

Image Courtesy of Chesapeake Bay Program



City of Annapolis and Sea Level Rise

Prepared By:

The Maryland Department of Planning



Sea level rise (SLR) is considered a national security issue by the Department of Defense and the Department of the Navy. Military installations, facilities, and defense communities located on or near coasts are at risk for high-tide and storm surge flooding, amplified by SLR. To preserve the military's mission and ensure the safety and well-being of surrounding communities, installations must partner with state, local, and community leaders to coordinate efforts to prepare for SLR. The [U.S. Naval Academy \(USNA\)](#), in conjunction with [Naval Support Activity \(NSA\) Annapolis](#), coordinates with the [City of Annapolis](#) and other partners to identify, mitigate, and respond to such challenges.

Impacts of Sea Level Rise and Flooding in Annapolis

According to continuous tide gauge records around the Chesapeake Bay, the rate of SLR in the 20th century accelerated, with current SLR rates more rapid than those over two decades ago.¹ Rising sea levels can make coastal infrastructure and communities more vulnerable to damaging floods and storm surges. The City of Annapolis experienced a total of 194 hours of flooding, equivalent to over eight full days, in 2020.² A predicted foot of relative SLR by 2045 would result in 360 days of flooding.³ Between 1929 and 2019, relative SLR was 1.06 feet,⁴ which is driven by both higher ocean levels and land subsidence along the Chesapeake Bay.⁵ Recognizing the impact of nuisance flooding, the Maryland General Assembly passed [House Bill 1427](#) in 2019, which required jurisdictions experiencing nuisance flooding to develop plans addressing it. In response, the Maryland Department of Planning (Planning) developed [Nuisance Flood Plan Development Guidance](#) in 2019.

SLR increases the frequency of [nuisance flooding](#) because it elevates high tide. Annapolis had the greatest increase in "nuisance flooding" of 45 study locations

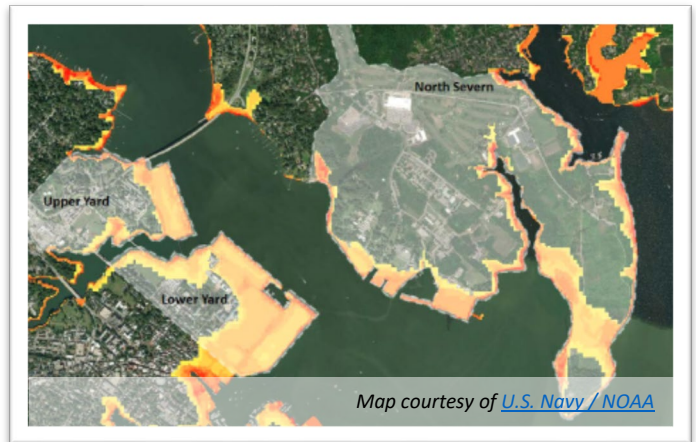
¹ ["Flood Mitigation Strategies for the City of Annapolis, MD: City Dock and Eastport Area."](#) City of Annapolis, Maryland. March 2011.

² ["Flooding Data,"](#) City of Annapolis, Maryland. 2021.

³ Spanger-Siegfried, E., M.F. Fitzpatrick, and K. Dahl. ["Encroaching tides: How sea level rise and tidal flooding threaten U.S. East and Gulf Coast communities over the next 30 years."](#) Union of Concerned Scientists. 2014. Page 28.

⁴ ["Report to Superintendent: Initial Analysis and Recommendations to Prepare for 21st Century Sea Level Rise and Storm Tides."](#) United States Naval Academy Sea Level Rise Advisory Council. July 16, 2019.

⁵ Ibid.



U.S. Navy properties in Annapolis (grey), including USNA and NSA Annapolis. Shading from yellow to red indicates areas with increasing flood hazard.

At-A-Glance

Active: 2015 - ongoing

Forums:

- USNA Sea Level Rise Advisory Committee
- City Dock Action Committee
- City of Annapolis MIR Project Policy and Technical Committee
- Meetings and projects of the City of Annapolis Planning and Public Works Departments

Stakeholders:

- City of Annapolis
- Army Corps of Engineers
- National Oceanic and Atmospheric Administration
- MD Department of Natural Resources
- Anne Arundel County Offices of Emergency Management
- MD Department of the Environment
- Maryland Silver Jackets
- United States Navy
- National and international stakeholders, including resiliency experts

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Flooding in a corridor on the USNA campus during the 2003 Hurricane Isabel storm surge

Image courtesy of U.S. Navy

around the nation, according to a 2014 National Oceanic and Atmospheric Administration (NOAA) study. Nuisance flooding is defined in §3-1001 of the Natural Resource Article of the Maryland Annotated Code as “high-tide flooding that causes public inconvenience” and is often also called sunny day flooding. Nuisance flooding can trigger road closures, overwhelm storm drains, and compromise infrastructure. While an average 3.8 nuisance floods affected Annapolis annually from 1957 to 1963, the average number of nuisance flood days from 2007 to 2013 was 39.3, a 925% increase.

