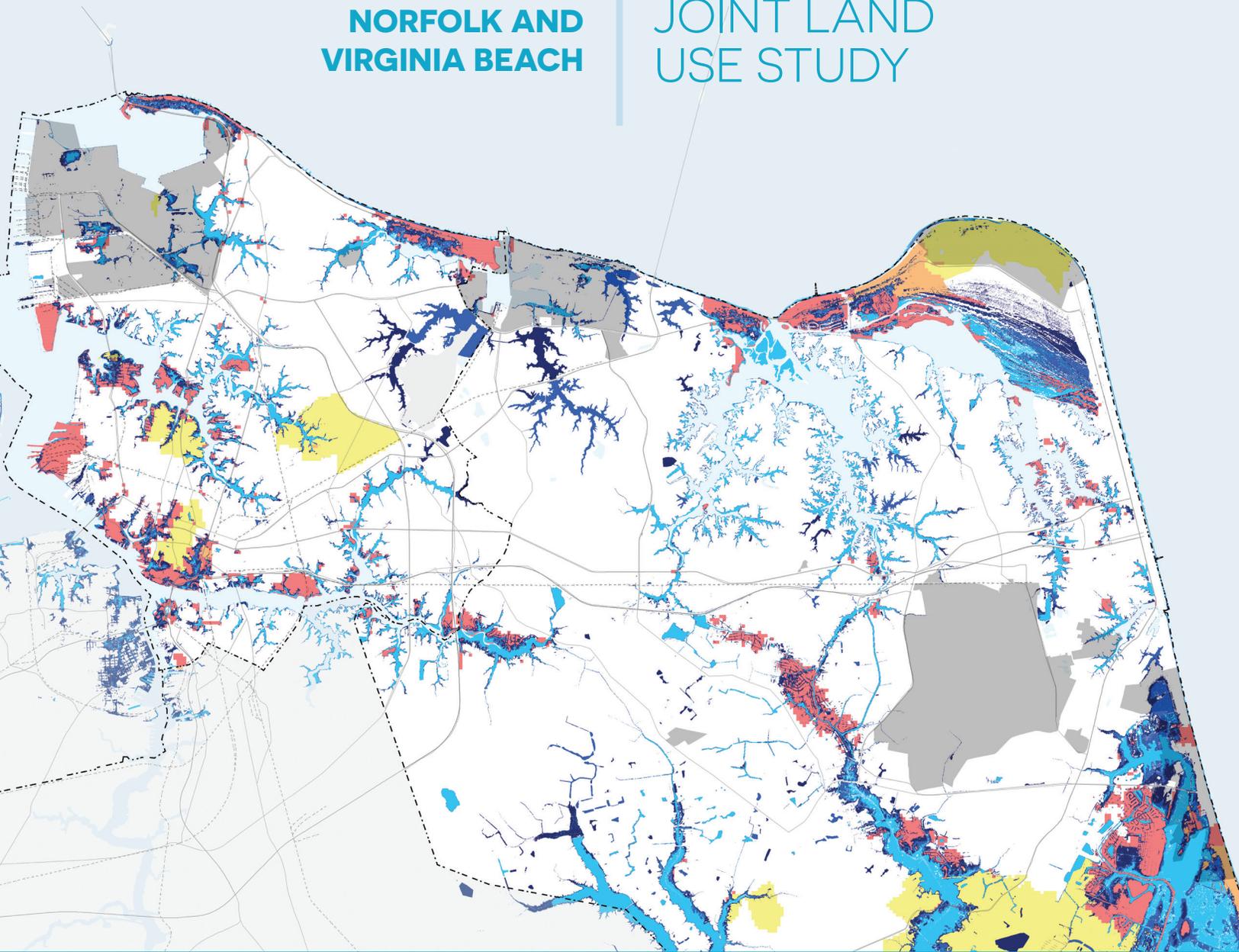


EXECUTIVE SUMMARY

**NORFOLK AND
VIRGINIA BEACH**

JOINT LAND
USE STUDY



HAMPTON ROADS PLANNING DISTRICT COMMISSION
AUGUST 2019
FINAL

The Hampton Roads Region – Norfolk and Virginia Beach Joint Land Use Study (JLUS) was prepared with assistance from a number of individuals that represented local, regional, and state government; the military, and advocacy organizations in the region. The Hampton Roads Planning District Commission (HRPDC) would like to thank these entities and their staff for their assistance, support, and advice. A full listing of the Policy and Technical Committees members can be found in the JLUS report.

