



Restoring Virginia Beach Waters

Climate-Driven Flooding in Virginia: Threats and Solutions

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Virginia – with its long coastline, low-lying river deltas, and sinking terrain – is on the front lines of climate-driven flooding. Scientists project that Southeast U.S. sea levels will rise dramatically – roughly 16–23 inches by 2050 compared to 2000 levels – causing high-tide flooding events to multiply by 5–10 times by mid-century. In practical terms, Virginia already leads the nation in flood frequency: a 2025 analysis found Virginia averages 158.7 coastal flood events per year, far more than any other state. (For comparison, the next-highest, Florida, averages ~108 events annually.) These rising floods – driven by sea-level rise, more intense storms, and heavy rain – imperil lives, livelihoods, and public infrastructure. They also interact with heat waves and other climate hazards, thereby compounding risks. Below, we examine the impacts on public health and safety, community resilience, policy, energy, and the economy, with a particular focus on the state of Virginia.

Public Health and Safety

Extreme weather events resulting from climate change pose direct threats to human health. Floods and storms cause injury and death (from drowning, accidents, and contaminated water) and trigger secondary hazards. For example, flooded homes often develop mold and mildew, which can cause respiratory illnesses and allergic reactions long after the water recedes. Generators used during power outages can lead to carbon monoxide poisoning. Contaminated floodwater can spread waterborne diseases.

The ramifications of flood events over the past 8 months demonstrate a human cost. In mid-February 2025, torrential rains swept through Southwest Virginia – washing out hundreds of roads, inundating dozens of homes, and resulting in at least one fatality. In May 2025, an atmospheric-river-driven flash flood affected thousands of homes, shut down major highways, and claimed another life in Albemarle County. And in September 2024, the remnants of Tropical Storm Helene ripped through Southwest Virginia – tearing up over 100 roads, destroying more than 100 homes and farms, and causing at least two deaths.

Floods also strain medical services and disrupt clean water supplies. In Hampton Roads, for instance, chronic tidal flooding undermines septic systems and drinking-water infrastructure. Even "sunny day" high-tide floods have damaged roads and sewers, creating public safety hazards. In short, Virginians now face more frequent and severe flood-related health risks than they did in the past.

Meanwhile, extreme heat – another outcome of climate change – looms as a deadly threat. Heat waves already claim more American lives each year than all other weather events combined. Yet federal disaster relief does not recognize heat as a disaster category. Advocates in Congress are calling on FEMA to treat

extreme heat as a major disaster so communities can access emergency funding. In Virginia, summers are hotter and longer than decades ago, raising heat-related illness and mortality (especially among senior citizens, outdoor workers, the unhoused, and the medically vulnerable). Without new prevention measures, climate-driven heatwaves and floods will compound the health toll.

Climate change also worsens chronic health burdens. The Southeast is already the worst U.S. region for many health indicators (obesity, poverty, limited healthcare access) and is particularly vulnerable to climate stress. The latest National Climate Assessment notes that "the Southeast ranks worst among all regions in the U.S. for the prevalence of mental illness and access to mental health services, which is concerning as extreme weather events cause displacement and stress." In other words, climate shocks (storms, floods, droughts) will hit communities already grappling with health inequities. For example, flooding uproots families (forcing evacuations, temporary housing, and job loss), causing anxiety, depression, and trauma. In Virginia's coastal tribal nations, leaders report "rising tides, more intense rainfall and erosion" have submerged ancestral lands and burial sites, causing cultural and psychological distress. These mental-health impacts, added to physical injuries and illnesses, make climate change a public-health emergency.

Key factors heightening risk include aging and dispersed rural populations, widespread poverty in certain parts of Virginia, and limited hospital access in some areas. While the highest concentrations of Virginians live in coastal and harbor cities like Norfolk and Virginia Beach, severe flooding also strikes communities far inland – where rivers such as the James, Shenandoah, and New overflow their banks during heavy rainfall. Overall, Virginians today face more health risks from extreme weather than ever, and the risks are forecasted to escalate. In total: Climate-driven disasters endanger Virginians' lives and health – from drowning and injury in floods, to heatstroke, heart attacks, and mental trauma in hotter summers.

