 Charleston earthquake and the January 1913 Union County earthquake. Earthquake risk varies by region of the state, as discussed below.

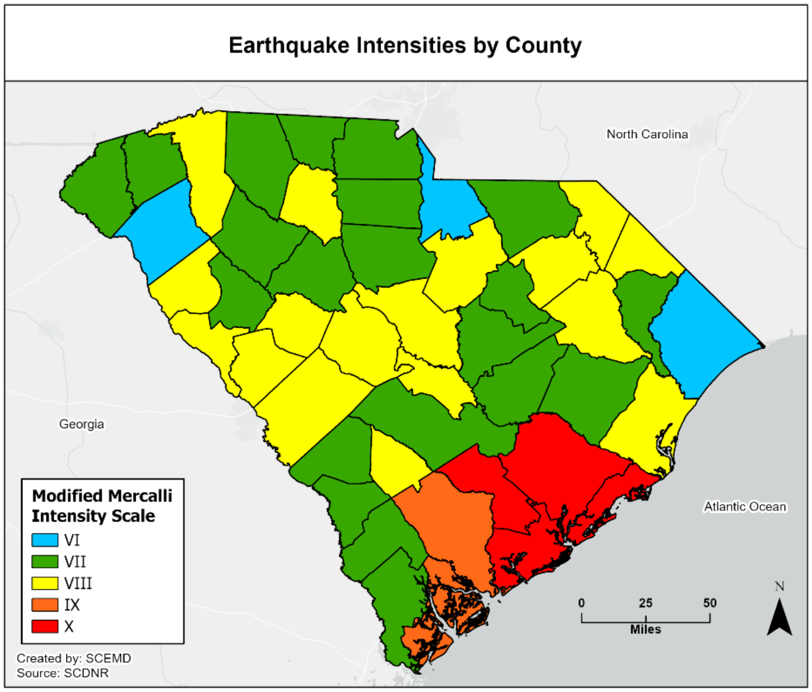


Figure 109: Projected Earthquake Intensities

Outer Coastal Plain

Counties in the Outer Coastal Plain consist primarily of young (<2 million years) surficial sediments. Areas of potential activity include the Summerville/Middleton Place area (1886 earthquake location), and places near Georgetown and Bluffton (based on paleo-liquefaction evidence). Counties along the South Carolina coastline have high potential for liquefaction, which can increase earthquake impacts. Coastal counties also have tsunami risk from distant or regional sources. Coastal counties include Horry, Georgetown, Charleston, Berkeley, Dorchester, Beaufort, Jasper, Marion, Williamsburg, Colleton, Hampton, and Florence.

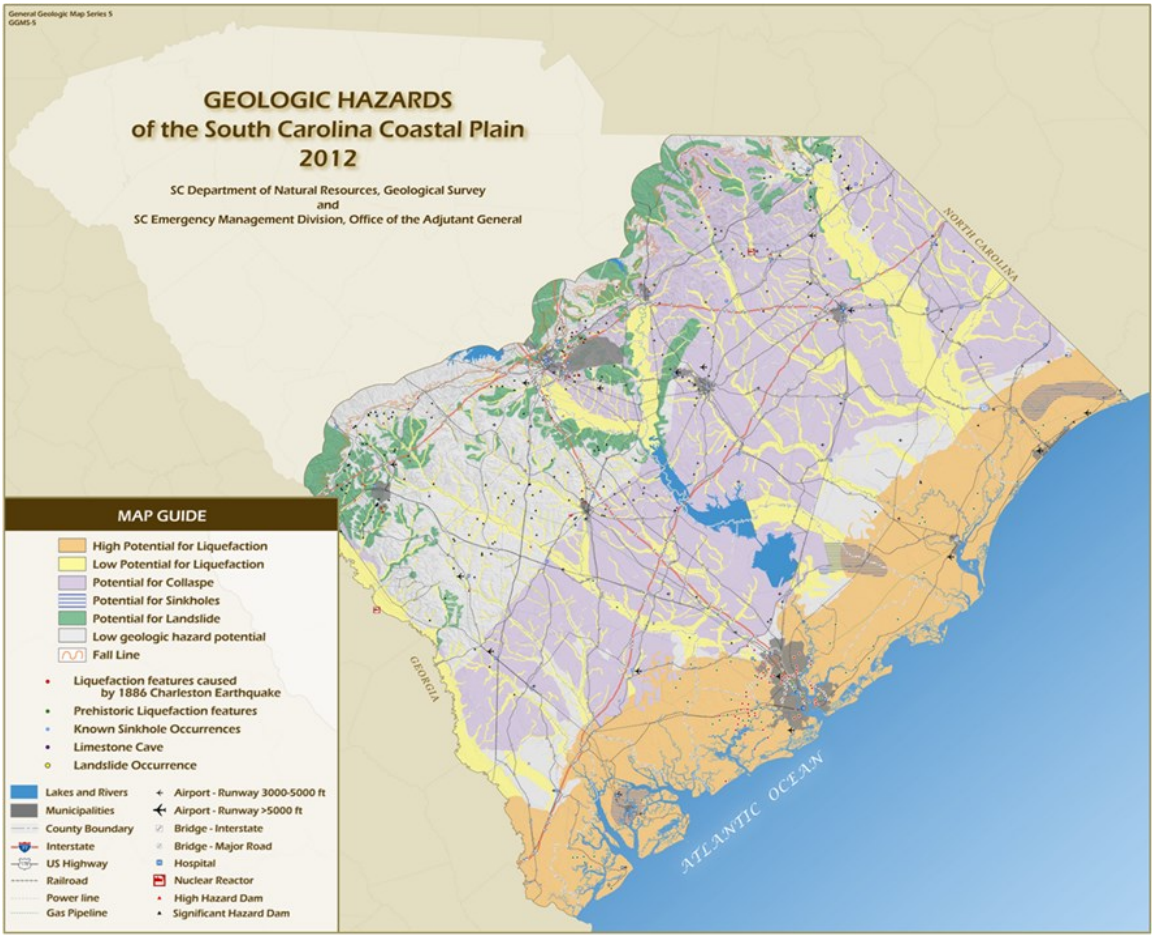


Figure 110: Geological Hazards in South Carolina Coastal Plain

Talwani and Schaeffer (2001) from the University of South Carolina used evidence from previous earthquakes to determine how often earthquakes like the 1886 earthquake have occurred in the Charleston area. They determined that earthquakes in the Charleston area appear to occur about every 400-500 years and the possibility that large earthquakes may occur in Georgetown and Bluffton on average 2,000-year cycles. Their data set is limited to only the last 6,000 years because of changes in groundwater levels, which affect the formation of earthquake features. Based on historic data, it seems unlikely that a large earthquake will occur anytime soon in the Lowcountry. Statistically, there is a 1/400 chance that a large earthquake will occur each year. Smaller (<5.5-6) earthquakes do not tend to leave much evidence behind for scientists to find later, so it is unclear how often these occur in this area. This region has a thick layer of sediment cover with a predominantly swampy characteristic; therefore, earthquakes that occur in this region tend to cause increased shaking and potential for liquification than in the other two regions of the state. Figure 111 displays the liquefaction and sinkhole potential for South Carolina.

Midlands

The Midlands region includes the counties on the inner coastal plain with older (> 2 million years) surficial sediments. This region also includes the Fall Line as a potential earthquake source. Counties in this region include Dillon, Marlboro, Chesterfield, Darlington, Lee, Kershaw, Clarendon, Sumter, Richland, Calhoun, Orangeburg, Lexington, Aiken, Barnwell, Bamberg, and Allendale.

While the Fall Line in South Carolina represents a change in geological composition and is the location of a large fault system, the Midlands is not known to have experienced large earthquakes in the past. The change in geology on the Fall Line represents a change in the harder crystalline rock of the Piedmont to the softer coastal plain sediment of the Lowcountry. This area was relatively inactive until recent activity in north-central South Carolina has indicated that this may be an active fault. Historical earthquakes in the Midlands have been small (magnitude 2-4) and have caused minimal damage. Two earthquakes near Florence in the fall of 2006 caused minor damage to homes located on weaker soils and swampy lands. The thin layer of loose sediment in the Midlands, especially around swampy areas, can increase the amplitude of earthquake waves and increase the shaking felt. More recently, a swarm of more than 50 small earthquakes occurred in the Elgin area of Kershaw County in late 2021 and in 2022.

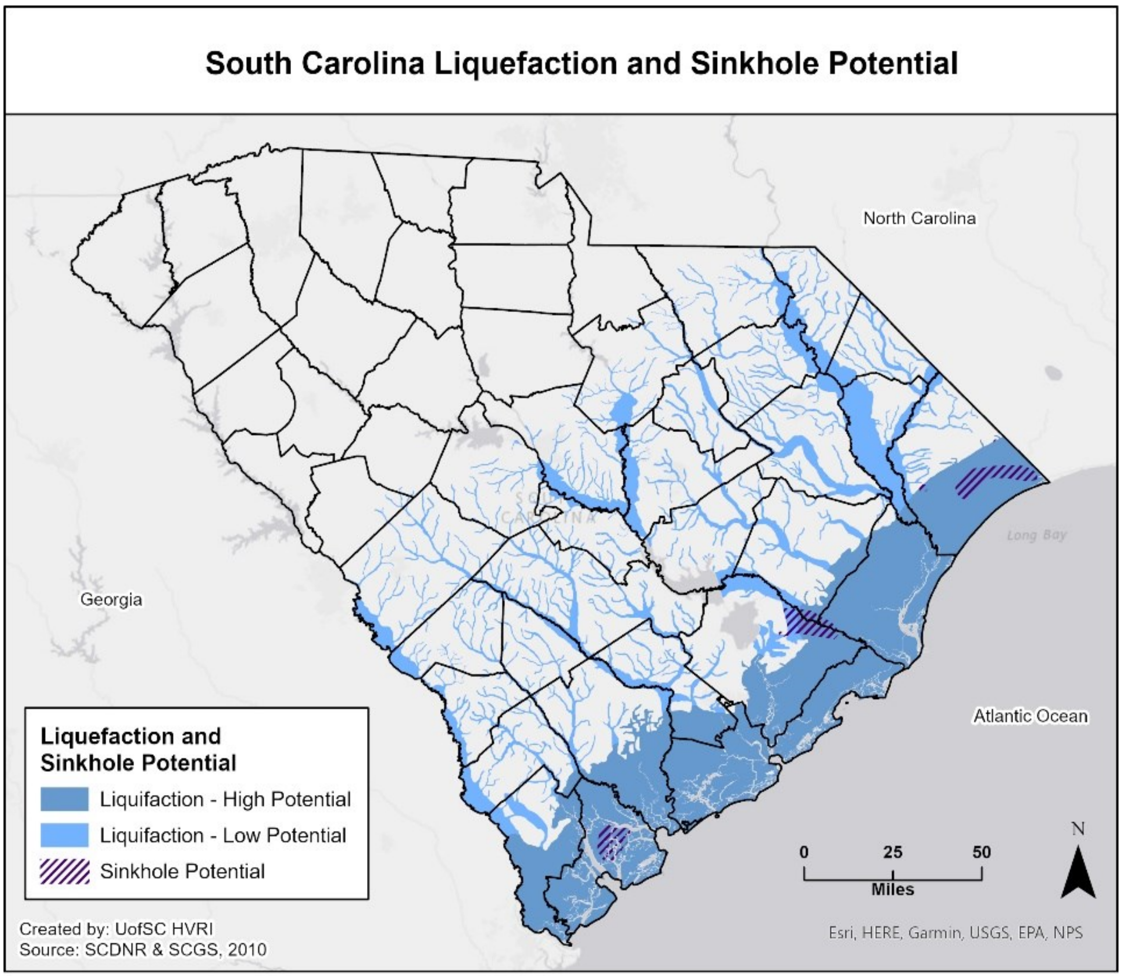


Figure 111: South Carolina Liquefaction and Sinkhole Potential

Piedmont/Blue Ridge

The counties in this region overlay almost entirely igneous/metamorphic basement rock with local river alluvium and weathered bedrock cover. The 1913 Union County earthquake occurred within this region. Counties include Oconee, Pickens, Anderson, Greenville, Spartanburg, Cherokee, Union, York, Chester, Laurens, Newberry, Fairfield, Lancaster, Abbeville, Greenwood, McCormick, Saluda, and Edgefield.

Generally, the Piedmont/Blue Ridge and Midlands section of South Carolina are considered at a low risk of major (magnitude 6+) earthquakes. Not much is known about the cause of the Union County earthquake because of the lack of technology at the time, but at the present, the risk of a major earthquake is considered low. The Piedmont/Blue Ridge area is susceptible to smaller earthquakes (magnitude 2-4) in other locations, especially near dams. University of South Carolina (USC) seismic stations have recorded numerous small earthquakes associated with dams in the Piedmont/Blue Ridge area and some smaller earthquakes distributed around the area. These small earthquakes not associated with dams may be associated with the uplift of the Appalachian Mountains as is seen in other areas near the mountains. Earthquakes in this region are likely to be felt over large areas because of the relatively unbroken mass of rock in which they occur. This allows earthquake waves to travel long distances before they become attenuated and are no longer felt. Because most buildings are built on rock, earthquakes will cause less damage than earthquakes in the Lowcountry because solid rock does not increase the amplitude of earthquake waves, whereas loose sediment can increase the shaking by increasing the amplitude of the waves.

Earthquake History

Historical and recent occurrence data is from the USGS Earthquake Catalogue unless stated otherwise. Loss-causing data is derived from SHELDUS V.20.0. For more information regarding methodology, please see the Hazard Narrative Methodology Appendix B.

1886 Charleston Earthquake

On August 31, 1886, a major earthquake occurred in Charleston with what would now be considered an intensity of X on the Modified Mercalli Scale. The magnitude of the earthquake ranged between 7.0 and 7.6 according to the USGS and SCDNR (USGS , n.d.). The event killed more than 70 people and left most structures damaged or destroyed, with an estimated damage of $23 million. The initial shock occurred at 9:51 P.M. and lasted between 35 to 40 seconds. There was a second strong aftershock 8 minutes after the initial shockwave, and six aftershocks followed within a 24-hour period. Within a 160-kilometer radius, cities of Columbia, South Carolina, and Savannah and Augusta, Georgia, also experienced damage. According to the Lithospheric Seismology program at the University of South Carolina, the meizoseismal area is roughly 20 miles by 30 miles in an elliptical shape between Charleston and Jedburg centered near present day Middleton Place. (Figure 111). The earthquake is the strongest known to impact the Eastern Seaboard with a total affected area covering more than 2.5 million square kilometers. It was felt as far south as Cuba, north as far as New York, east to Bermuda, and west to the Mississippi River (USGS , n.d.)(Figure 112). Scientists have yet to confirm the geologic fault that produced the earthquake (USGS , n.d.).

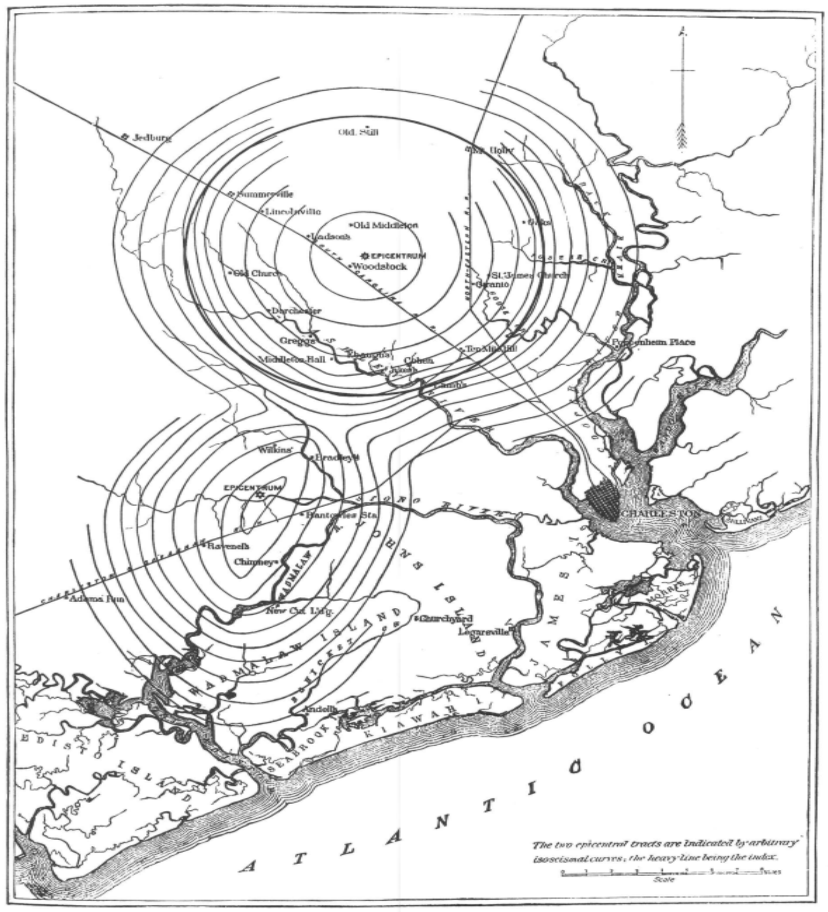


Figure 112: Isoseismal map displaying the intensity of the 1886 Charleston Earthquake.

As found in the 1889 report prepared by Captain Clarence E. Dutton, USGS

1900s

On June 12, 1912, and January 1, 1913, two earthquakes occurred in Union County, South Carolina. The second was felt from Georgia to Virginia. Witnesses report the earthquake was accompanied by a loud roaring noise. A house in Union County and chimneys in Union, Spartanburg, and Cherokee counties were destroyed. The shock was felt for more than 30 seconds in Raleigh, North Carolina. Isoseismals (lines on a map showing areas with equal seismic intensities) showed an elliptical area of approximately 43,000 square miles where the disturbance was felt. Although only minor damage occurred, the intensity of the earthquake was a VII and is the largest known earthquake to have occurred in South Carolina outside of the Charleston area.

Figure 113: Extent of 1886 Charleston Earthquake.

As found in the 1889 report prepared by Captain Clarence E. Dutton, USGS

Earthquake activity increased from 1989–1993. Seismologists consider almost half of South Carolina counties as being at high risk for seismic events because of the state's seismic history and current seismic activity.

Early 2000s

In 2002, 17 earthquake events were recorded in the Middleton Place-Summerville Seismic Zone (MPSSZ), which is located approximately 13 miles northwest of Charleston, with magnitudes ranging from 0.68 to 3.03. In addition, two earthquakes occurred on the continental shelf approximately 16 miles offshore from Seabrook and Kiawah Islands. An offshore earthquake recorded on November

11, 2002, had a magnitude of 4.32 and was felt over a wide area from Wilmington, North Carolina, south to Savannah, Georgia, and inland to areas near Columbia. There were no reports of damage associated with this event. Between 2002 and 2005, there were no major earthquakes. Numerous minor earthquakes occurred in the early 2000s, including eight in 2009, two in 2010, and 10 in 2011. The highest of these registered earthquakes is a 3.2 on the Richter Scale that originated around Summerville, Dorchester County. An August 23, 2011, major earthquake in central Virginia was felt in South Carolina, with reports of buildings shaking in Greenville, Georgetown, Myrtle Beach, and Rock Hill. Several buildings in downtown Columbia were evacuated; this was a magnitude 5.8 event[5].

Recent Activity (2018-2022)

On December 27, 2021, a 3.2 magnitude earthquake occurred at 7:18 P.M. with the epicenter located 5 km south-southwest of Lugoff. During the next five weeks, 18 more earthquakes registered a magnitude of at least 1.49. The earthquakes continued through 2022, including a total of 39 between June 26 and July 30 (the last recorded date for the earthquake dataset represented in figures in this plan). Figure 114 displays the location of recent Lugoff-Elgin earthquakes as well as their recorded magnitudes. The highest recorded magnitude was 3.6 with epicenter located 6 km east of Elgin; the average magnitude is 2.01 across 71 recorded earthquakes. While the earthquakes have been located between strands of the Eastern Piedmont Fault System, the specific source of or reason for the earthquakes is not confirmed at the time of this plan update.

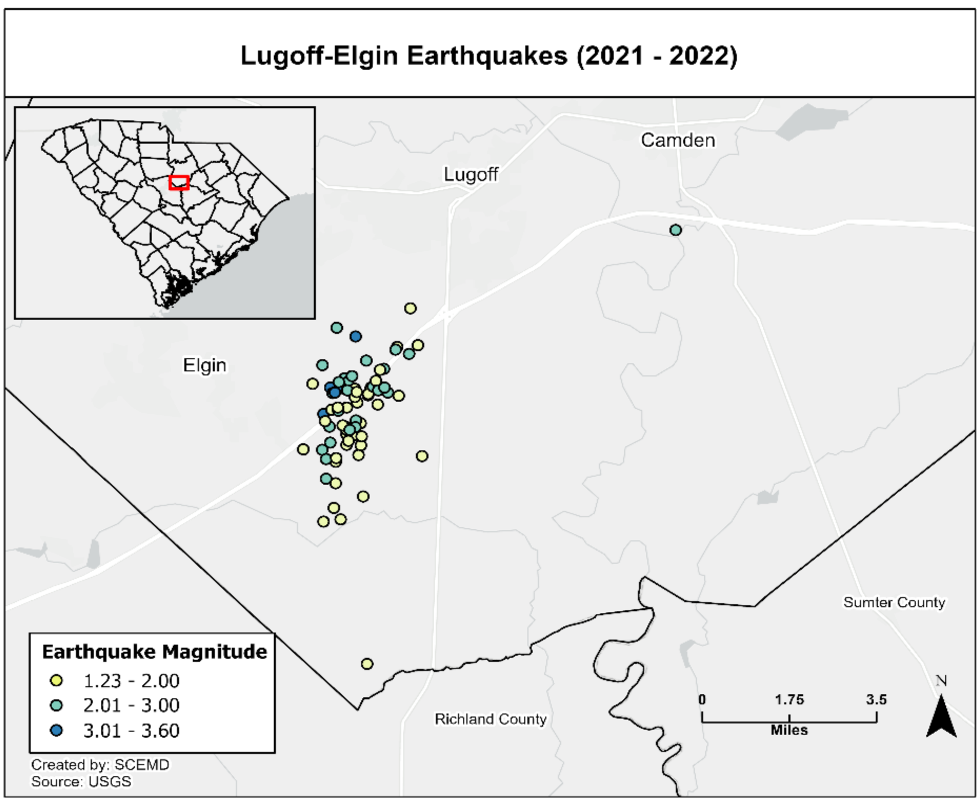


Figure 114: Lugoff-Elgin Earthquakes

Vulnerability

Vulnerability to earthquakes and their cascading impacts is higher as noted above in locations in proximity to fault lines. Infrastructure including water and wastewater systems, transportation, pipelines, and essential facilities can be vulnerable to damage from the energy and movement of earthquakes. Residential and unreinforced structures are susceptible to damage and collapse.

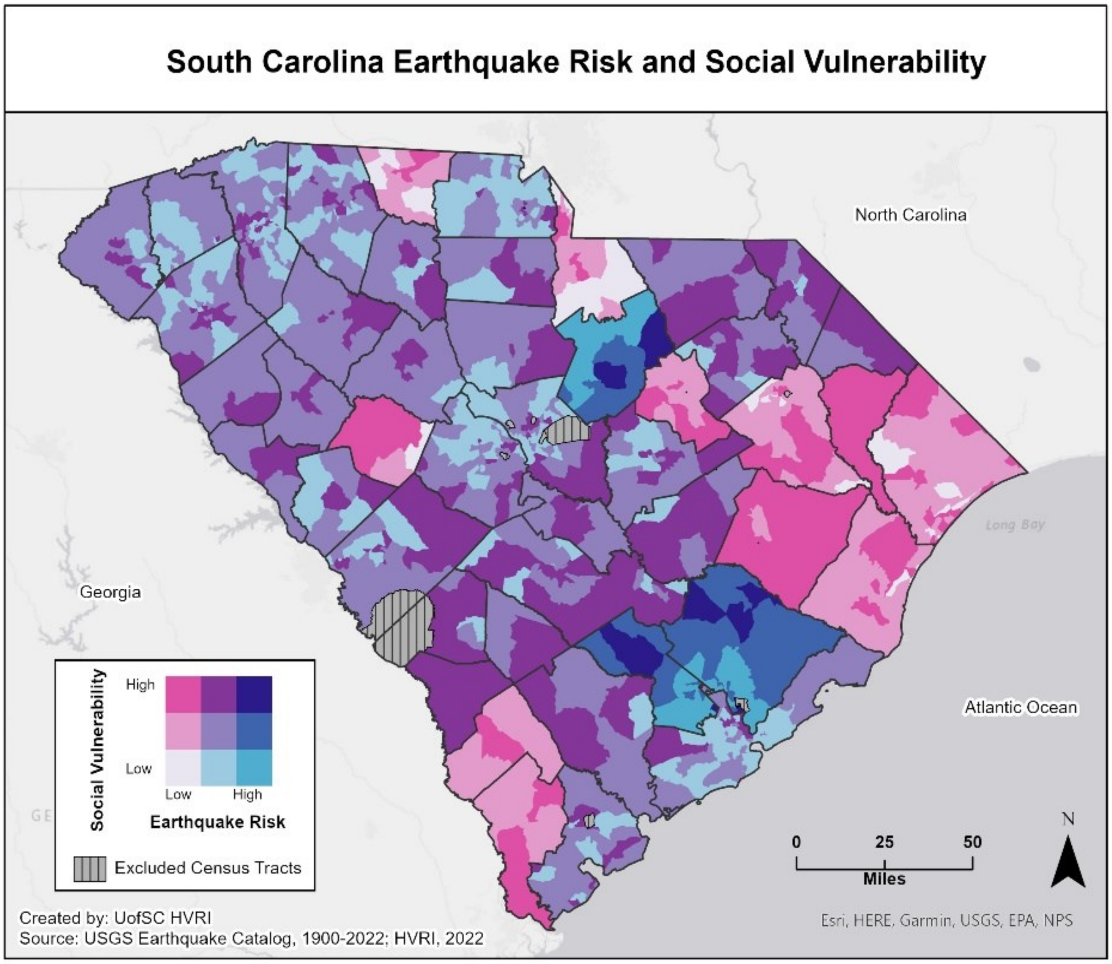


Figure 115: South Carolina Social Vulnerability and Earthquake Risk

Figure 115 shows the combination of earthquake risk and social vulnerability. Of the 1,303 census tracts mapped, 12 fall within the combined highest levels of social vulnerability and highest risk scores (dark blue). These high areas are concentrated in Berkeley, Dorchester, and Kershaw counties.

Potential Impacts

Earthquakes have the potential to cause catastrophic impacts to people, property, and infrastructure. The rapid onset nature of earthquakes usually means no warning before an occurrence. Liquefaction, landslides, and mass wasting that can accompany earthquakes further alter the physical landscape. Statewide, no losses, injuries, or deaths have been reported in SHELDUS from 1960-2020 because of earthquake events; however, in the event of a large earthquake, especially a reoccurrence of the 1886 Charleston earthquake, the potential destruction could be catastrophic.

HAZUS loss estimation software was used to model and provide estimates of potential earthquake impacts. HAZUS risk assessment methodology uses hazard and inventory parameters (for example, soil and liquefaction data, and average building types) to determine the impact (damages and losses) on the built environment. The baseline data in HAZUS is periodically updated. Annualized losses for earthquakes were modeled in HAZUS using earthquake events taken from South Carolina's Seismic Network.

Scenario 1: 100-Year Earthquake

A HAZUS probabilistic scenario of a 100-year earthquake with a 5.3 magnitude event was used to determine the annualized losses that could be expected to occur statewide. The total estimated economic losses in this scenario total $6,682,420,000. The following provides detail of estimated damages. The HAZUS Global Summary report can be found in Appendix H.

Buildings:

HAZUS uses an estimate of 1,976,000 buildings in the state with a total replacement value of $515,767,000,000. According to the results of this analysis, 30,734 buildings would sustain at least moderate damage; 1,841 buildings are expected to be completely damaged. The table Building Losses summarizes expected damage based on general building type. The table Building Damage provides detail on monetary economic losses, incorporating direct building and income losses. Direct building losses are the estimated costs to repair or replace the damage; income losses result from the inability to continue business operations because of sustained damages.

Essential Facilities:

HAZUS provides estimated damage to essential facilities, which include hospitals, schools, police and fire stations, and emergency operations facilities (EOC). Before the earthquake, the state had 14,840 hospital beds. The model estimates that 13,325 hospital beds remain available statewide. After one week, 94% will be available for use, and by 30 days, 97% will be operational.

Transportation and Utility Lifeline:

The total value of the lifeline inventory is more than $12,747,000,000,000. This includes more than 8,000 miles of highways, 9,957 bridges, and more than 28,739 miles of pipe.

Debris:

The model estimates that 1.53 million tons of debris will be generated, with 42% composed of brick and wood debris and the remainder being reinforced concrete and steel. The model estimates 61,200 truckloads of debris.

Shelter:

HAZUS estimates the number of households expected to be displaced from their homes who will require temporary public shelter for this earthquake event. The model estimates that 4,702 households will be displaced, and 3,029 persons will seek temporary shelter.

Casualties:

HAZUS categorizes casualties into four severity levels based on extent of injuries:

- Level 1: Require medical attention but not hospitalization
- Level 2: Require hospitalization, but injuries are not life-threatening
- Level 3: Require hospitalization; injuries can be life threatening if not treated

immediately
- Level 4: Victims killed

It also creates casualty estimates for three different times of the day for different settings that consider peak occupancy. For example, at 2:00 A.M., generally the peak occupancy of people will be in a residential setting.

Scenario 1: 100-Year, 5.3 Magnitude Earthquake HAZUS Run

A "100-year earthquake" is an earthquake that has a one in 100 (or 1%) chance of occurring in any given year The tables below detail HAZUS-estimated losses that would be sustained in such a scenario.

PROBABILISTIC MODEL - 100-YEAR RECURRENCE					
Building Interruption Losses (millions of 2018 dollars)					
	Residential	Commercial	Industrial	Others	Total
Wage	$1	$8	$0	$1	$10
	Residential	Commercial	Industrial	Others	Total
Capital-Related	$0	$7	$0	$0	$7
Rental	$4	$5	$0	$0	$10
Relocation	$10	$7	$1	$3	$20
Subtotal	$15	$27	$2	$4	$48
Direct Building Losses (millions of 2018 dollars)					
	Residential	Commercial	Industrial	Others	Total
Structural	$19	$8	$2	$2	$32
Non-Structural	$41	$10	$3	$3	$57
Content	$7	$3	$1	$1	$13
Inventory	$0	$0	$0	$0	$0
Subtotal	$67	$22	$7	$7	$102
Total	$82	$49	$8	$11	$150

Table 58 Economic Losses in 100-year Scenario

PROBABILISTIC MODEL – 100-YEAR RECURRENCE					
	None	Slight	Moderate	Extensive	Complete
Residential	1,818,993	11,733	2,606	86	2
Commercial	90,687	955	254	24	0
Industrial	26,237	258	67	6	0
Other	24,482	236	64	6	0
Total	1,960,399	13,184	2,991	122	2

Table 59 Building Damage in 100-Year Scenario

PROBABILISTIC MODEL – 100-YEAR RECURRENCE					
Time	Building Type	Level 1	Level 2	Level 3	Level 4
2:00 A.M.	Commercial	1	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Industrial	1	0	0	0
	Residential	37	3	0	0
	Total	39	3	0	0
2:00 P.M.	Commercial	33	3	0	0
	Commuting	0	0	0	0
	Educational	11	1	0	0
	Industrial	5	0	0	0
	Residential	8	1	0	0
	Total	57	5	0	0
5:00 P.M.	Commercial	24	2	0	0
	Commuting	0	0	0	0
	Educational	1	0	0	0
	Industrial	3	0	0	0
	Residential	14	1	0	0
	Total	42	3	0	0

Table 60 Building Damage in 100-Year Scenario

Scenario 2: 500-Year, 5.3 Magnitude Earthquake HAZUS Run

A "500-year earthquake" is an earthquake that has a one in 500 (or 0.2%) chance of occurring in a year. Tables below detail HAZUS-estimated losses that would be sustained in such a scenario.

