

WATER FACTS





Norfolk, Virginia: Identifying and Becoming More Resilient to Impacts of Climate Change



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Cities across the United States should anticipate significant water-related vulnerabilities based on current carbon emission trends because of climate change, ranging from water shortages to more intense storms and floods to sea level rise. To help cities become more resilient to the rising threats of climate change, NRDC reviewed more than 75 scientific studies and other reports to summarize the water-related vulnerabilities in 12 cities—including Norfolk. Although there may still be some uncertainty about what particular impacts threaten cities and how quickly or severely they might occur, action at the local level is the most effective method of reducing, mitigating, and preventing the negative effects of water-related climate change outlined in this fact sheet. NRDC urges cities to prepare for coming challenges relating to water resources. Fortunately, there are steps cities are already taking to become more resilient.

Norfolk and other areas in the Hampton Roads section of the lower Chesapeake Bay have garnered recent attention for flooding associated with a relatively rapid rate of sea level rise and land subsidence. These impacts put the vast infrastructure—including important naval bases—at risk. Based on climate research studying sea level rise and other impacts, we know Norfolk is vulnerable to:

Summary of water-related climate changes and impacts in Norfolk throughout the 21st century	
	Rising sea levels
	Increased flooding
	Increased annual precipitation
	More frequent and intense storm events

 Highly likely  Likely  Possible

Source: NRDC



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SEA LEVEL RISE AND COASTAL FLOODING

The rate of annual sea level rise measured at Sewells Point in Norfolk is the highest of all stations along the U.S. East Coast—nearly 4.5 millimeters per year. Relative sea level in Norfolk has steadily risen 14.5 inches (0.37 meter) over the past 80 years and is projected to increase by another 1.3 to 5.2 feet (0.39 to 1.6 meters) by 2100. The land in Norfolk and the rest of Hampton Roads is subsiding for a combination of reasons, exacerbating the effect of sea level rise. Further, most of the city of Norfolk is at an elevation of only 5 meters or less with a very shallow slope, therefore flooding from sea level rise is likely to be a priority issue for the city in the 21st century. Indeed, according to the Organization for Economic Cooperation and Development, the Norfolk–Virginia Beach metropolitan area ranks 10th in the world in the value of assets exposed to increase flooding from sea level rise.

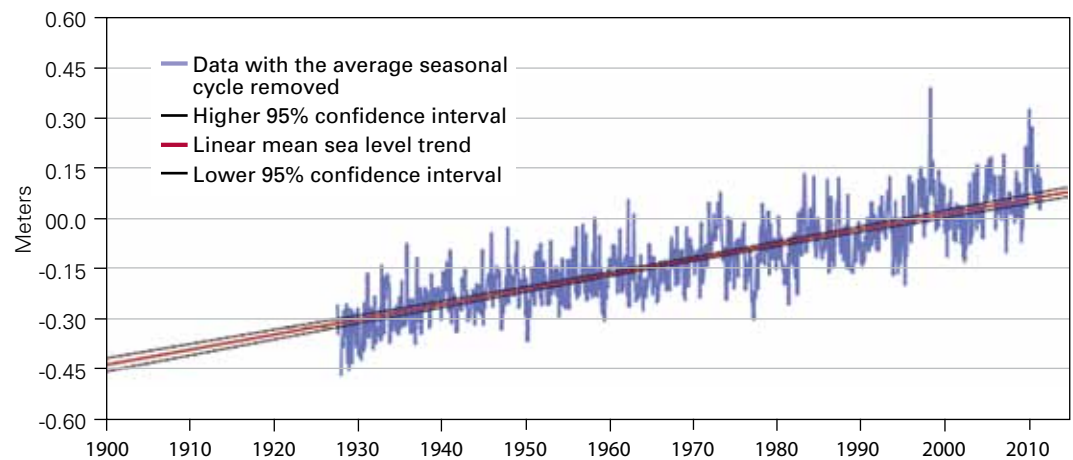
PRECIPITATION AND STORM EVENTS AND FLOODING

Under both higher and lower emissions scenarios, an increase in both the overall annual precipitation and precipitation intensity is projected throughout the 21st century. Increased storm intensity will also affect storm surges in the area. The combination of storm surges and sea level rise is expected to lead to significant flooding by tropical storms and nor'easters that did not cause significant flooding in the past. For instance, Hurricane Isabel caused as much damage as the “storm of the century” 1933 Chesapeake–Potomac Hurricane had 70 years earlier, despite the fact that Isabel’s storm surge was almost 2 feet (0.6 meter) lower. More intense rainfall could also have water quality impacts such as increased runoff, which elevates bacteria and algae levels.

NAVAL IMPACTS

Norfolk’s economy relies heavily on maritime industries; the U.S. Navy provided direct economic impact of more than \$14.6 billion in the Hampton Roads region in 2008. Norfolk is home to three major Navy facilities, as well as the Port of Virginia’s Norfolk International Terminal. All of these facilities are vulnerable to storm surge flooding. Temporary work stoppages or permanent transfer of these facilities because of flood damage could have a ripple effect on Norfolk’s economy.

Historic sea level rise at Sewells Point, Norfolk, Virginia, 1927–2006



Source: NOAA

INCREASED TEMPERATURE

Multi-model projections of annual average temperature suggest an increase of 3.1° to 3.8°F (1.7° to 2.1°C) for the Chesapeake Bay area by 2050, and 3.6° to 9°F (2° to 5°C) of warming by 2100. The combination of increased nutrient pollution of Chesapeake Bay waters from more frequent rainfall events, higher dissolved carbon dioxide concentrations, and higher temperatures will lead to more frequent and intense blooms of algae.

ACTION

While Norfolk does not have a comprehensive plan for addressing climate change impacts, the city is currently working on an update to its general plan, *plaNorfolk 2030*, which will include climate change impact considerations such as sea level changes. To date, Norfolk’s flood mitigation work has largely been composed of ad hoc response strategies and minor improvements to and maintenance of the city’s 60-year-old drainage system, which was originally designed to handle smaller storms than what it is now handling. Moving forward, the city has taken the bold step of hiring the Dutch coastal engineering firm, Fugro, to conduct a citywide flood vulnerability analysis that will be used to enhance the city’s current flood mitigation program and inform the development of a robust, cost-effective program for the future. The city will utilize the flood forecast model to evaluate the costs associated with implementing various flood mitigation mechanisms and the economic damages avoided by installing these mechanisms.