



SEA-LEVEL RISE AND ITS IMPACT ON VIRGINIA

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The Hampton Roads area¹ in Virginia is experiencing the highest rates of sea-level rise along the entire U.S. East Coast.² The area is also second only to New Orleans, LA, as the largest population center at risk from sea-level rise in the country.³

The Hampton Roads area possesses the second largest concentration of military capacity and activities in the United States,⁴ and is home to the world's largest naval base – Naval Station Norfolk. According to the former Commanding Officer of Naval Station Norfolk, Joe Bouchard, almost all major military facilities in Hampton Roads are threatened by sea-level rise, and as sea level continues to rise so will the likelihood that some of those facilities will need to be relocated.⁵ Since 46 percent of the local economy comes from Department of Defense spending,⁶ this makes Hampton Roads uniquely vulnerable to sea-level rise.

Virginia's state and local governments have recently taken the initiative to assess the threat of sea-level rise and increased coastal flooding,^{7,8} but more is needed. If Virginia's coastal communities are to withstand rising seas in the coming decades, initiatives that proactively address the threat of sea-level rise will be necessary. This is especially important around Hampton Roads, given that around half of historical sea-level rise in the area has been from the sinking of land (i.e., subsidence), which is anticipated to remain constant in the region while sea-level rise caused by climate change is expected to accelerate in the future.⁹

This fact sheet highlights Virginia's vulnerability to sea-level rise, costs the state could face, and a summary of state and local initiatives that have assessed the issue.

VIRGINIA'S VULNERABILITY AND COST ESTIMATES

- *Hampton Roads is second only to New Orleans as the area in the country most impacted by sea-level rise.¹⁰*
- *The Norfolk-Virginia Beach Metropolitan Area ranks 10th in the world in value of assets exposed to an increase in flooding from sea-level rise.¹¹*
- *Sea level at Sewells Point, Norfolk in the last 80 years has risen 80 percent higher (14.5 inches) than the global average (8 inches) in the last 140 years.^{12, 13}*
- *Sea-level rise is amplifying the storm surge and high water level of storms impacting Virginia.*
 - *The 1933 hurricane – widely known as the “Storm of the Century” – was significantly more powerful than Hurricane Isabel in 2003. While the 1933 hurricane produced a storm surge in Hampton Roads 21 percent higher than Isabel, the maximum water level¹⁴ for both storms was roughly the same. This was a result of the average monthly sea level being 1.4 feet higher during Hurricane Isabel than during the 1933 hurricane, which was mostly due to the increase in sea-level rise that occurred in the 70 years between the two storms.¹⁵*
 - *Although Hurricane Isabel made landfall in the Outer Banks of North Carolina, Virginia still experienced \$925 million in damages to insured properties.¹⁶*
- *According to the former Commanding Officer of Naval Station Norfolk, Joe Bouchard, the base would need to spend up to \$460 million to replace old piers already degraded by sea-level rise and hundreds of millions more to protect onshore infrastructure critical to the base’s maintenance, training, and logistics missions.*
- *Ron Williams Jr., Assistant City Manager of Norfolk, said the city needs a total investment of \$1 billion in the coming decades, including \$600 million to replace current infrastructure, to keep the water in its place and help make homes and businesses more resilient.¹⁸*

- *Paul Fraim, Mayor of Norfolk:*

“We deal with stormwater flooding in the city now on a monthly basis.”¹⁹

“A severe Category 2 or Category 3 storm, if we were to receive a direct hit, almost all of the city would be underwater.”²⁰

- *According to the recent Old Dominion University study “Climate Change, Global Warming and Ocean Levels,” when assuming a mid-range estimate of a 3.7-foot increase in local sea level by 2100:²¹*

“From north to south, vast areas of Mathews, Gloucester and York counties, most of Poquoson, and much of the cities of Hampton, Norfolk, Chesapeake and the Virginia Beach oceanfront will be underwater unless protected by dikes and levees.”

- *According to a recent study by the Hampton Roads Planning District Commission (HRPDC), costs from three feet of sea-level rise in the Hampton Roads region are expected to range between \$12 billion and \$87 billion.²²*

LOCAL CONCERNS AND GOVERNMENT RESPONSES TO SEA-LEVEL RISE

During a project led by the University of Virginia’s Institute for Environmental Negotiation in 2012, Virginia Beach residents surveyed about sea-level rise stated that the issue:²³

- *Is a long-term problem – 98%*
- *Should be a priority for local governments – 92%*
- *Requires immediate action to be taken to deal with the effects – 86%*
- *Is a very important issue in the Virginia Beach area – 86%*

Virginia Institute of Marine Sciences: “Recurrent Flooding Study for Tidewater Virginia”²⁴

- *The study was requested through a joint resolution²⁵ between Virginia’s House and Senate in 2012.²⁶*
- *Molly Mitchell, a lead scientist of the study and Marine Scientist at the Virginia Institute for Marine Sciences’ Center for Coastal Resources Management:*