PROBABILISTIC MODEL – 500-YEAR RECURRENCE					
Building Interruption Losses (millions of 2018 dollars)					
	Residential	Commercial	Industrial	Others	Total
Wage	$43	$340	$14	$26	$423
Capital-Related	$18	$281	$9	$6	$313
Rental	$222	$173	$5	$11	$412
Relocation	$485	$277	$29	$90	$880
Subtotal	$768	$1,070	$57	$133	$2,029
Direct Building Losses (millions of 2018 dollars)					
	Residential	Commercial	Industrial	Others	Total
Structural	$827	$336	$79	$82	$1,324
Non-Structural	$3,879	$920	$279	$237	$5,315
Content	$1,449	$540	$200	$141	$2,330
Inventory	$0	$16	$42	$2	$59
Subtotal	$6,155	$1,811	$600	$462	$9,028
Total	$6,924	$2,881	$657	$594	$11,056

Table 61 Economic Losses in 500-Year Scenario

PROBABILISTIC MODEL – 500-YEAR RECURRENCE					
	None	Slight	Moderate	Extensive	Complete
Residential	1,576,895	166,517	74,755	13,214	2,038
Commercial	74,299	9,271	6,136	1,828	386
Industrial	21,663	2,507	1,766	526	105
Other	20,533	2,378	1,404	393	81
Total	1,693,391	180,673	84,062	15,962	2,610

Table 62 Building Damage in 500 Year Scenario

PROBABILISTIC MODEL – 500-YEAR RECURRENCE					
Time	Building Type	Level 1	Level 2	Level 3	Level 4
2:00 A.M.	Commercial	32	7	1	2
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Industrial	36	7	1	2
	Residential	1,858	330	35	68
	Total	1,926	344	37	72
2:00 P.M.	Commercial	1,889	396	50	98
	Commuting	0	1	1	0
	Educational	631	137	18	36
	PROBABILISTIC MODEL – 500-YEAR RECURRENCE				
	Building Type	Level 1	Level 2	Level 3	Level 4
2:00 P.M.	Industrial	269	55	7	13
	Residential	383	69	8	14
	Total	3,173	658	84	161
5:00 P.M.	Commercial	1,353	285	37	70
	Commuting	9	10	19	4
	Educational	77	17	2	4
	Industrial	168	35	4	8
	Residential	718	132	15	28
	Total	2,325	479	77	114

Table 63 Building Damage in 500-Year Scenario

Scenario 3: 1886 Charleston Earthquake

The potential impacts of an earthquake of this magnitude on present-day South Carolina are reflected in the tables below, which contain loss estimates from a HAZUS run based on the 1886 Charleston earthquake. The 1886 Charleston Earthquake scenario differs from the 100-year and 500-year models in terms of the length of ground motion for the model. The 100-year and 500-year models represent a 100-year recurrence with short duration shaking and a 500-year recurrence with short duration shaking, whereas the Charleston Earthquake is a model replicating the 1886 event today.

HISTORIC MODEL – CHARLESTON EARTHQUAKE (1886), 7.1 MAGNITUDE					
Building Interruption Losses (millions of 2018 dollars)					
	Residential	Commercial	Industrial	Others	Total
Wage	$70	$545	$26	$43	$691
Capital-Related	$30	$459	$16	$9	$517
Rental	$349	$275	$9	$19	$706
Relocation	$837	$431	$46	$150	$1,588
Subtotal	$1,285	$1,709	$98	$222	$3,501
Direct Building Losses (millions of 2018 dollars)					
	Residential	Commercial	Industrial	Others	Total
Structural	$1,405	$585	$150	$157	$2,556
Non-Structural	$5,834	$1,504	$494	$419	$9,065
Content	$1,843	$767	$327	$218	$3,361
Inventory	$0	$25	$69	$3	$97
Subtotal	$9,082	$2,881	$1,039	$798	$15,079
Total	$10,367	$4,590	$1,137	$1,019	$18,580

Table 64 Economic Losses – 1886 Charleston Earthquake Scenario

HISTORIC MODEL – CHARLESTON EARTHQUAKE (1886), 7.1 MAGNITUDE					
	None	Slight	Moderate	Extensive	Complete
Residential	1,508,015	182,068	101,998	30,733	10,606
Commercial	70,517	9,332	7,612	3,157	1,303
Industrial	20,706	2,357	2,101	957	448
Other	19,469	2,488	1,816	718	297
Total	1,618,707	196,245	113,527	35,565	12,654

Table 65 Building Damage: 1886 Charleston Earthquake Scenario

HISTORIC MODEL - CHARLESTON EARTHQUAKE (1886), 7.1 MAGNITUDE					
Time	Building Type	Level 1	Level 2	Level 3	Level 4
2:00 A.M.	Commercial	79	20	3	6
	Commuting	0	0	1	0
	Educational	0	0	0	0
	Industrial	106	28	4	8

HISTORIC MODEL - CHARLESTON EARTHQUAKE (1886), 7.1 MAGNITUDE					
Time	Building Type	Level 1	Level 2	Level 3	Level 4
	Residential	3,944	832	88	168
	Total	4,130	881	96	182
2:00 P.M.	Commercial	4,685	1,203	174	338
	Commuting	3	3	6	1
	Educational	1,496	393	60	116
	Industrial	788	209	31	60
	Residential	850	182	20	37
	Total	7,822	1,990	290	552
5:00 P.M.	Commercial	3,387	874	128	245
	Commuting	45	54	99	19
	Educational	126	32	5	9
	Industrial	492	131	19	38
	Residential	1,510	326	37	68
	Total	5,561	1,417	287	378

Table 66 Historic Model Building damage in 1886 Charleston Earthquake Scenario

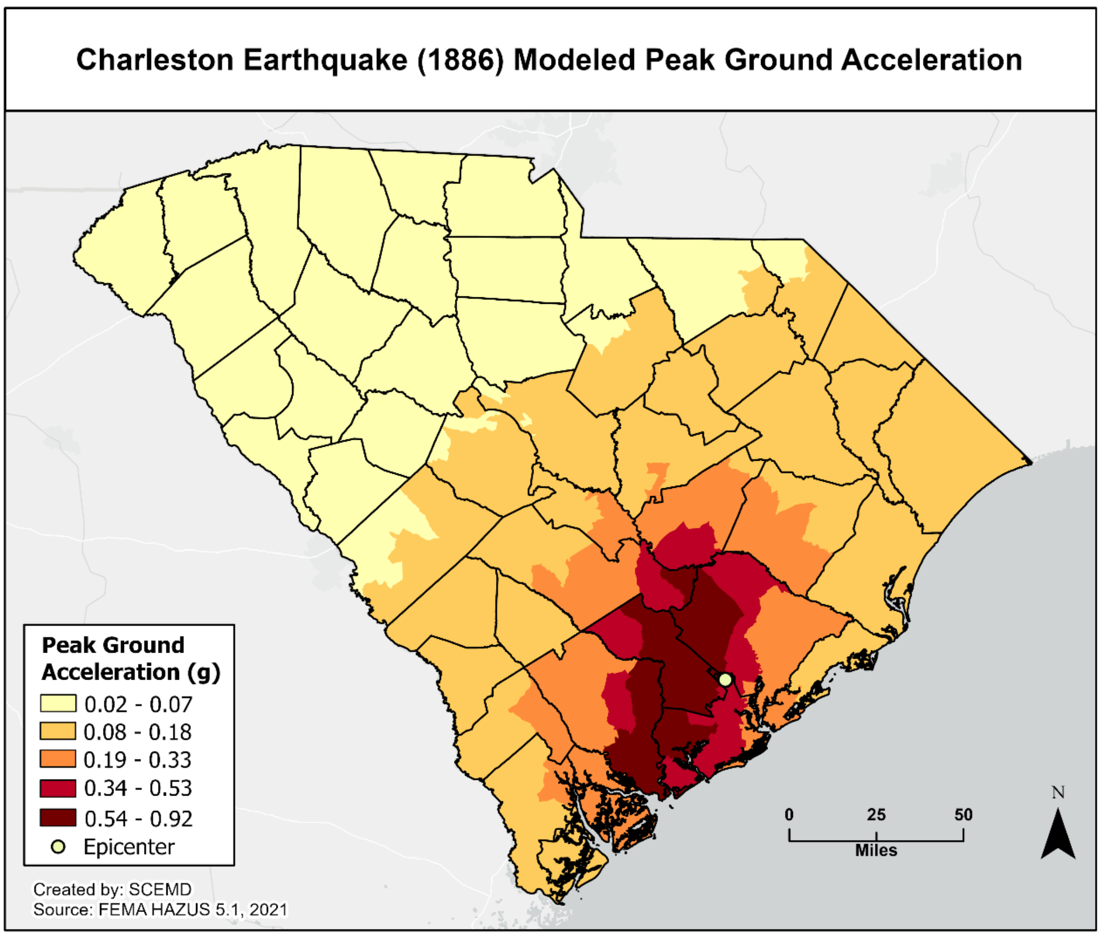


Figure 116: Potential Peak Ground Movement Source: HAZUS

Figure 116 depicts the potential peak ground acceleration using the parameters of the 1886 Charleston Earthquake. Peak ground acceleration is a measurement of the ground acceleration that occurred during earthquake shaking over an area. The earthquake would be felt throughout South Carolina and into neighboring states. The highest amount of ground movement is centered near the epicenter of the earthquake close to present-day Hanahan. Figure 115 displays current state assets located in potentially vulnerable areas in the Charleston Earthquake scenario, based on the HAZUS model.

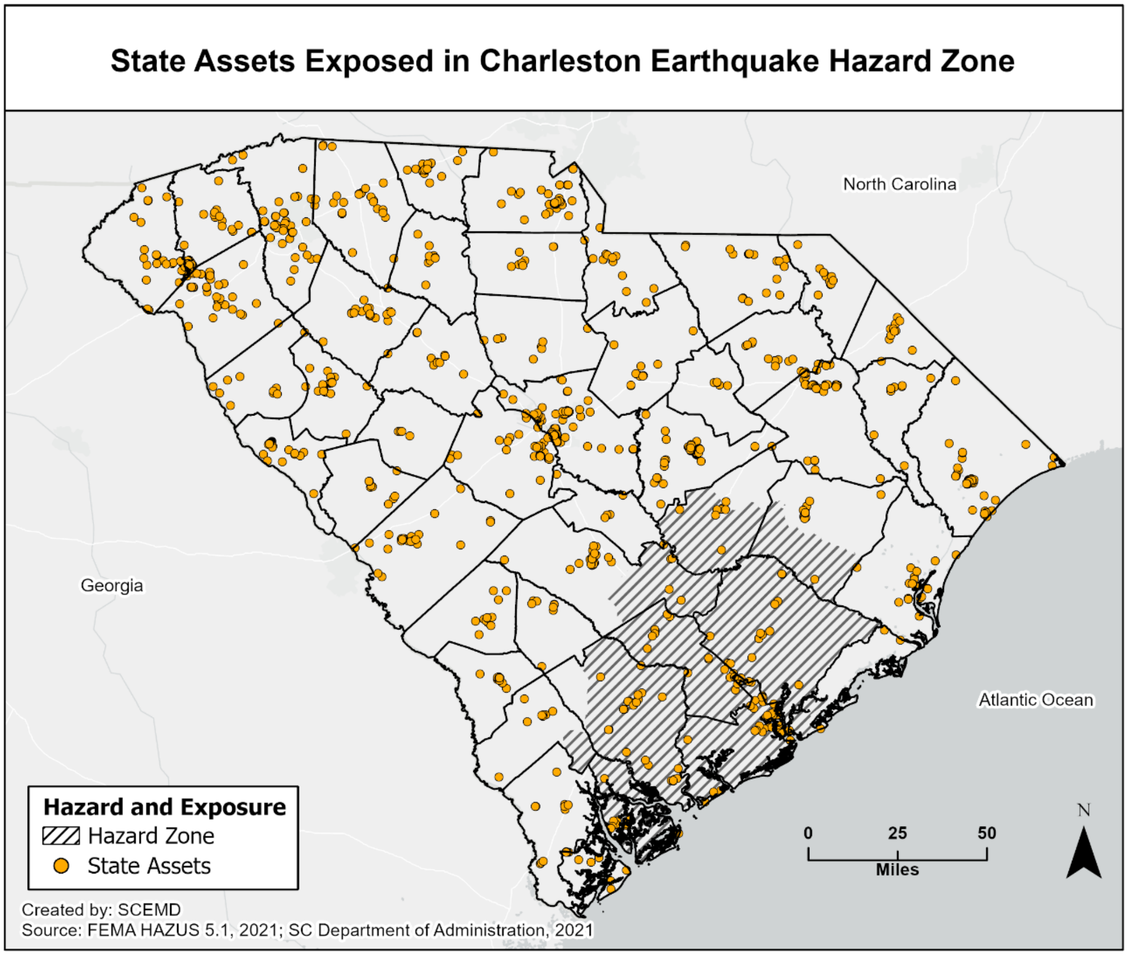


Figure 117: State Government Owned Assets in the 1886 Charleston Earthquake Hazard Zone

A significant earthquake would cause detrimental impacts to the community lifelines within South Carolina. The table below describes the high level of impacts from a major earthquake.

Community Lifeline	Level of Impact	Description of Impacts	Area of Impact
Communications	High	Communications infrastructure can be expected to be damaged, which will result in disruptions to services. Extent and duration will depend on severity. Emergency response/operations centers and critical infrastructure could be impacted and need prioritization for restoration. Broadband infrastructure would likely experience disruptions, making it more difficult to use VoIP phones and information sharing platforms. Emergency dispatch/911 services could be negatively impacted and require backup communications networks or support by centers not affected by the earthquake. Availability of financial services could be limited because of power and/or internet outages.	Localized or regional
Energy	High	Power lines and power generation facilities could see major damage based on location. Fuel supply chain could be disrupted because of damage to pipelines and transportation, storage, and transmission infrastructure, possibly throughout the state, causing fuel shortages. Fuel supplies could be brought in from other locations, but transportation dependencies could create delays. Critical facilities without power would rely on generators, creating additional demand for fuel.	Localized or regional; possibly statewide
Food, Water, Shelter	High	People within the impacted area could experience scarcity of food, water, and shelter, potentially for an extended period, depending on accessibility, transportation, and supply chain. Emergency shelters would need resupply; however, transportation issues would create challenges delivering necessities. Water lines would likely be damaged in a large earthquake, leaving large populations without potable water. Wastewater infrastructure could be damaged. Agricultural impacts could be seen due to lack or water and inability to move food in supply chain. Delivery of feed for livestock may be impacted.	Localized or regional; possibly statewide
Hazardous Materials	High	Releases of hazardous materials caused by structural failure and damage to storage containers and transportation infrastructure could cause environmental, human, and animal health risks.	Localized; possibly regional
Health and Medical	High	Medical facilities in affected areas could be damaged or destroyed at a time when an increased number of injured people would require medical care. Conditions could result in increased health	Regional; possibly statewide

Community Lifeline	Level of Impact	Description of Impacts	Area of Impact
		risks. Medical supply chains also could be disrupted. Power outage or lack of water for an extended period of time may necessitate transfer of patients to other facilities, which may be hindered by damaged transportation infrastructure.	
Safety and Security	High	Damage could cause gaps in response and security personnel and equipment availability and accessibility. Direct and cascading impacts including structural instability, fires, explosions, and hazardous materials may cause hazardous conditions. Search and rescue operations would be overwhelmed and require additional support from outside the affected area.	Localized and regional; possibly statewide
Transportation	High	Transportation infrastructure in the immediate area is expected to be heavily damaged. A high number of bridges and roads needing inspection will delay response and recovery. Large-scale evacuations and/or displacement may occur using undamaged roads, causing congestion. Railway systems will most likely be damaged, affecting the supply chain throughout the state and potentially the East Coast. The most effective way to travel in and out of the impacted area would be by helicopter as damaged runways at airports may render fixed-wing aircraft unusable. Maritime ports may sustain damage, causing supply chain disruptions.	Localized and regional; possibly statewide

Table 67 Potential Community Lifeline Impacts Based on Significant Earthquake Scenario

N. Landslide and Mass Wasting

Mass wasting describes the "down-slope movement of soil and rock under the direct influence of gravity." (USGS, n.d.). Landslide, a form of mass wasting, takes the form of "five modes of slope movement: falls, topples, slides, spreads, and flows." Debris flows, often called mudslides or mudflows, and rock falls are common types of landslide. The United States averages between 25 and 50 landslide fatalities annually through rock falls, debris flows, or lahars (volcanic debris flows) (USGS, n.d.). Historically, landslides causing significant damage or human injury are not common in South Carolina.

Formation

Slope movement occurs when forces acting downslope exceed the strength of materials that make up the slope. Slope movement occurs naturally from numerous, often compounding, factors (USGS, n.d.). The Earth's gravity is constantly applying pressure to the surface, which affects surface stability. While that pressure is constant, precipitation, snow melt, temperature changes, earthquake shaking, volcanic activity, and human activities combine to play a role in landslide occurrences (USGS, n.d.).

Classification

A common form of mass wasting is called flow, which occurs when a section of a slope becomes unstable and flows downhill. The movement can be quick, or it may be gradual. Flows are relatively small and are a shallow phenomenon that includes the movement of soil and loose rocks. The most common form of mass wasting is an earthflow, which involves a portion of a water-saturated slope that moves a limited distance, generally after a rainfall. This mass wasting often results in the forced closures of roads and rails (Gariano, Earth-Science Reviews , 2016).

As with meteorological hazards, advisories are issued for increased landslide risk. The United States Geological Survey provides forecasts for landslide potential, which the National Weather Service includes in weather briefings and forecasts. Landslide advisories are:

- **Landslide Advisory** is a general statement outlining the potential for landslide activity for a region because of rainfall predictions
- **Landslide Watch** is issued when landslide activity is possible but not imminent
- **Landslide Warning** occurs when landslide activity is occurring, and extreme caution should be taken (55).

Location and Probability

Significant landslide occurrences in South Carolina are possible but infrequent. Upstate South Carolina most closely fits the typical landslide topography as outlined by the U.S. Geological Survey (USGS). Steep slopes on Table Rock, Caesars Head, and Glassy Mountain see rockslides. In the Piedmont, minor landslides are more prevalent because of slope failure of saprolite and soil, leading to gully formation. These are primarily triggered by rain events and erosion. In the Coastal Plain, riverbanks are susceptible to slope failure on a larger scale, causing erosion. The lack of steep slopes in the Piedmont and Coastal Plain result in an extremely low landslide risk for these regions.

The small number of documented past occurrences and South Carolina's geologic profile present a challenge in calculating future probability, magnitude, and range of intensities for landslides in the state.

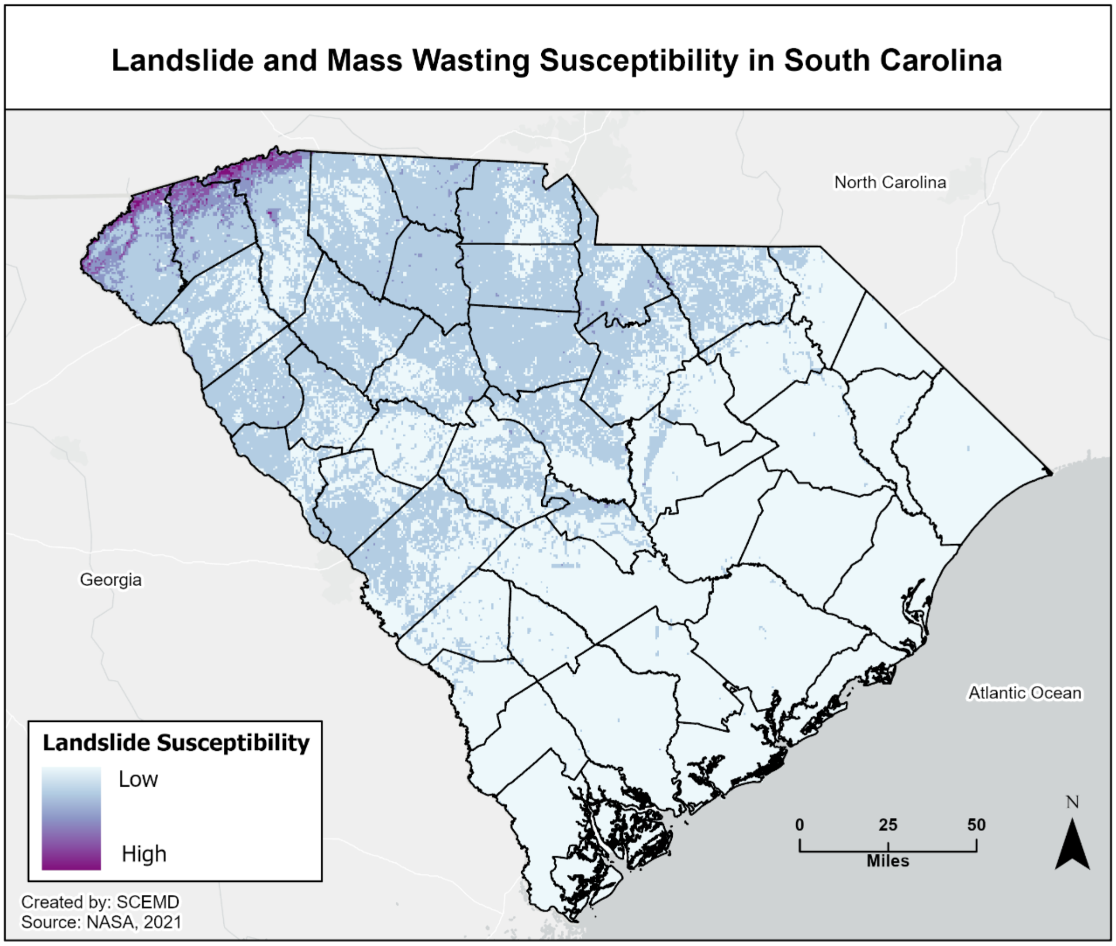


Figure 118: Landslide and Mass Wasting Susceptibility in South Carolina

Vulnerability

Sloped locations create vulnerability to landslide mass movement, so infrastructure and residences built on sloped locations or immediately downhill from sloped locations will see higher vulnerability to landslide and debris flows, particularly during and after periods of heavy rain. In the Lowcountry, a thick layer of sediment cover with a predominantly swampy characteristic adds to the potential for liquification from mass wasting.

Impacts

Impacts from landslide are possible but historically have not been frequent and have not caused significant damage. In the Upstate along motorways, landslides and rock falls may lead to road closures or power outages. Motorists may need to alter commuting routes to reach their destinations, and property owners may need alternate power sources in case of power outage.

Impacts to community lifelines from a landslide are not expected to be major; the table below describes potential impacts.

Community Lifeline	Level of Impact	Description of Impacts	Area of Impact
Communications	Low	No significant impact anticipated. Communications equipment in immediate area could be damaged.	Localized or regional
Energy	Low	No significant impact anticipated. Energy equipment or systems in immediate area could be damaged.	Localized or regional
Food, Water, Shelter	Low	No significant impact anticipated. Residential structures in immediate area could be damaged, resulting in the need for temporary shelter. Crops in the immediate area may be damaged or destroyed. Depending on location of landslide/mass wasting, food supply chain could be hindered if transportation network is impacted.	Localized
Hazardous Materials	Low	No significant impact anticipated. Storage or transportation equipment in the immediate area could be damaged, resulting in a release.	Localized
Health and Medical	Low	No significant impact anticipated. Medical facilities may see increased numbers of injured people seeking medical care. Depending on location of landslide/mass wasting, patient movement could be hindered if transportation network is impacted.	Localized or regional
Safety and Security	Medium	Responding personnel may encounter increased risk for which specialized training and equipment is required. A significant incident could result in increased search and rescue operations.	Localized; possible impact on statewide resources
Transportation	Medium	Damage to roads, bridges, or other transportation infrastructure could cause disruptions in transportation.	Localized or regional

Table 68 Potential Community Lifeline Impacts Based on Significant Landslide and Mass Wasting Scenario

Historic Occurrences

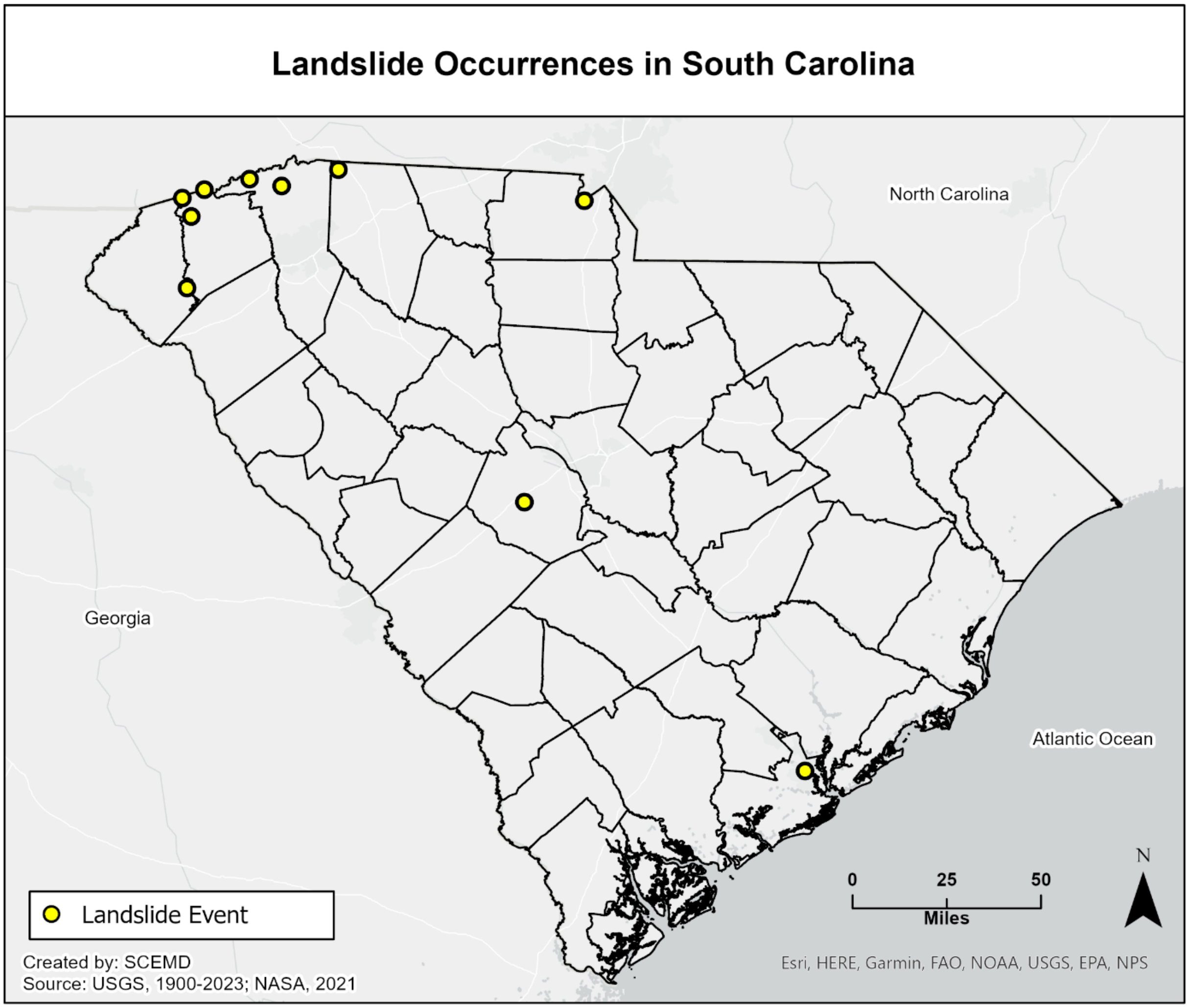


Figure 119: Landslide Events in South Carolina

August 31, 1886: The historic Charleston Earthquake of 1886 triggered a landslide in Lexington County. Details on the landslide are not available. (SCDNR Coastal Plains Map in earlier section of SHMP) (SCDNR and SCEMD , 2012)

August 13, 1916: The earthen dam at Lake Toxaway in North Carolina failed, resulting in a large debris flow. The debris flow continued down the Toxaway River into South Carolina in the upper portion of Lake Jocassee. (Richard M. Wooten, 2016)

June 26, 2006: A NWS survey team reported a significant debris flow in the Jones Gap State Park area of northern Greenville County. The debris flow carried trees, boulders, and other debris for several hundred yards. (NOAA, n.d.)

February 4, 2010: A landslide caused an accident that injured one person on Old Clemson Highway near Highway 123 (Oconee County).

May 22, 2013: A landslide occurred in the northern part of the county on Dividing Waters Road just off Highway 11 in Travelers Rest (Greenville County).

July 4, 2013: A 30-inch culvert failed during a rainstorm in Pickens County, resulting in the erosion of the downstream side of Highway 178; a mudslide carried away the pavement shoulder.

August 31, 2015: A shallow embankment along I-526 above the Paramount Drive on ramp failed, blocking Dorchester Road (Charleston County).

August 20, 2017: A retention dam burst near Lake Wylie along the North Carolina-South Carolina border. The dam, designed to keep sediment out of creeks and the lake, failed, resulting in a mudslide impacting housing developments in North and South Carolina.

April 28, 2019: Heavy rains over several weeks caused part of Horsepasture Road to collapse in the Jim Timmerman Natural Resources area at Jocassee Gorges in northern Pickens County. A three-mile section of the road was closed. (WLTX Associated Press, 2019).

Future Climate Considerations

Climate change projections could impact landslide susceptibility and occurrence and the state's ability to predict landslide. The last 125 years of observations provided by the South Carolina Climate Office provide no clear indication of a trend forming from annual precipitation observations; however, there are arguments for a trend of increased extreme rainfall events, which could increase landslide potential. Overall, the southeastern United States has observed an increase in rainfall intensity specifically in the warm spring and summer months. Additionally, if the trend of global annual temperature increases, the projected evaporation rate will increase as well. An increase in evaporation rate could lead to an increase in precipitation intensity, which will impact soil stability with both factors playing primary roles in landslide susceptibility and occurrences. While these reports may lend themselves to a higher projected occurrence of landslide in the future, further research is needed to develop an understanding of future conditions and effects on potential occurrences.