Community Resilience

With risks on the rise, Virginia communities are actively mobilizing to adapt. Local governments, businesses, and residents are implementing a range of resilience projects, from elevating homes to restoring natural shorelines. One standout effort is the "Fight the Flood" initiative on the Middle Peninsula. Run by a consortium of counties, it offers personalized support to flood-prone homeowners – guiding them through applications for state and federal grants, assisting with low-interest loans, and providing technical expertise on elevating structures, installing floodproofing, or installing living shorelines. While the consortium's total payouts are not publicly reported, these grassroots efforts are underpinned by statewide funding. In its sixth grant cycle (2025), the Community Flood Preparedness Fund (CFPF) distributed \$67 million for local storm drains, floodwalls, buyouts, and related flood-control measures.

Statewide, Virginia has boosted resilience funding across multiple programs:

- **Virginia Coastal Adaptation Program (VCAP):** Through planning grants, technical assistance, and capacity-building, VCAP helps coastal cities and counties design strategies to address sea-level rise and storm surge.
- **Stormwater Local Assistance Fund (SLAF):** Administered by the Department of Environmental Quality, SLAF grants support green infrastructure, retention ponds, stream restoration, and other stormwater management projects aimed at reducing both flooding and pollution.
- **Resilience Virginia Revolving Fund (RVRF):** This low-interest loan program enables local governments to finance major resilience projects – such as pump station upgrades or seawall construction – and

repay the loan over time.

- **Community Flood Preparedness Fund (CFPF):** Established in 2020 (first funded with RGGI auction proceeds in 2021), CFPF provides ongoing grants and loans for flood-control initiatives. In 2025 alone, the CFPF awarded \$67 million to communities statewide for storm drains, floodwalls, and property buyouts, emphasizing the equitable distribution of resilience resources.

In Virginia Beach, local government has taken proactive steps to reduce flood risk and plan for long-term resilience. The City's Sea Level Wise Adaptation Strategy, adopted in 2019 and updated in 2023, outlines a phased, data-driven framework for addressing sea-level rise, recurrent flooding, and stormwater infrastructure needs. In November 2021, voters overwhelmingly approved a \$567.5 million bond referendum, which funded a suite of priority projects identified through technical assessments conducted by the engineering firm Dewberry. The city is now advancing 21 major flood-reduction projects, including pump station upgrades, stormwater pipeline expansions, retention basin construction, roadway elevations, and living shoreline installations. Virginia Beach is also leveraging state and federal funds, including CFPF grants.

Major infrastructure projects are also underway elsewhere in Hampton Roads. Norfolk is advancing one of the nation's largest coastal flood defenses – a multi-phase Coastal Storm Risk Management (CSRM) project spearheaded by the U.S. Army Corps of Engineers. Virginia Beach is also adopting a CSRM, though it is still in the planning stage

Norfolk's CSRM project – now estimated at \$2.66 billion - will install roughly eight miles of floodwalls, tidal surge barriers, home elevations, and two new pump stations to manage heavy rainfall. Walls will range in height from approximately 6½ to 16½ feet and may incorporate portions of the Elizabeth River Trail atop the barrier. According to the Corps' 2019 feasibility study, these defenses are expected to generate net annual benefits of \$122 million by reducing damage to homes, businesses, and critical infrastructure. Without the project, nearly all of downtown Norfolk's interior would remain at high risk of flooding during a major storm by 2075. Although initial utility relocations and demolition are scheduled to begin this fall, construction of the actual floodwalls is not expected to start until 2027, with full completion pushed to around 2037 due to community concerns, environmental reviews, and ongoing funding negotiations. This evolution underscores how even well-funded, technically rigorous resilience efforts can be delayed by design changes, stakeholder objections, and the complexity of modern environmental permitting.

Other localities have launched targeted resilience measures to protect specific neighborhoods and communities. In Isle of Wight and Northampton counties, efforts to elevate roads and install pocket levees have reduced chronic roadway inundation. In Norfolk's Windsor Woods neighborhood, the city-funded neighborhood-scale flood barriers and drainage improvements have prevented repeated street flooding. Tangier Island has piloted shoreline stabilization projects and building elevation grants to help its residents adapt to persistent coastal inundation. Across Hampton Roads, more than 500 homes have been formally elevated or flood-proofed since 2021 using state and FEMA mitigation grants. Meanwhile, several Tidewater tribal governments are conducting climate vulnerability assessments – mapping culturally significant sites and collaborating with the Commonwealth to pursue protective measures as sea levels continue to rise.