- Hampton Roads Planning District Commission
- City of Norfolk
- City of Virginia Beach
- U.S. Navy Region Mid-Atlantic
- Joint Expeditionary Base Little Creek-Fort Story
- Naval Station Norfolk
- Naval Support Activity Hampton Roads
- Naval Air Station Oceana
- U.S. Army
- Norfolk District, U.S. Army Corps of Engineers
- Hampton Roads Military and Federal Facilities Alliance
- Hampton Roads Transportation Planning Organization
- Virginia Department of Transportation
- Commonwealth of Virginia Office of the Secretary of Veterans and Defense Affairs
- Department of Defense Office of Economic Adjustment

In addition, the HRPDC would like to thank all the citizens and stakeholders who gave their time in assisting in the development of the JLUS by participating in JLUS meetings.

The consultant team that assisted in the development of the JLUS includes:

AECOM



PURPOSE

Norfolk, Virginia Beach, and the Navy installations that call both cities home face significant and growing challenges related to tidal flooding, which are only expected to worsen over time as sea levels rise. The long-term threat from increased flooding and sea level rise (SLR) will place additional risk on infrastructure that has a critical role in Department of Defense (DoD) readiness, including major roadway corridors and community assets that military personnel rely upon on a daily basis.

Coastal resilience planning in the Hampton Roads region has been an ongoing and evolving process over the past 15 years. Previous and ongoing efforts by the Hampton Roads Planning District Commission (HRPDC), U.S. Army Corps of Engineers (USACE), universities, and local governments have studied tidal, storm surge, and precipitation flooding and identified actions to address stormwater management and flood risk mitigation.

This **Joint Land Use Study** is a different kind of study. It evaluates the present and future impacts of flooding on the facilities and infrastructure in the community that directly support the Navy and redefines locality and state priorities accordingly. The JLUS is a cooperative planning process between Norfolk, Virginia Beach, the Navy, the HRPDC, and the Commonwealth of Virginia.

The Norfolk and Virginia Beach JLUS is a cooperative planning process between the Cities of Norfolk and Virginia Beach, the Commonwealth of Virginia, and the following:

- Joint Expeditionary Base (JEB) Little Creek-Fort Story
- Naval Air Station (NAS) Oceana, including Dam Neck Annex and excluding Naval Auxiliary Landing Field Fentress
- Naval Station (NS) Norfolk
- Naval Support Activity (NSA) Hampton Roads

The HRPDC is the primary project sponsor.

The JLUS sets forth 22 Actions and related coordination strategies that Norfolk and Virginia Beach can implement in response to threats from flooding and SLR that aim to strengthen and enhance the Navy's ability to carry out its mission, improve the quality of life for sailors and their families, and allow the Navy to remain a major and robust part of the region's economy.



The JLUS public engagement process included over 75 stakeholder interviews, multiple focus groups, and three public meetings. The primary project phases are shown in the diagram above. A **Technical Committee** comprising city department heads and department staff, Community Plans Liaison Officers (CPLOs) from each Navy installation, and staff from other relevant agencies guided the process. A **Policy Committee** comprising elected and appointed officials, senior regional Navy representatives, the HRPDC’s Executive Director, leadership representatives from the USACE, and representatives from the Commonwealth of Virginia validated the work of the Technical Committee and ensured that the interests of the primary study partners and stakeholders were adequately represented.

CHALLENGES

Within the study area, there is a high degree of interdependency between local governments, the Navy, and other infrastructure providers when it comes to connected resources. To evaluate how transportation infrastructure, community assets, and services the military and community rely upon could be impacted by flooding and SLR, three flooding scenarios were defined, based on a review of multiple sources of SLR (SLR) projections. The JLUS flooding scenarios are:

- Minor tidal flooding with no SLR (a peak water level of 1.5 feet above local Mean Higher High Water)
- 1.5 feet of SLR plus minor tidal flooding
- 3.0 feet of SLR plus minor tidal flooding

These scenarios were used to evaluate vulnerabilities to flooding with a focus on addressing chronic tidal and stormwater flooding (also referred to as nuisance

flooding) issues that affect daily routines, which are expected to increase over time in the region as sea level rises.¹ Nuisance flooding is already a common occurrence in the study area, affecting access to Navy installations and community assets.