O. Infectious Disease

Introduction

Infectious disease can cause significant harm in a community as the COVID-19 pandemic that began in 2020 demonstrated. In addition to the thousands of deaths in South Carolina, a pandemic such as COVID-19 can result in long-term health problems for survivors, require significant response costs, and create serious economic damage. Infectious diseases are those which are communicable or transmissible among members of a population. Examples include tuberculosis, zoonotic bacterial diseases, and sexually transmitted infections.

Public health hazards are not limited to human diseases alone. Because agribusiness is the largest industrial sector in South Carolina, livestock and poultry diseases also bring risk, with special consideration for zoonotic diseases. Agriculture provides nearly 250,000 jobs throughout the state and produces an economic impact of more than $46 billion each year. South Carolina is ranked ninth in the country in poultry and egg production (Health C.U.) A significant outbreak of livestock or poultry disease could not only create significant economic hardship in this crucial sector but could potentially create shortages in meat, dairy, egg, and animal products, causing further cascading effects and impacting public health.

Formation

Public health hazards may develop in many ways. In most cases, infectious disease outbreaks occur as the result of natural mutation by a specific agent that makes it more deadly, more contagious, or both. It may occur when an agent is introduced into a population that does not have existing immunity, which can result in that disease rapidly spreading throughout the population. Finally, it is possible that disease agents may be artificially manipulated into becoming more dangerous, either accidentally or deliberately.

Classification

Infectious diseases are caused by a variety of organisms or agents such as bacteria, viruses, fungi, and parasites. The COVID-19 pandemic was caused by a form of coronavirus. Infectious diseases may be transmitted in multiple ways. Human-to-human transmission occurs by direct or indirect contact with the infectious agent on an infected person, contaminated object, in food or drinking water, exposure to bodily fluids, or airborne transmission. Transmission can also be animal-to-human for some diseases, known as zoonotic transmission, such as avian influenza or rabies virus. Vector-borne diseases are transmitted via the bite of an arthropod, such as ticks or mosquitos. Infectious disease can pose a public health threat as well as an animal or environmental health threat. Infectious diseases in livestock and poultry can have significant economic impacts because of restrictions on use or consumption of products from affected animal populations and in some cases requirements for depopulation and appropriate disposal of carcasses (The Mayo Clinic, 2022).

A disease that occurs regularly in an area or within a community is endemic to that area or population. An epidemic is a widespread occurrence of an infectious disease affecting a large number of individuals. A disease that is widespread and affecting people in multiple countries or throughout the world is considered pandemic.

Location and Probability

Infectious diseases outbreaks can and do affect the entire state. However, there can be differences in how areas are affected depending on factors including population density, type of infectious disease, and access to diagnosis and medical care. For example, rural areas generally have higher risk factors for exposure to zoonotic diseases because of closer contact with livestock, wildlife, and pests. Urban areas may have more cases of human-to-human transmission because of higher population density. Because there are multiple variables involved in transmission of infectious disease among humans and livestock, as well as the potential for zoonotic transfers and mutations of various agents, it is difficult to project overall probability for specific counties in developing outbreaks.

The table below shows the human deaths from infectious disease for South Carolina by area of the state from 1999 to 2019 along with COVID-19 deaths from January 2020 through December 2021. Death rates are per 100,000 people. COVID case and fatality data for South Carolina was compiled by USA Facts in coordination with the CDC and SCDHEC.

Region Name	2020 Regional Population	COVID-19 Deaths through January 10, 2022	Other Infectious and Respiratory Disease Deaths, 1999-2019	Total Deaths	Total Death Rate (per 100k)
Lowcountry	1,192,401	2,669	21,682	24,351	2,042
Midlands	1,413,121	3,273	27,040	30,313	2,145
Pee Dee	991,472	3,301	24,891	28,192	2,843
Upstate	1,521,431	5,393	36,248	41,641	2,737
State Total	5,118,425	14,636	109,861	124,497	2,432

Table 69 Infectious Disease Death Rates. Source USA Facts

Based on USA Facts data, through June 2023, South Carolina had seen 1,481,646 reported cases of COVID-19 and 17,869 COVID-19 deaths. COVID-19 case rates will be researched in the coming years to understand the spread of disease as well as impacts of population density, protective measures, and other factors. The figure below depicts case rates in the state for the first two years of the pandemic; it does not include data from subsequent spikes in cases related to variants of the initial virus.

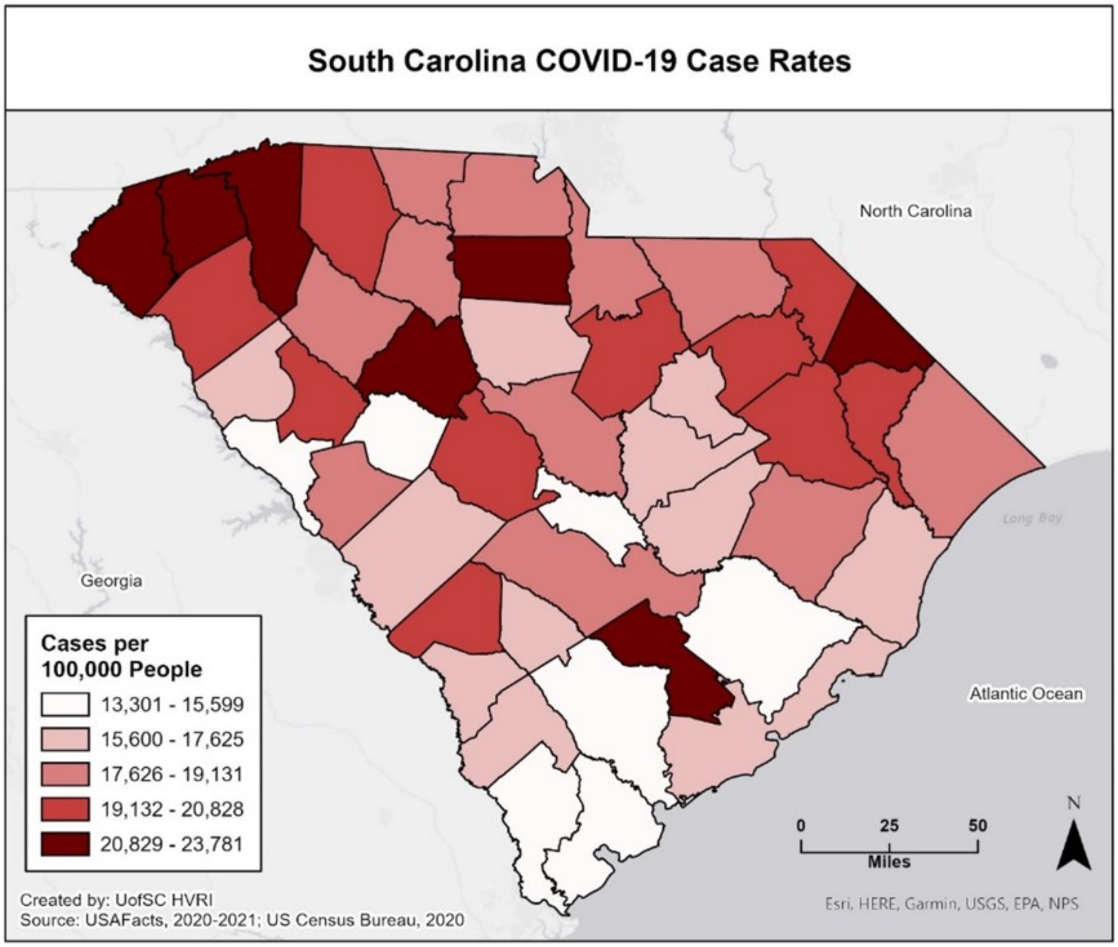


Figure 120: COVID-19 Case Rates in South Carolina Counties, January 22, 2020-January 10, 2022

Case rates equal the cumulative count of cases for each county divided by the 2020 population, multiplied by 100,000. Case rates normalize cases by population across the state and give a comparable measurement between counties. Statewide, there were 21,378 COVID-19 cases per 100,000 people. The counties with the highest COVID-19 case rates were Dillion (26,085), Dorchester (25,834) and Pickens (25,361). The counties with the lowest case rates were Calhoun (15,129), followed by Saluda (15,741) and Jasper (15,741). (Data Source: USAFacts, 2020-2022; data categorized by Natural Jenks).

During the 20-year period before the COVID-19 pandemic, from 1999 to 2019, 26,042 infectious disease deaths were recorded in South Carolina. Statewide, the average number of infectious disease deaths per county was 566. Death rates normalize deaths by population across the state and give a comparable measurement between counties. Infectious disease death rates equal the cumulative count of deaths for each county divided by the 2020 county population, multiplied by 100,000.

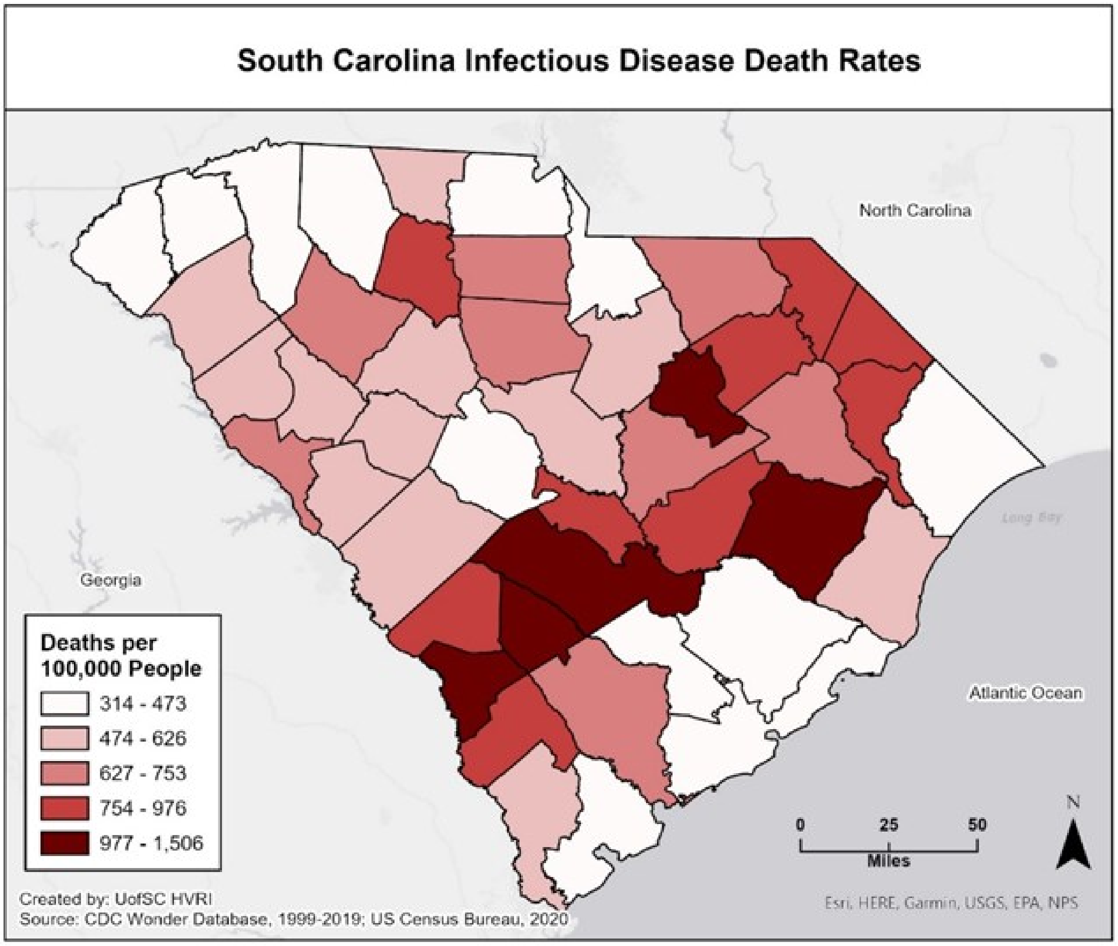


Figure 121: Infectious Disease Death Rates in South Carolina (1999-2019)

Counties with the highest death rates were Allendale (1,505), Lee (1,228) and Bamberg (1,225). The counties with the lowest infectious disease death rates were Berkeley (314), followed by Dorchester (321) and Lexington (353). (Data Source: CDC Wonder Database, 1999-2019; data categorized by: Natural Jenks).

Vulnerability

The following section provides information on hazard vulnerability from human infectious disease across South Carolina by county. Specifically, this section provides maps to summarize historical and recent infectious disease events and their associated case counts and fatalities. The occurrence data and totals for these cases and fatalities were calculated from USAFacts and the U.S. Census Bureau.

Although rural areas may be less vulnerable to diseases passed by human-to-human transmission than urban areas because of lower population density, they may be at higher risk for exposure to zoonotic diseases than urban areas. Population increases, combined with a trend toward urbanization, may increase population density, thereby increasing the risk of infectious disease by human-to-human transmission.

Certain groups may incur additional social vulnerability from infectious diseases. Populations such as elderly individuals or people with certain comorbidities may be at increased risk to some infectious diseases. Furthermore, lower income populations may lack access to adequate health care, and some rural populations may be medically underserved. In addition, transmission of disease is affected by behavior and may be more prevalent in certain groups that place themselves at increased risk because of engaging in such behavior. New and emerging diseases, especially zoonotic and foreign diseases, should continue to be considered when planning for infectious disease response.

Mitigation for infectious disease is largely addressed in the public health arena through symptom surveillance, prevention activities including vaccinations or other prophylaxis if available, recommendation and adoption of measures to contain disease spread, and related public education.

Impacts

Infectious diseases result in human illness and death and can cause agricultural and economic losses as well as disruption of vital services because of personnel shortages. COVID-19 has provided a harsh example of the human health and medical costs of infectious disease. The U.S. federal government has spent or committed more than $4 trillion in funding to support COVID-19 response and economic recovery.

In terms of deaths, in the two years from January 2020 (start of the COVID-19 pandemic in the U.S.) through January 10, 2022, COVID-19 caused 14,636 deaths in South Carolina, according to data assembled by USA Facts, which is an average of 5,854 deaths per year. As a means of comparision, other infectious diseases caused an average of 1,302 deaths per year for the period between 1999 and 2019, based on CDC data.

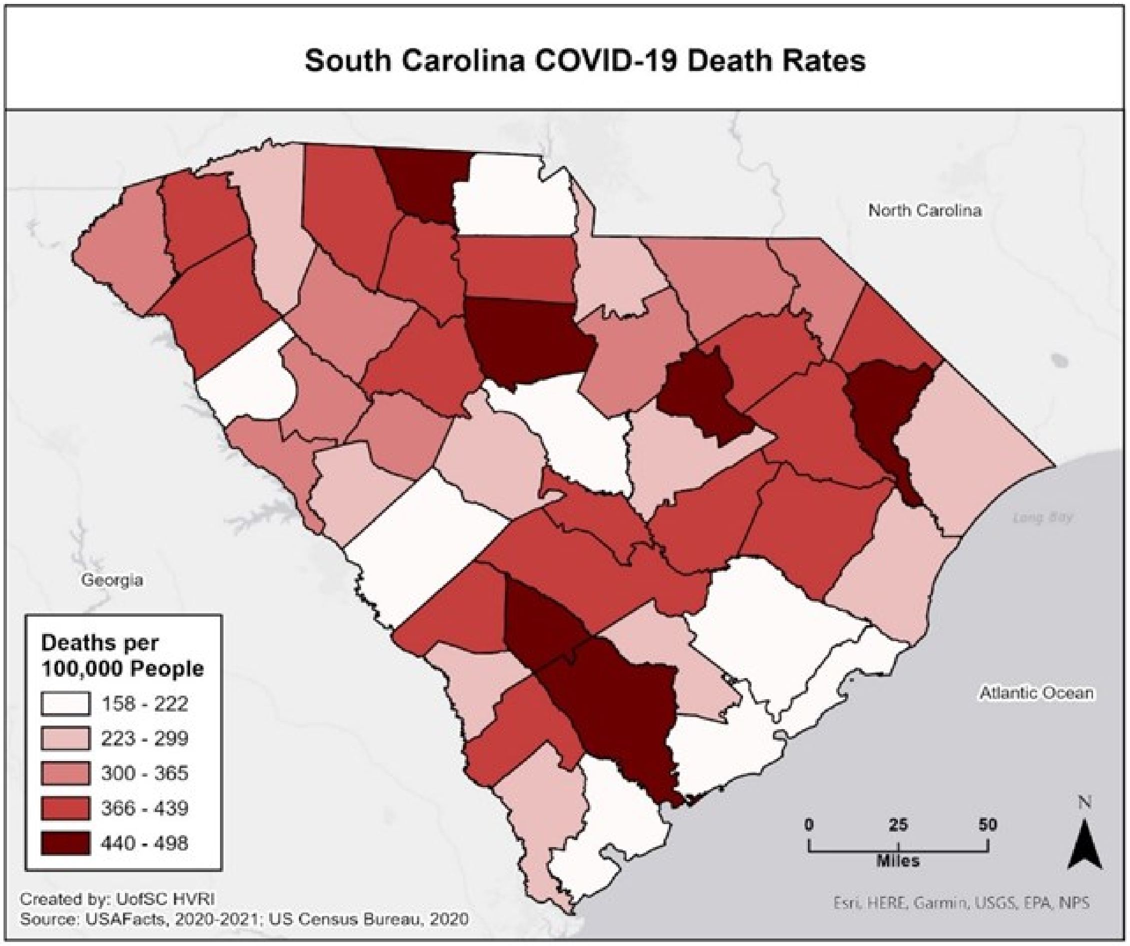


Figure 122: COVID-19 Death Rates in South Carolina, January 22, 2020-December 31, 2021

Death rates equal the cumulative count of deaths for each county divided by the 2020 county population, multiplied by 100,000. Death rates normalize the number of deaths by population to provide a comparable measurement among counties. Statewide, COVID-19 resulted in a total of 286 deaths per 100,000 people. The counties with the highest death rates were Colleton (497), Lee (496) and Marion (490). The counties with the lowest death rates were Berkeley (159), followed by Beaufort (174) and Charleston (185). (Data Source: USAFacts, 2020-2022; data categorized by: Natural Jenks).

Infectious disease can have a multitude of impacts on community lifelines. The table below describes the potential impacts an infectious disease could have on seven community lifelines; estimates are based on previous occurences and potential severe scenarios.

Community Lifeline	Level of Impact	Description of Impacts	Area of Impact
Communications	Low	Minimal impacts expected to communications infrastructure. Staff availability to operate and maintain communications equipment and systems may be reduced by infection, exposure, or public health guidance to minimize exposure. Extensive use of remote work and education approaches, if needed, may stress broadband networks.	Regional or statewide
Energy	Low	No significant impacts are anticipated. Staff availability to operate and maintain equipment and systems may be reduced by infection, exposure, or public health guidance to minimize exposure.	Regional or statewide
Food, Water, Shelter	Medium	Food supply chains could be disrupted because of disease spread or public health guidance to minimize exposure. Public concern could lead to panic buying/hoarding of food and water supplies.	Regional or statewide
Hazardous Materials	Low	No significant impacts are anticipated. Staff availability to operate and maintain equipment and systems may be reduced by infection, exposure, or public health guidance to minimize exposure.	Regional or statewide
Health and Medical	High	Medical staff and personnel will be overwhelmed by a significant hazard event. Staff availability may be reduced by infection, exposure, or public health guidance to minimize exposure. The medical supply chain could be stressed as demand for supplies increases. Fatality management could be a concern if the infectious disease has a high case fatality rate. Large numbers of people seeking care for the infectious disease could lead to increased wait times at emergency rooms.	Regional or statewide
Safety and Security	High	Response personnel may see an increase in calls for emergency care or for public incidents. Responders may need specialized training and protective gear to protect health and safety. Staff availability may be reduced by infection, exposure, or public health guidance to minimize exposure.	Regional or statewide
Transportation	Low	No significant impacts are anticipated. Staff and driver availability to continue operations may be reduced by infection, exposure, or public health guidance to minimize exposure.	Regional or statewide

Table 70 Potential Community Lifeline Impacts Based on Significant Infectious Disease Scenario

Vector-borne diseases are common in South Carolina and can include malaria, West Nile virus, Lyme disease, and several others. From 2010-2019, there were nearly 200 human cases of confirmed Lyme disease in the state (Centers for Disease Control and Prevention , 2022). From 1999-2020, there were 111 confirmed human cases of West Nile virus in South Carolina (Center for Disease Control and

Prevention , 2022). Infectious diseases that affect poultry, livestock, and other agricultural products can create significant economic losses. Other significant incidents involving infectious disease are described below.

Historical and Notable Events

March 1918: In 1918, a strain of H1N1 Influenza virus, later referred to as “Spanish Flu”, escalated into a global pandemic. The first cases in South Carolina were reported in spring of that year. By autumn, approximately 50,000 cases were reported in the state, with approximately 14,250 deaths, primarily from pneumonia, by the time the pandemic ended the following year.

***June 5, 1981*:** In June 1981, the first official report of a condition that would come to be known as Acquired Immune Deficiency Syndrome (AIDS) was reported in California. The first case in South Carolina was diagnosed in 1982 (University of South Carolina , 2011). This condition was tied to Human Immunodeficiency Virus (HIV) on January 11, 1985 (University of South Carolina, 2011). From 2008-2020, there were 9,324 new cases of HIV diagnosed in South Carolina. During that same time span, there were 4,197 deaths attributed to complications related to HIV (CDC, 2022).

June 11, 2009: On June 11, 2009, the World Health Organization (WHO) declared an influenza pandemic from a strain of the H1N1 influenza virus, commonly referred to as “Swine Flu” as the virus originated in pigs before mutating into a form transmissible from human to human. An estimated 927,000 human cases occurred in South Carolina, resulting in 1,091 hospitalizations and 49 deaths (Learner, Beasley, & and Drociuk, 2010).

Recent Activity (2018–2022)

January 2020-present: In early 2020, the WHO began tracking a respiratory illness emerging from Wuhan Province in the People’s Republic of China. The virus was designated as novel coronavirus 2019, officially named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), shortened to COVID-19 in laymen’s terms, and is the cause of an ongoing coronavirus pandemic in humans. On March 11, 2020, the WHO declared COVID-19 a global pandemic (World Health Organization, 2020). The first case of COVID-19 in South Carolina was detected on March 16, 2020 (SCDHEC, 2020). From that point through January 10, 2022, there were 975,320 diagnosed human cases of COVID-19 (Figure 122), with 14,636 fatalities for a mortality rate of 1.5%. Response and disease spread prevention costs tallied in the hundreds of millions of dollars.

April 2020: In March 2020, Low Pathogenic Avian Influenza (LPAI) was identified on 11 commercial turkey farms in North Carolina and one in South Carolina. The following month, an additional farm in South Carolina confirmed LPAI, as well as some limited cases of Highly Pathogenic Avian Influenza. To contain the spread of disease and the threat it posed, more 360,000 birds were depopulated across multiple locations (Youk S. L., 2020). As a result of this relatively contained outbreak, 55 countries imposed an international trade ban on some or all SC poultry and poultry products.

November 2022: As of January 2023, there had been 58 confirmed cases of zoonotic Eurasian Highly Pathogenic Avian Influenza (EA HPAI) in wild birds found in South Carolina (Clemson University Livestock Poultry Health , 2022). In October-November 2022, HPAI was identified in poultry on a community farm on an island in Beaufort County; 172 poultry were neutralized and composted. As of preparation of the SHMP update, no cases were reported in commercial farms. The same strain has infected commercial and backyard flocks in 38 other states necessitating the depopulation of more than 40 million birds. The multi-state outbreak had significant economic impacts and created supply chain disruptions that directly and indirectly impacted South Carolina.

November 2022: As of January 4, 2023 had been 58 confirmed cases of zoonotic Eurasian Highly Pathogenic Avian Influenza (EA HPAI) in wild birds found in South Carolina (Clemson University Livestock Poultry Health , 2022). In October-November 2022, HPAI was identified in poultry on a community farm on an island in Beaufort County; 172 poultry were neutralized and composted. As of preparation of the SHMP update, no cases were reported in commercial farms. The same strain infected commercial and backyard flocks in at least 38 other states, requiring the depopulation of over 40 million birds. The multi-state outbreak had economic impacts and created supply chain disruptions that directly and indirectly impacted South Carolina.

July 20, 2022: As of July 20, 2022, there were 16 confirmed cases of Monkeypox, a zoonotic disease, in South Carolina. No deaths were reported at that time (Centers for Disease Control and Prevention, n.d.). On July 23, 2022, the World Health Organization declared Monkeypox to be a Public Health Emergency of International Concern (World Health Organization, 2022).

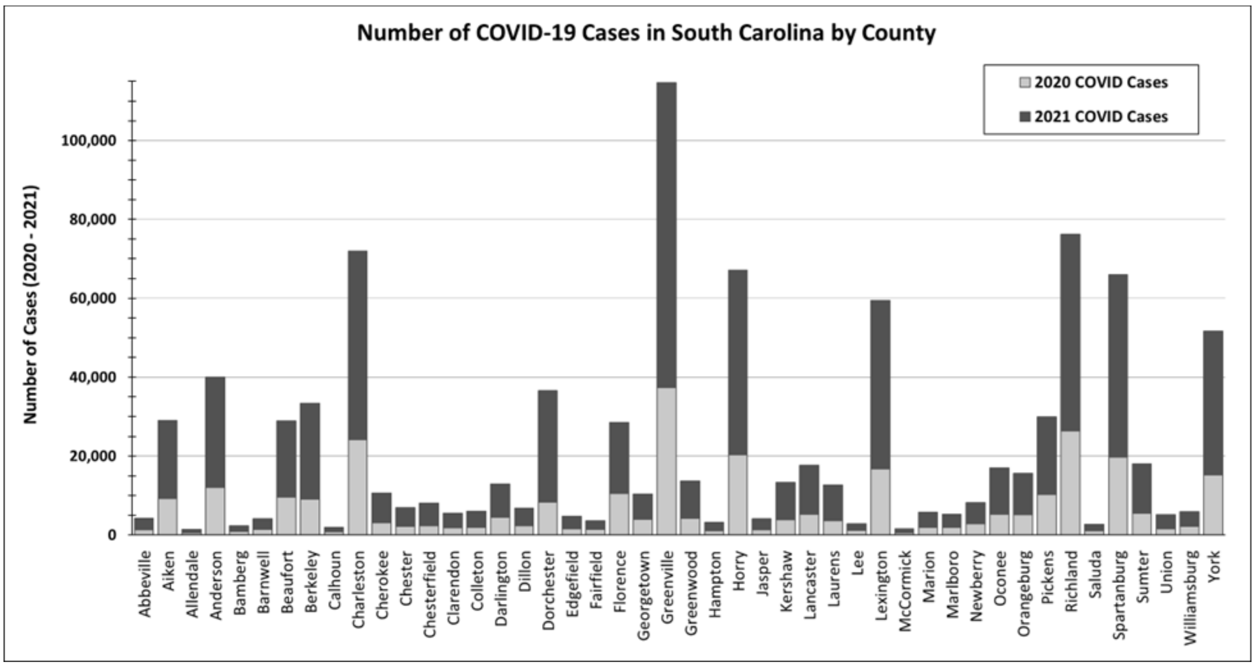


Figure 123: South Carolina COVID-19 Cumulative Case Counts between January 22, 2020, and December 31, 2021

This graph of 2020 and 2021 cases shows the total annual cases compared to the cumulative totals for each county over the time. The total number of cases for South Carolina for 2020-2021 was 975,320, with the majority (68.5% occurring in 2021). The average number of COVID-19 cases per county for the 2020-2021 period was 21,203. The counties with the highest total COVID-19 cases were Greenville (128,738), Richland (89,803) and Charleston (83,608). The counties with the lowest COVID-19 cases were Allendale (1,551), followed by McCormick (1,702) and Calhoun (2,136). (Data Source: USAFacts, 2020-2021).

Future Climate Considerations

Changes in climate patterns may result in changes in plant and animal success and in and supplies of food and water, which could impact human health. Warmer temperatures may be more favorable to some disease agents. In the event that climate change were to spur migration of people or vectors into new areas because of a loss of livable areas or habitats, there is the potential for increased population density and interaction between humans and wildlife, either of which may lead to increased incidents of exposure to infectious disease.

P. Hazardous Materials

In many places, people and communities are surrounded by chemicals and hazardous materials (hazmat). These materials can cause death, injury, long term health problems, and damage to property (U.S. Environmental Protection Agency, 2022). Hazardous materials come in many forms and incidents can occur at fixed facilities or in transit. Hazardous materials are stored in homes and businesses and shipped daily on highways, railroads, waterways, and pipelines. Facilities that store or use hazardous materials are present throughout the state, but many are located in coastal counties, where they may be exposed to winds and heavy rain from tropical systems. South Carolina's industrial capacity and network of highways and railways result in vulnerabilities to hazardous material releases. Hazardous material incidents can include spilling, leaking, pumping, emitting, discharging, escaping, leaching, or disposing of hazardous material into the environment. For this analysis, hazmat incidents exclude: (1) a release that results in exposure to poisons solely within the workplace with respect to claims that people may assert against the employer; (2) emissions from the engine exhaust of a motor vehicle, rolling stock, aircraft, vessel, or pipeline pumping station engine; (3) release of source, byproduct, or special nuclear material from a nuclear incident; and (4) the normal application of fertilizer.

Location and Probability

As noted above, hazardous materials releases can occur at fixed sites or during transit. **Error! Reference source not found.** shows the locations of Superfund sites, Toxic Release Inventory (TRI) facilities, and other hazardous material sites for South Carolina, for the year 2021 (U.S. Environmental Protection Agency, 2022). Data on these locations is reported to the federal Environmental Protection Agency (EPA) by operators to comply with federal laws and regulations. According to the EPA, Superfund sites are uncontrolled or abandoned places where hazardous waste is located that may potentially affect the local ecosystem or community. The TRI database contains information on 709 chemicals and chemical categories that industrial and other facilities manage (dispose of, recycle, treatment of, etc.) for the country (U.S. Environmental Protection Agency, 2022). Table 71 lists by county the number of TRI facilities, Superfund sites, treatment, storage, and disposal sites, and landfills. Greenville County has the most such sites, with a total of 237 sites (U.S. Environmental Protection Agency, 2022).