Nevertheless, resilience efforts face persistent obstacles – especially inequity and funding gaps. Wealthier areas are often more successful at securing grants and building protective infrastructure, while lower-income and rural communities struggle with fewer resources. In Norfolk, for example, residents in

historically underserved neighborhoods, such as Freemason and Lafayette, successfully advocated in 2023 for inclusion in planned floodwall protections – highlighting earlier gaps in planning that had prioritized wealthier enclaves. In Southwest Virginia, where towns like Hurley and Richlands have been hit by four major floods since 2021, there is no pre-existing flood mitigation system. Following two consecutive floods in 2024, many residents expressed frustration that Virginia counties, just across the border from West Virginia, received significantly less federal disaster assistance, despite comparable damage. These disparities reinforce the need for flood resilience investments that prioritize equity and regional needs.

Federal programs have played a critical role – and remain essential – but face growing threats. FEMA and USDA grants, through programs such as BRIC (Building Resilient Infrastructure and Communities) and the Hazard Mitigation Grant Program, as well as federal conservation initiatives, have helped fund local projects, including road repairs, dam safety improvements, wetland restoration, and home elevations. However, in 2025, the federal administration canceled all new awards from FEMA's BRIC program, including \$25 million in previously approved funding for Virginia projects such as a dam retrofit in Portsmouth. A senior Virginia official described the reversal as a loss of "nearly five years of progress" in local resilience planning. With these federal lifelines uncertain, many communities are forced to rely on strained state and local budgets, which slow critical adaptation efforts.

In summary, communities across Virginia are innovating to build resilience. Yet demand continues to outpace funding. The cost of inaction rises with every passing year. Studies consistently show that every \$1 invested in disaster preparedness yields \$4–\$6 in avoided future damages. To truly protect lives, property, and ecosystems, Virginia must continue to expand flood protections, enforce thoughtful land-use planning that avoids construction in high-risk, flood-prone areas, and accelerate the integration of natural solutions – such as wetlands, riparian buffers, and floodplain reconnection – into long-term climate planning.

Policy Recommendations

Addressing climate flooding demands urgent policy action at both the state and federal levels. Virginia and its leaders can take several steps to reduce risks and accelerate the clean-energy transition:

- **Rejoin Regional Climate Initiatives:** Virginia exited the Regional Greenhouse Gas Initiative (RGGI) in 2023, forgoing hundreds of millions of dollars in auction proceeds. RGGI funding has supported energy efficiency, renewables deployment, and adaptation programs. In 2022, RGGI investments were projected to yield \$2.7 billion in lifetime energy savings and prevent 7.8 million tons of CO₂ emissions. Rejoining RGGI would restore a reliable revenue stream that can fund flood mitigation, low-income energy assistance, and resilience grants.
- **Strengthen Clean Energy Standards:** The General Assembly should bolster Virginia's Renewable Portfolio Standard and Clean Economy Act targets, rather than weakening them. Clear mandates for solar, onshore and offshore wind, and energy storage – paired with streamlined permitting – will drive private investment and accelerate the decarbonization process. Renewable energy reduces greenhouse gas emissions, which fuel sea-level rise and extreme weather, while distributed clean resources (e.g., rooftop solar) enhance grid resilience during disasters.
- **Invest in Low-Carbon Transportation and Buildings:** Transportation accounts for over 40 percent of Virginia's carbon emissions. Policies that promote electric vehicles (EVs), expand charging infrastructure, and boost public transit can cut tailpipe pollution. Modernizing building codes to

require higher energy efficiency, electrification (e.g., heat pumps), and resilience features (elevated design, flood-resistant materials) will reduce energy demand and protect structures from storms.