In general, the Navy depends on the region’s local governments for its roadways, utilities, and many support services. Five core challenges were identified that influenced the analysis of interdependencies and vulnerabilities. The challenges include:

1. Getting to work

Over 200 miles of regional and local roadways were identified in the JLUS planning process as either primary or secondary corridors serving the Navy, including those corridors that are part of the DoD Strategic Highway Network (STRAHNET). A vulnerability analysis identified several roadways that would potentially be exposed to minor tidal flooding and SLR,² including sections of Hampton Boulevard, Shore Drive, and Sandbridge Road. These roads

1 The level of data needed to quantitatively evaluate frequency and depth of rainfall-induced flooding for the JLUS is not yet consistently available across the study area. The JLUS incorporated rainfall-related flooding qualitatively by utilizing historical street and property flooding observations, collected by city staff and reported by residents over several years, to identify areas that repeatedly flood during intense rainfall events (with and without high tide conditions).

2 This is based on the depth of water estimated to occur at the lowest elevation grade along each road segment.

provide direct access to installation access control points (gates). Several of the roadway segments affected have already been identified as problem areas for nuisance flooding in flooding complaint data from Norfolk and Virginia Beach. In addition, many adjacent local roads and connector streets will also be at risk.

The impacts of tidal flooding on roadways will be exacerbated by additional SLR in the future. If these routes are congested, flooded, or otherwise impeded, the ability of Navy personnel and civilians to get to work could be impacted, thereby impacting mission readiness. The conditions can result in operational inefficiencies, impact planned operations or security, and result in loss of work time. A reliable transportation network is essential for ensuring mission readiness and the smooth, efficient movement of both people and goods to and from the Navy installations.

2. Accessing community facilities and services

Roadway flooding along key corridors and in neighborhoods also limits access to community facilities that military personnel regularly rely upon, such as schools and hospitals, and life-safety services that they may require, such as police, fire, or emergency response. An analysis of community assets³ identified 20 facilities⁴ that could potentially be exposed under 3.0 feet of SLR plus minor tidal flooding. These include elementary schools, emergency shelters, police and fire stations, hospitals, waste water treatment plants, sanitary pump stations, and potable water pump stations. These assets have a direct relationship to installation and personnel readiness.

Floodproofing assets or elevating them above the floodplain will provide minimal benefit to the greater community if large numbers of residents are unable

to access the facility due to roadway flooding or flood-related congestion. If access to community facilities is greatly impeded or blocked, it impacts both the ability of staff who work at those facilities to get to work and the ability of others to use those assets or services. The access analysis conducted as part of the JLUS shows that large sections of Virginia Beach and Norfolk could experience blocked or limited access to certain community assets due to flooded roadways under 3.0 feet of SLR plus minor tidal flooding.

With rising sea levels and increases in frequency and levels of roadway flooding, as well as worsening congestion as the region's population grows, current transportation nuisances could become more serious problems in the future.

3. Managing stormwater

Undersized and/or inadequately maintained stormwater infrastructure can cause or exacerbate flooding issues on roadways and adjacent properties. Each locality owns its own stormwater infrastructure, which is managed and maintained by the city's public works department. Likewise, the Navy owns and maintains stormwater management infrastructure that is located on base. However, runoff from the installations often ends up in the localities' stormwater systems, and vice versa. Varying design standards and inconsistent maintenance regimens across the network can contribute to degraded system performance in some areas.

The ability of the existing stormwater management systems to collect, convey, treat, and discharge flow will be further reduced by higher water levels at outfall locations as sea levels rise. Improvements to both municipal and on-base stormwater management infrastructure will require collaboration and coordination with multiple jurisdictional partners.

³ Community assets are broadly defined to include both life-safety and transportation elements that provide a value or benefit to the Navy installations, military service members and their families, and the broader community.