County	TRI	Superfund	Hazardous Material Treatment, Storage, Disposal	Solid Waste Landfill	Total
Abbeville	13	0	0	3	16
Aiken	45	2	1	34	82
Allendale	7	1	0	2	10
Anderson	56	0	1	25	82
Bamberg	9	0	0	4	13
Barnwell	11	1	2	5	19
Beaufort	6	4	2	12	24
Berkeley	49	0	3	15	67

County	TRI	Superfund	Hazardous Material Treatment, Storage, Disposal	Solid Waste Landfill	Total
Calhoun	5	0	0	5	10
Charleston	77	3	6	18	104
Cherokee	28	1	0	9	38
Chester	33	1	0	9	43
Chesterfield	26	2	2	6	36
Clarendon	7	0	0	4	11
Colleton	13	0	0	8	21
Darlington	18	0	1	14	33
Dillon	8	0	0	6	14
Dorchester	36	0	1	14	51
Edgefield	6	0	0	5	11
Fairfield	9	0	0	4	13
Florence	35	1	4	11	51
Georgetown	20	0	1	10	31
Greenville	180	6	7	44	237
Greenwood	31	0	0	8	39
Hampton	11	0	1	3	15
Horry	25	0	2	16	43
Jasper	4	0	0	10	14
Kershaw	21	0	3	10	34
Lancaster	22	0	1	12	35
Laurens	30	0	1	12	43
Lee	3	0	0	4	7
Lexington	65	3	3	27	98
Marion	8	0	0	8	16
Marlboro	15	0	0	6	21
McCormick	67	2	2	24	95
Newberry	1	1	0	0	2
Oconee	24	0	0	8	32
Orangeburg	28	0	1	18	47
Pickens	37	0	3	8	48
Richland	30	1	1	9	41
Saluda	65	3	2	25	95
Spartanburg	2	0	0	3	5
Sumter	152	1	9	34	196
Union	35	0	8	10	53
Williamsburg	15	0	1	7	23

County	TRI	Superfund	Hazardous Material Treatment, Storage, Disposal	Solid Waste Landfill	Total
York	10	0	0	5	15
Total	1398	33	69	534	2034

Table 71 Hazardous Material Sites by County

Based on previous events, Cherokee County has the highest probability for future hazardous material events involving transportation, at 1,779.55% per year. From 2000 to 2021, the U.S. Departmart of Transportation reported 392 incidents in Cherokee County. Lee, Marion, Marlboro, and McCormick counties have the lowest historical probability, at 0% per year having no reported incidents during the time period.

County	Hazmat Transportation Occurrence (2000-2021)		County	Hazmat Transportation Occurrence (2000-2021)	
	Future Annual Probability (% chance per year)	Frequency Interval (Years between event)		Future Annual Probability (% chance per year)	Frequency Interval (Years between event)
Abbeville	6.82	14.67	Greenwood	54.55	1.83
Aiken	172.73	0.58	Hampton	61.36	1.63
Allendale	22.73	4.40	Horry	54.55	1.83
Anderson	302.27	0.33	Jasper	11.36	8.80
Bamberg	4.55	22.00	Kershaw	36.36	2.75
Barnwell	4.55	22.00	Lancaster	31.82	3.14
Beaufort	31.82	3.14	Laurens	22.73	4.40
Berkeley	199.68	0.50	Lee	0.00	-
Calhoun	13.64	7.33	Lexington	647.73	0.15
Charleston	449.68	0.22	Marion	0.00	-
Cherokee	1,779.55	0.06	Marlboro	0.00	-
Chester	36.36	2.75	McCormick	0.00	-
Chesterfield	27.27	3.67	Newberry	27.27	3.67
Clarendon	13.64	7.33	Oconee	15.91	6.29
Colleton	4.55	22.00	Orangeburg	63.64	1.57
Darlington	22.73	4.40	Pickens	54.55	1.83
Dillon	31.82	3.14	Richland	350.00	0.29
Dorchester	72.41	1.38	Saluda	6.82	14.67
Edgefield	22.73	4.40	Spartanburg	465.91	0.21
Fairfield	13.64	7.33	Sumter	63.64	1.57

Florence	313.64	0.32	Union	9.09	11.00
Georgetown	31.82	3.14	Williamsburg	13.64	7.33
Greenville	615.91	0.16	York	150.00	0.67
State Average				137.73	4.97

Table 72 Hazardous Materials Occurrence

Overall hazard risk, combining probability and impacts by county, in the form of county hazard risk scores for hazard material releases is depicted in the figure below.

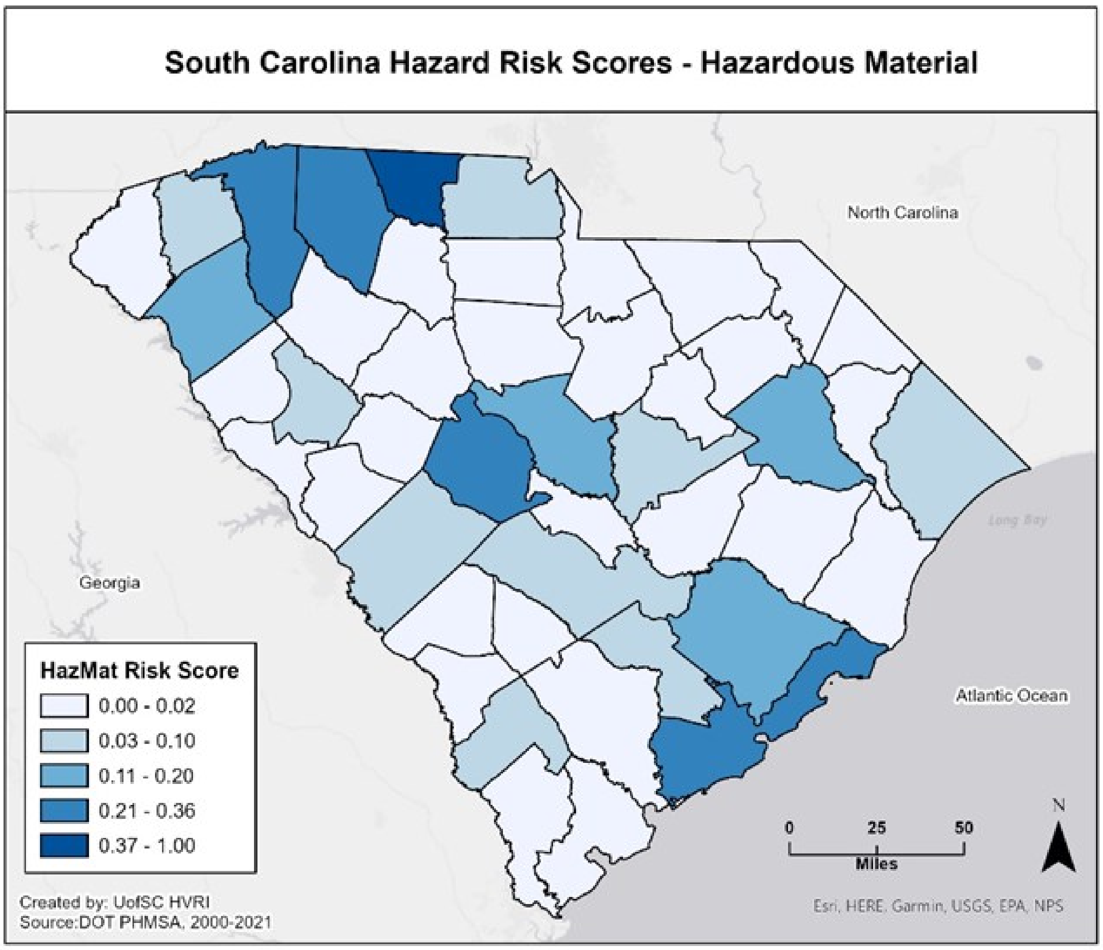


Figure 124: South Carolina Hazardous Material Incident Risk Scores by County

Vulnerability

Vulnerability to hazard material releases is relate to proximity to storage, production, and transportation sites for materials that can have hazardous effects. See location information above. Changes in a location's potential vulnerability to hazardous material events can occur quickly and can go unnoticed, such as through changes in transportation routes or volumes of materials transported. Development or expansion of industry can mean the presence of substances not previously found in a community.

In terms of the vulnerability characteristics of residents, of 1,303 census tracts in the state, 116 fall within the combined highest levels of social vulnerability and highest risk scores (dark blue). These high-high areas are concentrated in eight counties, including areas in Anderson, Charleston, Cherokee, Florence, Greenville, Lexington, Richland, and Spartanburg counties. Increased population density combined with the concentration of hazardous materials sites and intersections of transportation hubs in urban areas mean urban populations are at an increased risk to exposure to a hazardous material incident. Population increases combined with the ongoing tendency towards urbanization may potentially increase this risk in the future

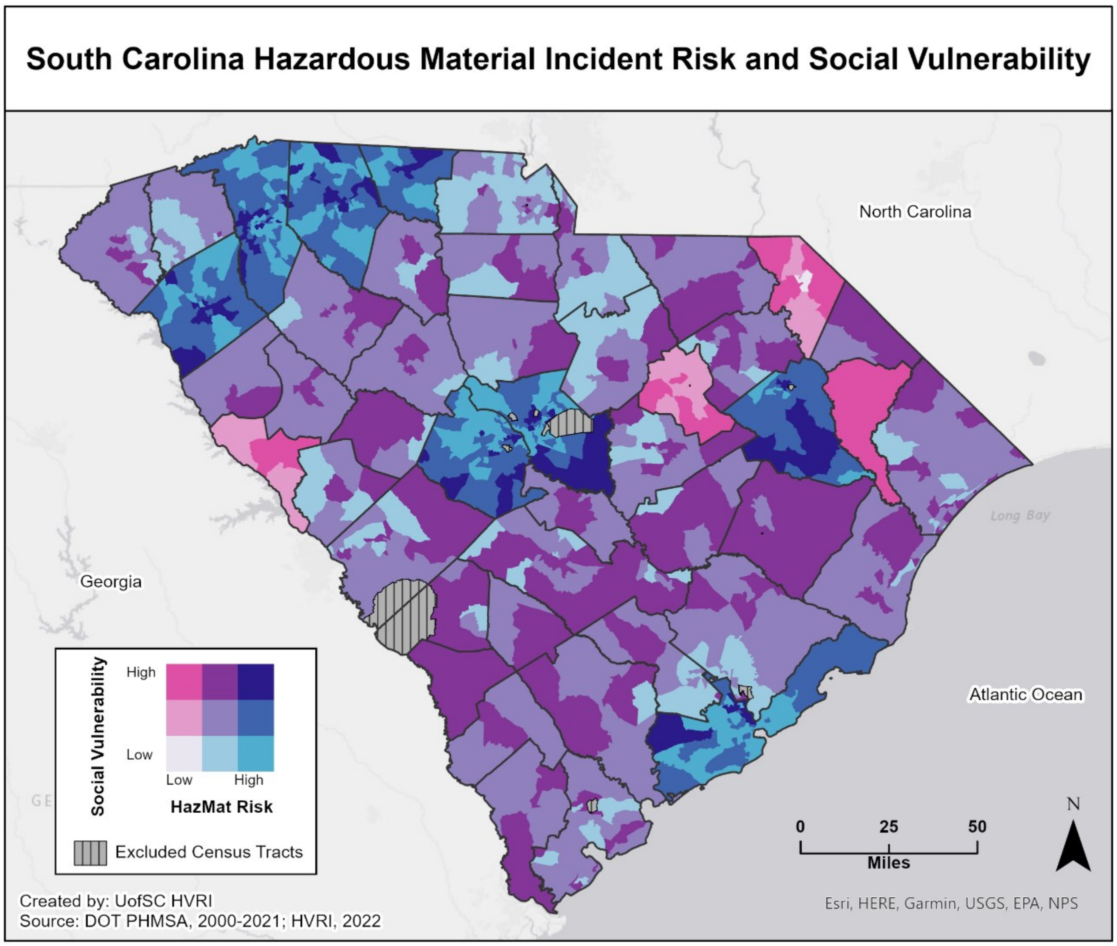


Figure 125: South Carolina Social Vulnerability and Hazardous Material Incident Risk

Impacts

Impacts of hazardous material incidents are typically calculated based on deaths and injuries as well as property damage and response costs measured in dollars. Hazardous material releases can create cascading effects, including traffic congestion and rerouting, permanent or temporary displacement of businesses and households, and environmental damage.

Historically, Aiken County has the highest number of annualized losses, and Cherokee has the highest future probability. Edgefield County has suffered the highest number of annualized losses in recent history (2015-2021). Details on historical events and losses are provided below.

County	Historical Impact (2000-2021)		Recent Impact (2015-2021)	
	Annualized Losses	Deaths	Annualized Losses	Deaths
Abbeville	$3,304	0	$0	0
Aiken	$138,580	9	$5,408	0
Allendale	$27,318	0	$265,445	0
Anderson	$34,330	1	$128,935	1
Bamberg	$252	0	$0	0
Barnwell	$58	0	$0	0
Beaufort	$353	0	$2,567	0
Berkeley	$13,821	0	$59,340	0
Calhoun	$286	0	$0	0
Charleston	$37,748	0	$60,155	0
Cherokee	$18,889	0	$105,508	0
Chester	$4,720	0	$45,504	0
Chesterfield	$3,941	0	$363	0
Clarendon	$112	0	$0	0
Colleton	$59	0	$600	0
Darlington	$460	0	$0	0
Dillon	$4,892	0	$1,458	0
Dorchester	$10,862	0	$13,032	0
Edgefield	$32,019	0	$267,000	0
Fairfield	$150	0	$792	0
Florence	$3,127	0	$6,733	0
Georgetown	$269	0	$1,033	0
Greenville	$10,910	0	$80,715	0
Greenwood	$8,570	0	$84,047	0
Hampton	$3,618	0	$36,208	0
Horry	$2,777	0	$9,222	0
Jasper	$134	0	$1,000	0
Kershaw	$4,266	0	$833	0
Lancaster	$15,215	0	$71,843	0
Laurens	$3,175	0	$250	0
Lee	$0	0	$0	0
Lexington	$26,245	1	$77,045	0
Marion	$0	0	$0	0
Marlboro	$0	0	$0	0

County	Historical Impact (2000-2021)		Recent Impact (2015-2021)	
	Annualized Losses	Deaths	Annualized Losses	Deaths
McCormick	$0	0	$0	0
Newberry	$1,697	0	$15,342	0
Oconee	$4,206	2	$846	0
Orangeburg	$24,859	1	$86,048	1
Pickens	$3,048	0	$27,350	0
Richland	$5,750	0	$17,493	0
Saluda	$1,407	0	$14,250	0
Spartanburg	$35,428	6	$64,769	6
Sumter	$7,046	0	$2,558	0
Union	$70	0	$381	0
Williamsburg	$541	0	$250	0
York	$9,371	1	$21,367	0
Grand Total	$503,883	21	$1,575,690	8
State Average	$10,954	0.46	$34,254	0.17

Table 73 Hazardous Material Incident Annualized Losses

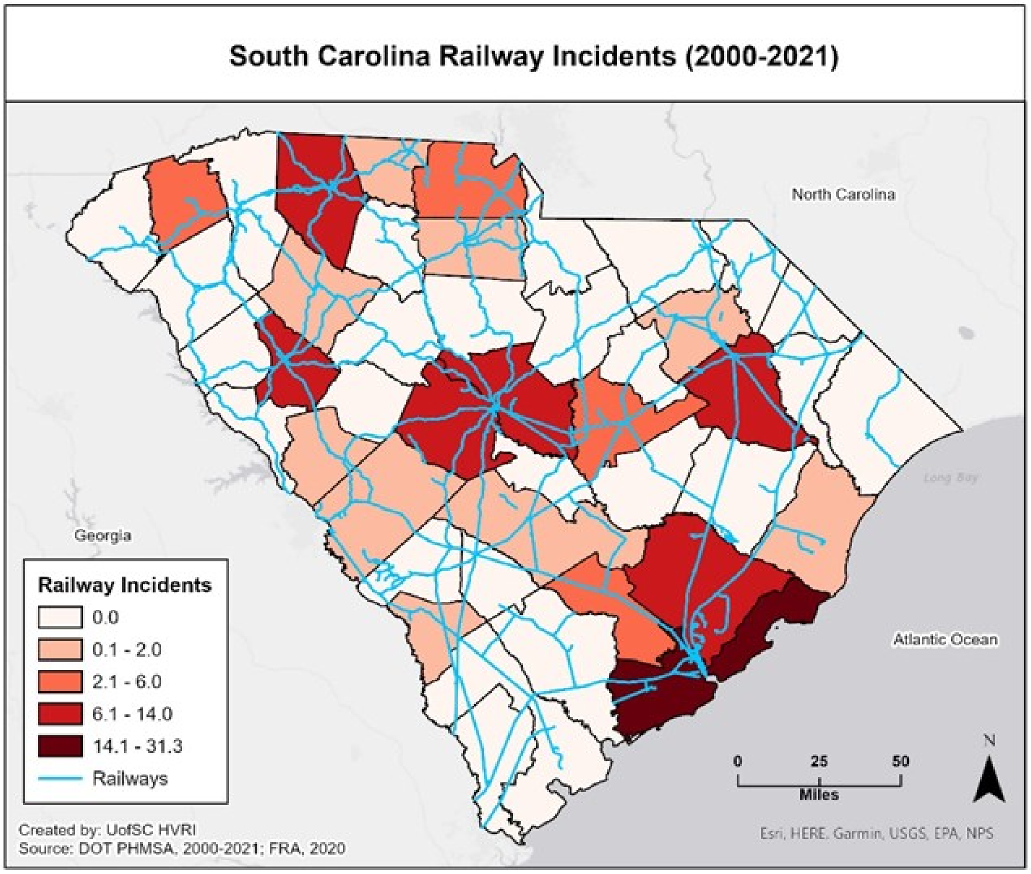


Figure 126: South Carolina Hazardous Material Incidents Occurring on Railways.

Source: Department of Transportation PHMSA, 2000-2021

A high consequence hazardous materials scenario can have impacts on community lifelines. The table below describes the potential impacts a significant hazardous material scenario could have on the seven lifelines.

Community Lifeline	Level of Impact	Description of Impacts	Area of Impact
Communications	Low	Significant impacts are not anticipated other than potential increases in telecommunications volume.	Localized
Energy	Medium	A release could cause loss/wastage of fuel, which could reduce supply. Releases may disrupt access to power facilities, fuel stations, or pipelines.	Localized or regional
Food, Water, Shelter	High	Release of hazardous materials may result in the need to evacuate residential areas and may cause contamination of local food or water supply. Residents in affected areas may need emergency shelter and other support. Large releases could result in embargos of crops and livestock.	Localized or regional
Hazardous Materials	High	A hazardous material release may damage or contaminate immediate facilities as well as nearby areas. This could cause public health and environmental risks. Damage could result in loss of material, causing economic loss. Site personnel may be injured or need to be evacuated. Operations related to the storage, production, or transport of the hazardous materials involved in the release may be disrupted or halted and supplies of the materials may be constrained.	Localized or regional
Health and Medical	High	A hazardous material release in the immediate area could create health and safety hazards that necessitate evacuation of medical facilities and interruption of normal operations. A release may cause contamination that requires decontamination. Medical facilities can expect an influx of patients who have been exposed to the hazardous material or report symptoms. Hazardous conditions may result in closure or rerouting of transportation used to access facilities or locations where medical assistance is needed.	Localized or regional

Community Lifeline	Level of Impact	Description of Impacts	Area of Impact
Safety and Security	Medium	A hazardous material release in the immediate area could create health and safety hazards that necessitate evacuation of nearby areas. Specialized detection, modeling, containment/mitigation, and safety equipment as well as training may be needed, depending on the type and volume of material. Responders will need to quickly identify the type of material and appropriate protocols to protect human health and safety, including their own, and the environment.	Localized
Transportation	Medium	Release of hazardous materials in transit could cause hazardous conditions on roadways or rail or at port or airport facilities, resulting in closures and disruptions to operations. From a fixed site release, significant impacts on transportation are not expected. A significant release of petroleum products could impact transportation through loss of supply.	Localized or regional

Table 74 Potential Community Lifeline Impacts Based on Significant Hazmat Event

Historical and Notable Events

The following narratives discuss historic events as well as more recent events, including those since the last plan update. Hazardous material release information is from the United States Department of Transportation's Pipeline and Hazardous Materials Safety Administration website. For information regarding data methodology, see Appendix B.

January 6, 2005: In the early morning of the January 6, 2005, a northbound freight train traveling through Graniteville in Aiken County was improperly diverted and collided with a parked train, causing the derailment of both locomotives and 16 of the 42 freight cars on the northbound train. Of the derailed, 3 were tank cars containing chlorine gas, one of which breached. Nine people died from chlorine inhalation and more than 500 were taken to hospitals for respiratory difficulties. About 5,400 people were evacuated within a one-mile radius of the derailment site. This incident caused damage of at least $6.9 million.

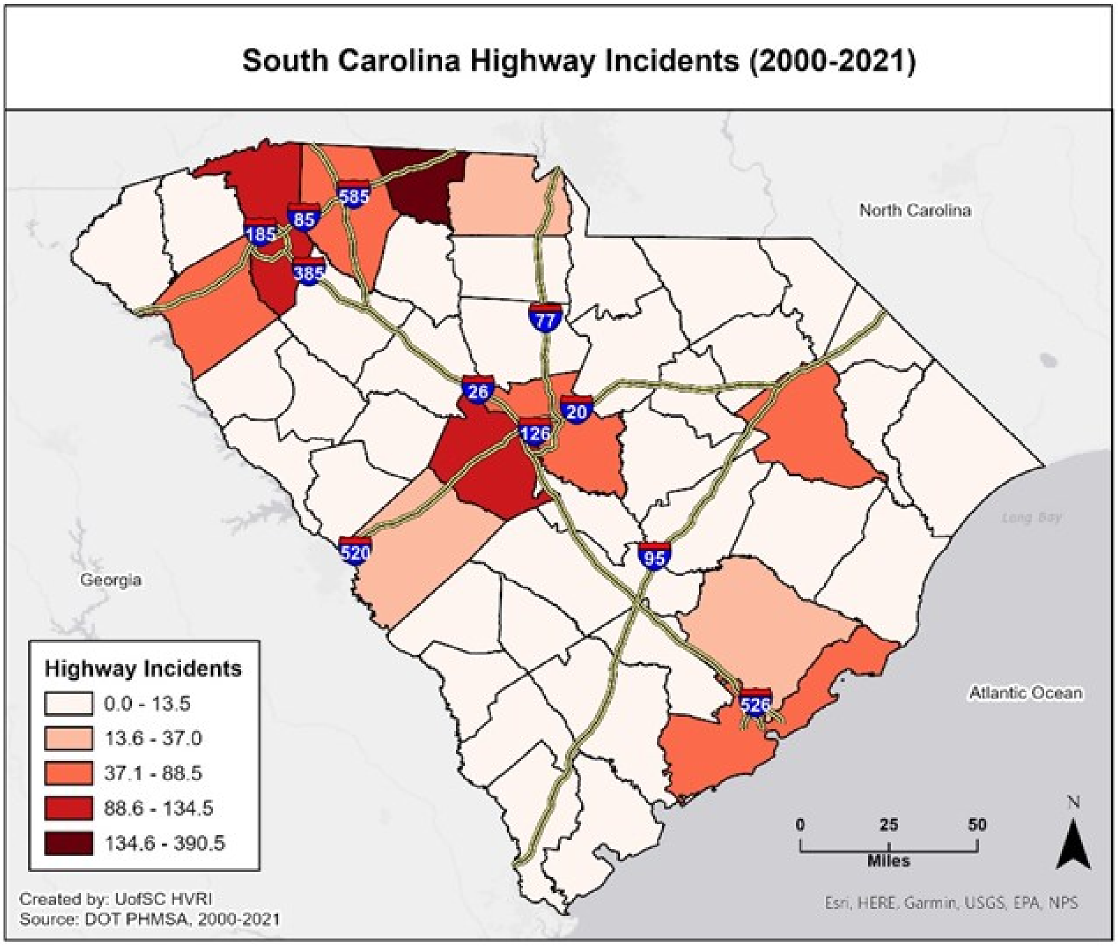


Figure 127: South Carolina Hazardous Material Incidents Occurring on Highways.

Source: Department of Transportation PHMSA, 2000-2021; Federal Railway Administration, 2020

Recent Activity 2018-2022

January 27, 2015: At 2:17 A.M. a train derailed after entering a siding in Martin, SC. The lead locomotive struck tank cars stored on the track, including a tank car of hydrochloric acid, which sustained severe damage. The car was breached on both ends of the container, releasing its contents. In addition, a loaded tank car of sodium hydroxide sustained damage on one end, which activated the pressure relief device valve, releasing approximately one gallon of product. Martin and Allendale County Fire Departments were dispatched to the site and evacuated one nearby residential home and as a precautionary measure and closed State Highway 125 and Chert Quarry Road. Total costs for the incident were $795,647.

April 10, 2015: At approximately 8:40 P.M., a train struck a downed tree and derailed two locomotives and 31 cars on the main line near Milepost R163 in Trenton, SC. The derailment caused the release of approximately 61,000 pounds of ammonium nitrate from two covered hopper cars. Total costs for the incident were approximately $800,000.

June 27, 2015: At 7:36 A.M., a tanker truck traveling westbound on I-26 near mile marker 17, loaded with gasoline and diesel fuel, wrecked along with two other vehicles, with the trailer coming to rest across both lanes of I-26 at the approach to a bridge spanning railroad track below. During the accident, the cargo ignited, and the other two vehicles were consumed by the fire. Another vehicle following those three was destroyed by the fire, although it was not involved in the wreck. The accident resulted in three fatalities and severe burn injuries to another person. The accident resulted in the closure of the westbound lanes at that location for over a day. Total costs of the incident were approximately $115,019.

March 23, 2016: At approximately 12:00 P.M., a tanker truck trailer overturned in Belton, SC, causing damage to the tanker that resulted in a spill and subsequent fire. The truck and trailer became immediately engulfed in flames, resulting in the operator's death. It is unknown how long gasoline spilled out of the tanker, although cleanup efforts revealed a significant amount spilled that was unburned. Because of land contour, the spill was contained in an area of approximately 5,000 square feet. A cleanup contractor vacuumed the standing product and water that was visible on the ground after the fire was extinguished. The cleanup crew excavated the area of the release, with the excavation ranging from 1 to 16 feet in depth. The excavation was filled with fill dirt and seeded. Total costs of the incident were approximately $273,000.

August 19, 2016: At approximately 3:00 A.M., a tractor-trailer was struck on left side of the trailer by another tractor trailer while backing across highway, which resulted in a fire that caused the death of one of the drivers. Approximately 2000 gallons of gas was released. The total cost of the incident was $256,285.

August 25, 2018: At approximately 2:57 A.M., rail station personnel in Maxwell Yard, Greenwood, SC, reported a rail car of hydrogen peroxide leaking from the top of the car after the car derailed and turned onto its side. The tank car was isolated, the shipper was notified, and a response contractor responded and found product leaking near the liquid line of the tank car. The contractor attempted to stop the leak but was unable to do so. Containment was placed under the liquid line until the tank car was turned upright. Total costs of the incident were approximately $61,000.

Future Climate Considerations

There is no indication of a direct relationship between climate change and hazardous materials incidents, although increases in temperature extremes and severe weather events could result in hazardous material releases as secondary effects.

Q. Nuclear Facilities

South Carolina's five nuclear facilities are located within or border the following seven counties: Aiken, Allendale, Barnwell, Darlington, Fairfield, Oconee, and York. (Figure 127). Most counties in the state fall within the 10-mile or 50-mile emergency-planning zone of at least one nuclear facility; Beaufort, Berkeley, Charleston, Dorchester, and Georgetown counties do not. Three nuclear power sites in neighboring states could potentially affect South Carolina residents. The total population within the 10-mile buffer zone of at least one nuclear facility is 310,686.

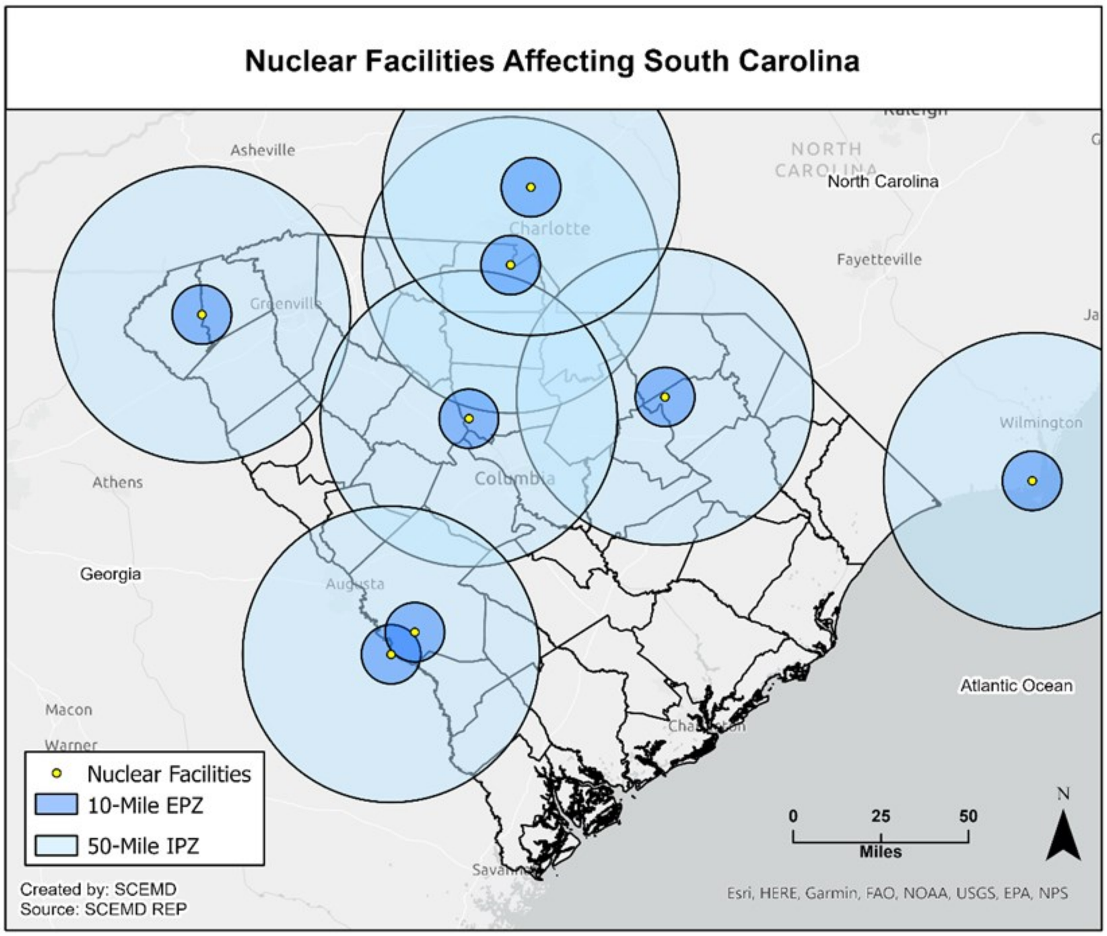


Figure 128: Nuclear Facilities with 10 and 50-Mile Buffers

Nuclear power plant accidents are rare. According to Duke Power, an operator of nuclear power facilities, typical nuclear power plants have the following risks:

- About a one in 20,000 chance per year that a nuclear power plant will experience a serious accident, and
- About one in 4 million chance per year that anyone in the public will die as a direct result of a nuclear accident.
- Although these statistics suggest that the chance of a serious accident is considered low, annual update of emergency operation plans for nuclear power plant incidents and regular training exercises are required to provide for the safety of the public and the environment.