- **Protect and Advocate for Federal Climate Programs:** Many local resilience and adaptation projects rely on federal grants – from FEMA's BRIC and Hazard Mitigation Grant Program to USDA conservation and EPA clean-water grants. Virginia must advocate for the complete restoration and expansion of these programs. In 2025, FEMA's abrupt cancellation of \$25 million in BRIC awards stripped nearly five years of progress from local hazard mitigation efforts. Similarly, EPA's freeze on \$1.7 billion in environmental justice grants jeopardizes community-led flood solutions. Virginia's congressional delegation should press federal leaders to reinstate and grow these vital funding streams.
- **Reform Disaster Relief Formulas:** Under current FEMA rules, disaster aid thresholds are based on statewide per capita damage, which can disadvantage rural or lower-income areas within wealthier states. After severe flooding in early 2025 devastated communities in Southwest Virginia, FEMA denied a federal disaster declaration for individual homeowner assistance, citing that the state did not meet the per capita damage threshold – despite the extensive losses in isolated counties like Hurley and Richlands. Policymakers should revise FEMA's criteria to reflect regional income disparities and localized impacts better, or create supplemental state-level assistance to ensure that recovery support reaches all affected communities fairly.
- **Update Land-Use and Insurance Policies:** State and local governments should limit development in high-risk flood zones and expand voluntary buyouts of properties that repeatedly flood, converting them into natural buffers such as wetlands or floodplains. Reforms to the National Flood Insurance Program (NFIP) – such as requiring complete flood-risk disclosures during property sales and aligning premiums with actual risk – will encourage safer development and reduce the frequency of taxpayer-funded losses.
- **Enhance Public Health Preparedness:** As flood and heat risks rise, Virginia should expand access to cooling centers, flood-relief shelters, and emergency medical services in vulnerable areas. Investments in hospital flood protection, mental health support for disaster survivors, and integrated climate-alert systems (including warnings for heat and waterborne illnesses) will protect public health and reduce long-term costs.

Energy Transition

A core response to climate change – and a prerequisite for limiting future floods – is decarbonizing Virginia's energy system. Key pillars of an effective energy transition include:

Scaling Up Renewable Energy. Virginia has strong offshore wind potential, as demonstrated by Dominion Energy's Coastal Virginia Offshore Wind (CVOW) pilot project, which launched two 6-MW turbines in 2020 and is scaling up to become the largest offshore wind project in the U.S., at 2.6 GW. The state's utility-scale solar sector has also expanded rapidly, especially in Southside and Central Virginia. To maintain momentum, the Commonwealth should strengthen procurement targets, bolster workforce development, reduce permitting and zoning barriers, and expand net-metering to encourage more rooftop and community solar installations. Pairing renewables with grid-scale battery storage and distributed storage (e.g., in homes and schools) will help ensure reliability during peak demand and after severe weather events.

Manage Growing Electricity Demand. Virginia's electricity use is surging, particularly in Northern Virginia, where rapid growth of data centers – now among the largest energy consumers in the state – is straining

capacity. According to the International Energy Agency (IEA), global electricity demand increased by approximately 1,080 terawatt-hours (TWh) in 2024, with advanced economies, including the U.S., among the top contributors. This surge was primarily driven by increased air-conditioning use and the rapid expansion of data centers. Virginia must adopt policies that promote demand-side efficiency, such as incentives for high-performance HVAC systems, reflective roofing, and passive cooling strategies. Upgrading grid infrastructure with smart meters and undergrounding key lines will also reduce the risk of outages during extreme weather.

Minimize Fossil Fuel Lock-In. New investments in natural gas infrastructure – such as pipelines or peaker plants – risk becoming stranded assets as the global energy market shifts toward clean energy. A 2025 analysis in *Forbes* and reports from Energy Innovation warn that expanding reliance on gas will not adequately meet rising demand and may harm the long-term competitiveness of the U.S. Virginia should instead prioritize renewable energy buildout, electrification of heating and transportation, and support for emerging low-carbon technologies such as green hydrogen and long-duration energy storage.

Develop a Just Transition Workforce. Virginia is building clean-energy career pathways through programs like solar installer apprenticeships in Southwest Virginia and entry-level technician credentials at multiple community colleges. The Virginia Energy Workforce Consortium supports these efforts by linking colleges, employers, K–12 education, and state agencies. Clean-energy policies such as the Clean Economy Act and Executive Order 43 further reinforce training programs and pipelines, ensuring equitable access to new energy jobs for workers transitioning from fossil-fuel industries and underserved communities.

Integrate Resilience into Energy Planning. As climate threats grow, energy policy must include resilience standards. These may include requiring backup power for critical facilities (e.g., hospitals, emergency shelters), incentivizing microgrids in flood-prone areas, and establishing regional mutual aid agreements for emergency response. Planning for extreme weather and rising demand will help ensure that energy systems can continue operating during disasters.

Economic Impacts

Climate-driven flooding already imposes heavy costs on Virginia's economy through disasters and chronic sectoral impacts.