⁴ The analysis excludes water pump stations and sanitary pump stations.

More detailed modeling will be required to pinpoint where roadway flooding is caused or exacerbated by inadequate stormwater infrastructure.

4. Maintaining utility services

Infrastructure providing utilities such as power, water, and wastewater is critical for maintaining operations on a military base. These networks are provided by the cities and other sources outside of the installations. Any disruption to the utility network infrastructure from current or future flooding could significantly disrupt military operations. Facilities located in vulnerable locations may face additional challenges due to flooded roadways that limit access for repairs. Both cities and the Hampton Road Sanitation District (HRSD) are actively working to address system-wide vulnerabilities, further emphasizing the importance of reliable and resilient utility networks.

5. Coordinating between jurisdictions

Virginia Beach and Norfolk both interact regularly with Navy representatives. However, in most cases, collaboration that occurs today is driven by project-specific needs of each city or the Navy. There is a lack of formalized coordination, which makes partnering on larger, regional-scale projects and strategies more challenging. Routine leadership changes that occur with the Navy and elected officials can also create challenges for continuity.

Effective regional planning requires coordination among federal, state, and local government agencies and the private sector. Good examples of partnering exist and can serve as a model for building on the cities' existing mechanisms for coordination with the Navy moving forward. However, a formalized, consistent mechanism for coordination, particularly about issues related to flooding, is needed.

TARGET AREAS AND GOALS

The results of the analyses led to the identification of five goals and four target areas where vulnerabilities were anticipated to have potential impacts on regional infrastructure or community assets the Navy relies upon.

Goals of the JLUS

- Reliable and resilient access routes for DoD personnel
- Adequate and well-maintained stormwater management systems
- Reliable and resilient utility networks
- Effective and institutionalized coordination, cooperation, and collaboration at multiple scales
- A regional prioritization mechanism for resiliency initiatives

Sub Area 1 – Priority Issues ► Infrastructure reliability and access to NS Norfolk and NSA Hampton Roads.

Home to both NS Norfolk and NSA Hampton Roads, this area has the highest number of miles of roadway that could potentially be flooded under the 3.0 feet SLR scenario. The Hampton Boulevard corridor is a key connection between NS Norfolk and downtown, as well as the many residential neighborhoods to the south of the installations.

Sub Area 2 – Priority Issues ► Shore Drive flooding and underperforming stormwater systems and flooding at JEB Little Creek.

Central infrastructure vulnerabilities include roadway flooding along Shore Drive and stormwater management infrastructure that may be contributing to flooding at JEB Little Creek.

Sub Area 3 – Priority Issues ▶ Flooded roadways and blocked access between JEB Little Creek and JEB Fort Story and adjacent neighborhoods. This area provides a critical connection between both properties and between the northwestern and northeastern halves of Virginia Beach. Parts of this area will potentially be cut off from access due to flooded roadways under the 3.0 feet of SLR scenario, thereby eliminating access to JEB Fort Story, neighborhoods flanking Shore Drive, and nearby community assets.

Sub Area 4 – Priority Issues ▶ Flooded roadways and blocked access on Sandbridge Road and Dam Neck Annex. This area includes sections of Dam Neck Road and Nimmo Parkway, both of which provide important east-west connections between the western part of Virginia Beach and the coast and links NAS Oceana to Fentress Airfield, an auxiliary landing field located in Chesapeake. When Sandbridge Road floods, the road is closed, and public traffic is re-routed north through Dam Neck Annex. This creates security challenges for the base related to force protection.

The four target sub areas and JLUS flooding scenarios are shown in **Figure ES-1**.