In addition to nuisance flooding, Annapolis is often impacted by severe storm flooding. In 2003,

Hurricane Isabel flooded buildings on the USNA campus, causing more than \$120 million in damage. A five-foot storm surge from Tropical Storm Ernesto in 2006 inundated much of downtown Annapolis.

Planning for Sea Level Rise in Annapolis and at the U.S. Naval Academy

The USNA created the Sea Level Rise Advisory Council (SLRAC) in 2015 to examine SLR and coastal flooding. The council focuses on the impacts to the operational requirements of the USNA, which includes the lower and upper yards, and federal property on the North Severn River.⁶ The SLRAC’s mission is to advise the USNA Superintendent on matters pertaining to flooding due to SLR and severe weather in the Annapolis area through 2100.⁷ According to the 2019 [Report to the Superintendent](#), the SLRAC provides data analyses, identification of vulnerabilities, and prioritization of solution sets, with the primary goal of minimizing negative impacts to the daily operations of USNA and its support activities.⁸ Members of the SLRAC include USNA faculty with expertise in oceanography, naval staff in facilities management and planning, and representatives of the City of Annapolis Public Works Department. SLRAC members have also participated in studies and consulted with national and international resiliency experts.

In April 2022, with guidance from the SLRAC, Naval Support Activity Annapolis (NSAA) and the United States Naval Academy (USNA) completed the development of a comprehensive resilience plan, project portfolio, and phased execution plan to cohesively address and mitigate the combined effects of land subsidence, sea level rise, coastal flooding/storm surge and stormwater management at the installation. A portfolio of projects for individual framework components within the installation’s four planning focal areas has



Failed section of seawall along the eastern side of Farragut Field

Image courtesy of Alex Weinrich, NAVFAC

The planned repair of this seawall along Farragut Field includes raising the height from existing 5.4 ft to 8 ft; the design will allow the wall to be raised an additional 1.7 ft in the future.

⁶ United States Naval Academy, Sea Level Rise Advisory Council, 2019. Report to the Superintendent: Initial Analysis and Recommendation to Prepare for 21st Century Sea Level Rise and Storm Tides, Annapolis, MD, USA.

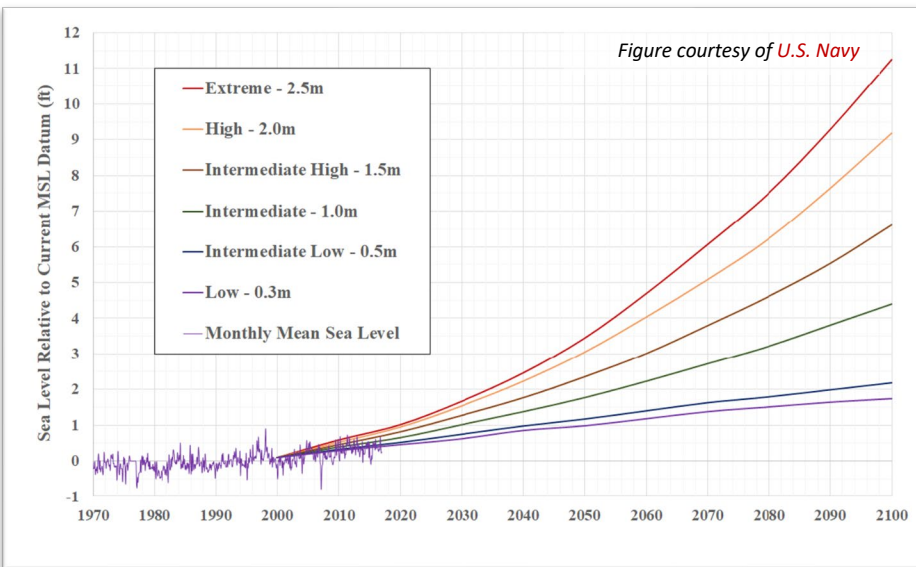
⁷ Ibid.

⁸ Ibid.

been proposed. The portfolio includes a combination of adaptation approaches: engineered defenses (seawalls, stormwater retrofits); adapted structures (building and infrastructure modifications); green infrastructure (earthen berms, stormwater retention, living shorelines); and, temporary solutions (deployable floodwalls or barriers). A phased execution plan, with project execution beginning in 2023 and continuing through 2065, has been recommended. Selection of individual projects to be brought forward for consideration within five-year planning cycles in line with Installation Development Plan updates.