Vulnerability

GIS analysis was performed to estimate the total population (at the census tract level) within 10-mile and 50-mile buffers of nuclear power sites in the state. Total population within the 10-mile buffer is 310,868; within the 50-mile buffer, total population is 2,557,063. Almost 50 percent of South Carolina's population lives within the 50-mile buffer of a nuclear facility. Given that there has only been one incident (see historical occurrences below), further occurrence analysis was not warranted or feasible. In an evacuation scenario because of a nuclear release, demographic factors including income, transportation dependency, and ability to receive and act on emerency notifications can be expected to increase vulnerability.

Impacts

A nuclear facility incident can result in multiple potential impacts depending on the scale of the incident. The initial incident may begin a series of cascading events. A nuclear incident could impact most counties in South Carolina as highlighted in Figure 128. The population within the 10-mile ingestion pathway zone (IPZ) will be most affected by a nuclear incident and to a lesser extent those within the 50-mile IPZ. These zones are identified for preparedness, planning, and public communication purposes based on potential for radiation exposure. Radiation exposure can lead to irritation, burns, and, in severe cases, death. The physical landscape would be affected as radiation will contaminate air, land, and water within the affected area, rendering the area a contamination zone. Weather at the time of incident plays a role in determining which areas are impacted. Wind speed and direction contribute to the size of the contamination zone.

A nuclear incident could cause impacts that would be felt regionally and statewide. The table below identifies potential impacts in the state's community lifelines.

Community Lifeline	Level of Impact	Description of Impacts	Area of Impact
Communications	Low	Increased use/call volume could result in disruptions of service.	Regional
Energy	Low	Nuclear power generation and transmission could be disrupted.	Regional and statewide
Food, Water, Shelter	High	Crops, stock animals, water, and shelter in the impact area and possibly surrounding areas may be contaminated with nuclear radiation. Emergency shelter and feeding operations outside the impact zone(s) will be needed. Agricultural products and livestock transportation will likely be embargoed, with affected livestock needing to be depopulated.	Regional or statewide
Hazardous Materials	High	Potential for hazardous nuclear materials or radiation to impact surrounding area for an extended period. This could cause environmental, human, and animal health risks.	Localized or regional
Health and Medical	High	Medical facilities in the immediate area may need to evacuate, depending on nature of incident. Large numbers of people may need decontamination and treatment for radiation exposure.	Regional

Community Lifeline	Level of Impact	Description of Impacts	Area of Impact
Safety and Security	High	Personnel may be needed from other parts of the state or interstate mutual aid to contain the hazard area and support access control points, evacuation, shelter, and other activities. Response personnel would need specialized training, equipment, and protective gear, as well as decontamination.	Regional; possibly statewide
Transportation	Medium	Transportation routes and modes could be interrupted because of evacuation and exclusion zones. Transportation equipment could be contaminated by radiation. Rail and air traffic may be impacted by flight restrictions and rail stoppage orders.	Regional

Table 75 Potential Community Lifeline Impacts Based on Significant Nuclear Incident

Historical and Notable Events

There has been one incident involving radioactive material in South Carolina since 2001, which occurred in Barnwell County. The May 27, 2004, incident, classified as a non-emergency event by the Nuclear Regulatory Commission, involved surface contamination levels greater than their prescribed limits. Contamination levels that exceeded U.S. Department of Transportation (USDOT) and Barnwell County limits were found on a ship in a sea-land container when it reached its destination. A condensation puddle inside the container leaked out onto the trailer bed; there were no personnel exposures.

Future Climate Considerations

Climate change may have a secondary impact on likelihood or severity of a nuclear incident. However, no current evidence on the type, location, or hazard type concludes to a direct link between climate change and the extent, frequency, intensity, or magnitude of a nuclear-related event.

R. Terrorism and Mass Violence

Terrorism and mass violence pose a threat in South Carolina as they do in other locations in the United States and internationally. The Code of Federal Regulations defines terrorism as "the unlawful use of force and violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives." (South Carolina Law Enforcement Division, 2020) According to the U.S. Department of Justice, mass violence is defined as "an intentional crime that results in physical, emotional, and or psychological injury to a sufficiently large number of people" (US Department of Justice , 2006). Based on definitions in several federal laws, mass killings include incidents in which three or more people are killed, and mass shootings are those in which four or more people are killed.

Classification

Not all instances of mass violence are terrorism. Terrorism is determined based on definitions such as that noted above from federal law and regulations. Some but not all instances of mass violence are classified as terrorism based on the intent or purpose of the actor. Potential characteristics and tools associated with terrorism incidents include:

- Agriterrorism/agroterrorism: "the malicious use of plant or animal pathogens to cause devastating disease in the agricultural sector" (US Department of Justice , 2006)
- Armed attack: "tactical assault or sniper attacks from a remote location" (South Carolina Law Enforcement Division, 2020)
- Arson/incendiary attack: "to unlawfully and intentionally damage or attempt to damage any real or personal property by fire or incendiary device" (South Carolina Law Enforcement Division, 2020)
- Biological agent: "Liquid or solid contaminants can be dispersed using sprayers/aerosol generators or by point or line sources such as munitions, covert deposits, and moving sprayers. May be directed at food or water supplies" (South Carolina Law Enforcement Division, 2020)
- Chemical agent: "Liquid/aerosol contaminants can be dispersed using sprayers or other aerosol generators; liquids vaporizing from puddles/containers; or munitions" (South Carolina Law Enforcement Division, 2020)
- Conventional Bomb/Improvised Explosive Device: "detonation of explosive device on or near a target; via person, vehicle, or projectile" (South Carolina Law Enforcement Division, 2020)
- Cyberterrorism: "the convergence of cyberspace (the computer-based world of information) and terrorism (premeditated, politically motivated violence perpetrated against noncombatant targets by sub-national groups or clandestine agents)" (South Carolina Law Enforcement Division, 2020)
- Radiological agent: "Radioactive contaminants can be dispersed using sprayers/aerosol generators, or by point or line sources such as munitions, covert deposits, and moving sprayers" (South Carolina Law Enforcement Division, 2020)

The South Carolina Law Enforcement Division (SLED) oversees terrorism prevention activities for the state. SLED's Office of Homeland Security fosters awareness for the state by providing capability developments through grants, guidance, equipment, training and exercises for law enforcement, fire, EMS, and emergency management organizations, to benefit communities throughout the state (South Carolina Law Enforcement Division , 2014). SLED's duties include coordinating the annual Threat

Hazard Identification and Risk Assessment (THIRA) and Stakeholder Preparedness Review (SPR) in conjunction with other state agencies. The results of these scenarios and other law enforcement threat assessments are sensitive and are not included in this plan.

Impact

Impacts of an act of terrorism or mass violence vary depending on the type and scale of occurrence, including human physical casualties, mental health impacts, and property damage. An initial incident may begin a series of cascading events. An act of terrorism or mass violence impacts the population physically as well as having secondary affects such as psychological trauma. The impacts of a shooting are widespread and long-lasting as most notably experienced in the Charleston Emmanuel AME church shooting in 2015. The physical landscape can change as well based on the tactic(s) used. Most recorded considered acts of terrorism experienced in South Carolina in recent years involve arson at religious establishments.

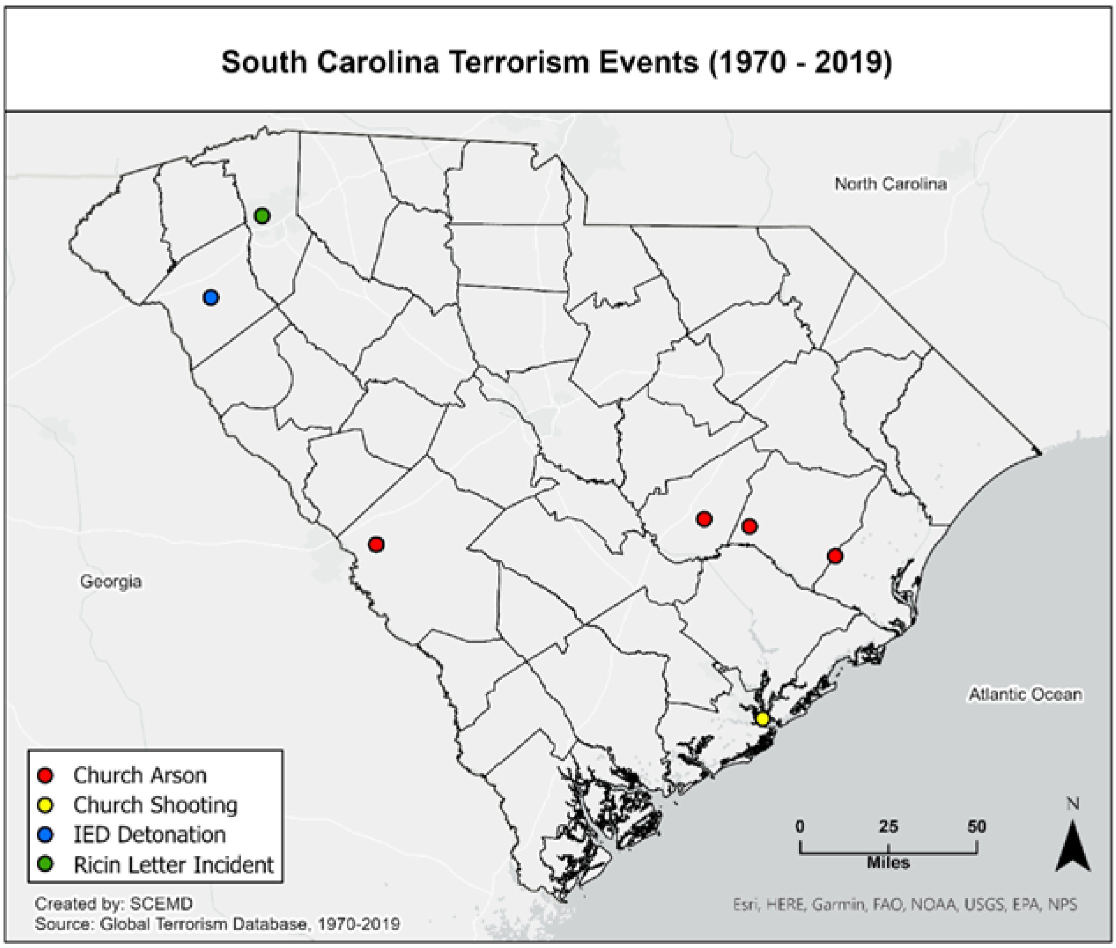


Figure 129: Terrorism events in South Carolina, 1970-2019

A significant terrorism/mass violence event could affect community lifelines. The table below identifies the affected community lifelines based on a severe terrorism/mass violence event.

Community Lifeline	Level of Impact	Description of Impacts	Area of Impact
Communications	Medium	Telecommunications and broadband systems may be damaged or service interrupted by a cyber intrusion/attack or physical attack. Service disruptions could negatively impact public sector information sharing platforms. Large numbers of people attempting to make phone calls in response to the incident may overload communications systems.	Regional or statewide
Energy	Medium	Power generation, transmission, and distribution equipment and systems as well as pipelines could be damaged, which may cause interruptions in service or fuel supplies.	Regional
Food, Water, Shelter	Low	Significant impacts are not anticipated unless the act targets water systems, food supplies, or residential areas. Depending on type and location of incident, emergency shelter may be needed.	Localized, regional, or statewide
Hazardous Materials	High	Hazardous material sites or hazardous material in transit could be damaged by a cyber intrusion/attack or physical attack. Damage could result in hazardous material releases with impacts depending on type and volume of material released.	Localized or regional
Health and Medical	High	Healthcare facilities may see an increased number of patients seeking emergency care. Healthcare facilities could be directly damaged by a cyber intrusion/attack or physical attack. Mental health needs of the public and responders would increase based on an intentional attack.	Regional or statewide
Safety and Security	High	Community safety in the impacted area would be compromised. Safety and security entities and personnel would see increased demand for response and investigation. Specialized training, equipment, and personal protective gear may be needed to protect health and safety of responders and the public. Facilities could be directly damaged or service interrupted by a cyber intrusion/attack or physical attack. Response may require large-scale search and rescue operations.	Localized or regional
Transportation	Medium	Transportation could experience disruptions from direct damage to roadways, bridges, ports, or airports as well as from increased traffic because of evacuations or relocations or from rerouted traffic.	Localized or regional

Table 76 Potential Community Lifeline Impacts Based on Significant Terrorism/Mass Violence Event

Historical and Notable Events

In the last 30 years, South Carolina experienced multiple acts of mass violence and/or terrorism related activities. The map above outlines events ranging from arson attacks at church buildings to incidents involving improvised explosive devices.

Emanuel African Methodist Episcopal Church Shooting (June 17, 2015): Nine people were killed by a man with a firearm while attending a bible study in Charleston. The shooter was sentenced to death following his conviction on federal hate crimes.

Future Climate Conditions

Based on the societal and political nature of terrorism and mass violence, while climate change is not expected to directly impact the frequency or severity of incidents, it may have a secondary impact on terrorism and mass violence risk. No current evidence concludes a link between climate change and the extent, frequency, intensity, or magnitude of terrorism and mass violence-related events; however, it is possible that climate change effects such as extreme heat or scarcity of key supplies or resources could lead to civil unrest or violent behaviors focused on institutions or the public.

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V. Integration of Local Hazard Mitigation Plans

This section was added in the 2007 plan and updated in the 2010, 2013, and 2018 plans. Updates include a revised county inventory (see table below) and a revised hazard list. This section discusses the status of local mitigation planning in South Carolina, an overview of the hazards addressed in the local plans, and an overview of the findings of the risk assessments from local HMPs

A. Status of Local Plans in South Carolina

Local governments in South Carolina have developed hazard mitigation plans for their jurisdictions. Most of these plans have been developed by counties and are multi-jurisdictional, meaning they include local municipalities and townships. Two municipalities have developed their own HMP separate from the county to address specific interests and concerns within their jurisdiction. The table below provides a list of jurisdictions in South Carolina with an HMP, the status of HMP approval (by FEMA), and the name and type of plan in which they are included. This list was last updated September 1, 2022. A list of municipalities and townships that have adopted and stated their approval in a resolution can be found in Appendix E**.** Tribal authorities may submit their plans directly to FEMA; however, SCEMD is available to assist tribal authorities in development, implementation, maintenance, and updating of HMPs as well. Tribal authorities choosing to submit through SCEMD follow the same submission timelines and guidance as local government authorities.

Local governments are responsible in the preparation and/or adoption of a jurisdiction-wide natural hazard mitigation plan as a condition of receiving project grant funds under the HMGP. Under the same provisions, they are required to review and update the local mitigation plan every five (5) years from date of plan approval to continue program eligibility. Local plans scheduled to be updated may request to meet with the SCEMD planning staff to discuss the update process. It is recommended that they begin this process as soon as the jurisdiction's plan is officially approved by FEMA and adopted by local jurisdictions. SCEMD mitigation planning staff is available to provide technical assistance and guidance to the county throughout the five-year update cycle. The jurisdiction will then submit its updated plan to SCEMD for review. Using the latest version of FEMA's Local Mitigation Plan Review Tool, the plan is reviewed for completion and feasibility. If any requirements are not met, the plan is sent back to the local government for review and revisions. Once SCEMD finds the plan to be complete, the local HMP is submitted to FEMA for official review and approval. Based on recent history, the average time for a plan to complete the review and approval process is approximately eight months.

Upon approval from FEMA, local plans are integrated into the SHMP by:

- Updating risks identified in the local plans and incorporating it into the State Plan
- Ensuring that local mitigation goals are reflected in the goals and prioritization of state mitigation goals
- Incorporating initiatives that have proven successful at the local level
- Reviewing existing state initiatives to determine if they are meet the overall mitigation needs of the state, including local jurisdictions
- Changing or eliminating existing mitigation initiatives that have not produced the anticipated results.

The State of South Carolina strives for all 46 counties and their incorporated jurisdictions to maintain local mitigation plans that comply with federal law, regulations, and policy. In 2008 and 2009 the

State of South Carolina was successful in achieving 100% coverage and again briefly in spring 2020, when 46 counties had FEMA-approved local hazard mitigation plans. While local HMPs are to be updated every five years, they expire on different dates and so are updated on varied schedules. As of January 2023, 39 counties had FEMA-approved local hazard mitigation plans, with the remaining seven under revision. State universities with expired plans are still covered under the South Carolina SHMP. For a mitigation plan to be approved, it must be compliant with the Disaster Mitigation Act of 2000 (DMA2K) and meet requirements in 44 CFR Part 201.

Jurisdiction	Plan Status	Name/Type	Date Expired
Catawba Nation	Expired	Catawba Indian Nation Pre-Disaster Multi-Hazard Mitigation Plan	07/16/2022
CCU	Expired	Coastal Carolina Disaster Resistant University Plan	03/13/2022
MUSC	Expired	Medical University of South Carolina Disaster Resistant University Plan	03/06/2021
Myrtle Beach	Approved	City of Myrtle Beach Hazard Mitigation Plan Update	04/25/2026
North Myrtle Beach	Approved	Hazard Mitigation Plan City of North Myrtle Beach	07/18/2026
The Citadel	Expired	The Citadel Hazard Mitigation Plan	10/05/2022
University of South Carolina (USC)	Approved	USC-Hazard Mitigation Plan	02/20/2025
Abbeville County	Approved	Abbeville County Natural Hazard Mitigation Plan	01/12/2028
Aiken County	Approved	Aiken County Hazard Mitigation Plan 2015	06/27/2026
Allendale County	Approved	Allendale County Natural Hazard Mitigation Plan	08/14/2027
Anderson County	Approved	Anderson-Oconee Hazard Mitigation Plan	03/11/2023
Bamberg County	Approved	Bamberg County Hazard Mitigation Plan 2021	04/10/2027
Barnwell County	Approved	Barnwell County Multi-Jurisdictional Hazard Mitigation Plan 2020	05/18/2026
Beaufort County	Approved	Lowcountry Council of Governments Multi-Jurisdictional Hazard Mitigation Plan 2021	06/27/2026
Berkeley County	Approved	Berkeley County Multi-Jurisdictional Hazard Mitigation Plan 2021	01/28/2026
Calhoun County	Approved	Calhoun County Multi-Jurisdictional Natural Hazard Mitigation Plan 2021	04/25/2026
Charleston County	Approved	Charleston Regional Hazard Mitigation Plan 2019 Update	03/27/2024

Jurisdiction	Plan Status	Name/Type	Date Expired
Cherokee County	Approved	Cherokee County Multi-Jurisdictional Hazard Mitigation Plan	08/15/2027
Chester County	Approved	Chester County 2021 Hazard Mitigation Plan	02/14/2027
Chesterfield County	Expired	Chesterfield County Hazard Mitigation Plan	10/17/2022
Clarendon County	Approved	Santee-Lynches Hazard Mitigation Plan 2020 Update	06/25/2025
Colleton County	Approved	Lowcountry Council of Governments Multi-Jurisdictional Hazard Mitigation Plan 2021	06/27/2026
Darlington County	Approved	Darlington County Hazard Mitigation Plan	02/25/2024
Dillon County	Expired	Dillon County Hazard Mitigation Plan	8/13/2022
Dorchester County	Approved	Dorchester County Hazard Mitigation Plan 2021 Update	07/07/2026
Edgefield County	Expired	Edgefield County Natural Hazard Mitigation Plan	03/07/2021
Fairfield County	Approved	Central Midlands Council of Governments Hazard Mitigation Plan 2021	12/06/2026
Florence County	Approved	Florence County Local Hazard Mitigation Plan 2019	02/23/2025
Georgetown County	Approved	2019 Georgetown County Hazard Mitigation Plan Update	10/14/2024
Greenville County	Approved	Greenville County Multi-Jurisdictional Hazard Mitigation Plan Update 2020	07/06/2025
Greenwood County	Approved	Greenwood Multi-Jurisdictional Hazard Mitigation Plan	06/28/2027
Hampton County	Approved	Lowcountry Council of Governments Multi-Jurisdictional Hazard Mitigation Plan 2021	06/27/2026
Horry County	Approved	Horry County Multijurisdictional All Hazards Mitigation Plan	04/11/2026
Jasper County	Approved	Lowcountry Council of Governments Multi-Jurisdictional Hazard Mitigation Plan 2021	06/27/2026
Kershaw County	Approved	Santee-Lynches Hazard Mitigation Plan 2020 Update	06/25/2025
Lancaster County	Approved	Lancaster County Hazard Mitigation Plan	12/18/2027

Jurisdiction	Plan Status	Name/Type	Date Expired
Laurens County	Approved	Laurens County Natural Hazard Mitigation Plan	3/24/2027
Lee County	Approved	Santee-Lynches Hazard Mitigation Plan 2020 Update	06/25/2025
Lexington County	Approved	Central Midlands Council of Governments Hazard Mitigation Plan 2021	12/06/2026
Marion County	Expired	Hazard Mitigation Plan, 2017	11/19/2022
Marlboro County	Expired	Hazard Mitigation Plan May 2017	12/17/2022
McCormick County	Approved	McCormick County Hazard Mitigation Plan	12/27/2027
City of Myrtle Beach	Approved	City of Myrtle Beach HMP Update, 2021	4/25/2026
Newberry County	Approved	Central Midlands Council of Governments Hazard Mitigation Plan 2021	12/06/2026
City of North Myrtle Beach	Approved	City of North Myrtle Beach HMP Update, 2021	7/18/2026
Oconee County	Approved	Anderson-Oconee Hazard Mitigation Plan	3/11/2023
Orangeburg County	Approved	Orangeburg County Hazard Mitigation Plan	09/25/2027
Pickens County	Expired	Pickens County Multi-Jurisdictional Hazard Mitigation Plan 2018 Update	06/26/2023
Richland County	Approved	Central Midlands Council of Governments Hazard Mitigation Plan 2021	12/06/2026
Saluda County	Approved	Saluda County Natural Hazard Mitigation Plan	08/16/2025
Spartanburg County	Approved	Spartanburg County Multi-Jurisdictional Hazard Mitigation Plan	02/22/2023
Sumter County	Approved	Santee-Lynches Hazard Mitigation Plan 2020 Update	06/25/2025
Union County	Approved	Union County Hazard Mitigation Plan	03/26/2025
Williamsburg County	Expired	Williamsburg County Hazard Mitigation Plan	9/5/2021
York County	Approved	York County Multi-Jurisdictional Hazard Mitigation Plan 2017	01/08/2028

Table 77 Local Hazard Mitigation Plan Status, January 2023

SCEMD's knowledge of and ability to analyze local risk as well as integrate this knowledge into the state plan will continue to improve as local mitigation plans are updated. This effort will continue through future enhancements to the SHMP as more standardized local risk assessment data becomes available through the submission of local hazard mitigation plans.

Overview of Hazards Addressed in Local Plans

The table below provides a summary of the hazards that have been evaluated in the local HMPs in comparison to the hazards identified and evaluated in the state HMP. The headings of the table below provide a list of the hazards found in this plan. Jurisdictions highlighted in blue are municipalities or townships that have community-specific plans. An (x) has been entered into the cells for each local plan to indicate whether the hazard was addressed in that plan.

Jurisdiction	Flood	Tropical Cyclone	Tornadoes	Severe Thunder-	Lightning	Coastal Hazards	Wildfire	Extreme Heat/Cold	Drought	Winter Storms and	Hail	Landslide	Earthquakes	Wind	Hazardous Materials	Terrorism/Mass Violence	Nuclear Release	Infectious Disease	Climate Change*	Other Hazards (Not Explicitly included in State Plan)
Abbeville County	X	X	X	X			X		X	X	X		X	X						
Aiken County	X	X	X				X		X	X	X		X	X						
Allendale County	X	X	X				X		X	X	X		X	X						
Anderson County	X	X	X	X	X		X	X	X	X	X		X	X						
Bamberg County	X	X	X				X		X	X	X		X	X						
Barnwell County	X	X	X				X		X	X	X		X	X						
Beaufort County	X	X	X		X	X	X	X	X	X	X		X	X						
Berkeley County	X	X	X	X			X		X	X	X	X	X		X					Tsunami, Dam Failure
Calhoun County	X	X	X				X		X	X	X		X	X						
Charleston County	X	X	X	X		X	X		X	X			X		X	X				Tsunami, Dam Failure

Jurisdiction	Flood	Tropical Cyclone	Tornadoes	Severe Thunder-	Lightning	Coastal Hazards	Wildfire	Extreme Heat/Cold	Drought	Winter Storms and	Hail	Landslide	Earthquakes	Wind	Hazardous Materials	Terrorism/Mass Violence	Nuclear Release	Infectious Disease	Climate Change*	Other Hazards (Not Explicitly included in State Plan)
Cherokee County	X	X	X				X	X	X	X	X		X	X						
Chester County	X	X	X	X			X	X	X	X			X	X						Dam Failure
Chesterfield County	X	X	X	X	X		X	X	X	X	X		X		X		X			
Clarendon County	X	X	X	X	X		X		X	X	X		X	X						Dam Failure
Colleton County	X	X	X		X	X	X	X	X	X	X		X	X						
Darlington County	X	X	X	X	X		X	X	X	X	X		X	X	X	X	X			Community Event, Cybercrimes, Dam Failure
Dillon County	X	X	X	X	X		X	X	X	X	X		X	X	X					
Dorchester County	X	X	X	X			X		X	X			X							
Edgefield County	X	X	X	X			X		X	X	X		X	X						

Jurisdiction	Flood	Tropical Cyclone	Tornadoes	Severe Thunder-	Lightning	Coastal Hazards	Wildfire	Extreme Heat/Cold	Drought	Winter Storms and	Hail	Landslide	Earthquakes	Wind	Hazardous Materials	Terrorism/Mass Violence	Nuclear Release	Infectious Disease	Climate Change*	Other Hazards (Not Explicitly included in State Plan)
Fairfield County	X	X	X	X	X		X	X	X	X	X		X	X						Fog
Florence County	X	X	X	X	X		X	X	X	X	X		X		X	X	X			Dam Failure
Georgetown County	X	X	X	X		X	X		X	X	X		X	X						Dam Failure, Sinkholes
Greenville County	X		X						X	X	X	X	X	X						Sinkholes, Climate Change
Greenwood County	X	X	X	X	X				X	X	X		X	X						Structural Fires, Technological Hazards
Hampton County	X	X	X		X	X	X	X	X	X	X		X	X						
Horry County	X		X	X	X	X	X	X	X	X			X		X	X				Tsunami
Jasper County	X	X	X		X	X	X	X	X	X	X		X	X						
Kershaw County	X	X	X	X	X		X		X	X	X		X	X						Dam Failure

Jurisdiction	Flood	Tropical Cyclone	Tornadoes	Severe Thunder-	Lightning	Coastal Hazards	Wildfire	Extreme Heat/Cold	Drought	Winter Storms and	Hail	Landslide	Earthquakes	Wind	Hazardous Materials	Terrorism/Mass Violence	Nuclear Release	Infectious Disease	Climate Change*	Other Hazards (Not Explicitly included in State Plan)
Lancaster County	X	X	X	X			X	X	X	X			X	X	X			X	X	Dam Failure, Train Derailment, Utility Failures, Infrastructure Failure, Cyberattack, Geomagnetic Disturbances
Laurens County	X	X	X	X			X		X	X	X		X	X						Structural Fires, Technological Hazards
Lee County	X	X	X	X	X		X		X	X	X		X	X						Dam Failure
Lexington County	X	X	X	X	X		X	X	X	X	X		X	X						Fog
Marion County	X	X	X	X	X		X	X	X	X	X		X	X	X		X			
Marlboro County	X	X	X	X	X		X		X	X	X		X	X	X		X			
McCormick County	X	X	X				X		X	X	X		X	X						
Myrtle Beach	X	X	X		X	X	X	X	X	X	X		X	X	X	X		X		Nor'Easter, Tsunami, Airplane Crash, Civil Disturbance,
Newberry County	X	X	X	X	X		X	X	X	X	X		X	X						Fog

Jurisdiction	Flood	Tropical Cyclone	Tornadoes	Severe Thunder-	Lightning	Coastal Hazards	Wildfire	Extreme Heat/Cold	Drought	Winter Storms and	Hail	Landslide	Earthquakes	Wind	Hazardous Materials	Terrorism/Mass Violence	Nuclear Release	Infectious Disease	Climate Change*	Other Hazards (Not Explicitly included in State Plan)
North Myrtle Beach	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X		Sinkholes, Rip Currents
Oconee County	X	X	X	X	X	X	X	X	X	X	X		X	X						
Orangeburg County	X	X	X				X		X	X	X		X	X						
Pickens County	X	X	X	X			X	X	X	X			X	X	X	X	X	X		Civil Disturbance, Dam Failure, Transportation Disruption, Utility Disruption, Economic Crisis, Urban Fire
Richland County	X	X	X	X	X		X	X	X	X	X		X	X						Fog
Saluda County	X	X	X	X			X		X	X	X		X							
Spartanburg County	X	X	X	X	X		X	X	X	X	X	X	X	X	X					Transportation Incident
Sumter County	X	X	X	X	X		X		X	X	X		X	X						Dam Failure
Union County	X	X	X	X	X		X	X	X	X	X			X						

Jurisdiction	Flood	Tropical Cyclone	Tornadoes	Severe Thunder-	Lightning	Coastal Hazards	Wildfire	Extreme Heat/Cold	Drought	Winter Storms and	Hail	Landslide	Earthquakes	Wind	Hazardous Materials	Terrorism/Mass Violence	Nuclear Release	Infectious Disease	Climate Change*	Other Hazards (Not Explicitly included in State Plan)
Williamsburg County	X	X	X	X			X		X	X	X		X							Dam Failure
York County	X	X	X	X			X		X	X			X							Dam Failure

Table 78 Counties and their Relative Hazards

Overview of Findings from Local Risk Assessments

As part of the SHMP update, the University of South Carolina Hazards and Vulnerability Resilience Institute (HVRI) completed an overall risk rating for each county (see Appendix G). The risk rating calculates a score that considers the hazards that threaten each county as well as vulnerability, recurrence, and hazard loss/impact estimates.

Additional Local Planning Capability

Local HMPs are one example of local planning capability. Local communities also have zoning and land development plans, floodplain management plans, beach management plans, flood ordinances, and development ordinances that incorporate and support mitigation strategies, depending on the location's hazards and development. The South Carolina Local Government Comprehensive Planning Enabling Act of 1994 gave local governments the authority to adopt and update comprehensive plans. This act included the creation of local planning commissions, guidance for development and redevelopment, and support for zoning ordinances. Plans developed by communities serve as a roadmap for decision making regarding growth and development, public infrastructure investments, regulation of land uses, and economic development initiatives. Because comprehensive plans involve regulated development and design, it is an excellent place to incorporate the local mitigation strategies and actions. The South Carolina Disaster Relief and Resilience Act approved in 2020 amended state law to require that local comprehensive plans address resilience to the effects of flood, high water, and natural hazards. S.C. Code Annotated Section 6-29-510 (D).

As a resource to local counties, cities, and towns throughout South Carolina, the state established 10 councils of governments (COGs) to support and coordinate with multi-county districts. COGs work in partnership with federal and state agencies to obtain and administer grants for community-based programs and economic development initiative. Each of the state's 46 counties falls within a COG region. Three COGs, which include four counties each along with the municipalities within those counties, have developed regional or local HMPs for the counties in their regions.