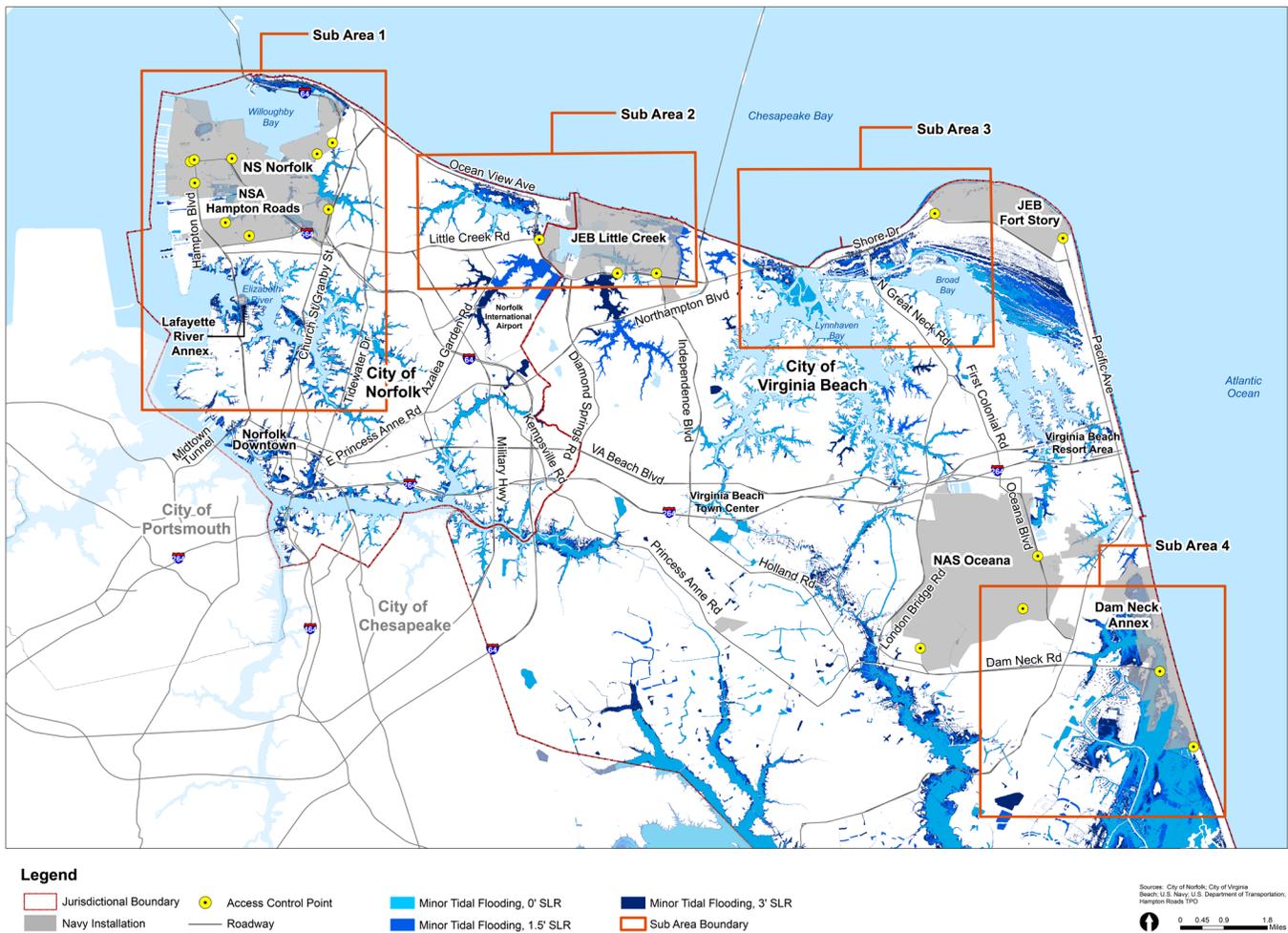


FIGURE ES-1: SLR Scenarios and Target Sub Areas

ACTIONS AND STRATEGIES

The JLUS identifies 22 Actions, 23 Regional Coordination Strategies, and seven Conversations.

22 Actions address challenges identified in specific target areas that impact access to the installations and/or critical community facilities, stormwater and flood risk management, or utility reliability.

23 Regional Coordination Strategies address issues related to coordination and outreach; advocacy, policy, development regulations; and technology and data. They identify opportunities to work together more effectively by improving processes and policies that promote more consistency on issues of importance to the JLUS partners.⁵

7 Conversations require further discussion and exploration among JLUS stakeholders to determine whether an idea should be studied further. Conversations may lead to agreement that further study is needed or that a certain course of action should be pursued.⁶

In many instances, the Actions refer to studies and projects in need of more technical engineering analysis and coordination across jurisdictions to define appropriate and site-sensitive design solutions. In other instances, where appropriate, actions prescribe potential infrastructure upgrades that could improve existing or forecast conditions. The Actions also include relevant projects already proposed or underway by the localities or other agencies that have a direct relationship to the vulnerability analysis findings and impact on military readiness.