Cooperation and Awareness Building

The USNA identifies flood risk not only from surrounding waterways, but from bordering city and private lands at City Dock, highlighting the need for collaboration. The SLRAC shares information and plans, inviting the city's Planning and Public Works departments to SLRAC meetings. It also engages with the city at committee and public meetings, and conferences.



The SLRAC also consults with regional stakeholders about data and best practices, including the Army Corps of Engineers, NOAA, the Maryland Department of Natural Resources, the Anne Arundel County Office of Emergency Management, and the Maryland Department of the Environment. Additionally, the Maryland Silver Jackets Team, a state interagency team that facilitates collaborative solutions to flood risk priorities, has contributed information through its diverse participating agencies, such as the Environmental Protection Agency, Federal Emergency Management Agency, Interstate Commission on the Potomac River Basin, and the Eastern Shore Land Conservancy.

Relative sea level rise projections, including the monthly mean sea level, for Annapolis based on six global scenarios published by NOAA. The scenarios are based on greenhouse gas emissions projections. Planning by the SLRAC is based on the Intermediate scenario (green line). More information on these projections can be found in the [Report to Superintendent](#).

The USNA has emphasized the importance of SLR by joining the City of Annapolis and the Chesapeake Bay Foundation and testifying before Congress in 2015. In 2019, the USNA superintendent briefed members of the Board of Visitors, which includes members of Congress and presidential appointees, on the effects on increased flooding and proposals to raise the sea wall.

Projects to Support Resiliency

Annapolis is undertaking multiple projects to protect itself, including building four miles of flood walls and raising the historic City Dock by nine feet. The city is also oversizing a wet well linked to storm sewers and culverts, with the assumption that higher tides will cause more future flooding. Backflow preventers are also being installed in street drains that have historically allowed tidal waters to flood streets and parking areas. The backflow preventers will directionally restrict the waterflow toward the Chesapeake Bay.

The City of Annapolis has and continues to work in conjunction with the Navy through the design and implementation of these projects. It is important for both entities to continue to work collaboratively to ensure capital improvements complement each other rather than pass off SLR issues from one area to another and potentially have flood waters breach an unprotected area. The City of Annapolis and the Navy have demonstrated the importance of this collaborative effort in the following project examples.

City of Annapolis Hillman Garage and City Dock Resiliency Project

The Annapolis City Dock is at the center of the community's downtown historic and economic district. Proximity to the Severn River and Chesapeake Bay makes City Dock and neighboring streets vulnerable to SLR and flooding. To protect the vitality of the area, the City of Annapolis launched a project in 2020 to re-develop the Hillman Garage, located adjacent to the area, and implement resiliency solutions within a re-imagined City Dock public space. The City Dock Action Committee (CDAC), a

92-member workgroup created in early 2019, guided the early stages of the project by facilitating workshops and public outreach to vet ideas and develop a consensus design. The CDAC partnered with numerous stakeholder groups, including the USNA, National Park Service, Historic Annapolis, Anne Arundel County, and the Urban Land Institute, to ensure the plan would move forward with support and commitment.



A goal of redeveloping the City Dock is to build resilience against floods. For example, a proposed public restroom will include a pumphouse to clear the storm drain system during a 10-year storm. Other concepts include **constructing fixed bulkheads into park areas** that add five to six feet of barrier height and **flip-up flood barriers** offering eight feet of protection. Of critical importance to the Navy is that the planned barriers connect to the sea wall at USNA, providing continuous protection to the south of the campus.

The project is being developed as a progressive Public-Private Partnership. Completion of the City Dock and Hillman Garage projects is anticipated by spring 2024. Visit the [project website](#) to keep up to date on progress, view additional renderings, and review stakeholder meeting materials.

City of Annapolis Military Installation Resilience Review for NSA Annapolis

The U.S. Department of Defense Office of Local Defense Community Cooperation awarded a grant to the City of Annapolis, in partnership with Anne Arundel County, to complete a Military Installation Resilience Review (MIRR) for NSA Annapolis. This includes the USNA and surrounding communities. The intent of the MIRR is to build shared resilience to extreme weather and changes in environmental conditions. Through its completion shared vulnerabilities and risks will be assessed, while paying special attention to the unique resilience requirements for NSA Annapolis and its surroundings.

The project will result in the development of a Resilience Action Plan with recommended resilience actions and priority projects. The plan will also recommend funding sources that specifically focus on critical infrastructure, programs, and services that support resiliency in the study area. Visit the [project website](#) to keep up to date on progress and learn more about resiliency planning.





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