Recovery and redevelopment plans are another planning capability that can include mitigation-focused priorities. Multiple counties in South Carolina have developed or are developing a pre-event plan for post-disaster recovery and reconstruction. The Beaufort County Recovery Plan, one of the first comprehensive plans developed in the United States, is composed of policies, plans, implementation actions, and designated responsibilities related to post-disaster recovery and rebuilding, with an emphasis on mitigation. The plan serves as a guide to the essential recovery functions of Beaufort County following a disaster and has served as a model to other counties within the state in the development of their own recovery plans.

Data Limitations

With the initial development of local mitigation plans in South Carolina, SCEMD developed a standard methodology for conducting local risk assessment that it encouraged but did not require. As local plans have been developed and updated, counties and other jurisdictions use a variety of methodologies to complete local risk assessments and hazard analysis. This creates substantial variability affecting the state's ability to generalize and integrate local risk assessment data into the SHMP. In the future, use of the state's HIRA data made available in the Mitigation SC platform will provide information and tools to provide a foundation for consistent and robust local hazard risk assessment and spatial analysis.

Changes From the Last Plan

Information on local mitigation plan and adoption resolution was updated. The local hazards table was updated to incorporate hazards addressed in this SHMP. Reference to a new state resilience requirement for local comprehensive plans was added.

VI. State Capability Assessment

A. Plans, Programs, Policies, and Funding

Capability assessment provides part of the foundation for the state's mitigation strategy. The assessment process also continues to identify gaps or weaknesses that may need to be addressed through mitigation planning goals and actions. The assessment also highlights state-level measures in place or initiatives in progress to support and enhance mitigation efforts.

B. State Agency Programs

The state maintains an array of departments, agencies, offices, and programs that can directly or indirectly impact the state's ability to reduce the impact of hazards. The table below lists state agencies and their programs, including their relevance to hazard loss reduction and severe repetitive loss reduction (SRL). Programs available in a post-disaster environment are shown in italics. This table serves as the basis for the analysis found in the remainder of the assessment.

For the column titled Effects on Loss Reduction, the following definitions apply:

- **Support**: Programs, plans, policies, regulations, funding, or practices that help the implementation of mitigation actions.
- **Facilitate**: Programs, policies, etc. that make implementing mitigation actions easier.

The following agencies are listed in the order that they appear in the following state capability assessment table.

- Office of the Adjutant General- Emergency Management Division
- Governor's Office
- Department of Administration
- Department of Archives and History
- Department of Commerce
- Department of Education
- Department of Health and Environmental Control - Office of Ocean and Coastal Resource Management
- Department of Health and Environmental Control - Bureau of Water
- Department of Insurance
- Department of Labor, Licensing and Regulation
- Department of Labor, Licensing and Regulation - Building Codes Council
- Department of Natural Resources
- Department of Public Safety
- Department of Transportation
- Forestry Commission
- University of South Carolina
- The Citadel
- College of Charleston - Department of Geology and Environmental Geosciences
- Clemson University - Department of Civil Engineering
- South Carolina Sea Grant Consortium
- South Carolina Association for Hazard Mitigation
- South Carolina Office of Resilience
- State Law Enforcement Division

AGENCY	RELEVANT PLANS, POLICIES, PROGRAMS AND/OR GRANTS	EFFECTS ON LOSS REDUCTION		PROGRAM PROVIDES FUNDING	DESCRIPTION
		SUPPORT	FACILITATE		
Office of the Adjutant General Emergency Management Division	Hazard Mitigation Grant Program	X		X	This program provides funding for mitigation initiatives following a Presidential disaster declaration.
	Public Assistance Program		X	X	This program, available after a Presidential disaster declaration, allows mitigation measures to be incorporated into the repair of public facilities following a disaster.
	Building Resilient Infrastructure in Communities Program	X		X	This annual, nationally competitive program funds mitigation plans and projects to reduce or eliminate the effects of future disasters. **Funding is dependent on Congressional appropriations.*
	Hurricane Program		X		The hurricane program coordinates efforts to prepare for and respond to hurricanes and supports mitigation through public education and studies.
	Earthquake Program		X		The earthquake program provides coordination of seismic safety programs and supports mitigation through public education and promoting tools to support seismic hazard reduction.
Governor's Office	Executive Order 99-11		X		This executive order established the Interagency Coordinating Committee (ICC) and mandated it be responsible for developing and maintaining the State Hazard Mitigation Plan.

AGENCY	RELEVANT PLANS, POLICIES, PROGRAMS AND/OR GRANTS	EFFECTS ON LOSS REDUCTION		PROGRAM PROVIDES FUNDING	DESCRIPTION
		SUPPORT	FACILITATE		
Department of Administration	General Services Division, Facilities Management		X		The mission of Facilities Management is to deliver electrical, mechanical, maintenance, energy management, fire protection, horticultural, custodial, technical training, project management, safety, and building renovation services for state owned buildings in the most efficient manner.
	Insurance & Grant Services, Insurance Reserve Fund		X		The Fund currently provides insurance on real property valued at $29.6 billion. Coverage is provided on an "all risk" form including flooding and earthquake. The flood coverage provided is similar to the National Flood Insurance Program's coverage. This program provides insurance coverage for state and local facilities at a lower cost than commercial insurance.
	Materials Management Office, Office of the State Engineer		X		The State Engineer is designated as the Floodplain Administrator on behalf of the state with respect to state buildings and state development in floodplains. The State Engineer also serves as the Chair of the Variance Committee for all state construction. The State Engineer is also the Building Official for all state-owned buildings and assures that state facilities are built to current building codes.

AGENCY	RELEVANT PLANS, POLICIES, PROGRAMS AND/OR GRANTS	EFFECTS ON LOSS REDUCTION		PROGRAM PROVIDES FUNDING	DESCRIPTION
		SUPPORT	FACILITATE		
	Office of Research & Statistics, State Geodetic Survey		X		Mapping coordination performed by this office supports the development of an accurate, uniform statewide mapping system on a county-by-county base. Accurate mapping and elevation reference markers are vital to regulating new construction in floodplains.
Department of Archives and History	National Historic Preservation Act		X		Review and comment on the proposed impact of federal or state assisted hazard mitigation projects on historic properties pursuant to applicable federal and state laws.
	SC Coastal Zone Management Act		X		Review and comment on the proposed impact of federal or state assisted hazard mitigation projects regarding the presence of archaeological or historic resources in Coastal Zones as defined by the Coastal Zone Management Act and the potential impact of the permitted project on such resources.
Department of Commerce	Community Development Block Grant (CDBG)		X	X	The CDBG Program assists communities in providing decent housing, a suitable living environment, and expanded economic opportunities. CDBG funds can be used for mitigation projects.
Department of Education	Office of School Facilities		X		The Office of School Facilities (OSF) serves as the Building Official for public school facilities in South Carolina. The office regulates school construction in the floodplain, ensures schools meet building codes, and provides technical assistance in evaluating school sites and facility conditions.

AGENCY	RELEVANT PLANS, POLICIES, PROGRAMS AND/OR GRANTS	EFFECTS ON LOSS REDUCTION		PROGRAM PROVIDES FUNDING	DESCRIPTION
		SUPPORT	FACILITATE		
Department of Health and Environmental Control Office of Ocean and Coastal Resource Management (OCRM)	Federal Coastal Zone Management Act, as amended (PL 104-150); SC Coastal Tidelands and Wetlands Act, as amended: SC Coastal Program Document	X			The Coastal Tidelands and Wetlands Act requires permits for activities in the designated critical areas of the state, defined as coastal waters, tidelands, beach/dune systems, and beaches. DHEC-OCRM also reviews proposed state and federal permits in the eight-county coastal zone to ensure the activity is consistent with the state coastal zone management policies.
	Beach Restoration Fund	X		X	This program provides funding for beach nourishments projects.
Department of Health and Environmental Control Bureau of Water	SC Stormwater Management and Sediment Reduction Act of 1991		X		This act requires permits to ensure development does not create substantial amounts of stormwater runoff or sediment buildup.
	SC Erosion and Sediment Act of 1983		X		This act requires permits to ensure development minimizes erosion soil and sedimentation of streams.
Department of Insurance	SC Safe Homes		X	X	The South Carolina Hurricane Damage Mitigation Program, also known as the SC Safe Home Grant Program, offers grants for South Carolinians to strengthen their homes against the damaging effects of high winds from hurricanes and severe storms.

AGENCY	RELEVANT PLANS, POLICIES, PROGRAMS AND/OR GRANTS	EFFECTS ON LOSS REDUCTION		PROGRAM PROVIDES FUNDING	DESCRIPTION
		SUPPORT	FACILITATE		
Department of Labor, Licensing, and Regulation (LLR)	Manufactured Housing Board		X		The board sets regulations for the installment of manufactured homes in the state. Proper installation of manufactured housing provides enhanced protection against hazards such as floods, earthquakes, and hurricanes.
	Office of State Fire Marshal		X		Deputy fire marshals conduct fire safety inspections to ensure compliance with fire safety codes. Enforcement of fire safety codes increases protection to structures from fire, thereby reducing property damage and loss of life.
	Office of State Fire Marshal		X	X	The State Fire Marshal administers the V-SAFE grant program, which provides grants to eligible volunteer and combination fire departments for fire equipment.
	Office of State Fire Marshal		X		The State Fire Marshal's Office administers the Fire Safe SC Community Risk Reduction program, which provides programs aimed at reducing the loss of life and property from fire.
	South Carolina Fire Academy	X			Provides all hazard training courses to fire and emergency services providers statewide to enhance response capabilities at the local level.
Department of Labor, Licensing, and Regulation (LLR) Building Codes Council	Building Codes Program		X		The program assures uniformity in the use, adoption and interpretation of building codes on a statewide basis.

AGENCY	RELEVANT PLANS, POLICIES, PROGRAMS AND/OR GRANTS	EFFECTS ON LOSS REDUCTION		PROGRAM PROVIDES FUNDING	DESCRIPTION
		SUPPORT	FACILITATE		
	Modular Building Program		X		The program ensures that the construction of modular buildings conforms to established building codes for site constructed buildings and meets the regional requirements for resistance to earthquakes, and hurricanes.
Department of Natural Resources (DNR)	Biggert-Waters Flood Insurance Reform Act of 2012	X		X	The Biggert-Waters Flood Insurance Reform Act of 2012 merged the Repetitive Flood Claims (RFC) Program and the Severe Repetitive Loss (SRL) Program with the Flood Mitigation Assistance (FMA) Program. FMA provides funding to assist states and communities in implementing measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the National Flood Insurance Program (NFIP).
	National Flood Insurance Program (NFIP)	X			SCDNR administers the NFIP in South Carolina. They assist local governments in developing and administering floodplain ordinances and provide technical assistance on flood insurance issues. SCDNR also provides technical assistance to communities in developing flood mitigation plans.

AGENCY	RELEVANT PLANS, POLICIES, PROGRAMS AND/OR GRANTS	EFFECTS ON LOSS REDUCTION		PROGRAM PROVIDES FUNDING	DESCRIPTION
		SUPPORT	FACILITATE		
	Risk Map	X			SCDNR implemented the Map Modernization Initiative to begin a complete update of flood maps in the state and produce them in a digital format. The Map Modernization program has morphed into the Risk Map initiative with FEMA. This program continues to update and digitize the flood insurance rate maps, as well as aid in the development of non-regulatory products that help communicate risk to homeowners in South Carolina. As of 2018 the flood map updating process is ongoing.
	South Carolina Drought Response Act		X		This act established procedures by which the state's water resources could be monitored, managed, and conserved in the best interest of South Carolinians during periods of drought. DNR serves as the primary agency to monitor drought conditions, or potential for drought, throughout the state and to coordinate the state's response.
	Geologic Survey		X		The mission of the Geological Survey is to provide a service-oriented research program, which collects, studies, interprets, and reports all information pertaining to geology affecting the daily lives of the citizens of this state. A goal of this program is the dissemination of geologic information, which can be used for better land use planning, economic development, emergency preparedness and education.

AGENCY	RELEVANT PLANS, POLICIES, PROGRAMS AND/OR GRANTS	EFFECTS ON LOSS REDUCTION		PROGRAM PROVIDES FUNDING	DESCRIPTION
		SUPPORT	FACILITATE		
Department of Public Safety	Hurricane Evacuation Program	X	X		This program provides planning and coordination in order to mitigate the proper implementation of hurricane evacuation procedures. This program evaluates staffing and procedures for all established evacuation routes and lane reversals in coordination with local and state emergency responders. This program develops response plans through route reconnaissance, planning meetings, tabletop exercises, and resource assessments with all hurricane evacuation stakeholders. SCDPS provides manpower to support this program.
	Winter Storm Response Program	X	X		This program provides planning and coordination in order to mitigate the impacts severe winter weather may have on travel on SC roadways. This is accomplished by developing response plans through planning meetings, tabletop exercises, and resource assessments with the SCDOT, SCNG, ESF-13, and SCEMD. SCDPS provides manpower to support this program.
Department of Transportation	Division of Engineering		X		The division ensures that roads and bridges are engineered and designed to state and federal regulations. They also conduct flood and earthquake studies and bridge design in cooperation with communities. The results of these studies can be used in floodplain regulatory programs.

AGENCY	RELEVANT PLANS, POLICIES, PROGRAMS AND/OR GRANTS	EFFECTS ON LOSS REDUCTION		PROGRAM PROVIDES FUNDING	DESCRIPTION
		SUPPORT	FACILITATE		
	Prescribed Burning Assistance	X			The Commission provides assistance to landowners on development of a prescribed burning plan, constructing firebreaks, or conducting the actual prescribed burns.
	Forest Stewardship Program	X		X	This program assists landowners in development of a Stewardship Management Plan that helps to reduce wildfire and erosion risks. Funding is available to implement plans once they are approved.
	Wildfire Detection	X			The Forestry Commission provides aerial detection via the use of federal excess aircraft to locate wildfires for quick response to minimize loss to life, property and our natural resources.
	Wildfire Prevention		X		The Commission has trained personnel in the area of wildfire education and prevention techniques and implements those ideas through statewide or community wide efforts. Wildfire prevention is especially valuable during periods of high fire danger and drought.
	Wildfire Prevention-Law Enforcement		X		The Commission informs and enforces all outdoor burning laws related to forestry, wildlife, and agriculture to ensure that fire is used safely and properly. Law Enforcement is used primarily as an educational tool.

AGENCY	RELEVANT PLANS, POLICIES, PROGRAMS AND/OR GRANTS	EFFECTS ON LOSS REDUCTION		PROGRAM PROVIDES FUNDING	DESCRIPTION
		SUPPORT	FACILITATE		
	Wildfire Suppression	X			The Forestry Commission provides wildfire suppression equipment and personnel to fight wildfires on all lands outside incorporated areas and assists federal agencies with wildfire suppression on their lands. This may include direct and indirect wildfire suppression, utilizing dozer, aircraft, and hand crews.
	Forest Health	X		X	This program assists landowners by monitoring insect and disease outbreaks and storm damage and providing those affected with forest management recommendations to reduce the resultant increasing wildfire hazard due to the accumulation of dead fuels.
University of South Carolina	Hazard & Vulnerability Research Institute (HVRI)		X		HVRI developed and maintains the State of South Carolina Hazards Assessment, which describes the hazards that affect the state. HVIR also compiled a GIS-based database of hazards data and made it available through an internet site that was instrumental in developing state and local hazard mitigation plans.
	Earth Sciences and Resources Institute		X		The Institute conducts studies of hazard events such as earthquakes, floods, and erosion, and hosts a web site with relevant information for public information.
	Department of Civil Engineering		X		The research conducted by this department has spawned the development and testing of products for retrofitting buildings and infrastructure for enhanced earthquake resistance.

AGENCY	RELEVANT PLANS, POLICIES, PROGRAMS AND/OR GRANTS	EFFECTS ON LOSS REDUCTION		PROGRAM PROVIDES FUNDING	DESCRIPTION
		SUPPORT	FACILITATE		
The Citadel	Department of Civil Engineering		X		This department has conducted research on earthquake-related codes and standards. This department also participates in traffic studies with the S.C. DOT to determine where road improvements may be needed to enhance emergency evacuation of residents.
South Carolina Office of Resilience	CDBG-MIT Program		X	X	The CDBG-MIT program provides grants to local governments in 17 counties to fund infrastructure, buyout, planning and federal match programs.
	Reserve Fund Disaster Relief Program	X		X	After a federally declared disaster, this program may provide the local match portion of Public Assistance funding and may provide other relief identified in statute.
	Reserve Fund Hazard Mitigation Program		X	X	In the absence of a federally declared disaster, if state funds are available, this program can provide grants and loans to local government entities for hazard mitigation projects.
	Resilience Revolving Fund		X	X	The fund provides below-market loans to state and local governments or accredited land trusts to buy repetitive loss properties or perform floodplain restoration.

AGENCY	RELEVANT PLANS, POLICIES, PROGRAMS AND/OR GRANTS	EFFECTS ON LOSS REDUCTION		PROGRAM PROVIDES FUNDING	DESCRIPTION
		SUPPORT	FACILITATE		
College of Charleston Department of Geology and Environmental Geosciences	Santee Cooper GIS Laboratory		X		This Department coordinates the Santee Cooper GIS Laboratory. The SCGIS lab maintains GIS and remote sensing data sets from across the state and maintains State of the Art facilities to support mapping and data needs of the regional GIS community. Additionally, facilities have been designed to be useful for training local and state government personnel on many aspects of using geospatial data. Including Drone, LiDAR and hazards / resilience mapping data sets.
College of Charleston Department of Geology and Environmental Geosciences	The Lowcountry Hazards Center (LCHC)		X		The Lowcountry Hazards Center (LCHC) includes facilities and staff that aid in the training local and state government personnel on the HAZUS software packages for estimating damages associated with hazard events. The LCHC develops primary data sets that can be used by agencies for natural and environmental hazards planning and assessment.
College of Charleston Department of Geology and Environmental Geosciences	South Carolina Earthquake Education Preparedness Program (SCEEP)		X		The SCEEP program develops educational materials for the general public on earthquake hazard mitigation and monitors earthquake activity is able to aid the state in communicating earthquake risk across the state.

AGENCY	RELEVANT PLANS, POLICIES, PROGRAMS AND/OR GRANTS	EFFECTS ON LOSS REDUCTION		PROGRAM PROVIDES FUNDING	DESCRIPTION
		SUPPORT	FACILITATE		
Clemson University Department of Civil Engineering	Wind Load Testing Facility		X		The Wind Load Test Facility houses one of the largest boundary-layer wind tunnels in the nation. The research performed there helps to understand wind fields within hurricanes and their effect on structures. The department performed experiments on homes in Horry County after Hurricane Floyd to determine their ability to withstand hurricane force winds.
South Carolina Sea Grant Consortium	Water Chats		X		Water Chats is a new water quality technical training program designed to connect natural resource professionals and decision-makers with the latest water quality research in the state to inform management decisions. The four main topic areas: emerging contaminants, harmful algal blooms, stormwater control measures, and source water protection.
	Low Impact Development (LID) Atlas		X		S.C. Sea Grant Consortium recently remodeled and updated the S.C. Low Impact Development (LID) Atlas, an online tool that displays current LID projects statewide, and created an interactive GIS map and a data entry survey for individuals and organizations to submit entries for both publicly and privately owned LID sites.

AGENCY	RELEVANT PLANS, POLICIES, PROGRAMS AND/OR GRANTS	EFFECTS ON LOSS REDUCTION		PROGRAM PROVIDES FUNDING	DESCRIPTION
		SUPPORT	FACILITATE		
	SC Coastal Information Network				S.C. Sea Grant Consortium manages the SC Coastal Information Network, which enhances coordination of outreach efforts and the strategic dissemination of information to coastal communities, including low impact development workshops, accredited continuing education courses for real estate professionals, the newly redesigned S.C. Low Impact Development Atlas and other resilience-related information.
	Long-Term Monitoring of Groundwater Table and Mapping of Marsh Vulnerabilities		X		S.C. Sea Grant Consortium, alongside a team of experts, began a long-term monitoring study with the installation of a network of groundwater wells across a barrier island system and mapped the vulnerabilities of the salt marsh system and mitigation options.
South Carolina Association for Hazard Mitigation (SCAHM)	SCAHM Annual Conference and Roundtable Meetings		X		The association serves as a state chapter of the Association of State Flood Plain Managers. SCAHM hosts an annual conference as well as periodic roundtable meetings to discuss hazard mitigation issues.

Table 79 State Agencies/Organizations and Capabilities

C. Administrative Capability

The state has a high level of administrative capability to carry out hazard mitigation policies, programs, and projects spread across several state agencies. The state is taking steps to improve its focus on and capabilities for hazard mitigation. Examples include: 1) goals addressing enhanced legislation and codes, 2) improved interagency coordination, 3) identification and implementation of specific mitigation projects, 4) improved use of existing resources and data, and 5) improving outreach and training. Capabilities were evaluated by reviewing state staffing and the organizational structure across state government. Because SCEMD and SCDNR have significant roles in managing Stafford Act mitigation programs, an emphasis was placed on the review of the capabilities of these agencies. Other ICC member agencies, SCDOI and SCDHEC, also are included below.

As of April 2022, SCEMD had 16 positions devoted to mitigation-related duties, which represents an increase of 33% in positions from the 2018 SHMP update. The state hazard mitigation officer (SHMO) oversees and manages the mitigation team within SCEMD. Grant programs administered by the team include the Hazard Mitigation Grant Program (HMGP) and the Building Resilient Infrastructure and Communities (BRIC) Program. The SHMO coordinates statewide hazard mitigation activities with technical support from state agencies through the Interagency Coordinating Committee (ICC). The mitigation manager oversees the mitigation planning team. Mitigation planners are tasked with the oversight of the development of this plan and review and support for county hazard mitigation plans. The GIS planner provides GIS expertise in the development of the SHMP and support to local jurisdictions in support of developing LHMPs. A mitigation administrative assistant provides administrative assistance, and mitigation specialists and coordinators manage HGMP and BRIC grant applicants through application development, project implementation, and reimbursement processes.

The South Carolina Department of Natural Resources (SCDNR) is responsible for the application, award, grant management, and closeout of the Flood Mitigation Assistance grant program. This grant program offers federal mitigation assistance through the Federal Emergency Management Agency (FEMA) to update the flood mitigation portion of Hazard Mitigation plans and projects to protect against flooding. Also, the SCDNR is the agency that contains the National Flood Insurance Program (NFIP) State Coordinating Office and is a Cooperating Technical Partner (CTP) in FEMA's flood hazard mapping program. The NFIP State Coordinating Office provides a vital link between the Federal government and local communities on matters related to floodplain management. Under the CTP agreement, the SCDNR collaborates with local communities and FEMA in creating and maintaining up-to-date flood hazard maps and other flood hazard information.

The South Carolina Department of Insurance established the mitigation grant program, SC Safe Home following the passage of The Omnibus Coastal Property Insurance Reform Act of 2007. SC Safe Home was one of several incentives included in the law that was designed to help lower coastal property insurance and make their homes more attractive risks for insurers. The Act was specifically designed to minimize the impact, and speed recovery efforts in the coastal regions of the state resulting from a hurricane or strong wind event.

The SC Safe Home mitigation grant program provides homeowners in the coastal communities up to $5,000 in one-time grant funds to assist them in mitigating their property to make it stronger and more resilient. By focusing on roof and window retrofits, SC Safe Home follows scientifically proven guidance for strengthening the envelope of the structure. A structure that has had these retrofits made to it is less likely to be compromised or receive as much damage during a hurricane or high wind event as those have not been retrofitted to the proven code enhanced standards. The program provides grant funds to homeowners for their primary residences. To date, the program has awarded more than 7,291 grants totaling more than $32.8 million to coastal residents. SC Safe Home continues to provide a strong an economic impact to the coastal counties by working with small businesses and more than 150 contractors and inspectors that have received specialized training required to do code-plus retrofit work to the homes.

SC Safe Home continues to grow and receive national recognition, as the longest running program doing these retrofits. The program has been featured in webinars, on websites and at conferences for organizations including the National Housing Policy Council, The National Association of Insurance Commissioners, CERES, The Heinz Foundation, The Wharton Risk Center at the University of Pennsylvania, and FEMA. The South Carolina Department of Insurance and SC Safe Home continue to receive recognition at state and national meetings hosted by organizations such as Ren Re, Weather Predict, The Travelers Institute, The Federal Alliance for Safe Homes, The Institute for Business and Home Safety and others.

The South Carolina Department of Health and Environmental Control (DHEC) is the environmental and health regulation agency of the state. It is responsible for the implementation of state and federal regulations related to the protection of the environment and the health of its residents, including the regulation and oversight of licensed health care facilities. By the regulatory nature of this agency, SCDHEC conducts mitigation planning and activities by ensuring that regulated entities meet the minimum standards as established in regulations. The agency also implements surveillance measures to monitor, advise, and protect the public and healthcare providers in the case of bioterrorism or disease outbreaks.

The Department of Labor, Licensing and Regulation (LLR) grants licenses to contractors (general and residential) and design professionals (architects, engineers, land surveyors) who practice in South Carolina. Qualification examinations are administered to those seeking permission to practice in these professions. Enforcement procedures are in place for those who violate applicable codes or standards and do not adequately correct the violations.

SCDHEC's Office of Ocean and Coastal Resource Management (OCRM) is directed by the SC Coastal Tidelands and Wetlands Act (1977) "…to provide for the protection and enhancement of the State's coastal resources." A component of protecting the State's coastal resources is mitigating disasters. The Department promotes disaster mitigation through: 1) Critical Area permitting, 2) local beach management plans, and 3) coastal zone consistency review of federal and state activities in the Coastal Zone. First, OCRM administers a permitting program for the utilization of Critical Areas, which are defined as coastal waters, tidelands, beach/dune systems, and beaches. Construction or reconstruction seaward of the beachfront jurisdictional baseline or between the baseline and setback line is regulated, and there are limitations (i.e,: square footage of heated space; sited as far landward as possible) on development of property that falls between these lines. Retreat from the active beachfront is also encouraged, particularly post-disaster. Habitable structures are guided to be constructed or reconstructed as far landward as possible and cannot be located on active beach. New beachfront erosion control devices, such as seawalls, are prohibited and beachfront erosion control devices that are damaged beyond repair may not be reconstructed. Second, local comprehensive beach management plans are prepared by local governments with assistance from OCRM. The comprehensive plans include an inventory of erosion rates, structures within the Department's beachfront jurisdiction, public access points, and facilities for each beachfront community. Moreover, the plans require the local government to have a post-disaster plan to promote preparedness. Lastly, state generated revenue is sometimes available for beach renourishment needs, but funding is contingent on local governments having updated comprehensive beach management plans, adequate public access, and matching local funds. Coastal Zone Consistency reviews ensure that proposed activities avoid or minimize impacts to coastal resources.

Improvements continue in the degree to which state agencies coordinate complimentary objectives in addressing hazard mitigation, such as coordination on hazard studies and maximizing available grant funds. The Mitigation Action Plan, in sections VI and VII, serves as a primary means to improve interagency coordination. Actions include timelines, further linking policy and project completion. Actions can be tracked over time to assess the degree to which the plan is achieving desired aims. Finally, the Mitigation Action Plan is updated as needed following a disaster or as required by the Stafford Act.

Sound floodplain management involves a series of programs designed to reduce flood-related damages. Programs such as the National Flood Insurance Program (NFIP), the Community Rating System (CRS) and the Flood Mitigation Assistance (FMA) program provide the framework to implement a successful floodplain management program. The NFIP contains specific regulatory measures that enable government officials to determine where and how growth occurs relative to flood hazards. For a county or municipality to join the NFIP, it must adopt a Local Flood Damage Prevention Ordinance. This local law provides local governments with a powerful regulatory tool to reduce future flood-related losses. Another key service provided by the NFIP includes the mapping of identified flood hazard areas. Flood insurance rate maps (FIRMs) and studies are used to assess flood hazard risk and set flood insurance rates. The maps also provide an important means to educate residents, government officials and the business community about the likelihood of flooding in their community.

Impacts from three presidentially declared disasters in four years led, in part, to creation of the South Carolina Office of Resilience. The Disaster Recovery Office, established by Executive Order 2016-13, was incorporated into SCOR by the Disaster Relief and Resilience Act. SCOR was tasked with the development of a Strategic Statewide Resilience and Risk Reduction Plan (Statewide Resilience Plan). The Statewide Resilience Plan will provide recommendations to mitigate flood risks and the impacts of flood events on natural resources, infrastructure, the economy, commercial and residential property, cultural resources, and community services.

SCOR manages $162 million in HUD CDBG-Mitigation (CDBG-MIT) grant funds for mitigation activities that will increase resilience to future disasters and reduce or eliminate long-term risk of loss of life, injury, damage to and loss of property, and suffering and hardship. The South Carolina General Assembly allocated American Rescue Plan Act (ARPA) State and Local Fiscal Recovery Funds (SLFRF) to SCOR for stormwater infrastructure projects and acquisition of properties in floodplains.

D. Technical Capability

The state has a moderate level of technical capability to implement the state hazard mitigation strategy. The state is taking steps to improve information sharing and increase technical capabilities. Additional factors affecting technical capability include:

Information on past disasters and mitigation projects; Experience in disaster management and mitigation planning; and the application of technology to address hazards. Examples include the use of GIS-driven risk assessments and information technologies to facilitate the formulation, development, implementation, and monitoring of mitigation actions.

Technical capability can be defined as possessing the skills and tools needed to accomplish specific tasks and distribute the results to those associated with the State of South Carolina Hazard Mitigation Program. Technical capability can be measured across three primary elements: 1) geographic information systems (GIS) and database management; 2) grants management; and 3) hazard mitigation planning. Measuring the degree to which each element is found in the state was conducted through interviews with state staff.

Geographic information systems (GIS) and database management capabilities can be measured by reviewing existing tools (hardware and software) and the access to individual experts who can effectively gather, analyze and display relevant information. In the case of South Carolina, SCEMD developed the data analyses needed for the hazards. In addition, during an activation of the State Emergency Operations Center, the GIS section provides continuous support to help with the Operations Section by fulfilling map and data requests, dashboard development and maintenance, as well as any other services needed. Upon request, the section may also provide support to the Plans Section and to National Guard taskings. They may also request assistance from ESRI with imagery services and other tools, such as the Living Atlas, both pre-and post-disaster. The SCEMD GIS section may also partner with other organizations, such as the Civil Air Patrol, NOAA GIS Services, FEMA GIS Services and citizen science drawn from social media posts and images which include locations. Finally, SCEMD is part of the South Carolina Geospatial Information Consortium (GIC). The GIC includes GIS departments from other state agencies who combine efforts to assist with information sharing during disasters.

The Hazards Vulnerability and Resilience Institute (HVRI) within the University of South Carolina (USC) conducts field and survey research on group, organizational, and community preparation for, response to, and recovery from natural and technological disasters and other community-wide crises. The HVRI, in conjunction with SCEMD, has compiled hazard and loss data for the entire state and made it available in GIS format. This data is used to conduct risk assessments for this plan as well as local hazard mitigation plans. The USC Geology Department has conducted numerous earthquake-related studies in South Carolina, including on-going analysis of earthquake vulnerability in the Charleston-Berkeley-Dorchester county area.