TOP-RATES ACTIONS AND PRIORITIES

A set of 15 criteria were established to evaluate how well each proposed Action addresses the JLUS goals and reduces overall risk to military readiness. The criteria consider *Installation Readiness, DoD Personnel Readiness, System Performance and Design, and Co-Benefits*. Installation and personnel readiness criteria were each given a weighting multiplier of 3 and 2, respectively, to place an intentional emphasis on Actions that support these JLUS objectives. Action scores are the primary indicator of priority for implementation.

Based on the application of the criteria, **eight priority Actions** received a score of 15 or above. These are shown in **Figure ES-2**, Priority JLUS Actions, and described in **Table ES-1**. The two highest-scoring Actions are comprehensive flood mitigation and stormwater management strategies for Hampton Boulevard and Shore Drive – both of which are primary roadway corridors serving the DoD. Each of the navy installations is represented in one or more of the priority actions. More detail about all 22 Actions can be found in the full JLUS report.

In addition to Actions, **23 Regional Coordination Strategies** are recommended by the JLUS to address coordination and outreach, advocacy, policy, development regulations; and technology and data. The need for effective and strategic collaboration among the JLUS partners is critical but also challenging: effective regional planning requires coordination among Federal, state, and local government agencies and the private sector. These coordination strategies can be pursued to improve or expand existing coordination mechanisms, promote consistency, and enable progress toward a regional framework for addressing SLR and flooding across jurisdictions.

⁵ Additional strategies that were discussed, but were either not identified as a priority, or that were outside the scope of the study, are included in the Appendix of the JLUS Report.

⁶ Conversations are described in the Appendix of the JLUS Report.