Our review of strategies already being used in other vulnerable areas suggests that the Commonwealth can mount an effective response to its increasing flood risk, but that we must start now, as it will take 20 to 30 years to effectively plan and implement many of the adaptive measures.²⁷

Key Findings

- *“Recurrent flooding is a significant issue in Virginia coastal localities and one that is predicted to become worse over reasonable planning horizons (20-50 years).”*
- *Sea level in Southeast Virginia is expected to rise between 1 and 3+ feet by as early as 2060.*

Key Recommendation

- *“Given the long time frame necessary to effectively address recurrent flooding and sea level rise issues and given the speed at which risks are projected to increase, Virginia and its coastal localities should immediately begin comprehensive and coordinated planning efforts.”*

Stakeholder Advisory Panel

- *The Virginia General Assembly requested that as part of the study, the Virginia Institute of Marine Sciences (VIMS) convene a stakeholder advisory panel to discuss and assess the feasibility of employing the comprehensive list of strategies aggregated by the VIMS study in Tidewater and Eastern Shore Virginia; and offer recommendations for detailed investigation of preferred options for adapting to relative sea-level rise.*

- *The Stakeholder Advisory Panel consisted of 25 individuals selected to provide a broad representation of the Virginia coastal localities and agencies working within the region. The panel focused on the roles of the state and localities in addressing flooding and sea-level rise issues.*

Key Conclusions of the Panel

- *“[F]elt strongly that Virginia localities are not adequately empowered to address the issues through policy and management actions, and localities do not have the necessary financial resources for many accommodation or protection strategies.”*
- *“[T]he state should take a strong leadership role, incorporating flood and sea level rise management into state purviews.”*

Hampton Roads Planning District Commission study: “Climate Change in Hampton Roads”²⁸

This report focused on analyzing the potential future impacts of sea-level rise on the region’s population, built environment, infrastructure, economy, and natural environment.²⁹

Key Findings

Residents currently living in or near areas that could be inundated, permanently or regularly, by 3 feet of sea-level rise:

- *Low estimate: 59,059 residents (or the equivalent of more than four times the estimated population of Williamsburg, VA)³⁰*
- *High estimate: 176,124 residents (or the equivalent of 84 percent of the estimated population of Richmond, VA)³¹*

Roads currently in or near areas that could be inundated, permanently or regularly, by 3 feet of sea-level rise:

- *Low estimate: 162 miles (or more miles than driving from Charlottesville, VA to Newport News, VA)*³²
- *High estimate: 877 miles (or more than four times the miles travelled when driving from Washington, DC to Virginia Beach, VA)*³³

Virginia Governor's Commission on Climate Change (2008)³⁴

Key Findings

- “Sea level rise is a major concern for Coastal Virginia, particularly the highly populated Hampton Roads region.”
- “Climate change is widely viewed as a threat to national security. In Virginia, there are several major military installations located in low-lying areas that will be affected by sea level rise and storm surge.”
- “The continued affordability and availability of insurance for Virginia’s landowners is a concern as our climate changes. These effects are already being felt in Coastal Virginia. The frequency and severity of storms in the future are expected to exceed those of the past, and the insurance industry may not have the ability to handle several concurrent events.”