The information generated and analyzed has proven valuable to assist in the identification of hazard vulnerability, assess past events and document specific mitigation measures adopted across the state.

Hazard mitigation-related grants management capabilities were measured by assessing the State HMGP Administrative Plan, the number of staff assigned to conduct identified duties, and the degree to which state and FEMA mitigation staff should train local governments to implement mitigation grant programs. Adequate staff support and training were reviewed in the context of the overall vulnerability of the state to hazards, which took into account the size of the state and the number and magnitude of past events. In the state, hazard mitigation grants management duties are the responsibility of the SHMO and the State NFIP Coordinator who administer the Hazard Mitigation Grant Program (HMGP), the Building Resilient Infrastructure and Communities (BRIC) Program and the Flood Mitigation Assistance (FMA) program, respectively. FEMA Region IV provides technical support as needed. Structured and regular training of local governments to administer grant programs continues to impact the statewide mitigation strategy. This training should allow for a source of expertise and staffing at the county and municipal level.

Hazard mitigation planning capabilities are the responsibility of the mitigation team within SCEMD and the State Flood Mitigation Program with SCDNR. The SHMO also relies on the ICC to assist in the multi-agency implementation of the SHMP. Based on state law created in 2020, the South Carolina Office of Resilience (SCOR) has created a statewide Resilience and Risk Reduction Plan primarily focused on reducing or managing flood risk.

E. Fiscal Capability

The ability to take action is closely associated with the amount of money available to implement policies and projects. Funding for mitigation actions may be obtained from grants or state and local revenue. The costs associated with policy and project implementation vary widely. In some cases, policies are tied to staff costs associated with the creation and monitoring of a given program. In other cases, funding is linked to a project, like the acquisition of flood-prone homes that can require a substantial commitment of a combination of local, state, and federal funding and resources. In either case, decisions must be made concerning how the state can reduce vulnerability to an acceptable level considering the availability of existing and future finances.

Taking into account both state agency operating budgets tied to mitigation-related activities and external funding sources obtained in recent years, the state has a limited fiscal capability for South Carolina's size and hazard vulnerability. Fiscal capability can be increased over time as a more direct link is made between existing state-level environmental and economic development programs and hazard mitigation objectives identified in this plan. Specific examples include the use of existing state and non-profit environmental land acquisition programs and the Community Development Block Grant (CDBG) program to address mitigation-related projects. The identification of eligible Building Resilient Infrastructure and Communities (BRIC) Program projects, as well as other federal funding sources identified in this plan, should allow communities in the state to compete nationally for available funding and serve to highlight opportunities for state agencies to coordinate funding resources.

The state currently has funds available because of HMGP grants from nine federally declared disasters, CDBG grants, and non-disaster mitigation funding including BRIC, FMA, and the High Hazard Potential Dam (HHPD) program. Funding from these programs is made available to counties and local governments as well as state agencies in accordance with program criteria. These funding sources have been helpful in furthering mitigation activities for communities throughout the state. The non-federal share match required for several of these programs – usually 25% or more – can be a barrier to seeking federal grant funds for low-resource communities.

In 2020, the General Assembly created the Disaster Relief and Resilience Reserve fund, administered by SCOR, which can be used to support disaster recovery efforts as well as mitigation investments in the state. S.C. Code Annotated Sections 48-62-60 and 48-62-70.

F. Legal Capability

In 1975, the General Assembly passed the Local Government Act, commonly called the Home Rule act, which gave counties authority to enact regulations and ordinances and make decisions regarding taxation and spending. While the state may provide the authority of a local government to act, most specific mitigation projects and hazard reduction decisions are determined and implemented at the local level. Broad policy objectives and programs often exist at the state and federal levels, and federal and state funding often drive local project initiatives. Because of the required interaction of multiple levels of government this SHMP recognizes the local, state, and federal legal frameworks that affect hazard mitigation planning and implementation.

In general, local governments have authorities regarding regulation including general police power, building codes and building inspections, land use and zoning; acquisition of property for public use, taxation and spending; and use of local tax revenues for infrastructure and mitigation investments. Each of these categories provides tools that local governments can use to implement hazard mitigation measures.

Police Power: Local governments have the authority to enact hazard mitigation measures, based on their authority to protect public health, safety and welfare. One means to do this is using local ordinances. In addition, local governments can cite their authority to address "nuisances," which may include, under certain circumstances, those actions that make people or property more vulnerable to hazards.

Building Codes: Building codes represent a regulatory tool that can is used to reduce the impacts of hazards. Local governments in the state have the authority to enforce building codes adopted by the state and to adopt local flood damage prevention ordinances. The state has a standard minimum building and related codes for plumbing, mechanical, gas, and electrical installations that local governments are required to enforce.

ENABLING LEGISLATION, RULES, AND EXECUTIVE ORDERS

The State of South Carolina and the Federal government maintain several relevant forms of enabling legislation, rules and executive orders that are directly relevant to hazard mitigation planning:

- *Federal-State Agreement (The agreement executed between the Governor and FEMA Regional Director following a disaster to receive federal assistance);*
- *The Robert T. Stafford Act of 1988 (PL 93-288), as amended;*
- *Title 44, Code of Federal Regulations;*
- *President's Executive Order 11988, Floodplain Management;*
- *President's Executive Order 11990, Protection of Wetlands;*
- *Flood Control Act of 1950, Section 215, PL 81-516 (33 USC 4001, et. seq.);*
- *National Flood Insurance Act of 1968, as amended (42 USC 4001, et. seq.);*
- *National Flood Insurance Reform Act of 1994 (established the Flood Mitigation Assistance (FMA) program.)*
- *Bunning-Bereuter-Blumenaur National Flood Insurance Reform Act of 2004 (repetitive flood loss provisions)*
- *Biggert-Waters Flood Insurance Reform Act of 2012*
- *Coastal Zone Management Act of 1972, as amended by PL104-150, The Coastal Zone Protection Act of 1996;*
- *SC Coastal Zone Management Act of 1976, as amended (Title 48, Chapter 39 of the South Carolina Code of Laws;*
- *Governor's Executive Order 99-11, Establishment of Interagency Coordinating Committee*
- *Regulation 58-1, Local Emergency Preparedness Standards, SC Code of Regulations;*
- *Regulation 58-101, State Emergency Preparedness Standards, SC Code of Regulations; and*
- *South Carolina Local Government Comprehensive Planning Enabling Act of 1994 (Title 6, Chapter 9 of the South Carolina Code of Laws*

G. Political Willpower

One of the most difficult and sensitive capabilities to evaluate involves the political will of a state to enact meaningful policies and projects designed to reduce the impact of hazards. A variety of qualitative information was gathered to assist in this evaluation, including a review of current practices, programs and policies, the use of survey results, and conversations with state staff. Following an analysis of this information it was determined that the state has a moderate level of political will to enact meaningful and proactive mitigation policies. SCEMD and members of the ICC are knowledgeable about the potential hazards the state faces and have become more familiar with the practices and principles of mitigation, particularly considering recent disasters. The current political climate at the state-level is favorable for supporting and advancing both existing and future hazard mitigation measures. Because of recent disasters there is a greater awareness of hazards, causing government officials to seek ways to reduce the impact of future events.

Completed hazard mitigation projects show an understanding of hazard mitigation, including the political will necessary to carry them out. Local governments should evaluate their effectiveness following events. The results should be presented to elected officials in order to provide examples of how mitigation can protect the lives and property of citizens. This can provide political support to improve the state's mitigation program.

H. State Hazard Management Capabilities

As part of the plan update process, the SHMP has highlighted the following examples of hazard management capabilities of the state:

- As of August 2022, 239 communities in the state participate in the Federal Emergency Management Agency's National Flood Insurance Program (NFIP). Of these communities 47 (or 20%) participate in the Community Rating System (CRS).
- Creation of a South Carolina Office of Resilience (SCOR) and development of a statewide Resilience and Risk Reduction Plan.
- Continuous adoption and maintenance of a statewide building code.
- Coordination with the USC Hazards and Vulnerability Resilience Institute (HVRI) to support hazard identification and risk assessment and social vulnerability assessment.

VII. Local Capability Assessment

Local capabilities to conduct hazard mitigation activities varies across South Carolina jurisdictions. Differences in resources, staffing levels, and access to expertise between local governments with smaller populations or that are rural and their larger and more urban counterparts are evident in disparities in status of mitigation plans and the number and complexity of grant project applications (and successful awards). Local jurisdictions in the state have initiated 76 HMA-funded mitigation projects in the past five years and have completed 124 projects during the same period. Of those subrecipients, 38 percent have a SoVI rating higher than the average of the state, which is 0.87.

> **Requirement 44 CFR §201.4(c)(3) (ii):**
> *The mitigation strategy shall include a general description and analysis of the effectiveness of local mitigation policies, programs, and capabilities.*

ICC agenciess encourage local governments to identify actions that will be most effective for hazard mitigation. The state provides guidance to the local governments and communities by providing model ordinances and sample plans. SCEMD and partner state agencies work with local governments throughout the state to generate interest and develop initiatives for hazard mitigation. SCEMD mitigation staff schedule and conduct mitigation workshops to educate local emergency managers on the various mitigation programs and initiatives that are available and the benefits of those programs. These workshops provide an opportunity for an exchange of ideas and the development of mitigation initiatives based on the evaluation of state and local needs. Additionally, it helps generate interest in the mitigation program from the ground up. The state has identified funding through federal programs such as HMGP and BRIC for interested communities to adopt hazard mitigation plans and actions. SCEMD's knowledge of and ability to analyze local policies, programs and capabilities will continue to improve through the local mitigation plans currently being developed. SCEMD will incorporate that improved knowledge and analysis in future updates of the State Hazard Mitigation Plan as local plans are approved.

The table below provides a listing of local policies and programs, a brief description of those policies and programs, a discussion of their applicability and their effectiveness. These policies and programs help the state to mitigate against hazards and flood prone repetitive loss properties.

A. Planning

The South Carolina Local Government Comprehensive Planning Enabling Act of 1994 gave local governments the authority to adopt and update comprehensive plans. These plans contain the planning process that examines an inventory of existing conditions, a statement of needs and goals, and implementation strategies with time frames. A comprehensive plan contains population, economic development, natural resources, cultural resources, community facilities, housing, and land use elements and can be an important vehicle in avoiding or reducing hazard risk. Adoption of a comprehensive plan gives a community the authority to enact zoning and land use ordinances. An important addition to the plan includes the inclusion of mitigation-related activities into comprehensive plans. In addition, the plans state that counties and municipalities should try to identify innovative ways to use existing planning requirements to reduce future disaster losses. In 2020, the General Assembly added a resilience requirement for local comprehensive plans. Each of the 46 counties is covered by a local hazard mitigation plan, some of which are multi-county/regional in coverage. Each 46 counties are covered by a Local Hazard Mitigation Plan. In 2018, all counties were covered by a FEMA- approved LHMP. As of May 2023, six counties' LHMPs were expired; all of which were in progress.

Disparity among South Carolina counties, primarily based on resources and local government capacity, affects the comprehensiveness, participation, and timeliness of planning activities. Less well-resourced and less well-staffed counties tend to experience challenges in updating local hazard mitigation plans before expiration dates. Ten councils of government (COG) established by the state support local governments in developing and maintain comprehensive plans and in development planning. A statewide repository of local government land use and zoning ordinances and plans does not exist but would be valuable to support vulnerability research, mitigation and disaster resilience planning, and mitigation project scoping activities. Another challenge in preparing and maintaining relevant local plans lies in the uncertainty created by climate change. While international and national research and projections are improving, localized data may not be available or accessible for all areas. Planning based on historic hazard occurrence data is likely insufficient to analyze future risk from hazards including extreme temperatures, drought, flood, severe thunderstorms, tornadoes, tropical cyclones, wind, and winter storms.

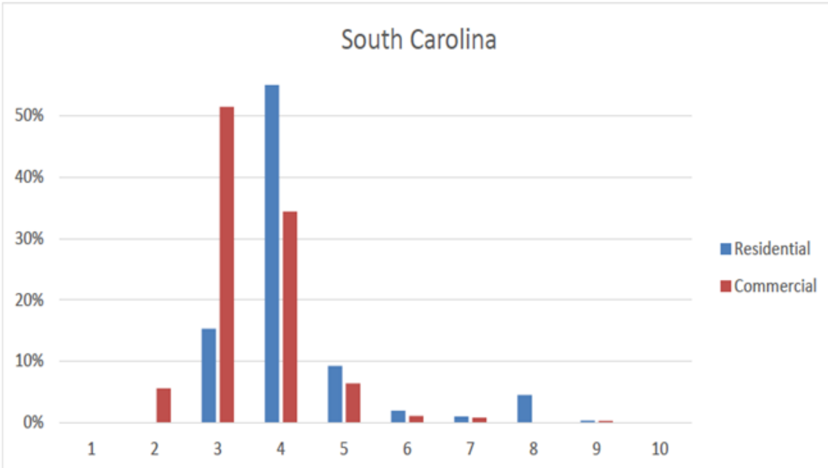
B. Building Codes

Building codes are regulations developed by recognized agencies establishing minimum building requirements for safety such as structural requirements for wind, earthquake, flood, and fire protection. Building codes address acceptable design standards. The South Carolina Building Code Council reviews and adopts acceptable building codes. In July 2013, the Building Code Council updated the mandatory and permissive building codes to reflect the new 2012 International Code series. The Building Codes Council registers all code enforcement officials in the state to verify the credentials of those performing these duties.

Enforcement of building codes sees challenges in local capacity and effectiveness because of limited availability of staffing and resources in smaller jurisdictions. Other challenges include pressures to incentivize and support development. From 2021-2022, South Carolina was the third-fastest growing state in terms of percentage of population growth. Development pressures in some locales make it difficult to keep up with the pace and types of building development.

C. Building Code Effectiveness Grading Schedule

The Building Code Effectiveness Grading Schedule (BCEGS), administered by the International Standards Organization (ISO), assesses the ability of local governments to enforce building codes. The program promotes the adoption and enforcement of building codes to reduce losses from natural hazards. ISO rates communities from 1 to 10, with 1 being the highest rating. The closer the BCEGS rating for a community gets to 1, the better insurance rates it may receive. The ratings are divided into two categories: personal lines and commercial lines. The personal lines rating addresses building code adoption and enforcement for one and two-family dwellings. The commercial lines rating is for all other buildings. See Figure 130: BCEGS Ratings in South Carolina for a distribution of BCEGS ratings for South Carolina.



State Average

	Score	Class
Commercial	75.12	4
Residential	68.41	4

Figure 130: BCEGS Ratings in South Carolina

D. Community Rating System (CRS) Participation

The primary goals of the CRS are to reduce flood losses, facilitate accurate insurance ratings, and promote the awareness of flood insurance. The CRS achieves these goals by encouraging communities to adopt regulations stricter than the minimal requirements of the NFIP. The CRS is an incentive-based program that encourages counties and municipalities to accept defined actions designed to reduce the impacts of future flooding. Each of the 18 activities, or measures, is assigned points. As points are accumulated and reach identified thresholds, communities can apply for a reduced CRS class. Class ratings, which run from 1 to 10, are tied to flood insurance premium reductions. Therefore, as class ratings get closer to 1, the percent reduction in flood insurance policies held in that community increases (see Table below).

CRS CLASS	DISCOUNT
1	45%
2	40%
3	35%
4	30%
5	25%
6	20%
7	15%
8	10%
9	5%
10	---

Table 80 CRS Premium Discounts

In the State of South Carolina, 47 communities participate in the CRS as of August 11, 2022, an increase of three compared to 2018. Challenges associated with encouraging participation include demonstrating benefits and local political will and capability to take steps to meet CRS requirements. An overarching challenge associated with activities to mitigate flood risk is the lack of full coverage of high-resolution, up-to-date flood maps for the state. Local jurisdictions often use federal Flood Insurance Rate Maps (FIRMs) for local mapping and planning purposes; however, FIRMs do not cover all locations, particularly areas of new development or areas where watershed issues impact flood risk. FIRMs also have not been updated for all locations. State agencies are working to improve flood mapping and modeling data and capabilities to support local planning, flood risk awareness, insurance participation, dam safety, and hazard mitigation. Communities participating in CRS are listed in *Table 81.*

COMMUNITY	DATE OF ENTRY	CRS CLASSIFICATION
Aiken County	10/01/1993	9
Awendaw, Town of	10/01/1996	6
Beaufort County	10/01/1991	6
Beaufort, City of	10/01/1992	5
Berkeley County	05/01/2008	8
Cayce, City of	05/10/2010	9
Charleston County	10/01/1995	3
Charleston, City of	10/01/1993	6
Colleton County	05/01/2005	8
Columbia, City of	05/01/2019	9
Edisto Beach, Town of	10/01/1992	6
Florence, City of	10/01/1991	6
Florence County	05/01/2010	9
Folly Beach, Township of	10/01/1996	4
Georgetown, City of	10/01/1993	7
Georgetown County	05/01/2010	7
Greenville County	10/01/1993	5
Greenville, City of	10/01/1991	7
Hanahan, City of	10/01/2018	7
Hilton Head Island, Town of	10/01/1991	5
Hollywood, Town of	10/01/2010	7
Horry County	10/01/2010	7
Isle of Palms, City of	10/01/1994	6

COMMUNITY	DATE OF ENTRY	CRS CLASSIFICATION
James Island, Town of	05/01/2020	6
Kershaw County	05/01/2014	9
Kiawah Island, Town of	10/01/1996	5
Lexington County	10/01/1991	7
McClellanville, Town of	10/01/2000	7
Meggett, City of	10/01/1996	6
Mount Pleasant, City of	10/01/1994	6
Myrtle Beach, City of	10/01/1991	5
North Charleston, City of	05/01/2003	7
North Myrtle Beach, Town of	10/01/1991	6
Orangeburg County	10/01/2016	9
Pawley's Island, Town of	10/01/2005	5
Pickens County	04/1/1999	9
Port Royal, Town of	05/01/2011	9
Ravenel, Town of	10/01/1996	6
Richland County	10/01/1995	8
Rock Hill, City of	05/01/2020	7
Rockville, Town of	10/01/1998	6
Seabrook Island, Town of	10/01/1995	5
Sullivans Island, Town of	05/01/2004	5
Sumter County	10/01/1992	7
Sumter, City of	10/01/1992	7
Surfside Beach, Town of	10/01/2010	5
York County	10/01/2009	8

Table 81 Community Rating System Participation in South Carolina

E. Contractor and Design Professional Licensing

The Department of Labor, Licensing and Regulation (LLR) grants licenses to contractors (general and residential) and design professionals (architects, engineers, land surveyors) who practice in South Carolina. Qualification examinations are administered to those seeking permission to practice in these professions. Enforcement procedures are in place for those who violate applicable codes or standards and do not adequately correct the violations.

F. Mutual Aid Agreements and Volunteer Services

Many local governments have entered into mutual aid agreements to support resource sharing in emergency situations. Through the mutual aid agreements, fire suppression, building inspection, and other essential services are able to be performed with support from other jurisdictions when service demands exceed capabilities of the local government, such as in disaster response and recovery.

The Department of Natural Resources Fish and Wildlife Department has a cadre of local volunteers who assist with enforcement of wildlife preservation laws and regulations when its staff levels are unable to meet demands. These resources are also available, if needed, for hazard mitigation activities or post-event.

Project Impact

Project Impact (no longer active) was a program under FEMA that preceded the Pre-Disaster Mitigation program and BRIC. The purpose of the program was to identify communities as "Project Impact Communities" and provide them with funding to help set up mitigation programs. The five Project Impact communities in South Carolina are Orangeburg County, Charleston County, Georgetown County, Horry County, and the City of Florence. Each of the communities established public-private partnerships that led to successful mitigation programs.

StormReady®

Storm Ready is a program established by the National Weather Service (NWS) to help communities prepare for severe weather events. The NWS works in conjunction with SCEMD to implement the program. To be considered a "Storm Ready Community," a community must meet criteria including: 1) have a severe weather annex within the county EOP or other response plan, 2) have numerous ways in which to receive and disseminate weather and flood warnings, 3) have a team of trained storm spotters within the community, and 4) participate in weather-related public education seminars and exercises, including the statewide tornado drill for public schools. The program also requires participants to have NOAA weather radios located within all public buildings. The benefits of the program include being better prepared for severe weather events, which could lead to fewer casualties, as well as the community receiving credit under the Community Rating System (CRS) to help lower flood insurance premiums. The program is continually looking to add more communities to the list of ones that have already met the criteria. SCEMD maintains a member on the StormReady Advisory Board and participates in approving communities' applications and conducting site reviews to ensure compliance with the program. The National Weather Service and SCEMD continue to encourage communities to participate in the program. Figure 130 shows the communities approved in South Carolina in the StormReady program.

TsunamiReady™

The TsunamiReady Program, developed by the National Weather Service, is designed to help cities, towns, counties, universities, and other large sites in coastal areas reduce the potential for tsunami-related consequences. Since June 20, 2001, TsunamiReady has helped community leaders and emergency managers strengthen their local operations. TsunamiReady communities are better prepared to save lives through better planning, education and awareness. Communities have fewer fatalities and property damage if they plan before a tsunami arrives. Figure 130 shows the communities approved in South Carolina in the Tsunami Ready and StormReady programs.

To be recognized as TsunamiReady, criteria a community must meet include:

- Establish a 24-hour warning point and emergency operations center
- Have more than one way to receive tsunami warnings and to alert the public
- Promote public readiness through community education and the distribution of information
- Develop a tsunami plan, which includes holding emergency exercises.

Since the last SHMP update, South Carolina has added two counties to its list of TsunamiReady counties. TsunamiReady consist of 4 counties and 5 communities total.

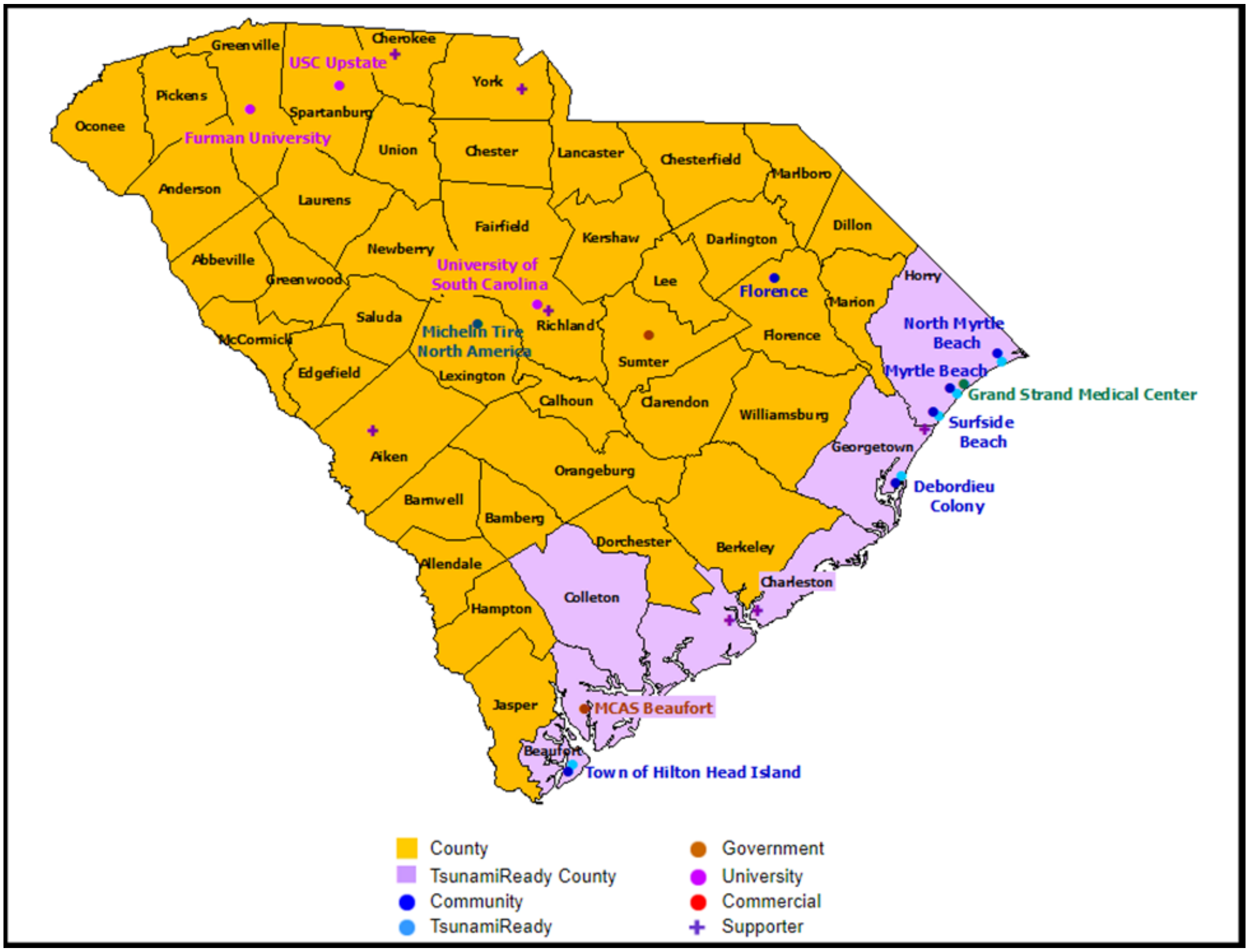


Figure 131: Communities In the StormReady and TsunamiReady Program

G. Conclusion

As noted, significant disparities exist in the capabilities and capacity of counties and local governments to design, pursue funding for, and implement hazard mitigation planning and mitigation actions. Larger, well-resourced counties have developed or begun developing climate change resilience strategies, for example, while smaller, less-resourced counties or communities are challenged in conducting a five-year LHMP update. Mitigation measures being implemented by local governments have been successful in reducing hazard risk, such as acquisitions to avoid future flood damage, and improving resilience, such as hardening emergency shelters and installing backup electric generators. Many local governments in more hazard-prone areas of the state are beginning to look for means to conduct larger and more complex mitigation projects.

The findings of the state capability assessment are intended to help the ICC and state agencies meet the needs of county and local governments while creating a state-level approach that is feasible given identified agency capabilities. In addition, the assessment is intended to identify potential agency partners who assist in the development and implementation of the state's comprehensive mitigation strategy as well as identify areas in need of improvement. The capability assessment serves as part of the planning foundation, helping to craft a practical statewide mitigation strategy. As capabilities change, the assessment will be updated to reflect new programs, resources, and initiatives.

H. Changes from the Last Plan

Changes were made to this section to add state agency capabilities, such as noting the creation of a Disaster Relief and Resilience Reserve Fund, and to maintain SHMP compliance with updated FEMA requirements. As part of the plan update process, the state took the opportunity to re-evaluate pre- and post-disaster hazard mitigation programs, policies, and capabilities. This included conducting an assessment of hazard management capabilities of the state that have changed since the plan was last adopted. The state also assessed its funding capabilities for hazard mitigation projects. The results of this re-evaluation have been incorporated into this section.

VIII. Mitigation Strategy

A. Introduction

This section outlines the state's approach to hazard mitigation actions. Based on the findings of the risk assessment, a state-level capability assessment, and mitigation goals, goals and actions are intended to guide day-to-day operations of mitigation-related programs and the state's long-term approach to reducing the impacts of hazards. This section is organized in nine subsections:

EMAP Standard 4.2
An accredited Emergency Management Program has a mitigation program that regularly and systematically utilizes resources to mitigate the effects of emergencies/disasters associated with the risks identified in the HIRA.

- Goals, Objectives and Activities
- Identification and Analysis of Mitigation Measures
- Identification of Mitigation Techniques
- Process Used to Evaluate and Prioritize Mitigation Actions
- Post-Disaster Implementation
- Repetitive Loss and Severe Repetitive Loss Property Specific Priorities
- Monitoring Implementation of Mitigation Measures and Project Closeouts
- Funding Sources for Mitigation Actions
- Monitoring Progress of Mitigation Actions

The SHMP provides a comprehensive review of hazards and identifies policies and projects intended to reduce the future impacts of a wide range of hazards and assists the state, counties, and municipalities in achieving compatible economic, environmental, and social goals. The plan is strategic in that it supports collective effort toward established mitigation goals. Policies and projects are linked to departments or individuals responsible for their implementation. Potential funding sources are identified.

The Mitigation Action Plan (MAP) lists specific actions, those responsible for implementation, potential funding sources, and estimated target dates for completion. This approach provides those in charge of the plan's implementation with a monitoring tool. The collection of actions also serves as an easily understood menu of policies and projects for decision makers and identifies actions and projects that are ripe for future funding opportunities.

B. Mitigation Goals, Objectives, and Activities

Federal requirements for state hazard mitigation plans:
44 CFR §201.4(c)(3) (i): *The mitigation strategy shall include goals to reduce long-term vulnerabilities from the identified hazards.*

This section identifies goals and objectives of the state mitigation program. To be effective, these goals and objectives must be achievable while supporting and complimenting both state and local mitigation programs. The state of South Carolina evaluated possible goals, objectives, and mitigation measures (actions) based on ability to contribute to hazard risk reduction. It is important that state and local government, public-private partnerships, and individual citizens can see the results of mitigation efforts. By establishing achievable goals and objectives, entities involved in the process see that their efforts make a difference, which can foster additional mitigation activity.

As local plans are submitted for review and approval, the risk assessment outlined in this plan will be updated accordingly. As part of that process, the goals and objectives outlined in this plan will be reviewed and updated as needed to reflect the current situation in the state. Every mitigation action considered for implementation should, at a minimum, have the potential to reduce the effects of a future hazard event.

EMAP Standard 4.2.1: *The Emergency Management Program has a plan to implement mitigation projects and sets priorities based upon loss reduction. The plan establishes interim and long-term strategies, actions, goals, and objectives.*

Planning Approach

The plan follows a traditional planning approach. The goals are designed to support the intent of the plan. Mitigation actions are identified and tied to established goals. Actions may include policies or projects designed to reduce the impacts of future hazard events. Each step is intended to provide a clearly defined set of policies and projects based on a rational framework for action. The components of the planning framework are explained in greater detail below:

- Goals: Goals represent broad statements that are achieved through the implementation of more specific, action-oriented policies or projects. Goals provide the framework for achieving the intent of the plan. Objectives provide additional detail for activities or approaches to achieve goals.
- Proposed hazard mitigation policies: Policies are defined here as an ongoing agreed-upon course of action. If appropriate, potential funding sources are listed.
- Proposed hazard mitigation projects: Projects are defined as discrete actions taken to address defined risk or vulnerabilities to existing buildings or systems. Potential funding sources are listed for each project.
- Mitigation action plan (MAP): The MAP is a prioritized list of actions (policies and projects), each of which includes a categorization of the mitigation technique or type, hazards addressed, the organization responsible for implementation, an estimated timeline for completion, and a series of potential funding sources.