Disaster Costs and Trends: Over the past decade, Virginia has faced a rising toll from extreme weather and climate-related disasters. While federal data does not provide state-specific counts, the broader Southeast region – which includes Virginia – averaged 13 billion-dollar disasters per year from 2020 to 2024, up from 4.9 billion-dollar disasters per year over the more extended period from 1980 to 2024. In 2024 alone, the region experienced 17 billion-dollar events, with total damages reaching \$118 billion. Although not all of these events occurred within Virginia, the increasing frequency and cost across the region signal growing risk and vulnerability for the Commonwealth. These disasters – including hurricanes, floods, and severe storms – are driving up insurance premiums, reducing property values, and placing greater strain on public budgets.

Agriculture and Fisheries: Flooding and saltwater intrusion increasingly threaten Virginia's farmland and the Chesapeake Bay seafood industry. Rising salinity can reduce crop yields and degrade soil health, while tidal inundation damages coastal agricultural land. Salt marsh ecosystems – which support oyster beds and

crab populations – are particularly vulnerable. Modeling across the mid-Atlantic indicates that up to 60–90% of existing tidal marshes may not be able to sustain themselves under projected sea-level rise scenarios by mid-century. Without intervention, the salt marsh area in the Chesapeake Bay could decline significantly by 2050, putting key fish and wildlife habitats, as well as coastal livelihoods, at risk.

Real Estate and Insurance: Homes in flood-prone areas of Virginia are losing value as private insurers either withdraw or impose steeply rising premiums. Many homeowners now rely on the National Flood Insurance Program (NFIP), which offers up to \$250,000 in building coverage (and \$100,000 for contents). This limit often falls short in today's housing markets, leaving owners underinsured. While cities like Virginia Beach have begun requiring elevation certificates for new builds, broader reforms – such as risk-based premiums, mandatory risk disclosures, and expanded coverage limits – are needed to align insurance with real flood risk and discourage construction in hazardous zones.

Infrastructure and Supply Chains: Recurrent flooding increasingly disrupts Virginia's infrastructure – but closures at major river-crossing tunnels like the I-64 Hampton Roads Bridge–Tunnel are rare and only occur during exceptional events, such as the July 2009 closure caused by a burst water main triggered by extreme rainfall. While floodwater has occasionally impacted tunnel approaches, more typical flood risks involve the inundation of surface roads, localized ferry disruptions (e.g., Elizabeth River crossings), and high-water delays on waterways such as the James River. These interruptions cascade through supply chains, disrupting commerce, hampering emergency responses, and increasing costs beyond flood zones.

Energy Sector Impacts: Virginia's energy grid is becoming increasingly vulnerable to disruptions from extreme weather events, such as floods and heatwaves. These events can damage substations, topple lines, and overwhelm demand – leading to widespread power outages. According to Virginia's State Corporation Commission, weather-related outages cost the state's economy between \$600 million and \$1.4 billion annually in lost productivity and economic activity. Infrastructure upgrades – such as flood-proofing substations, under-grounding key power lines, and deploying mobile backup systems – can significantly reduce these impacts. Enhancing grid resilience is crucial for maintaining service during disasters and facilitating a swift recovery afterward.

Unequal Economic Burdens: Displacement from climate disasters deepens socio-economic divides. In 2024, FEMA denied individual homeowner assistance to flood victims in Southwest Virginia – despite comparable damage earning aid across the border in West Virginia – because the state did not meet federal per-capita damage thresholds. In response, the Virginia General Assembly created a \$50 million state disaster fund in 2025, splitting it equally between immediate recovery and long-term resilience projects. This disparity underscores the need for equitable funding frameworks and targeted investment to support recovery in under-resourced regions.

Benefits of Proactive Investment: Numerous federal and nonprofit analyses, including reports by FEMA and the National Institute of Building Sciences, show that every \$1 spent on pre-disaster mitigation, such as levees, buyouts, or wetland restoration, can save \$4–\$6 in future damages. Norfolk's floodwall project, as analyzed in the U.S. Army Corps of Engineers' feasibility study, is expected to yield a benefit-cost ratio of approximately 1.5:1 over 50 years – translating to \$1.50 in avoided damages for every dollar invested. Separately, independent modeling by resilience planners suggests that a \$2 billion statewide investment in flood preparedness by 2030 could avert \$8–\$12 billion in climate-related losses by 2060, reflecting broader cost avoidance from rising disasters.

This report integrates the latest findings from the Fifth National Climate Assessment (Chapter 22: Southeast), recent peer-reviewed research, independent expert analyses, and current policy developments. Urgent action on adaptation and mitigation can protect Virginia's communities, economy, and environment from the accelerating threats of climate change.

Prepared by Dylan Mason, Public Policy Manager @ Lynnhaven River Now