ENDNOTES

- 1 Hampton Roads is an area in southeast Virginia that is comprised of 16 local governments: Chesapeake, Franklin, Gloucester, Hampton, Isle of Wight County, James City County, Newport News, Norfolk, Poquoson, Portsmouth, Southampton County, Suffolk, Surry County, Virginia Beach, Williamsburg, and York County (<http://www.hrpdcva.gov/page/locality-profiles/>).
- 2 <http://tidesandcurrents.noaa.gov/sltrends/msltrendstable.htm>.
- 3 http://www.virginia.edu/ien/sealevelrise/docs/Sea_Level_Rise%20final%20report%207-19.pdf.
- 4 <http://nsglc.olemiss.edu/SGLPJ/vol5no2/3-hartley.pdf>.
- 5 Correspondence with Joe Bouchard.
- 6 <http://www.odu.edu/content/dam/odu/offices/economic-forecasting-project/docs/2012-sor-report.pdf>.
- 7 http://ccrm.vims.edu/recurrent_flooding/Recurrent_Flooding_Study_web.pdf.
- 8 http://www.hrpdcva.gov/uploads/docs/HRPDC_ClimateChangeReport2012_Full_Reduced.pdf.
- 9 http://ccrm.vims.edu/recurrent_flooding/Recurrent_Flooding_Study_web.pdf.
- 10 <http://www.vbgov.com/government/departments/planning/2009CompPlanProcess/Documents/cp-policy-document-web.pdf>.
- 11 <http://leg1.state.va.us/cgi-bin/legp504.exe?121+ful+HJ50E+pdf>.
- 12 <http://leg1.state.va.us/cgi-bin/legp504.exe?121+ful+HJ50E+pdf>.
- 13 Church, J. A. and N. J. White (2006), *A 20th century acceleration in global sea-level rise*, Geophys. Res. Lett., 33, L01602, doi:10.1029/2005GL024826. Available at: <http://onlinelibrary.wiley.com/doi/10.1029/2005GL024826/abstract>.
- 14 Storm surge is the abnormal rise of water generated by a storm above the predicted astronomical tide. Water level is defined as the sum of the storm surge and the astronomical tide.
- 15 http://www.vims.edu/research/units/programs/icccr/_docs/coastal_sea_level.pdf.
- 16 http://www.csc.noaa.gov/hes/docs/postStorm/Isabel_PostStorm_Summary.pdf.
- 17 Correspondence with Joe Bouchard.
- 18 Correspondence with Ron Williams Jr.
- 19 <http://m.npr.org/news/Science/164362276>.
- 20 <http://m.npr.org/news/Science/164362276>.
- 21 http://www.odu.edu/content/dam/odu/offices/economic-forecasting-project/docs/2009_sor_ch5.pdf.
- 22 http://www.hrpdcva.gov/uploads/docs/HRPDC_ClimateChangeReport2012_Full_Reduced.pdf.
- 23 <http://www.vbgov.com/government/departments/planning/boards-commissions-committees/Documents/BAC/SLR%20Presentation%20July%2019.pdf>.
- 24 http://ccrm.vims.edu/recurrent_flooding/Recurrent_Flooding_Study_web.pdf.
- 25 <http://lis.virginia.gov/cgi-bin/legp604.exe?121+ful+SJ76ER+pdf>.

- 26 The study was undertaken with the collaboration and assistance of Old Dominion University, the Hampton Roads Planning District Commission, Wetlands Watch, the University of Virginia Institute for Environmental Negotiation, the William and Mary Coastal Policy Clinic, and relevant state agencies.
- 27 <http://www.wm.edu/news/stories/2013/vims-calls-for-flexible,-multi-step-approach-to-deal-with-flood-risk123.php>.
- 28 http://www.hrpdcva.gov/uploads/docs/HRPDC_ClimateChangeReport2012_Full_Reduced.pdf.
- 29 Starting in 2008, the Hampton Roads Planning District Commission (HRPDC) engaged in a three-year focal area grant project. The project was partially funded by the Virginia Coastal Zone Management Program (VCZMP), on Climate Change Adaptation. The first year focused on researching the types of impacts that the Hampton Roads region could potentially experience from climate change and on engaging and educating local government staffs about those impacts. The focus during the second year was on analyzing the impacts of storm surge flooding on various sectors, such as the built environment and economy, and on engaging the public. This report summarizes the work for the third and final year of that project.
- 30 <http://quickfacts.census.gov/qfd/states/51/5186160.html>.
- 31 <http://quickfacts.census.gov/qfd/states/51/51760.html>.
- 32 According to Google Maps, the estimated driving distance from Charlottesville, VA to Newport News, VA is 140 miles.
- 33 According to Google Maps, the estimated driving distance from Washington, DC to Virginia Beach, VA is 208 miles.
- 34 http://www.sealevelrisevirginia.net/docs/CC_meeting_agendas_notices/CCC_Final_Draft_Findings_111108.pdf.

ABOUT WRI

WRI is a global research organization that works closely with leaders to turn big ideas into action to sustain a healthy environment—the foundation of economic opportunity and human well-being.

Our Challenge

Natural resources are at the foundation of economic opportunity and human well-being. But today, we are depleting Earth's resources at rates that are not sustainable, endangering economies and people's lives. People depend on clean water, fertile land, healthy forests, and a stable climate. Livable cities and clean energy are essential for a sustainable planet. We must address these urgent, global challenges this decade.

Our Vision

We envision an equitable and prosperous planet driven by the wise management of natural resources. We aspire to create a world where the actions of government, business, and communities combine to eliminate poverty and sustain the natural environment for all people.

Our Approach

COUNT IT

We start with data. We conduct independent research and draw on the latest technology to develop new insights and recommendations. Our rigorous analysis identifies risks, unveils opportunities, and informs smart strategies. We focus our efforts on influential and emerging economies where the future of sustainability will be determined.

CHANGE IT

We use our research to influence government policies, business strategies, and civil society action. We test projects with communities, companies, and government agencies to build a strong evidence base. Then, we work with partners to deliver change on the ground that alleviates poverty and strengthens society. We hold ourselves accountable to ensure our outcomes will be bold and enduring.

SCALE IT

We don't think small. Once tested, we work with partners to adopt and expand our efforts regionally and globally. We engage with decision-makers to carry out our ideas and elevate our impact. We measure success through government and business actions that improve people's lives and sustain a healthy environment.