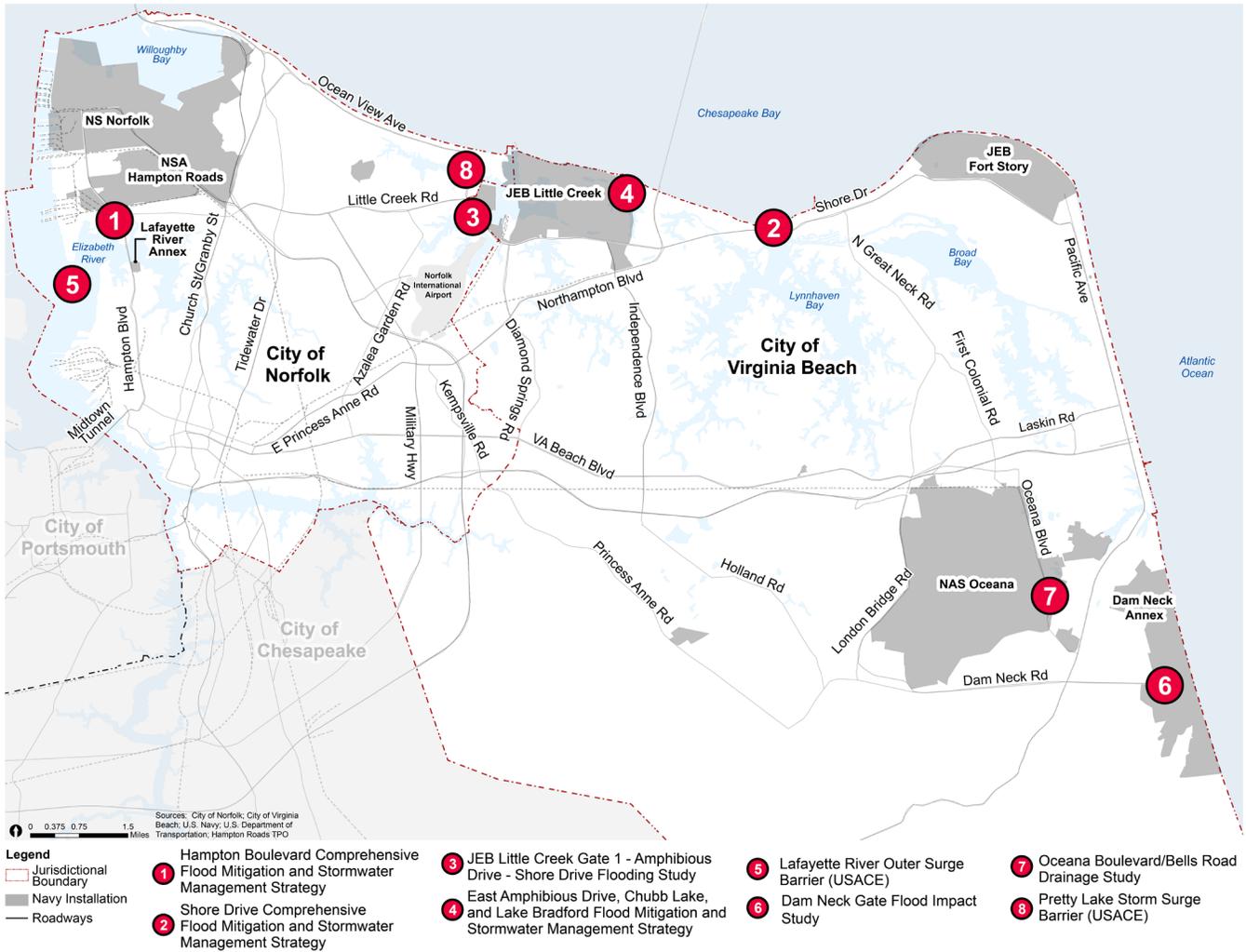


FIGURE ES-2: JLUS Priority Actions (score 15 or above)

TABLE ES-1: PRIORITY ACTIONS

#	ACTION	SCORE	DESCRIPTION
1	Hampton Boulevard Comprehensive Flood Mitigation and Stormwater Management Strategy	19	Hampton Boulevard is a major north-south roadway in Norfolk linking major economic engines for the region including NS Norfolk, NSA Hampton Roads, and the Port of Virginia. This corridor provides direct access from downtown Norfolk and the Midtown Tunnel Area to critical DoD assets, and is a primary route to connect NS Norfolk to Special Area Craney Island Fuel Depot to the west and Lafayette River Annex to the south. A comprehensive flood mitigation and stormwater management strategy is needed that considers Norfolk, U.S. Navy, and VA Port Authority infrastructure. The strategy should explore a range of measures, including increased stormwater infrastructure capacity and roadway elevation options, to address both recurrent flooding today and long-term SLR over time.
2	Shore Drive Comprehensive Flood Mitigation and Stormwater Management Strategy	19	Shore Drive is a heavily-traveled east-west corridor that connects JEB Little Creek and JEB Fort Story. With an additional 3 feet of SLR, several segments of the roadway could become vulnerable to flooding, and access to JEB Fort Story from Shore Drive could be completely cut off over time. A comprehensive corridor study that focuses on the Western Shore Drive segment is needed to develop a range of options and identify a preferred approach for addressing the impacts of SLR.
3	JEB Little Creek Gate 1 – Amphibious Drive - Shore Drive Flooding Study	18	Recurrent precipitation flooding around the JEB Little Creek Gate 1 causes congestion and delays for military personnel attempting to enter and exit the base. This issue can be compounded when recurrent flooding occurs on Amphibious Drive, the only internal roadway connecting the eastern and western sides of JEB Little Creek. A joint technical hydrologic and hydraulic (H&H) modeling study between Virginia Beach, Norfolk, and the Navy is needed to determine the cause(s) of the recurrent flooding in this area and to inform the development of design solutions to manage stormwater and drainage around the gate and to account for long-term SLR impacts near the gate and along Amphibious Drive.
4	East Amphibious Drive, Chubb Lake, and Lake Bradford Flood Mitigation and Stormwater Management Strategy	17	Tidal and storm events, combined with aging stormwater management infrastructure both on and off JEB Little Creek, regularly impact the areas south of Lake Bradford and Chubb Lake. In general, JEB Little Creek is at the receiving end of a large drainage area that includes several neighborhoods outside the installation. A coordinated and comprehensive strategy for mitigating flooding along East Amphibious Drive on JEB Little Creek, and surrounding areas, is needed to define appropriate infrastructure improvements and coordinated management and maintenance procedures.
5	Lafayette River Outer Surge Barrier (USACE)	16	Flooding from the Lafayette River during tidal and storm events is a recurring issue in the adjacent neighborhoods and along Hampton Boulevard, a primary corridor serving NS Norfolk, NSA Hampton Roads, and Lafayette River Annex. The 2018 USACE CSRM Feasibility Study for Norfolk proposes implementing a storm surge barrier on the Lafayette River, from Norfolk International Terminals to the Lambert’s Point Golf course, as a way to manage flood risk to the Lafayette River watershed.
6	Dam Neck Gate Flood Impact Study	15	Impeded access to the Dam Neck Annex’s Main Gate would have a significant impact on military readiness. Jointly pursuing an H&H study to assess the potential flood impacts of additional SLR on the Main Gate would allow the installation and Virginia Beach to take adequate measures to ensure that access is not impeded in the future.
7	Oceana Boulevard/Bells Road Drainage Study	15	NAS Oceana’s Bells Road Gate is a heavily used entrance to the installation that currently experiences issues with ponding and standing water that contributes to congestion delays getting onto the base. A coordinated hydrological and hydraulic study is needed to evaluate drainage conditions and appropriate solutions for resolving the issues.
8	Pretty Lake Storm Surge Barrier (USACE)	15	Portions of the Pretty Lake watershed routinely flood during tidal/storm events, impacting the adjacent neighborhoods and roadways, including Shore Drive, a primary east/west corridor serving the DoD. The 2018 USACE CSRM Feasibility Study for Norfolk proposes a system of measures, including floodwalls and a storm surge barrier at the mouth of Pretty Lake, to reduce flood risk in the Pretty Lake/Little Creek watershed and to protect Shore Drive.