Mitigation Goals

The goals, objectives, and mitigation provide the comprehensive approach taken by the state of South Carolina to reduce the impacts of natural hazards. Goals identified in the SHMP evolved from in those initially generated in an SHMP brainstorming session in July 2004. Attendees of the brainstorming session included members of the Interagency Coordination Council (ICC) and invited stakeholders. Goals and actions in the SHMP have been updated as hazard research, understanding of vulnerabilities, and mitigation opportunities have changed in the past two decades. On October 19, 2021, SCEMD conducted a State Hazard Mitigation Plan Partners Workshop for state agencies and non-profit organizations to discuss updating action items for the SHMP. Following the workshop, all attendees were asked to report from their respective agencies to identify additional actions that would be considered for inclusion in the plan update.

As part of the plan update process in 2021, the ICC reviewed the mitigation goals. It was determined that goals used in the 2018 plan update were largely still valid and useful. The ICC voted to continue use of those goals in the 2023 plan update with revisions and addition of one goal.

Goal 1: Implement policies and projects designed to reduce or eliminate the impacts of hazards on people and property.

Objective: Implement processes and systems to share hazard and vulnerability analysis data across jurisdictions and sectors.

Objective: Use research and tools like the Social Vulnerability Index to provide insight and guidance to local planners and jurisdictions to support mitigation actions in areas with high poverty rates and/or high social vulnerability.

Objective: Provide opportunities to support jurisdictions, agencies, and communities in generating mitigation project ideas and learning through examples of other projects that focus on reducing and eliminating hazards.

Goal 2: Obtain resources necessary to reduce the impact of hazards on people and property.

Objective: Provide and promote opportunities to include agencies and stakeholders on grant-funded projects, including mitigation planning and related initiatives.

Objective: Provide technical assistance and support to make sure grant or programmatic requirements are met to maximize potential funding opportunities.

Objective: Share information regarding ongoing and post-disaster mitigation funding opportunities and coordinate across organizations to stretch mitigation dollars throughout the state.

Goal 3: Enhance training, education, and outreach efforts focusing on the effects of hazards, importance of mitigation, and ways to increase resilience.

Objective: Provide outreach dedicated to mitigation topics to encourage thinking and collaboration toward mitigation solutions and nature-based options that strengthen resilience from major hazards.

Objective: Provide regular updates on hazard risk, importance of hazard mitigation, and mitigation and resilience measures.

Objective: Prepare mitigation and resilience instructors and public speakers with current and accurate information that incorporates updates in hazard research, climate science, and innovation .

Goal 4: Collect and utilize data, including studies and analyses, to improve policymaking to support hazard resilience and identify appropriate mitigation projects.

Objective: Identify and fund studies and technical assistance in areas that have less resources to conduct data collection and analysis and project development. Conduct or support studies that focus on small, impoverished communities and low-population areas.

Objective: Establish practices and processes for cross-agency data, modeling, and information sharing to support risk analysis and hazard mitigation. Identify data gaps and means to address.

Objective: Prioritize data collection and analysis that include social vulnerability and climate change impacts on hazard risk, including sea level rise.

Goal 5: Improve interagency coordination and planning to reduce the impact of hazards on people and property.

Objective: Provide or support communication among local and state-level planners and state planners to share information and recommend practices.

Objective: Provide information to local planners to support work with building code officials, local decisionmakers, and the private sector to identify and implement local codes and ordinances that can reduce damage from frequent and/or high-impact hazard occurrences.

Objective: Include multi-agency planning resources in classes, presentations, events, and digital materials so that collaborative projects and planning initiatives use current, comprehensive data and information.

Goal 6: Enhance policies and compliance to reduce risk and damage, incorporating current trends and projections regarding population growth and climate change.

Objective: Identify plans and regulations in which intensified or modified effects from climate change should be addressed.

Objective: Support inclusion of climate change considerations in state and local policy and mitigation planning and projects.

Objective: Incentivize compliance with land use ordinances, building codes, and related policies.

Goal 7: Maximize use of natural resource protection measures and nature-based solutions as cost-effective means to reduce the impacts of hazards on people, property, and infrastructure.

Objective: Provide educational opportunities to a broad audience on benefits and examples of nature-based solutions and natural resource protection.

Objective: Coordinate across sectors and levels of government to support projects that use nature-based solutions and conservation.

Objective: Provide incentives and technical assistance to potential grant subapplicants for incorporating nature-based solutions in planning and mitigation projects.

Goal 8: Pursue and prioritize mitigation actions that include and benefit multiple stakeholders and geographic areas to achieve broad, comprehensive results and leverage available resources.

Objective: Conduct in outreach and assistance to foster multi-organizational and multi-jurisdictional participation in mitigation planning and projects.

Objective: Support collaborative action and coordination on mitigation projects.

Objective: Highlight and share success stories of multi-group, multi-participant projects to new subapplicants.

C. Identification and Analysis of Mitigation Measures

In formulating the state mitigation strategy, a range of activities was considered. Activities chosen by participating stakeholders fall into one of the broad categories of mitigation techniques listed below. Each mitigation action contributes to the overall mitigation strategy. When considering the priority of these actions, there are limitations such including capabilities and funding sources. Because of these constraints, no preference or priority among mitigation techniques is defined here to allow for flexibility to pursue actions that are most feasible and effective based on hazard type, funding availability, and other factors. Inclusion in the mitigation techniques list does not necessarily indicate a technique is eligible for mitigation grant funding.

EMAP Standard 4.2.1: *The Emergency Management Program as a plan to implement mitigation projects and sets priorities based upon loss reduction. The plan is based on the natural and human-caused hazards identified in Standard 4.1.1 and the risk and consequence of those hazards; and is developed through formal planning processes involving Emergency Management Program stakeholders.*

D. Mitigation Techniques

Prevention

Prevention activities are intended to avoid hazard-related problems getting worse. They are particularly effective in limiting a community's future vulnerability, especially in areas where development has not occurred, or capital improvements have not been substantial. Examples of prevention activities include:

- Planning and zoning;
- Hazard mapping;
- Building codes;
- Studies/data collection and analysis;
- Open space preservation;
- Floodplain regulations;
- Stormwater management;
- Drainage system maintenance;
- Capital improvements programming; and
- Riverine setbacks.

Federal requirements for state hazard mitigation plans:
44 CFR 201.4(c)(3)(iii): *[State plans shall include] an identification, evaluation, and prioritization of cost-effective, environmentally sound, and technically feasible mitigation actions and activities the State is considering and an explanation of how each activity contributes to the overall mitigation strategy. This section should be linked to local plans, where specific local actions and projects are identified.*

Property Protection

Property protection measures are intended to enable structures to better withstand hazard events, remove structures from hazardous locations, or provide insurance to cover potential losses. Examples include:

- Acquisition;
- Relocation;
- Building elevation;
- Critical facilities protection or hardening;
- Retrofitting (i.e., wind proofing, flood proofing, seismic design standards);
- Insurance; and
- Safe room construction.

Natural Resource Protection

Natural resource protection activities reduce the impact of hazards by preserving or restoring the function of environmental systems. In some cases, natural systems may include high hazard areas such as floodplains, steep sloped areas, or barrier islands. Natural resource protection measures can serve a dual purpose of protecting lives and property while enhancing environmental goals such as improved water quality or recreational opportunities. Parks, recreation or conservation agencies and organizations often implement natural resource protection measures. Examples include:

- Floodplain protection;
- Riparian buffers;
- Fire resistant landscaping;
- Best land management practices
- Fuel breaks;
- Erosion and sediment control;
- Wetland preservation and restoration;
- Habitat preservation; and
- Slope stabilization.

Structural Projects

Structural mitigation projects are intended to lessen the impact of a hazard by physically modifying the environment. They are usually designed by engineers and managed or maintained by public works staff. Examples include:

- Reservoirs;
- Levees/dikes/floodwalls;
- Diversions/detention/retention areas;
- Beach nourishment;
- Channel modification; and
- Storm sewer construction.

Emergency Services

Although not typically considered a mitigation technique, emergency services capabilities can reduce injuries and loss of life associated with hazards. These actions may be take prior to, during, or in response to a hazard event. Examples include:

- Warning systems;
- Search and rescue;
- Evacuation planning and management; and

- Flood fighting techniques.

Public Information and Awareness

Public information and awareness activities are used to advise residents, business owners, potential property buyers, visitors, and government officials about hazards, hazardous areas and mitigation techniques they can use to protect themselves and their property. Measures used to educate and inform the public include:

- Outreach and education;
- Speaker series, demonstration events;
- Real estate disclosure; and
- Training.

Mitigation Action Plan

Mitigation actions identified by the State of South Carolina are listed in Appendix C. Each has been designed to achieve the goals of the plan. Mitigation actions are specific measures to be undertaken by members of state agencies and state-level organizations. They will be used as a key measure of progress of the plan's implementation. This approach is intended to ease the implementation of the actions and facilitate the quick review and update of the plan as described in the Plan Maintenance Procedures in Section VIII. Mitigation actions included in this plan were contributed and reviewed during the planning process. It is anticipated that other actions can and will be developed as needed during the five-year period of this plan.

Mitigation Action Information
A. Category
B. Hazard(s) Addressed
C. Priority (High, Moderate, Low)
D. Estimated Cost
E. Potential/Current Funding Sources
F. Lead Agency/Department Responsible
G. Implementation Schedule
H. Implementation Status
I. Milestones Achieved/ Impediments to Implementation

Table 82 Mitigation Action Information Collected

Category: Mitigation actions fall within the following categories: prevention, property protection, natural resource protection, structural projects, emergency services, and/or public information and awareness. Classification of actions allows those developing and using the plan to assess an action's relevance to the comprehensive mitigation strategy.

Hazard(s) addressed: The hazard(s) the action is designed to mitigate.

Priority (high, moderate, low): Indicate whether the action is a

- 1) High priority – short-term immediate – reducing overall risk to life and property;
- 2) Moderate priority – an action that should be implemented in the near future because of political or community support or ease of implementation;
- 3) Low priority – an action that should be implemented over time, but does not have the same sense of urgency or impact on hazard vulnerability as other higher priority actions.

Estimated cost: If applicable, indicate what the cost will be to accomplish the mitigation action. The amount can be estimated until a more accurate project cost can be determined.

Potential/current funding sources: If known, indicate how the action would be funded. For example, funds may be provided from existing operating budgets (General Revenue), from a previously established contingency fund (Contingency/Bonds), or a federal or State grant (External Sources).

Lead agency/department responsible: Identify the state agency, department, or organization that is best suited to accomplish the mitigation action.

Schedule: Indicate when the action will begin and when the action is expected to be completed. Some actions will require a minimum amount of time, while others may require a long-term commitment.

Implementation schedule: Provide an update as to the status of the implementation of the action. Common answers may be that the action has been completed, is being planned, deleted, or deferred.

Milestones achieved/impediments to implementation: Provide information regarding the success or difficulty experienced in implementing the action.

E. Process To Evaluate and Prioritize Goals and Mitigation Actions

To ensure that South Carolina is meeting the goals as outlined in the mitigation strategy, it is necessary to review and evaluate progress on a routine basis. Annually, the ICC discusses mitigation goals to determine if the goals are still relevant, if progress has been achieved, and if the mitigation actions need to be changed to reflect updates. Progress is defined as implementation of the mitigation strategy and initiatives to reach the outlined goals. For example, if a state agency institutes an enhanced training and outreach program for community resilience, the ICC would note this achievement in the discussion as supporting Goal 3. As part of this process, the ICC may determine that a goal has been met and a new goal should be created in its place. Changes, improvements, and progress will be noted in the next update of the SHMP.

Federal Requirements for State Mitigation Plans
44 CFR 201.4(c)(5)(ii) and (iii): *The State plan maintenance process should include] 1) A system for monitoring implementation of mitigation measures and project closeouts. 2) A system for reviewing progress on achieving goals as well as activities and projects in the Mitigation Strategy.*

To reach state mitigation goals, mitigation actions must be developed and completed. Funding will be an important issue when considering mitigation actions. State and federal mitigation funds are limited. As such, a process has been developed to evaluate and prioritize mitigation actions proposed for federal and state funding.

The ICC approves the priorities SCEMD uses to review Hazard Mitigation Assistance (HMA) grant applications submitted by county and local governments and state agencies. Local jurisdictions are encouraged to incorporate mitigation initiatives, based on established hazard risk assessments, into all proposed development projects and as improvements to existing projects. To varying degrees, this has been established as a part of project development and approval. The following issues will be reviewed and discussed as part of the process to evaluate and prioritize HMA-funded mitigation projects. These also can be useful in review of projects proposed for other funding sources.

Mitigation planning activities will maintain a high priority to ensure that all jurisdictions keep and maintain an approved hazard mitigation plan.

Mitigation actions that are only available under specific funding opportunities (state set-asides, nationally competitive, or post-disaster) will be given priority in that specific category or opportunity.

Mitigation actions must meet eligibility requirements for the funding opportunity being applied for. Requirements generally include aligning with the jurisdiction's approved hazard mitigation plan and independently solving a hazard-related problem or mitigating a hazard. The action must be cost-effective, technically feasible, and environmentally sound and must reduce the risk of future damage from the hazard(s) mitigated.

Additional priority considerations include:

- The hazard being mitigated is a priority based on the jurisdiction's current risk assessment.
- If available funding is post-disaster mitigation, relevance of proposed actions to the hazard that caused the declared incident and whether the applicant jurisdiction was impacted by the disaster.
- Reduction of risk to socially vulnerable populations or economically disadvantaged, rural communities.
- Jurisdiction has not conducted grant-funded mitigation activities in recent years (to promote mitigation activities in those areas).
- Potential for risk reduction to multiple hazards or incorporating multiple mitigation actions.
- Disaster history of the jurisdiction including number of repetitive flood loss and severe repetitive loss properties.

This plan does not differentiate or classify mitigation initiatives as primary or alternates. Mitigation initiatives will be evaluated and prioritized based on the considerations described above and federal and state-set criteria for specific grants. A mitigation project approved for funding is done so on the basis that it will benefit the community at large and therefore the state.

In its mitigation priorities, the state of South Carolina seeks to support actions that will reduce social vulnerability to hazards by considering socioeconomic and demographic factors that indicate a potential for increased vulnerability. The state recognizes that communities with higher social vulnerability tend to have more significant post-disaster impacts and can take longer to recover.

Prioritizing these more socially vulnerable communities in the state's mitigation strategy will reduce the burden on these communities and the state post-disaster by supporting these communities in becoming more resilient.

The state's priorities consider hazards, risk, vulnerability, and capabilities. In general, prioritization considerations are given to communities that have the highest risk. Mitigation actions that reduce vulnerability and impacts to frequent, recurring, and high impact hazards will continue to be a priority.

F. Post-Disaster Implementation

Following a presidential disaster declaration, the state is responsible for determining how to allocate the HMGP funding for state and local mitigation actions and projects. The ICC will define how HMGP dollars for the event will be prioritized and allocated. Depending on the disaster type, geographic location, and scope of the disaster, a decision will be made if certain regions or types of mitigation activities will be prioritized. For example, if a flooding event devastates most of the state, South Carolina may choose to open funding to the entire state. If the event is a tornado that affects only a few municipalities, a decision may be made to prioritize projects in the impacted areas or specifically tornado or wind-related mitigation projects. In recent declared events, the state has opened HMGP for applications for eligible applicants in all 46 counties regardless of whether a county was declared for the disaster.

One year after the declaration, FEMA provides the state the funding ceiling or lock-in value for the HMGP grant for that disaster. FEMA may provide HMGP estimates prior to 12 months; however, these estimates will not represent a minimum or floor amount. The ICC will finalize funding priorities for the post-disaster grant, which may include priorities for mitigation action types, subapplicants, location of work being conducted, and federal share funding caps if deemed necessary. Each application will be reviewed by SCEMD mitigation staff and the SHMO for eligibility in accordance with the criteria as defined by 44 CFR Section 206.434, priorities set by the ICC, guidance outlined in the previous subsection, and grant-specific requirements.

Non-disaster mitigation grants including BRIC and FMA are administered on an annual basis based on a notice of funding opportunity released by FEMA. The ICC reviews and approves criteria for prioritizing projects for state set-aside funding under BRIC.

G. Monitoring Implementation of Mitigation Measures and Project Closeouts

Project Management

Upon notification from the FEMA that a project has been approved and is eligible for funding, the State Hazard Mitigation Officer (SHMO) or a designated mitigation grants coordinator will notify the sub-grantee and arrange a meeting to provide the sub-grantee with information on Section 404 program requirements. SCEMD is the grantee for project management and accountability of funds in accordance with 44 CFR 13. Approved applicants are considered sub-grantees and as such are accountable to the grantee for funds awarded to them.

The state and SCEMD (as grantee) recognize responsibilities in 44 CFR 206.438(a): *The State serving as grantee has primary responsibility for project management and accountability of funds as indicated in 44 CFR part 13. The State is responsible for ensuring that sub-grantees meet all program and administrative requirements.*

Technical Assistance and Project Monitoring

SCEMD provides technical assistance to all eligible and funded subgrantees and monitors project progress. The SHMO and other mitigation staff assigned to support the subgrantee attend subgrantee meetings to ensure the policies and procedures are explained and questions are addressed. SCEMD and state agency partners regularly provide training and assistance opportunities to support grant applicants and sub-grantees.

Mitigation staff meet with sub-grantees as needed assist in completing quarterly progress reports and submitting reimbursement documentation.

Site visits, telephone conversations, and email as well as documentation uploads in SC Recovery Grants are the prime communication tools for monitoring and managing mitigation projects with sub-grantees.

As a general rule, only 75 percent of administrative funds will be released prior to project closeout.

Cost Overruns

For purposes of the mitigation program, cost overruns are defined to be additional funds needed to complete a mitigation project defined in the original project scope of work and budget approved by FEMA. Cost estimates for mitigation projects, such as acquisition and demolition costs for structures and lots, can be change as the project is implemented. (Property closings resulting in an overrun based on the estimate that can be offset by property closings resulting in a net underrun are not considered cost overruns for this purpose, and thus, do not need FEMA approval as outlined in 44 CFR 206.438(b)).

Once it is recognized that the approved scope of work cannot be accomplished with the grant funds allocated, the subgrantee submits a request for additional funds with appropriate justification documents to SCEMD for approval by the Governor's Authorized Representative (GAR), which is usually the SCEMD director, for submission to FEMA for consideration If the request is not justifiable, the GAR will deny the request. The total amount obligated to the state cannot exceed the funding limits set forth in 44 CFR 206.432(b).

Appeals

Subgrantee appeals to FEMA decisions are administered in accordance with 44 CFR 206.440.

Quarterly Reports

Quarterly progress reports based on a calendar year will be provided to the FEMA Region IV administrator as required by 44 CFR 206.438(c).

Project Closeout

Upon completion of a hazard mitigation grant project, SCEMD mitigation staff will conduct a closeout site visit or review to view files and documents related to the use of hazard mitigation grant funds and any State General Revenue funds provided. Procurement records and contracts to third parties will be reviewed. Worksheets to aid in closeout review are provided to subgrantees.

Reports generated at the closeout site visit are compared with requests for funds submitted for the project. Any significant findings are reported to the SHMO for final determination and corrective action. Corrective action notices will be sent to sub-grantees and another site visit will be conducted, if necessary, prior to the release of remaining funds.

Closeout reports are submitted for each subgrantee before expiration of the grant. The closeout report will summarize the following:

- Grant application and approval award
- Procurement
- State Historical Preservation Office approvals
- Use of administrative allowance
- Final list of properties acquired, if a buyout project
- Summary of costs incurred
- Verification of project monitoring and correspondence
- Demolition (open space) if a buyout project
- Certificate of completion
- Closeout reports are submitted 90 days after notification by quarterly report that a project has been completed, to include demolition (if applicable).

Audit Requirements

44 CFR 14, Administration of Grants: Audits of State and Local Governments, requires all subgrantees receiving $750,000 or more in Federal assistance to have an audit conducted in accordance with the Single Audit Act. Such reports by an independent certified public accountant will be maintained by SCEMD. All general audit requirements in 44 CFR Part 14 will be adhered to by the state and by non-state subgrantees receiving FEMA hazard mitigation grant awards.

General Compliance Assurance Statement

As referenced throughout this plan, it is the state's intent to comply with administrative requirements in 44 CFR Parts 13 and 206 in their entirety and to monitor all subgrant activities to ensure compliance with 44 CFR Parts 13 and 206.

H. Funding Sources for Mitigation Actions

The following examples are a few current and ongoing sources of funding that can be used to implement mitigation actions listed in both the State Hazard Mitigation Plan and local mitigation plans. Other funding sources, such as federal infrastructure improvement appropriations, public-private partnerships, and state resilience funds, also are options.

> **Federal requirements for state hazard mitigation plans:**
> **44 CFR 201.4(c)(3)(iv):** *The State mitigation strategy shall include] the identification of current and potential sources of Federal, State, local, or private funding to implement mitigation activities.*

Hazard Mitigation Grant Program (HMGP)

HMGP funds are based on a percentage of the total federal share of funds received by the state as a result of a presidential disaster declaration. HMGP funds are awarded based on the disaster, so they are awarded to the state and are not nationally competitive. The state is able to set the priorities for the funding within the state which can include but not be limited to mitigation action type, area for the work being conducted, and characteristics of the subapplicant.

Building Resilient Infrastructure and Communities (BRIC)

BRIC is the grant program that replaced PDM after it was discontinued. Fiscal year 2020 was the inaugural year for BRIC funding, with the total amount available nationwide based on a percentage of the nation's previous year's disaster spending. Each state can prioritize funding allocations across eligible projects in its state set-aside amount, and a larger amount of funding is available as nationally competitive grants. BRIC focuses on large-scale projects that incorporate nature-based solutions and supports economically disadvantaged rural communities.

Pre-Disaster Mitigation (PDM)

FEMA's standard PDM grant discontinued in 2020 and was replaced by Building Resilient Infrastructure and Communities (BRIC) grant. Funding was dependent upon Congressional allocation of funds and was nationally competitive. South Carolina still has projects being conducted with PDM funds. The Congressional Community Project Funding PDM program that is available through Congress continues. Projects are submitted through the jurisdiction's member of Congress and typically follow the PDM or BRIC notice of funding opportunity's eligible project types.

Flood Mitigation Assistance (FMA)

FMA funds are allocated every year. Although FMA is a nationally competitive grant, applications are submitted to the state, where they are ranked and prioritized for funding. FMA funds mitigation planning, localized flood reduction projects, and individual mitigation actions such as elevation and acquisition. One must have a NFIP flood insurance policy or show a benefit to policy holders to be eligible for FMA. The required match varies depending on the amount of flood insurance claims.

High Hazard Potential Dam (HHPD)

The HHPD Rehabilitation program is a reimbursement-based grant program that started in 2020 with an emphasis on supporting mitigation and rehabilitation conducted on dams that pose a high hazard risk. The South Carolina Department of Health and Environmental Control monitors applications submitted to the state and provides the initial ranking and prioritization of funding based on eligibility before sending applications to FEMA for the final say on funding eligibility. Eligible project sponsors will be offered subawards through DHEC for planning, design, and construction of dams.

Community Development Block Grant - Mitigation (CDBG-MIT)

In February 2020, funds became available through the Department of Housing and Urban Development's Community Block Grant program to support recovery and mitigation relate to qualifying disasters in 2015, 2016, and 2017. The purpose of CDBG-Mitigation funding is to increase resilience and provide a stream of funding directly to states with needs from previous disasters. In South Carolina, CDBG-MIT funding is administered by the South Carolina Office of Resilience. A portion of CDBG-MIT is designated for use in the most impacted and distressed (MID) counties within South Carolina.

Of the funding sources listed above, HMGP and PDM funds historically have been used most frequently to implement activities found in the Mitigation Strategy. In recent years, BRIC has replaced PDM, and CDBG-MIT funds have increased in use because of availability. Other funding opportunities also may be available to conduct mitigation actions.

I. Monitoring Progress of Mitigation Actions

EMAP Standard 4.2.3: *The Emergency Management Program has a process to monitor overall progress of the mitigation activities and documents completed initiatives and their resulting reduction or limitation of hazard impact on the jurisdiction.*

SCEMD developed and uses a mitigation action tracking database to monitor initiation, status, and completion of mitigation activities. It tracks:

- A listing of all Mitigation Actions that have been identified,
- The category of the action (Prevention, Property Protection, Natural Resource Protection, etc.),
- Hazard(s) addressed by the action,
- The priority (high, moderate, low) for implementation of the action,
- The estimated cost to implement the action,
- Potential and/or current funding sources for implementing the action,
- The lead agency or department responsible for implementing the action,
- The implementation schedule,
- A section for providing a comment on the status of the action's implementation and,
- Milestones achieved or impediments to implementation of the action.

SCEMD is responsible for tracking and updating the mitigation action database. The SHMO or mitigation staff monitor progress on mitigation activities and projects identified in the database and request periodic updates from state agencies. Progress will be evaluated and reported, including percentage complete and upcoming actions in the next six months, as applicable.

Specific to the tracking of BRIC, PDM, and HMGP-funded activities, SCEMD maintains the MitigationSC platform to tracks the status of mitigation projects.

J. Changes From the Last Plan

This section was updated to reflect state partners, current grant programs, and technology tools that support grants administration.

IX. Plan Maintenance

The South Carolina SHMP is a living document supported by a process designed to adapt it to changes in the hazard environment and other factors contributing to risk. These may include changes in: frequency and intensity of hazards, population and infrastructure vulnerability to hazard impacts, capabilities of state agencies and other stakeholders, and resulting modifications to the state's mitigation strategy. The plan is reviewed and updated at scheduled intervals and as needed to address lessons from hazard occurrences or from updated data, analysis, and research.

The SHMP is used on an ongoing basis and is reviewed and updated at several intervals:

- Annual review
- Amended after significant hazard occurrences as needed
- Updated every five years in accordance with federal law and policy.

> **Federal requirements for state hazard mitigation plans**
> **44 CFR 201.4(c)(5):**
> *(i)* *An established method and schedule for monitoring, evaluating, and updating the plan.*
> *(ii)* *A system for monitoring implementation of mitigation measures and project closeouts.*
> (iii) *A system for reviewing progress on achieving goals as well as activities and projects identified in the Mitigation Strategy*
> *(iv)* *An established method and schedule for monitoring, evaluating, and updating the plan.*
> *(v)* *A system for monitoring implementation of mitigation measures and project closeouts.*
> *(vi)* *A system for reviewing progress on achieving goals as well as activities and projects identified in the Mitigation Strategy*

A. Annual Reviews and Reports

Annual review includes monitoring goals, strategies, and mitigation actions to identify updates that may be needed. Monitoring considers mitigation efforts that are being carried out to support compliance with the plan and with state and federal requirements. SCEMD is responsible for coordinating ongoing monitoring and annual review of the SHMP.

SCEMD mitigation staff as appointed by the State Hazard Mitigation Officer (SHMO), in conjunction with the SHMP Steering Committee, conduct an annual review of the plan to determine if updates are needed. Annual reviews include:

- Significant changes to hazard profiles, including hazard occurrences with major impacts during the past year;
- Significant changes to vulnerability including physical and social vulnerability;
- Progress regarding implementing the mitigation strategy to achieve stated objectives;
- Changes to state capabilities to implement the mitigation strategy including policy, organization, or funding;
- Updates or additions to mitigation actions found in the Mitigation Action section and tracking of mitigation actions taken or in progress;
- Inclusion of measures of effectiveness of mitigation actions, where available.
- The SHMO will report staff and SHMP Steering Committee findings and recommendations to the ICC for consideration and approval.
- Based on the ICC's input and approval, annual review findings and revisions to

the SHMP will be noted as an attachment to the SHMP and made available via the SCEMD website.

- The State participates in an annual Mitigation Program Consultation with FEMA that provides an opportunity to discuss SHMP monitoring and updates, local mitigation planning progress, training and technical assistance, and mitigation programmatic priorities and initiatives. SCEMD, SCDNR, SCDHEC, and SCOR participate in the consultation.
- Unless the annual review schedule must be adjusted because of disaster activity or other unavoidable constraints, the annual review will be completed by June 1 each calendar year, and any annual review reports or appendix will be posted to the SCEMD website.

B. Post-Disaster Review of Mitigation Objectives, Measures, and Benefits

South Carolina agencies involved in hazard mitigation, coordinated by SCEMD mitigation staff, will review findings and information compiled after significant hazard occurrences (e.g., major disaster) to identify hazard profile updates, impact analyses, loss avoidance reports, and mitigation success stories to assess and inform current and future goals, objectives, and measures. The post-disaster review will consider at least the following (other items may be added based on the nature and severity of the incident(s)):

- Update of hazard probability, severity, and impact data and resulting risk analysis;
- Revision of vulnerability analysis, including physical and social vulnerability, based impacts of disaster;
- Measures of effectiveness of mitigation actions, where available;
- Revision or addition of mitigation goals, objectives, and actions if needed.
- The post-disaster review will be initiated within six months of the occurrence unless ongoing response and/or recovery activities require delay of the review.
- The SHMO will report staff and partner agency findings and recommendations to the ICC for consideration and approval. Based on the ICC's input and approval, updates and revisions to the SHMP will be either:
- Compiled as an attachment to the current SHMP and made available via the SCEMD web site, or
- Captured in a report and incorporated into the SHMP during the next five-year update cycle.

C. Five-Year Update Cycle

The State of South Carolina conducts a comprehensive update of the State Hazard Mitigation Plan no less frequently than every five years. The timeframe for completion may vary based on recent disaster declarations or other factors beyond the control of SCEMD and/or partner agencies and organizations. The SHMO will convene the SHMP Steering Committee and engage state-level agencies and organizations for updates and input. Additionally, SCEMD will take the lead in conducting or updating the hazard identification and risk assessment that informs the plan as well as drafting or updating the text of the plan.

The SHMP update process steps and activities include:

- Hazard identification and risk assessment (HIRA): Collecting, analyzing, and summarizing statewide hazard data and studies, physical and social vulnerability analyses, and risk analyses;
- Integration of local risk assessment and mitigation priorities: Collecting and summarizing local risk assessment findings and mitigation priorities;
- Development of mitigation goals and actions: Developing updated or new state-level mitigation goals, program initiatives, and proposed mitigation actions;
- Plan development: Integrating hazard data and mitigation actions and state-level analyses and program initiatives into the SHMP update;
- Interagency coordination and approval: Convening an SHMP Update for both the Steering Committee and the ICC as well as compiling ICC input for incorporation into the SHMP update; and
- Submission to FEMA: Producing a final SHMP update for submission to FEMA in advance of the current plan expiration date.

The expected schedule determines that no later than the third year of the planning cycle (three years after SHMP Update approval), the state will begin planning for the next SHMP update, including initiating review and update of state agency and partner mitigation actions and update of the HIRA. SCEMD will pursue funding to support the SHMP update, if needed and available. SCEMD will develop a work plan to support management of the plan update project.

The planning process for this 2023 SHMP update began in 2020 with the initial Steering Committee meeting held in April 2021. For details and documentation regarding the planning process, see Appendix F.

D. Changes From Previous Plan

This section was reviewed and analyzed by the SHMP Steering Committee and the ICC as part of SHMP update completed in 2022. The narrative was condensed and revised to delineate activities and considerations for annual reviews, post-disaster reviews, and full updates (five-year cycle). Expected timing for each type of review/update process was added. It was determined that the system and methods identified in this section are appropriate and will support successful monitoring, maintenance, and update of the SHMP.

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