Each strategy included in Chapter 4 was designated as a high priority by the JLUS Technical and Policy Committees. The full list of recommended regional coordination strategies is too long to include herein; however, a sample of the strategies is included below, and more detail is available in the report.

- Adopt a **Memorandum of Understanding (MOU)** among JLUS partners to commit to working together to advance and implement JLUS priorities and establish a JLUS Implementation Committee as an outcome of the MOU.
- Develop a **stormwater systems maintenance MOU** for each installation and respective locality to define ongoing roles and responsibilities for routine maintenance of ditches, culverts, and other drainage components that span locality/ Navy jurisdiction.
- Encourage Congress to **appropriate funding for the Defense Community Infrastructure Program (DCIP)**.⁷
- Pursue an **amendment to the Code of Virginia and the Virginia Residential Property Disclosure Act** for mandatory disclosure requirements for flood hazard for real estate transactions (purchase and rental).
- Develop **regional guidance for incorporating flooding and SLR into city capital planning** projects to ensure that all projects adequately address flooding and SLR vulnerability, risk, and adaptation.

- Define **Geographic Information System (GIS) data sharing protocols, requirements, and points of contact** at cities and Navy to support cross-jurisdictional technical studies, analyses, and project execution.

The Actions, Regional Coordination Strategies, and Conversations recommended by the JLUS provide an actionable framework for the cities and the Navy to use as a set of “next steps” to address pressing concerns about the impact of flooding and SLR on mission readiness and broader community health, safety, and welfare, now and in the future. The JLUS process aims to facilitate an ongoing dialogue between JLUS partners that should continue far beyond the conclusion of the study itself. As conditions change and new information becomes available, the project partners should continue to incorporate that information, updating the JLUS Actions, Regional Coordination Strategies, and Conversations as appropriate to ensure that the JLUS remains an actionable, “living” document.

⁷ The 2019 National Defense Authorization Act, H.R. 5155, Subtitle D, Section 2816, authorizes a defense community infrastructure pilot program that could provide funding to state and local governments to address deficiencies in community infrastructure supportive of a military installation. As of January 2019, funding has not been appropriated for the program.

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